

Hardwood Strip Flooring

How to lay out and install it

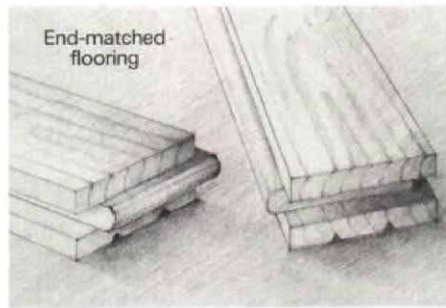
by Don Bollinger

Putting down a hardwood floor is one of the few kinds of woodworking that can be classified as both rough and finish carpentry. Any one who has installed a $\frac{3}{4}$ -in. oak floor will attest to the brute force required to drive home the nails, and to the telltale evidence of every mistake. And since all the work happens at ground level, a floor mechanic spends half his time on his knees and the rest stooped over like a field hand.

Still, the bundles of hardwood flooring that get broken open for each job contain some of the most carefully graded and highest-quality building materials available today. It's a pleasure to work with this stuff, and when wood this good is properly installed and cared for, it makes for a durable floor that can add a lifetime of color and warmth to any home.

Strip flooring—There are two basic types of strip flooring: tongue-and-groove (T&G) and square-edged. Some T&G strips are end-matched (drawing, above right), which means they're T&G on their ends as well as along their lengths. Strip flooring ranges from $\frac{5}{16}$ in. to 1½ in. thick, and from $\frac{3}{4}$ in. to 3¼ in. wide. Here in the Northwest, most strip flooring is red oak, white oak or maple, and the most common size, as it is throughout the country, is $\frac{3}{4}$ -in. thick by 2¼-in. wide T&G. I like end-matched strips because they give the floor a bit more strength, and reduce bouncing where strips butt end to end between joists.

Hardwood strip flooring is further subdivided into random lengths and shorts, depending on quality. The better the grade, the



fewer the knots, sapwood and pinworm holes, and the longer the strips. For instance, the best grade of oak is called *clear*, and the strips are at least 1¼ ft. long, averaging about 3¾ ft. They are usually flatsawn, but the more attractive quartersawn strips can be special ordered. The poorest grade is #2 *common*. These strips, which average 2¼ ft. in length, have knots, checks and worm holes. When you order any grade, add 5% to 10% to allow for waste.

Precautions—Have your flooring delivered at least three days before you install it, and break the flooring bundles open so the boards can adjust to the ambient moisture. If the floor is going into a new house, make sure the place is sealed up, and that all masonry, plaster, drywall and other wet-process work is completely dry. Three weeks before the flooring is to be delivered, turn up the thermostat to your typical setting to help dry things out. If there is too much moisture in the house when

the floor is installed, the floorboards will shrink when the humidity drops, and you'll get ugly gaps between them. Moisture can also come up through the subfloor, so make sure the basement is dry and well ventilated.

Subfloors—A hardwood floor is no better than what's under it. Almost all squeaky floors, cracking finishes and other signs of early aging can be traced directly to inadequate underlayments. I've found it best to install a subfloor that's heavier than those generally specified in the building code (see the chart below). You will need an especially heavy subfloor if you're planning to lay your strip flooring parallel to the joists.

Plywood is the most common underlayment for strip flooring—I don't use particleboard because nails don't hold in it and water deteriorates it. For $\frac{3}{4}$ -in. thick strips (like the ones we're talking about in this article), use $\frac{3}{4}$ -in. plywood blocked under all edges, with a $\frac{1}{8}$ -in. expansion gap between each panel. Glue the plywood sheets down with panel adhesive and nail them with either hot-dipped galvanized or ring-shanked nails. This combination will reduce movement and squeaks.

If you use planks for your subfloor, they should be 6 in. to 8 in. wide and at least $\frac{3}{4}$ in. thick. They can be either square-edged or shiplapped, but shouldn't be T&G unless they are at least 1½ in. thick—anything less will flex and squeak.

