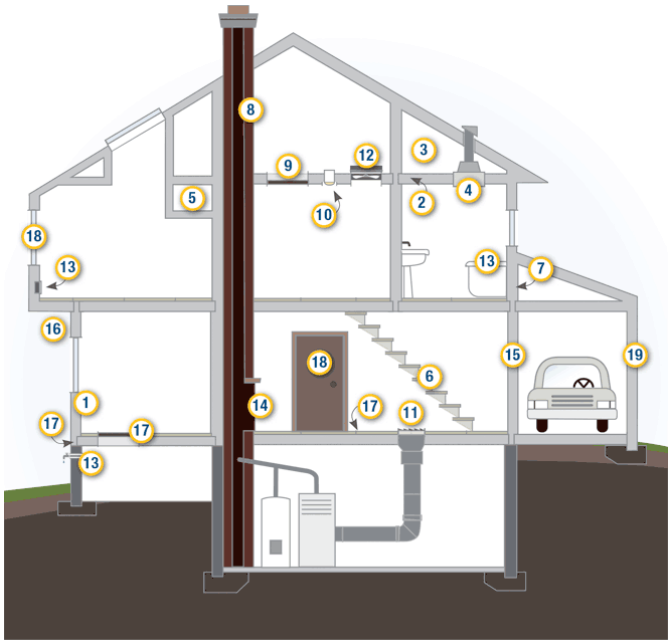
E3A: Energy Management for Home

Sarah Hamlen, Mike Vogel and Milton Geiger eds. E3A Program

AIR SEALING

To keep heating costs down during cold Montana winters, it helps to seal cracks and unwanted openings in your house to prevent air infiltration – unwanted drafts that displace precious heat. Warm air will naturally move to a cooler space. So if your house is not well sealed, your heat – and your heating costs – will escape to the cold outdoors. As the warm air escapes, cold outside air is also pulled in through cracks around the foundation and near doors, windows and other openings to replace the lost heated air.



Air Sealing Trouble Spots

1. Air Barrier and Thermal Barrier Alignment
2. Attic Air Sealing
3. Attic Kneewalls
4. Shaft for Piping or Ducts
5. Dropped Ceiling/Soffit
6. Staircase Framing at Exterior Wall
7. Porch Roof
8. Flue or Chimney Shaft
9. Attic Access
10. Recessed Lighting
11. Ducts
12. Whole-House Fan
13. Exterior Wall Penetrations
14. Fireplace Wall
15. Garage/Living Space Walls
16. Cantilevered Floor
17. Rim Joists, Sill Plate, Foundation, Floor
18. Windows & Doors
19. Common Walls Between Attached Dwelling Units

Source: U.S. Department of Energy
http://energy.gov/energysaver/air-sealing-your-home

Since warm air also rises, cracks and openings in the ceiling are of major concern. This air movement pattern is called the stack effect. Poorly sealed houses act like giant chimneys, and the greater the temperature difference between outside and inside, the faster your heat moves up and out. Winter winds also speed the process. You can reduce this great heat escape by tightening up your house. Before you begin, though, be sure to first correct any moisture or indoor air quality problems in your house, because air-sealing could make them worse. It's also very important to make sure all combustion appliances such as furnaces and water heaters are working right and are properly vented. Read the Home Energy Efficiency Fact Sheets on condensation control, indoor air quality, gas appliances, and carbon monoxide for more information.

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Blower Door Tests

If you're eligible for weatherization assistance, you may be able to arrange to have your house air-sealed and insulated. To assure that your house is not too tight, the work will likely start with a blower door test to help find the air leaks and determine the tightness of your house. The blower door is primarily a large fan that pulls air out of your house. As it draws air out, a technician can accurately measure air tightness and locate air leaks throughout the house.

You can conduct your own air leak test on a windy day using your hand. Dampen your hand and hold it around closed windows, doors and other suspect places. A slight leak will make your hand feel very cool.

"Blower Door" by Ket555 - Own work. Licensed under CC BY-SA 4.0 via Commons - https://commons.wikimedia.org/wiki/File:Blower_Door.png#/media/File:Blower_Door.png

Caulk, Foam and Weatherstripping: Basic Air-sealing Materials

How efficiently you are able to seal air leaks depends on the size and location of the openings and in choosing the right material for the job. For a quick and cheap fix, you can plug larger holes with pieces of drywall or cardboard. Or, stuff the holes with plastic bags filled with glass fiber insulation scraps. For small holes, cracks, and openings, caulking and sealants are the most common solution.

Caulk is a semi-solid, toothpaste-like substance you apply into gaps of up to 3/8-inch where different building materials meet, such as along a wall and the foundation. Hardware and building supply stores carry many varieties of caulk. Most often, caulking comes in tubes either applied by using a caulking gun or squeezed by hand. Caulk is also available in rope form, applied with your fingers. For sealing cracks and holes in a climate like Montana, select a quality product that seals well in temperatures below 0°F and in the heat of summer.

Ask a store salesperson for help in choosing the right caulk for the job and carefully follow the product directions. You'll need different types of caulk for different surfaces on the inside and outside of your house. Some caulk is waterproof, some not; some can be painted, some not. Higher-end caulk seals better, lasts longer, and isn't much more expensive than the bargain varieties. With caulking, you get what you pay for. Air-sealing is one area in which you don't want to scrimp on materials, because a poorly sealed crack is still a crack!

Foam sealants are commonly used to fill larger gaps of up to one inch. Once applied, they expand to fill and seal the space and, like caulk, they harden as they dry. The two most common types are urethane and latex foam, both of which are available in cans at hardware and building supply stores. Latex foam cleans up easier and often comes with a reusable applicator so you don't have to finish a whole can at once. Urethane foam can be difficult to remove from hands and clothes, and most applicators are not reusable.

Weatherstripping eliminates gaps between movable parts when they are closed – around the perimeters of exterior doors and operable windows, for example. Replaced weatherstripping can be made of metal, foam, rubber, vinyl or felt and is often sold by the foot, or in pre-packaged window/door kits. If possible, always try to match the product that originally came with the door or windows – the finished result will look its best and likely be the most effective. Again, ask a store salesperson for help in selecting the right product for your job. Some materials are nailed or tacked on; others are applied with self adhesive tape. Well-installed weatherstripping will be slightly compressed when doors and windows are closed.

Start at the Top!

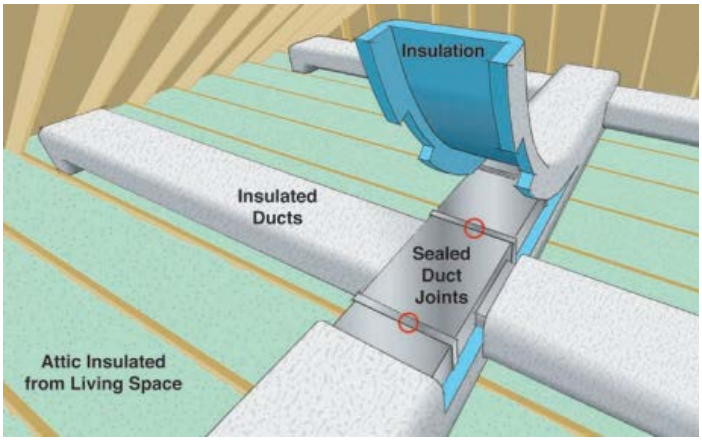
Start by closing gaps between your roof or attic and the living space below. Attention to this area will save the most on your heating bill. Every opening in the attic floor is a potential heat escape route. Check around electrical wires, light fixtures, chimneys, stove flues, ductwork and plumbing vent pipes. Also check along the tops of walls. To walk around up there, lay boards on top of the joists, because the ceiling won't support your weight. Wear a dust mask and don gloves if you have to roll insulation back to look for leaks. Dirty spots on your insulation will generally indicate an air leak.

In some old homes, partition walls from below open into the attic space. These large openings are best sealed by stuffing plastic bags filled with glass fiber insulation. Chimneys and stove flues require special attention. Be sure to use heat-resistant caulk for small gaps and add a sheet metal collar to seal larger openings. Treat the attic hatch as an outside door and apply weatherstripping around it.

Examine, Seal and Insulate Ductwork

If you have a forced air heating system, it pays to seek out leaks in both the supply and return ducts in attics or crawl spaces. Make sure all the pieces are properly connected, with the furnace fan operating, run your hand over the duct seams/joints to feel for air leaks. Holes in supply ducts will blow air out, and gaps in return ducts will suck air in (tissue will stick to the hole). Plug any leaks you find with foil tape (not duct tape), or better yet, use water-based mastic applied to the duct seam.

Once the leaks are fixed, you can save even more by insulating the ducts located in unheated areas with foil-faced glass fiber duct insulation. Just wrap the insulation around the duct and tie or tape it into place.



Source: U.S. Department of Energy
http://energy.gov/sites/prod/files/2014/09/f18/61628_BK_EERE-EnergySavers_w150.pdf

Tackle the Low Spots

Now you're ready to seal up those places where cold air can get in – around window and door frames and between your living space and unheated basement or crawl space. You can use the same methods and materials as you did up in the attic: weatherstripping around doors and operable windows and plugging gaps with caulk, foam or drywall. Again, make sure to use heat resistant products around chimneys and stove flues.

