

Finding and Fixing Hidden Leaks: Part 2

Sealing Special Areas

Finding and fixing the hidden air leaks in a home is usually the least expensive and most effective energy improvement a homeowner can make. These efforts will improve your comfort by reducing drafts and minimizing temperature differences between floors and ceilings, probably allowing you to lower your thermostat setting while remaining comfortable. Do-it-yourself air sealing shouldn't take more than an afternoon and will probably cost less than \$50 in materials. Our last issue discussed what causes air leaks, where to find them, and sealing materials. This issue continues with information on how to seal some of the most important areas.

Attics

Check for holes where plumbing vent pipes and electrical wiring enters the attic space. In some homes, pipes and wiring are framed in a small shaft or "chase" that runs from the basement or ground floor to the attic. Lift up the insulation and look for holes where wiring drops down into the rooms below. Find where the interior partition walls are and look for air leak passageways. Fiberglass insulation over these holes often is gray rather than pink or yellow because it filters out the dust from the escaping air. On cold days you may be able to feel the hot air coming up through the pathways.

Wear a face mask or respirator when working in the attic, since you'll disturb lots of dust which has settled over the years. Use caulk to seal small wiring and plumbing holes. Fill larger spaces by packing them with rolled pieces of unfaced insulation stuffed into a plastic vegetable bag. Seal very large gaps by taping a piece of polyethylene sheeting around pipes and sealing the other end to the attic and basement framing.

For fire safety, use only non-combustable material to seal air leaks around the fire clearance area of chimneys and heating system flue pipes. Around narrow gaps you can tightly stuff rock wool or other Class II fire-rated fiberglass insulation into

the gap between the chimney and attic framing with specially rated high temperature caulk.

Some types of connectors, called thimbles, used for passing stovepipe through floors or walls, need an air space around them for cooling. Don't stuff anything into these holes. If you don't know whether your woodstove has this type of thimble, don't seal this area.

The attic access panel or door is an often-overlooked but one of the most effective places to seal. Because the access is often located in a closet, it is easily forgotten and not weatherstripped. Depending on how the panel or door is framed, use V-type weatherstripping mounted on the jamb or self-adhesive foam tape mounted on the flange that supports the panel. Install a latch to keep the panel or door tightly closed.

Since the fit between sheetrock and most electrical junction boxes and bathroom fans in ceilings can result in large gaps hidden by trim plates, check and caulk these areas from above whenever possible. However, don't seal or allow insulation to be placed over recessed lighting fixtures unless they are designed for it (they should state "IC rated"), since most recessed lighting fixtures need the additional air flow to dissipate excess heat for safety.

Don't seal the attic vents to the outside along the eaves and gable ends. These are designed to provide ventilation allowing any moisture that does get into the attic to escape outside.

Vaulted Ceilings

Cathedral or vaulted ceilings often allow significant air leaks. The edges of exposed beams can provide a direct passageway outside for warm air. You may need to caulk the edges of the boards in a tongue-and-groove ceiling if there is no polyethylene air-vapor barrier behind them (Figure 4). Sometimes the best solution is to remove the boards and install

polyethylene rather than trying to caulk every joint. Even if polyethylene has been installed, it may not be caulked to the beam and framing members and will permit leaks.

Kneewall Attic Spaces

In attics converted into living spaces, short walls (kneewalls) are added to separate the area where the roof meets the floor. The area behind the kneewall often is used as a storage space and sometimes has built-in cabinets behind it. This area should be isolated from the heated area of the house. Weatherstrip and insulate any access doors into the kneewall area. Build enclosures behind any built-in cabinets or weatherstrip the drawers to prevent air leaks into the unheated area behind the storage space.

If the floor joists of this attic space open into the kneewall area, large amounts of air can escape up interior walls from below, and into the attic (Figure 5). To stop this heat loss, professional weatherizers often cut squares of rigid insulation, such as polystyrene or polyurethane foam board, and fit these plugs into the open joist ends below the kneewall. If this area is used for storage, put down floor board to avoid compressing the insulation here.

