

## Air Leakage

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### Introduction to Air Leakage

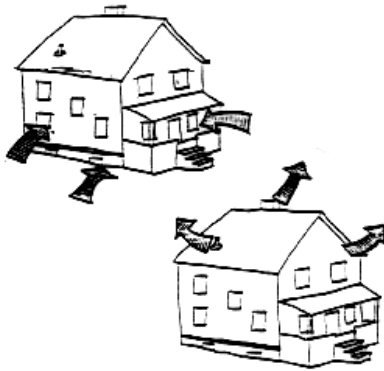
In the winter, cold air seeps into your house, replacing the warm heated air which escapes.

In the summer, the opposite occurs. Air leakage is the result of pressure differences between the inside and the outside of your house, and can arise from temperature differences, wind, appliance use, and living habits.

Cold winter air leaks into the home in the basement and first floor levels when the pressure outside is higher. This is called infiltration. Cold air infiltration can often be felt around doors, windows, walls, and foundations.

In the attic and upper floor levels, warm air leaks out through cracks in attic doors and walls, and around windows, plumbing vents, and chimneys. This is called exfiltration.

Enough air escapes from a typical house every day to fill two Goodyear blimps.



### **Benefits of Leak Sealing: [Save Energy and Money](#) (top)**

If you live in an older house that has not been fully weatherized, somewhere between 20% and 50% of your heating and cooling bills can be attributed to air leakage alone. You may be needlessly losing hundreds of dollars each year as heated or cooled air slithers through the cracks in your home.

Sealing air leaks is the first step in a program to improve the energy efficiency of your home. The energy, time, and money you spend will pay for itself quickly - often in one winter! A thorough job of leak sealing can cut your home's total air leakage by 33-46% - reducing your heating and cooling bills up to 20%.

Once air leakage is controlled, insulation can reduce your bills by another 25-75%!

### **Improve Comfort Levels**

Reducing air leakage and proper insulation help in the winter to stop uncomfortable drafts in your home. They also make it easier to maintain adequate humidity levels for indoor air. The amount of cold dry air which enters and warm moist air that leaves your home is reduced. In summer you can get the opposite advantage, keeping dry, cool air indoors where you want it.

### **Maintain Air Quality**

Unweatherized older homes leak 4-5 times more air than is necessary to maintain adequate air quality. Most of this air leakage occurs where you need it the least - in your basement and attic. By taking the steps described below you can greatly reduce air leakage in an older home, while also maintaining air quality.

**Caution:** It is advisable to test your basement for radon, especially if you are going to seal it thoroughly. If you also thoroughly seal the other living areas of your home, you should pay careful attention to managing air quality. When effective sealing reduces infiltration and exfiltration nearly to zero, toxic fumes from household items - from cleaners to carpets - can build up to serious levels.

### **Reduce Moisture Damage**

Tremendous quantities of moisture are generated inside the home from bathing, cooking, laundry, plants, and people. Moisture also enters through basements and crawl spaces. Warm air can leak into your cold wall cavities and attic, carrying moisture which can then condense. If unchecked, moisture may contribute to the deterioration of building materials and reduce the effectiveness of your insulation.

### **Before You Start** ([top](#))

#### **A few important items should be noted:**

- Exercise caution when performing work on your house - follow all necessary code and safety procedures outlined by local government agencies and product labels.
- All fuel and dollar savings are estimates based upon currently available research.
- Consider adding a combustion air supply vent to your furnace or boiler room. Otherwise the combustion exhaust process will tend to increase infiltration into your home and reduce heating system efficiency.

#### **Tools and safety equipment**

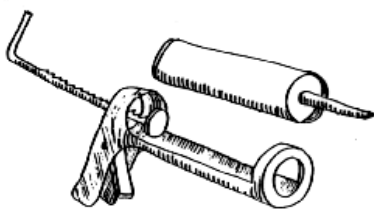
Leather gloves protect your skin from fiberglass and sealants. Long sleeves and pants are recommended too. A face mask filters out insulation particles when you're working in the attic. Rags should be used to clean surfaces for proper adhesion. Use a wet sponge (not your mouth) to moisten your finger before finger-smoothing the caulk you apply. A hacksaw and screwdriver are necessary to install aluminum door sweeps and some types of weatherstripping. A flashlight, hard hat, and broom come in handy during attic and basement leak sealing. Boards, laid crosswise over ceiling joists, may be needed when working in unfinished attics.