You can also buy inexpensive foam gaskets that fit behind electrical outlet and light switch cover plates. If you have a fireplace, be sure the damper is closed when you're not using it, and seal it up tighter if you don't use it much.

Provide Combustion Air

All combustion appliances, such as gas furnaces, water heaters and ranges, need fresh air to operate properly, and cutting off that air supply could cause carbon monoxide and other dangerous gases to build up inside. Combustion air should be sized properly and come from the outside. Contact a heating contractor for assistance in determining if your appliances are receiving adequate outside combustion air.

Air-Sealing Brings Many Benefits

No matter who does the work, you or a contractor, the time and money spent on air-sealing will provide many returns, especially when coupled with attic, wall and floor insulation. Read the four Power Bill insulation brochures for more information on that step. Making your home energy-efficient will not only lower your heating bills, but also keep your home cooler in the summer and cleaner because less dust will blow in. Now that's an added bonus anyone can appreciate!

Notes

Notes

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COOLING YOUR HOME

Montana summer days are usually just right, but we do get a few "cookers" from time to time. Fortunately, you can beat the heat without spending much money or using much energy. These low-cost/no-cost strategies are sure to please!

Weatherization

Sealing air passages and insulating your home may not seem like cooling strategies, but they are. The same weatherization methods that keep heat in during winter keep it out during summer. Attic insulation, especially, provides strong protection from the hot sun beating down on your roof each day. Attic ventilation is important, too. Make sure you have both eave and ridge vents. Together, they provide a pathway for heat to rise up and out. Look for the Home Energy Management Fact Sheets on insulation and air-sealing for further details.

Ventilation

Here in Montana, we can pretty much count on enjoying a refreshing, cool breeze in the early mornings and late evenings. To make the most of these cooler times, open windows and doors on opposite sides of your house to let the breeze flow through. Openings at the highest and lowest points (such as a front door and a back upstairs window) are particularly good natural ventilators. Don't leave your house open all day though. Once the morning coolness is gone, close it up until evening.

Use fans if needed to create even more air flow through your house during these cooler periods. Whole-house fans mounted in the attic work best. They pull warm air out of your living space through ceiling vents and blow it outside through the attic vents. Other options include ceiling-mounted paddle fans and portable box fans. A box fan mounted in an upstairs window will also blow warm air outside, prompting more cool air flow into main-floor windows and doors.

Window Shading

Houses warm up fast with direct sunlight pouring through the windows. We welcome it in winter, but during summer it's best to keep the sunshine out. Start in the morning by leaving east-side curtains or shades pulled until the sun climbs higher in the sky. Later on, shade south and west-facing windows to block that hot sun throughout the day. The most effective interior sun blocks are curtains and shades with light colors facing outside. Light colors reflect, rather than absorb, the heat. You can also buy special solar screens made of densely woven fiberglass or aluminum. They block out up to 75 percent of sunlight. Even more effective (though less convenient) are exterior shutters or shades because they keep the sun's heat entirely outside.

An option for windows is reflective plastic film applied directly to the glass. As an alternative to permanently applied film, when winter comes, some brands allow you to

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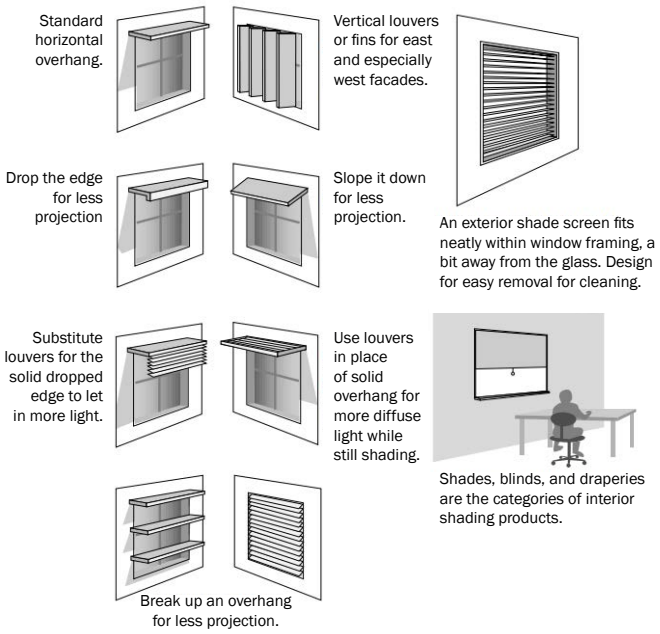


Source: USDE https://windows.lbl.gov/pub/designguide/section5.pdf

peel the film off and put it away till next year. Films are also available on pull-down retractable roller shades. Window awnings are yet another choice that lets you block the sun while keeping the curtains open. Make sure the awnings extend at least halfway down the window on all three sides. You can buy or make them out of canvas or nylon. Just remember to take them down on south windows in the fall so you can catch that winter sun.

Inside your Home

You'd be surprised at how much heat major appliances add your house. As an example, the refrigerator/freezer spills heat into the kitchen as its motor works to keep food cold. Open the doors as little as possible during the summer to keep it from working overtime. Also, cook outside on the barbecue whenever possible to avoid generating heat from the oven and burners. Run other appliances such as washers, dryers, and dishwashers at night or early in the morning when it's cooler. And use lights sparingly, for they generate heat as well.

You'll also stay cooler if you keep humidity levels down. Moist air will make your home seem even hotter than it is. For help, see the Home Energy Efficiency fact sheet called Controlling Condensation in the Home. Dress appropriately, too, by wearing loose-fitting, lightweight shorts and short-sleeve shirts. Every little step helps!

Landscaping

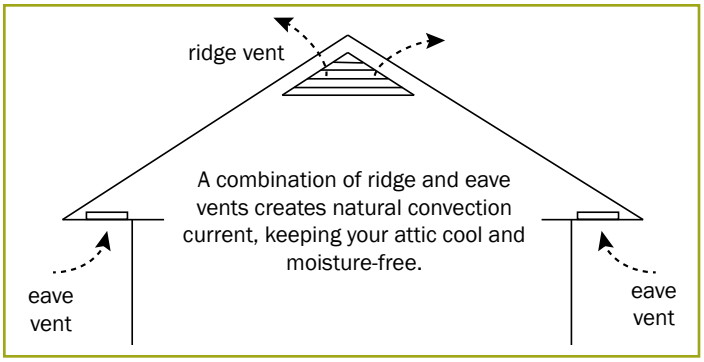
Landscaping is a more long-term cooling option, but it's never too late to start planting! Actually, it's more important to landscape for winter than for summer in our cold climate. A grove of evergreens to block the cold northwesterly winds will surely trim your heating costs. For a summer cooling aid, your best bet is to plant small- to medium-height deciduous shade trees near the east- and west-facing walls of your house. During summer, they'll block your windows from the morning and evening sun, and in the winter they'll shed their leaves to let the sun in. To shade your roof, you could plant taller deciduous trees in the southwest and southeast corners of your yard, but keep the true south side of your house tree-free. You need all the southern exposure you can get during the winter. Visit a local nursery or call your cooperative extension office to find out what tree varieties grow best in your area and how to care for them. Also be sure to plant away from overhead power lines and underground water, sewer, and utility lines.

Architectural Elements

You don't have to wait around for the trees to grow to enjoy shade and wind protection in your yard. Tall fences will also block the north winds, and trellises (vine-covered if you'd like) can shade your windows and provide a nice cool spot for summer lounging.

Evaporative Coolers

If you're still too hot after trying all of the above strategies, you may be tempted to buy an air conditioner as a last resort. Wait! There's one more option called an evaporative cooler that uses considerably less energy than a conventional air conditioner. Evaporative coolers are simple devices that deliver cool, damp air to your living space. They work well in arid climates such as ours. Check them out at your local hardware or building store before buying an air conditioner–they may be just the cool solution you seek!



Follow the tips below for cool results!

Four tried and true cooling strategies:

1. Air-sealing with caulking and weatherstripping
2. Attic insulation and ventilation
3. Air circulation
4. Cooking outdoors

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Gas Appliances

Many Montana homes have furnaces, water heaters, clothes dryers and cook ranges/ovens that use propane or natural gas as the fuel. While these appliances are safe, these precautionary steps must be taken by the consumer to assure they remain that way throughout their life:

- Operate appliance(s) as they were designed and intended for (DON'T ALTER EQUIPMENT).
- Keep appliance(s) clean.
- Do not use as a source of home heating.
- Never use unvented gas and kerosene heaters.
- Routinely inspect and provide preventive maintenance.

Sounds easy doesn't it?

It is; however, these simple items are generally overlooked by the consumer and can create potentially dangerous situations:

- Incomplete gas combustion, which also wastes energy.
- Spillage of combustion gas by-products into the home: carbon monoxide, nitrogen dioxide, sulfur dioxide and respirable particles.
- Backdrafting harmful exhaust gases down the chimney and into the home.
- A trained technician can check these items for safety.

