

4 Comprehensive air leakage control

4.1 Finding leakage areas

4.2 Caulking and other air sealing materials

Contracting the work

Homeowners can usually do a relatively effective air sealing job if they have the time and patience and are conscientious about air sealing in areas that can be difficult and uncomfortable to work in (e.g. the attic). However, professional air sealers can usually do a much better job because of their experience in locating and sealing leaks.

Contractors may use a depressurizing fan door (sometimes called a blower door) with smoke pencils to locate air leaks and use specialty caulking and sealants. The infrared scanner, used in conjunction with a blower door test, is also a powerful tool to locate air leaks and missing insulation.

Many air sealing companies also offer testing and assessment of ventilation and combustion air requirements, including testing for backdrafting.

COMPREHENSIVE AIR LEAKAGE CONTROL

Air leakage control is the single most important retrofit activity, and it should be considered first in any retrofit strategy. Air leakage control is essential, so every time you insulate, install or upgrade the air barrier system, ensure that moisture does not enter the insulation or building envelope.

Comprehensive air leakage control is the systematic identification and sealing of as many air leakage paths as possible with weatherstripping and caulking and by applying gaskets and tapes.

Effect on a house as a whole

As the envelope is tightened, household humidity levels rise. Condensation and moisture problems can occur, less fresh air is circulated through the house and less air is available for combustion appliances. Therefore, an important part of comprehensive air leakage control is attention to controllable whole-house ventilation and combustion-air supply.

Each house will respond to comprehensive air sealing in its own unique way, so monitoring is important. Older houses may require remedial measures before comprehensive air sealing.

For example, moisture can accumulate in the walls over time, resulting in mould buildup. This situation may require cleanup and replacement of the affected materials and installation of an improved air and vapour barrier. The best way to avoid problems is to understand how they occur and to take steps to control humidity and ventilation.

Furnaces, water heaters, fireplaces, woodstoves and any other fuel-burning appliances require air for combustion and for exhausting the products of combustion out of the house. If there is not enough air, the chimney or flue could spill dangerous gases into the house.

Humidity, ventilation and combustion air are discussed in more detail in Chapter 9, “Operating your house.”

4.1 FINDING LEAKAGE AREAS

Air leaks occur where there is a hole in the building envelope and a pressure difference. In winter, the house tends to operate like a chimney due to stack effect, where air enters the house at lower levels and exits at the upper levels and ceiling.

4.1.1 How to locate air leaks

Identifying the specific leakage areas requires a little detective work. For optimal results, hire an air sealing contractor or professional energy advisor. However, you can also do it yourself, as described below.

Make yourself a *leak detector* – all you need are burning incense sticks. Hold two or three together for more smoke and easier detection. Powerful leaks will cause the smoke to dissipate and the tips of the incense to glow. Slower leaks will cause the smoke to trail away or move toward the leak.

On a cold day, check for drafts in all suspected areas. It is easier to locate air leaks on a windy day. Check for possible leaks on the interior walls and features, such as electrical outlets and switches, because there may be a direct route through partition walls or along floor joists to the outside that should be sealed.

You can perform a rudimentary fan test by closing all windows and doors and turning on all the exhaust appliances in the house, i.e. bathroom and kitchen fans, clothes dryers (on cool cycle) and any portable fan placed in a window (if you can seal around it). However, before starting, turn off any fuel-fired space and water heaters to prevent backdrafting. You can now go around the house with your leak detector and identify and mark the air leakage locations that should be sealed.

