



ATTIC AIR LEAKS & ICE DAMS

Minnesota Department of Commerce Energy Information Center

Ice dams on a roof can lead to damage of roofing, insulation, and interiors of homes. They are an obvious symptom of a common problem: attic air leaks. Although sufficient insulation and attic ventilation are important, neither is a solution to the problems caused by attic air leaks. Sealing air leaks is the most effective way to avoid ice dams—and save energy in the bargain.

How to locate attic air leaks

Common air leaks and how to fix them

Attic air leaks are hidden air passageways that lead from the heated space into the attic. Because warm air rises, it is continuously moving up through these passageways and escaping into the attic during cold weather. (Figure 1) Even though attic air should be cold, attic air leaks make it a semi-heated space, which is a waste of energy and the primary source of ice dams.

Although often thought of as a problem with roofing materials or attic ventilation, ice dams are actually caused by the presence of warm, moist air in the attic, combined with snowpack on the roof and the right weather conditions. Ice dams occur when heat gets into the attic and melts the underside of the snow on the roof. The melted snow then flows down the roof, underneath the top layers of snow, until it reaches a cold spot such as the eaves, where it freezes, forming a dam, behind which more snowmelt and ice build up. The ice build-up can back up under the shingles, damaging them, and allowing water to leak down to the ceilings and walls below. (Figure 2)

Attic air leaks also contribute to damage to insulation and other building components. Water vapor carried with the escaping warm air may condense, freeze, and build up in the insulation. When this water builds up, it can soak the insulation (wet insulation has almost no insulating value), cause plaster and paint to crack and peel, and lead to rot and other structural damage. When moisture problems appear in the attic (even after it has been insulated) attic air leaks are often the cause.

Adding insulation or increasing roof ventilation will not solve the problems of ice dams or excess moisture in the attic. In fact in some situations, it may actually make things worse. To avoid these types of problems and to receive full benefit from your insulation, you need to plug up your attic air leaks. But before sealing them, you have to find them. Most of the major air leaks are in the common areas described in this pamphlet. In addition, a comprehensive energy audit (including a blower door test) can indicate the presence of air leaks; an infrared scan can pinpoint exact locations. Most insulation contractors are also qualified to do attic air sealing should you choose to not do the work yourself. Regardless, knowing how to find and remedy attic air leaks is important, whether you do the work or hire it done.



- Related Guides:
- Basement Insulation
 - Home Insulation
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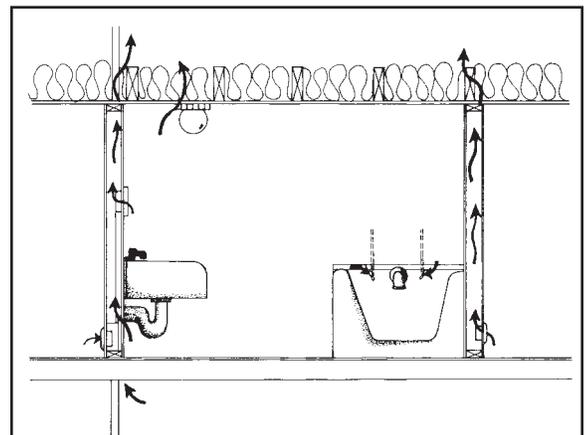


Figure 1
Warm air moves up hidden passageways, through cracks and leaks, then through the insulation into the attic.

Looking for air leaks

Before you climb into the attic, it is a good idea to wear protective clothing. Handling insulation can temporarily irritate the skin, so keep your shirt sleeves rolled down. Wear gloves, goggles and a facemask rated for the insulation you will be working around. If your attic contains vermiculite, do not disturb the insulation because it contains asbestos. (See sidebar below).

To look for air leaks, you may have to lift up your existing attic insulation and/or some floorboards. Signs to look for are wet insulation, dirty insulation, dust build-up underneath the insulation, water staining under the insulation, frost build-up on roofing nails, water staining on roof boards, and places below where you have had ice dam and moisture condensation problems. Another thing to look for on cold days is a patch of frost on top of the insulation. Finding any of these signs doesn't necessarily mean there is a air leak below, but they are good indicators.

Some common air leaks and how to fix them

Chimney chaseway. For fire safety reasons, a clearance of two inches must be maintained between the chimney and any combustible materials, including the wood framing. But a draft stop can be built by cutting a piece of 24 gauge or thinner sheet metal to fit tightly to the chimney and the framing. (IMPORTANT: This is a draft stop only. Do not put insulation on top of it. Insulation must still be kept at least two inches away from the chimney.)

