KEEP WARM
ILLINOIS

Home Series
1

Home Tightening, Insulation and Ventilation

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- **Lower your utility bills** with energy-efficient home improvements
- **Plug air leaks**, inside and out—page 3
- **Insulation can pay for itself** in just a few years—page 15
- **Ventilation is one of the keys** to year-round energy savings—page 22

A little effort can pay big dividends

The average Midwestern family spends more than half of its annual household energy bill on heating and cooling. That's a significant number, but you can dramatically reduce these costs—up to 30 percent, according to the U.S. Department of Energy—by making some simple energy-saving **weatherization** and **insulation** improvements to your home. In addition—with a little attention to proper **ventilation**—you can protect your home from moisture damage year-round, reduce problems caused by ice dams on the roof during the winter and significantly cut summer cooling costs. As a bonus, these projects can extend the life of your home and may increase the resale value of your property.

If you like to fix things around the house, you can handle many of the projects suggested in this book and make the most of your energy-improvement budget. However, don't hesitate to call a professional for help if you'd rather not do the work yourself; the dollars gained through energy savings in upcoming years will be worth the expense.

? Did you know?

Many utilities will perform a free energy audit on your home and identify areas needing insulation and other improvements.

Check with your utility or bank first

Although many energy-efficiency projects—caulking windows, weather-stripping exterior doors or insulating water pipes—will cost just a few dollars, others—insulating exterior walls, installing ventilated soffits or adding storm windows—will cost considerably more. Some utilities offer **rebates** on larger projects by giving you a discount on future heating and cooling bills or even sending you a rebate check when the work is completed. Call your local utility for details.

Your bank may be able to help too. Ask about a **low-interest loan** designed specifically to cover the cost of your energy-saving projects, or consider a home-improvement loan to fund them.

Finally, be sure to look into the availability of government-sponsored **assistance and grant programs** designed for low-income and elderly homeowners. For more information, get in touch with the Illinois Department of Healthcare and Family Services or a Community Action Agency in your area. (See page 24 for a list of contacts.)

Get the most for your money

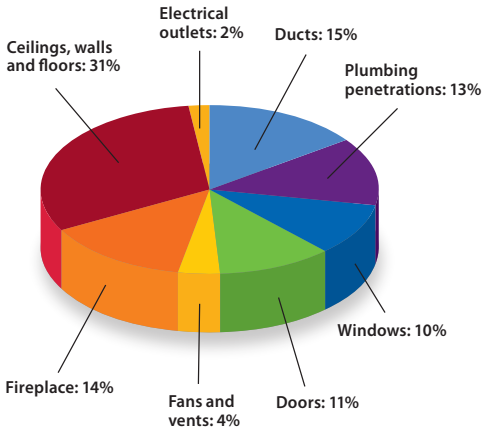
To help you decide which energy-efficiency jobs you should tackle first, consider more than just the increased comfort you'll experience from your planned projects; analyze their **return on investment** too. In most cases, it makes sense to start with the ones that cost the least now but offer the most later in terms of energy dollars saved.

It's easy to figure how long it will take for your energy-saving improvements to pay for themselves through reduced energy bills. Just divide the total cost of each project by the annual estimated energy bill savings—ask your utility for help—to find the **payback period.** For example, if a project costs $1,600 and you'll save $200 per year, the payback period is eight years.

Eliminate air leaks—then insulate

You may think that insulating should be the first step in making your home more energy-efficient, but consider this: Air leaks through the ceiling, walls, foundation and other areas typically are the greatest sources of heat and cooling losses in a home. So, controlling air leaks is the best way to extend the life of your home, as well as to conserve energy, save money and increase your home's comfort. The bottom line is this: *If you don't tighten up your home first, money spent on insulation may be wasted.*

Sources of air leaks in a typical home



Air infiltrates into your home through every hole, nook and cranny. About one-third of this air infiltrates through the openings in your ceilings, walls and floors.

According to the U.S. Department of Energy, you can save 10 percent or more on your energy bills just by plugging air leaks in these places in your home.

Source: *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy*

Home Tightening

Ventilation is a good thing—air infiltration is not

Every home needs a certain amount of fresh air for the furnace and appliances that burn fuel, for getting rid of excess moisture and reducing odors and stuffiness. When this air exchange is controlled, it's called **ventilation.**

A large amount of air is exchanged in uncontrolled and invisible ways, too, through hidden cracks and openings present in every home. This is called **infiltration,** and it occurs in three ways.

- *Wind-driven* infiltration happens during cold-weather months when the wind blows cold air into a house and forces hot air out. During warmer weather, the wind blows in warm air, forcing cooler air out.
- *Chimney effect* infiltration takes place during the natural process of convection. As warm air rises and escapes through cracks, it pulls cold air into the lower portion of a house.
- *Negative air pressure* infiltration starts when appliances that burn fuel use air for combustion or when ventilation fans exhaust air. Outdoor air enters through any available openings to equalize the pressure inside a home.

Typically, air infiltration causes drafts and a chilly feeling in some rooms during the cool-weather months. Adjusting your thermostat will not stop the drafts, but sealing hidden cracks and openings will. By stopping drafts at their source, you'll stay warmer at lower thermostat settings, use less fuel and reduce your utility bills.

Where do you start?

Fortunately, air infiltration is one of the easiest forms of heat loss to correct. The process requires only a careful inspection of your home and some inexpensive weather stripping, caulking and filler materials.

Most people know they should caulk and weather-strip various spots around the exterior of their homes to protect them from the elements. However, it is equally important to protect your home from interior air leaks. Moist interior air can enter the walls and ceiling through cracks and holes, and condensation buildup in those locations can damage or destroy insulation, wiring, wood and other building materials.

Test for leaks

The first step is performing a **detailed inspection** of your home for air leaks. You can do this yourself during a windy day or hire a professional energy auditor to identify where heat loss is occurring in your home and how to stop it. Before hiring an energy auditor, check with your local utility company; it may offer free energy audits to customers.

The most complete type of energy audit—which is usually not available from utilities—includes a **blower door test.** A blower door is a large fan that fits tightly into an exterior doorway in your home. It depressurizes the space inside your home, which then causes air to flow in through the cracks and other openings. The energy auditor then can walk around and tell you where the leaks are by feeling for airflow by hand or by using a *smoke pencil* and noting where the smoke is blown.

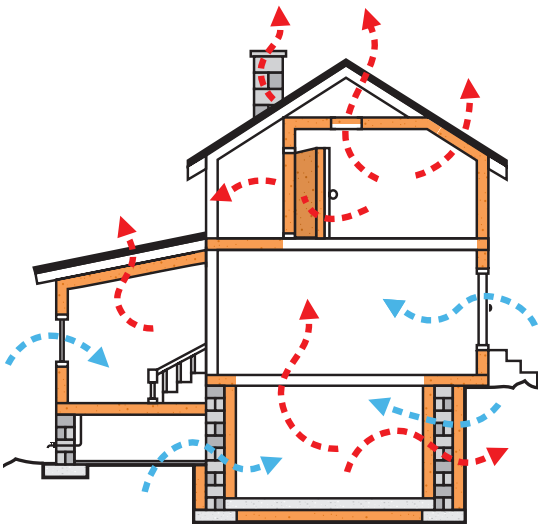
You can perform a similar test yourself by closing all the windows and doors and using a whole-house fan or a large portable fan temporarily sealed in an open window to exhaust the air from your home. Use your hand or a lighted incense stick to look for leaks. This home version of the test won't be as accurate as the professional test, but it can get you started.

Once you've located the air leaks in your home, you're ready to start plugging them. A good rule of thumb is to **seal the high and low air leaks first;** in other words, start by plugging holes and leaks in the attic and basement. Then move to the exterior walls, and look for smaller leaks around doors, windows and electrical switches and outlets.

