



## The basics of air sealing and insulating your home

To Midwesterners used to long, cold winters, it should come as no surprise that heating systems are a home's largest energy user. To keep energy costs under control, it helps to understand the basics of air sealing and insulation—two important measures that help improve a home's efficiency and maintain uniform indoor temperatures all year long.

Sealing and insulating a home's "envelope" or "shell"—its outer walls, ceiling, windows, doors, and floors—is often the most cost-effective way to reduce energy bills and improve comfort. The national ENERGY STAR® program estimates that a skilled contractor can save a homeowner up to 20 percent on heating and cooling costs (or up to 10 percent on their total annual energy bill) by sealing and insulating.

### CAUTION

Before doing any air sealing or insulation work, it's critical to take respiratory precautions and to be aware of the structures within which you are working. Be especially mindful of electrical wiring and possible fire hazards. If you are not comfortable doing this type of work, we strongly recommend hiring a professional.

### AIR SEALING

Air leakage, or infiltration, occurs when outside air enters a home or unconditioned air exits a home uncontrollably through unintentional cracks and holes. Properly air sealing these leaks can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment.

Leaving these leaks unsealed, on the other hand, can make temperature control difficult and force your heating and cooling systems to run longer. This wastes energy and money, decreases occupant comfort, and can even damage your home.

Here's the problem: cold air leaking into your home can make the basement and main floor difficult to heat, even



Installing sidewall blow-in insulation.

with the thermostat turned up. In fact, turning up the thermostat will actually draw more cold air inside, effectively turning the house into a chimney by pushing warm air out through the roof and cooling the lower levels even more. This cold, dry air can reduce indoor relative humidity, causing static electricity (shocks), dry skin and throats, and aggravating allergies and respiratory problems. It can also wreak havoc on houseplants and hardwood floors.

But that's not all. The warm air that leaks from your home carries moisture in vapor form. This moisture can condense (become liquid water) on cold surfaces in the attic, crawl space, or inside wall cavities, and cause long-term deterioration, including rotted roof sheathing, rotted framing members, wet insulation, mold growth, buckled siding, musty odors, cracked bricks, and stained ceilings.

### Testing for air leaks

Many air leaks and drafts are easy to find because they are easy to feel—such as those around windows and doors. But holes hidden in attics, basements, and crawlspaces are usually bigger problems. Sealing these leaks with caulk, spray foam, or gasketing material can have a great impact on your comfort and energy costs.

**For more information,**  
call 800.762.7077 or visit [focusonenergy.com](http://focusonenergy.com).

The best way to find and measure air leakage is with a blower door test conducted by a contractor or home energy consultant. A blower door is a door-mounted fan that fits into an exterior doorframe. The fan pulls air out of the house, lowering the indoor air pressure and allowing outside air to leak in. Leaks often show up around plumbing penetrations, chimney chases, recessed light fixtures, and dropped soffits (where kitchen cabinets attach to the ceiling).

**Where to seal**

In terms of priority, start at the top of the home. Properly done, attic air sealing not only saves energy and money, but it can reduce or eliminate ice dams (icy buildups along the edges of roofs that can push water from melting snow back up under the shingles) and help control moisture that can contribute to mold and structural damage. Other important areas to seal include basements, crawl spaces, baseboards, the tops of foundations—sill plates (rim joists), attic hatches, and pathways to the attic resulting from electrical wires, plumbing vents, chimneys, recessed light fixtures, exhaust fan housings, and more. If your home has a fireplace, make sure the damper fits tightly. Windows and doors are also important to seal.

**IMPORTANT**

Studies have shown that carbon monoxide (CO), water vapor, and pollutants have the potential to migrate into a house from an attached garage. It is imperative to thoroughly air-seal the common walls and doors, if present, between the living space and the garage.

Finding and fixing hidden air leaks can be difficult and is best done before installing or upgrading insulation. For best results, Focus recommends contacting a consultant partnering with Home Performance with ENERGY STAR for help.

