Figure 7-5 Underbelly Patch

A technician puts caulking around the perimeter of a patch. The patch is made of an air leakage barrier which is permeable to water vapor.

Cut out a rectangular piece of the floor including its damaged area. Patch the hole with plywood or particle board of the same thickness. Cut the patch about $^{1}/_{4}$-inch short in both length and width to allow for its fit and expansion. Fasten the new patch to the joists with flathead screws, countersunk to make the screw heads even with the floor.

Some technicians use an alternate method of cutting the flooring on the edge of the joist and attach a 2-by-4 wood nailer to the side of each floor joist to support the patch.

Squeaky floors can usually be fixed by driving flathead screws into the squeaky area. Sometimes, a small wedge inserted from underneath between the floor joist and the particle board floor is needed to stop the squeak.

Humps and sagging areas in the floor are sometimes caused by floor joists that hump or sag. The joists can be repaired using a 4-by-4 wood beam or a steel beam. Lag screws provide the force to pull the floor joists into the level plane established by this beam. A small hydraulic jack can provide lift for the sagging floor joists.

If a bent chassis is pushing the floor up, the bent section may need to be cut off and the floor re-supported from piers, footings, and beams underneath. If a bent chassis is causing the floor to sag slightly, wedges between the frame and underside of the floor joists will re-support the joists.

If the repaired floor section seems weak, add another footing and pier underneath that section for additional support.

Figure 7-6 Outward Clinch Stapler

This stapler, sometimes called a stitch stapler, fastens paper and fabric underbelly to patches made of a similar flexible material.

Improving Energy-Efficiency of Floors

Floors are an important source of heat loss in cool climates, due to their relatively low R-value. The low R-value is such a big problem in warm climates.

Floors are also a major source of air leakage—an energy problem in both cool and warm climates. Air flow between indoors and the crawl space wastes energy, reduces the insulation's effectiveness, and can cause condensation in the floor. In addition to floor's air leakage, the main duct—usually housed in the floor assembly—is often a source of severe air leakage.

There are 5 main energy problems related to mobile home floor assemblies:

1. Inadequate floor insulation (3 inches or less, attached to the bottom of floor joists, is common);
2. Air leakage into the home caused by holes in the underbelly and floor;
3. Movement of outdoor air around and through the insulation, decreasing the insulation's R-value;
4. Space between flooring and insulation, allows heat loss by convecting air moving around the insulation; and
5. Leaks in the heating/cooling ducts and in floor cavities used as return plenums. These leaks can cause: 1. Heated or cooled air to escape the heating or cooling system, or 2. Outdoor air to enter the heating or cooling system.

Floor insulation and the associated repairs to the underbelly can effectively solve the first four problems. The fifth problem is addressed in this book's *Chapter 11 Heating*, and *Chapter 12 Cooling Systems*.

Preparing the Floor for Insulation

Before beginning to install insulation into the floor cavity, follow the five preparatory steps listed below.

Step 1: From above, tightly seal all openings in the floor to prevent loose insulation from entering the living space.

Step 2: Inspect and seal the ducts thoroughly, to prevent blown insulation from entering the ducts. (*See "Leaky Supply Ducts" on page 151.*)

Step 3: Install a plastic, ground-moisture barrier to protect the new insulation from moisture damage.

Step 4: Repair the underbelly as necessary using the techniques described earlier this chapter. Consider blowing insulation through damaged sections of the underbelly before you patch any holes. Using a flexible fill tube, you may be able to fill several cavities through one large tear in the belly.

Step 5: Water supply pipes, separated from the warmth of the home by new insulation, could freeze in very cold climates. Locate the plumbing supply pipes from underneath and note their locations. Check the pipes for leaks. Repair any leaks before adding insulation. If these pipes are installed close to the floor or next to the heating duct, they won't need added protection. But if the pipes are below the floor joists and away from the heating duct, find a way to strap them up closer to the floor. An alternative is to insulate underneath the pipes with rigid foam or a fiberglass batt with a facing to facilitate fastening.