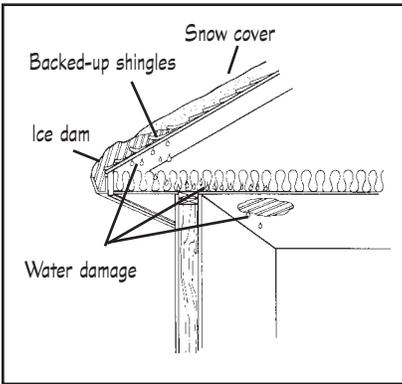


Figure 2

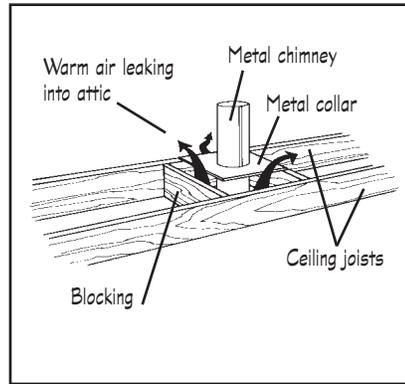


Figure 3

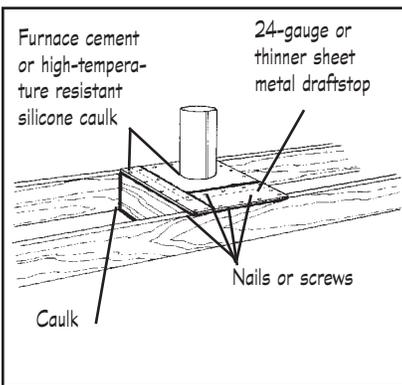


Figure 4

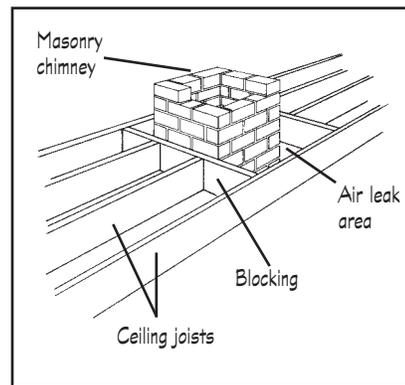


Figure 5

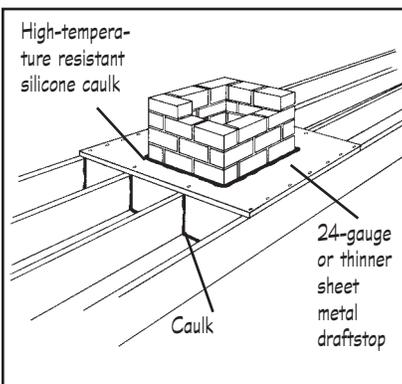


Figure 6

Consumer Alert: Vermiculite Insulation

The federal Environmental Protection Agency has issued a warning about vermiculite insulation because the product contains asbestos fibers. Disturbing the vermiculite has the potential to release the fibers in the air. If the fibers are inhaled, they may cause serious diseases such as lung cancer.

Vermiculite is a lightweight mineral that is shaped like a small nugget or granular and varies in color from silver-gold to gray-brown. It was commonly used as loose fill insulation in attics and walls of many homes built before 1990.

Because fixing attic air leaks usually means removing portions of the existing insulation, if you have vermiculite insulation you need to remove

it prior to fixing the air leaks. A licensed and trained professional must do the removal. The alternative is to not fix the air leaks and leave the vermiculite insulation in place.

For more information:

- U.S. Environmental Protection Web Site (www.epa.gov/asbestos/insulation.html)
- Minnesota Department of Health Web Site (www.health.state.mn.us)
- A list of licensed asbestos contractors is available from the Minnesota Department of Health (651-215-0900)
- Minnesota Department of Commerce Energy Information Center (See left margin for contact information)

Newer homes usually have metal chimneys. (Figure 3) The chimney should have a metal collar where it penetrates the ceiling. As the illustration shows, the collar may be loose or may not cover the entire opening in the ceiling. To repair, add new sheet metal if necessary, and then use screws and fire-stop “red” caulk to seal the sheet metal to the framing. Do not use other types of caulk. They may not withstand the temperatures next to the chimney. Also caulk the corners of the wood blocking so you have an airtight box below the sheet metal. (Figure 4)

Older houses often have an open gap between a brick chimney and the wood joints. (Figure 5) You can fix this opening in the same way as with a metal chimney. Cut the sheet metal into two halves to fit the chimney and then seal it in place the same way as with a metal chimney. (Figure 6)

The Energy Information Center does not recommend using tightly packed fiberglass insulation to stop this air leak because it could come loose over time and because the fiberglass could transfer too much heat to the framing, posing a possible fire hazard. Gypsum board should also not be used as a draft stop around the chimney because its paper backing poses a potential fire hazard. Stick with narrow gauge (thin) sheet metal.