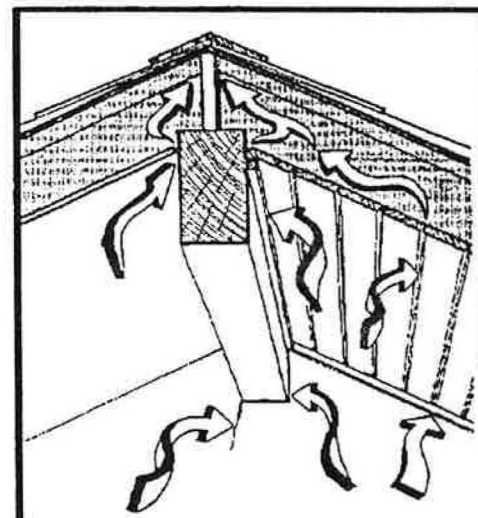


Figure 4. Caulk along all edges and cracks of vaulted ceilings.

Basements and Foundations

The basement or foundation is usually the source of cold air entering the house. Where to air seal in basements and foundations depends on whether the area is heated, such as in a daylight basement design. If the house has a crawl space, sealing through the floor is critical because the crawlspace is vented to the outside. If the basement area is heated or semi-heated, or contains the furnace and other appliances, then you need to seal both the foundation walls and air leaks through the floor. Foundation air leaks in homes built on slab foundations must be sealed along interior floor-wall baseboards or from the outside.

Pipe and electrical penetrations to the floor above are the most important areas to seal. Use expanding foam or, for gaps several inches wide, fiberglass insulation stuffed into plastic bags and packed into the holes. Reduce air leaks in the fire clearance area around chimneys and flue pipes with the non-combustible materials described in the section on attics.

Another important area to seal is around the board that supports the floor joists resting on the foundation wall, called the sillplate or mudsill. In areas where the crack is larger than the tip of the caulk gun, use expanding foam. Caulk the entire length of the board because air may move a great distance along the mudsill until it finds an opening into the house. The boards covering the ends of the floor joists, called the band joist, should also be caulked.

Be sure to fill the holes around pipes for outside water faucets, electrical service entry, and telephone or cable television wiring. Make sure windows are latched tightly and rough openings of the frames are sealed. Replace any missing panes of glass in basement windows. Be sure the dryer vent flapper closes when the dryer is not in use. Replace the outside weather hood if necessary.

Furnaces and Ductwork

The joints in metal ductwork sections are often not sealed or may have come loose over the years. Since the furnace blower

creates a great deal of pressure-while distributing its heat, it is important to seal the joints of all accessible ductwork, both heating supply ducts as well as cold air returns. Don't forget the joints on the cold air return ductwork as well as the large air chamber or "plenum" attached to the furnace as well. Except in homes with heated basements, all ductwork and furnace plenums should be insulated after sealing.

While inspecting the ductwork look for loose or disconnected sections. Use sheet metal screws to fasten duct sections before taping. When the furnace blower is on, use burning incense to locate air leaks in ductwork joints. Some homes use an enclosed floor joist space to form a return air duct. Be sure all edges of this cavity are effectively sealed, especially the ends. Any holes for wiring or pipes passing through this cavity should be sealed. Check the opening in the floor or wall where the ductwork terminates, called the "register boot." After removing the grilles and register covers in each room, caulk the edge where the sheet metal meets the floor.

Flue and Damper Work

Fireplaces with poorly fitting dampers provide a continuous stack for air to escape. Most fireplace glass doors don't solve this problem because they are designed to fit loosely so that heat will not crack the glass. Clean out any material resting on the ledge which might prevent the damper from closing completely. Sometime an existing

