

INSTALLING OVER RADIANT HEAT:

BE SYSTEMATIC

A three-step process to successful installation

STEP 1: KNOW THE RADIANT-HEAT SYSTEM

Radiant-heat systems typically involve hot water running through tubes embedded in concrete or stapled to plywood subfloors, but there are many variations.

Radiant heat in frame construction: The simplest type of radiant-heat system in frame construction involves stapling tubes to the underside of the wood subfloor, between the floor joists. (See Figure 1.) The wood finish floor is then nailed, as usual, to the wood subfloor, with shorter nails, if necessary, to avoid puncturing the tubing.

In a sandwich system, the pipes are laid between sleepers over an existing wood subfloor. (See Figure 2.) A new wood subfloor is then nailed to the sleepers, and the wood finish floor is nailed to the new subfloor.

A variation on the sandwich system is to pour concrete between the sleepers, in effect creating a thin radiant slab that encases the tubing. (See Figure 3.)

In all of the above cases, a layer of insulation is normally placed below the tubes or the existing subfloor to ensure that most of the heat from the pipes is directed upward.

Radiant heat in slab construction: In new construction, the radiant-heat tubing is often embedded in the slab. This is often referred to as a “cast-in-slab” construction.

In retrofit installations, sleepers may be placed over the existing slab, with the tubing run between the sleepers and embedded in new concrete.

In either case, the wood flooring can then be installed above the slab by a variety of methods.

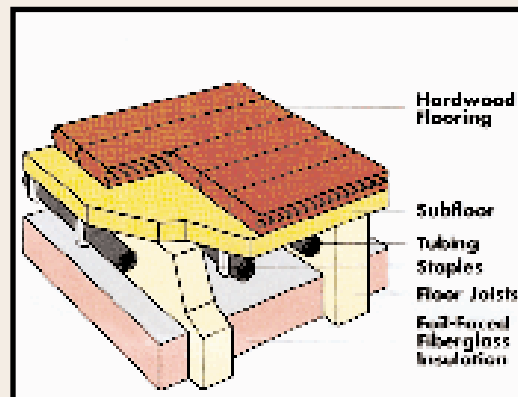
- A plywood subfloor can be placed over the slab, with the wood flooring nailed to the subfloor.
- Wood flooring can be glued directly to the slab. (See below.)
- Wood flooring can be “floated” over the slab. Many floating floor systems are engineered wood flooring, but there are also some solid wood floating floor systems.

STEP 2: CHOOSE THE RIGHT WOOD FLOORING

Not all species and styles of wood are good candidates for installation over radiant heating. The primary goal is dimensional stability, to minimize the effects of expansion and contraction. It's best to follow the manufacturer's recommendation for a product's suitability over radiant heat. In general, however, the following guidelines apply:

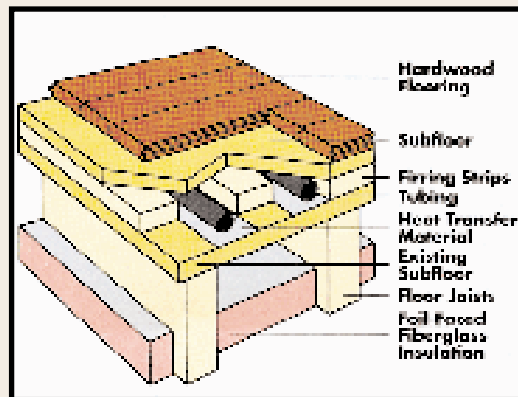
- **Engineered wood flooring** is more dimensionally stable than solid wood flooring.
- **Floating floors**, whether engineered or solid, help accommodate moisture-content changes, because the floor tends to move as a unit.
- **Some species** are known for dimensional stability. (See