Without a moisture meter, it's hard to tell whether boards will expand or contract. To play it safe, leave $\frac{1}{8}$ -in. gaps between your

Recommended underlayments for tongue-and-groove hardwood flooring

Orientation of flooring	Random-length strip		Shorts (18 in. or less)	Square-edge strip
	up to 3¼ in. wide, $\frac{3}{4}$ in. thick	4 to 8 in. wide, $\frac{3}{4}$ in. thick	up to 3 in. wide, $\frac{3}{4}$ in. thick	1 to 3 in. wide, $\frac{1}{2}$ to $\frac{5}{16}$ in. thick
Strips running at 90° to joists set 16 in. o.c.*	$\frac{3}{4}$ -in. T&G plywood	$\frac{7}{8}$ -in. T&G plywood 1-in. square-edge plywood	1-in. T&G plywood or square-edge plywood	1½-in. T&G plywood or square-edge plywood
	$\frac{3}{4}$ -in. square-edge plywood $\frac{3}{4}$ -in. by 6 to 8-in. plank or shiplap laid diagonally or two layers of $\frac{1}{2}$ -in. square-edge plywood with staggered seams	$\frac{7}{8}$ -in. square-edge plywood $\frac{3}{4}$ -in. by 6 to 8-in. plank or shiplap laid diagonally or two layers of $\frac{1}{2}$ -in. square-edge plywood with staggered seams	Two layers of $\frac{1}{2}$ -in. square-edge plywood with staggered seams	Two layers of $\frac{5}{8}$ -in. square-edge plywood with staggered seams
Strips diagonal or with joists set 16 in. o.c.*	1½-in. T&G plywood or two layers of $\frac{5}{8}$ -in. square-edge plywood with staggered seams Bridging between joists			

* For joists set 24 in. o.c., add $\frac{1}{4}$ in. underlayment, for joists set 12 in. o.c. subtract $\frac{1}{8}$ in. underlayment

subfloor planks. A standard $\frac{3}{4}$ -in. plank subfloor should be installed diagonally across joists spaced 12 in. to 16 in. o.c. Thicker T&G material may be laid at right angles to the joists. In either case, be sure that all underlayment planks butt end to end over a joist or blocking. Otherwise you'll get soft spots, fractured finishes and squeaks.

Whatever underlayment you use, be sure that its moisture content has stabilized before you install any hardwood over it. Don't use for underlayment plywood that has been used in concrete forms, because it has absorbed a lot of moisture and could delaminate.

Once the subfloor is installed, any differences in height between adjoining pieces of underlayment should be sanded flat with a belt sander using a coarse-grit belt. Scrape away any plaster or joint-compound lumps, then sweep or vacuum the subfloor. Prowl it one more time with a handful of 2-in. ring-shanked nails, and fix any humps and squeaks. Finally, mark the location of each joist at the base of the wall.

It's usually best to run the flooring in the direction of the longest dimension in the room. This will reduce the area over which the flooring will do most of its seasonal expansion and contraction. A vapor barrier between subfloor and finish flooring will keep out dust and moisture from below, help prevent squeaks and stop unwanted airflow through plank subfloors. I usually use three-ply resin paper, but 15-lb. to 30-lb. asphalt-saturated felt works just as well. Roll it out in the direction you want to run the strip flooring. If the floor is directly over a furnace or uninsulated heating ducts, add an extra layer of paper or felt to help keep the finish flooring from drying out.