Tops of interior walls. The tops of interior walls are easy to inspect if the attic is unfinished and uninsulated. If it is not, you will have to pull up some floorboard and move the insulation. As mentioned before, a sketch of the room layout will help you find the tops of interior walls. In almost all older homes, the walls were built before the ceiling, so the area above the wall is not plastered. Figure 7a and 7b show air flow from gaps at the top of the wall. Flexible long-life caulk can be used to seal the smaller gaps and holes. (Figure 8) Larger gaps can be filled with expanding foam sealant, or sealed with strips of wood or rigid board insulation caulked or foamed in place.

A few older homes have completely open tops of walls. Wood, plywood, rigid board insulation, or gypsum board can be cut to fit over these openings and then caulked into place.

Plumbing and electrical penetrations. Electrical wires are often run up walls, into the attic, and

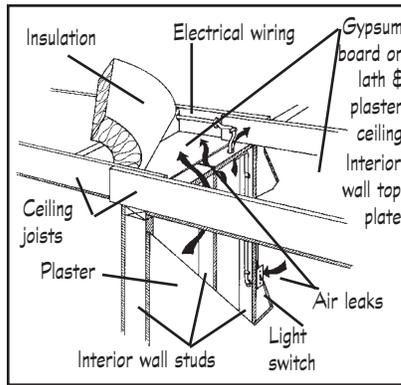


Figure 7a

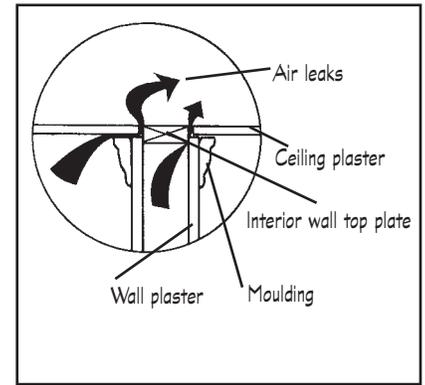


Figure 7b

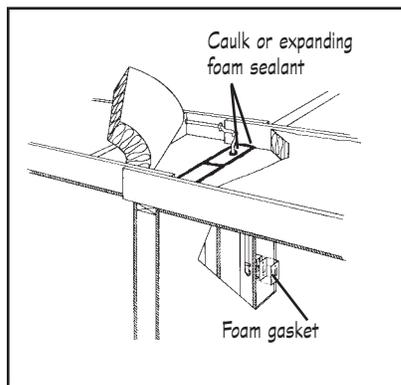


Figure 8

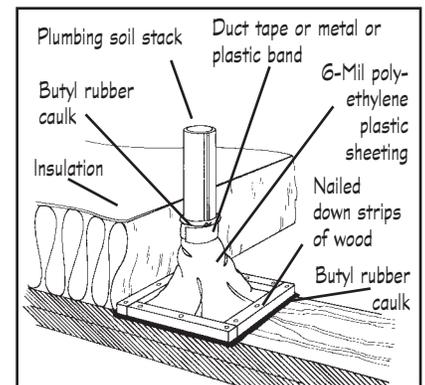


Figure 9

then down to provide power to ceiling fixtures and electric outlets. These penetrations can be sealed with expanding foam sealant where they enter the attic and where they leave the attic. With a ceiling light fixture, you need to seal the junction box above the fixture. This is covered in the section on lighting fixtures.

