

INSTALLING HARDWOOD FLOORING



**NOFMA/WFI
TECHNICAL
SERVICE**

INSTALLATION MANUAL

Wood Flooring that carries the WFI and/or NOFMA trademark/certification is a precision-made product of enduring beauty. The ultimate appearance and performance in any application, however, are dependent upon the installer and upon close attention to a number of details prior to and during the actual installation process.

In this manual we have incorporated many years of practical experience to describe the simplest methods of achieving successful installations of various types of oak and other hardwood flooring.

This information is generally applicable to most hardwood flooring. Individual manufacturers may provide instructions which vary from these, particularly in the laying of specialty floorings. **Always read and follow the instructions provided by the manufacturer.**

Before starting any flooring installation please be sure to read all sections of this manual.

Should you encounter a situation not covered here, or have additional questions, we invite you to contact the Technical Department of NOFMA for assistance. 901/526-5016, 8:30 a.m. - 4:30 p.m. Central Time, Monday through Friday.

NOTE: This brochure covers only the installation methods. Finishing is treated in a separate manual available on request from the WFI.

HANDLING AND STORAGE.

Wood Flooring is a quality product made from lumber that has been kiln-dried. To maintain the moisture level, don't truck or unload it in the rain, snow or other excessively humid conditions. Cover it with a tarpaulin or vinyl if the atmosphere is foggy or damp.

Kiln-dried flooring should be stored in an enclosed building that is well ventilated with weather proof windows and located in areas where similar fine millwork is stored. The storage area within the building should be clean and dry. Leave adequate room for good air circulation around stacks of flooring. Continual dry heat may over-dry flooring, which may later result in buckled floors when flooring is delivered to the job and installed without a proper acclimation or spacing.

JOB SITE CONDITIONS.

Check the job site before delivery. Be sure the flooring will not be exposed to excessive periods of high humidity or moisture. The surface grade or slope should direct water away from the building.

Basements and crawl spaces must be dry and well ventilated. In joist construction with no basement, outside cross ventilation through vents or other openings in the foundation walls must be provided with no dead air areas. A surface cover of 6 mil polyethylene film is essential as a vapor retarder in crawl space construction.

The building should be closed in with outside windows and doors in place. All concrete, masonry, sheet-rock and framing members, etc. should be thoroughly

dry before flooring is delivered to the job site. In warm months the building must be well ventilated; during winter months heating should be maintained near occupancy levels at least five days before the flooring is delivered and until sanding and finishing are complete.

Because materials used to provide energy efficient structures trap moisture in a residence, it may be necessary to delay delivery and installation of flooring to allow the excessive moisture trapped during construction to evaporate. The average moisture content of framing members and subflooring should be below 12%-14% before delivery of the flooring. Moisture contents above 12%-14% can cause moisture related problems.

When job site conditions are satisfactory, have the flooring delivered and broken up into small lots and stored in the rooms where it will be installed. Allow 4 to 5 days or more, for the flooring to become acclimated to job site conditions. If flooring is packaged, open or remove packaging for acclimation.

From the time flooring is delivered and until occupancy, temperature and humidity should be maintained at or near occupancy levels. After occupancy, continue to control the environment. Extended times (more than 1 month) without HVAC controls can promote elevated moisture conditions which can adversely affect flooring.

Protect flooring from excessive heat. Flooring installed over a heating plant or un-insulated heating ducts may develop cracks unless protection from the heat is provided. Use a double layer of 15 lb., or a single layer of 30 lb. asphalt felt/building paper, or $\frac{1}{2}$

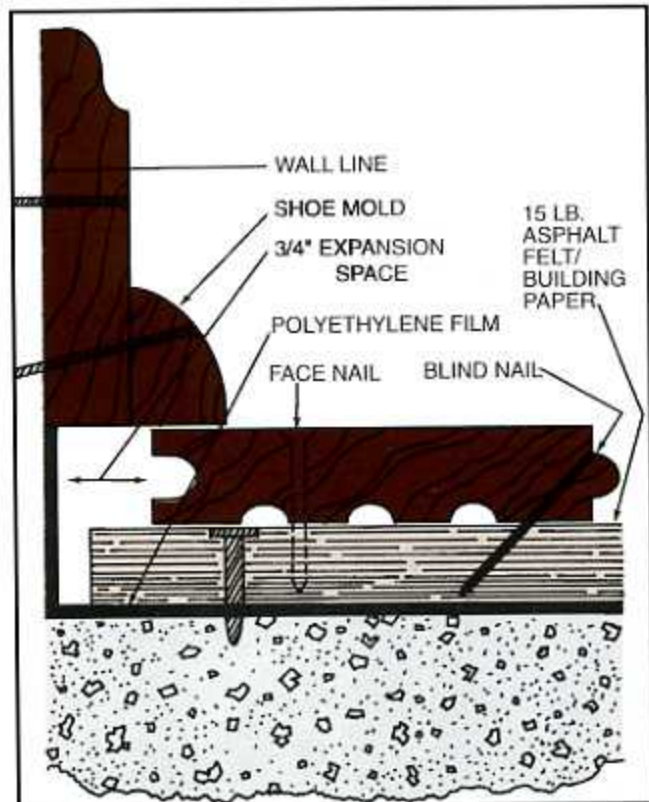


Fig. 1. Plywood-on-slab method of installing strip flooring.

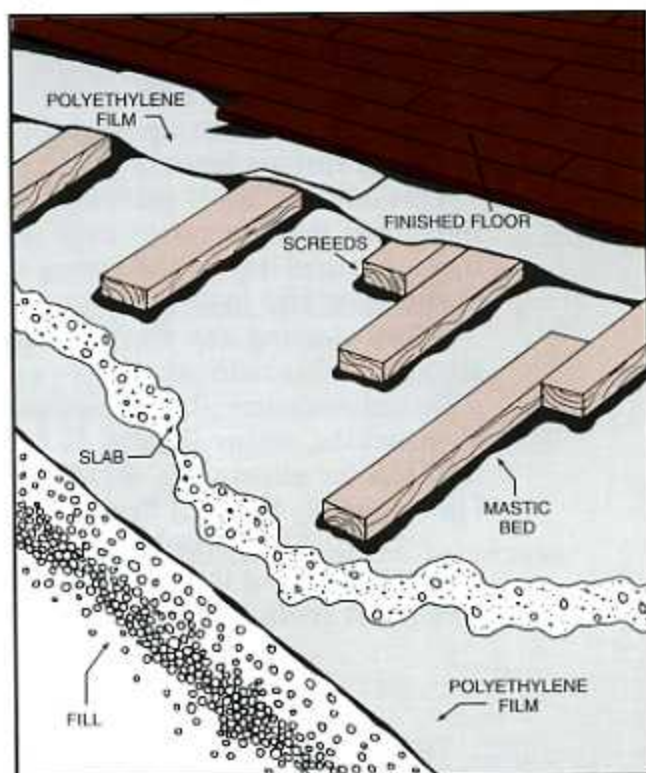


Fig. 2. Screeds method of installing strip flooring on slab.

standard insulation board between joists under the flooring in these areas. Over a heating plant the insulation used should be non-flammable.