**INSULATION**

When correctly installed in a home that has been air sealed, insulation can help you achieve both comfort and energy savings during the hottest and coldest times of the year.

Insulation is the material installed in your attic, walls, and other “cavity” areas to prevent or slow the transfer of heat from one area to another (see diagram on page 3). Heat travels toward cooler areas. In winter, for instance, heat will move toward an attic or unheated garage. The process also works in reverse. During hot summer months, hot air trapped in an attic can warm the cooler air in the rooms



**Insulating the sill box with spray-in foam.**

| RECOMMENDED INSULATION LEVELS FOR HOMES                             |         |
|---|---------|
| AREA  | R-VALUE |
| <b>Attic</b>  | R-44*   |
| <b>Walls</b>  |         |
| Above-grade   | R-19    |
| Below-grade   | R-10    |
| <b>Floors</b>   |         |
| Slab on grade   | R-10    |
| Floor over unconditioned space (e.g., garage)                       | R-21    |
| <b>Exterior foundation</b>  | R-10    |
| *R-50 FOR ELECTRICALLY HEATED HOMES AND NORTHERN AREAS OF WISCONSIN |         |

below. Insulation slows the movement of heat and helps keep it where you want it—inside in the winter and outside in summer.

The performance of insulation is measured by R-value—a measure of thermal resistance. The higher the R-value, the greater the insulating power. Insulation only works when air is not moving through or around it. So it's very important to seal air leaks before installing insulation to ensure that you get the best performance from the insulation. Insulating a home is a fairly permanent measure since it's generally applied only once.

**Types of insulation**

Insulation is made from several different materials. The most common types include fiberglass, cellulose (recycled newspaper), urethane foams, and recycled cotton fibers. Insulation also comes in different forms to fit specific applications.

### Loose-fill

Loose-fill insulation was developed to easily fill the open cavities of walls and attics. This type of insulation comes in bags of fibers or granules and is usually blown into place with special equipment. Depending on the application, loose-fill insulation may be treated with water and adhesives to assist in filling open cavities with a stable, uniform product.

### Batts and blankets

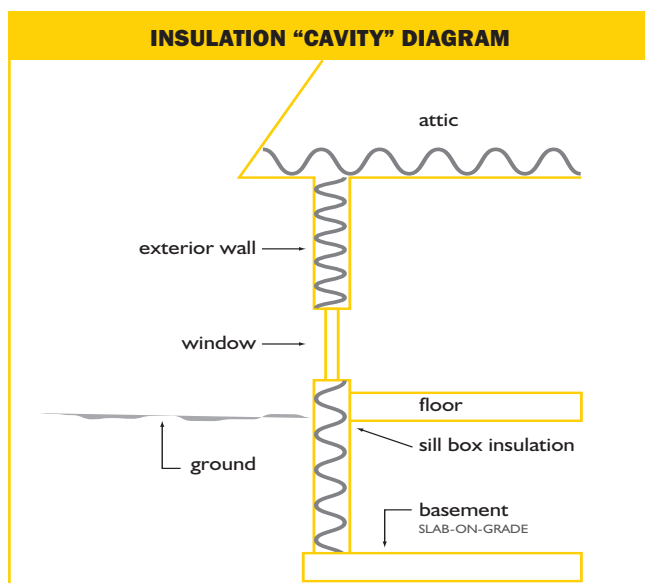
Typically made of fiberglass, this type of insulation is either packaged in blanket rolls or pre-cut into batts, both of which fit the cavities between ceiling, wall, or floor framing boards. This form of insulation is very flexible and, depending on its R-value, can be quite thick. Each is available with or without a vapor-barrier lining. A vapor barrier helps prevent moisture from accumulating inside the wall cavities.

### Rigid sheets

Rigid insulation is made from fibrous materials or plastic foams that are shaped into board-like sheets. They are generally used in new construction, especially on outer walls beneath the siding and on building foundations. They provide a relatively high R-value per inch of thickness. For fire-safety reasons and to prevent degradation from the sun, this type of insulation must be covered with finishing materials.