Did you know?

If you're building a new home or putting an addition on your existing one, consider enveloping the new structure with a house wrap as a secondary weather barrier (behind the siding). Think of the house wrap as a raincoat under the siding; not only will it help reduce air and water infiltration into your home, but also it will "breathe" to allow moisture to escape from your home's walls.

How does air escape?

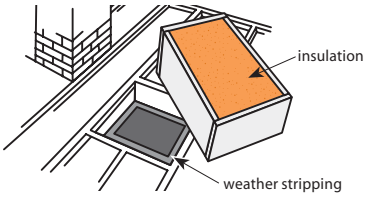


Plugging air leaks after a careful inspection of your home's structure—both inside and outside—can yield a significant reduction on your monthly heating and cooling bill. In this illustration, blue arrows indicate outside air infiltration and red arrows show where conditioned (heated or cooled) air can escape.

CAUTION!

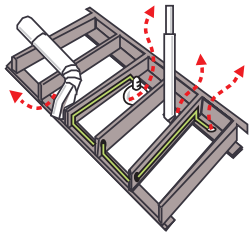
Check local building codes before starting an insulation project at your home.

Insulate the attic hatch



If you have an attic hatch, make sure it fits tightly and is backed by insulation. Do this by weather-stripping the edges of the access hole and building a simple wood box to hold insulation on the backside of the hatch.

Fix attic air leaks



Recessed lights, wiring, plumbing and other openings in insulated ceilings and walls can result in a tremendous amount of heat loss.

Look for air leaks in your home

Attic

Hatches and doors to the attic	Weather-strip the edges of the access hole and insulate the back of each attic hatch and door.
Holes in attic floor	Seal all holes for wires, pipes, ducts and vents with a good general-purpose caulk or spray foam. You may need to use a filler material for larger holes.
Chase for plumbing stack(s)	This channel may run inside the walls of your home, from the basement to the attic, with openings at each floor where the pipes branch off. If the chase isn't much larger than the pipes, seal with expanding foam. For larger chases, use drywall, wood or rigid foam—and caulk or foam around all edges.
Fireplace chimney and vent flues for furnace and water heater	Close the gap between house framing and the chimney and vent flues with 26-gauge sheet metal; seal the edges with high-temperature caulk.
Interior walls and partitions	Caulk or foam along the tops of interior walls where the top plate meets the plaster or drywall.
Exterior walls	Caulk along the tops of exterior walls where the top plate meets the plaster or drywall.
Soffits (usually in kitchen or bath) or a change in ceiling height	Caulk along the joints where the walls change height.
Attic knee wall storage drawers	If storage drawers are recessed into the attic space, build an airtight, insulated box around the backside of the drawers.
Other holes	Using the appropriate materials, seal all other holes between the heated space in your house and the attic.

Your fireplace can waste more heat than it creates

A charming old fireplace may seem warm and cheery, but it likely loses more heat from your home than it gives off. Warm air in a home is sucked up the chimney and is replaced by cold air leaking into the house.

- If you never use the fireplace, put a plug in the flue of the chimney to reduce heat loss. Seal the plug to the chimney with caulk, and be sure to tell anyone who may want to start a fire that the chimney is plugged. If you occasionally use the fireplace, make a tight-fitting plug for the fireplace opening from rigid board insulation backed by plywood with pipe insulation around the edge.
- Improve the seal of the flue damper. To test the damper's seal, close the flue, light a small piece of paper and watch the smoke. If the smoke goes up the flue, there's an air leak. Seal around the damper assembly with refractory cement, but don't seal the damper closed. If the damper has warped from high heat, have a sheet metal shop make you a new one.
- Install tight-fitting glass doors. Controlling the airflow in your fireplace improves combustion efficiency by 10 to 20 percent and reduces air leaks up the chimney.

Basement

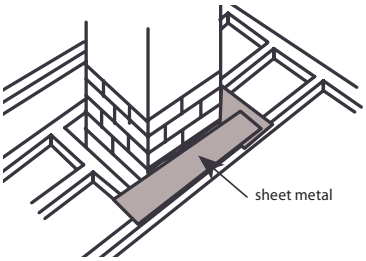
Sill plate and band joist	Caulk any crack between the sill plate and foundation wall using a caulk that works well with masonry. Use caulk to fill any cracks between the sill plate and band joist. Then insulate the band joist area. (See page 19.)
Chase for plumbing stack(s)	This channel may run inside the walls of your home, from the basement to the attic, with openings at each floor where the pipes branch off. If the chase isn't much larger than the pipes, seal with expanding foam. For larger chases, use drywall, wood or rigid foam—and caulk or foam around all edges.
Vent flues for furnace and water heater	Close the gap between house framing and the chimney and vent flues with 26-gauge sheet metal; seal the edges with high-temperature caulk.
Openings running through basement ceiling	Seal the hole where the bathtub drain comes down and any other holes for plumbing or electrical wiring in the basement ceiling with caulk or foam. You may need to use a filler material for larger holes.
Ducts	In homes with forced-air heat, there may be large cracks or gaps where the ducts pass through the ceilings, floors and walls. Caulk or foam where the metal duct opening and the ceiling, floor or wall meet.
Basement windows	Using a caulk that works well with masonry, fill cracks where the frames of the windows are set into the walls. Windows that are not used for summer ventilation or as fire exits can be caulked shut permanently.
Hatch or door to the crawl space	Weather-strip the edges and insulate the back of the hatch or door.
Other holes	Seal any cracks or holes in the foundation of your house with caulk, foam or the appropriate patching material.

Living spaces

Door frames, trim and baseboards	Caulk around frames for exterior doors and around trim and baseboards with an interior-grade caulk. Use a clear-drying caulk for hardwood or tile floors and trim with natural wood finishes—and paintable caulk for painted trim and carpeted floors.
Windows	Check the weather stripping on all windows, and repair or replace as necessary. Replace broken glass and reglaze or putty any loose windowpanes. Caulk all cracks between the walls and window frames and trim, especially under the windowsills. During the cold-weather months, caulk around the moving parts of windows with a strip-away, nonpermanent caulk you can remove easily in the spring.

continued on page 6

Seal around the chimney

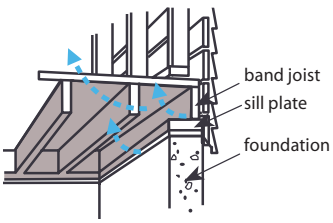


Heat can escape around the chimney, if it isn't properly sealed.

Did you know?

Trying to plug an air leak with fiberglass insulation won't work very well, because the material is not a good air barrier. Instead, use solid materials such as caulking, spray foam, drywall, plywood or rigid foam to stop air infiltration.

Caulk basement air leaks



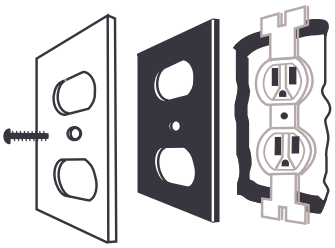
Get rid of drafts on the main floor by caulking along the sill plate and band joist in the basement.

continued from page 5

CAUTION!

Before starting to seal air leaks around wires, switches or outlets, turn off the power to those devices at the circuit breaker box or fuse box.

Add foam gaskets



Install outlet gaskets between the electrical outlet and the coverplate. Plastic plugs—such as "child safety" inserts—also will prevent air from entering your home.