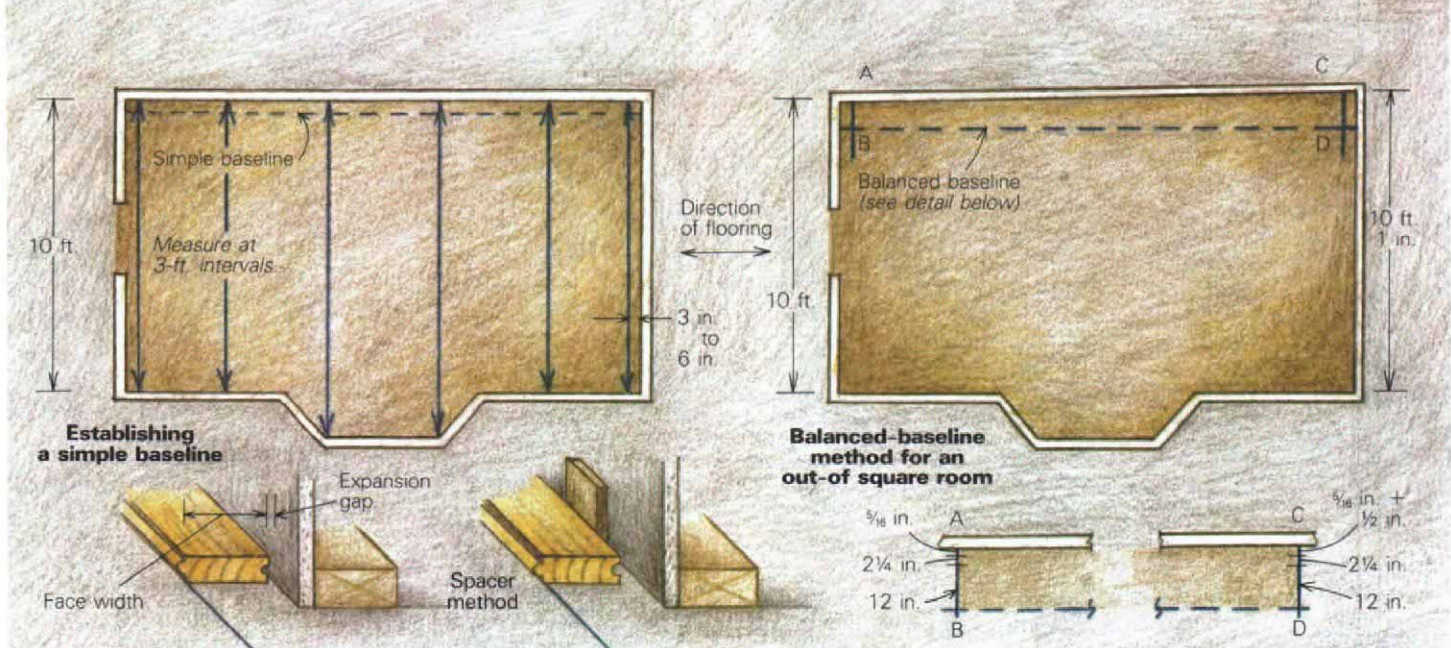
Cover the length of the room where the floor-laying will begin with a few courses of VB paper or felt stapled to the floor. The baseline (see next page) is chalklined onto the felt. Subsequent courses needn't be stapled. Overlap the edges of the strips 3 in. to 6 in., and lay more down as the floor progresses, to keep traffic from tearing up the paper.

If the total thickness of the subfloor plus underlayment is $\frac{3}{4}$ in. or less, nail $\frac{3}{4}$ -in. strip flooring into and between all joists. Snap chalklines between the marks on the wall so you know where the joists are. You'll have to restrike this line each time you lay a new strip of felt.

Moisture and movement—Like any wood, each piece of hardwood flooring expands across its grain as it picks up moisture, and contracts as it loses it. Given a large lateral area, the cumulative effect can cause a floor to

Installing a hardwood strip floor requires planning, especially in places like hallways, where misaligned boards are easy to see. Once the first few rows are nailed in place, the floor is racked, or loosely laid out, several rows at a time. When the flooring is extended into the kitchen (at right), a hardwood spline will connect the grooves of adjacent boards, allowing a change in the direction of the leading edge.





The first course of flooring follows a baseline. To locate it, measure at 3-ft. intervals to find out if opposing walls are parallel. If they are within $\frac{1}{2}$ in., use a simple baseline, left. The balanced baseline, right, averages the error in a room whose opposing walls are more than $\frac{1}{2}$ in. off parallel.

buckle. I've seen entire walls uprooted at the plate as a result of a leaky roof.

A little seasonal movement is normal. To allow for expansion, leave gaps between the edge of the floor and the wall. Since a baseboard or shoe molding will conceal this gap, many installers simply allow $\frac{3}{4}$ in. around the entire perimeter. A rule of thumb is to expect hardwood to expand and contract $\frac{1}{8}$ in. for every running foot of cross-grain flooring.