Figure 4-1 Do-it-yourself leak detector

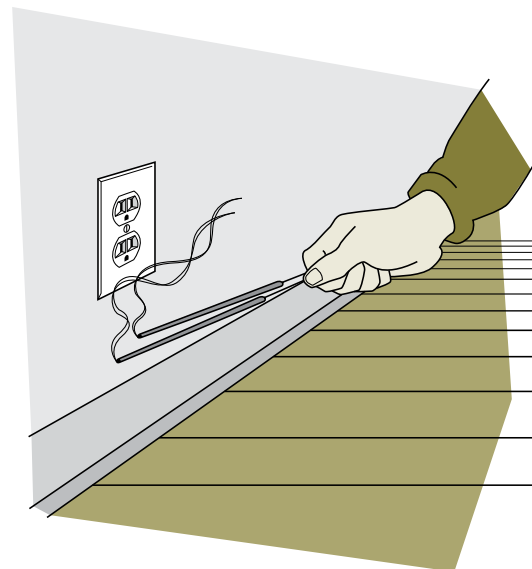
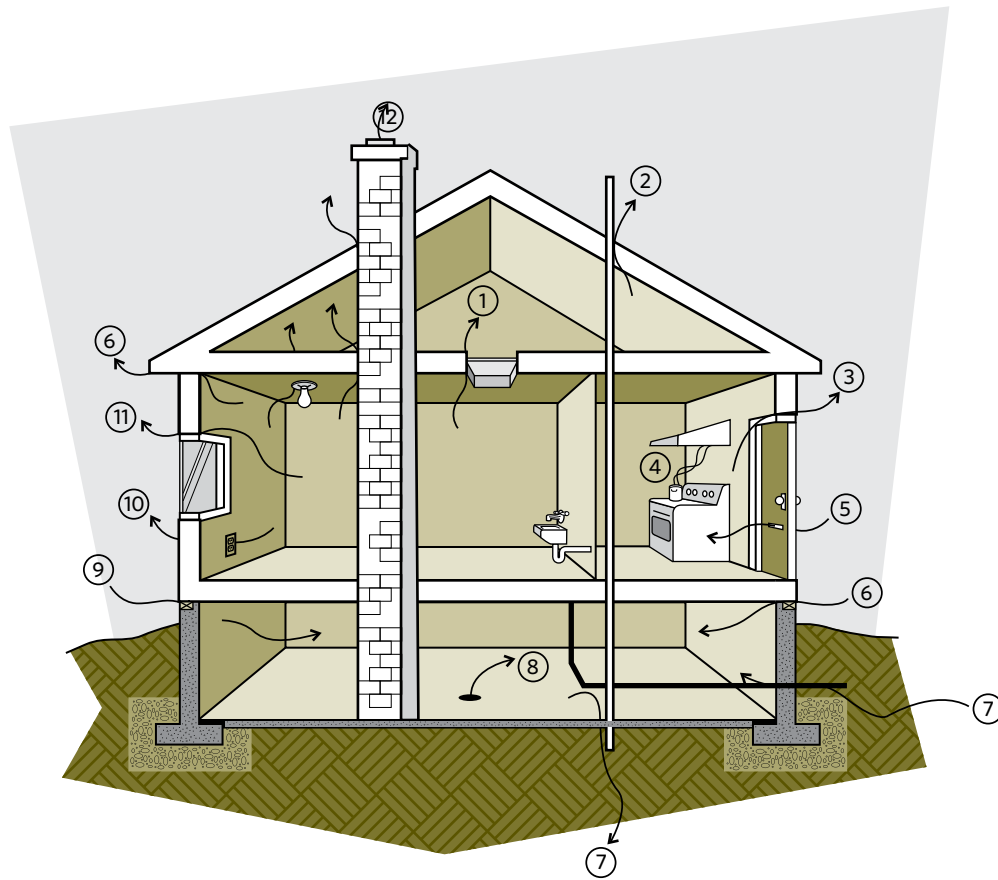


Figure 4-2 Typical leakage areas



Where to look

Key locations to check for leaks

- | | | | |
|--|--------------------|---------------------|-----------------------|
| 1. attic hatch | 4. exhaust vent | 7. service entry | 10. electrical outlet |
| 2. ceiling penetrations into the attic | 5. mail slot | 8. floor drain | 11. window |
| 3. door | 6. sill and header | 9. foundation crack | 12. chimney |

4.1.2 Checklist of air leakage areas

A few areas deserve special attention but do not limit your detective work to just these places.