Electrical switches and outlets	Install foam gaskets on all switches and outlets—even on interior walls. Use child-safety plugs to minimize the amount of cold air coming through the sockets.
Recessed lights and bathroom fans	These fixtures can poke into the attic insulation and create a pathway for air leaks. Caulk around them from below with flexible, high-temperature caulk.
Missing plaster	Exposed laths indicate a direct hole into wall and ceiling cavities. Repair with plaster or cover with new drywall.
Cracks in plaster and drywall	Repair cracks using the appropriate patching material, and repaint.
Other holes in exterior walls	Caulk or foam around all ceiling fixtures, heat registers, medicine cabinets, bathtubs, kitchen cabinets, drains and water pipes where they enter the wall in the kitchen and bath. Also seal any other holes in exterior walls.
Fireplace damper	A missing or poorly fitting damper allows air to move freely up and down the chimney. Install a new damper or repair the existing one, so it closes tightly.

Exterior

Holes for utility pipes and wires	Caulk or foam around openings for electric, gas, oil and water-supply lines; drainage pipes; plumbing for outside spigots; cable TV and telephone cables.
Vents	Caulk or foam around dryer vents, heating and cooling system vents and fresh-air supply vents for fuel-burning furnaces and water heaters.
Windows	Caulk around window frames. If you have combination storm windows, caulk around the windows where the metal storm window frame meets the window's frame; don't seal the moisture weep holes at the bottom of the frame. If you have wooden storm windows that must be exchanged for screens in the spring, use non-permanent, non-staining rope caulk to seal around them.
Doors	Caulk around door frames. Install storm doors where you have none.

Caulking is easy and cost-effective

Use caulk to **permanently seal air leaks** in spots such as the cracks and gaps between window frames and your home's siding. Generally speaking, you can seal openings up to 1/4 inch. For larger gaps, you'll need to add a backing material before caulking or use a spray foam sealant instead.

Most types of caulk are sold in tubes that fit a caulking gun. In addition, some caulks come in aerosol cans; they're a good choice for filling gaps up to 1/2 inch.

When shopping for caulk, you may be overwhelmed by the choices (and prices ranging from under a dollar to several dollars per tube), so be sure to read the labels on the tubes and choose the caulk that will adhere best to the materials you're sealing.

If your budget allows, spend a little more for a higher-quality caulk. The benefit will be a longer-lasting seal; inexpensive caulks may last only a few years, while premium-priced caulks are rated for 20 years or more.

Also note that some caulks are for indoor use only, and that some are paintable—while others are not. In addition, many of the moderately priced caulks combine different chemistries; for example, you'll see *acrylic-latex* or *acrylic-latex with silicone* caulks.

Once you have applied the caulk, it takes time for it to dry, or *cure.* Curing time is described two ways. The *tack-free time* tells you how quickly the fresh caulk's outer surface will dry—or skin over. The *total cure time* indicates the time required for the caulk to become completely stable—or reach the point where no further drying or shrinking will occur.

Most caulks pose no known health hazards after they're fully cured. However, some high-performance caulking compounds contain irritating or potentially toxic ingredients, and you should apply them only when there's adequate ventilation; carefully read the manufacturer's instructions and take the appropriate precautions. In addition, make sure pets and small children do not come into contact with fresh caulk.

Caulking materials

Silicone

Uses	Seals most dissimilar building materials such as wood, stone, metal flashing and brick
Shrinkage	Little or none
Adhesion	Good to excellent
Cleanup	Dry cloth immediately. Mineral spirits after curing starts, as specified on package.
Cost	High
Comments	Permits joints to stretch or compress. Sticks to painted surfaces, but most cured silicones not paintable. Very durable and long-lasting; some rated 20 years or more.

Latex

Uses	Seals joints around tub and shower. Fills cracks in tile, plaster, glass and plastic; fills nail holes.
Shrinkage	5% to 10%
Adhesion	Good to excellent
Cleanup	Water, as specified on package
Cost	Low to moderate
Comments	Easy to use. Smooth seams with moist finger or tool. Water-resistant when dry. Paintable. Less elastic than other materials. Varied durability of 2 to 10 years. Will not adhere to metal. Little flexibility once cured. Must be painted when used on exteriors.

continued on page 8

Did you know?

If you're replacing windows in your home, caulk twice—first, where the window meets the sheathing and second, between the window trim and the siding. If you're building a new home or putting an addition on your existing one—and you're using a house wrap/weather barrier under the siding—be sure to follow the installation instructions that come with that material.

continued from page 7

CAUTION!

Carefully read and follow the manufacturer's instructions when applying caulking materials.

Butyl rubber

Uses	Seals most dissimilar materials such as glass, metal, plastic, wood and concrete. Seals around windows and flashing. Bonds loose shingles.
Shrinkage	5% to 30%
Adhesion	Good
Cleanup	Mineral spirits, as specified on package
Cost	Moderate to high
Comments	Durable; lasts 10 or more years. Resilient, not brittle. Paintable after one week curing. Variable shrinkage. May require two applications. Does not adhere well to painted surfaces. Toxic; follow label precautions.

Did you know?

In their original tubes, some caulks have a shelf life of a year or less—especially if the tubes have been opened. Don't buy caulk until you're ready to use it, and tightly seal opened tubes between jobs.

Oil- or resin-based

Uses	Seals exterior seams and joints on building materials
Shrinkage	10% to 20%
Adhesion	Good
Cleanup	Mineral spirits, as specified on package
Cost	Low
Comments	Least-expensive of the four types. Rope and tube forms available. Oils dry out and cause material to harden and fall out. Low durability of 1-4 years. Poor adhesion to porous surfaces such as masonry. Should be painted. Can be toxic—check label. Limited temperature range.

Urethane

Uses	Seals most dissimilar building materials such as vinyl, wood, stone, metal flashing and brick
Shrinkage	Little or none
Adhesion	Excellent
Cleanup	Solvent (such as xylene), as specified on package
Cost	High
Comments	Permits joints to stretch or compress. Sticks to painted surfaces and is paintable. Very durable. Takes a week or more to fully cure. Often available only at commercial construction or building supply outlets.

Source: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy

Use expanding foam for large gaps

Expanding foam is ideal for filling cracks that caulks can't handle. It comes in aerosol cans and takes a short time to cure. The foam is very sticky and attaches itself quickly, so be prepared to pick up any messes fast.

You also can use foam instead of caulk for applications such as sealing along the tops of interior walls where the top plate meets the plaster or drywall in your attic; low-expansion foam will stick better to dusty and dirty surfaces in your attic than caulk.

In fact, when you're working in a large area such as your attic, it may be inconvenient to carry and keep track of several cans of expanding foam. Instead, consider renting a contractor's foam gun, which has a long nozzle and can help you get into tough-to-reach spaces.

Expanding foam

Water-based, low-expansion foam sealant

Uses	Around window frames and door frames, in small cracks
Shrinkage	None; expands only 25%
Adhesion	Good to excellent
Cleanup	Water
Cost	High
Comments	Best for most applications. Takes 24 hours to cure to soft consistency. Water-based foam does not produce greenhouse gases. Will not over-expand to bend window or door frames. Must be exposed to air to dry. Not useful for larger gaps, as curing becomes difficult.

Polyurethane expanding spray foam sealant

Uses	Expands when curing; good for larger cracks indoors or outdoors. Use in non-friction areas, as material becomes dry and powdery over time.
Shrinkage	None; expands quite a bit
Adhesion	Good to excellent
Cleanup	Solvent such as lacquer thinner, immediately
Cost	Moderate to high
Comments	Quickly expands to fit larger, irregularly-shaped gaps; may put excessive pressure on sides of gaps. Flexible. Can be applied at variable temperatures. Must be painted for exterior use to protect from ultraviolet radiation. Manufacturing process produces greenhouse gases.