#### **Code and Safety Warning**

These instructions do not explain all necessary code and safety procedures. Consult with your local building permit office for code specifications. In Michigan check with MIOASHA (Michigan Occupational Safety and Health Administration) for safety guidelines before beginning a project. (MIOASHA is listed in the phone book under the State of Michigan, Department of Labor, Bureau of Safety and Regulation.)

### **Leak Sealing Materials** ([top](#))

Most leak sealing techniques can be completed in a few hours with just a few tools and a variety of common materials that can be found at most hardware stores, lumber yards, or large department stores. Use quality materials to insure durable and effective leak seals.



**Caulk** is used to fill small cracks and holes. A caulk gun dispenses the caulk. Pure silicone caulk is necessary around areas subject to high heat (lights, vents, or chimneys). Siliconized latex or acrylic caulk can be used in other areas.

Here's a quick guide to selecting the right caulk for your caulk jobs:

**Acrylic Latex** - for wood siding, around doors and windows. Easy to apply, cures fast, paintable, comes in colors, water clean-up, good for interior use, low odor and useable on exterior.

**Silicone** - for metal, glass, tile, smooth and non-porous surfaces. Good flexibility, low shrinkage, can be applied at most temperatures, joins many dissimilar materials and cures fast.

**Butyl Rubber** - for concrete, block and brick, gutters, aluminum siding, flashing and chimneys. Can be used in high-moisture areas and below the soil level. Paintable and comes in colors. Can be applied in below-freezing temperatures.

**Siliconized Acrylic** - for wood siding, masonry, metal, glass and tile. Excellent adhesion and flexibility, weather-resistant, easy to apply, water clean-up, paintable and comes in colors and clear.

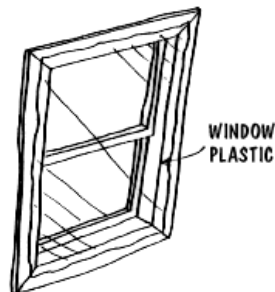
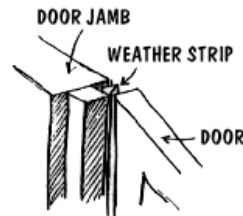
**Foam sealant** can be used to fill larger holes and gaps. It is normally sold in pressurized cans. Since it sticks well to most surfaces - including your hands - be sure to use the plastic gloves provided in the box! Do **not** use foam sealants that contain CFCs. (CFCs - chlorofluorocarbons - are a major contributor to ozone depletion.) Around windows and door frames be sure to use **non-expanding** foam.

Tightly rolled, "unfaced" (paperless) **fiber glass** insulation can be used to help insulate larger holes and gaps along the basement foundation sill or along attic rafters, but it is not a good sealant by itself. If you plan to use it in these ways, first caulk the sill seal or outer cracks, then place the fiber glass insulation. Finish up by friction fitting extruded polystyrene into the gaps.



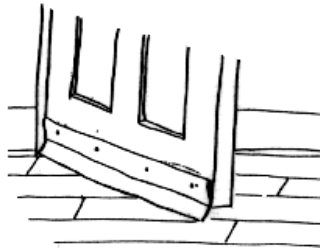
**Rope caulk** provides a temporary seal around windows and doors. It can be removed easily in the spring and stored in a plastic bag for use next year. To fill larger gaps, use several strands twisted together.

Weatherstripping, such as **V-strip**, works well around the movable parts of doors and most older windows. Installation for windows requires dismantling the lower sash.



**Clear plastic** is used to seal and insulate the inside of windows. It is typically attached with a double-sided tape or a vinyl snap-in track. For best adhesion, apply these only to clean, dry, oil-free surfaces.

**Door sweeps**, made of either vinyl or aluminum, are a form of weatherstripping used to seal the bottoms of doors to unheated areas.