Inside the main living areas, check the following:

- window glazings for tightness and around the window sash and casing
- around the door, including the threshold and around the door frame
- electrical outlets and switches, including ones on interior walls
- exhaust fans and vents (these should vent to the outside and close properly when not in use)
- corners where two walls meet with an imperfect seal
- light fixtures in the ceiling
- interior trim and baseboards
- cracks in the wall finish or ceiling
- the joint where a wood frame wall joins a masonry wall or chimney
- doors and hatches into unheated attics

- fireplace dampers and fireplace bricks
- behind bathtubs and under sinks
- above sliding pocket doors
- around plumbing pipes and ductwork

Inside the attic, check the following (you may have to move aside existing insulation):

- around the plumbing stack and any other pipes entering the attic
- around wires or ceiling light fixtures that penetrate the attic floor
- around ducting that enters the attic from inside the house
- at the junction of the ceiling with interior wall partitions
- around attic access doors
- around chimneys
- along any shared walls
- the ceiling area in bathrooms and above stairwells

SAFETY WARNING: See Section 1.4, Health and safety considerations, for a warning about asbestos and vermiculite insulation.

Inside the basement, check the following:

- where the wood-frame wall (sill plate) meets the masonry (concrete or stone) foundation or where joists penetrate the masonry wall
- holes or gaps where the electrical service, gas service or oil fill pipes go through the wall; be careful around electrical wires and gas pipes; do not disturb connections
- holes for wiring, cabling and plumbing, and air conditioning pipes going into internal and external walls

- leaky ducting or poorly fitted hot air registers or cold air intakes
- around window and door framing
- cracks in the foundation wall and slab
- floor drains
- the base of the chimney or flue

4.2 CAULKING AND OTHER AIR SEALING MATERIALS

Air seal cracks and penetrations on the inside surface of exterior walls, ceilings or floors to prevent air from escaping into the walls and roof.

On the exterior, caulk cracks that will allow water and insect entry. If you are painting the house, try not to plug the joints in the siding and use a permeable paint or stain. The outside of the walls must be able to dispel moisture. For these same reasons, do not paint stucco; special sealers are available for stucco.

4.2.1 Caulking basics

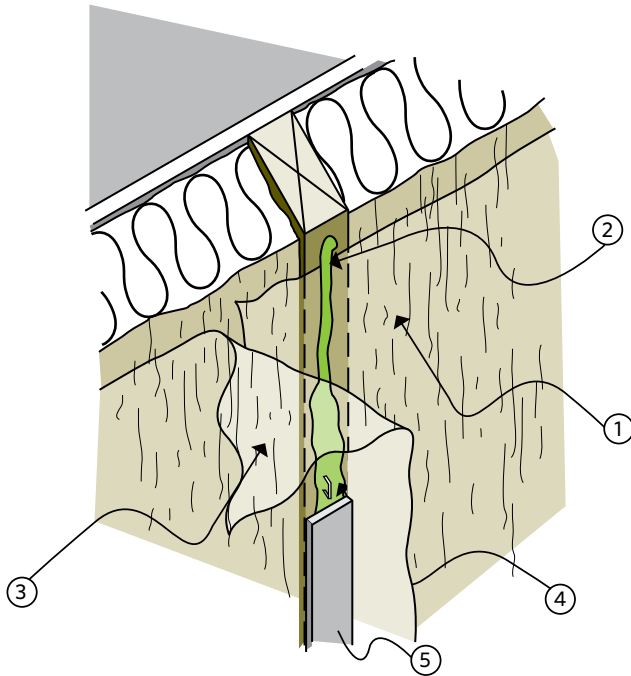
Buy a good quality caulking gun that easily fits your hand to avoid strain. The gun should have a pressure release lever. A thumb release is convenient since it permits one-hand operation, as are a nozzle cutter and tube piercer.