INSTALLATIONS OVER A CONCRETE SLAB.

Hardwood flooring can be installed successfully over a slab which is on-grade or above grade. Below-grade installations are not recommended. The slab must be constructed properly (dry and flat with a trowel finish).

Watch out for water. New concrete is heavy with moisture, an inherent enemy of wood. Proper on-grade slab construction requires a vapor retarder such as 6 mil polyethylene film between the gravel fill and the slab. While this prevents moisture entry through the slab, this membrane also retards curing of the slab. So test for dryness, even if the slab has been in place over two years. Slabs younger than 60-days are generally too wet for flooring installation.

TESTING CONCRETE FOR EXCESSIVE MOISTURE.

NOTE: Make tests in several areas of each room on both old and new slabs. When tests indicate too much moisture in the slab, do not install hardwood floors. For a moist slab, wait until it dries naturally, or accelerate drying with heat and ventilation then test again.

1. The Rubber Mat Test. Lay a smooth, non-corrugated rubber mat on the slab, place a weight on top to prevent moisture from escaping, and allow the mat to remain 24 hours. If the covered area shows water marks when the mat is removed too much moisture is present. This test is worthless if the slab surface is other than light in color originally.

2. The Polyethylene Film Test. Tape a one-foot square of 6 mil clear polyethylene film to the slab, sealing all edges with plastic moisture resistant tape. If, after 24 hours, there is no "clouding" or drops of moisture on

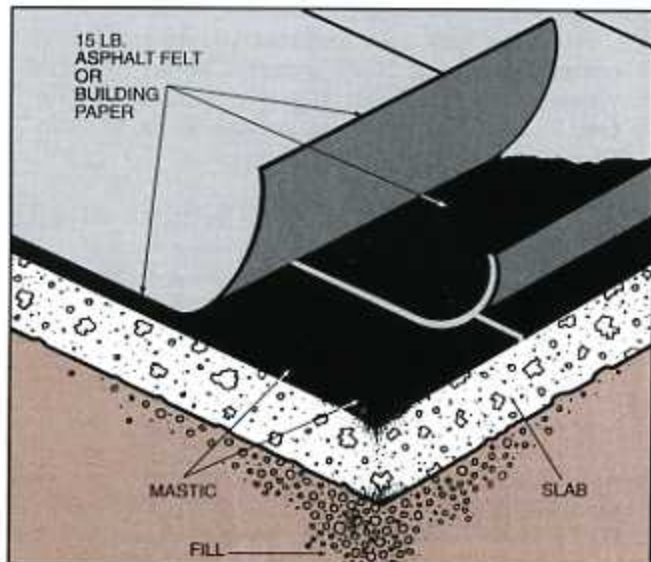


Fig. 3. Moisture Retarder using two layers of asphalt felt or building paper.

the underside of the film, the slab can be considered dry enough to install wood floors.

3. The Calcium Chloride Test. Place a quarter teaspoonful of dry (anhydrous) Calcium Chloride crystals inside a 3-inch diameter putty ring on the slab. Cover with a glass so the crystals are totally sealed off from the air. If the crystals dissolve within 12 hours the slab is too wet.

4. The Phenolphthalein Test. Put several drops of a 3% Phenolphthalein solution in grain alcohol at various spots on the slab. If a red color develops in a few minutes, too much moisture is present.

SLAB PREPARATION.

The slab must be sound and flat. To prepare the slab grind off any high spots, fill low spots, clean up grease, oil and other contaminants, and sweep clean. If the slab is "mealy" and excessively dusty, it may not be of proper strength.

VAPOR RETARDER.

To be certain normal slab moisture does not reach the finished floor, a proper vapor retarder must be used on top of the slab. Where this is placed will depend on the type of system used. The vapor retarder should have a U.S. perm rating of less than 1 perm. 6 mil polyethylene film has a 0.04 perm rating and is considered a good choice.

With $\frac{3}{4}$ " plywood used as a nailing base, the recommended vapor retarders are affixed to the slab. These systems may be either 2 membrane asphalt felt/building paper and mastic or a 4-6 mil polyethylene film or an equivalent system as described below.

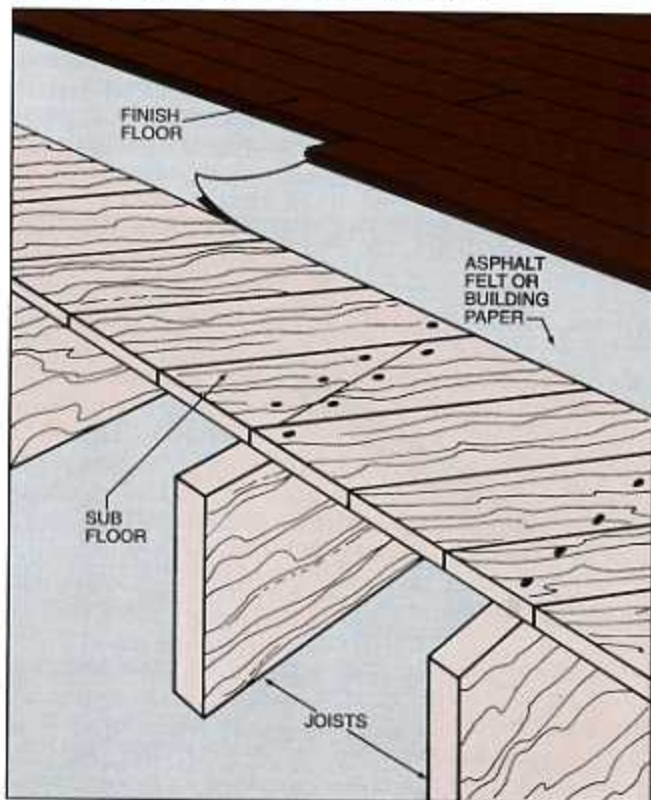


Fig. 4. Wood joist construction using square-edge board subfloor.

Two membrane asphalt felt or building paper system. Prime and apply cold cut-back asphalt mastic with a notched trowel at the rate of 50 sq. ft per gallon. Let set 2 hours. Roll out 15 lb. asphalt felt/building paper, lapping edges 4". Butt ends. Over this apply a second similar coating of mastic and roll out a second layer of asphalt felt/building paper. Lay both layers of felt in the same direction, but stagger the overlaps to achieve a more even thickness.