### ***Sneaky Leak Detection Techniques*** (top)

Many air leakage spots can be seen with the naked eye or felt during harsh weather conditions with your hand. A moistened finger is one of the best tools to detect air movement into the house. A burning stick of incense serves nicely to detect air leaving the house.

To improve your effectiveness in finding air leakage points, use an exhaust room fan or attic fan to depressurize your house. Outside air will be artificially sucked into the home - making small leaks easier to detect. First turn off or turn down the thermostat on any appliances which may allow harmful combustion by-products into your home (such as your furnace and hot water heater). Then, tightly shut all your doors and windows. If you have a fireplace, be sure to clean out any ashes and close the flue and fireplace doors before turning on the fan. If you use a window fan, seal the gap around the fan with rags or plastic and tape. To test for leaks, turn your fan on high speed.

The method described above is a less sophisticated method of performing a "blower door test". The blower door quickly depressurizes the house. Air leaks are then

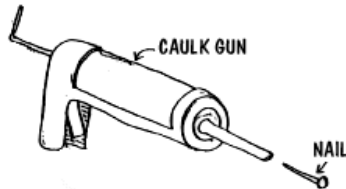
efficiently located using special "smoke guns" developed for the test.

### Windows

For indoor caulking, a clear acrylic or siliconized latex caulk are recommended. These are durable and easily painted.

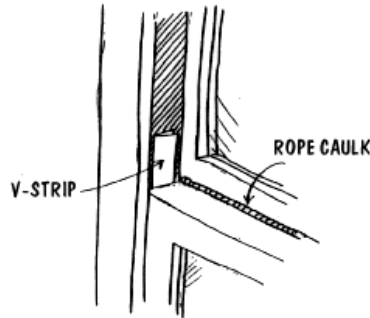
Seal the gap between the wall and the window trim. The surface should be clean and dry. First insert the tube in the caulk gun

and cut the tip off the tube with a sharp knife. Varying the depth and angle of the cut will affect the size of the caulk "bead". Pierce the plastic seal in the tube by inserting a long nail or coat hanger into the tip opening. Apply the caulk "bead" in a continuous motion, pushing the bead into the crack by holding the caulk gun at a 45° angle to the work surface. Release the handle before reaching the end of the crack to reduce bead "run-on" and reduce waste.



Run a sponge-moistened finger over the caulk to provide a smooth surface. Keep plenty of rags on hand to deal with drips and clean up. Place the nail you used to pierce the tube back into the opening to prevent the caulk from drying.

"V-strip" weatherstripping is used to seal gaps around the sides and bottom of older windows. First clean the surface where the V-strip will go. Then cut two strips 2-3" longer than the bottom window sash. This will allow you to extend the weatherstripping above the sash so the window won't catch on the weatherstrip edge when opened in the spring. Also apply V-strip under the bottom window sash. For the center of the window where the sashes meet, use rope caulk. Close and lock the window to make the sash fit tightly.



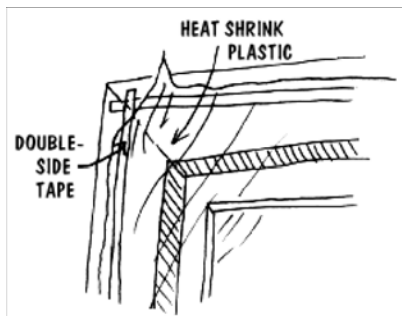
Apply the rope caulk, pushing it into the crack. Rope caulk can be used as a temporary alternative to weatherstripping and to seal gaps around storm windows or sliding windows and in other areas where weatherstripping is not easily applied. Do not caulk "weep" holes in storm windows. These tiny holes, usually at the bottom of the storm, prevent moisture damage by allowing moisture to escape.

Window plastic is added to windows to reduce air leakage. It also adds an insulating layer to your window.



Two types of window plastic are popular, clear vinyl with snap-in track and clear "heat shrink" film with double-sided tape. Vinyl with snap-in track is reusable for several years. Heat shrink plastic is less expensive but is not easily reused.