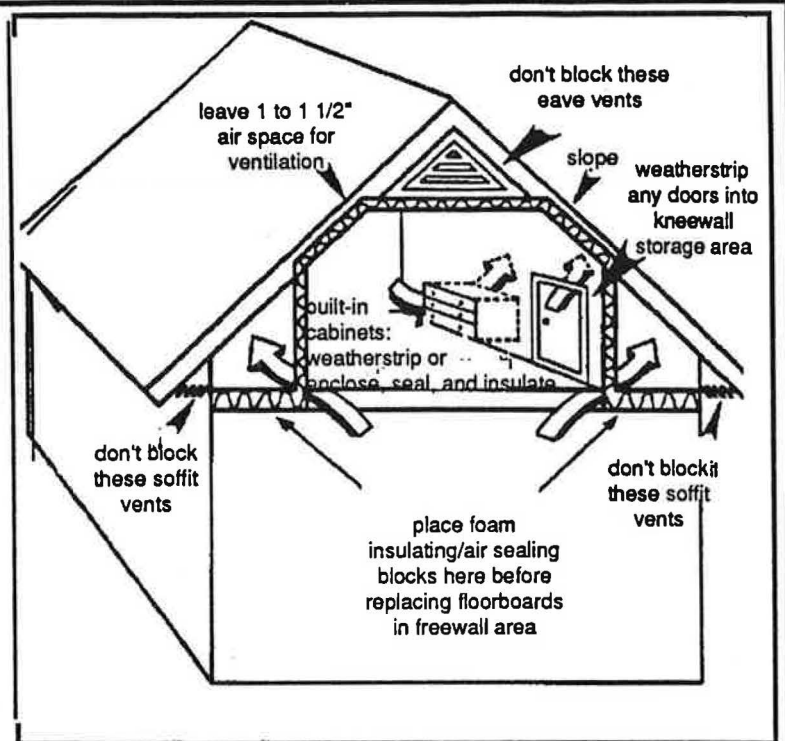


Figure 5. Kneewall attics have many air leak points.

damper can be adjusted for a better fit. If a new damper is needed consider a chimney top damper for masonry chimneys. This damper has a long chain that hangs down the chimney for easy opening and closing.

Built-ins and Drop Ceilings

Sometimes the area behind cabinets, closets, or built-in bookcases and window seats is not plastered or sheetrocked. This allows heat to escape directly into the wall or ceiling and to the outside. The solution is to install sheetrock, or at least polyethylene with taped seams, in the closet or behind built-ins and cabinets. You may not have access to the area behind built-in cabinets but you can weatherstrip each drawer and carefully caulk all joints in the cabinets to minimize air leaks.

Sometimes kitchen remodelers install a suspended ceiling if the original ceiling is in poor condition. However the holes from electrical box removal or pipe installation in the original ceiling are rarely patched. Use expanding foam to seal smaller holes or install sheetrock with taped joints if large areas are exposed.

Air Leaks In Building Components

	Area in sq. inches		Area in sq. inches		Area in sq. inches
Ceiling					
1. General (per 100 sq. ft.)	0.05	16. Pipe in wall	2	32. Mounted in wood wall:	
2. Dropped ceiling		17. Electric junction box		uncaulked	0.6
no plastic vapor barrier	78	gasketed	0.2	caulked	0.1
plastic vapor barrier	8	18. Polyethylene vapor		Vents	
3. Chimney framing :open	12	barrier - (deduct)	-30	33. Kitchen range hood:	
insulated	1	19. Foam sheathing (deduct)	-15	damper open or missing	9
4. Whole house fan		Doors		damper closed	2
louvers closed	8	20. Attic fold-down stairs	17	34. Clothes dryer:	
covered with tight box	0.6	weatherstripped	8	damper open or missing	4
5. Lighting fixtures		insulated cover	2	damper closed	1
recessed	4	21 Attic hatch	8	35. Bathroom fan:	
surface	0.3	weatherstripped	3	damper open or missing	3
6. Pipe or duct penetration		22. Sliding patio glass door	16	damper closed	1
uncaulked	1	23. Entrance door (plain)	8	36. Fireplace	
caulked at ceiling	0.2	weatherstripped	6	damper open or missing	54
7. Pocket door	5	magnetic weatherstrip	4	average fitting damper	9
8. Pipe or duct in wall	2	24. Airlock entry (deduct)	-4	tight damper	2
9. Recessed cabinet	0.8	25. Storm door (deduct)	-3	37. Fireplace insert	2
10. Electric junction box		Windows weatherstripped		Heating System	
ungasketed	0.2	26. Double hung	0.8	38. Ducts in unheated space	
gasketed	0.03	27. Horizontal slider	0.6	not taped or caulked	58
Interior Walls		28. Awning	0.2	taped or caulked	28
11. General per 100 sq.ft.	0.8	29. Casement	0.2	39. Oil furnace:	
12. Sill on masonry:		30. Fixed (picture windows)	0.2	flame retention burner	12
uncaulked	65	(For new windows, see		with vent damper	12
caulked	13	Manufacturers' Specs for		with both above	9
13. Band joist (box sill)		air leakage data for each		40. Gas water heater	8
uncaulked	65	Door & Window Frames			
caulked	13	31. Mounted in masonry wall			
14. Floor-wall joint	27	uncaulked	2		
baseboard caulked	7	caulked	0.4		
15. Duct in wall	9				

