

Price: \$30



National  
Wood Flooring  
Association

# PROBLEMS, CAUSES AND CURES

OF HARDWOOD FLOORS

*2<sup>nd</sup> Edition*

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#### NO GUARANTEE OR WARRANTY

The information contained in this publication represents widely accepted industry practices. There are, however, no universally approved methods of troubleshooting wood floors. The National Wood Flooring Association accepts no risk or liability for application of the information contained in this publication.

# PROBLEMS, CAUSES AND CURES

## INTRODUCTION

In a perfect world, this technical manual wouldn't be necessary. Every wood flooring installation would be flawless, every contractor would get paid, and every customer would be happy. Of course, that is not the case. Many variables go into the installation, sanding and finishing of hardwood floors. Sometimes things go wrong, and sometimes there are pre-existing problems with a job site that could not be detected at the time the floor was installed or sanded and finished (flooring contractors are not responsible for such pre-existing problems).

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

## HOW TO INSPECT A FLOOR

Inspection of wood floors should be done from a standing position (5 feet up and 2 feet away) with normal lighting. Glare, particularly from large windows and flood lighting, magnifies any irregularity in the floors and should not determine acceptability.

Just as no two floors are the same, the inspection process varies for each floor problem. However, there are two basic goals every time you go to inspect a floor:

- 1 - DETERMINE WHAT THE PROBLEM IS.
- 2 - FIND THE CAUSE OF THE PROBLEM.

Sometimes it may be necessary to remove and replace a limited number of flooring boards during the inspection.

## TOOLS FOR INSPECTION

- **MOISTURE METER(S)**: (for wood and concrete): to get an average reading of the flooring moisture content percentage, and also to get an average reading at various levels through the wood floor and subfloor (for the latter, moisture meters with 1/8-inch pins are commonly used).
- **ELECTRONIC HYGROMETER/THERMOMETER**: to measure temperature, relative humidity and dew point.
- **TAPE MEASURE**: to measure distances, aggregate

widths of strips, etc.

- **POCKET KNIFE OR DEPTH GAUGE**: can be inserted between boards to determine the wear layer depth.
- **FLASHLIGHT**: to look in crawlspaces. Also can be used to throw shadows to determine if a single strip is moving up and down.
- **EARTH MAGNETS**: to locate flooring cleats or staples.
- **HAMMER**: to drive in moisture meter probes and aid in removing flooring samples.
- **BLADE AND PHILLIPS SCREWDRIVERS**: to scrape and pry with; also useful for working on moisture meters.
- **THIN "FEELER GAUGE" OR TAPER GAUGE**: both are used to measure the width of gaps. The taper gauge is easier to use.
- **NOTEPAD AND PEN/PENCIL**: to record data.
- **MICROMETER**: to measure the width of the materials for comparison to original manufactured width.
- **CAMERA (DIGITAL PREFERRED)**: to create a visual record of observations.
- **THERMOMETER**: for checking surface temperature. Electronic hygrometers also may do this.
- **STRING (ABOUT 15 FEET)**: can be pulled taut across boards to determine if the floor is flat.
- **LIT MAGNIFYING GLASS**: Commonly available at electronics stores, this is useful for seeing scratch patterns and debris on the floor.

## DETERMINE THE PROBLEM

The first step in the inspection is talking to the client to discover exactly what he or she is unhappy about. Sometimes floors that are a "problem" to the customer are well within industry standards. Such situations often are a case of misunderstood customer expectations.

Although handling complaints from unhappy clients probably is your least favorite aspect of being a wood flooring contractor, there are steps you can take to minimize the grief involved, especially when customers are really angry. Here are some things to keep in mind when meeting with the unhappy client:

- **LISTEN**. Except for the few "professional complainers" who use complaints to avoid contractual obligations, most clients first need to vent their frustration—and you need to know the problem. So, listen all the way through customers' re-

marks, even if they become offensive. Clients may feel that to get some attention, they must shout at somebody. Let that happen. Afterwards, they probably will be easier to deal with.

- **BE SYMPATHETIC.** Never take a complaint personally—not even a tirade. You can express your concern without taking sides, even if you later must dispute much of the customer’s view of the problem. You can’t blame the owners for wanting the problem fixed.
- **BE OBJECTIVE.** Do not allow emotions or prior knowledge to get in the way of handling facts as facts. Just collect all the facts. By the same token, keep in mind that a few boards do not always make a legitimate complaint.
- **LOG ALL INFORMATION.** Keep written records throughout the project, from the first contact through a full inspection. Initially, get all pertinent data such as owner’s name, address and phone, plus the same information on the builder, retailer or contractor; what the product is; brand; when purchased; quantity, when installed and when finished. And get a full description of the problem at the outset.
- **INSPECT THE FLOOR AS SOON AS POSSIBLE.** Delays can create a second complaint and do little for your credibility. Do not make a snap judgment of the problem and, above all, do not report your findings on the spot to the client, builder, or any other interested party.

## FIND THE CAUSE

Once you have defined what the problem is, it’s time to do the detective work and determine why the problem happened (or still is happening). Sometimes this is cut-and-dried—such as when you see a big footprint in the topcoat. More often, rooting out the cause takes more investigation. The following is a detailed list of standard things to consider when inspecting a floor. Of course, not all details are necessary for every inspection, but they all are possible factors in a problem floor. If you’re the one who installed the floor, the troubleshooting may be easier. If you’re trying to follow up on someone else’s failed floor, it may take a more detailed investigation.

Many of the following questions relate to the most common culprit when dealing with wood flooring problems—moisture. For further information on moisture and wood flooring, refer to NWFA’s Technical Publication No. A100: Water and Wood.

### Questions for the client:

- When did you occupy the house/building?
- When was the HVAC system made operational?
- Does the HVAC system operate year round?
- Do you monitor or control the humidity level of

the house/building?

- How do you maintain the building environment?
- Are windows open during the year? For how long?
- Do you live in the space year round, or is this a vacation home that is closed up for part of the year?
- How do you clean the floor? What products are used in flooring maintenance?
- When did you notice the problem?
- Where did the problem start?
- How did the problem progress?
- Has the problem worsened since you first noticed it? Stayed the same?
- Has any action been taken to correct the problem? What has been done?

### Questions about the history of the job site:

- When did job site construction begin?
- When were the foundation and framing constructed? When was the roof in place? When were the windows and doors in place?
- If over a crawl space, was the earth covered with 6- to 8-mil polyfilm, and if so, when?
- If over a slab, what is the underfloor and subfloor set-up from the slab to the flooring? Is a vapor retarder in place between the concrete slab and the subfloor? What is the vapor retarder?
- Was the subfloor exposed to adverse weather conditions prior to the roof, windows and doors being installed?
- When was the HVAC system installed? When was it turned on?
- When were the masonry, concrete, drywall, and other wet-work installed and dried?