Wood movement along the grain is negligible, but we leave about a $\frac{1}{2}$ -in. gap at each end wall. This space makes it easier to fit the boards together and allows air circulation.

Layout—Assume there is no such thing as a square room. I know I've never found one. The most carefully constructed rooms are usually out of square by $\frac{1}{2}$ in. to $\frac{3}{4}$ in. These inaccuracies are easy to mask in the typical strip floor just by allowing for them in the expansion gaps around the edges of the room. Severe cases of out-of-square can call for a tapered floorboard hidden under a cabinet kick-space or a counter overhang, or a mask in the form of some type of border arrangement. In one terribly out-of-square room, I finally installed the flooring diagonally, after checking to make sure the subfloor would support it.

A good installer will spend as much as a third of the job sizing up the layout, installing the first few boards and anticipating and avoiding the glitch that would foul up the floor. Remember that some wall-to-floor intersections are in more visible locations than others, and that the baseboards and floorboards should be as close to parallel as possible. Converging floorboard and baseboard lines look especially awful in hallways. The error caused by out-of-square walls has to be dispersed gradually. Don't try to deal with it at a single intersection, where it will smack you in the eyes.

When you're installing strip flooring you need to worry only about the alignment of walls parallel to the flooring. Run a tape measure between these walls every three feet along their lengths. Start 3 in. to 6 in. away from the corners. They tend to flare out because of the way wallboard is taped. If there are more than two facing walls, make at least two measurements for each additional wall. If the opposing walls are less than $\frac{1}{2}$ in. out of parallel, you can use a simple baseline to begin laying the floor.

Baselines—The baseline is a starting point for the flooring in a room, and is used as a reference device to keep straight, even runs of flooring. Since every installation is different, the location of the baseline is never quite the

same, but there are some guidelines to determine where to put it. It usually parallels the longest wall or longest uninterrupted run of flooring in the room. Given a choice between two walls of equal length, establish the baseline near the most visible wall.

In the simplest situation, you go to the end of one wall and pencil a mark on the vapor barrier. The distance from the wall to the mark is equal to the face width of one floorboard plus the expansion gap, as shown in the drawing, above left. Repeat the procedure at the other end of the wall and snap a chalkline between the two marks. This is the baseline. The first course of flooring is then face-nailed in place with the baseline as a guide. Begin nailing halfway along the length of each board, then work toward each end.

If the opposing walls are close to parallel, an easier way to start the first strip is to place removable shims equal to the thickness of the expansion gap against the wall. The first strip butts these shims, and is nailed in place. If you are using this method, be sure to sight along the leading edge of the flooring to make sure any dips or wows (depressions or bulges) in the wall aren't being telegraphed into the strips.

The balanced baseline—If opposite walls are more than $\frac{1}{2}$ in. out-of-parallel, the baseline has to average out the discrepancy and distribute the error to both sides of the room. This is called a balanced baseline.

In the drawing above right, one wall is 10 ft. long and the opposite wall is 10 ft. 1 in. Start at point A and measure out $14 \frac{5}{8}$ in. to find point B. This dimension is the total of the expansion gap ($\frac{5}{8}$ in. per side for 10 ft. of cross-grain floor) plus the flooring face width ($2 \frac{1}{4}$ in.) plus a 1-ft. workspace. At point C, add $\frac{1}{2}$ in. to the measurement to account for half of the 1-in. discrepancy. Mark point D. This total measurement is $15 \frac{1}{8}$ in.

Now snap a chalkline between point B and point D, and forget about any other reference