Polyethylene method. When slabs are well above grade and the expected annual rainfall is light to moderate, cover the entire slab with 4- to 6-mil polyethylene film, overlapping edges 4-6" and allowing enough to extend under the baseboard on all sides.

Where moisture conditions are considered more severe, prime and apply* cold-type cut-back asphalt mastic with a straight-edge or fine tooth trowel over the entire slab surface (100 sq. ft. per gal.). Allow to dry about 1 hour. Lay the 4-6 mil polyethylene film over the slab, covering the entire area and lapping edges 4-6". "Walk in" or roll in the film, stepping on every square inch of the floor to insure proper adhesion. Small bubbles are of no concern, and may be punctured to allow captive air to escape.

PLYWOOD-ON-SLAB SYSTEM.

This system uses $\frac{3}{8}$ " or thicker sheathing grade exterior plywood as the subfloor over the appropriate vapor retarder. Loose lay $\frac{3}{8}$ " plywood panels over entire floor. Laying plywood on a diagonal to the direction of the finished floor will help prevent cracks associated with panel edges.

Stagger plywood and joints every 4' by cutting the first sheet of every other run in half. Leave $\frac{1}{8}$ " space at all wall lines and $\frac{1}{8}$ " to $\frac{1}{4}$ " between panels. Cut plywood to fit within $\frac{1}{8}$ " near and around door jambs and other obstructions where finish trim will not be used.

Fasten the plywood with a powder-actuated concrete nailer or hammer-driven concrete nails. To be sure to flatten out the plywood, start at the center of the panel and work toward the edges. Use at least nine nails per panel or more to fasten securely.

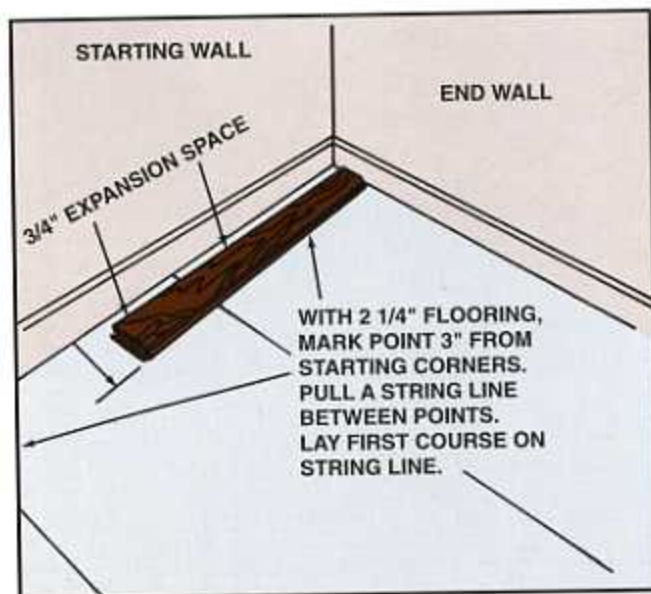


Fig. 5. Establishing starter line for nailing first strip.

An alternate method is to glue the $\frac{3}{8}$ " plywood over the vapor retarder systems which include the cut-back mastic. Cut the $\frac{3}{8}$ " plywood into 4' x 4' squares or 16" x 8' planks, score the back $\frac{3}{8}$ " deep on a 12" x 12" grid, and lay panels in the cut-back mastic applied with a $\frac{1}{4}$ " x $\frac{1}{4}$ " notched trowel (35 sq. ft. per gal.). Remember to stagger panel joints by 2 ft.

SCREEDS SYSTEM.

This system uses as a nailing base flat, dry 2" x 4" screeds of Group 1 density wood (sometimes called sleepers) of random lengths from 18" to 48", as a nailing base. They must be preservative treated with a product suitable for interior installation. After treatment screeds must be dried to a Moisture Content of 12% or less, if saturation with water is involved.

Screeds are laid on their flat face in rivers of mastic with screed runs 12" on center at right angles to the direction of the finished floor.

Sweep the slab clean, prime with an* asphalt primer and allow to dry. Apply hot (poured) or cold (cut-back) asphalt mastic and imbed the screeds. Stagger joints and lap ends at least 4" and leave $\frac{1}{2}$ " space between lapped edges. Be sure there is enough mastic for 100% contact between screeds and slab. Leave $\frac{1}{8}$ " space between ends of screeds and walls with a continuous run of screeds at end walls.

Over the screeds lay a 4- to 6-mil polyethylene vapor retarder with edges lapped over rows of screeds. Avoid bunching or puncturing it, especially between screeds. The finish flooring will be nailed to the screeds through the film.

The system with screeds spaced 12" on center and a moisture retarder without a subfloor is satisfactory for all $\frac{3}{8}$ " Strip Flooring and Plank Flooring less than 4" wide. Plank Flooring 4" and wider requires either the Plywood-On-Slab subfloor, or screeds plus a wood subfloor, to provide an adequate nailing surface. The subfloor over screeds may be $\frac{3}{8}$ " or thicker plywood, $\frac{3}{8}$ " OSB (performance rated), or $\frac{3}{8}$ " Group 1 dense softwood boards or equivalent no wider than 6". If subfloor boards are used over sleepers or screeds, allow $\frac{1}{2}$ " spacing between boards.

NOTE: When area moisture conditions are considered high (Gulf coastal area) use the vapor retarder glued directly to the slab system in addition to or in substitution for the film draped over screeds.

INSTALLATION OVER WOOD JOIST CONSTRUCTION.

Outside cross ventilation in the foundation walls must be provided through vents or other openings with no dead air areas. A surface cover throughout the crawl space (100%) of 6 mil polyethylene film is essential as a moisture retarder.

Subflooring. With $\frac{3}{8}$ " thick strip flooring use either kiln-dried boards of NO. 1 or NO. 2 Common Pine or other dense, Group 1 softwoods suitable for subfloors over wood joists, or exterior sheathing grade plywood. If plywood, $\frac{3}{8}$ " ($\frac{1}{2}$ " or $\frac{3}{4}$ " ($\frac{3}{4}$ " performance rated products are preferred. Also, $\frac{3}{8}$ " ($\frac{3}{4}$ " OSB is a comparable substrate. With $\frac{3}{8}$ " thick strip flooring use a $\frac{3}{8}$ " ($\frac{3}{4}$ " subfloor.