### Questions about the job site at time of the inspection:

- What is the subfloor? Is it concrete slab or over joists? If it’s over wood joists, what is the thickness of the subfloor? Is the subfloor approved for wood flooring application?
- Are there screeds?
- What are the floor joist or truss materials? What is the spacing of the floor joists or trusses? Are they close enough together to support a flat floor? (For recommended joist or truss spacing, see the NWFA Installation Guidelines.)
- In a crawl space, is the square footage of the perimeter vents through the foundation equal to 1.5 percent of the square footage of the area within the crawl space? Are vents open to allow proper cross ventilation? Is the relative humidity in the crawl space no higher than it is in the house interior?
- Is the soil within the crawl space properly cov-

ered with 6- to 8-mil black polyfilm or equivalent?

- Is there a 6-mil polyfilm or equivalent moisture retarder beneath the slab?
- What is the moisture content of the subfloor and what is the relative humidity of the job site? (Ideally, relative humidity should be between 30-50 percent, although it may vary according to geographic region.)
- Is the concrete slab's moisture level suitable for installation? How old is the concrete slab? In a new building, it must be at least 30 days old before you can consider moisture testing.
- Are all major appliances and systems properly vented to release warm, moist air? Visually inspect plumbing in the area where the floor is installed.
- Is there a sense of damp, moist or stagnant air when entering the home? Check the interior with a hygrometer. Are the heating and air conditioning systems operational? Ideally, temperatures of the subfloor, adhesives and flooring should be over 60 degrees Fahrenheit during installation.
- Are the HVAC systems in place and working? The intent is for flooring be installed as close to normal living conditions as possible.
- What type of heating is it? Radiant, baseboard, radiator, forced air (electric or gas)? (Baseboard or radiator heat may overdry adjoining flooring; radiant heat may cause problems if the correct procedures were not followed for wood flooring installation.)
- Is the heating system equipped with a humidifier?

**Questions about the home's exterior:**

- Check the eave overhang on the building. Is all rain water funnelled away from the foundation?
- Check the gutters and downspouts. Is all rain water properly diverted away from the foundation? During a rain, the depressions below the spouts can fill with water that eventually finds its way indoors.
- Are there raised flower beds or planter boxes adjoining the building's foundation? If so, a special moisture membrane should be installed. Are landscape sprinklers directed away from the house?
- Is there an outdoor pool or body of water elevated above the home's foundation that could overflow or leak into the home's foundation?
- What is the lot's relationship to the street, to the neighboring site, to a nearby hillside, to a nearby pool? The site should be properly graded to divert water away from the foundation.
- Does the driveway slope away from the house?
- Are the roof, windows and doors all in place and weather-stripped?

**Questions about the history of the wood flooring:**

- Who manufactured the products (wood flooring, finish, adhesive, etc.)?
- When were the products manufactured?
- Does the manufacturer have records of the wood flooring moisture content at time of shipment?
- When was the wood flooring delivered to the distributor warehouse?
- Was the wood flooring unloaded in a covered warehouse?
- Was the wood flooring completely covered and protected on the truck at time of arrival?
- Did the distributor check the moisture content, grade, and appearance of the wood flooring at time of delivery?
- When was the wood flooring delivered to the job site? Was it in an enclosed delivery truck and protected during transfer to the job site?
- What were the weather conditions when the wood flooring was unloaded at the job site?
- What were the job-site conditions at time of delivery?
- At time of delivery to the job site, what was the moisture content and overall condition, grade and appearance of the flooring?
- Where was the wood flooring placed at the job site? Did it remain there until it was installed?
- Was the flooring acclimated correctly?
- Was the wood flooring completely unwrapped/unpacked at time of delivery?
- When did flooring installation begin and end?
- At time of installation, was the job site at or near normal living conditions? What were the environmental conditions of the job site?
- At time of installation, what were the moisture content and conditions/appearance of the flooring and the subflooring?
- Where did flooring installation begin and how did it proceed through the house?
- What are the fasteners? How far apart are they? Were the tools pneumatic or manual?
- What kind of adhesive was used? Was the correct spread rate followed? Was the right trowel used?
- Is there a moisture retarder between the subfloor and flooring? What is it?
- Where did sanding and finishing of the flooring begin and end?
- What is the finish? How was it applied? What was the sanding sequence and finishing process?
- When was the job site occupied?
- Has any action been taken to correct the problem? What has been done?

# JOB-SITE PROBLEMS

## BUCKLING



**What it is:**

Excessive expansion causing the wood flooring to release from the subfloor.

**Cause:**

- Moisture caused by:
  - Excessive job-site moisture (airborne, subfloor or flooding).
  - A house left vacant

with no HVAC operating or inadequate HVAC (“greenhouse effect”).

- Grade conditions.
- Pipe leaks.
- A wet slab.
- Excessive humidity.

Excessive moisture is always the main cause of buckling. Factors that may aggravate the problem include these improper installation techniques:

- For nail down products, inadequate nailing, incorrect fasteners, incorrect subfloor construction.
- For glue-down products, incorrect adhesive, insufficient adhesive, the wrong trowel used, inadequate adhesive transfer, subfloor separation, improper subfloor preparation or subfloor contamination.
- Inadequate expansion space.

**Cure:**

Fix the high-moisture condition (including the use of dehumidifiers) and allow the floor and subfloor to dry to normal levels. Release stress on the floor by providing relief at all vertical obstructions (walls, cabinets, etc.) and possibly removing a row of flooring. If caught early, spot repair/replacement may be possible. In many cases, complete replacement is necessary.

## CHATTER/WAVE MARKS

**What it is:**

Chatter marks are consistent sanding imperfections across the grain of the wood varying from ¼ inch to 1 inch apart. Wave marks are two or more irregularities in a floor occurring along the direction of travel of a sander. They generally are 1 to 3 inches from peak to peak.

**Cause:**

- Most chatter marks are caused by the sanding drum. It may be out of balance, out of round, have hard spots, have incorrect paper installation

or have compressed rubber. Also,

- Poor splice/seams on the abrasive belt, drive belts and fan belts
- Running the big machine in the wrong direction
- Bad bearings in the fan housing.
- Most wave marks are caused by imperfections already present on the floor that are transferred through the wheels of the big machine to the sanding job.
- Wheels on the big machine that are out of round or dirty.
- Improper electrical hookup—voltage that is too high or low.
- Undulation of the floor from joist truss deflection.

**Cure:**

First, the problem with the big machine must be determined and fixed. Then, use a hard plate, paper disc or multi-disc sander. A sanding screen only highlights the chatter and causes the floor to dish out. Use a disc sander and hard plate while working right to left, traveling down and back in the same path and working the disc sander at slight angles for the best cut of the unit. Repeat the same procedure, overlapping the last cut one-half the size of the first disc.