Nail schedule			
Tongue-and-groove flooring			
Flooring (in.)	Size	Fasteners	Spacing*
$\frac{3}{4}$ x $1 \frac{1}{2}$	2-in.	machina-driven	10 to 12 in
$\frac{3}{4}$ x $2 \frac{1}{4}$		7d or 8d	
$\frac{3}{4}$ x $3 \frac{1}{4}$		screw or cut nail	
$\frac{3}{4}$ x 3-in to 8-in plank**			8 in into and between joists
$\frac{1}{2}$ x $1 \frac{1}{2}$	$1 \frac{1}{2}$ -in	machine-driven fastener	10 in
$\frac{1}{2}$ x 2		or 5d cut steel or wire casing nail	
$\frac{3}{8}$ x $1 \frac{1}{2}$	$1 \frac{1}{4}$ -in	machine-driven fastener	8 in
$\frac{3}{8}$ x 2		or 4d bright wire casing nail	
Square-edge flooring			
$\frac{5}{8}$ x $1 \frac{1}{2}$	1-in., 15-ga fully	2 nails	7 in o c
	barbed flooring brad		
$\frac{5}{8}$ x 2	1-in., 15-ga fully	5 in o c,	
	barbed flooring brad	on alternate	
$\frac{5}{8}$ x $1 \frac{1}{8}$		sides of strip	
Dimensions in this chart are nominal, not actual, size. Flooring $\frac{1}{2}$ in. or thinner must be laid on a subfloor. Tongue-and-groove flooring must be blind-nailed. Square-edge flooring is face-nailed through top face. *If the subfloor is $\frac{1}{2}$ -in. plywood, flooring should be nailed into each joist, with additional fastening between joists. **If planks are wider than 4 in., screw or glue them to the subfloor.			

line. Measure back 1 ft. to locate the leading edge of the first piece of flooring.

Sometimes a balanced baseline alone won't solve a special problem. We once had a job in which a stairwell, in a run of only 2 ft. 4 in., wandered $\frac{3}{8}$ in. out of parallel. We decided to compensate for the error with two different steps. We added $\frac{1}{2}$ in. to one end of the baseline measurement, bringing the stairwell and baseline a little closer to parallel, then we took up the rest of the error by slightly skewing the nosing around the stairwell. This left that opening slightly out of square, but no one without a tape will ever notice.

Installing the first boards—Sort through your longest bundles and find enough straight pieces for two starter and four finishing rows. Check them by sighting down the boards as though you were looking for a good pool cue. Using bent or crooked pieces to finish out a floor usually results in ugly gaps in the last few rows. It's hard enough to pull the flooring up tight next to a wall without having to fight recalcitrant boards.

For right-handers, it's easier to work from left to right, so most floors begin at the left-hand corner (drawing, top right). Set the first strip squarely on the baseline $\frac{1}{2}$ in. out from the wall; the tongue side should face you, with the end-matched groove to your right.

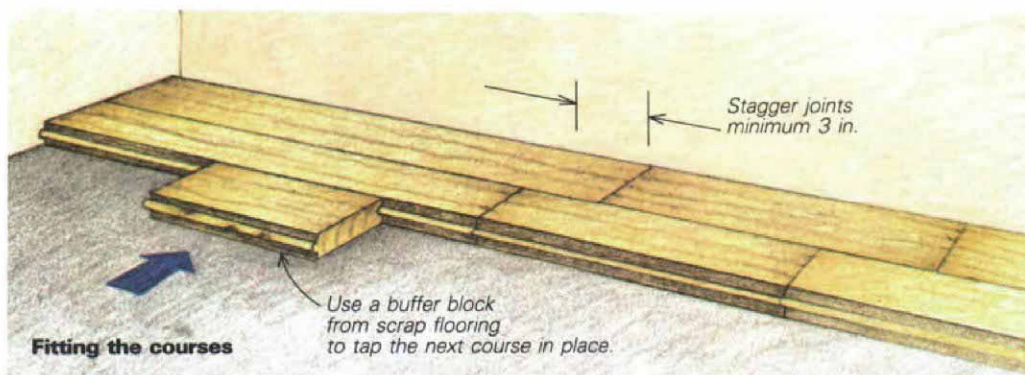
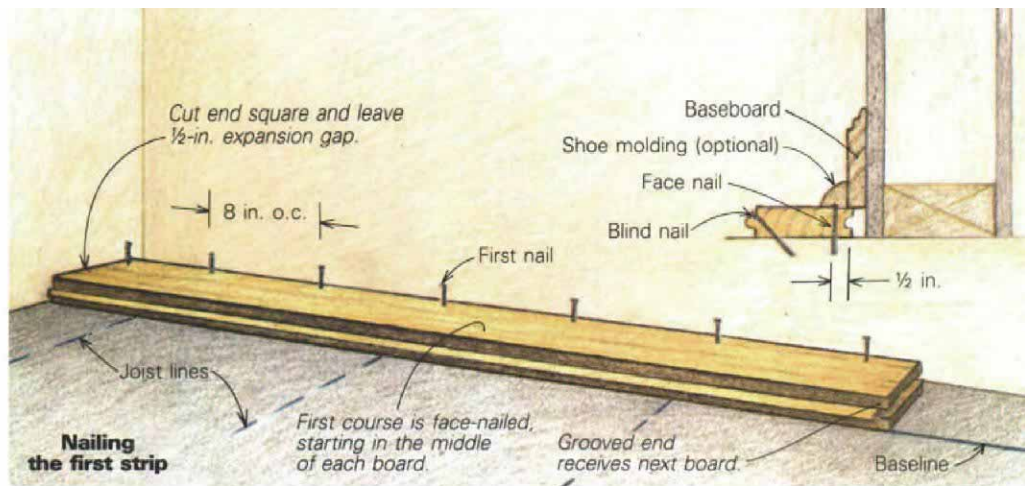
Align the leading edge of the groove side with the baseline. Starting in the middle of the board's length, about $\frac{1}{2}$ in. from the grooved edge, face-nail $\frac{3}{4}$ -in. boards with 8d cut nails or 2-in. power-driven fasteners (the chart on the facing page gives other, nailing specs).