Figure 1



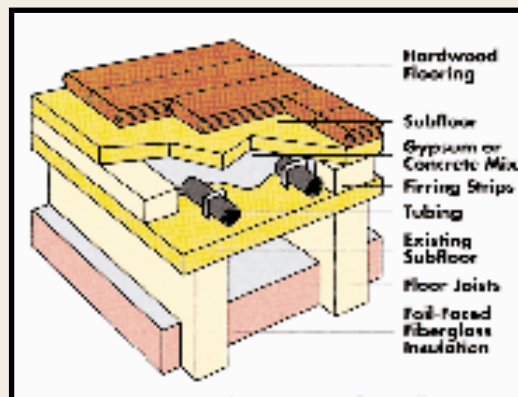
Stapled to subfloor

Figure 2



Sandwich over frame construction

Figure 3



Masonry-filled sandwich

Illustrations courtesy of the Hardwood Council

The National Wood Flooring Association's publication, *Wood Species Used in Wood Flooring*.) Common North American species recommended for installation over radiant heat include cherry and walnut. Mesquite is known as an extremely stable wood, although it is much more common in the Southwest than anywhere else. Teak is also considered very stable. Maple and beech, on the other hand, tend to exhibit a lot of movement in response to moisture changes.

- **Solid wood flooring over radiant heat:** Strip flooring is generally considered a better choice than plank, because narrow boards expand and contract less than wide boards do. Using narrow boards also means there are more seams in a floor to take up movement. Some flooring professionals recommend that only strip flooring (2¼ inches wide or less) be used over radiant heat if the customer demands solid wood.

- **Quartersawn or rift-sawn flooring** is more dimensionally stable than plainsawn flooring. It is usually more expensive, though not necessarily prohibitively so. Quartersawn oak, for example, might give you the dimensional stability you need at a cost of perhaps 30 percent more than plainsawn. Quartersawn wood is not always expensive, however. Fingerblock parquet is mostly quartersawn wood, and it is one of the least expensive types of flooring available.

- **Plank flooring over radiant heat:** Plank flooring can be successfully installed over radiant heat, but there's little margin for error. All the precautions recommended for strip flooring apply — make sure the slab is properly cured and dried, that an approved vapor barrier is in place and that the wood is properly acclimated. Installers should be even more rigorous in following recommended practices. For example, standard practice dictates that the moisture content of wood flooring and the moisture content of a wood subfloor should be within 4 percentage points — and also fall within the equilibrium moisture content range for that region. For plank flooring over radiant heat, some professionals recommend a maximum variation of 2 percentage points, so that a wood floor with a moisture content of 8 percent should not be installed over a wood subfloor with a moisture content of more than 10 percent. Some professionals also recommend using the double-layer plywood subfloor system (see Figure 6), and most prefer to use quartersawn wood for its dimensional stability.

STEP 3:
CHOOSE A WOOD FLOOR SYSTEM

In frame construction, with the radiant-heat tubing stapled to the underside of the wood subfloor or with a

COOL DOWN

When sanding and finishing a wood floor over radiant heat, turn the heating system off or down before applying finish, since a too-warm surface can interfere with application and curing.

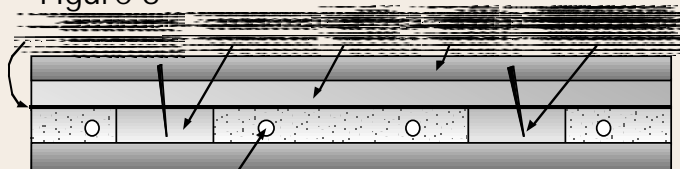
Figure 4



Engineered wood flooring glued directly to slab

A flat slab is essential

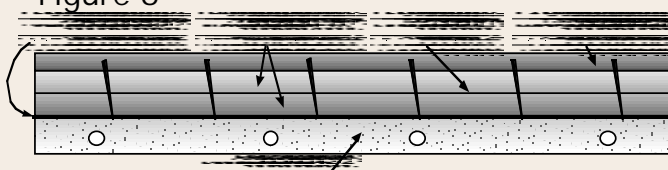
Figure 5



Single-layer, nail-down subfloor

Laid over sleepers and radiant slab

Figure 6



Double-layer floating subfloor

Two layers of plywood, laid perpendicular to one another

sandwich system, a wood flooring installation may not be significantly different than it would be in a home with a forced-air heating system. The flooring can be nailed into the wood subfloor as usual, except that installers have to be sure that nails don't puncture the tubing, and also be sure to use enough nails — perhaps nailing more frequently than they might in a home with forced-air or baseboard heat.