Another technique is to do a light sanding with the big machine at a 7-15 degree angle, then go over the floor again, this time straight.

If using a multi-disc sander, walk slowly with the grain from side to side, always overlapping the unit as you move from right to left. This blends in the floor and prevents deep scratches.

If joist design or loose flooring is the problem, the structural flaws must be corrected before the floor is resanded and refinished.

## CHECKS



**What it is:**

Separations of the wood that normally occur across or through the annual rings.

**Cause:**

- Loss of moisture due to drying processes during manufacturing, or environmental conditions

during storage or after installation.

**Cure:**

Board replacement, with a recoat if necessary.

## COMPRESSION-SET

### What it is:

Boards being subjected to a substantial increase in moisture while being restrained from swelling by adjacent boards, resulting in a permanent narrowing of the boards due to the edges of the boards being crushed. The gaps often begin to darken with age and the edges may become slightly lifted and splintered. The compression is often exaggerated by debris becoming embedded in the gaps between boards. It is normally associated with flooring that has been installed for more than one year.

### Cause:

Any exposure to a substantial increase in moisture causing excessive expansion, which is followed by lower moisture levels and contraction that makes the gaps between boards apparent. Some examples of excessive moisture include:

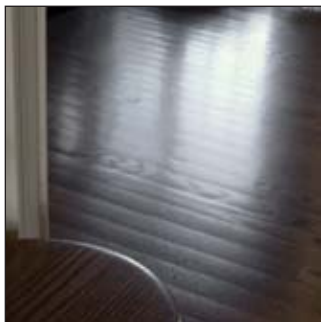
- Water leaks, such as those under a plant, by refrigerator icemakers and by dishwashers.
- Flooded floors.
- Excessive surface moisture during maintenance.
- Floors with high moisture content created by high relative humidity.

Note that the look of a compression-set floor may be similar to gaps from other causes, such as flooring that was milled and installed with a 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.

### Cure:

Correct the source of the high moisture and follow proper maintenance procedures. Fill gaps as necessary and sand, fill and refinish the floor if necessary. In some cases, some boards (or, occasionally, the whole floor) may need to be replaced.

## CROWNING



### What it is:

The center of the pieces of flooring appears to be higher than the edges.

### Cause:

- While it is possible that excessive moisture could cause crowning, it is more likely that the floor

previously cupped and was sanded before the moisture content returned to normal. Sanding too soon removed the raised edges. When the boards eventually dried, their edges were lower than the center.

- Excessive drying from below can cause a moisture imbalance that causes crowning.

### Cure:

First, determine if the moisture content in the subfloor and floor has stabilized and returned to normal levels, and if all of the crowning from the original cupped condition has occurred. After the floor has stabilized, resand and finish.

## CUPPING



### What it is:

Cupping occurs across the width of the individual pieces of flooring. The edges are high and the center is lower. It generally develops gradually.

### Cause:

- A moisture differential within individual pieces of flooring, usually excessive moisture on the underside of the flooring. More subtle cupping can be caused by lack of proper acclimation (this is generally permanent cupping). Potential sources of excessive moisture include:

- Building leaks
- Poor drainage
- Plumbing leaks or overflows
- Leaks from dishwashers or refrigerator ice-making units
- Wet or damp basements/crawlspace
- Concrete subfloors that have not cured
- Plywood subfloors with excessive moisture
- Poor or no ventilation
- HVAC system not operating.
- Solid flooring also may cup when a wood floor experiences conditions that cause rapid drying on the surface. This condition occurs with gaps as the flooring shrinks.
- Low humidity levels can cause cupping in engineered flooring that is usually referred to as "dry cupping." With dry cupping, the wood in the top layer attempts to shrink across its face while the shrinkage of the plywood backer is considerably less. (Dry cupping is also often accompanied by "face-checking"—cracks in the board faces; see page 9.)

### Cure:

Never attempt to repair a cupped floor until all of the sources of excessive moisture have been located and eliminated. This can be verified only with a moisture meter that takes readings of the underlying subfloor. As long as the wood is not permanently deformed or damaged, the flooring

will return to its original shape and size when the excessive moisture is removed. This may take weeks, months, or even an entire heating season.

Attempting to sand a cupped floor while it is still too wet may cause subsequent crowning when the floor dries. Flooring that does not return to its original shape, even after completing an entire heating season, probably is permanently deformed. (Taking moisture readings at different levels in the wood flooring also can help determine this—if there is a difference of 1 percent or more between the top and bottom of the boards, they probably are not done drying.) If the boards are permanently deformed, the cupped edges may be sanded off.

For floors that have cupped due to drying, relative humidity should be increased. Relative humidity below 20 percent is considered very dry for wood flooring, and it is suggested that humidification be provided under such conditions.

## DELAMINATION



### What it is:

The separation of a layer from an adjoining one within a piece of engineered wood flooring.

### Cause:

- When it happens on the job site: flooding or other excessive moisture, or humidity

that fluctuates between extremes.

- Manufacturing error (when there is minimal or no wood tissue attached to adjoining layers due to lack of glue).

### Cure:

Replace the affected boards. In most cases, the delamination will affect only a small number of boards—not the entire floor.

## DENTS



### What it is:

A crushed spot in the wood.

### Cause:

- High heels.
- Dropped heavy objects.
- Metal tips on furniture legs.
- Shipping damage.

### Cure:

Remove and repair the damaged boards. The entire floor may need to be resanded and refinished. Institute good floor maintenance procedures, such as removing high heels and using floor protectors.

## DISH OUT



### What it is:

Areas on the wood floor where softer parts of the wood appear to have been sanded or hollowed out more than other areas. It is more evident in wood species that exhibit pronounced spring (soft) and summer (hard)

grain patterns (see also “Shellout/Dishing of Springwood” on page 12) or between mixed species of varying hardness together on a floor, such as in feature strips, borders and medallions.

### Cause:

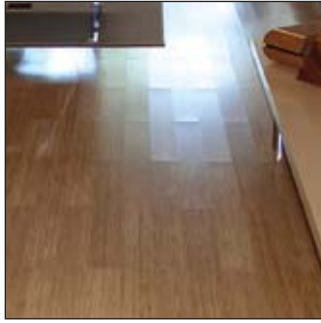
- Using the wrong angles while sanding with the big machine.
- Using a too-flexible pad on the buffer during the screening process.

### Cure:

Resand the floor using a slight angle with the big machine; do not cross borders at a right angle. A hard plate or multi-disc sander may be needed.



## ENDLIFTING



### What it is:

Ends of engineered wood flooring boards appear raised.