### Sprayed or extruded foam

This form of insulation requires special equipment which either sprays or extrudes (forces) foam into the wall, floor, or attic cavities. In addition to slowing the passage of heat, this type of insulation also seals spaces from air infiltration.



**Insulation is essential to lowering heating and cooling bills. The most important places to insulate (in order of priority) are the attic, walls, floors above unheated spaces, sill box, and the basement. The sill box is the space where the floor joists meet the foundation wall.**

### Where to insulate

Let's take a look now at the places within your home where insulation may be applied and consider the R-value needed (see table on previous page). In general, you should insulate open cavities of all walls, floors, and ceilings adjacent to your home's living spaces.

### Attic

In attics, insulation is blown in, rolled, or placed (using blankets or batts) between the joist boards above your ceiling. The attic should have a minimum of 12 inches of loose-fill or fiberglass batt insulation. If your attic already has insulation that rises to the top of the joists, additional blankets or batts can be added perpendicular to the joists, or additional insulation can be blown in as required.

### Walls

Be sure your above-grade walls are insulated. Insulating these cavities can have a major impact on heating bills and comfort. Existing walls can be insulated by blowing or spraying insulation through small holes drilled into the wall cavities underneath the siding. Done correctly, this insulation will not settle and helps air-seal the house.

### Floors and basement

Floors or walls that are located above or next to unheated spaces, such as crawl spaces, can also be insulated. Converting an unheated basement into a heated, insulated living space can help eliminate heat loss from ductwork and reduce the risk of freezing water pipes. In addition, a properly dehumidified, insulated basement can decrease condensation, which can help prevent mold and mildew.



**Stick-frame house during construction. Later, wall and ceiling cavities will be sealed and insulated.**

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## Foundation

The tops of foundation walls, where the foundation wall meets the upper part of the house sill box, can also be insulated. It's best to caulk any cracks first in order to prevent air leakage. This is a good application for sprayfoam insulation, although fiberglass batts with an inwardfacing vapor barrier can also be used.

Also, insulating a slab floor or foundation can help prevent heat loss primarily along the edges where the walls meet the floor. Other areas that can be insulated include exposed heating ducts and water pipes.

## WINDOWS: WEATHERSTRIP OR REPLACE?

Probably the easiest way to tell if your windows need caulking or weatherstripping is to first visually inspect them and then touch them (especially during cold, windy weather). If you feel outside air coming inside, apply caulk (you may need to add storm windows as well). However, a draft near a window may not be due to leakage, but to the cold glass convective loop near the window. A blower door test can help determine if your windows are leaking.

Cold windows are not efficient windows; if yours are getting old, consider replacing them with ENERGY STAR qualified units. Windows that are badly cracked or have very large gaps where they meet the house frame should be air-sealed or replaced.

Inspect doors, too. Check the way doors close and look for gaps. One of the easiest ways to inspect for gaps is to look for light around the door's edges when it is closed. Check the weatherstripping that runs along the bottom edge of the door. If badly cracked, it may need replacing. Don't forget to check your garage door if you have an attached garage.

## Home Performance with ENERGY STAR

Because mechanical systems interact with the air tightness and insulation of your home, every change you make affects the entire house. Consultants partnering with Home Performance with ENERGY STAR show homeowners exactly how their homes are performing. Recommended improvements help maximize the comfort and safety of your home, and minimize building maintenance and utility costs. For more information, call 800.762.7077.

## TAKE ACTION TODAY. SEE RESULTS TOMORROW.

Lower energy costs. A healthier home. Cleaner air and water. These are the results when Wisconsin residents tap into energy efficiency and renewable energy. To find out how you can reduce energy costs and improve the comfort, safety, and durability of your home, call Focus on Energy at **800.762.7077** or visit [focusonenergy.com](http://focusonenergy.com).

## Minnesota Department of Commerce Office of Energy Security

Click "Efficiency" to browse an array of residential topics from air sealing to moisture and more.

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## The U.S. Department of Energy

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