There are some wood floor systems that lend themselves especially well to installing over radiant heat:

- **Glue-down directly to slab (See Figure 4.):** This is typically an engineered wood flooring product, although solid parquet may be glued directly to concrete, and some manufacturers of solid strip flooring now allow their products to be glued to the slab under specified conditions. You need a flat slab to make a glue-down installation work well, but the method has the advantage of being a fairly easy installation and floor height can be minimized. Engineered wood flooring is more dimensionally stable than solid wood, so it may be less affected by changes in temperature and humidity.

To ensure that the bonding process works properly, some flooring professionals recommend turning off the radiant-heat system before gluing the floor down. Follow the flooring manufacturer's recommendations on which

adhesive to use over radiant heat.

Gluing a solid strip product to a slab should be attempted only if a flooring manufacturer does recommend this method and then only if specific instructions are followed.

• **Single-layer, nail-down subfloor (See Figure 5.):** Usually over a slab or existing subfloor, 2-by-4 sleepers are attached to the slab or subfloor, with tubes running between the sleepers and a radiant slab poured over the tubing.

The radiant slab needs to cure and dry, with the heating system turned on, before a wood subfloor is laid over it. The right moisture content may vary from one region to another, but 8 to 12 percent moisture content in the slab (which is usually compatible with 6 to 8 percent moisture content in wood flooring) is a good average to aim for in many areas.

Once an acceptable moisture content has been achieved, a 6-mil polyethylene or other approved vapor barrier should be placed over the slab and sleepers, and the wood subfloor should be laid. Many flooring professionals recommend a minimum of 3/4-inch plywood subfloor, screwed or nailed to the sleepers. Some prefer using both glue and screws. Standard practice dictates that a 1/4-inch to 1/2-inch expansion space be left around each sheet of plywood and at the walls.

With the heating system still on, the wood subfloor should dry to an acceptable moisture content (6 to 8 percent in many regions) before wood flooring is brought into the structure. (In addition, the interior environment should be stabilized at temperature and humidity levels that reflect “normal living conditions.”) Solid wood flooring should be broken out of bundles and spread out in the area where it will be installed, and allowed to acclimate to interior conditions. The National Wood Flooring Association recommends that subfloor’s moisture content be within 4 percentage points of the wood flooring before installation is safe. Engineered wood flooring may not need to acclimate prior to installation.

Once the moisture content of all elements — radiant

NAIL IT

In any nail-down installation, wood flooring installers must take care that nails don’t puncture the radiant-heat tubing. It may be a question of accuracy: The location of the tubing must be identified and avoided, or nails should be driven into the sleepers or joists. Or it may be a question of nail length: They should be short enough not to penetrate the subfloor above the tubing. If you’re nailing only into joists or sleepers, be aware that joists are normally placed 16 inches on-center and sleepers are often placed 12 inches on-center. The National Oak Flooring Manufacturers Association’s optimum nailing schedule for solid strip flooring is one nail every 8 to 10 inches. The maximum allowable distance between nails is 10 to 12 inches.

slab, sleepers, subfloor and wood flooring — are in balance, the flooring should be laid perpendicular to the sleepers and blind-nailed through the subfloor to the sleepers. After installation, standard practice recommends that wood flooring be allowed to acclimate from four days to three weeks (depending on regional moisture conditions) before being sanded and finished.

• **Double-layer floating subfloor (See Figure 6.):** This system, preferred by some flooring professionals, is commonly used over a cast-in-slab radiant-heat system, with no sleepers required.

After the slab has cured and dried to an acceptable level, place a 6-mil polyethylene (or other acceptable) vapor barrier over the slab. Then float two layers of wood — typically ½-inch plywood — over the slab. Lay the first layer of plywood over the slab, with staggered butt joints and expansion gaps of ⅛ to ¼ inch around each sheet and a 1/4-inch to ½-inch gap at the walls. Some flooring professionals recommend spreading adhesive over the first layer. Lay the second layer of plywood over the first, with sheets perpendicular to or at a 45-degree angle to the first layer and the seams staggered so that no seam from the bottom layer is uncovered. Leave a ⅛-inch to ¼-inch expansion gap around each sheet. Then screw the top layer to the bottom with ⅜-inch wood screws, about 12 inches on-center and 6 inches on the seams. Some flooring professionals staple the two layers together, rather than gluing.