The most common plumbing penetration into attics is the soil or vent stack, the large pipe that runs from the drain plumbing through the roof. This is usually one of the major leaks into the attic and should receive priority sealing. Special care needs to be taken in sealing this air leak. This is because wide temperature swings, plus wind pressure can cause the pipe to move in relation to the rest of the house. Therefore, you need to provide some flexibility to allow for this movement so that the seal will not be broken. To do this, use 6-mil polyethylene plastic sheeting to make a collar around the stack. (Figure 9) Gather the collar a couple of inches to accommodate the pipe’s movement. Attach the bottom of the collar

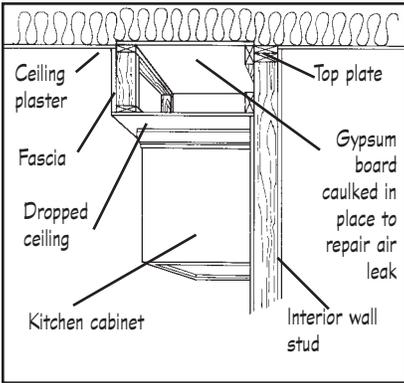


Figure 10

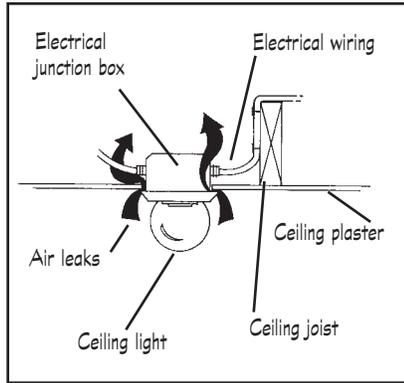


Figure 11

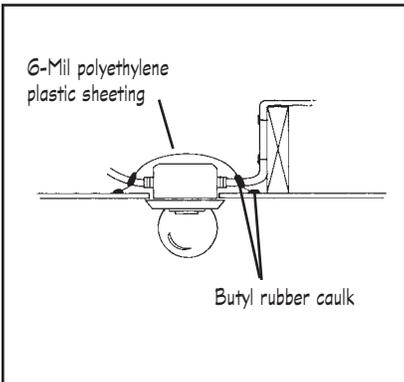


Figure 12

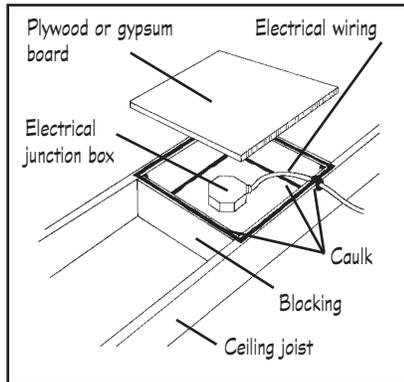


Figure 13

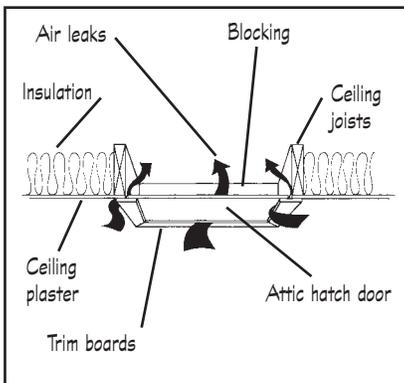


Figure 14

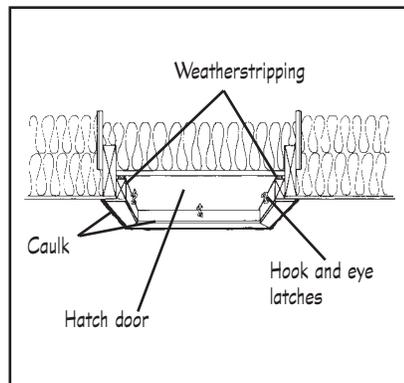


Figure 15

to the top of the plaster or framing with butyl rubber caulk and secure it there with staples or strips of wood and nails. Attach the top of the collar to the soil stack with a good heavy bead of butyl rubber caulk and secure by wrapping duct tape or a metal or plastic band around the plastic and the soil stack. To seal the seam of the collar, lay on a good bead of butyl rubber caulk, fold over the seam a couple of times, and then use small spring binder clips (those black triangular paper clips) to secure the seam.

In addition, you should wrap the soil stack in insulation all the way from the attic floor to the roof. This will prevent the moisture in the gases venting out of the stack from condensing and freezing in very cold weather, which could possibly block the vent and cause sewer gases to back up into the house.

Dropped ceilings. Kitchens, bathrooms and other areas of the home often have sections of ceiling that are lower than the ceiling in the rest of the house. These areas often are above kitchen cabinets, bathtubs and places like linen closets. One common type dropped ceiling is the slanted ceiling above stairwells. These dropped ceilings are an air leakage problem area because the house builder often did not continue the gypsum board or plaster to the top of the wall above the dropped ceiling. This allows warm air to move up the walls into the dropped area, and out the opening above the dropped ceiling.