When using combustion appliances follow these guidelines:

- Properly operate appliance(s).
- Never alter a combustion appliance, its exhaust flue or gas piping from original installation.
- If a combustion appliance and connections must be relocated or replaced, seek the services of the gas fuel provider or a professional technician.
- Never block off fresh air intake vents.
- Never enclose a combustion appliance without assuring adequate combustion air is available to the appliance.
- Never use a gas range or oven as a heater.
- When a naturally vented gas appliance (e.g., water heater or range) is operating do not run a powered exhaust (e.g., counter top down-draft exhaust fan) fan in the same room – this may result in exhaust gas backdrafting.

Routinely inspect and provide preventive maintenance

Inspect gas appliances for:

- Blocked or clogged chimney opening.
- Blocked off crawl space or mobile home opening where fresh air is supplied for the

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gas appliance.
- Leaks and obstructions in furnace supply and return duct work.
- Cracked or separating exhaust flues.
- Corroded or disconnected vent pipe.
- Dirty filters.
- Pilot light failures.
- Exhaust gas odors or burning odors.
- Malfunctioning kitchen range or cooktop vent.
- Irregular or abnormally short or long cycling of the furnace.

Preventive maintenance by a service technician should include:

- Testing all combustion appliances for carbon monoxide.
- Checking for gas leaks.
- Fresh-air supply for all combustion appliances.
- Proper exhaust draft to prevent backdrafting.
- Heat exchanger examination.
- Cleaning blower
- Flue and vent system examination.
- Proper operation of fan and limit switches

Keep appliance(s) clean

A dirty furnace filter, clogged oven and range gas orifices, restricted duct work and intake air–flow vents and lint–clogged dryer vents can all alter the performance of gas appliances. Every effort should be made to keep combustion appliances clean from lint, dust, oil and grease.

Never use unvented gas and kerosene heaters

Unvented combustion heating systems should never be used indoors without proper outside fresh air and exhaust. Infiltration reduction measures (caulking, weatherstripping, etc.) should not be installed if any unvented combustion heater is present in the home. Although unvented heaters are approved for use in some situations, they must be equipped with an oxygen depletion sensor and they must never be used as the primary source of heat nor may they be used in a bedroom.

Beware of carbon monoxide

Among the most serious results of incombustion is the production of carbon monoxide, a odorless and colorless deadly gas. To detect carbon monoxide install at least two carbon monoxide detectors; one located in the furnace room, the other near sleeping areas. These devices may be available at your local building supply or hardware store.

Air-tightening precaution

Air-tightening measures – caulking, weatherstripping, etc. – should never be done without first correcting problems associated with combustion appliances.

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HOME INSULATION CHOICES

In poorly insulated homes, keeping warm costs so much because heat doesn't stay in your home very long. Warm air produced by your heating system naturally wants to go to cold areas or surfaces. As a result, heat travels right through your home's walls, floors and roof. This is called heat loss, and to compensate for the house heat loss, the furnace will operate, costing you money. Insulation materials placed in walls, floors and the roof slow the flow of heat, as if to say, "Slow down, partner." During winter, insulation keeps the heat in, and in the summer, insulation works to keep your house cooler.

Resistance is Key

The ability of an insulation material to reduce heat flow is measured in terms of resistance or "R-value". The higher the R-value, the better the insulation properties of the material used. Here in Montana, it is recommended that an existing home's attic be insulated to at least R-49, floors to R-19 and exterior walls to R-19. Achieving these R-values depends on the type and the thickness of insulation installed. For example, glassfiber batt insulation has an R-value of around 3.2 per inch of insulation, so one 3.5 inch batt will insulate a wall cavity to about R-11. The R-value of extruded polystyrene board insulation is R-5 per inch, so just two inches of that material have about the same insulation effectiveness as the glass-fiber.

Insulation Types

Different types of insulation have different uses. It's important to select the right type of insulation for the job you're doing and to install it according to manufacturer's instructions so it will be as effective as possible.

The easiest time to install insulation is when your home is under construction, but you can also add insulation to most existing houses. Insulation can be purchased in four basic forms:

1. Batts, Blankets or Rolls
2. Loose Fill
3. Rigid Board
4. Foamed in Place

Batts, Blankets or Rolls. Insulation batts or blankets consist of fibers made from spun rock, slag or glass. Glass fiber, the most common insulation, is made from glass and has an R-value of 2.2 to 3.2 per inch. The R-value of an inch of rock or mineral wool, made from rock or slag, is 3.1. Batts are cut to specific lengths, and blankets come in long, "cut-it-yourself " rolls. Both types are available in thicknesses that range from one inch to 12 inches and are wide enough to

Rockwool.
CC BY 3.0 Achim Hering , Commons - https://en.wikipedia.org/wiki/Mineral_wool#/media/File:Rockwool_4lbs_per_ft3_fibrex5.jpg

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fit either a 16-inch or 24-inch cavity opening depending on your insulation needs. Batts and blankets work well when the space you want to insulate is an unfinished, framed-in area. Common applications include insulating unfinished walls, open attics and basement or crawl space ceilings.

You can buy batt and roll insulation with a built-in vapor barrier made of kraft paper or foil, or you can buy it "unfaced" (without a vapor barrier) and install a plastic barrier separately. A vapor barrier is necessary to prevent moisture absorption, which lessens the effectiveness of the insulation. Both glass-fiber and mineral wool are non-flammable, but their vapor barriers aren't, so they must be covered with a fireproof material such as a half-inch of sheetrock.

Finally, it's important not to compress batt or blanket insulation into a tight space. The insulation relies on tiny air pockets to slow heat flow, and crushing these pockets decreases the insulation's effectiveness.

Loose Fill. This type of insulation comes in bags and can be made from cellulose (mulched newsprint or wood fibers), glass-fiber and mineral wool. Its R-values range from a low of 2.2 per inch for glass-fiber to 3.7 per inch for cellulose fiber. For maximum R-value effectiveness, it's important to install loose fill insulations to the proper density. Cellulose, glass-fiber and mineral wool loose fill insulations are most commonly installed by a professional who blows it into finished walls and open or finished attic spaces. By applying special adhesives to loose fill insulation, unfinished wall cavity can also be insulated. The adhesives assure that the insulation will not settle in the wall cavity.

Rigid Board. The most common rigid board insulations are made from a wide range of plastic materials, including expanded polystyrene (R 4.0 to 4.5 per inch), extruded polystyrene (R 5.0 to 5.5 per inch), polyurethane (R 6 to 7.5 per inch), and polyisocyanurate (R 6 to 7.5 per inch). Because of their ability to resist moisture damage, polystyrene rigid board insulations are commonly used in basement and crawl space walls and around slab foundations. However, for exterior below-ground installation, only extruded polystyrene products are recommended. All rigid board products can be used to insulate cathedral ceilings and insulation sheathing under exterior siding.

Plastic rigid board insulations are flammable and must be covered with a fire-resistant material such as a half inch of sheetrock.

Foamed-in-Place. Some of the plastic insulations are also available in a foam form that can be sprayed by professionals into walls or roof cavities during construction. The most common is polyurethane, and when foamed in place, it has an R-value of about 6 per inch. Advantages of foamed-in-place insulations include providing excellent air sealing and vapor barrier control, as well as being excellent insulation qualities.

General Guidelines

Seal first, then insulate. Adding insulation to your home's attic, walls or floors will not be effective if heat can easily travel through cracks and holes between framing members and around windows and doors. Seal all major cracks and openings before insulating.

Install a vapor barrier between your living space and your insulation. Installing a vapor barrier is necessary to keep moisture out of your insulation and other building materials. The air in your house contains large quantities of moisture due to showers, cooking and washing clothes. This moisture can pass right through your walls, roof and floor. It condenses when it hits a cold surface, causing blistering paint, wet insulation and possibly structural damage. For existing homes, vapor barrier paints can be used.

Ensure adequate ventilation. Adding insulation increases the need for ventilation in attics and crawl spaces. Pay close attention to ventilation requirements for these areas.

Insulation Type	R-value/Inch
Glass Fiber - Loosefill	2.2
Glass Fiber - Batts or Rolls	3.2
Cellulose Fiber	3.7
Mineral Wool/Fiber	3.1
Expanded Polystyrene Board	4.0 - 4.5
Extruded Polystyrene	5.0 - 5.5
Polyurethane Board or Spray	6.0 - 7.5

Notes

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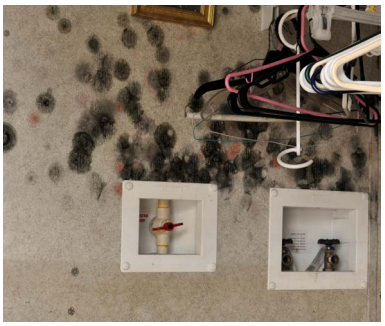
INDOOR AIR QUALITY

We usually think of air pollution as an outdoor problem – car exhaust and smokestacks and such. Surprisingly, the air you breathe in your own home may be even more polluted than outside air. Home indoor air pollutants can cause health problems, even if you are exposed to some pollutants for a short time. Symptoms range from allergic reactions (sneezing, coughing, watery eyes) to headaches, nausea, and fatigue. Some pollutants have even been linked to cancer and other serious illnesses.