Just as with the single-layer system, the subfloor must be allowed to dry to an acceptable moisture content before the finish flooring can be acclimated (if necessary) and installed. Some flooring professionals recommend placing 15-pound roofing felt between the subfloor and the wood flooring.

• **Engineered floating floor:** This method works well directly over a slab. Compared with solid wood, the engineered wood flooring is less subject to expansion and contraction as moisture content changes, but what movement there is can be accommodated by the entire floor moving over the slab. Like the glue-down floors, engineered floating floors minimize height gain and are also available in prefinished products to eliminate sanding and finishing.

Place the recommended pad over the slab, then float the floor over the pad. The floor is held in place by gravity, not attached to the subfloor. Use the manufacturer's recommended adhesive for gluing the flooring pieces together and follow manufacturers' recommendations for expansion space at the walls.

• **Solid floating floor:** This system, which uses metal clips to mechanically hold the flooring pieces together, has many of the advantages of the engineered floating system, including minimized height gain. While solid wood is more susceptible to expansion and contraction than engineered wood, the floating system does allow the floor to move as a unit to accommodate moisture-content changes. — *R.B.*

INSTALLING OVER RADIANT HEAT: GET THE MOISTURE NUMBERS RIGHT

The key to a successful wood flooring installation over radiant heat is to pay meticulous attention to the moisture content of the wood flooring, subfloor, concrete slab and other surrounding materials, as well as the interior environment of the structure. Your first priority is to follow the flooring manufacturer's recommended guidelines. However, the National Wood Flooring Association has some general guidelines.

Before solid wood flooring can be installed in any application, it needs to be properly acclimated to "normal living conditions." That means that the structure itself must be at "normal living conditions" before the wood floor can be acclimated.

To be at "normal living conditions," the structure must be totally enclosed, with all "wet trades" work completed. The HVAC (heating, ventilation and air-conditioning) system should be operating at occupancy level. Finally, testing with moisture meters should show that materials in the structure (especially the slab and subfloor) are acceptably dry, and hygrometer tests should indicate that the relative humidity in the interior environment is stabilized.

The wood flooring should then be allowed to reach the equilibrium moisture content (EMC) that is consistent with the interior environment. In most cases, this will be a moisture content of 6 to 9 percent. However, proper moisture content will vary from one region to another and from one season to another within regions.

In general, rely on the recommendations of your wood flooring manufacturer or supplier for the length of time the slab and subfloor should dry and for the proper moisture content.

Wood flooring at the right moisture content is only one step. In addition, a wood subfloor should be within 4 percentage points of the wood flooring's EMC. That is, if the EMC of the wood flooring is 8 percent, the wood subfloor should have a moisture content of no more than 12 percent.

For installation over a concrete slab, NWFA recommends that moisture vapor emission from the slab should not exceed 3 pounds per 1,000 square feet in 24 hours. Rely on your flooring manufacturer's recommendations for what moisture test to use.

Regardless of the season, make sure the heating system is turned on to drive any excess residual moisture out of the slab or subfloor before the wood flooring is acclimated and installed.

(However, once the slab and subfloor have been dried, the system must be turned down or off before a glue-down installation can begin, since a too-warm slab or subfloor will keep the adhesive from bonding properly. For site-finished floors, the system should also be turned down or off before finish is applied, since the heat can keep the finish from curing properly.)

How long the radiant-heat system should be on is more problematic, depending in part on what type of radiant-heat system is in place.

- In frame construction, the radiant-heat tubing may be installed by stapling it to the bottom side of the wood subfloor. In those cases, it is recommended that the radiant-heat system be operating at least 72 hours prior to acclimating the wood flooring.
- When concrete is used as part of the radiant-heat system, you have the additional problem of making sure the slab is cured and dry. That can take anywhere from 30 to 60 days, and sometimes more. — *R.B.*

For a more detailed discussion of the relationship between moisture and wood flooring, consult the National Wood Flooring Association's Technical Publication, Water and Wood. To obtain a copy, contact NWFA by phone at 800/422-4556 (U.S.), 800/848-8824 (Canada) or 636/391-5161 (local and international), by fax at 636/391-6137; or by e-mail at natwood@aol.com. You can also visit NWFA's Web site at www.woodfloors.org.