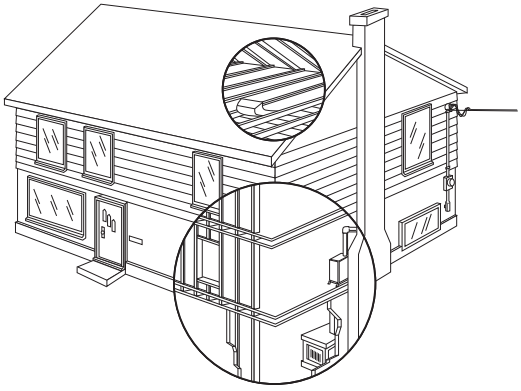
## Attic Insulation

Insulation is your primary defense against heat loss. If your attic is poorly insulated, you could save up to 25 percent of your heating costs by insulating. That's why, when it comes to adding insulating materials, it's a good idea to start at the top and work your way down.

Adding insulation to the attic is usually easy. If your attic doesn't have a floor, simply add more insulation—either loose fill or fiberglass batts. If your existing insulation already comes up to the top of the joists, add an additional layer of unfaced batts across the joists.

If your attic does have a floor, you may have to lift the boards to put batts in place or make holes in the floor and

***Seal air bypasses around vents, chimneys, and wiring.***



blow insulation underneath it.

The recommended depth of attic insulation here in Minnesota Power country is 12 to 14 inches. This gives an R-value of R-44 (the higher the value, the better the insulation).

Be sure to check your attic for warm air bypasses and seal them. These are areas around vents, chimneys, wiring, etc., that leak heated air into the attic. Bypasses cause 30 to 70 percent of heat loss in or from the attic.

Keep in mind the tips from Chapter 1 for working with fiberglass insulation—wear goggles, gloves, and a mask over nose and mouth.

## Wall Insulation

Adding insulation to an uninsulated wall can reduce heat flow in the wall by as much as 50 percent. An uninsulated wall has an R-value of approximately R-4. A standard 2-by-4 wall with fiberglass batts has a value of R-14.

Be advised that putting insulation into walls in an existing home can be difficult. (If you're not sure about whether your walls have insulation, pull off an electric outlet cover and peer into the wall cavity, or drill a test hole—but not near an electric outlet or wiring!

It might not be cost-effective to add insulating materials to walls if you already have an inch or more. A wall cavity has room for only about 3 1/2 inches of insulation. If you are able to add only a couple of inches or less of new material, the purchase and installation costs might outweigh the benefits.

But if you're planning to put on new siding, insulating sheathing can be applied to the outside of your walls. This is also a good opportunity to fill in any uninsulated cavities.

With the sheathing, be sure to use materials that have an R-value of at least 3.6. It's available up to R-7.2. Anything less than 3.6 is not cost-effective.

In the event that your walls don't have insulation and you're not going to have new siding put on, consider calling in an insulation contractor to blow cellulose, fiberglass, spray foam, mineral wool, or rock wool into your walls. This is best done from the outside.

## Foundation Wall Insulation

The benefits of foundation-wall insulation are just now beginning to be appreciated. The more above-ground foundation you have, the greater the energy savings and comfort you'll realize if you have foundation insulation.

This insulation can be added either to the inside or the outside of the foundation walls.

Exterior insulation is considered to be 10 to 20 percent more effective than interior insulation because the foundation wall is kept warmer and stores heat from the home, thus helping to moderate temperature swings within the house.

If you choose to insulate the exterior foundation walls, all of the above-ground wall surface should be covered, and the material should reach to at least a foot below the ground. (On new homes, insulation goes all the way to the footings or the frost line.)

The material to insulate the outside of your foundation walls is extruded polystyrene, which comes in boards and should have an R-value of R-10. You fasten the board to the wall by drilling a hole through the board and into the wall and inserting a mechanical fastener to anchor the board in place. Next, on the above-ground portion comes a coating to protect the insulating material from the ultra-violet rays of the sun and from physical wear and tear. The most commonly used coatings are made of a portland-type cement base that is mixed with an acrylic or latex bonding agent to assure adhesion and elasticity so the coating can withstand the weather without cracking. The coating can be applied by troweling or spraying it on. It should be about a quarter-inch thick.