### Cause:

- Too much moisture during installation.
- Improper spacing of staples/cleats.
- Adhesive not drying due to excessive slab

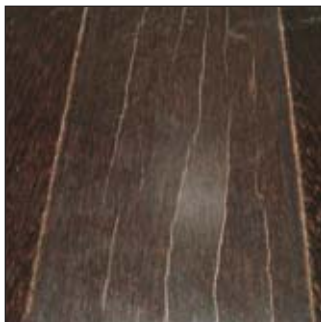
moisture.

- Wrong adhesive or trowel.
- Manufacturing error.
- Improper maintenance.

### Cure:

Before any cure happens, any problems related to excessive moisture must be resolved and then affected areas repaired. For endlifting caused by improper staple/cleat spacing or the wrong adhesive or trowel, the affected areas must be repaired.

## FACE-CHECKING



### What it is:

Long cracks in the veneer that run along the length of the board in engineered flooring.

### Cause:

- It typically occurs when flooring is manufactured with a MC incompatible with the

environmental conditions where it is installed.

### Cure:

Correct the humidity levels and follow proper maintenance procedures. Fill gaps as necessary and sand, fill and refinish the floor if necessary (this may not always restore the original appearance of the floor). In some cases, some boards (or, occasionally, the whole floor) may need to be replaced.

## FLOODED FLOORS

### What it is:

Standing water on the wood floor.

### Cure:

Remove the source of the water intrusion and dry the floor as quickly as possible. Elevate the temperature, dehumidify and increase air flow using fans. In basement houses, dry from below. In crawlspace homes, use exhaust fans.

Do not repair the floor until moisture meter readings on the top and bottom of the boards and subfloor are at normal levels. When flooring is stabilized, determine the damage. If the flooring has loosened from the subfloor, repair the necessary areas or the entire floor. If it is cupped, sand it flat. If the floor is flat, fill if necessary and abrade/screen and recoat.

If the subfloor is plywood over concrete, it is unlikely that the plywood and concrete subfloor will dry out in a reasonable time. Full removal to concrete usually is best to allow the slab to dry.

In some cases partial or full removal of the finish may accelerate the dry time.

In cases where you have determined that the flooring system has not returned to normal levels, do not succumb to pressure from involved parties for a quick fix.

## GAPS, ABNORMAL



### What it is:

Gaps in the floor that remain with seasonal change. If some boards appear glued together by the finish on the surface, see "Sidebonding" on page 18.

### Cause:

- Edge crush/compression set from prior exposure to extreme moisture (especially for solid, flat-grained flooring).
- Hot spots in the subfloor, such as poorly insulated heating ducts, hot water plumbing lines, radiant heating systems, register openings and appliance motors.
- Debris between boards during installation.
- Improper nailing/nail position.
- Cracked tongues.
- Flooring installed with an excessively high moisture content or over a subfloor with excessive moisture.
- Flooring not installed tightly together to begin with.
- Foundation settlement or subfloor movement.
- Improper subfloor materials that will not hold nails.

- For glue-down floors, early foot traffic, incorrect adhesive, the wrong amount of adhesive transferred or used, the wrong amount of flash time for the adhesive, or not using a roller when recommended.

**Cure:**

Eliminate the cause, then restore normal humidity levels. After the floor has stabilized, use filler in gaps that are small enough to be filled (typically up to 3/32 inch) and recoat the floor. For larger gaps, use a sliver/“Dutchman” or wider board to fill in the gap.

## GAPS, NORMAL

**What it is:**

Gaps that appear between individual boards and open and close with changes in humidity.

**Cause:**

- Most normal gaps are caused by seasonal fluctuations in relative humidity—the floor expands with high humidity and contracts during periods of low humidity. This type of expansion and contraction is considered to be normal and expected for wood floors. Wider boards have even wider gaps.
- Square-edged floors show gaps more than beveled floors, and light-colored floors show gaps more than dark floors.

**Cure:**

Normal gaps can be minimized by using the HVAC system to control fluctuations in humidity in the building. The use of humidifiers and/or dehumidifiers can narrow the overall range of humidity fluctuation.

## GRADE PROBLEMS

**What it is:**

Unhappiness with the floor due to the appearance (i.e., knots, grain pattern, color variation, etc.)

**Cause:**

- Unrealistic customer expectations.
- Ordering mistake by supplier, distributor or installer.
- Poor grading at the mill.
- Improperly labeled product.

**Cure:**

Replacing the offensive boards may be necessary. (See *Technical Manual A500: Grading and Packaging*)

## GREENHOUSE EFFECT

**What it is:**

Floors that shrink or swell due to limited air movement and inconsistent humidity levels.

**Cause:**

Buildings closed up with no air control or air exchange. Sunlight through windows can generate heat, creating condensation and abnormal humidity levels. Noticeable shrinkage or expansion will occur when an attempt is made to stabilize the atmosphere.

**Cure:**

After the environment becomes stable, follow cures discussed for cupping floors, buckling or gaps. Controlling the atmosphere during and after the installation is critical to avoid issues caused by the greenhouse effect.

## INSECTS



**What it is:**

A sagging surface or small fresh holes surrounded by a halo of fine dust or small holes appearing in the surface of the flooring.

**Cause:**

- If the surface of the flooring is sagging, it is likely that termites have created eating corridors beneath the surface. Termites are white or cream-colored.
- If fresh holes, often surrounded by a light-colored powder, about 1/16-inch wide are found, powderpost (lyctid) beetles are probably the cause.
- Small holes that are present at the time of installation or appear at a later date may be evidence of pin worms, which are often misidentified as powderpost beetles.

**Cure:**

Almost all wood flooring is kiln-dried, and proper kiln-drying will kill any insects and larvae in the wood. However, new material quickly may become infested by insects entering through windows, in firewood, etc., and the life cycle from eggs to live insects is very short. Also, check all surroundings for infested wood molding and furniture (especially bamboo, mesquite and ash).

For termites, a professional exterminator should eliminate the insects. Then, structural damage should be repaired. Damaged floorboards should be pulled and replaced. Termite infestation is not related to wood flooring manufacturing or installation; it is a site-specific condition.

For powderpost beetles, determine the extent of the contamination, and remove and replace boards as necessary. Or, if only a few holes are found, fill them. If further evidence of insect contamination occurs at a later date, follow the instructions above. Note that holes appearing in the surface of the wood surrounded by a thin halo of powder (frass) indicate the end of a life cycle—the insect has bored out of the wood to fly and mate. Filling the hole may prevent recurrence, as the insect, once mated, will not be able to return to the bore hole to lay eggs. Powder post beetles do not mate and repopulate in the wood, and their life cycle is fairly short—generally 3 to 6 months.

All oak flooring grades allow the presence of pinworm holes in the face of flooring strips. When flooring containing the pinworm holes is sanded and finished, sanding dust and/or filler sift into the holes. As the finish is applied, a film is formed over the holes. With wear, the film breaks and the pinworm holes are revealed. They often are about the size of powderpost beetle emergence holes and sometimes are mistaken for real infestations. Pinworms only occur in the living tree, and they can typically be identified by examining the hole with a magnifying glass for the presence of finish and filler within the hole.