Step 6: In floors with crosswise joists and a dropped underbelly, you can push the dropped belly up and brace it. This will reduce the volume of insulation that the floor cavity will consume. The floor doesn't need insulation two feet thick. With dropped fabric underbellies, you can pin the fabric up to the floor joists with wood strips. If you use this procedure, be extremely careful not to damage the duct. Leave a 2-to-3-inch space between the underbelly and pipes and ducts to avoid freezing pipes or damaging ducts.

Figure 7-7 Blowing Floors from Underneath

The advantage of blowing the floor from underneath is that you can use a large flexible fill tube (2 inch diameter) for rapid insulation flow.

Insulating Floors

Installing additional floor insulation saves up to 10% of the mobile home's annual heating cost. Blowing fiberglass insulation is the easiest and fastest way to insulate the floor cavity.

The crawl space area underneath the mobile home is the best access point for insulation. Installing the ground moisture barrier before starting to insulate makes the lying on the ground more comfortable. (*See "Installing Ground-Moisture barriers" on page 43.*)

To install insulation safely, wear a respirator, safety glasses, and coveralls.

The most effective insulating materials for floor cavities include un-faced fiberglass batts, rigid foam insulation, blown fiberglass, and polystyrene beads.

Floors vary in construction, accessibility, and state of repair. Because of this variation, use more than one insulation technique if necessary.

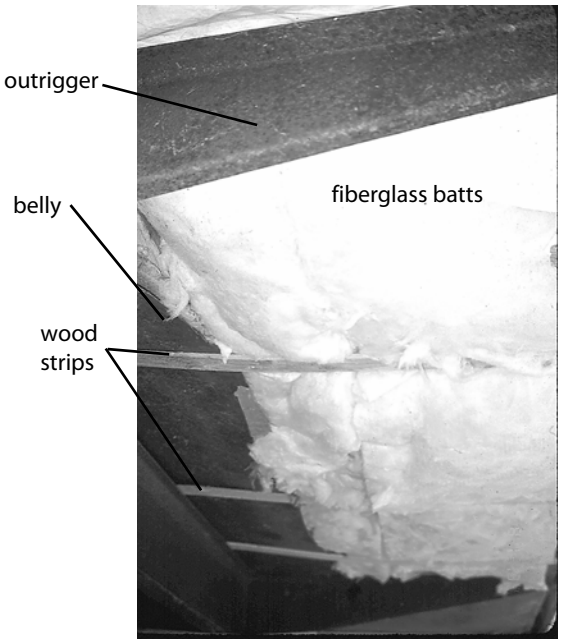
Damaged or Missing Underbelly — When large sections of the underbelly are damaged or missing, you can stuff fiberglass batts into the floor cavity. Install the fiberglass batts directly against the underside of the floor to prevent air from convecting between the floor and the new insulation.

Using batts designed for a thicker cavity and compressing them gives a slightly higher R-value per inch and inhibits air convection.

Use lightweight wood strips to hold the batts up to the floor; these strips serve as backers for stapling large fabric or polyethylene patches needed to repair the underbelly.

Sheeting Over the Underbelly — Sheeting over the underbelly with insulation is also a good option, either by itself or combined with stuffing fiberglass batts into the floor cavity. Installing insulation under sections of the floor with ducts or piping is a good option when you won't be blowing insulation into those areas

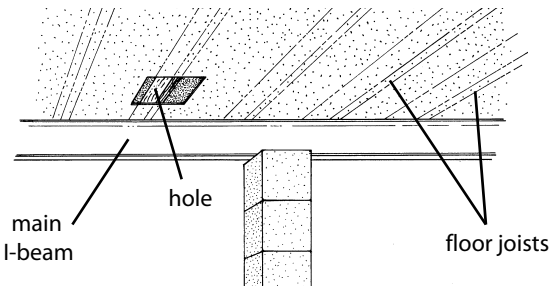
Figure 7-8 Stuffing Fiberglass Batts



Fiberglass batts are stuffed into a floor cavity where the belly had been torn away and the insulation removed. Wood strips hold the batts up and act as a backer for staples, holding a building-paper patch, to be applied next.