Source: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy

Try these materials for special jobs

In addition to the types of caulk and spray foam sealant described above, you may need to use **fillers** to plug extra-wide gaps. Fillers come in a wide variety of materials—cotton, fiberglass, foam and sponge rubber—and you can find them in the caulking department of your local hardware store or home center. However, these fillers are not designed for exposure to the elements; you'll need to caulk or seal over them.

To close gaps too wide for foam, use foil-faced bubble wrap. And for really large holes, cut sections of rigid foam insulation to fit and glue into place with expanding foam—before covering the area with wood or another appropriate building material.

For winter, use **rope caulk** to seal windows and other spots that you'll want to be able to open during the spring. Rope caulk is a gray, putty-like material that comes in long strips or rolls. It's easy to install and remains flexible—and you can just pull it off when the weather turns warm. Note that rope caulk will not last longer than a year, and oil-based rope caulk may stain painted areas.

Seal around pipes in exterior walls

Expanding foam sealant works well for sealing gaps more than 1/4 wide.

CAUTION!

When you go shopping for expanding foam to fill gaps around window and door frames, look for the type made specifically for that task. Standard expanding foam may expand so much that it will put pressure on the frames and bend them.

Weather-stripping windows and doors is the next step

Did you know?

A 1/8-inch air gap under an exterior door may seem insignificant, but it will let as much cold air into your home as a four-inch-diameter hole punched in the wall!

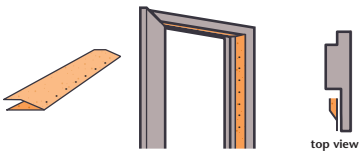
After you've handled the larger air leaks in your home's attic, walls and basement, tackle the smaller leaks you can stop by weather-stripping doors and windows. If you do the doors and windows first, you'll just be adding to the *chimney effect* in your home that allows warm air to rise and escape through the attic, pulling outside air into the main level.

Weather-stripping prevents air infiltration around windows and doors by sealing the gaps between the frames and moving parts when they're closed. With weather stripping, one or both surfaces of a door or window must be free to move, as opposed to caulking, which builds a permanent seal between two stationary surfaces.

Weather stripping comes in several sizes and shapes (often designed for specific uses) and may be made from metal, plastic, vinyl, rubber, felt or foam—or a combination of these materials. You should weather-strip all exterior doors, along with any doors that lead to unheated areas, such as the attic, garage or basement. In addition, weather-strip all operable windows.

You can buy weather stripping by the foot or in kits at a local hardware store or home center. Before you buy anything, determine what kind of weather stripping you want to use. Checking the size of the gap between the fixed and moveable sections of your doors and windows, as well as thinking about the amount of expected wear and tear in these areas, will help you decide which material is the most appropriate. Obviously, less durable materials will have to be replaced more frequently.

You can calculate the amount of weather stripping you'll need by measuring the perimeter of all the windows and doors to be weather-stripped. It's a good idea to add five to ten percent more for waste.



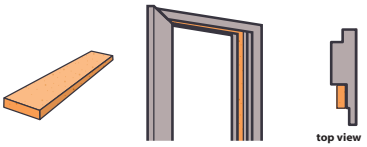
Weather-stripping materials

Tension seal

Description	Self-stick plastic or vinyl, folded along its length in a V-shape; also a springy bronze (copper, aluminum or stainless steel) strip shaped to bridge a gap and nailed in place. Material creates a seal by pressing against the sides of a crack to block drafts.
Uses	Inside the track of a double-hung or sliding window and top and sides of door
Cost	Moderate. Varies with material used.
Advantages	Durable. Invisible in place. Very effective. Vinyl is easy to install. Look of bronze works well for older homes.
Disadvantages	Surfaces must be flat and smooth for vinyl. Can be difficult to install, as corners must be snug. Bronze must be nailed in place (every three inches or so) to prevent bending or wrinkling. Can increase resistance in opening and closing doors or windows. Some kit manufacturers include an extra strip for the door striker plate.

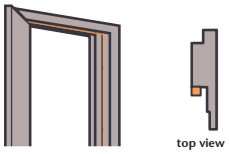
Felt

Description	Plain or reinforced with a flexible metal strip; sold in rolls. Must be stapled, glued or tacked into place. Seals best if staples are parallel to the length of the strip.
Uses	Around a door or window, fitted into a door jamb so door presses against it
Cost	Low
Advantages	Easy to install. Inexpensive.
Disadvantages	Low durability. Least effective at preventing airflow. Do not use where exposed to moisture or where there is friction or abrasion. All-wool felt more durable and more expensive. Very visible.



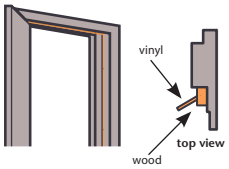
Foam tape

Description	Nonporous, closed-cell foam, open-cell foam or EPDM (Ethylene Propylene Diene Monomer) rubber
Uses	Top and bottom of window sash, door frames, attic hatches and non-operable windows. Good for blocking corners and irregular cracks.
Cost	Low
Advantages	Extremely easy to install. Works well when compressed. Inexpensive. Self-adhesive may not adhere well in cold weather. Can be reinforced with staples.
Disadvantages	Durability varies with material used, but not especially high for most types. Use where little wear is expected. Visible.



Reinforced vinyl

Description	Pliable or rigid strip gasket attached to wood, plastic or metal strips
Uses	Door or window stops, top or bottom of window sash
Cost	Low to moderate
Advantages	Easy installation. Low to moderate cost. Some types of rigid strip gaskets provide slot holes to adjust height, increasing durability. Comes in varying colors to help with visibility.
Disadvantages	Visible. Self-adhesive on pliable vinyl may not adhere well to metal or during cold weather.



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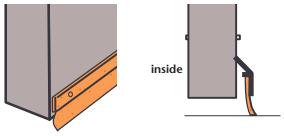
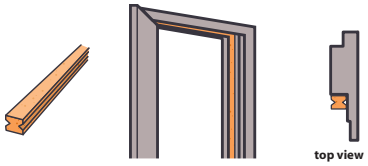
Door sweep



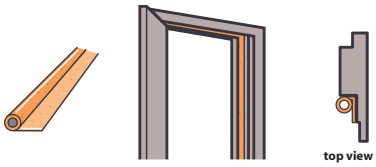
Description	Aluminum or stainless steel with a brush of plastic, vinyl, sponge or felt
Uses	Bottom of interior side of in-swinging door, bottom of exterior side of out-swinging door.
Cost	Moderate to high
Advantages	Relatively easy to install. Many types adjustable for uneven threshold. Automatically retracting sweeps also available to reduce drag on carpet and increase durability.
Disadvantages	Visible. Can drag on carpet. Automatic sweeps are more expensive and may require a small pause before retracting, once door is unlatched.

Magnetic



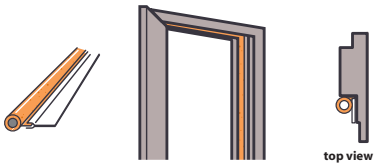
Description	Works similarly to refrigerator door gasket
Uses	Top and sides of doors, double-hung and sliding window channels
Cost	High
Advantages	Very effective air sealer
Disadvantages	Expensive

Tubular rubber



Description	Vinyl or sponge rubber tubes with a flange along length to staple or tack into place. Door or window presses against them to form a seal.
Uses	Around a door or window
Cost	Moderate to high
Advantages	Effective air barrier
Disadvantages	Self-stick versions challenging to install

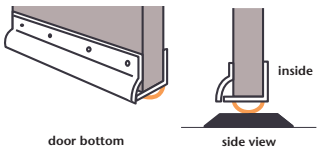
Reinforced silicone



Description	Tubular gasket attached to a metal strip that resembles tubular vinyl
Uses	On a doorjamb or a window stop
Cost	Moderate to high
Advantages	Seals well
Disadvantages	Installation can be tricky. Hacksaw required to cut metal; accurately butting corners poses a challenge.