Gases and particles from fuel-burning appliances can pollute the air in your home. No matter the fuel source – natural gas, propane, kerosene, wood or coal – all combustion appliances have the potential to release harmful gases such as carbon monoxide into your home. Wood-burners can also introduce irritating smoke and ash particles. Always closely follow installation and operating instructions for furnaces, water heaters, wood stoves, ranges, clothes dryers, space heaters, and fireplaces, and keep these appliances in good working order. If you have any combustion appliance, it is recommended that you install a carbon monoxide detector. For more details, read the *Home Energy Efficiency Fact Sheet on Carbon Monoxide and Gas Appliances.*

Photo: Public domain, Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Fireplace_Burning.jpg



Mold
Photo: FEMA, https://www.fema.gov/media-library/assets/images/59181

Biological pollutants include mold, mildew, bacteria, fungi, dust mites, pollen and animal dander. These microscopic pollutants often cause allergic reactions and can trigger asthma attacks. You can't eliminate them entirely, but you can keep their numbers down with adequate ventilation and regular cleaning. Use a vacuum with a high-efficiency particulate air (HEPA) filter. Minimize dampness by venting the clothes dryer and kitchen and bathroom fans to the outdoors – not to the crawl space, basement, or attic. Be sure there are vents in the attic and crawl space to the outside. Regularly clean humidifiers and evaporation trays in air conditioners and refrigerators. And for even more tips on controlling moisture, read the *Home Energy Efficiency Fact Sheet called Controlling Condensation in the Home.*

Asbestos is a mineral fiber often found in many products such as pipe insulation in older homes. However, until the late 1970s, it was also used to make floor tiles, roof and siding shingles, thermal insulators, and other fire-retardant, insulating building materials. Asbestos is harmful only when disturbed, usually during remodeling jobs. Inhaling its tiny fibers can cause lung and abdominal cancer years after the exposure. If your house

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contains an asbestos product in good shape, it is probably best to leave it alone because it only causes harm if the fibers become airborne. If it is deteriorating or must be repaired or removed, contact a professional for advice before disturbing.

Lead found in house paint made before 1978 is a big indoor air quality concern, especially during remodeling projects. Breathing lead paint dust as a result of weatherizing or remodeling your home can harm blood cells and kidneys and damage the brain and central nervous system. It can also cause serious developmental problems in children and pregnant women. Old paint in good condition and not disturbed is less of a threat, but dust and loose paint chips are common in old homes, especially around windows, and should be corrected as soon as possible. To limit exposure, duct tape works well for picking up chips, and frequent damp cleaning is a good way to control dust. Consult an EPA certified renovator before remodeling jobs, especially if you have small children and the house was build before 1978. If you're unsure about the presence of lead, never sand, scrape or undertake a construction project in a home built before 1978 without determining if lead paint is present. To conduct a lead risk assessment contact an EPA certified firm (see www.epa.gov/lead for a list of certified firms).

Household products such as paints, solvents, paint strippers, glues, pesticides, aerosol products and some cleaners must be handled with care – especially those containing volatile organic compounds (VOCs). VOCs are chemicals that are released into the air when you use products that contain them. Some VOCs escape even from stored, closed containers.

Breathing the gases can irritate your eyes, nose and throat, or cause headaches and dizziness. Long-term exposure may cause liver, kidney or nervous system damage. Buy these products only in quantities you'll use right away, always follow the directions closely, and work in a well-ventilated area.

Formaldehyde is a smelly gas commonly found in the glues used to make pressed wood products such as particleboard, paneling and furniture. It's also in some draperies and upholstered furniture. Some people are much more sensitive than others to this gas, which can cause watery eyes, burning sensations in the eyes, nose and throat, rashes, headaches, loss of coordination and breathing difficulties. Keeping your house cool and at humidity levels below 50 percent reduces formaldehyde emissions.

You can also coat pressed-wood surfaces with a special sealant to reduce out-gassing.

Radon is an odorless, radioactive gas that can cause lung cancer. It naturally occurs in rocks and soils and usually enters homes through basements or crawl spaces, although it can also enter with well water and granite building materials. The only way to find out if you have a radon problem is by testing. This can be done by hiring a monitoring service or by buying a do-it-yourself test kit at your local hardware store or Extension office and carefully following the directions. Radon problems can be fixed, but you should consult a professional before tackling the job.

Second-hand smoke is a combination of the tobacco smoke exhaled by smokers and that produced by the burning end of a cigarette, cigar, or pipe. It irritates the eyes, nose and throat and may lead to lung cancer, asthma and chronic respiratory ailments such as coughing, wheezing and excess phlegm. Children are especially prone to problems caused by passive smoking as it's also called. You can eliminate this indoor air hazard by asking smokers to smoke outdoors. If smoking does take place indoors, make sure children aren't present and increase ventilation by opening windows or using an exhaust fan.

Energy-Efficiency Alert!

If your home is energy-efficient – if it's insulated and air leaks are sealed with caulking and weatherstripping – maintaining good indoor air quality is all the more important. The easiest way is to cut back on your use of fuel-burning appliances and use of products that produce volatile organic compounds (VOCs). Another important step is to make sure your home is adequately ventilated. If you're particularly sensitive to pollution, you could also consider buying a home air-cleaner, but always try to reduce the source of air pollution first.

Signs of possible indoor air quality problems include:

- unusual and noticeable odors, stale or stuffy air
- noticeable lack of air movement
- dirty or faulty central heating or air conditioning equipment
- damaged flue pipes or chimneys
- no source of combustion air for fossil fuel appliances
- no exhaust ventilation for fossil fuel appliances
- excessive humidity
- tightly constructed or remodeled home
- presence of molds and mildew
- health reaction after remodeling, weatherizing, using new furniture, use of household or hobby product, or moving into a new home
- feeling noticeably healthier outside the home

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E3A: Energy Management for Home

Sarah Hamlen, Mike Vogel and Milton Geiger eds. E3A Program

INSULATING SIDE WALLS

Unless they're insulated, the exterior walls of your home provide an ideal escape route for precious heat in the winter and absorb the sun's energy during the summer. During the winter, without insulation, heat travels right through your walls in its natural quest to join the cold outside. Insulation slows down this migration of heat and saves you money on your utility bill. For Montana's cold climate, the U.S. Department of Energy recommends insulating existing house exterior walls to an R-value of at least 19. R-value is the measure of an insulation material's ability to resist heat flow. It's measured per inch of the material's thickness, and the higher the R-value, the better the insulating ability. For example, glass-fiber batt or blanket insulation has an R-value of around 3.2 per inch; the R-value of loose-fill cellulose is about 3.7 per inch, and rigid polystyrene board has an R-value of 4.5 to 5.5 per inch. All of these insulation types are commonly used to insulate walls. Which type works best depends on what kind of walls your home has.

Wall Insulation Strategies

There are three ways to insulate the exterior walls of an existing home:

1. Fill existing above ground wall cavities with insulation.
2. Apply insulation to the exterior of the walls before re-siding.
3. Add insulation to the interior surface of the walls and refinish with sheetrock. This option is generally used for unfinished basement walls.

Existing above ground sidewalls are most commonly insulated by removing siding or drilling holes into the sidewall and blowing loose-fill into cavities.
Photo: Photo: Edward Minch, NPS.gov, http://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm

When it comes to insulating walls, above ground walls should be your first priority. To do this, the most economical, as well as the least disruptive method that doesn't require that you refinish your inside walls or put new siding on your home's exterior is to blow insulation into the wall cavities. Of course, it can only work if your home's walls have cavities, and some brick or cement walls do not.

To find out what kind of walls your home has and if insulation can be added, first remove a light switch or an electrical outlet coverplate (after shutting off power to it) and peek inside your wall from there. If the outlet provides no clues, check in the attic, if it's accessible. The tops of exterior walls are sometimes left exposed up there. Wooden stud walls are usually covered with a wood 2x4; brick or stone walls are often left exposed.

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To insulate an interior solid masonary wall, you can install rigid board insulation between studs. Department of Energy https://basc.pnnl.gov/resource-guides/floor-above-unconditioned-basement-or-vented-crawlspace#block-views-guide-static-blocks-block-2

Wooden stud walls are the most common. If the cavities between the studs already have insulation in them, it may be too difficult or may not be cost effective to add more. If they are empty, however, your house is a good candidate for wall insulation.

If you are on a limited income, you may qualify for a free wall insulation job and other weatherization assistance. Contact your local utility and your local Human Resources Development Council for details. This service is particularly valuable for wall insulation projects since they should be done by experienced contractors rather than do-it-yourselfers.