Choose the right sealant for the job. People often have a bad experience when they first try caulking because they purchase a low quality or inappropriate caulk and/or caulking gun. Choose premium caulks for durability. Practice running and smoothing beads before starting on the actual job.

See Section 3.3, Air barrier materials, for a guide to the different types of caulking.

- Use wide sheets to minimize seams.
- Overlap all seams and edges over a solid backing such as a stud.

Figure 4-3 Sealing air and vapour barrier seams

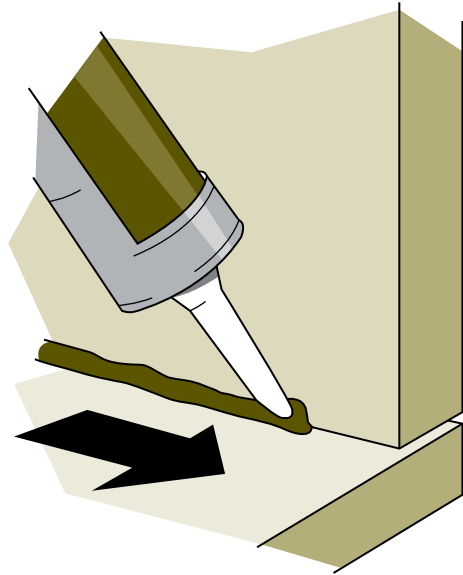


Polyethylene air and vapour barrier installation

1. first sheet placed over a solid member
2. bead of acoustical caulking
3. second sheet pressed into the bead
4. staples through the bead
5. wallboard or batten attached for mechanical support

- Run a bead of non-hardening acoustical sealant between the overlapped sheets over the support.
- Staple through the sheets and the bead of sealant. Avoid or minimize the use of all other staples.
- The finish (e.g. drywall) acts as an anchor, securing the seam. If the polyethylene is recessed in the wall, a batten nailed over the seam can provide mechanical support.
- Seal all penetrations. Where possible, penetrate at a solid backing such as plywood or drill through a single or double stud.

Figure 4-4 How to lay a bead of caulking



Hold the caulking gun approximately perpendicular to the line of travel.
Cut the nozzle squarely.
Force the caulk into the crack.

SAFETY WARNING: Use non-combustible caulking around heat sources (chimney, light fixtures, fan motors, etc.). Silicone or polysulphide sealants usually work well. Special high-temperature silicones are available for flue pipes. Check the product labels.

4.2.2 Other sealing materials and applications

Other materials are used to provide an air barrier at different locations in the house, including specialty gaskets and tapes, as well as sheet materials such as polyethylene, spun-bonded olefin, rigid insulation, drywall, plywood, Oriented Strand Board (OSB) and sheet metal. Installation techniques are critical when using sheet materials as an air barrier. Seal all edges, seams and penetrations in the sheets.

4.2.3 Air and vapour barriers

It is often possible to install a new air and vapour barrier by using sealed drywall as the air barrier and layers of paint or sheet polyethylene as the vapour barrier. Alternatively, sealed sheet polyethylene installed on the warm side of the insulation can provide both an air barrier and a vapour barrier. Proper installation is critical (see Figure 4-3).

4.2.4 Refinishing the interior

If an attic retrofit is part of interior renovations, consider removing the ceiling and installing a new sheet-polyethylene or sealed drywall air barrier on the underside of the ceiling joists. Although sealing the air barrier on the ceiling to the one on the wall should pose no difficulties, maintaining continuity at interior partitions will require some ingenuity and detailed work.

Where partition walls run perpendicular to the ceiling joists, maintain continuity by working from above, using connecting strips of polyethylene or extruded polystyrene.

Where partition walls run parallel to the ceiling joists, install blocking and nailing strips to provide support for the new ceiling materials.