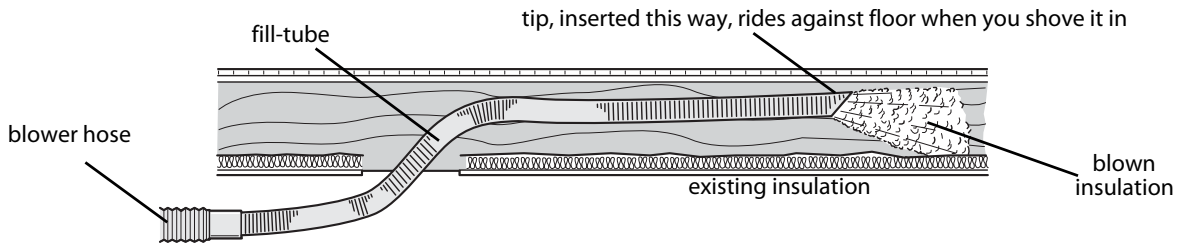
The insulation used for sheeting over the underbelly should have a strong foil, paper, or vinyl facing. Use $^{1}/_{4}$-inch foam board (called Foamcore), thicker rigid foam board, fiberglass batts, or fiberglass blankets. Fasten the insulation using screws or nails with large washers to prevent the fastener from tearing through the soft insulation material.

Figure 7-9 Cutting a Hole at a Floor Joist



A hole directly beneath a floor joist gives the technician access to two joist spaces for blowing insulation.

Figure 7-10 Flexible Fill-tube



Flexible fill-tubes blow insulation quickly into the floor cavity. The technician works from underneath the floor in the crawl space.

Blowing Insulation into the Floor Cavity —

Following are four practical options for blowing insulation into floor cavities. Before you begin, observe the floor's construction characteristics and the condition of the underbelly. Locate the main duct and plan your fill holes and fill-tube insertions to avoid damaging the main duct.

Remember: You can blow insulation into nearby areas through existing holes and tears in the underbelly before you patch them.

During the insulation process, inspect any areas where you doubt insulation has filled. Cut the underbelly for inspection to make sure that insulation fills the cavity.

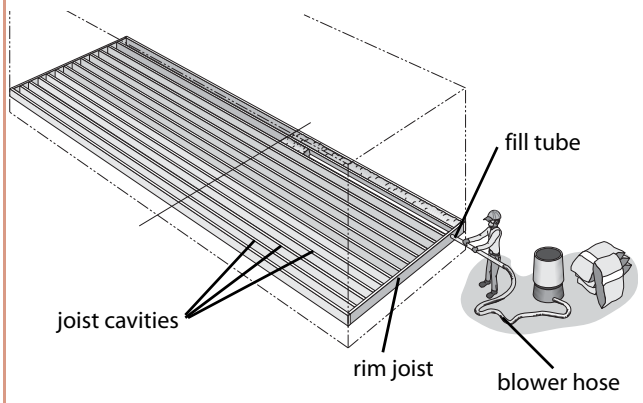
You can add insulation to almost any floor using one or more of these methods:

Option 1: Flexible fill-tube through underbelly for crosswise floor joists: For joists running the width of the home, cut a hole or slit near the center of the width of the underbelly. Insert a flexible fill tube through the underbelly over top of the I-beam and towards the rim joist. Insert the fill tube so that its curvature causes the tip to ride against the floor's smooth underside as it goes in. This avoids snagging existing insulation. Fill the cavity from the floor's edge towards the hole at its center; then insert the tube in the other direction and repeat the procedure. Try to fill the entire cavity without allowing any voids.