What to Expect

Before insulating your above-ground, wood stud walls, the contractor or weatherization crew will first inspect them to make sure the interior walls will support the pressure of adding insulation and are free of moisture damage. Once your walls are approved for insulation, weatherization crews can start preparations for adding insulation into the wall cavities using special blowing equipment. The work typically takes place outside, so it doesn't disrupt your living space and interior walls. To get insulation into the walls, crews may remove part of the exterior siding and then drill two-inch holes through the wall sheathing. Depending on the insulation used, one or two holes per cavity will be drilled. The blowing nozzle, which is fitted to a long hose and insulation blowing machine, is then inserted into the holes and fills the cavities with either cellulose, glass-fiber or mineral wool loose-fill insulation. The crews make sure the insulation is blown to just the right density inside the walls and that the entire wall cavity is filled and the insulation will not settle.

Once the insulation is installed, the crews plug the holes and remount the siding. Your walls look just like they did before – only now they are insulated. If the siding is too difficult to remove, holes will be drilled directly into the siding and later plugged. This operation is best for siding that needs a new paint job anyway.

Wall Variations

Other types of walls require different insulating techniques. Below are some variations you may encounter:

Brick or stone walls. Some of these wall types also have an open wood frame cavity within the wall. If yours does, it may be possible for a contractor to add loose-fill insulation down into the cavities from the attic or other opening. Cellulose or glass-fiber insulation works well in these cases. Again, it's important to make sure the cavities are fully filled.

Solid walls. Brick or stone walls and walls made of poured concrete or concrete block contain no cavities. In these cases, a layer of insulation must be added to either the interior or exterior of the walls. On the inside, your options include putting up wooden studs and filling the cavities with fiberglass batts or installing rigid board insulation such as extruded or expanded polystyrene. Rigid board insulation can also be adhered to existing wall surfaces.

Regardless of the route you choose, make sure the insulation is placed on the outside (on the cold side) of all pipes to prevent them from freezing. A vapor barrier such as polyethylene plastic is generally NOT recommended on a wall located below ground level. Rigid board insulation must be covered with a fire resistant material like half-inch sheetrock board. If you want to put the insulation on the outdoor side of a concrete wall, rigid board insulations work well because they can be installed right over the concrete or existing siding and then covered with new siding or with stucco-like finish. Because rigid board insulations will not readily allow water vapor to pass through them, they are not recommended to be added to poorly insulated wood-cavity walls – you can create a major moisture problem in the wall. Adding insulation to solid walls is a difficult job no matter where the insulation is placed. It often involves readjusting door and window frames and extending electrical outlets and switches to accommodate the added insulation. It also requires careful attention to air-sealing and moisture control. These projects require the skills of a professional as well, and they may not be cost-effective unless you need new exterior siding or you're considering an interior remodeling project that involves some wall modifications.

Sarah Hamlen, Mike Vogel and Milton Geiger eds. E3A Program

MOBILE HOMES

There are about 54,000 mobile homes in Montana. Their low cost (compared to site–built houses) enables more people to own homes. Unfortunately, however, about half of existing mobile homes were built with little or no insulation or other energy efficiency features. Many were manufactured before 1976, the year in which a federal housing code was passed requiring the homes to be built more efficiently. The good news is that there are many way to increase the energy efficiency of your mobile home, which will in turn lower your utility bills and make your home more comfortable. Some steps you can do yourself, and others require the skills of trained weatherization professionals.

Mobile Home Construction

The construction process for mobile homes is radically different from that of site-built homes. The floors, walls, and roof are built in assembly line fashion to form the home. Portability is achieved by mounting the home on a steel frame with wheels and using strong but lightweight materials for framing.

First the floor, complete with water lines, waste lines, ductwork and insulation, is fastened to the steel frame foundation. The floor is protected by a rodent barrier, a sheet of heavy cloth or paper that also keeps animals out. Next, the furnace (typically a sealed combustion type) and plumbing fixtures are added and then, the interior walls. The homes are assembled from the inside out, with the ceiling/roof portion being the last major component installed.

Once the home arrives at its destination, it must be secured on a level foundation on dry ground with proper drainage. If the home is not level or the ground below too moist, weatherization and repair steps will not be effective. Enlist the help of a qualified professional for these siting tasks.

Most effective conservation measures

In the late 1980s, the U.S. Department of Energy sponsored a two-year study to determine the most cost-effective energy conservation measures for mobile homes in cold climates. The study identified the following "top five" measures:

1. Sealing air leaks and furnace ducts;
2. Furnace tune-up;
3. Blowing insulation into the home's underside (called the belly);
4. Installing interior storm windows; and
5. Blowing insulation into the roof.

Because of the wide construction variations of mobile homes, with the exception of installing plastic storm window kits that you can purchase at a hardware store, these measures will likely require the skills of trained professionals. Though you can also easily seal noticeable leaks around your home's windows and doors, these efforts will have little

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effect on your energy consumption if the big hidden leaks go untouched – leaks which are most easily found using a blower door, equipment commonly used by professional weatherization crews.

If you are on a limited income, you may qualify for free weatherization assistance. Contact your local utility, Human Resources Development Council or tribal weatherization program for details.

Do-It-Yourself Tips

If you cannot enlist professional help, you can still go after some big leaks. Plug all holes around chimneys, vents, water pipes and heating system ductwork. Seek out hidden air passageways in closets and cabinets. Make sure the rodent barrier is intact and patch it if torn. Once you've stopped all the big leaks you can find, then turn your attention to the little ones – around windows, doors, electrical outlets and light switches.

For more information on these and other low-cost energy conservation tips, obtain a copy of Home Energy Efficiency Top Ten Energy Saving Tips fact sheet. There are fact sheets on water heaters and storm windows, too.

Air quality cautions

Weatherization makes good sense but before tightening your home, it is imperative to make sure all combustion appliances such as furnaces, stoves and water heaters are in good working order and are properly vented. Failure to do so could lead to the accumulation of dangerous amounts of carbon monoxide in your home. This is another good reason to consult with a weatherization professional before taking on a major weatherization job yourself.

It's also important to regularly use exhaust fans in the kitchen and bathroom to maintain good indoor air quality and minimize moisture problems. Remember to ventilate constantly when using paints and other chemical compounds in the house.

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SAVING ENERGY

In older homes, about 75 cents of every home energy dollar goes for heating your house. There are several low- and no-cost strategies you can employ to keep heating costs under control. Here's how to get started saving energy.

All heating systems

Never use an unvented (without an exhaust) combustion heater in your home.

- If you suspect fuel or exhaust leakage with any combustion heating system, contact a heating contractor at once.
- The simplest and easiest way to save money this winter is to turn down your thermostat. A setting of 68°F during the day is both comfortable and economical. Even lower is possible, if you wear warm clothes. You can also save money by turning your thermostat down a few degrees when you are away from the home during the day.
- Many people find that a setting as low as 55°F at night is both energy saving and refreshing. If that is too cold, find the lowest setting possible while still maintaining your comfort. With gas forced air furnaces you can expect to save one percent on your energy bill for every degree you turn your thermostat down at night. If you want to wake up to a warm and toasty house, you can invest in a programmable thermostat, available from hardware stores for less than $75. These thermostats automatically lower and raise the temperature setting at the times you specify. If you want more than one time setting or different weekend settings, pick a thermostat with that feature. Of course, settings for those with infants or elderly persons cannot be as low and you should always make sure that pipes sensitive to freezing are not at risk.
- If you have a boiler, you can still save money by turning your thermostat down. Since the water in a boiler takes time to return to a temperature suitable for heating your home, you may not be able to lower the thermostat as much as with a forced air furnace.
- Vacuum around furnace air intakes, vent registers, baseboard heaters and radiators. Even a little dust can alter air flow to and from the heating system.

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Electric baseboards and hot water radiators

- Keep them clean!
- For proper air circulation and heating keep furniture and draperies away from the baseboards and radiators.
- For hot water heating systems insulate pipes running through unheated spaces.
- Place a sheet of aluminum foil or other non-flammable reflective material behind the radiator; it will reflect heat back into the room.
- To improve the efficiency of a hot-water heating system, if it is possible bleed the air from your radiators once or twice during the heating season. Turn the air valve or the key on each radiator until water comes out. Hold a bucket under the valve and remember that the water is hot. Shut the valve tightly when the water stops spurting.

Forced-air furnaces

- Furnace filters should be replaced or cleaned once a month during the heating season.
- Do not block off furnace supply and return vents. For maximum efficiency furnaces need a balanced air supply.
- Also, draperies and furniture blocking vents can create a fire hazard.
- If furnace has outside combustion air intake check to assure that it is not blocked off.
- Check exhaust flue/chimney to make sure it has no obstructions – birds, collapsed pipe, etc..
- Have furnace checked at least every three years by a qualified serviceman.
- If heating and return ductwork run through an unheated area (crawlspace or attic) insulate the ductwork with R-11 fiberglass.
- Check your heating ducts for cracks and other openings.
- Seal duct work with duct mastic or a foil tape (not duct tape)
- For furnace blower motors that require lubrication, oil annually. Also, clean the blower blades so that air can move more easily.

A WELL-TUNED AND MAINTAINED HEATING SYSTEM WILL SAVE YOU ENERGY AND MAKE YOU MORE COMFORTABLE!