To repair these air leaks, cut a piece of gypsum board to fit over the area above the dropped ceiling and nail and caulk it in place to the ceiling joists. (Figure 10) Do not use polyethylene plastic sheeting or other such material because it may not support the weight of the insulation placed on it for long periods of time.

Ceiling light fixtures. Before sealing these air leaks, check the wiring in the attic. Insulating over some older electrical cables might cause a heat build-up that will lead to deterioration of the cable wrapping and pose a fire hazard. If there is any noticeable deterioration, or if the wiring is very old (such as the old knob and tube wiring with two thick cables strung across porcelain insulators), you should have a qualified electrician replace it.

In a surface mounted fixture, the light bulb is below the ceiling. Since the fixture is not airtight, there is an air leak through and around the electrical wiring box above the fixture. (Figure 11) There are several ways to seal this air leak. The simplest (although most expensive and difficult to remove if you ever want to run another electrical line off that fixture) is to use a can of expandable spray foam sealant and provide a thin cover over and around the box. If the working surface is flat (i.e., a gypsum board ceiling), you can cut a piece of polyethylene plastic sheeting to cover the junction box and attach it to the ceiling with butyl rubber caulk. Cut small slits for the wires to pass through and then seal these holes with caulk.

(Figure 12) If the work surface is very uneven (i.e., some lath and plaster ceilings), it may be difficult to get a good seal at the ceiling level. In these cases, you can build a box around the electric fixture. (Figure 13) Cut wood blocking to fit between the ceiling joists to make the sides of the box. Notch the wood just enough to allow the electrical cables to come in. Then cut a top to the box out of plywood. Seal all the cracks and holes of the new box with flexible, long-life caulk. If you are adding a new fixture, use an airtight electrical box.

In a recessed light fixture, the bulb is above the ceiling in a metal box. Besides being a large air leak area, many types of recessed lights (especially older ones) can be a fire hazard in insulated ceilings. If covered with insulation, the light bulb heat can build up to a point where nearby combustible material may catch fire. As a result, the Energy Information Center recommends that recessed lights at the attic level be removed and replaced with either surface mounted fixtures or with new recessed light fixtures that are specifically rated for placement within insulation. If this is not feasible, it is sometimes possible to build an enclosure over the fixture and caulk this enclosure to the ceiling for an airtight seal. However, the size of the enclosure (it might have to be as big as nine cubic feet), and the amount of ventilation the fixture will require will depend on the size and type of fixture, the size and type of lamp, and the location of the light. You should not attempt building an enclosure over recessed lights without first having them thoroughly checked by the electrical inspector in your jurisdiction. This is essential because recessed lights in improper con-

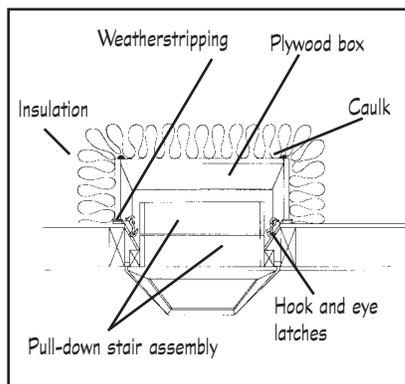


Figure 16

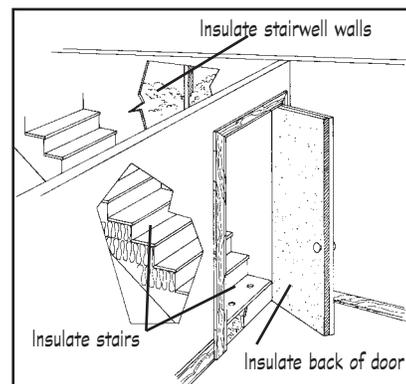


Figure 17

tact or close proximity to combustible materials can cause house fires.

CAUTION: Whenever you are working with lighting fixtures, be sure the electricity to them is shut off at the fuse box or circuit breaker.

Attic Entry. If your access to the attic is through a simple hatch, repairing this major air leak is easy. (Figure 14) To fix it, install weatherstripping to the edges of the opening where the door sets. Then install eye hooks to the underside of the hatch to pull the hatch down and compress the weatherstripping for a tight seal. (Figure 15) Also, caulk where the trim meets the ceiling. Don't forget to insulate the top of the hatch. Do this by cutting a piece of faced fiberglass batt to fit snugly within the blocking and staple the facing paper to the hatch door. Or you can glue rigid board insulation to the top of the door.