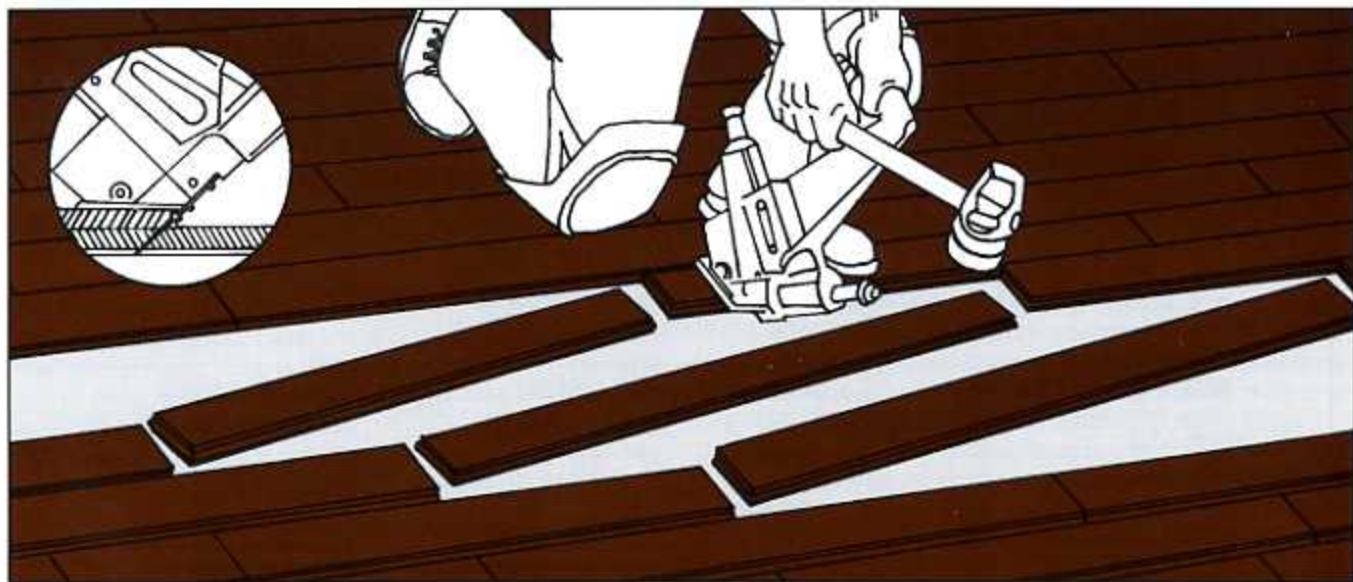


Fig. 6. Use of the power nailer for installing strip flooring.

Thinner materials cannot be recommended as a preferred subfloor material.

A summary of subfloor test results is available. Install subfloor panels as recommended by the panel manufacturer. They should be installed with grain of faces at right angles to joists, nailed every 6" along each joist with appropriate nails and with appropriate spacing at panel ends and edges unless otherwise recommended by the panel manufacturer.

For a board subfloor, use only flat, dry $\frac{3}{4}$ " dressed square edge boards no wider than 6". Lay diagonally across the joists; allow $\frac{1}{8}$ " to $\frac{3}{8}$ " expansion space between boards. Don't use tongue and groove boards. Nail to every bearing point (includes blocking) with two 8d common nails. All mitered joints must rest on joists.

Mark location of joists so flooring can be nailed into them.

Good nailing is important. It keeps the boards rigid,

preventing creeping sometimes caused by shrinkage in subfloor lumber. Without adequate nailing it is impossible to obtain solid, non-squeaking floors.

LAYING AND FASTENING THE FLOORING

The following instructions apply to strip flooring laid on plywood-on-slab, on screeds, and plywood or board subfloors.

(NOTE: Flooring "SHORTS" - 1' or 2' bundles of flooring strips are "Strip Flooring" and should be installed as such.)

NOFMA does not recommend gluing Shorts directly to a slab.

With plywood or board subfloors, start by re-nailing any loose areas and sweeping the subfloor clean. Mark location of joists on perimeter walls so that starting runs and finishing runs, which require face nailing, can be nailed into joists. Then cover subfloor with a good grade of 15 lb. asphalt felt/building paper, lapped 2"-4" along the edge seams. This helps keep out dust, retards moisture movement from below, and helps prevent squeaks in dry seasons.

Direction of finish flooring. Direction of finish flooring should be at right angles to the joists as shown in Fig. 4. This is generally the longest dimension of the room or building and gives best appearance.

Begin flooring installation along the longest continuous wall parallel to the flooring direction of most rooms. (i.e. Down a long hallway wall.) Work from there into the room. Use a slip-tongue to reverse direction and complete the rooms. Glue and blind nail the slip tongue. At any change of direction, always provide tongue and groove engagement either with a slip tongue, or factory edge or end.

Starting to lay the floor. Location and straight alignment of the first course is important. Place a mark $\frac{3}{8}$ " plus the width of flooring (3" for 2 $\frac{3}{4}$ " flooring) on the end wall near a corner of starting wall. (Figure 5.) Place similar mark at opposite corner and insert nails into each mark. Pull string line between nails. Nail the first strip with its leading edge on this line.

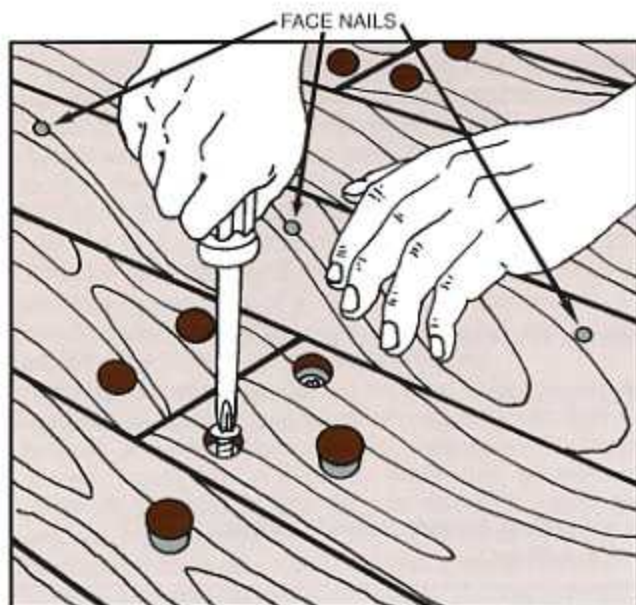


Fig. 7. Countersink screws in plank flooring, cover with plugs.

NAILING SCHEDULE

NOFMA Certified wood flooring must be installed over a proper subfloor.*
Tongue & groove flooring is blind nailed on the tongue edge with face nailing required on starting runs (1-2) and finishing runs (2-4).
Square edge flooring is face nailed.

Inadequate nailing contributes to cracks and noisy floors by allowing movement of the flooring.

* (Use 1 1/2" fasteners with 3/4" plywood subfloor on a concrete slab, or use an angled adapter so that fasteners do not exit the bottom of the plywood. A concrete slab with screeds 12" o. c. does not always require a subfloor.)

| SIZE FLOORING | SIZE NAIL TO BE USED | SPACING |
|---|---|---------------------------------------|
| 3/4" thick T&G Strip x 1 1/2", 2 1/4" through 3 1/4" | 2" barbed flooring cleat,* 7d or 8d flooring nail, casing nail (galvanized nails are preferred) or 2" 15 gauge staples with 1/2" crowns* | 10" - 12" apart 8" - 10" preferred |
| Plank 4" - 8" | 2" barbed flooring cleat,* 7d or 8d flooring nail, or 2" 15 gauge staples with 1/2" crowns* | 8" apart |

Always be sure that fasteners do not fracture (split) the tongue edge. With standard casing nails and some harder species of wood, pre-drilling may be required.