## OVERWOOD/UNDERWOOD

### What it is:

A difference in height between boards.

### Cause:

- Insufficient subfloor holding power.
- Irregular subfloor.
- Incorrect nailing schedule or the wrong fasteners.
- Tongue fracture.
- The wrong type of adhesive, trowel and/or spread rate.
- Improper manufacturing.

### Cure:

For factory-finished flooring, correct the problem, then replace the affected boards.

For unfinished flooring, correct the problem, then resand the floor if necessary.

## PANELIZATION

### What it is:

A generally uniform appearance of gaps in the surfaces of the floor that represents the size of the subfloor panel beneath it.

### Cause:

Excessive movement, shrinkage or expansion of subfloor panels.

### Cure:

Issues related to the subfloor must be resolved; typically this is not the responsibility of the flooring contractor. Then, repair the wood floor as necessary.

## PICTURE FRAMING (“HALO”)



### What it is:

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

### Cause:

- Sanding the edges of a room with an improper grit sequence relative to the field.

The edges are then

either smoother or rougher than the center of the floor, causing the finish and/or stain to appear different.

- Applying more finish around the floor’s perimeter than in the field can sometimes cause a picture-frame appearance.

### Cure:

Resand the floor, being sure to use the proper grit sequence on all parts of the floor.

## SANDING MARKS



### What it is:

Sanding imperfections seen as scratches, drum marks, dishouts, sanding scratches, swirl marks and stop marks.

### Cause:

- Problems with the big machine.
- Drum out of balance.
- Drum out of round.
- Hard spots on the drum.
- Incorrect paper installation.
- Running the machine in the wrong direction.
- Worn pulleys.
- Bad bearings in the

fan housing.

- Wheels out of round and/or dirty.
- Improper electrical hook-up.
- Poor splice/seams on the abrasive.
- Damage to the abrasive.
- Poor workmanship.
- Dirt or grit on the buffer's abrasive.
- Using an abrasive that is too aggressive on the buffer.

### Cure:

If the problem is with any equipment, it must be determined and fixed. Check the abrasive for any imperfections. Hand-scraping to remove very deep scratches, drum or stop marks may be necessary. Another technique is to do a light sanding with the big machine in the affected areas at a 7-15 degree angle, then go over the floor again, this time straight.

If using a multi-disc sander, walk slowly with the grain side to side, always overlapping the unit as you move from right to left. This blends in the floors and prevents deep scratches.



## SHAKE

### What it is:

Separation or weakness of wood's fiber bond between or through its annual rings. Shake is often confused with checks parallel to the face (as happen in quartersawn and riftsawn boards) or raised grain.

### Cause:

Shake is usually considered to be naturally occurring in the tree. Changes in environmental humidity can make shake visible when it was not visible at the time of installation.

### Cure:

Shake should not be installed if visible at time of installation. If boards with shake appear in the floor, it may be possible to repair the boards using low viscosity, CA (cyanoacrylate) adhesive. Apply the adhesive under the seam of the shake. The adhesive will wick down and hold the shake. Or, the boards may need to be removed and replaced.

## SHELLOUT/DISHING OF SPRINGWOOD



### What it is:

Uneven wear between segments of annual rings. (For "Dishout," see page 8)

### Cause:

- Heavy traffic.
- Repeated sliding of heavy furniture.
- Water used in maintenance.
- Seen especially in peeled-face engineered products under desks with heavy foot and caster wear.

### Cure:

Sand and refinish, then implement better maintenance practices. Change casters to wide, non-marking rubber if necessary.

## SLIVERS/SPLINTERS

### What it is:

Slivers and/or splinters protrude from the surface of the floor, especially at the edges of the boards.

### Cause:

- Unevenness caused by expansion, cupping, edge crush/compression set from expansion, grain raise from moisture or subfloor irregularities.
- Damage during installation.
- Shake (see "Shake" on page 12).
- May tend to occur more frequently with beveled prefinished products and wirebrushed products.
- Improper grading.

### Cure:

If a floor is producing rough/raised fibers, not splinters, buff vigorously with a commercial buffer and tampico/soft brush attachment.

For slivers along the sides or edges, shave off with a razor knife, then re-stain and putty as necessary.

For expansion, cupping and grain raise, correct the moisture source, then wait for flooring to stabilize before making final repairs.

## SQUEAKY/LOOSE FLOORS ("POPPING")

### What it is:

Objectionable squeaks or other noises.

### Cause:

- Movement of the wood flooring system, subfloor system or underfloor supports.
- Improper joist spacing.
- Inadequate or improper nailing.
- Weak subfloor.
- Improper subfloor materials (thickness and/or type).
- Insufficient or incorrect adhesive.
- Floor subjected to excessive moisture or excessively dry conditions.
- Mismilled flooring.
- Old age of the floor.

### Cure:

Noises in only certain areas may be fixed by injecting adhesive into the problem area, screwing the floor down from below, or strengthening the subfloor from below.

For floors that are noisy and loose throughout, the cause must be identified and resolved.

## STICKER/STICK STAIN



### What it is:

Light brown marks that appear on the wood flooring surface. They occur across the width of the strip, measure ¾ to 1 inch wide and occur about every 12 to 24 inches across the face of the floor. (In photo shown, right side of

the strip is coated with oil-modified finish; left side is unfinished.)

### Cause:

- Discoloration of the rough sawn lumber while air drying or being kiln-dried on stacking sticks before being made into flooring.

### Cure:

Sticker stain is allowed in some grades. Sticker stain generally does not sand out.

## UNEVENNESS OF ENTIRE FLOOR

### What it is:

The entire floor as a unit appears to be uneven.

### Cause:

- In a wood joist system, causes include warped and loose subfloors, joists that are warped or fractured, settled support pillars, foundation settlement or installing flooring parallel to joists.
- In a concrete slab system, a cracked and/or settled slab.
- Uneven subfloor.
- Flooring installed over uneven screeds.

### Cure:

Structural integrity of the subfloor system is not the responsibility of a wood flooring contractor unless he or she installed the subfloor system. However, wood flooring contractors should check the floor for flatness before beginning an installation, and the party responsible for the subfloor installation should make necessary repairs prior to wood flooring installation.

# FINISH PROBLEMS

**A**lthough many problems can result with finish, the source is not necessarily the finish itself. Consult the following list for some of the most common problems and solutions. If you have questions not covered here, members can call the NWFA's technical hotline at 800/422-4556 or 636/519-9663 (local and international).

## APPLICATOR STREAKS



### What it is:

After the floor dries, marks still are visible from the path of the applicator. It usually is associated more with water-based finishes than other types of finishes, although it may affect all other finish types, as well.