Adapted from D.T. Jarrje and G.J. Born, Cataloging Air Leakage Components in Houses, Princeton Univ 1984

Baseboards, Outlets, and the Kitchen Sink

Since the sheetrock or plaster may not extend all the way to the floor, baseboards on both interior and exterior walls are another important area to seal. Removing the baseboard and sealing the gap between the wallboard and floor with caulk or expanding foam is usually the best solution although care must be taken not to break it during removal. You also can seal both the top and bottom edges of the baseboard but you must seal the entire length. Experience with blower doors demonstrates that if only the visible cracks along the baseboard are sealed, air leaks simply find another pathway to the inside of the house and have to be "chased" along the baseboard with a caulk gun.

Installing foam gaskets behind outlet and switch plate covers on exterior walls has long been recommended. But to effectively block warm air from getting into hidden pathways, you need to install these gaskets on outlets and switch plates

on interior walls as well. In some cases you will need to use "childproofers" caps to stop air flowing through the receptacle itself.

The holes where sink drain pipes and supply pipes pass into floors and walls are another source of air leaks, because they invariably are cut larger than necessary (Figure 6). Complaints of frozen dishwashing soap in the winter are usually the result of air leakage beneath the sink. Use expanding foam or stuff fiberglass tightly in the opening to seal these holes. Getting access to the holes for bathtub or shower pipes and drains can be difficult, but sealing them usually is very effective. Be sure to locate and seal openings in the basement and attic where this plumbing extends.

One of the few places you may have to seal air leaks from the outside is underneath sections of the house that extend past the foundation walls. These

cantilevered areas allow air into the floor joists, which might connect with interior air leak pathways, such as plumbing chases. If these areas are uninsulated, remove the bottom board and fully insulate before replacing and caulking tightly.

Windows and Doors

Much has been written about weatherstripping doors and windows to keep winter drafts out of the house. As indicated above, such efforts may be very effective at reducing wind-driven air leakage, but they may not have a very significant effect on overall air leakage of homes unless they are located in areas strongly influenced by stack effect.

One area around windows and doors that can contribute to hidden air leakage is around the frames. The most effective way to seal these "rough openings" between the wall and the frame is to remove the trim molding and add a layer

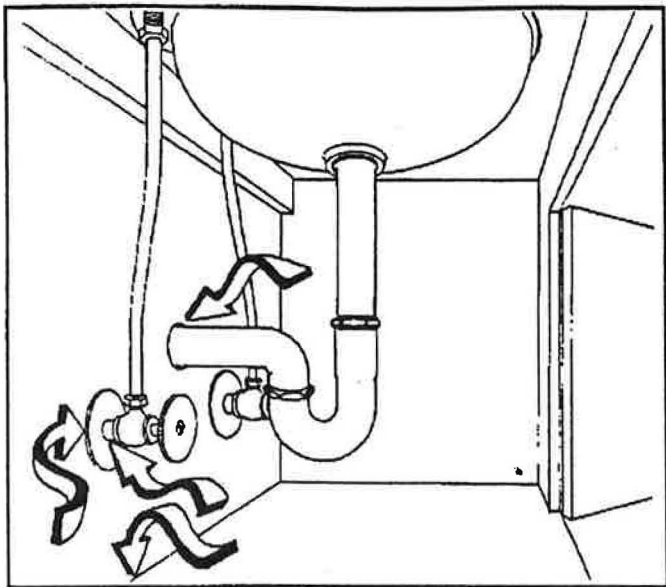


Figure 6. Repair broken plaster and caulk all trim plates.