Make sure your window trim is clean and dry. First attach a continuous strip of trim or track around the inside edge of the trim. With vinyl, start at the top of the window, snapping the edge of the vinyl into the track with the "retainer strips" provided. Wrinkles in the vinyl will disappear with time. Heat-shrink plastic is sealed on the window edges with double-sided tape. It can be "heat-shrunk" using a blow-dryer for a wrinkle free finish, but don't overshrink the plastic or you will pull off the tape.



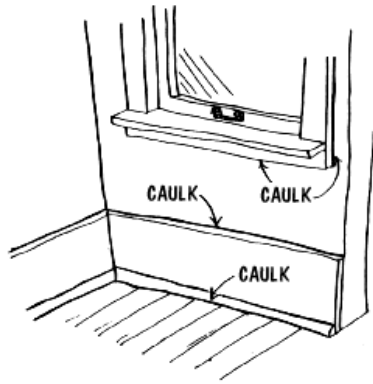
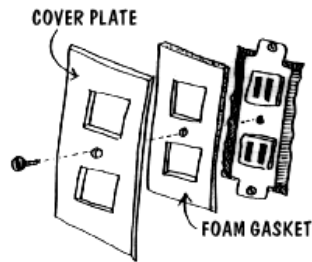
### Doors

Caulking and weatherstripping are also performed on the exterior doors of a home. The technique is similar to that of windows, with the exception of the door bottom. Here a "door sweep" is used to seal against the door threshold. Measure the bottom of the door to determine the length of the sweep. Cut equal amounts off each end of the sweep, using a hacksaw for metal sweeps or scissors for vinyl sweeps. Make sure that

the door sweep overlaps the threshold without interfering with the operation of the door. Attach the sweep to the bottom of the door with the screws provided. With vinyl sweeps, remove the protective plastic from the self-adhesive backing and stick the sweep to the door.

### Walls

Foam gaskets are used to seal switches and outlets which are not paint-sealed to the wall. Use a screwdriver to remove the screws holding the cover to the wall. Put the screwdriver down while you install the gaskets. Air leaks through interior walls, flowing up into the attic, as well as through exterior walls. So install the gaskets on all your walls. Plastic safety plugs are available to stop air leaks through unused electrical outlets.



Caulk can seal the smaller cracks in walls. Places to caulk include areas where electrical, phone, TV antenna, and plumbing penetrations occur. Another common area is the baseboard where trim, drywall, and the flooring come together. Use a clear or paintable caulk if you're sealing within the living area.

Pressurized expanding foam is useful in filling large cracks. Proper skin protection is important. Most products have plastic gloves included in the box.

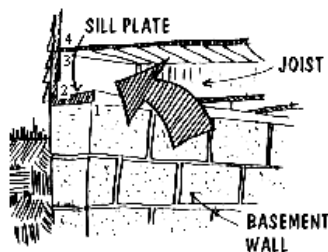


Shake the can thoroughly. Hold the can upside down and squeeze the trigger. Allow for expansion by filling the crack only 40% full. The unused foam doesn't store well, so it is best to use up as much of the foam as possible in one day.

### Basements

Many of the air leaks in a basement can be found around the rim joist area. Some cracks can also be spotted when it's light outside and darker in the basement. Check around basement windows, plumbing penetrations, gas lines, and dryer vents. Make sure the outside flapper on your dryer vent closes and is not obstructed with lint. If you have basement moisture problems, be sure to take care of them before sealing leaks.

Clean and caulk wherever air penetrates. Around the rim joist caulk the joint where the wood sill plate meets the foundation wall (1), the top and bottom edges of the rim joist (2 and 3), and the edge of the floor baseboard (4). Butyl rubber or pure silicone caulk provide good elasticity, adhesion, and durability in these spots. Expanding foam can be used for larger cracks.



### Attics

Attics have been proven to be one of the worst culprits for air leakage. Time spent here can be more productive than any other area in your home.

If your attic is accessible, the elimination of leaks should be performed inside of the attic as well as from the ceiling below. Seal and insulate all ductwork in the attic or crawlspaces. Check the tops of partitions and endwalls, and look closely around chimney and vent penetrations. From below, in the living area, look for cracks in the ceiling, recessed lights, and gaps around moulding and drywall.