### Cause:

- Using an applicator that has hardened spots in the fibers.
- Finish not applied evenly, with inconsistent finish thickness.
- Excessive air movement and abnormally high temperatures causing the finish to dry too quickly, resulting in a wet edge of finish being pulled over one that has already started to dry.
- Applying a satin or semi-gloss finish that has not been stirred properly, resulting in flattening agents leaving dull streaks when they are spread out.
- Applying finish in directly sunlit areas that are too hot to be coated successfully.
- Areas where direct airflow dries the finish faster than on the remainder of the floor (for example, in front of heating registers or directly in front of a refrigerator, where warm air blows over the finish).

### Cure:

Abrade/screen and recoat under favorable application conditions after the finish has dried sufficiently. Follow the finish manufacturers' directions.

## BLEED BACK



### What it is:

Bleed back of oil-based stain occurs when excess stain seeps up after it has been applied on open grain or from the gaps between boards.

### Cause:

- Excessive stain application.
- High-viscosity or highly pigmented stain.
- Excessive heat during drying.
- Knots or burl areas.

### Cure:

If bleed back occurs before the finish is applied, wipe off the excess stain or burnish/buff the floor with a white pad to remove the excess and even out the stain color. Then, let the stain dry thoroughly before applying another coat.

If finish already has been applied over bleed back, a complete resand is often required.

Trowel filling a floor may help reduce the potential for bleed back from very grainy wood. Cover windows during application to prevent hot spots on the floor. Make sure that stain is not left to puddle for a long time on a floor before it is wiped off.

## BUBBLES



### What it is:

Dried bubbles are visible on the surface of a finish.

### Cause:

- Overworking finish during application.
- Too much air movement across the floor, drying bubbles into place before they have a chance to pop and flow out.
- Applying finish to a floor that is too warm, resulting in the finish drying too fast.
- Floor not being abraded/screened or sufficiently cleaned between coats of finish.
- Using an improper applicator.

**Cure:**

Problems in the top finish coat can be abraded/ screened and recoated. Cover windows during application to prevent hot spots on the floor. Do not overwork the finish you are applying and reduce excessive airflow over the floor. Select an applicator that is less likely to induce excessive foam formation; check with the manufacturer for the recommended applicator.

**CHIPPING**



**What it is:**

Dried finish separates from the surface in the form of flakes or chips.

**Cause:**

- Applying a less elastic finish on top of a more elastic one.
- Improper adhesion between coats.

- Spot contamination.
- Incomplete/insufficient abrasion between finish coats.
- For factory-finished products, edge chips may be caused by rough handling, hitting edges with installation tools or excessive finish on the edge.

**Cure:**

If the chipping is in an isolated area, spot-repair may be possible. When the chipping is widespread, a sand and refinish may be required. For factory-finished products, individual board replacement is an option.

**CLOUDY FINISH**

**What it is:**

The finish appears cloudy or milky.

**Cause:**

- Applying finish over a coat that isn't dry enough to be recoated yet.
- Applying waterborne finish during very high relative humidity or over a floor that is too cold to be coated.
- Applying an oil/solvent-based finish during very high relative humidity, causing condensation on the surface of the drying coating. This will leave a dull appearing finish once the finish is dry, often referred to as "blushing."

**Cure:**

Abrade/screen and recoat, being sure to increase the dry time between coats. Check with a damp rag before abrading/reapplying finish to make sure the cloudiness has disappeared. If the finish

appears clear when it is dampened with water or solvent, the problem can be fixed with an abrade/ screen and recoat (the cloudy/milky appearance will appear again when the spot dries). Be sure to do this when the application conditions are favorable.

However, when the cloudy/whitish appearance does not disappear upon wetting the substrate, the problem is throughout the coating film and requires removal of the existing finish and application of a new finish to restore the appearance.

**CRATERING**



**What it is:**

The formation of small bowl-shaped depressions in the finish.

**Cause:**

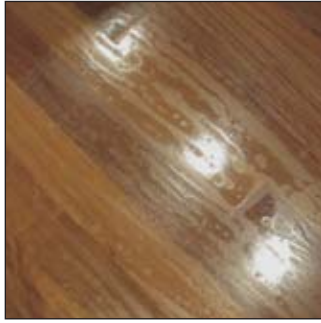
- Contamination of the floor or finish.

**Cure:**

Sand the problem areas by hand-sanding or using a small electric random orbital sander, and then abrade and recoat. Often, hand-sanding out craters will leave an unevenness/dip in the finish on the floor. To eliminate low spots, spot finishing the areas may be necessary before the entire floor is recoated (this will also prove if the fix takes care of the contamination problem). If the problem is widespread, the floor may need to be completely resanded.

If it is determined that the problem is caused by contaminants between the boards, trowel-filling the floor may help prevent problems. When you suspect that there is a chance of contamination on the floor, make sure you first clean the floor thoroughly before attempting to abrade and refinish the floor.

## CRAWLING



### What it is:

Defect in which the finish recedes from small areas of the surface, leaving them apparently uncoated. (Photo also shows fish eyes.)

### Cause:

- Contamination of the floor or finish.

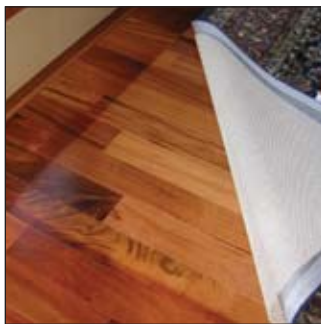
Often the contamination presents itself in a pattern left by the cause of the contamination (often a footprint or hand print).

### Cure:

Sand the problem areas by hand-sanding or using a small electric random orbital sander, and then abrade and recoat. If the problem is widespread, the floor may need to be completely resanded.

If it is determined that the problem is caused by contaminants between the boards, trowel-filling the floor may help prevent problems. When you suspect that there is a chance of contamination on the floor, make sure you first clean the floor thoroughly before attempting to abrade and refinish the floor.

## DISCOLORATION



### What it is:

The floor changes color (darkens or lightens) over time. Some areas may change color more than others.

### Cause:

- Oil-modified finishes amber in appearance and will yellow

even further over time—this is to be expected.

- Wood lying in direct sunlight will change color over time; this is a natural change.
- Wood also changes color through oxidation and/or photochemical exposure, which is a change that cannot be prevented. This is a naturally occurring phenomenon.

### Cure:

Despite the pervasive myth that an oil-modified finish recoated with waterborne finish will stop ambering, ambering of oil-modified finishes cannot be prevented. If marks are left on the floor by area rugs or furniture, moving them around can equalize the change in color. Customers should

be informed that all wood species, particularly cherry, Brazilian cherry and many exotics, will change color greatly as they age and are exposed to light.

To minimize changes, reduce the floor's exposure to light.