Blind nail along the length of strip/plank and near the ends (1" - 3").
 Minimum of 2 nails per strip/plank.

(Plank flooring may require face nailing and/or screws for additional fastening)

Follow manufacturer's instructions for installation of plank flooring.
Widths 4" and over must be installed on a proper subfloor.

| SIZE FLOORING | SIZE NAIL TO BE USED | SPACING |
|---------------------------------------|---|-----------|
| 1/2" thick T&G STRIP x 1 1/2" & 2" | 1 1/2" barbed flooring cleat, 5d screw, cut steel, or wire casing nail | 10" apart |
| 3/8" thick T&G STRIP x 1 1/2" & 2" | 1 1/4" barbed flooring cleat, 4d bright wire casing nail | 8" apart |

Must install over proper subfloor.

| SIZE FLOORING | SIZE NAIL TO BE USED | SPACING |
|---|--|---|
| 5/16" SQUARE-EDGE (Not Tongue & Grooved) | | |
| x 1 1/2" & 2" | 1" 15 gauge fully barbed flooring brad | 2 nails every 7" |
| x 1 1/3" | 1" 15 gauge barbed flooring brad | 1 nail every 5" on alternate sides of strip. |

Follow manufacturer's instructions for installing square edge flooring.
Must install over a subfloor.

(Do not mix types of fasteners when blind nailing the field, except near walls where hand nailing is required.)

For additional information - write to:

6 NOFMA: The Wood Flooring Manufacturers Association
 P. O. Box 3009, Memphis, TN 38173-0009



The gap between that strip and the wall is needed for expansion space and will be hidden by the shoe mold (Fig. 1).

If you're working with screeds on slab make the same measurements and stretch a line between nails. Remove line after you get the starter board in place.

Lay the first strip along the starting string line, tongue out, and drive 6d or 8d flooring nails or casing nails (galvanized or screw shank hold best) 1" from the grooved edge. Nails should be driven into the top surface of strips and counter sunk (face nailing). Position nails over supporting joists, and near ends of strips or into each screed crossed. Keep the starter strip aligned with the string line. (Pre-drilling nail holes will prevent splits.) Also, blind nail starting strip through the tongue according to nailing schedule.

Rack the floor. Lay out seven or eight rows of flooring end to end in a staggered pattern with end joints at least 6" apart. Find or cut pieces to fit within $\frac{1}{2}$ " of the end wall. Watch your pattern for even distribution of long and short pieces and to avoid clusters of short boards (Fig. 6).

Nailing the floor. With plywood on slab construction the face nails should be cut to slightly less than 1 $\frac{1}{2}$ ". After the starter run fit each run of successive strips snug, groove-to-tongue. Blind nail through the tongue along the length of the strip according to the schedule shown in the table (page 6). Countersink all nails. After the second or third run is in place you can change from a hammer to a floor nailing machine which drives nails mechanically or pneumatically, and does not require additional countersinking. Various floor nailing machines use either a barbed cleat or staples, fed into the machine in clips. The nailing machine drives fasteners through the tongue of the flooring at the proper angle.

When using the floor nailing machine to fasten $\frac{3}{4}$ " thick strip or plank flooring to plywood laid on a slab, be sure to use a 1 $\frac{1}{2}$ " cleat, not the usual 2" cleat which may come out the back of the plywood and prevent nails from countersinking properly and tearing the vapor retarder. In all other applications the 2" cleat is preferred.

Continue installing across the room, ending up on the far wall with the same $\frac{3}{4}$ " expansion space as on the beginning wall. It may be necessary to rip a strip to fit. Avoid nailing into a subfloor joint. Position flooring strips so that they do not meet over subfloor joints. Blind nail by hand where the nailing machine can not be used. Face nail the last runs when unable to blind nail by hand. With 2 $\frac{1}{2}$ " strip face-nailing is required the last 2 or 3 runs and in a ripped piece of a strip if one has been used. Use an offset pry bar or lever device to tighten these last face-nailed runs all at once before face-nailing.

Nailing to screeds. When nailing direct to screeds (no solid subfloor), nail at all screed intersections and to both screeds where a strip passes over a lapped screed joint. Since flooring ends are tongue and grooved, all end joints do not need to meet over screeds but end joints of adjacent rows should not break over the same void between screeds.

Some boards may not be straight. A large screwdriver, sharpened pry bar, or wedges can force such boards into position or pull two or three runs together.

Shoe molding. Nail this to the baseboard, not the flooring, after the entire floor is in place.

PLANK FLOORING

NOTE: With wide plank over 4" extra care is necessary for good performance since the units move more with changing conditions. Proper acclimation before and after installation is critical. After acclimation and before installation, sealing the back surface may help prevent some cupping normally associated with wider widths.

This flooring is normally made in 3" to 8" widths and may have countersunk holes for securing planks with wood screws. These holes are then filled with wood plugs.

Random width Plank is installed in the same manner as strip flooring, alternating courses by widths. Start with widest boards, then the next width, etc., and repeat the pattern. Manufacturers' instructions for fastening the flooring vary and should be followed.

The general practice is to blind nail through the tongue as with conventional strip flooring. Then countersink one or more flat head screws, No. 7 - No. 9 phillips head or dry wall screws at each end of each plank and at intervals along the plank to hold it securely. Cover the screws with wood plugs glued into the holes. Take care not to use too many screws which, with the plugs in place, will tend to give the flooring a "polka-dot" appearance.

Be sure the screws are the right length. Use 1" if the flooring is laid over $\frac{3}{4}$ " plywood on a slab. Use 1" to 1 $\frac{1}{4}$ " in wood joist construction or over screeds. Some manufacturers recommend face nailing in addition to other fastenings.

Another practice sometimes recommended is to leave a slight expansion crack, about the thickness of a putty knife, between planks. Consult manufacturer's installation instructions for details.

LAYING A NEW STRIP FLOOR OVER AN OLD FLOOR

The existing wood floor can serve as a subfloor. Drive down any raised nails, re-nail loose boards and replace any warped boards that can't be made level. Sweep and clean the floor well, but don't use water.

Remove thresholds to allow the new flooring to run flush through doorways, remove doors and baseboards. Lay asphalt felt or building paper over the old floor.

Do not install the new floor to the old floor in the same direction. Install at a right angle or on a diagonal. If the preferred direction is in the same direction as the old floor, overlay the old floor with 3/8" to 1/2" plywood.