If the access to your attic is through a stairway or pull-down stairs, sealing the air leak is more difficult. With pull-down stairs, the best solution is to build an airtight plywood box that will fit over the stair assembly. (Figure 16) Caulk all the seams of the box and use weatherstripping and eye hooks to hold it tightly in place. You should then insulate over the box in the same way as described for hatch doors.

If there is a fixed stairway and the entry door is at the bottom of the stairs, you have two basic options. One is to build a trap door at the top and seal and insulate it as you would an attic hatch. The second is to weatherstrip the existing door and attach insulation to the back of it. If you choose

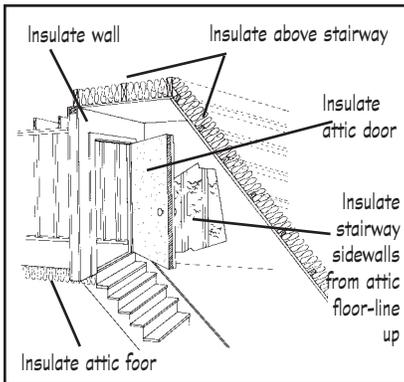


Figure 18

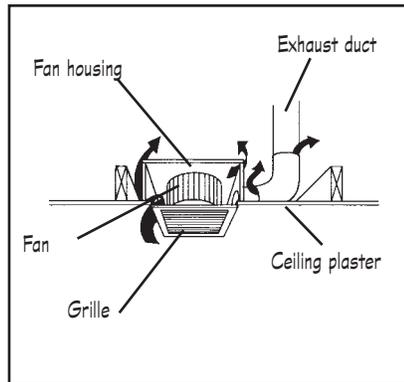


Figure 19

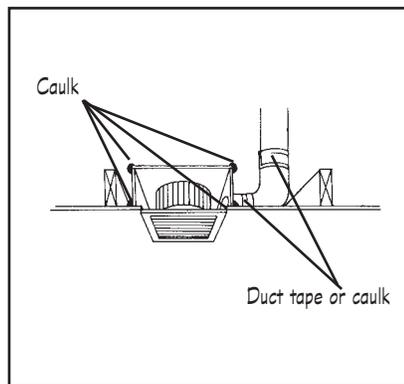


Figure 20

Fan mounted to ceiling below attic: The metal box that encloses an exhaust fan is usually not airtight, and there is usually a gap between the box and ceiling. (Figure 19) To repair, use metal duct tape or caulk to seal gaps in the metal box and between joints and seams in the duct. Caulk the enclosure to the ceiling and framing. (Figure 20)

Exhaust fans should have a flap valve in the fan box as well as at the outdoor outlet of the duct to prevent moist air from drifting up and freezing at the outlet. Check the valves in all exhaust fans and the clothes dryer. Dust, lint and grease build-up, or a sticking hinge, may prevent the valve from closing completely. Clean and adjust the valves to correct this problem.

Fan located on wall or non-attic ceiling: The point where the fan penetrates the wall or first floor ceiling should be sealed as well as possible to prevent warm air from filtering into the walls. If the exhaust fan ducting exits the warm living area of the house into the attic, seal the penetration with a rigid insulation board, plywood or gypsum board collar caulked into place. Be sure to seal any seams in the ducting with metal duct tape to prevent warm air from leaking into the attic.

this second option, be sure the steps and walls are insulated and airtight. Then insulate the stairway walls and under the steps and risers. (Figure 17)

If the door is at the top of the stairway, insulate the back of the door, any wall space around the door, the stairway sidewalls (from the attic floor-line up) and above the stairwell. (Figure 18) Be sure to seal all cracks and weatherstrip.

Whole house cooling fans. A whole house cooling fan can provide comfort and energy savings in the summer, but needs to be sealed up in the winter to prevent it from being a major source of warm air leaks into the attic. To seal, build a box or cap the same way as described for pull down stairs and place it over the top of the fan.

Kitchen and bath exhaust fans. Kitchen and bath exhaust fans must be vented to the outside, not into the attic. If they are presently vented into the attic, you need to extend the ducting to the outside through the roof or soffit, to avoid water damage to the attic. Once you are sure fans are properly vented, you can fix the air leaks around them.

With any ducting going through the attic, you need to insulate around the duct to prevent moisture from freezing inside the duct and blocking it.