of expanding foam into the space. Don't fill the opening with foam as it can easily expand and warp the frame, preventing the door or window from operating smoothly. Simply stuffing fiberglass scraps into the opening won't effectively stop much of the air passing through. A new product of tubular polyethylene foam, called "backer rod," can also be stuffed into the rough opening for effective air sealing. An alternative to removing the trim around the window or door is to caulk both edges of the trim to seal it.

Ghost Drafts

Sometimes you can feel drafts for which there are no corresponding holes. These

Prioritizing Air Sealing Efforts

- Heating duct repairs (supply and return ductwork in unheated space)
- Ceiling penetrations
- Furnace flue and fireplace damper work
- Floor air leakage sites
- Exterior door and window frames (rough openings)
- Interior door frames (rough openings)
- Ceiling cracks
- Plumbing and electrical penetrations
- Wall air leakage sites
- Wall cracks

From *House Tightening Manual for Homeowners and Weatherization Contractors*, Bonneville Power Administration, U.S. Department of Energy, 1986.

"ghost drafts" are often caused by air convection currents coming off single pane windows or breaks in insulation. Another cause of ghost drafts is a floor or interior wall that is open to the outside on only one end. No stack effect occurs but cold surfaces next to the cavity may cause convection currents in the room. These ghost drafts will be especially noticeable on windy days.

Fix the Big Leaks First

Remember that fixing the air leaks from the inside of the house in the areas of greatest pressure difference — leaks near foundation and upstairs ceiling areas — is the top priority. Sealing those leaks before undertaking the standard weatherstripping and caulking measures for your home will result in the greatest energy and cost savings and comfort.

In some areas of the country companies offer blower door air sealing services to effectively identify and seal air leaks.

Experienced contractors know where to look for the hidden air leaks and have developed many effective techniques for sealing them. These firms will provide a printout of the before and after air leakage characteristics of your home. Although the price may seem high, the resulting energy savings can easily pay back your investment in a year or two.

From: *Finding and Fixing Hidden Air Leaks*, by D. Brook; Oregon State University Extension Service, Bulletin EC 1286, February 1990

GARBAGE

(Continued from page 1)

equipment for the purpose of waste reduction, recycling, treatment or disposal.

HB 478 provides grants of up to \$50,000 for solid waste management planning and technical assistance, so that communities can explore waste reduction and recycling when planning for their solid waste needs in the future. It also ensures that communities and industrial solid waste facility operators begin to focus on waste reduction and recycling, by requiring that these options be considered as part of the permitting process.

HB 532 requires the placement of coding on all plastic bottles sold in the state. Coding plastics by the type of resin used to make them allows them to be more easily and inexpensively sorted and recycled.

Representative Fran Ulmer, from Juneau, has been a key proponent of these pieces of legislation, and believes that their passage will have a positive impact on residents of Alaska. Combined with efforts undertaken in each community they will "move us toward a day when recycling and waste reduction will be a way of life for all of us."

Recycling efforts are under way in communities around the state. Anchorage has a state-of-the-art recycling center. Petersburg, Wrangell and Ketchikan are cooperating to find an effective approach to dealing with their solid waste, and communities in Bristol Bay and southwest Alaska are also working on a regional approach. In Juneau, a new recycling business is opening and the city is funding a new solid waste plan, a small recycling pilot project, and a recycling coordinator.

For information on how your community can begin to explore waste reduction and recycling, contact ALPAR (Alaskans For Prevention of Litter and Recycling) 272-9326. ALPAR is involved in recycling and litter cleanup programs in 84 communities in Alaska and the Yukon.

Order?