## EARLY FINISH WEAR

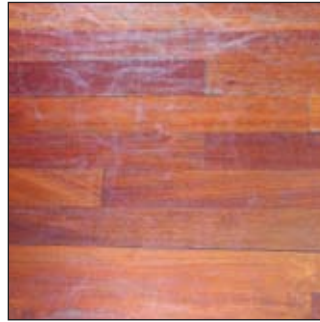


### What it is:

The appearance of too much (premature) wear on a relatively new finish.

### Cause:

- Improper maintenance procedures that may include failure to fully remove grit from the floor's surface, using water to clean the floor, or using strong cleaners on the floor.
- Pet nails and chair legs may contribute to the problem.
- Inadequate film build.
- Wear caused during the construction process.



- Applying finish over coats that have not had enough time to gas-off and dry, resulting in improper (delayed or incomplete) curing.
- Improper sanding procedures—when the floor is left too rough, finish accumulates in the bottoms of the grooves in the floor, leaving little coverage on the “peaks,” where the finish then wears through. This may give the appearance of ridges in the flooring.

### Cure:

Institute proper maintenance procedures, including regular vacuuming and dust-mopping using an approved wood floor cleaner. Use throw rugs at each entryway and use good floor protectors under the legs of furniture. (For complete maintenance directions, see publication *Technical Manual C100: Maintenance and Recoating*.) If the cause is improper sanding, then resand with the proper grit sequence and recoat. If the finish is not worn through, just abrading/recoating may be an option.



## FISH EYES



**What it is:** Defect that manifests itself by the crawling of wet finish into a recognized pattern resembling small “dimples” or “fish eyes.” They can measure up to about 1 inch in diameter. You may find a tiny particle in the middle

of some fish eyes, which may be the cause for some to form.

**Cause:**

- Contamination in the surface.
- If the finish container has sat undisturbed for some time and has not been properly agitated, a disproportionate amount of flow and leveling agents may be put on the floor, causing a fish-eyed appearance.

**Cure:**

Abrade/screen and recoat. Assure that the finish used is well stirred/mixed up as directed by the finish manufacturer.

## ORANGE PEEL



**What it is:** The surface of the finish has a texture that resembles an orange peel.

**Cause:**

- A finish that dries too quickly.
- A finish or substrate that is too cold, causing poor flow

and leveling.

- Use of an improper applicator that causes small bubbles to form in the finish. The bubbles then pop, leaving small dimples in the finish.
- Covering a floor before the finish has fully cured.

**Cure:**

Abrade/screen and recoat. Select the recommended applicator for the product being applied. Make sure that the floor and the product applied have adjusted to proper temperature; consult with the finish manufacturer. A wood floor may take a few days to warm up in very cold climates, so allow for this.

## PEELING



**What it is:** The finish releases from the wood floor or previous finish coat.

**Cause:**

- Stain or previous finish coat that was not dry.
- Skipping abrasion or using too fine of a

grit abrasive between finish coats.

- Stain not sufficiently wiped up.
- Improper tacking between coats.
- Surface contamination such as wax or oil-soap cleaners.
- Finishes that are not compatible.

**Cure:**

Resand and recoat. Be sure to abrade well using the recommended grit size between coats until completely dull.

## PIN HOLES



**What it is:**

A defect similar to fish eyes, but very, very small.

**Cause:**

- A coat of finish being applied over a coat that was not dry, or a finish coat applied too thick. Solvents are still evaporating and pushing through the finish that has already started to form a skin, leaving pinhole-sized openings in the finish. This may also show in areas where finish has puddled.

**Cure:**

Give the floor sufficient time to totally dry, then abrade/screen and recoat using correct dry times between coats. Follow the finish manufacturer's recommendations, including spread rates.

## POLY BEADS



### What it is:

Beads or “BBs” of finish that form along the edges of the flooring pieces. They can be soft and sticky when first formed, but will become quite hard if left undisturbed.

### Cause:

- Generally, poly beads are associated with oil-based polyurethane finish, particularly higher solids/viscosity products, with a slow drying condition and excessive amount of sealer and/or finish that seeps into small gaps between boards. When the product dries/skins over, the solvent may be trapped in the still-wet finish between the boards and tries to evaporate, forming beads on the surface where the wet finish oozes out.

### Cure:

Check with the finish manufacturer for its recommendation. Time will allow the floor to expand and contract, eventually allowing all of the undried finish to surface. When soft, the beads can smear, leaving an unsightly appearance; consult with the manufacturer regarding how to remove the beads when soft. For hardened beads, the solution is to first gently remove them with a sharp-edged tool (i.e., scraper, plastic putty knife or the edge of an old credit card) and, if necessary, abrade/screen and recoat. Do not attempt to just abrade/screen the hardened beads, as that may easily cause circular scratches within the finish.

## ROUGHNESS/GRAIN RAISE



### What it is:

The surface of the wood floor is rough to the touch.

### Cause:

- Inadequate sanding, including skipping too many grits.
- Contamination of the finish during dry time.
- Not allowing sufficient dry time for waterborne sealers to flatten.
- Moisture causing the wood grain to rise.
- Not using enough coats of finish.
- Not abrading well enough between coats.
- Insufficient cleaning between coats.



### Cure:

If a roughness problem is evident, abrading/screening and recoating may fix the problem. However, resanding may be necessary.

## SIDEBONDING



### What it is:

With sidebonding, the edges of the individual boards are “glued” together by the finish. It can occur with all types of finish, although it happens more frequently with water-based products. (Panelization and sidebonding may

appear similar but are different problems. For panelization, see page 11.)

### Cause:

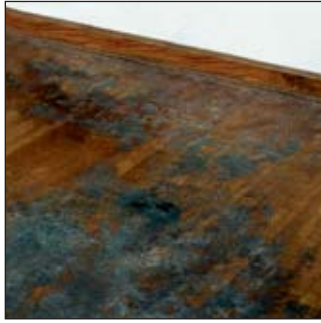
- Sidebonding results from the finish seeping down into the spaces between boards and gluing the boards together. It is usually noticeable only after a drastic decrease in humidity.

### Cure:

Restoring normal humidity levels may return the floor to an acceptable appearance. If there are still gaps, see the “Cure” for “Gaps, Abnormal” on page 9.

Staining or sealing floors with a specifically designed sealer may reduce sidebonding. Consult your finish manufacturer for other preventive steps.

## STAINS



### What it is:

Discoloration on one area of the floor.

### Cause:

- Spilled liquids.
- Pet stains (shown at left).
- Residue from improper cleaners.
- Continual moisture leading to mildew

(black), decay (brown/white) or alkaline conditions (white).

### Cure:

Cloudy surface finish can be fixed by lightly rubbing with a proper cleaner and buffing, although some stains require abrading/screening and re-coating. Pet stains frequently require total board replacement. For moisture problems, eliminate the source of moisture, then evaluate the condition of the flooring before deciding on corrective action.