Knee walls. Many of the older houses in Minnesota are story-and-a-half houses, where the second floor is essentially a finished attic with slanting ceilings and knee walls. Knee walls are the short walls between the ceiling and the floor.

Knee wall construction often means major air leaks, leading to ineffective insulation and often leading to ice dams. These air leaks are a very important area to fix. Unfortunately, it is usually not an easy job.

Story-and-a-half houses are plagued by air leak problems because warm air moves through the second floor joist cavities—the open spaces between the first floor ceiling and the second floor flooring. (Figure 21) Because these open joist cavities extend beyond the knee wall, the warm air moves underneath the knee wall and reaches the cold space behind the knee wall. Besides being a big energy loss area, this situation often

results in moisture condensation leading to wet insulation, water damaged paint and plaster, dry rot, and ice dams at the eaves.

Depending on the characteristics of the house, there are a number of ways to approach this problem:

Situation 1. The area behind the knee wall is accessible through a door, and there is subflooring behind the wall. To address this area, you will have to cut and pull up the subflooring just behind the knee wall. Then cut pieces of gypsum board or rigid board insulation for blocking to fit snugly between the floor joists below the knee wall. (Figure 22a and 22b) Fit the blocking in place and then caulk all four edges for tight seal. The top edge is easier to caulk if the blocking is not pushed all the way under the knee wall. Then, if the area has not been insulated, you can blow in insulation under the floor boards in the area behind the knee walls. Be sure to weatherstrip and latch the access door so that warm air won't filter into the cold space.

Situation 2. There is no access to the area behind the knee wall. There are three ways to approach this problem. One is to remove the floorboards and subflooring on the interior (warm) side of the knee wall and install the blocking in the same way as described in situation 1. Before installing the blocking, insulate under the floorboards on the cold side of the knee wall.

The second way, which is preferable because you can insulate the back of the knee wall, is to cut an access through the knee wall and then fix the air leaks and insulate as described in situation 1. Then either install an access door or repair the wall after making the repairs and insulating. If you put in an access door, be sure to weatherstrip and insulate it.

The third way to get at the previously inaccessible area behind the knee wall is to come through the roof. This is a feasible alternative if you are putting in roof vents for attic ventilation, but should be attempted only by very skilled do-it-yourselfers or professionals. After you have cut the hole for the vent to go in, there should be enough room for an average sized person to drop in and repair the air leaks as described in situation , and to insulate the area. Be sure you have a utility

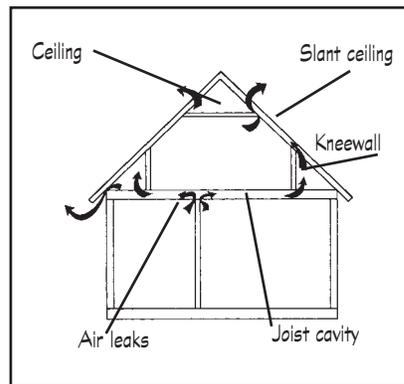


Figure 21

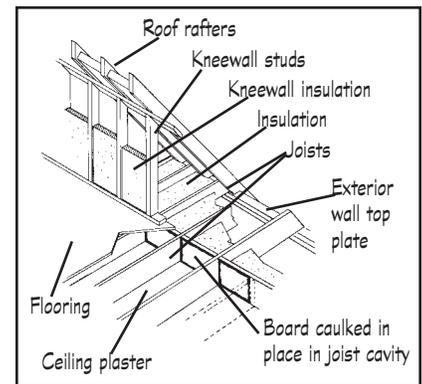


Figure 22a

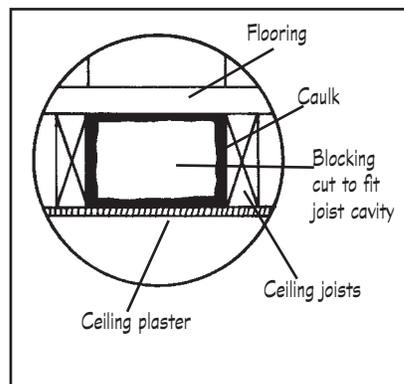


Figure 22b

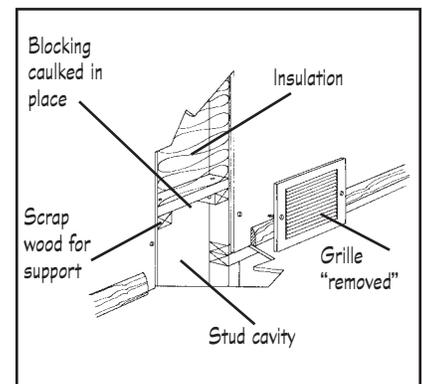


Figure 23

light and someone to help you.