We use a power nailer to set the boards (photo right). It fits over the leading edge of the board, and with one blow of the mallet to the nailer's plunger, the tool draws the board tight against its neighbor as it drives a barbed fastener through the top of the tongue and into the subfloor at a 45° angle. We use a power nailer designed for face-nailing in tight spots near walls.

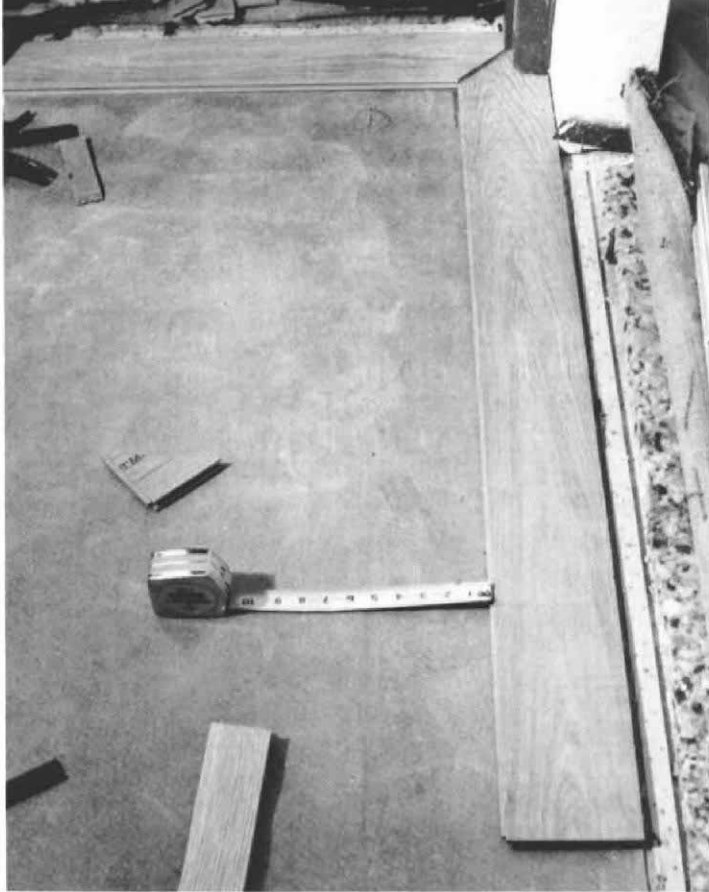
Power nailers are fast and easy to use. They lessen the chance of dings from misguided hammer blows. You can rent one from a tool-rental yard or a flooring-supply center, or buy your own. Two companies that make them are Porta-Tools (Box 1257, Wilmington, N.C. 28402) and Power Nailer (Power Nail Co., Rte. #22, Prairie View, Ill. 60069).