If you choose to insulate your foundation and basement walls from the inside, you may use boards or fiberglass batts.

Keep in mind, though, that you can have too much of a good thing. If your house has poor drainage away from the foundation or if you have heavy, non-porous soil along the foundation wall, your house is susceptible to frost damage. In this case, insulate just to a few feet below ground level, leaving enough uninsulated area to allow intentional heat loss, which will help prevent frost heave outside your basement walls.

When installing your insulation from the inside, be careful around plumbing and wiring, and be sure that you've corrected any moisture problems before you begin.

## Crawlspace Insulation

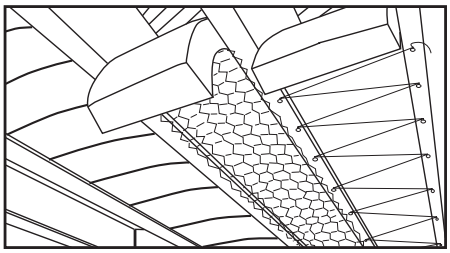
If your home has a crawlspace instead of a basement, your insulation strategy depends on whether the crawlspace is heated or unheated.

In either case, though, it is important to correct any moisture problems and create as dry an area as possible. Your old reliable—the six-millimeter plastic sheet—again is your best choice of materials. Place it on the ground of your crawlspace to prevent water vapor from entering the space.

Also, be sure you've sealed any gaps in the rimjoist area, and around pipes and wires, as discussed in Chapter 1.

If your crawlspace is heated, place the insulation around the perimeter, either on the outside or inside walls, using boards on the outside or batts on the inside. If you've elected to insulate the exterior of your crawlspace, you'll have to use the same finishing technique as for exterior foundation walls.

To insulate the floor of an unheated crawlspace, the recommended action is blowing the cavities full of loose fill or installing fiberglass batts, with a vapor barrier already



attached, to the underside of the floors. The vapor barrier goes on the "winter-warm" side of the insulation—in other words, toward the inside of the house.

To keep the batts in place, you can use string, wire or wire mesh, or plywood, chipboard or foam insulation boards that you nail in place under the floor joists. Using the insulation boards not only keeps the batts in place but also insulates the joists.

## Insulating Materials

Cellulose is commonly used as attic insulation. It is installed with a blower. Cellulose is made from newsprint that is chemically treated to resist fire, corrosion, odor, fungi, and vermin.

Fiberglass and, less commonly, mineral wool and rock wool, are used in attics and walls. Fiberglass comes in batts in various widths and thicknesses—and in blankets, which are continuous rolls. Fiberglass comes unfaced or faced with a paper or foil vapor barrier.

Vermiculite and perlite are loose-fill products that can be poured into wall cavities. They are mineral products that are formed as small beads and are poured into wall cavities. They are noncombustible and can be used in tight spaces, but they tend to be more expensive than other products and have a lower R-value than others.

Insulating boards for sheathing exterior walls are made from plastic foams, including expanded and extruded polystyrene, polyurethane, and polyisocyanuate.

Now that you've sealed all the leaks and gaps in your home and you've properly installed the right insulation, two of the three major components of your "house as a system" are in good order.

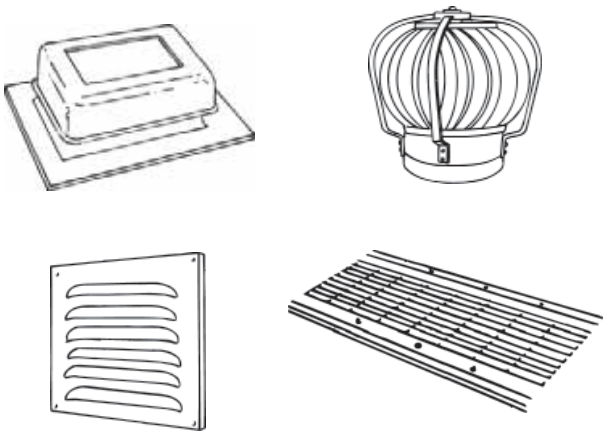
But you don't want your home to get too stuffy inside its over-coat. Next comes a third vital factor—ventilation.