PARQUET, BLOCK, HERRINGBONE AND SIMILAR FLOORING

The styles and types of block and parquet flooring as well as the recommended procedures for application vary somewhat among the different manufacturers. Detailed installation instructions are usually provided with the flooring or are available from the manufacturer or distributor.

This section applies only to $\frac{3}{4}$ " tongue-and-groove parquet flooring where tongues and grooves are engaged.

DOES NOT APPLY TO SLAT-TYPE OR FINGER-BLOCK PARQUET.

Lay both blocks and the individual pieces of parquetry in mastic over a double layered wood subfloor or a concrete slab with a moisture retarder as described on Pages 3 and 4.

Use a cold, cut-back asphalt mastic spread at the rate of 35-40 sq. ft. per gallon. Use the notched edge of the trowel. Allow to "flash off" overnight or as directed by the manufacturer. The surface will be solid enough after 12 hours to allow you to snap working lines on it. Use blocks of the flooring as stepping stones to snap lines and begin the installation.

There are two ways to lay out parquet. The most common is with edges of parquet units (and thus the lines they form) square with the walls of the room. The other way is a diagonal pattern, with lines at a 45° angle to walls.

Square pattern. Never use the walls as a starting

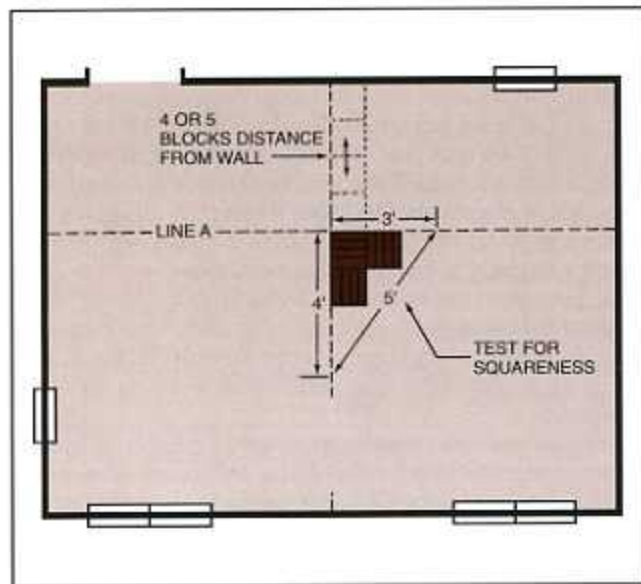


Fig. 8. Working lines for laying block in a square pattern.

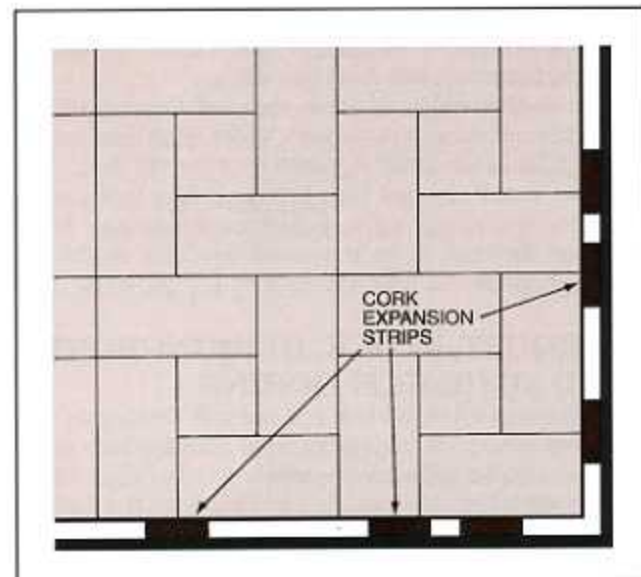


Fig. 9. Use of cork blocking around edges of a block floor.

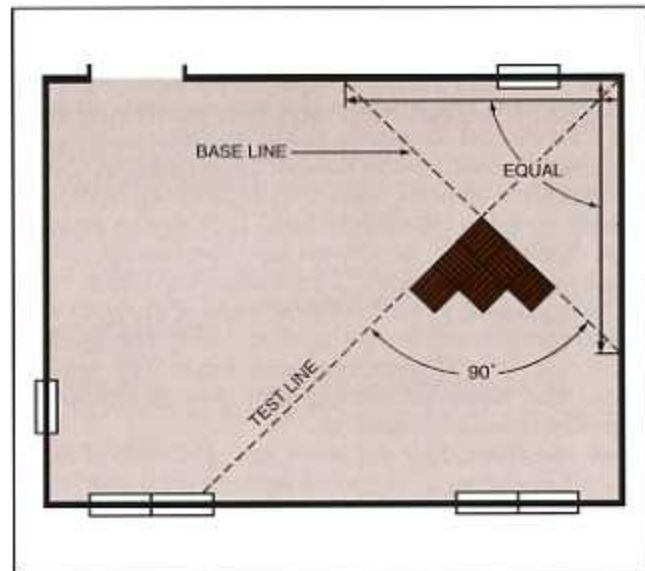


Fig. 10. Working lines for laying block in a diagonal pattern.

line because walls are almost never truly straight. Instead, use a chalk line to snap a starting line about 3 ft. or so from the handiest entry door to the room, roughly parallel to the nearest wall. Place this line exactly equal to four or five of the parquet units from the center of the entry doorway.

Next find the center point of this base line, and snap another line at an exact 90° angle to it from wall to wall. This will become your test line to help keep your pattern straight as the installation proceeds. A quick test for squareness is to measure four feet along one line from where they intersect, and three feet along the other. The distance between these two points will be five feet if the lines are true (Fig. 8).

Diagonal pattern. Measure equal distances from one corner of a room, along both walls, and snap a chalk line between these two points to form the base line. (This pattern need not be at a precise 45° angle to walls in order to appear perfect.) A test line should again intersect the center of the base line at an exact 90° angle (Fig. 10).

Special patterns. Most existing parquet patterns can be laid out with these two working lines. Herringbone will require two test lines, however; one will be at the 90° line already described; the other crosses the same intersection of lines, but at a 45° angle to both.

If such elaborate preliminary layout preparation seems a bit overdone, keep in mind that it is wood we are installing. Each piece must be carefully aligned with all of its neighbors. Small variations in size, natural to wood, must be accommodated during installation to keep the overall pattern squared up. You cannot correct a "creeping" pattern after it develops; the more carefully laid out floor causes less problems during field work.

Wood parquet must always be installed in a pyramid, or stair-step sequence rather than in rows. This again prevents the small inaccuracies of size in all wood from magnifying, or "creeping" to gain an appearance of misalignment. Place the first parquet unit carefully at the intersection of the base and test lines. Lay the next units

ahead and to the right of the first one, along the lines. Then continue the stair step sequence, watching carefully the corner alignment of new units with those already in place. Install in a quadrant of the room, leaving trimming at the walls until later. Then return to the base and test lines and lay another quadrant, repeating the stair-step sequence.