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STORM WINDOWS

Even windows that are caulked and weatherstripped lose a great deal of heat through the glass. By installing storm windows, you can reduce this heat loss and cut air leaks around the window frames.

One of the best insulators is trapped air. A storm window installed inside or outside traps air between it and the existing window. Air space of ¾ to 4 inches is recommended. If they have a good seal, storm windows also reduce moisture formation on the window. This moisture, or condensation, can freeze resulting in frost and ice on the window.

Storm Window Options

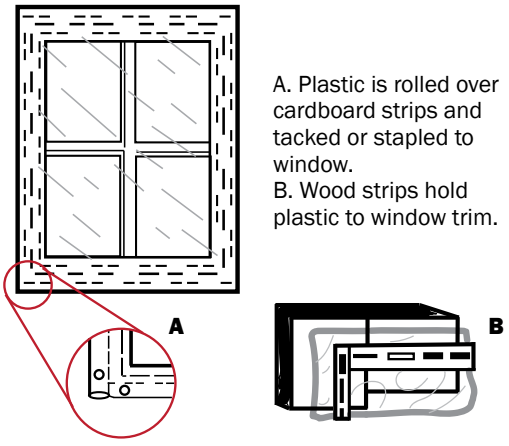
There are three basic types of "add-on" storm windows:

1. **Plastic film storm windows** – the low cost plastic type that you can make yourself or purchase as a kit and place inside or outside the existing window
2. **Glass or plastic sheets** – medium-priced removable glass or rigid plastic windows (rigid plastic storm windows should be mounted inside the home)
3. **Combination storm windows** – more expensive, but permanent (usually with an insect screen) and are mounted outside the existing window

All three are equally effective, but the higher-priced windows are more attractive and more convenient. They also give you the option of opening your windows to allow for natural ventilation.

Selection and Do–It–Yourself Installation Tips

Plastic Film Storm Windows*



A. Plastic is rolled over cardboard strips and tacked or stapled to window.
B. Wood strips hold plastic to window trim.

- Plastic films – vinyl, polyester and polyethylene – are available in several thicknesses. The thicker the plastic, the more expensive it is, but the easier it is to work with and the longer it will last.
- For the best appearance, look for clear plastic window kits that stretch to provide a tight fit when warmed with a hair blow-dryer.
- When using films as storm windows, there are a variety of installation methods. Although tacking and stapling is low cost and quick, this method damages the window frame. A better solution may be to construct a low-cost frame from 1-inch by 2-inch wood. The plastic film is stapled to the frame and the frame is then mounted to the window frame.
- Today most hardware stores offer special mounting tracks or frames for making your

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own plastic film storm windows. These frames mount to the outside frame of the inside window and may be permanent. This allows you to save money by using the same frame each winter while only replacing the plastic film.

Rigid Plastic Sheets*

- These are made from acrylic (often known as Plexiglas®). While they cost more than films, they are more durable and are closest in appearance to glass. Rigid plastic is lightweight, is easily cut and drilled and does not shatter when broken. It does scratch easily, however.
- To hold the plastic on the window frame and create a dead air space, rigid plastics should be mounted in frames. Magnetic, self-adhesive and other mounting hardware and frames are sold at hardware stores and building centers. Installation instructions are included with the frame kits and must be followed accurately.

* *Although plastic films and rigid outdoor sheets can be applied to the window, they are easier to install on the inside. That's especially true for apartment dwellers and those with multi-story homes. There's no wind damage when they are installed indoors. Interior mounted storm windows also cut infiltration heat loss when mounted on the outside frame of an interior window.*

Combination Storm Windows

- Combination storm windows have glass panes and a screen and they open and close. Generally, they are made of aluminum frames mounted to the window's exterior.
- Different brands may appear to be the same, but quality does vary. Look for weatherstripping around the storm sash, tight-fitting but easy sliding windows and screen, welded corners rather than screws, sturdy hardware, ease of maintenance, and a reputable dealer offering and backing a warranty.
- While these windows are permanent, they are the most expensive of the storm window options and short-term energy savings may not merit the expense of the units.

Air Sealing Storm Windows

The effectiveness of a storm window depends on the air-tightness of the primary existing window sash and frame. To assure an energy-saving installation and to control window moisture, you should caulk and weatherstrip the primary window sash and frame. To create an effective air space, the storm window should also be weatherstripped.

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TOP TEN TIPS

1. Control Your Gas/Forced Air Thermostat.

You can save on your heating bill by keeping your thermostat at an energy efficient and comfortable setting during the day and turning the heat down at night and when you're not home. Try 68°F or less during the day and 60°F when you're away or sleeping.

You'll save approximately one percent for every degree of night setback. When you're chilly, put on a sweater rather than click on the heat. Night set-back is also worth while with boilers (hot water heat). However, because of slower recovery times you may not be able to set your thermostat back as much as with a forced air furnace.

2. Lower Your Water Temperature.

Your hot water is probably hotter than necessary. Most heaters are set at 140°F, and this high setting is only needed if you have a dishwasher without a booster heater. Turn the temperature down to 120°F (medium setting on a gas heater dial), and you'll cut your water-heating costs by six to 10 percent. Most electric heaters have both an upper and a lower thermostat to adjust. Be sure to first turn the electricity off at the circuit breaker before adjusting.

3. Insulate Your Water Heater.

To keep your coffee hot, you put it in a thermos or an insulated cup. That same common-sense approach works for your water heater, too. If your water heater is located in a cold location, wrapping the tank in a blanket of glass fiber insulation will reduce heat loss by 25 to 45 percent. This means a savings of four to nine percent on your water-heating bill. Water heater jacket kits are available for $10 to $20 at your local hardware store or through your utility. Be sure to follow the installation directions.

It's especially important not to block exhaust vents and air intakes on gas models, and thermostat access panels on electric heaters with insulation. Insulation wraps and jackets are appropriate for older water heaters and those located in unheated areas. The manufacturer may not recommend an insulation wrap for newer water heaters.

4. Replace Your Showerhead.

A standard showerhead sprays you with up to eight gallons per minute of hot, steaming water. Replacing it with a quality low-flow showerhead will allow you to use only one to two gallons of water per minute – and you'll hardly notice a difference – except on your utility bill! Low-flow showerheads cost between $10 and $20 and pay for themselves within a year by reducing water consumption and energy used to heat the water.

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5. Discover the Cold Water Wash.

Water heating accounts for 90 percent of the energy used by washing machines. Washing in hot water costs 20 to 40 cents per load. That adds up, and it's not necessary, except for special loads such as diapers or stained work clothes. Try washing in cold water using cold water detergents, and wash full loads whenever possible. To save even more, on sunny days, use the clothesline instead of the dryer to dry your laundry.

6. Plug those Leaks!

On a cold, windy day, do you feel the breezes blowing through your house – especially near trouble spots such as wall outlets, windows, doors and fireplaces? As the cold comes in, your heat (and your money) flies away. You can stop this heat loss quickly and easily with low-cost materials.

On windows, use clear weatherstrip tape along the gap where the glass meets the frame and to seal any cracks. On double-hung windows, tape over the pulley hole and use rope caulk between the upper and lower windows. To stop leakage under exterior doors, roll up towels to block the breeze or buy an inexpensive door sweep. If the door leaks around the entire frame, install foam weatherstripping with adhesive backing between the door and the frame.

If you don't use your fireplace much and it doesn't have a door, make sure the damper is closed and the opening is sealed. Cardboard and tape are low-cost and effective materials to do the job. Another low-cost option is to plug the chimney with a plastic bag full of crumpled newspaper or insulation. Be sure to post a highly visible reminder to remove the bag before building a fire.

Use caulk or foam to seal along the basement sill plate and around door and window frames. Also seal little holes around water pipes and stuff insulation into big holes around plumbing fixtures. Heat leaks out of light switches and electrical outlets, too. Inexpensive foam gaskets that fit behind the cover plates easily solve this problem. Remember, every hole you plug means fewer drafts, a cozier home and lower heating bills.

7. Install Storm Windows.

Once you have sealed air leaks around your windows, you can double their insulating value by installing storm windows. Adding another layer of glass or plastic creates a dead air space, and trapped air is an excellent insulator. Plastic film window kits are the lowest-cost option and can be easily installed on the inside or outside of your existing windows. Be sure the air space is at least ¾ inch and not more than four inches.

8. Regularly Clean or Replace Your Furnace Filter.

All forced air furnaces have filters that keep dust and dirt from blowing into your house. If not periodically cleaned or replaced, dirty filters can greatly affect the heating ability of the furnace and waste valuable fuel.

Some filters are disposable; some can be washed and reused. Do not reuse disposable filters. New ones can often be purchased for less than a dollar. Each month of the heating season, clean or replace your furnace filter(s)

9. Watch Your Refrigerator.

Refrigerators cost $5 to $8 per month to operate and consume three to five percent of your home's total energy use. To keep out warm room air, keep the door closed as much as possible. It also helps to regularly clean dust out of the coils and to minimize freezer ice build-up. Keep the refrigerator at 36 to 38°F and the freezer at 0 to 5°F. If you have more than one refrigerator or freezer and one doesn't get much use, unplug it and save.