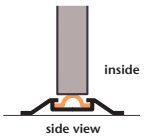
Door shoe

Description	Vinyl or sponge rubber tubes with a flange along length to nail or screw into place. Door presses against it to form a seal.
Uses	Seal space beneath door
Cost	Moderate to high
Advantages	On the exterior, product sheds rain. Durable. Can use with uneven opening. Some door shoes have replaceable vinyl inserts.
Disadvantages	Fairly expensive. Installation moderately difficult. Door bottom planing may be required.



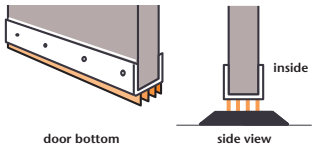
Bulb threshold

Description	Vinyl and aluminum
Uses	Door thresholds
Cost	Moderate to high
Advantages	Combination threshold and weather strip. Available in different heights and lengths.
Disadvantages	Wear from foot traffic. Relatively expensive.



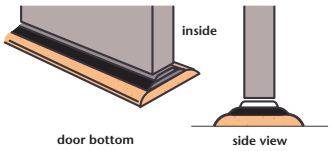
Finned door bottom

Description	U-shaped vinyl with fins on bottom that contact threshold
Uses	Door bottom
Cost	Moderate
Advantages	An effective air-blocker when new; multiple fins seal even if one is damaged or worn. Easy to install.
Disadvantages	Very visible. Cutting to exact length is critical, or air can leak around ends. Entire unit must be replaced when fins are worn.



Frost-break threshold

Description	Aluminum or other metal on exterior, wood on interior; door-bottom seal and vinyl threshold replacement.
Uses	Seal beneath a door
Cost	Moderate to high
Advantages	Use of different materials means less cold transfer. Effective. Threshold is adjustable.
Disadvantages	Moderately difficult to install; involves threshold replacement.



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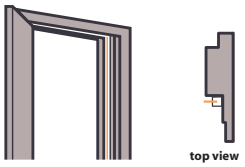
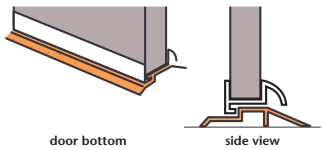


Fin seal

Description	Pile weather strip with plastic Mylar fin centered in pile
Uses	Aluminum sliding windows and sliding glass doors
Cost	Moderate to high
Advantages	Very durable
Disadvantages	Can be difficult to install



Interlocking metal channels

Description	Enables door and frame to engage one another when closed
Uses	Around door perimeters; also at bottom.
Cost	High
Advantages	Exceptional weather seal
Disadvantages	Very difficult to install; alignment is critical. Professional installation only.

Source: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy

Did you know?

You can test the air gap at your weather stripping with a dollar bill. Just close a door or window with the dollar positioned across the weather strip. If the dollar falls out, the gap is too large; if you can't pull out the dollar, the weather strip is doing its job by stopping air infiltration.

Keep in mind that less-durable materials such as felt or foam will have to be replaced more frequently. Weather-strip doors and windows all the way around their outer edges. It's best to apply one continuous strip along each edge (or joint), making sure the weather stripping is tight at the corners.

For self-adhesive products, be sure to clean the surfaces to which you'll be applying the weather stripping. In addition, follow the manufacturer's directions for the minimum outdoor temperature needed for a solid installation; some weather-stripping adhesives lose their gripping power in temperatures under 40-50 degrees F.

Insulation

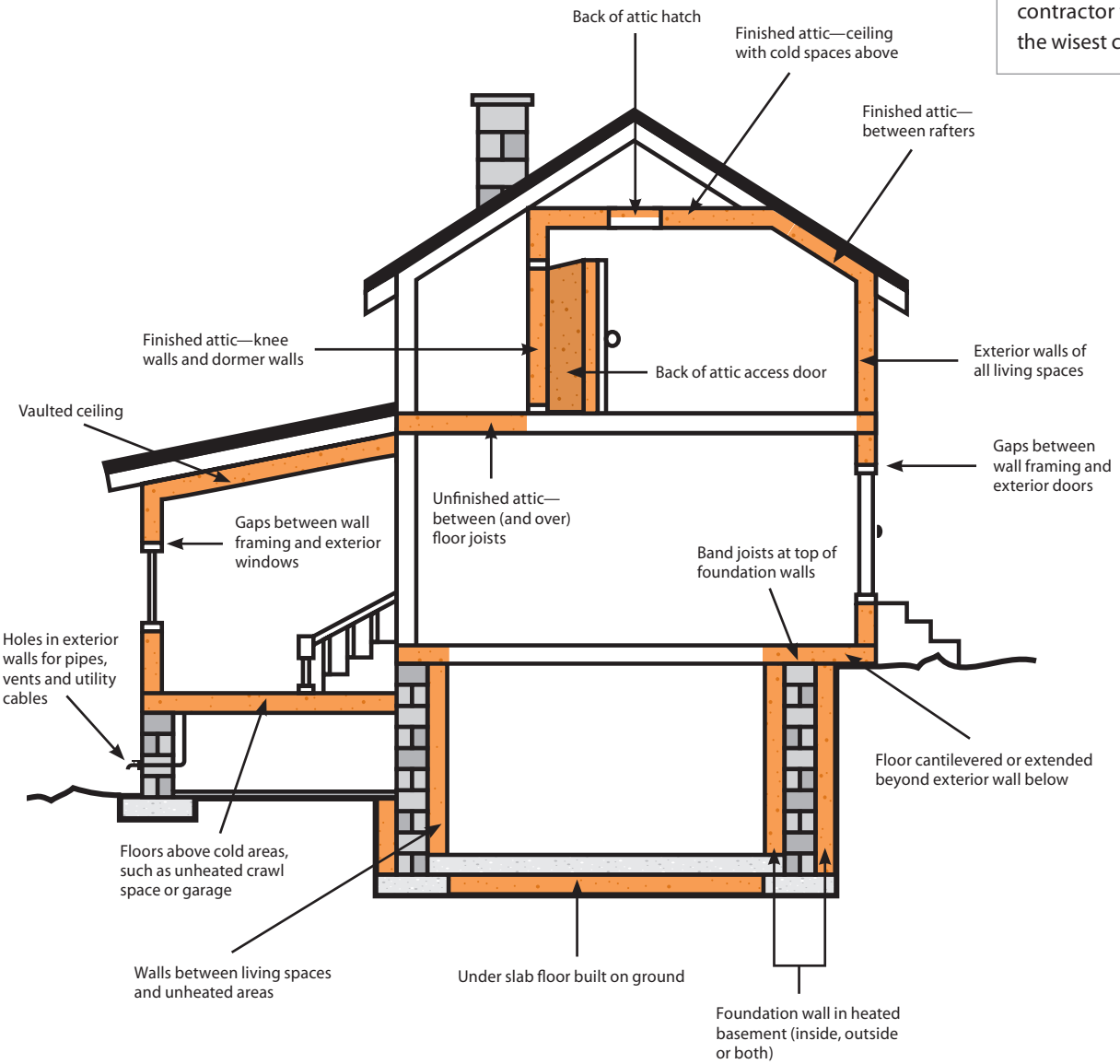
Create an energy-saving thermal envelope for your home

Insulation slows down the heat flow through a building's envelope. A home's building envelope contains the walls, attic, roof and basement—basically everything that surrounds the space you want to keep warm in the winter and cool in the summer.

Insulation works all year long to make your home more comfortable and energy efficient. In the winter, it slows heat loss and helps prevent condensation buildup. During summer months, insulation reduces heat gain and helps keep your home cool.

Where to insulate

Source: *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy*



Did you know?