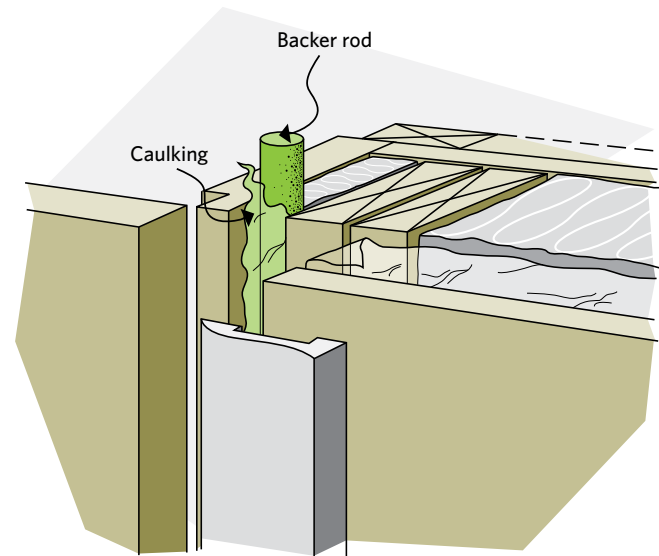
4.2.5 Tips on sealing some of the leakiest areas

Electrical outlets

If you notice a draft through any wall electrical outlet, seal it. Inside wall outlets can also be leaky and need to be sealed. Turn off the power to the outlet by turning off the circuit breaker or removing the fuse. Check to make sure the power is disconnected by turning on a lamp. There are special approved foam pads that fit between the cover plate and receptacles.

You will obtain a better seal if you caulk the gasket before installation. Place child safety plugs in seldom-used outlets. Some foam pads come with a gasket that fits on the safety plug (see Figure 3-3).

Figure 4-5 Sealing behind window or door trim



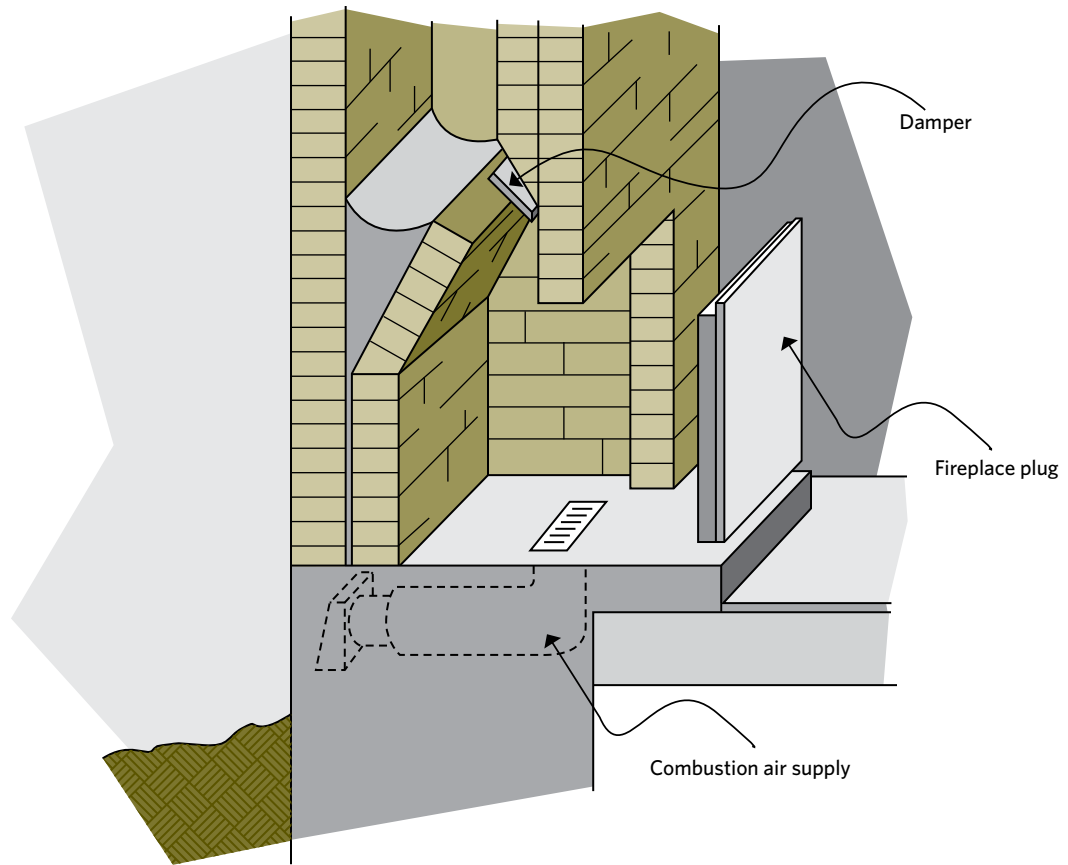
If you are installing an electrical outlet during a renovation, place it in a special plastic box available from building supply stores for an optimal seal. Caulk the penetration for the wire, and seal the new air and vapour barrier to the edge of the box.