10. Devise an Energy Action Plan!

The most important energy saving step of all takes place inside your head. Once you make the decision to "do it," you'll discover that reducing your home energy consumption is easy and the rewards are great.

SPACE HEATING AMOUNTS TO ABOUT 60 PERCENT OF YOUR WINTER UTILITY BILL. BY ACTING ON THESE TIPS, YOU HAVE THE POTENTIAL FOR SIGNIFICANT SAVINGS.

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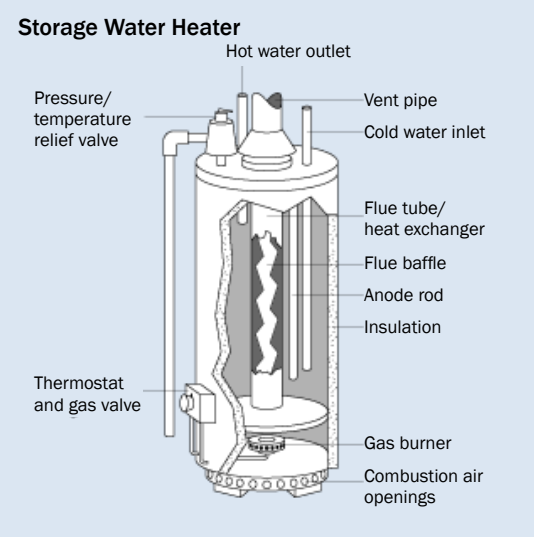
WATER HEATER ENERGY SAVING

A water heater is like a trusty workhorse – steady, reliable and practically maintenance-free. By giving your water heater a little attention can extend its life and significantly reduce your energy costs. Water heating can account for up to 20 percent of your home's energy use – second only to space heating.

How Water Heaters Work

When you turn on the hot water tap, heated water is drawn into your home's pipes from the top of your water heater. To replace the water being used, fresh cold water flows into the bottom of the tank, activating the heating element. Gas and electric storage water heaters basically operate the same way. However, gas heaters have a pilot light at the bottom to ignite the burner. They also have a flue running through the center of the tank to exhaust combustion gases. And while gas models have only a single burner, electric heaters may have a lower and an upper heating element inside the tank.



"Natural gas storage water heater" by US Department of Energy http://energy.gov/eere/energybasics/articles/conventional-storage-water-heater-basics

Both heaters must have a temperature/pressure release valve near the top of the tank. This valve will allow steam or hot water to escape safely, should a thermostat malfunction occur. It should be checked annually to ensure that it's working properly.

Energy-Saving Options

There are several strategies you can take to save water, energy, and money. By following these five steps, you can ensure that your water heater will operate efficiently.

1. Adjust the Thermostat

Your tank is probably keeping your water hotter than necessary. Most electric heaters are set at 140°F, but this high setting is only needed if you have a dishwasher without a booster heater. Turn the temperature down to 120°F (midway between low and medium on a gas heater dial), and you will cut your water-heating costs by six to 10 percent. Since gas water heaters do not have a temperature thermostat, use a cooking thermometer to test

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the temperature of the water at the tap. You will also slow tank and pipe mineral build-up and corrosion. Mark the current setting with a permanent marker so that if you need to adjust the temperature later, you can easily see where you started.

Electric heaters may have both an upper and a lower thermostat you'll need to adjust. However, before removing the thermostat access panels, be sure to first turn the electricity off at the circuit breaker or fuse box.

When you're going to be away from home for several weeks, turn the thermostat down to the lowest setting or turn the heater off completely. Electric heaters can be shut off at the electrical circuit breaker box. If you turn-off a gas heater, be sure to learn how to re-light the pilot light (see page 3). It only takes about an hour to reheat the water once the heater is turned back on.

2. Insulate the Tank

Unless the owner's manual specifically states not to, wrap your water heater with an insulating blanket, especially if it is located in a cold space (garage, crawl space, etc.). If possible, put the heater in a heated space. Wrapping the tank in a blanket of fiberglass insulation will reduce standby heat loss by 25 to 45 percent. Standby heat loss results from keeping water heated at all times so that it is ready when needed – it's on "standby." Some of the heat is transferred through the tank and pipes out into the surrounding air. Insulating can result in a savings of four to nine percent on your water-heating bill. Water heater insulation kits are available for about $20 at your local hardware store. They are easy to apply and will pay for themselves in less than a year. Be sure to carefully follow the directions. It's especially important to not cover exhaust vents and air intakes on gas models with insulation and to cut the insulation so you can access the thermostat panels on electric heaters. Never cover the pressure temperature relief valve. It's a good idea to put a strap near the top and near the bottom to further secure the insulation.

3. Insulate Hot Water Pipes

To save even more, reduce heat loss by insulating the first five feet of your hot and cold water pipes from the water heater. You can insulate your hot lines beyond five feet if they are accessible using pre-formed foam insulation, available in different diameters and lengths at your local hardware store.

Keep tank and pipe insulation at least three inches away from the gas burner and the hot exhaust vent/pipe and draft hood on gas water heaters.

4. Flush the Tank

Over time, sediment and scale (dirt and mineral deposits from the water) build up inside your water tank. They reduce both heating element efficiency and the overall capacity of the water heater. You can reduce this build-up by periodically flushing water from the tank.

The drain valve is located near the bottom of the tank. Open the valve and let the murky water drain into a bucket until it runs clear (usually after one to two gallons). If the valve hasn't been opened in years, you may want to have a garden hose cap handy the first time you drain, in case it's difficult to shut off and avoid drips. In some areas, depending on the hardness of the water, monthly flushing is recommended, and in others the tank need only be flushed once a year.

5. Install Heat Traps

Heat traps are one-way valves placed inside both the hot and cold water lines running into your water heater. They keep the hot water from rising out and the cold water from dropping in to your water heater when you're not drawing water from a tap or for an appliance. If your existing water heater does not have heat traps, or you are not sure, contact a plumber to check your system and install them. New water heaters should have them as an option or already installed.

New Water Heaters

If you're in the market for a new water heater or are doing homework to know what's available once the old one quits working, you will have a variety of choices to consider and discuss with your heating contractor or plumber.

High Efficiency Gas Storage Water Heaters

A High-Efficiency Gas Water Heater is an upgraded version of the conventional gas water heater. It has better insulation and heat traps and more efficient burners. Look for storage tanks with a high thermal resistance (R-value) of around R-25 to reduce standby heat losses.

Gas-Condensing Water Heaters

Regular gas water heaters vent combustion gases to the outdoors at a high temperature. A gas-condensing water heater is more efficient because it uses/captures more of the combustion gas's high temperature to heat the water.

Heat Pump Water Heaters

Instead of generating heat to heat water, a heat pump uses heat from the surrounding air to heat water. It's like how a refrigerator works, only in reverse. They may not work as efficiently in Montana during winter if a living space's heated air is pulled/pumped to heat the water.

Tankless (on-demand) Water Heaters

Most water heaters keep water heated at all times – whether needed or not. Powered by either gas or electricity, tankless water heaters save energy by heating water only when it is needed. How do they work? A flow sensor detects when the hot water faucet is turned on or the warm/hot water selection

is made for an appliance. For a gas-powered heater, the gas valve opens and the burner fires-up. The system measures the incoming water temperature and calculates how quickly the water should flow past the burner through to the faucet or appliance. The burner's heat is transferred to the water. While these systems can supply a limitless amount of heated water, they must be sized for your hot water needs.

Solar Water Heating System

You can also heat your water using the sun's energy. There are several types of solar hot water systems that work well in cold climates. The sun's energy is absorbed by a south-facing "collector" that heats a fluid (water or antifreeze). The fluid transfers its heat to potable water stored in a tank. In cold climates, these systems typically require a back-up system for higher than usual demand or cloudy days. The back-up can be a tankless water heater.

Seismic Bracing

The mountainous areas of Montana are in seismic zones where plumbing code requires water heaters be anchored to resist movement during earthquake motion. Even if you do not live in an area where code requires bracing, it's not a bad idea given the geological activity in our state. Bracing code requires that a strap be anchored to the wall on the top and bottom thirds of the vertical dimensions of the tank. Straps are to be four inches above the controls.