Choose a day that is not too cold and not too hot for your work in the attic. A hard hat, boards to walk on, a face mask, flashlight, protective clothing, gloves



and a good eye for wiring are essential.

Take special care with the attic door - the most important door in your house to weatherstrip! Follow the same procedure used in weatherizing your exterior doors. Seal all four sides. V-strip, rope caulk, or foam weatherstripping can be used.

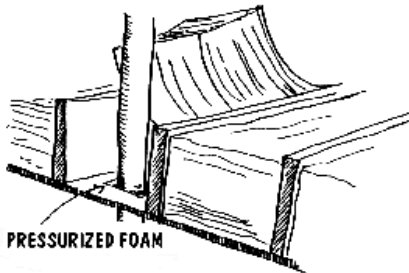
Use high-temperature silicone caulk around

chimneys. A collar of sheet metal

may also be used to seal large gaps around the chimney. Caulk around the sheetmetal to complete the seal.

Pressurized foam can be used around plumbing stacks.

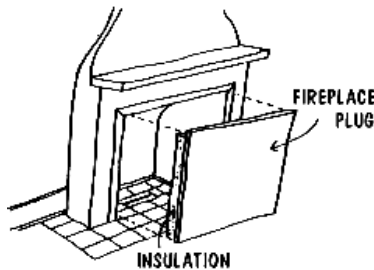
If necessary, use a broom to temporarily brush aside insulation, exposing other potential cracks or penetrations through end walls and partition walls. Use caulk and plastic to seal these.



### Fireplaces:

Fireplaces draw a lot of heat from a home, whether they are in operation or not. You might want to temporarily seal the fireplace opening with an inflatable, heavy vinyl bag called a "chimney plug." Be sure to close the damper before sealing the fireplace.

Other options are to use plastic or an insulated and weatherstripped panel (a "fireplace plug") made of sheet metal, wood, or similar material.



### Checklists For Leak Sealing [\(top\)](#)

Air Leakage Survey

Check off the areas that need leak sealing in your home...

**WINDOWS & DOORS:** \_\_\_ broken or loose panes \_\_\_ trim, frames, jambs, and sashes \_\_\_ storm windows

**WALLS:** \_\_\_ switches and outlets \_\_\_ electrical, phone line and TV antenna \_\_\_ pipes/plumbing \_\_\_ baseboard

**BASEMENTS:** \_\_\_ rim joist \_\_\_ windows \_\_\_ plumbing & gas lines \_\_\_ dryer vents \_\_\_ cracks in brick

**ATTICS:** \_\_\_ attic door \_\_\_ plumbing stacks, chimneys and vents \_\_\_ recessed lights and wiring \_\_\_ ceiling cracks \_\_\_ tops of walls cavities

Leak Sealing Tools & Equipment

\_\_\_ scissors \_\_\_ rags \_\_\_ caulk gun \_\_\_ screwdriver \_\_\_ measuring tape \_\_\_ flashlight \_\_\_ leather gloves \_\_\_ broom

(optional) \_\_\_ wire brush \_\_\_ hard hat (in attics) \_\_\_ utility knife \_\_\_ safety glasses\* \_\_\_ dust mask\* \_\_\_ sponge \_\_\_ boards to walk on in the attic

\*when working with insulation

Materials

\_\_\_ silicone caulk \_\_\_ acrylic latex caulk \_\_\_ siliconized acrylic caulk \_\_\_ butyl rubber caulk \_\_\_ v-strip weatherstripping \_\_\_ rope caulk \_\_\_ expanding foam sealant \_\_\_ non-expanding foam sealant \_\_\_ backer rod sill sealer \_\_\_ aluminum tape (for ductwork) \_\_\_ door sweeps \_\_\_ fiberglass insulation \_\_\_ polyethelene tape for cracks in windows or doors \_\_\_ duct tape for temporary use only \_\_\_ electrical switch and socket plate sealers (gaskets) \_\_\_ clear window plastic with track or double-sided tape

Adapted from **Air Leakage** and **Insulation**, publications of the Lansing Energy Action Network and Urban Options.

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