Should you install your own insulation?

For many insulating jobs, such as those in your attic and basement, handling the work yourself can save money. However, some jobs—insulating walls and foundations, for example—are more difficult and time-consuming. In those cases, calling a professional insulation contractor for installation may be the wisest choice.

Adding insulation to your home can cut heating and cooling costs anywhere from 15 to 45 percent, depending on factors such as the original amount of insulation in your home, house size, air leaks and personal energy use and living habits. Many variables affect the amount you'll save, but the fact remains that **insulating your home is a wise energy investment.**

The idea behind insulation is pretty simple

While every house is different, the basic rule of insulating is the same for all homes: **Install insulation on any surface separating a heated space from an unheated space.**

Recommendations vary for the amount of insulation necessary for peak energy savings, depending on factors such as climate conditions, the sections of your home being insulated and the kinds of materials used in your home's construction. The recommendations shown here are for a typical Midwestern home; of course, your home may not include all of the building elements discussed. However, even if your home already has some insulation in these areas, be sure there's enough.

Types of insulation

Blankets: batts or rolls

Material	Fiberglass, rock wool
Method of installation	Fitted between studs, joists and beams
Where applicable	All unfinished walls, floors and ceilings
Advantages	Do-it-yourself. Suited for standard stud and joist spacing, which is relatively free from obstructions.

Loose-fill or spray-applied

Material	Rock wool, fiberglass, cellulose, polyurethane and polyicynene
Method of installation	Blown into place or spray-applied with special equipment
Where applicable	Enclosed existing wall cavities or open new wall cavities. Unfinished attic floors and hard-to-reach places.
Advantages	Commonly used for retrofits (adding insulation to existing finished areas). Good for irregularly shaped areas and around obstructions.

Rigid foam

Material	Extruded polystyrene foam (XPS), expanded polystyrene foam (EPS or beadboard), polyurethane foam and polyisocyanurate foam
Method of installation	*Interior applications*—must be covered with 1/2-inch gypsum board or other building-code approved material for fire safety. *Exterior applications*—must be covered with weatherproof facing.
Where applicable	Basement walls, exterior walls under finish materials and unvented low-slope roofs
Advantages	High insulating value for relatively little thickness. Can block thermal leak when installed continuously over frames or joists.

Did you know?

A water heater insulation jacket works well for covering and insulating a room air conditioner you can't remove from its window or wall location for winter.

Reflective or radiant barrier

Material	Fiberglass or rock wool
Method of installation	Foils, films or papers fitted between the attic floor and the roof, usually to the underside of the roof sheathing. (Note: In cold climates installing reflective or radiant barrier material is not recommended due to the potential for moisture accumulation.)
Where applicable	Most commonly used in attics to reduce heat flow through roofs, although overall contribution to energy savings may be small
Advantages	All suitable for framing at standard spacing. Bubble-form appropriate if framing is irregular or if obstructions are present. Effectiveness depends on climate, spacing, ventilation and heat-flow direction. Do-it-yourself.

Note: *Loose-fill vermiculite or perlite may be found in older homes, but they no longer are used for home insulation.*

CAUTION!

When you're insulating or sealing air leaks in the attic, be careful not to step on wires or wiring devices such as ceiling boxes or recessed lighting fixtures. Turn off the power to those devices at the circuit breaker box or fuse box before you start. Follow manufacturer's recommendations for insulating around lighting fixtures.

Insulation is rated by R-values

The **R-value** (or thermal resistance) of insulation is a measure of its ability to resist heat loss or heat gain. The higher the R-value, the better a material insulates.

It's important to note that an insulation's R-value is based on its performance in a 70°F environment with no air movement. Ironically, those ideal conditions are *not* when you need insulation the most!

Therefore, the *rated R-value* from the insulation's manufacturer may be much higher than its *effective R-value* if the insulation is not properly installed—or air leaks are not plugged before the insulation is added. Some types of insulation—such as blown-in wet cellulose, polyurethane and polyicynene—combine both air sealing and insulation in one step. The rated and effective R-values for these products are very similar, and they have a good performance record when installed correctly.

CAUTION!

Wear protective clothing and a dust mask when you're installing insulation such as batts, blankets or loose-fill products.

When you go shopping for insulation, it's important to remember that the product with the highest R-value per inch may not be the most cost-effective one. For example, when insulating a basement wall to an R-12 value, using 3 inches of an R-4 per inch insulation material might be less expensive than using 2 inches of an R-6 per inch product. To get the most insulating value for your money, compare the total costs of insulating an area to a specific R-value.

In addition, some materials may settle after installation, reducing their effective R-value by 10 percent or more. Be sure to check the manufacturer's specifications before you buy insulation.

Insulation needs a vapor retarder

As you've seen with a glass of ice water, condensation occurs when warm, moist air touches a cold surface. When this happens in your home, it can cause water or frost damage, mold and mildew.

A **vapor retarder** slows the movement of air and water vapor through building materials; in fact, a good vapor retarder will allow very little moisture to pass through. When you go shopping for a vapor retarder, you likely will find it mislabeled as a *vapor barrier.*

Whenever you install insulation in an uninsulated area, always include a vapor retarder. If you're adding insulation to an area that already has a vapor retarder, you don't need to add another one. Vapor retarders generally fall into these categories:

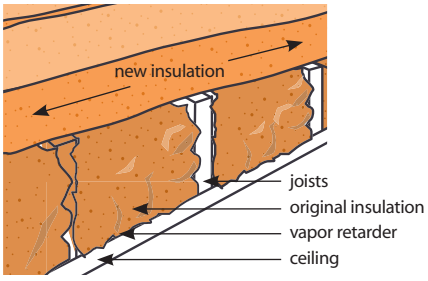
- *Foil or kraft paper* often is part of fiberglass batt or blanket insulation. The vapor retarder should face the warm side of a ceiling, wall or floor surface.
- *Rigid board insulation* acts as a vapor retarder when installed under an interior covering material such as drywall. The seams of rigid foam board should be taped— for both interior and exterior use —to improve its performance; this will help prevent moisture condensation problems, because the foam keeps the temperature in the wall cavity above the dew point temperature.
- *Sprayed-in materials* such as polyurethane and polyicynene insulation may not need a vapor retarder when installed properly. Check your local building codes for vapor retarder requirements.
- *Polyethylene sheets* are sometimes used, but they may not be a good choice if you have central air-conditioning; the material can trap hot, humid air inside your home, potentially causing moisture problems in your walls or ceilings.

From top to bottom, here are some things to know about insulating your home

Start in the attic

Because your home can lose a significant amount of heat through the roof, the best place to begin insulating is the attic. This usually is the easiest place for "do-it-yourselfers" to begin, because access is good and you can install loose-fill, batt or blanket insulation over existing insulation. If you choose to use a blown-in insulation such as wet cellulose, polyurethane or polyicynene, you'll need to have it professionally installed.

New attic insulation



When you add insulation to your attic, run the new batts perpendicular to the direction of the ceiling joists to cover air gaps that may have developed in the existing insulation along the joists.

What about open ceilings or flat roofs?

Insulating a cathedral ceiling, A-frame house or flat roof is an especially difficult job, because there is little or no space between the ceiling and roof. With these types of ceilings, professional installation of spray-in insulation materials is recommended.

Insulated ceiling panels are another possible solution; the panels are made from insulation batts covered with a vapor retarder.

Another solution is to build a wooden framework to hold the insulation, which is installed against the ceiling and covered with a vapor retarder and new drywall. Ventilation of the space between the cathedral and new dropped ceiling may be necessary to avoid condensation.