Trim areas

Seal areas of air leakage around all baseboards, mouldings and window and door casings. In some cases, this can be done easily by sealing all the joints with a flexible caulk that is clear, paintable or of a matching colour. A more effective solution is to carefully remove the trim and seal behind it. Insulate wide cracks with a foam backer rod and seal them with caulking, the appropriate type of polyurethane foam or other suitable material. If you remove baseboards, you might also be able to caulk between the wall finish and the bottom wall plates, and between the plates and the floor.

Glass panes (glazings)

The seal between glass and its wood frame should be tight. Check the glazing carefully and be certain

Figure 4-6 Duct for an outside combustion air supply to a fireplace

that all the seals are intact, with no cracks or missing sections. If not, repair them with glazing compound that lasts longer and stays semi-soft and usable longer than putty. Remove the old putty and apply the new materials with a putty knife. Press it firmly into the space for a good seal and then paint, allowing the paint to just touch the glass.

Fireplaces

Close the chimney damper when a fireplace is not in use. Take a flashlight and make sure the damper fully closes. If it does not, have it repaired by a certified chimney specialist. However, even with the damper closed, a great deal of heat may still escape up the chimney. You can install tight fitting glass

doors but be aware that most are not very tight or effective. The door frame should be tightly sealed to the fireplace with non-combustible caulk, and the frame should include a combustion air gate or damper. The air gate permits entry of combustion air from the outside to supply the fire, but when not being used, the air gate should be closed. Ask for door kits at your wood-burning appliance dealer or local building-supply outlet.

Seal an unused or seasonally used fireplace by putting an airtight plug of some sort in the chimney or across the fireplace opening. This can be made from board material that is cloth-covered and provides a good seal at the edges (see Figure 4-6).

Check for air leaks where the chimney meets the wall (remove the trim if necessary). Caulk this joint with a high-temperature caulking.

Chimney

Chimneys pose particular challenges for air-sealing and insulating.

SAFETY WARNING: Fire safety is a real concern when air-sealing and insulating. Refer to Section 5.1.2, Fire and other hazards in attics, for methods of dealing with this area.

Attic hatch

Seal the attic hatch exactly as you would seal an exterior door. Caulk around the frame and between the casing and the ceiling drywall. Weatherstrip along the edges of the casing or the access panel itself. Finally, install hooks with eyebolts or some sort of latch mechanism to hold the hatch firmly against the weatherstripping. The hatch itself should be insulated.

Windows that are never opened

Seal windows that are not needed for ventilation or as a possible emergency escape route with caulking rather than weatherstripping. Use special strippable caulk that can be removed when you want to operate the window again.

Figure 4-7 Cutaway view of a well-sealed attic hatch