Install the last quadrant from the base line to the door. A reducer strip may be required at the doorway.

Most wood floor mastics will allow the tiles to slip or skid when sideways pressure is applied for some period after the open time* has elapsed. You avoid this sideways pressure by working from "knee boards" or plywood panels laid on top of the installed area of flooring. For the same reason no heavy furniture or activity should be allowed on the finished parquet floor for about 24 hours. Some mastics also require rolling the flooring after installation.

Cut blocks or parquet pieces to fit at walls, allowing $\frac{3}{8}$ " expansion space on all sides. Use cork blocking in 3" lengths between flooring edge and wall to permit the flooring to expand and contract.

With blocks, a diagonal pattern is recommended in corridors and in rooms where the length is more than $1\frac{1}{2}$ times the width. This diagonal placement minimizes expansion under high humidity conditions.

SPECIAL CONSTRUCTION SITUATIONS

Wood flooring over a radiant heated concrete slab. Flooring is an insulator and may require higher water temperatures for a radiant heat system. Also an outside thermostat is recommended to anticipate rapid temperature changes. Boiler water temperature must be controlled to keep it to a maximum of 125°. This will limit the temperature of the slab surface to about 85°, an acceptable level for most mastics.

The flooring is installed as in any other slab project, except do not fasten plywood to concrete with either nails or powder-actuated fasteners. Turn on the heating system 4-5 days prior to delivery of the flooring to the job. The heat will drive extra or excessive moisture out of the slab.

(NOTE: Check flooring and mastic manufacturers' specifications for suitability of use over radiant heat.)

Strip flooring in a wood plenum system. This method of construction utilizes a crawl space that is completely sealed from the outside as a plenum to which air from the heating/cooling system is supplied. The air then enters each room through floor registers.

A ground cover of polyethylene film is essential, as well as having the heating system operating for at least 4-5 days prior to delivery of the flooring to stabilize the moisture condition. No other special consideration is necessary in installation of the flooring. Proceed with previous recommended procedures and time tables.

Flooring Expanses 20 feet and wider. In large rooms, across diagonals and/or where flooring runs through doorways to produce an expanse over 20' wide, additional installation techniques should be considered. Begin line-out near the center of the space (i.e. across the center of the room with diagonal installation

or near center line of total expanse), insert and glue a slip tongue in the starter strip groove, and proceed with installation in the two opposite directions. Inclusion of field expansion spaces may also be necessary in the wide expanse.

TIPS FOR EASIER AND BETTER FLOORING INSTALLATIONS

"In-use" Moisture Content: Differences of more than 4% between the expected in-use average moisture content of flooring and the in-use average moisture content of underfloor construction are likely to cause problems such as cupping. The greater the difference the more severe the problems. A significant difference of 8% or more may result in buckling of the floor when the underfloor is the higher moisture content.

Finishing should proceed 1-3 weeks after installation is completed. Longer periods of exposure to job site conditions can result in future problems. Finishing immediately after installation does not allow the flooring adequate time to acclimate to its new environment.

Work from left to right. In laying strip flooring you'll find it easier to work from your left to your right. Left is determined by having your back to the wall where the starting course is laid. When necessary to cut a strip to fit to the right wall, use a strip long enough so the cut-off piece is 8" or longer and start the next course on the left wall with this piece.

Short pieces. For best appearance always use long flooring strips at entrances and doorways. Incorporate as many short pieces as possible at random in the floor. Do not group them in one area.

Put a "frame" around obstructions. You can give a much more professional and finished look to a strip flooring installation if you "frame" hearths and other obstructions, using mitered joints at the corners.

Reversing direction of strip flooring. Sometimes it's necessary to reverse the direction of the flooring to extend it into a closet or hallway. To do this, join groove edge to groove edge, using a slip tongue available from flooring distributors. Glue slip tongue in place and blind nail that edge. Proceed in the opposite direction nailing in the conventional manner.

Use only sound, straight boards for subfloors. The quality of the subflooring will affect the finish flooring. Use only square edge $\frac{3}{4}$ " dressed boards no wider than 6". Boards which have been used for concrete form work are often warped and damp and should not be used.

Don't pour concrete after flooring is installed. Concrete basement floors are sometimes poured after hardwood flooring has been installed. However, many gallons of water from drying concrete are evaporated into the house atmosphere where it may be absorbed by hardwood flooring and other wood components. This is not a recommended building practice since excessive moisture will cause problems with wood floors and other woodwork. Wood flooring should not be installed until after all concrete and plaster work are completed and dry.

Doorways, Stair Treads, and High Traffic Areas. If flooring direction changes, always use slip tongues or

engage the flooring end matching into groove side of flooring to prevent movement and give a solid transition. **Put voids between screeds to good use.** Masonry insulation fill, normally used in hollow concrete blocks, can be poured between the screeds of a slab installation to give additional moisture protection and deaden the drumming sound that sometimes occurs from foot traffic.

Sound deadening in multi-story building. Noise transmission from an upper to a lower floor can be reduced. Nail subfloor to the joists in the normal manner and cover this with $\frac{1}{2}$ " or thicker cork or insulation board laid in mastic. Cover this with another $\frac{1}{2}$ " plywood subfloor also laid in mastic. Nail the finish strip or plank floor to the plywood, or lay block or parquet floors in mastic on the plywood. In the case of parquet the second subfloor plywood can be $\frac{1}{2}$ " tongue-and-groove type. Note that specifications for some high-rise apartment buildings call for other types of sound-deadening construction.

Mastics and trowels. There are several types of mastics available that are satisfactory for use in laying hardwood floors. Hot asphalt* is generally used only for laying screeds on concrete and the screeds must be positioned immediately on pouring the mastic. Cut-back asphalt, chlorinated solvent and petroleum-based solvent mastics are all applied cold and are used for laying tongue and grooved block and parquet floors. Cut back asphalt mastic can be used to hold a recommended vapor retarder and/or to glue a plywood subfloor to the slab. Follow manufacturers' instructions on coverage, drying time and ventilation.

Trowels usually have both straight and notched edges. The notched edge is for use where a correct mastic thickness is specified. Both mastic and trowels may be available from flooring manufacturers and distributors.

Different Manufacturers Products. Do not randomly mix different manufacturers' products. Use transition areas such as doorways to separate the different manufacturers.