Head for the basement

Most Midwest homes have basements with either concrete block or poured-concrete walls. While such walls make sturdy foundations, they're poor insulators and have a very low R-value. As a result, an uninsulated basement can account for a significant amount of a home's total heat loss.

Before you begin any insulation projects in the basement, **check for moisture problems and air leaks.** You can repair minor problems on the inside of the foundation wall with sealant or waterproofing compounds, but any serious water leaks will require more extensive repairs. In addition, make sure downspouts are in good shape and the ground around the foundation slopes away from the house to ensure that water drains away from it.

If you don't correct these problems before insulating—or don't install a proper vapor retarder—you may cause **mold problems** in your basement.

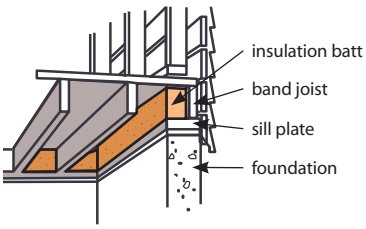
Did you know?

If you are building a new home, make sure a proper vapor retarder is installed under the concrete slab.

Check the top of the basement foundation

The wooden joists and other building materials offer only token resistance to heat flow from your basement. The **band joist** area (where the house's wooden structure rests on the concrete foundation) is the best place to begin. It's the simplest and least expensive basement area to insulate, and it will bring you the highest return on your investment. Insulate it to R-19.

Insulate along band joists



Cut insulation to fit band joist spaces between the sill and subfloor.

Then do the basement walls

Insulating the **interior** of your basement's perimeter walls (using batts or blankets) usually is less-expensive and less-involved than insulating the outside of the perimeter walls. Although the techniques necessary for building new stud walls around the perimeter require some carpentry skills, they generally are within the skills of the average do-it-yourselfer. Before beginning, check your local fire code for special insulation requirements.

Exterior foundation insulation usually is done during construction; on an existing home, it's a job for a professional. The job starts with trenching around the foundation to allow enough work space. Then rigid panel insulation is glued to the exterior wall of the basement. Above ground level, the insulation is covered with cement board or pressure-treated plywood to protect the insulation, and both are secured to the foundation. The dirt is then replaced around the house.

If you have a crawl space …

Insulate crawl space foundation walls and the floor to a value of R-10 or higher. If your crawl space has a dirt floor, cover it with polyethylene sheeting and extend the plastic several inches up the walls before insulating. See page 22 for details on properly ventilating a crawl space.

CAUTION!

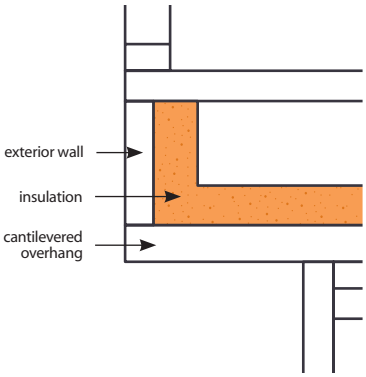
Crawl spaces may require special attention for moisture-related issues. Consult a building professional if you suspect any problems, and fix them before you insulate.

Insulate floors over unheated spaces

Floors over a basement that has a heat source such as a furnace, boiler or wood stove don't need to be insulated. However, floors over an unheated area such as a garage, a porch or open ground can be a source of considerable heat loss.

- A *cantilevered floor* over an exterior wall needs insulation just as much as a floor over an unheated basement, because it's exposed directly to the outside and may have many air leaks that cause drafts. Depending on how the floor is built, there are a few ways to make cantilevered floors more comfortable. One way is to hire a professional to spray in polyurethane or polyicynene insulation. If you choose to insulate this area yourself, use R-19 batts with a vapor retarder facing up, toward the heated part of the house.
- Insulate the floor in a *mobile home* or a *home supported by piers* to R-19 or higher. Cover the ground and the batts or blankets to protect against moisture, wind and animals.
- If your home was constructed *slab-on-grade,* the cold slab can damage wood and carpets if water and ice condense on the floor. During construction, rigid board insulation should have been installed around the entire perimeter of the slab. If not, a professional can insulate the slab using rigid insulation board with plywood flooring on top.
- Use rigid board insulation or spray-in foam to insulate the "floor" of a *bay window* projection or other *cantilevered spaces.*

Use batts in cantilevered spaces



Insulate under bay windows and other cantilevered spaces.

How much wall insulation do you already have?

Generally speaking, homes built during the mid-1950s and before do not have insulated walls. There are a few simple ways to determine whether your walls contain insulation.

- Turn off the electricity and remove an electrical outlet or switch plate on an exterior wall. Using a flashlight, look behind the electrical box for insulation.
- Remove a section of baseboard molding or paneling to expose an exterior wall cavity and check for insulation.
- Cut a hole in the wall of a closet or cabinet that faces an outside wall.
- Go to the attic and look down openings in the top plates of exterior walls.

A job for a professional

Although you may be able to rent the equipment for blowing insulation into your home's exterior walls, the job is very involved and is best handled by and experienced insulation contractor.

When should you add wall insulation?

Insulating the walls of an existing home is difficult and generally should be done by a professional insulating contractor. Because of the high cost of blowing insulation into exterior walls, consider this job only after your home has been thoroughly tightened and the attic and basement or crawl space have been insulated.

Insulating your walls is a good idea when there is less than one inch of insulation in the wall cavities. (Typically, walls have space for 3 1/2 inches of insulation.) If you already have some insulation there, however, the cost of adding more insulation may outweigh the benefits.

One time it makes sense to consider insulating your walls is when replacing your home's siding. Insulation can be blown into empty stud cavities before the new siding is installed; another option is to install foam board insulation under the new siding.

As an alternative, if you're planning an extensive interior renovation—to the point of gutting the interior walls of your home—fill the wall cavities with insulation as long as they're already open.

If you decide to insulate your walls, obtain bids from several contractors and compare the R-values provided, as well as the cost to complete the job. Walls should be insulated to a level of R-18 or more with blown-in, loose-fill or spray-in insulation. (See chart on page 17.)

Keep heated and cooled air in your ducts

The **ductwork** for a forced-air heating and air-conditioning system can be one of your home's biggest energy wasters—especially if those ducts run through unheated or uncooled spaces.

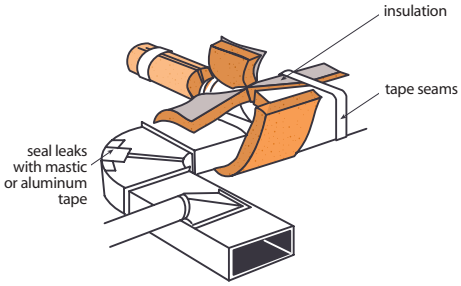
- Check the ducts for air leaks. Repair leaking joints first with sheet-metal screws; then seal remaining leaks with latex-based mastic and embedded fiberglass mesh or mastic or aluminum tape. Don't use plastic or cloth duct tape because it will harden, crack and lose its adhesion in a very short time.
- Wrap the ducts with special duct insulation; don't use leftover insulation from other jobs. Seal all insulation joints with the appropriate tape—not duct tape.
- Make sure ducts fit tightly to the register openings in floors and walls; if they don't, seal them with caulk.
- Seal return ducts, too, so you won't be breathing basement or crawl space air.

Insulate your pipes

The longer they run through unheated spaces, the faster the hot water pipes from your water heater or hydronic heating system will cool, causing these systems to work harder than necessary to meet your family's needs. Use inexpensive foam insulation sleeves from your hardware store or home center to insulate these pipes; secure the insulation with duct tape.

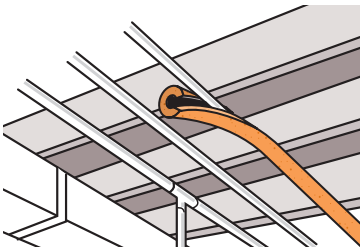
For boilers and steam heating system pipes, use insulation with a high enough temperature rating so it won't melt.