## Attic Ventilation

Ventilation for attics is extremely important. If the air leaks from your living spaces aren't completely sealed, warm moist air from inside the home escapes into the attic and can cause damaging condensation and ice dams. Sealing warm air leaks into the attic minimizes these problems and reduces the need for excess attic ventilation. Heat gain from the sun also can cause problems if the attic isn't adequately ventilated.

Several forms of ventilation are available to cope with these problems.

***Various roof and soffit vents***



Here's the rule of thumb for attic ventilation: If there is a vapor barrier, one square foot of outside ventilation is needed for each 300 square feet of attic floor. If there is no vapor barrier and the roof has less than a three-foot rise from eave to peak, one square foot of ventilation is needed for every 150 square feet of attic floor.

In both cases, the ventilation space should be evenly split between high and low locations. This is usually achieved by using a combination of roof vents, such as ridge and soffit vents or gable end vents and soffit vents. Passive static vents also can be used.

Ventilation also is important in your crawlspace, if you have one.

In non-heating seasons, one square foot of venting for every 150 square feet of floor space is recommended for crawlspaces without a vapor barrier and one square foot of venting for every 1,500 square feet of floor space with a vapor barrier.

During our heating seasons, crawlspaces should have insulated and weatherstripped covers installed over the vents to control heat loss.

## Indoor Ventilation

As you work around your home to make it tighter and more energy-efficient, you also lower the amount of available fresh air and increase your need for controlled ventilation.

Inside your home's living spaces, proper ventilation is even more important. You need a healthful supply of clean, fresh air.

Normal, day-to-day activities within the home generate a substantial amount of water vapor. As homes become tighter, this buildup of water vapor can result in problems.

Normal activities also create indoor air pollution from the sprays, cleaners, smoke, dust, laundry supplies, and cooking that are part of our modern lives.

In addition, in an especially tight home, serious backdrafts can develop in a gas- or oil-burning furnace and water heater. This happens when the natural draft that is normally created by the hot gases of combustion are drawn back down the flue and pour into the surrounding area instead of flowing up the chimney and out of the home. These exhaust fumes can eventually overwhelm the oxygen in the area and begin producing large amounts of lethal carbon monoxide and other harmful gases.

All homes using gas or propane heating or water heating systems should be equipped with carbon monoxide detectors.

Together, water vapor and indoor pollution can create the need for some form of mechanical ventilation system.

Here are some products you can use to be sure that your home is getting plenty of breathing space. For the older home that's been sealed and insulated, it may be necessary to add the following:

- Exhaust fans can be installed in high-humidity areas such as kitchens and baths. Fresh, "makeup air" comes from passive sources—basically, miscellaneous building leaks that even the most conscientious resident cannot seal. These fans don't have sophisticated air-management controls and are the least efficient of all mechanical systems.

- The central heat recovery ventilator, also known as an air-to-air heat exchanger, is the most complete and effective ventilation system. It consists of an intake fan, exhaust fan, and a heat-exchanging duct system. A heat recovery system reduces indoor heating and cooling loads. It brings fresh air into the home, passes it through one side of the heat exchanger and distributes it throughout.

  Stale air is drawn through the other side of the heat exchanger, transferring heat to the fresh-air side, and is dumped outside.

  This system can be run continuously or can be controlled by a timer or a humidistat.
- Central intake and exhaust fans, with their own duct system, are similar to the heat exchanger but don't have the heat-recovery feature. The central intake system also can be run continuously or controlled by a timer or humidistat. The initial cost is significantly lower than that of a heat-recovery ventilator.
- In a mechanical exhaust with metered air inlets, fresh air is introduced into each room and the exhaust is central and controlled to provide a continuous level low, even ventilation.

Now your whole-house system is in order! Congratulations on sealing air leaks, insulating, and keeping your indoor environment fresh.