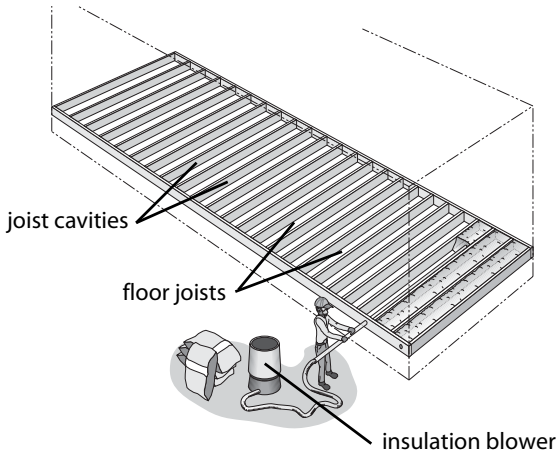
Option 2: Flexible fill-tube through underbelly for lengthwise floor joists: Starting 8 feet from one end (assuming your fill tube is 8 feet long), cut a row of holes or slits into each joist cavity through the underbelly across the width of the belly. Or, cutting larger holes (10-by-10 inches) directly under alternating floor joists results in half as many holes to patch, because each hole gives access to two cavities. Insert the fill tube so that its curvature causes the tip to ride against the floor's underside as it goes in. This avoids snagging the existing insulation. Fill the cavity first blowing in one direction, then the other. Cut the next row of holes 16 feet away or twice the length of the fill-tube.

Option 3: Rigid fill-tube through rim joist: Loosen or remove the metal trim piece at the bottom of the wall on the ends or sides of the home. Drill a hole 2-to-$2^{3}/_{4}$ inches in diameter through the rim joist into each joist cavity. Attach a long plastic or metal tube to the end of the blowing hose and insert it into the cavity extending to the opposite rim joist. This method is favored by many technicians who prefer to avoid climbing underneath the home. A disadvantage of this method is that these holes may weaken the rim joist excessively—a problem if the home is ever moved. To prevent excessively weakening

Figure 7-11 Blowing Floor-Joist Cavities



Lengthwise - The technician uses a 20-to-30-foot rigid fill-tube to fill cavities between lengthwise joists from holes in the rim joist.

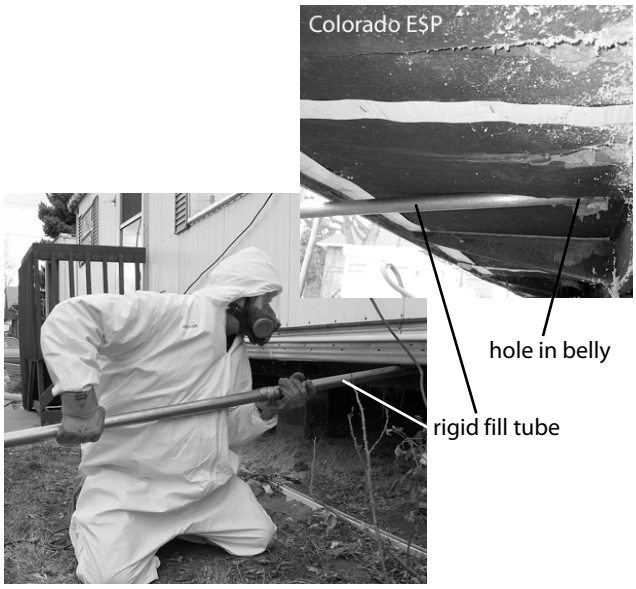


Crosswise - Technician uses a 16-foot rigid fill-tube to insulate joist cavities of crosswise floor joists.

one rim joist, drill holes into adjacent cavities from opposite sides of the home. Avoid locating holes below the sides of large windows and doors. You can add extra piers and footings under the rim joist for added support after drilling. Drilling rim joists on homes with lengthwise joist cavities isn't a structural problem. However, you may not be able to blow half of the home's length from each end. In this case, finish the job by blowing through the underbelly as described above or below.

Option 4: Insert a metal pipe into the floor through a hole in the edge of the belly. The pipe should be bent into a very gentle arc. If the tube is bent right, you can often fill the whole joist cavity from one side of the home without crawling underneath and without drilling a hole in the rim joist. This method is often the best option. Copper drain pipe $1^{1}/_{2}$ inches in diameter is a good choice for the rigid fill tube, used to blow the insulation.

Figure 7-12 Blowing Floor Insulation



Blowing the floor through the edge is often the easiest and least destructive.