Place the nails 8 in. o.c., and make sure every other nail sinks into a joist. At board ends, drill $\frac{1}{8}$ -in. pilot holes to keep the boards from splitting. Blind-nail the same number of fasteners through the board's tongue, taking care to avoid knocking the board out of alignment. Set all nails below the face of each board.

Select strips for the second row that won't end within 3 in. of the butt joints in the first row (drawing, center right). You should stagger butt joints this way throughout the floor. Tap the boards in place using a buffer



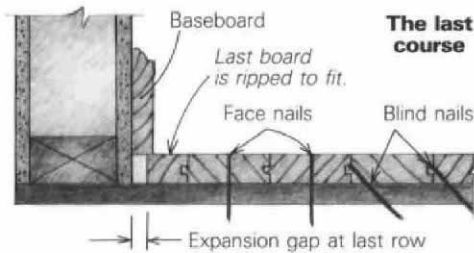
One blow to the power nailer is enough to pull the flooring tight against the previous course and set a barbed nail.



Two header boards intersect in a mitered corner. The door casing has been trimmed off at the bottom to allow the flooring to slip under for a finished look. The tape measure registers the distance from the board's face edge to the baseline.



At a doorway, a header board is screwed in place 8 in. o.c. with #10 2-in. square-drive screws. Hardwood plugs, with their grain turned at 90° to the grain of the header board, will fill the counterbores. The first course of flooring will be mitered to meet the edge of the header board.



The last course. Strips are levered into place, above, and face-nailed with a power nailer.

At row ends, left, boards are marked for length by eye and cut off at 90° with a power miter box. Trimming this board will remove a flaw, making it a good candidate for a row-ending piece. Another common practice is to pick end pieces that leave cutoffs at least 6 in. long, which are used to start subsequent courses.

board—a short offcut used to protect the board from hammer blows while positioning it—and blind-nail them in place. In most cases you'll get a snug fit with little effort, but occasionally a crooked piece will require levering with a prybar or a screwdriver. Before you exert too much force, check to see if a board is hung up on a cracked tongue, on an unset nail or on a small bit of wood.

Once you've gotten this far, you can move right along. I like to keep my power miter box just behind me and to my right as I'm nailing. It's easy to reach there, and the sawdust it makes is away from my clean vapor barrier.

Once the first few rows are nailed down, we "rack" the floor. This means laying out several loose rows of flooring a few inches ahead of the last row installed (photo p. 43). We place the pieces so the butt joints are as far apart as possible, and so that short pieces get evenly distributed. We use long strips across doorways and down halls, and save the shorts for closets, bathrooms and other confined areas.

Unless a precise cut is needed, we don't measure cutlines at the end of a row. Instead, we hold the board against the wall so that its tongued edge faces the nailed-down rows and eyeball a cutline (photo bottom left). When the board is drawn tight into its end-matched groove, there is a ½-in. gap at the wall.

If the flooring butts something that isn't already in place, such as a threshold, hearth or finished trim, we work to a temporary straightedge, start the flooring at it and face-nail the ends of each board.

Header boards—At doorways and passages, we install header boards for decorative effect. They're wider T&G planks than the rest of the flooring, and they're screwed to the subfloor rather than nailed (photos facing page, top). Instead of blending into the flooring with a butt joint, they join at a 45° angle. Their countersunk screw holes are plugged using the same wood, with the grain turned 90° for a subtle highlight.

You can't leave an expansion gap when you install header boards. Instead, we add 50% to the minimum gap at the opposite wall.

Check the alignment of the rows as they march across the room to make sure the occasional dip or wow isn't becoming amplified. Usually they can be handled with a buffer board and a small sledge, but sometimes a board will need a little wood removed. I use a plane to take material off the groove side of the strip to match fluctuations in neighboring boards. Cull out the really distorted pieces—they're just too much trouble to deal with.