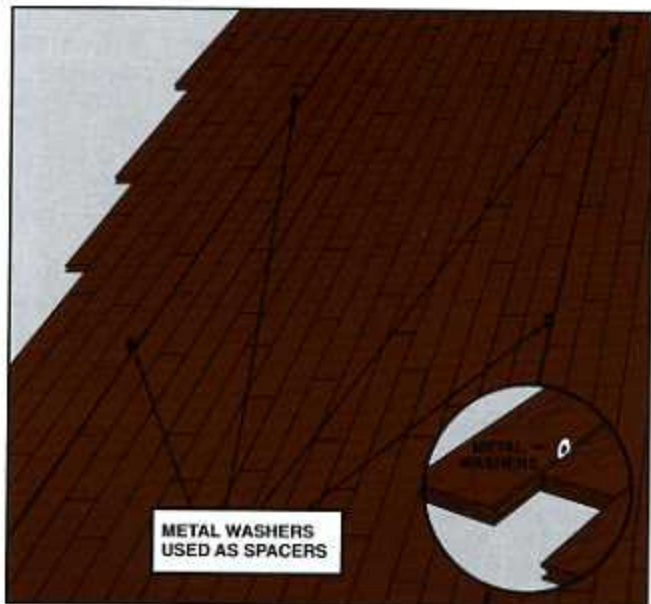


Fig. 11. Use of metal washers to provide expansion space on a gym floor.

STRIP FLOORING ON WALLS AND CEILINGS

Because of its beauty and decorative quality, strip flooring is being used more and more for interior wall and ceiling applications.

Storage and handling practices are identical to those for a flooring installation, and precautions concerning moisture conditions must be observed. In particular, the building should be closed in with all doors and windows in place and all concrete, masonry and plaster thoroughly dry. On exterior walls install a vapor retarder within the wall system. Check with an HVAC engineer for proper placement.

The flooring can be nailed direct to the studs for a horizontal application.

For vertical or diagonal application to a stud wall, nail $1\frac{1}{2}$ " thick furring strips (2 x 4s) to the studs at 12" spacing and nail the flooring to these strips.

For masonry walls, fasten lengths of 2 x 4s on 12" centers to the walls with concrete fasteners designed for the expected load. Nail size and schedule are the same as for flooring applications.

INSTALLATION OF GYMNASIUM FLOORS OVER A CONCRETE SLAB

Gymnasium floor products offered by NOFMA mills are most often made of $\frac{3}{4}$ " oak, pecan or maple. Some NOFMA mills make $\frac{5}{8}$ " maple. Beech and birch are also suitable. It is most important to have some resiliency built into these floors, but in most respects installation closely follows the screeds-in-mastic method recommended for conventional use, with a plywood or board subfloor installed over the screeds. Also, 2 layers of $1/2$ " plywood cushioned and laid on a 45° angle to each other may be used as a subfloor.

Acclimate all floor system materials to the established environment well in advance of installation.

Make sure the slab is dry and level with a good float finish. Maximum surface variation is $\frac{1}{8}$ " in 10'. Grind down high areas and fill low areas with concrete leveling compound.

Sweep the slab clean and prime with asphalt primer.* Let dry thoroughly and coat with asphalt mastic, using a notched trowel designed to apply at a rate of 50 sq. ft. per gallon. Embed a layer of 15 lb. asphalt felt or building paper, starting at a wall with a half sheet. Lap seams. Cover this with another layer of mastic and embed a second layer of asphalt felt or building paper, starting at the same wall with a full sheet to cover the seams of the first layer.

Either hot or cold mastic is satisfactory. If the cold type is used be sure to allow time (2 hours) for solvents to evaporate before applying the building paper.

An alternate method for a surface vapor retarder is to embed a 4 to 6 mil polyethylene film in a cold mastic (See Page 4.) Lap film edges 6".

A suspended concrete slab with a controlled environment below needs no surface vapor retarder.

A suspended slab over exposed earth or an uncontrolled environment requires a proper vapor retarder over the slab. In this case cross ventilation below the slab is essen-

tial, and, if over exposed earth, a ground covering of 6 mil polyethylene should be provided.

Screeds used and their application are identical to that previously described, **with these exceptions.** Place them on 12" centers, (9" centers with 3rd grade flooring) unless a subfloor is to be used, then 16" centers are allowed. Leave 2" space between the ends of the screeds and the base plate on all walls to allow for expansion.

The strip flooring may be nailed directly to properly spaced screeds, but a much more sound and satisfactory floor can be achieved by installing a subfloor of $\frac{3}{4}$ " minimum plywood or $\frac{3}{4}$ " dressed square-edged boards no wider than 6". Follow arrangement and nailing schedules described previously. If boards are used, leave $\frac{1}{2}$ " space between them.

Start laying the finish flooring in the middle of the room and work toward the walls. Engage the first two courses groove-to-groove with a slip tongue glued into one groove. Join the strips and face nail as well as blind nail both courses. Proceed with succeeding courses in the conventional manner, using either 7d or 8d flooring nails, 2" flooring cleats or 2" 15 gauge staples with $\frac{1}{2}$ " crown.

After an area 3' or 4' wide has been laid across the room, leave a $\frac{3}{8}$ " expansion space between the last course laid and the next course. Repeat this expansion space evenly at 3' to 4' intervals across the room. Different area environmental conditions may require more or less field expansion.

Nailing is most important. Nail to all screeds and to both screeds when a strip passes over a lapped screed joint. All end joints do not need to meet over screeds but adjacent strips should not break over the same screed space.

If a subfloor is used, nails must be no more than 10" to 12" apart with a minimum of 2 nails per board near the ends (1"-3") along the length of strips.

Allow 2" expansion space along all walls and at doorways. This can be covered at the walls with an angle iron bolted to the wall or a special wood molding, and at doorways by a metal plate designed for such use.

After installation and through the sanding and finishing process, the interior environment should be maintained near to an occupied condition. Extended times with no HVAC in operation should be avoided. This can promote a static "green house" effect. These conditions can allow an abnormal increase in moisture which may adversely affect flooring.

If problems occur during installation contact the distributor immediately. If problems arise before installation or you have questions, call the NOFMA office 901/526-5016 between 8:30 a.m. - 4:30 p.m. Central Time.

***ALWAYS FOLLOW MANUFACTURERS' DIRECTIONS**

OTHER PUBLICATIONS OF INTEREST

Hardwood Flooring Finishing/Refinishing Manual - Information on finishing new hardwood flooring and refinishing old floors to restore their original beauty.

Wood Floor Care Guide - How to keep hardwood floors beautiful with minimum care; tips on stain removal, and other subjects.

Most major producers of wood flooring in the United States are members of NOFMA: The Wood Flooring Manufacturers Association, an organization which upholds industry standards. The WFI and/or NOFMA trademark/certification on every bundle of flooring produced by an association member is your assurance of quality wood flooring.



*NOFMA: The Wood Flooring Manufacturers Association
supports sustainable forestry and the responsible stewardship
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The specifications and instructions contained herein supersede all previous and updated publication from NOFMA/WFI.