Whenever you enter an inaccessible knee wall area to repair air leaks, be sure to put in any insulation you want to add. For more information on this and on ventilating the attic with roof vents, see the Home Energy Guide on insulation.

Attic with a floor. If the attic has an installed floor, sealing the air leaks requires one of two methods. One option is to pry up the floorboards and seal around any penetrations into the attic space using the methods described elsewhere in this guide. It is important not to miss locations such as the tops of walls or where wiring may enter the space above the ceiling and below the attic floor.

A much easier approach is to simply treat the floor joist space as if it were a wall and fill it with insulation using the "Dense Pack" method. Using either mineral wool or cellulose, an insulation contractor can 'pack' the insulation into the space at a sufficient density to act as both insulation and an air barrier (4 lbs/cu ft for cellulose and 7 lbs/cu ft

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This information will be made available, upon request, in alternative formats such as large print, Braille, cassette tape, CD-ROM.

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for mineral wool). Additional insulation can then be added on top of the flooring as needed.

Heating ducts. If you have heating ducts that go through the attic, seal around them where they enter and leave the ceiling level. Be sure to seal all the seams and joints with metal duct tape. For a longer lasting seal, you can caulk all the seams with a long life flexible caulk. Make sure they are well insulated (we recommend R-19), so that the warm air they are carrying doesn't cool off going through the cold attic.

Ceiling/exterior wall junction. Exterior walls are less of a air leak problem than interior walls if they are insulated. When exterior walls are filled with cellulose or loose, short-fiber fiberglass blown in at high pressure and density, air flow up the wall will be greatly reduced.

The rule of thumb with this area is to seal it wherever you can, but realize that in a lot of homes there are many areas that can't be reached without taking off roof boards. (If you plan to re-roof, it may be a good time to take off the first few roof boards and repair the air leaks from above.)

A common problem in this area is not being able to get enough insulation into the small area. This often causes cold spots and condensation, especially in corners near the ceiling. Whenever possible, cut pieces of high R-value rigid board insulation to fit, and caulk them into the top plate area. This will stop any air movement and improve the insulating value.

One area that needs special attention is above the cold air returns in exterior wall stud cavities. To solve this problem, remove the cold air return grill on the second floor (or first floor if a one-story house; third floor if a three-story house). Then nail some scrap 2x4 lumber into the studs so that you can put in a piece of gypsum board or wood cut to fit the stud cavity at a point just above the register. (Figure 23) Lay the cut piece of wood on top of the scrap lumber blocking and then caulk the perimeter. You can now blow insulation into the stud cavity used as a cold air return at least down to the uppermost part of the air grill.

Other things you can do to prevent air leaks in this area are to seal any penetrations that may be coming up exterior walls, such as plumbing or electrical penetrations, and to fix any cracks in the ceiling/wall juncture inside the house. If there is wood molding at the ceiling/wall junction, caulk the top and bottom sides of it, and the cracks where trim pieces meet. Often when molding was used, the builders did not plaster or drywall behind the molding, leaving a gap through which air can escape. Clear or color-matched caulks are available for areas like this where aesthetics are important.

Conclusion

If you have just read through this whole brochure, your reaction is probably, "What a lot of work!" Well, you're right. But it is extremely important to get your attic air leaks sealed if you want your insulation to really work well, and to protect your house from moisture damage. The air leaks presented in this guide are just the common ones. There are many more individualized situations that are present in the wide variety of houses in the state. It's more than likely that you have at least one problem that is not addressed here. But the basic principles of sealing air leaks should help you solve these problems.

Fortunately, the materials required for fixing any of these air leaks are very inexpensive. Although it is work that requires a lot of attention to detail, it can be easily accomplished if you are willing to navigate your attic. If not, most insulation contractors are qualified to do attic air sealing. In fact it should be part of every insulation job, so be sure to ask.

To determine whether air leaks are a problem in your home, a comprehensive energy audit (or home performance review) can help determine air leakage rates and pinpoint potential locations for air leaks. Get one that includes a blower door test and ask if an infrared scan is available. Energy audits are available from utility providers or through the non-profit organization Minnesota Building Performance Association (mbpa.us).