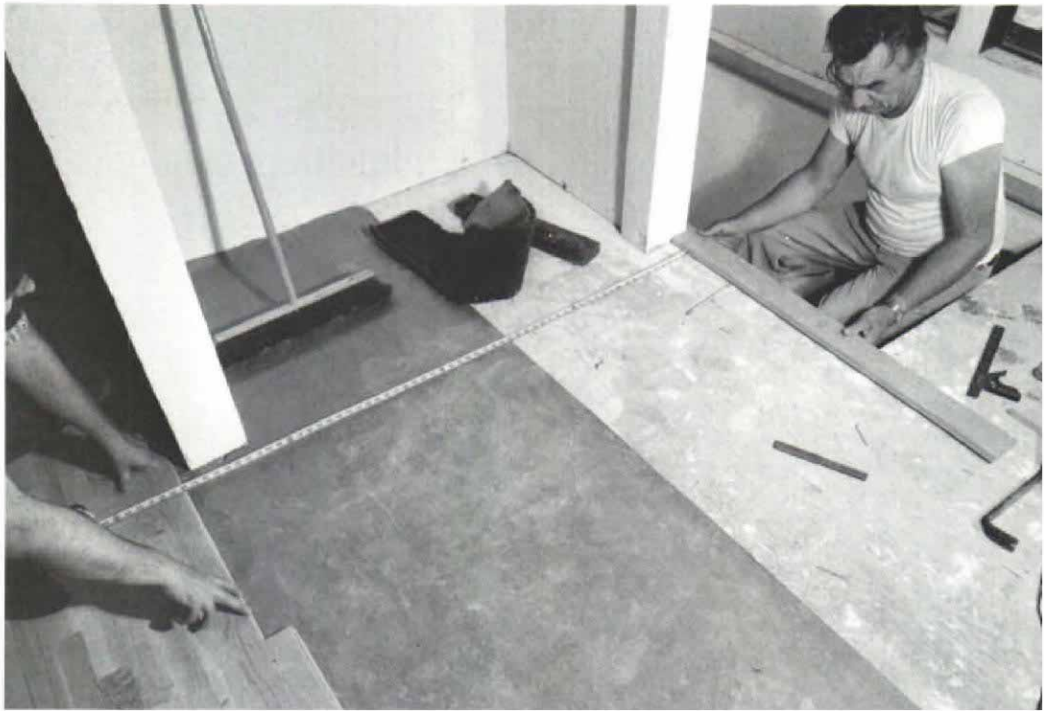
When you reach the opposite wall, you'll need to face-nail the last few rows while they're held tightly in place. Don't do more than two rows at a time. Get out those straight boards you've been saving and use a piece of flooring held against a block on the wall to lever them into position (photo facing page, bottom right). Position the force of the lever over a wall stud, as shown, and use a block long enough to span two studs to keep from damaging the wallboard.

Once the last full row has been nailed down, you'll probably need to rip one last course to finish the floor (drawing, facing page). Occasionally a ripped piece will be too narrow to nail without splitting. In such a case, I glue the narrow piece to the last full strip with yellow glue and temporarily wedge it in place until the glue dries.

Stairwell nosing—When hallway flooring is nailed off, we take another set of measurements to see how close the strips and the stairwell are to being parallel (photo above right). If things are a bit off, we pencil-mark the necessary adjustment on the subfloor and adjust the nosing strips to compensate for the error. Then we temporarily screw them in place. When it's time to install the notched floorboard (photo below right), we remove the nosing so that we have room to tap the grooved edge of the flooring into place. If there's no nosing to adjust, we dress a slight taper into a number of strips with a plane to hide the error.

Finishing up—We wait two weeks before we go back to a floor to sand and finish it. Here in the humid Northwest, this allows the newly installed floor to acclimate itself to its new surroundings, and to adjust to the stresses brought on by being nailed and screwed to a flat surface. After sanding, we stain the floor and finish it. And that's another story. □

Don Bollinger owns the Oak Floors of Greenbank in Seattle, Wash.



The distance from the advancing floorboards to the stairwell nosing is measured to check for parallel, above. Once this is established, the nosing is cut to length and screwed in place. In the finished floor, below, the strip next to the angled nosing piece required notching. The nosing was removed to let in the strip, then replaced. The countersunk screw holes were plugged.