## STICKY BOARD SYNDROME

### What it is:

The finish will not adhere or cure properly on one or more boards.

### Cause:

- Excessive tannic acid or pH imbalance in the wood. This is most common with oil-modified finishes and white oak.
- Too much stain, and then finish, applied over very open grain.

### Cure:

When one board or several boards scattered throughout the floor will not take stain or finish, the most common solution is to repair the floor by replacing the boards.

## TANNIC ACID DISCOLORATION/PULL/BLEEDING



### What it is:

Tannic acid discoloration/pull (also sometimes called tannic acid bleeding) is a dark/greenish/brown discoloration that may occur with a freshly applied coat of waterborne floor finish on a wood species containing high

levels of tannic acid (in the wood flooring business, typically oak). This discoloration develops in the surface of the wood and may partially bleed up in the applied finish. Tannic acid discolors when it gets in contact with materials that are alkaline by nature, such as ammonia. Tannic acid is water-soluble and may discolor when it gets in contact with iron (carpet staples) and water, which usually appears as a bluish/dark grey discoloration in the wood. Waterborne finishes are typically manufactured with pH adjuster (such as ammonia) and therefore are known to potentially contribute to tannic acid discoloration on woods containing higher levels of tannic acid.

### Cause:

- Excessively thick applied finish in localized areas (puddles, heavy streaks, etc.).
- Not using a sealer well-suited for blocking or reducing tannic acid discoloration.
- Sealer applied thin in localized areas or areas missed by the sealer ("holidays").
- Applying a finish over a sealer that has not sufficiently dried.

### Cure:

- The coating and the discoloration needs to be removed down to bare wood in the affected area before re-coating. Small areas can be taken care of using a sharp scraper and sandpaper, but when the discoloration is widespread across the floor, it is often best to resand the floor.
- First apply a specially designed sealer (as recommended by the manufacturer of the finish) for reducing/preventing tannic acid discoloration. Apply this consistently, without leaving heavy spots or thin spots.
- When the sealer is abraded, abrade it lightly, moving along swiftly without abrading through the sealer coat.
- Apply waterborne finish coats evenly without leaving puddles of finish in one area for too long, as puddles may cause an adverse reaction with tannic acid in the wood.
- A thinner first coat of finish will reduce the likelihood of adverse reactions with tannic acid in the

wood. Subsequent coats may be applied as thick as recommended by the manufacturer.

## UNEVEN SHEEN LEVELS (see also “Applicator Streaks”)



### What it is:

The sheen of the finish is inconsistent.

### Cause:

- Insufficient mixing of finish prior to application.
- Uneven sanding.
- Uneven finish thickness.
- Illusion caused by

lighting.

- A contaminated finish applicator, such as a lanolin-rich lambswool applicator that hasn't been thoroughly cleaned.

### Cure:

Abrade/screen and recoat. If lighting is the cause, discuss with the customer the reasonable inspection position for looking at a hardwood floor—from a standing position under normal lighting conditions.

## WRINKLING



### What it is:

Once the finish starts to dry, it takes on the appearance of the skin of a dried prune. Wrinkling may happen with all types of floor finish, but is more likely to occur with oil-modified polyurethane.

### Cause:

- A coat of finish applied over a previous coat that has not dried/cured sufficiently for recoating.
- Solvent in the applied coat softening the layer beneath, such that when the newly applied finish coat starts to dry, it begins to move along with the coat below, causing wrinkling.
- A finish coat applied in excess, creating puddles.
- A floor too cold for application, such as over a cold crawl space.
- An incompatible finish applied over another finish, such as conversion varnish over waterborne or oil-modified polyurethane finish.

### Cure:

- Small affected areas should be scraped down carefully to a dry surface, allowed to dry/cure further and the transition sanded smooth before touching up and recoating.
- When large areas are affected, it is best to resand the floor before recoating (be careful with sanding dust from fresh coats of oil-modified polyurethane, which is extremely combustible).
- When applying finish, use the recommended spread rate for the product being applied and be sure that the ambient temperatures of both the floor and air are at the recommended temperature. (Note that hardwood floors do not heat up instantly when the heat gets turned on; it is best to turn up the heat a few days before starting a job. Cold crawl spaces can be a serious problem.)
- If needed, allow more dry/cure time between coats.

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# SOURCES AND CREDITS

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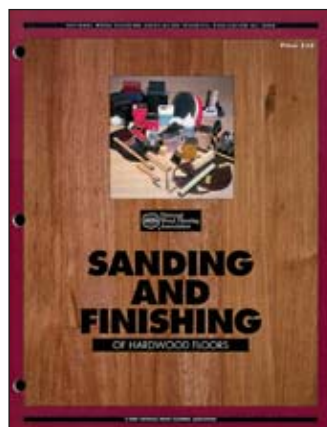
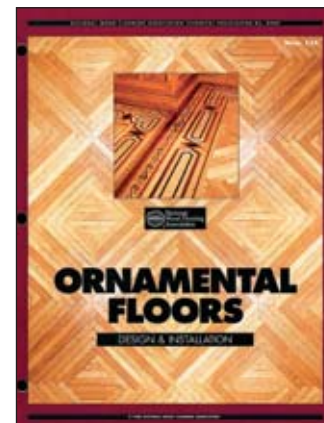
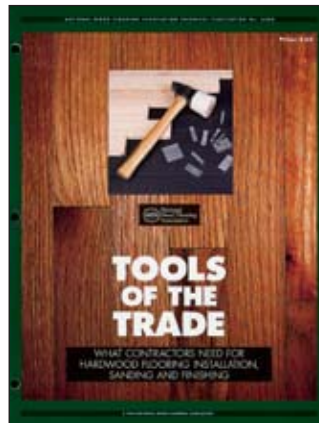
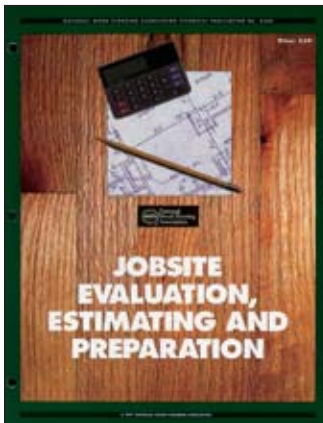
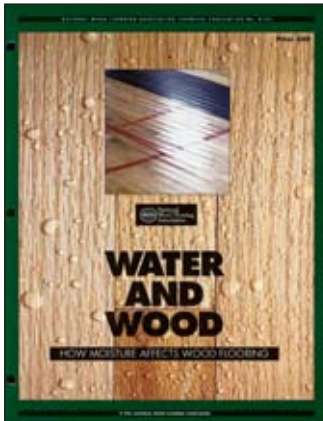
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# RESOURCES

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