Seal and insulate ducts



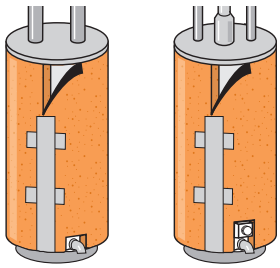
Tighten and seal leaky ducts before insulating with foil-or paper-faced batts made especially for ducts.

Insulate pipes



Use foam insulation on hot water pipes in your basement or crawl space. The water will stay warmer in the pipes, cutting the time you need to wait for hot water for sinks, bathtubs or showers.

Save hot water



Giving your water heater a blanket to lower your water-heating bills is an easy, do-it-yourself job. Be sure to follow the insulation manufacturer's installation instructions—the process differs for electric and gas water heaters.

Ventilation

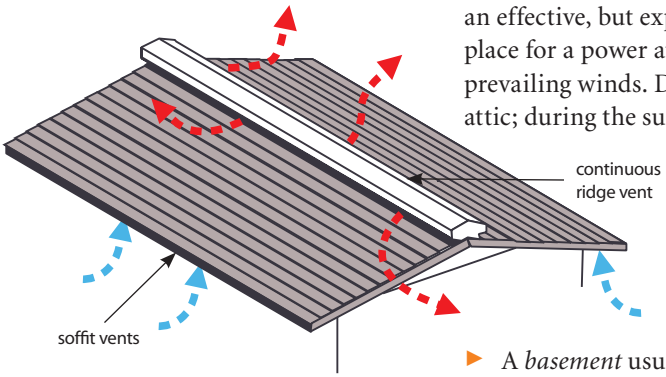
Did you know?

A power attic ventilator can rob your home of warmed air in the winter or cooled air in the summer, if your attic doesn't have adequate ventilation.

CAUTION!

Call a professional to install a whole-house fan or power attic ventilator.

Continuous ridge vent



If you're reroofing or building a new home, a continuous ridge vent combined with soffit vents offers optimal attic ventilation. In this illustration, blue arrows indicate outside air flowing into the attic and red arrows show attic air flowing out.

A healthy, energy-efficient home needs to breathe

Proper ventilation is important to protect your home from moisture damage during the winter and to reduce heat buildup during the summer.

Even if your home is very tight, some moisture will travel to the attic, where it can cause a lot of damage if it's not vented outdoors; you'll see problems such as wet insulation (which is ineffective), water stains on your ceilings and ice dams on the roof during the winter.

Your home needs at least two ventilation sources for circulating air through the attic. Vents high—at or near the top of the roof—and low—at the lower edge of the roof—let air circulate naturally.

At the top of the roof, you can use continuous ridge vents, static roof vents, gable end vents or wind-driven turbines. At the lower edge of the roof, install continuous soffit vents or several single vents in the roof overhang; make sure these vents aren't blocked by attic insulation and allow air to circulate naturally.

Attics with a ceiling vapor retarder should have a minimum of one square foot of vent area for every 300 square feet of ceiling area. If your ceiling doesn't have a vapor retarder, your attic needs twice the amount of vent area, or one square foot for every 150 square feet of ceiling area. (See page 18 for vapor retarder information.)

Good natural ventilation makes a power ventilator unnecessary for most homes. However, if you can't get enough air flowing through your attic on its own, a *power attic ventilator* is an effective, but expensive, solution to solve moisture problems and to cool an attic. The best place for a power attic ventilator is near the top of the roof on the side facing away from the prevailing winds. During the winter, a humidistat starts the fan to remove moisture from the attic; during the summer, a thermostat starts the fan when the attic gets too hot.

Here are a few more home-ventilating tips

While keeping the air moving through your attic is the largest ventilation issue in your home, there are some other things you can do to promote proper ventilation throughout your home.

- A *basement* usually doesn't need to be ventilated, but a crawl space containing water pipes or other utilities does (unless it's insulated). Install vents that can be opened in the summer and closed tightly in the winter to reduce heat loss. You'll need about one square foot of vent for every 150 square feet of floor in your crawl space. Vents at each corner of the crawl space provide the best air circulation.
- A *whole-house fan* can be a good substitute for air conditioning, reducing indoor temperatures by several degrees. All you do is open your home's windows during the evenings on warm-weather months and start the fan to draw cool air into your home and expel warm air into your attic and out the attic vents; you can expect lower air-conditioning costs through the prudent use of this energy-saving system.
- Install an *exhaust fan* in each bathroom to remove moisture from showers or steamy baths, as well as putting one in the kitchen to vent moisture and cooking smells. Note that exhaust fans remove heated or cooled air as well as moisture and odors, so use them only when needed. When you go shopping, make sure the fans you buy are properly sized for the rooms in which they're located and their planned usage.

For your safety, try a carbon monoxide detector

Because carbon monoxide(CO) can't be detected in any other way, buy at least one battery-powered CO alarm or an AC-powered unit with a battery backup for each level of your home and near sleeping areas. Other beneficial features include a digital display, which allows you to see both the level of CO as soon as it's present and the memory of the peak level. This information lets emergency personnel know how high the level was—and how to treat victims of CO poisoning.

Follow the manufacturer's directions for placement, installation and replacement. And after you install your CO alarms, make sure you test them regularly.

Can your home be too tight?

Tightening up your home with caulking and weather-stripping, installing insulation and sealing ducts to reduce energy costs will have a significant effect on the way your home operates, as well as your comfort. However, it is possible to get your home too tight, causing it to trap stale air and moisture inside. One sign that you do not have enough ventilation in your home is the appearance of **condensation** on walls, attics or crawl spaces.

In extreme cases, your fuel-burning appliances—such as the gas furnace, water heater and stove—can use more than their fair share of the air in your home for combustion, creating a **negative air pressure** inside and causing the appliances to back-draft. This can lead to a number of problems—including CO poisoning and even death. The same thing can happen if you have a wood-burning stove, a fireplace or an attached garage where you let your car idle to "warm up."

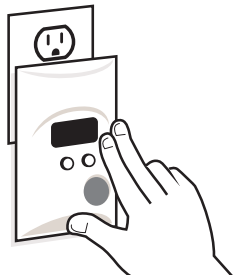
The smart thing to do is to have a blower door test performed after you've completed all your energy-saving improvements to check the amount of fresh air coming into your home. If it's not sufficient for healthy living, you can add an **air-to-air heat exchanger** to your heating and cooling system to bring in fresh air. In addition, hire a technician to check your furnace and water heater flues to make sure they're drawing properly and sending combustion byproducts up their flues and out of your home. If they're not working properly, you may need to have the technician add a fresh-air intake to these devices.

In the future—when you're replacing the heating units in your home—choose a direct-vent sealed combustion furnace or consider installing an electric unit such as a ground-source heat pump.

Did you know?

When a CO alarm sounds in your home, never ignore it. Get your family out of the house immediately, and open the windows to allow the CO to dissipate. Call emergency personnel from a neighbor's home or a cell phone once you're out of the house.

Test your CO alarm monthly



The best type of CO detector to buy is one that plugs into an outlet and has a backup battery.

CAUTION!

To protect your family from carbon monoxide (CO) poisoning, have all fuel-burning heating appliances checked by a qualified heating contractor every year. And be on the alert for these signs of carbon monoxide poisoning:

- Your entire family is sick at the same time with flu-like symptoms such as headaches, nausea, fatigue and dizziness.
- Flu-like symptoms decrease while you're away from home.
- Illness is present when gas appliances are in use.
- Excess moisture appears on the inside of windows.

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Energy Efficient Rehab Advisor
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