Photo courtesy of Seasmic Safety Commission, State of California
http://www.seismic.ca.gov/HOG/waterheaterbracing_08-11-04.pdf

Lighting a Gas Water Heater Pilot Light

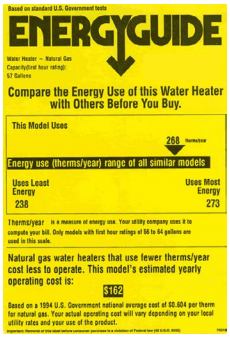
Instructions for lighting a pilot light should be on a plate mounted to the water heater. The instructions, which apply to most gas water heaters, are repeated here:

1. **Turn the thermostat indicator knob to OFF.**
   a. This shuts off gas supply to the heater.
   b. Wait 5 minutes for any gas that might be in the combustion chamber to clear the heater.
   c. If closed, open the gas valve in the gas supply pipe.
   d. Turn the indicator knob to PILOT.
2. **Depress the indicator knob and light the pilot.** (Continue holding the indicator knob for one minute after the pilot is lit. The pilot flame should remain on when the knob is released.)
3. **Turn the indicator knob to ON.** The main burner should ignite.
4. **Set the water temperature dial to the desired temperature.**
5. **Repeat these instructions if it is necessary to relight the heater.**

If the pilot light goes off when you release the reset button, try holding the button down again for an additional 10 to 15 seconds. If it still fails to stay on, either the thermocouple is defective or it is not positioned properly in the flame of the pilot. The flame from the pilot should bathe the top ½ inch of the thermocouple rod. If it does not, loosen the bracket nuts and reposition the rod. In case you are wondering what the thermocouple does, it acts as a safety cutoff for the gas valve. When the pilot is lighted, the heat generates a slight electric current in the thermocouple, which then allows gas to come from the gas valve. When the pilot goes out, the thermocouple stops sending the current, and the gas supply stops. If the thermocouple is faulty, replace it.

If you still cannot get the pilot lighted, there is probably something obstructing the flow of gas. Check the tiny orifice for clogs, and clean it if necessary, or call a plumber or heating contractor for maintenance.

Before you buy, consider both purchase and operating costs. Heaters with the lowest price tags are often the most expensive to operate. Look for the Energy Star label for energy efficient water heaters that will save you money. Also look for and compare the bright yellow EnergyGuide labels. These labels provide information on energy efficiency and estimated annual operating costs.



Notes

E3A: Energy Management for Home

Sarah Hamlen, Mike Vogel and Milton Geiger eds. E3A Program

CONDENSATION CONTROL

For many Montanans a winter does not pass without some moisture build-up in the home. The moisture that forms on the inside of your windows is called condensation. In some cases condensation can be short-term – during a cold spell or localized to humid areas of the home such as the kitchen, bathroom and laundry area. In other cases excessive moisture can condense on walls, windows, and other cold surfaces causing paint to peel, wood to rot and mold to grow.

To limit condensation and its damaging effects you must control three elements: indoor humidity, surface temperatures and moisture migration into walls, attics and crawlspaces.

1. Indoor Humidity Control.

During the heating season in cold climates, the indoor humidity level should be kept around 35 to 50 percent. High humidity is often the result of too much moisture generated indoors; however, exterior sources can also contribute to high indoor humidity. It is possible for an average family of four to add over six gallons of moisture to the air each day. Some of these activities include:

Mopping Floors = 2.4 pounds of moisture per day
Drying Clothes (dryer unvented into house) = 26.4 pounds of moisture per day
Washing Clothes = 4.3 pounds of moisture per day
Cooking with Electric Range without Exhaust Vent On = 2.0 pounds of moisture per day
Shower or Bath = 2.0 pounds of moisture per day
Dishwashing by Hand = 1.0 pounds of moisture per day
Individual Breathing and Perspiring = 16.8 pounds of moisture per day
House Plants = 1.0 pounds of moisture per day
Total Moisture = 55.9 lbs/day or 6.7 gallons/day

To reduce indoor humidity, follow these simple tips.

- While cooking, bathing and laundering, use an exhaust vent. Make sure the exhaust is vented to the outside and not into the attic or crawlspace.
- Never run your clothes dryer with the exhaust vented to the inside. Also you might want to avoid hanging wet clothes inside your home during cold weather.
- Cover pots and pans while boiling foods.
- If you have a crawlspace keep the moisture in the ground by covering it with 6 mil plastic sheeting.

2. Surface Temperature Control.

In order for moisture vapor to condense, it must come in contact with a cold surface like a poorly insulated or uninsulated wall, ceiling, floor, or single-paned window.

Warm air holds more moisture than cold air and warm air will naturally move toward a cold surface. If warm moist air comes into contact with a cold surface it will condense forming water, frost or ice on the surface.

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To reduce surface condensation here are some simple solutions:

Allow air to circulate around the room – especially across cold surfaces. Do not cover furnace supply or return registers with furniture or household furnishings. Use a ceiling fan to move air. During the day leave drapes open to allow air to circulate freely over the windows. During the night close drapes to prevent warm moist air from reaching the cold window surface.

Have your walls, ceiling and floor checked for insulation. This can be done by contacting an insulation contractor, your utility, or if you qualify, your local weatherization agency. If insulation levels are low or the insulation isn't filling all the nooks and crannies, cold surfaces will result. Insulation resistance "R" values should be at least:

- Ceiling/Roof . . . . . R 49
- Side Walls Above Ground Level. . . . . R 19
- Below Ground Walls. . . . . R 11
- Floors Over Unheated Spaces. . . . . R 19

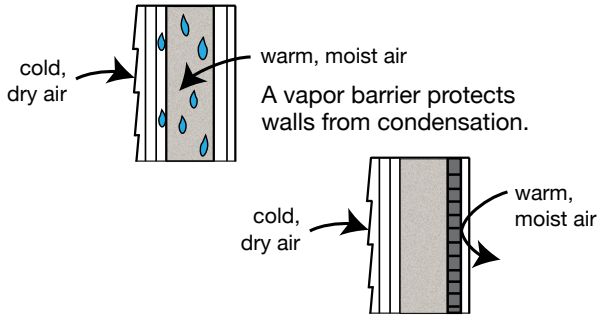
While it may be impossible to achieve these levels in an existing home, contact an insulation contractor to assess your options.

Add storm windows. If your windows are single-paned, condensation is probably a common problem. Installing a plastic or glass storm window over the window increases the surface temperature which reduces the condensation. The storm window must be installed with at least a ½ inch space between the two windows and sealed on the edges. While it may not be as cost-effective, adding a storm window to a double-paned window will allow for a higher relative humidity in the home without condensation taking place.

3. Moisture Migration Control.

Even with properly installed insulation, moisture can migrate into cold walls, attic spaces and crawlspaces to form condensation. Although condensation taking place in these areas is less obvious, it is where moisture can do the most harm – rot the framing, degrade insulation and corrode fasteners. Moisture can sneak into these cold areas through cracks or diffuse through building materials.

To control condensation in walls, attics and crawlspaces two remedies are common: a) block moisture from entering using vapor barriers and sealants, and b) ventilate to remove moisture.



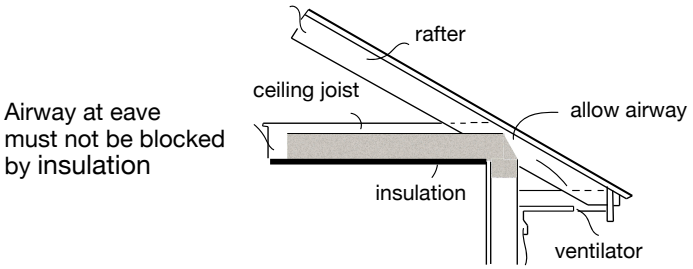
While difficult to install in existing homes, vapor barriers have been used with insulation in colder climates for many years in new construction. A vapor barrier is a low-permeable material that slows the movement of moisture. Vapor barriers should always be placed near the warm side of a wall, floor and ceiling. Materials near the cold side should let moisture escape from the wall or ceiling to the outside. A vapor barrier placed on both the warm and cold side may trap moisture causing problems.

Several materials are effective vapor barriers including polyethylene plastic and aluminum foil attached to insulation.. Since it is difficult to add a vapor barrier to existing homes, oil-based paints, foil and vinyl wall-coverings, and specially formulated low-permeability paints can be used to retard moisture vapor.

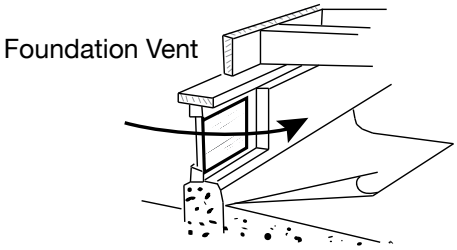
Keep in mind that where a hole or a crack exists, warm air and moisture can sneak through. All openings should be sealed with a long-lasting caulk, sealant or gasket material.

Ventilation is effective in removing moisture that has migrated into an attic or crawlspace. To be effective, ventilation must provide air movement through the entire area. The most effective attic ventilation should have inlet vents along the eave and outlet vents near the ridge. Eave vents must not be blocked by ceiling insulation.

The amount of attic ventilation depends on the type of vent, roof and vapor barrier used. As a rule of thumb for attics without a vapor barrier: one square foot of attic vent should be installed for every 150 square feet of attic space.



During mild seasons, crawlspaces should be vented to the outdoors. If the vents are near a corner, they will permit good air movement through the crawlspace. In a typical crawlspace, the total vent area should be at least one square foot for each 150 square feet of floor area. Have an energy auditor or contractor check to ensure that you have adequate ventilation.



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CARBON MONOXIDE

Carbon monoxide (CO) is an invisible gas that you should be aware of. You can't see or smell it; yet it can kill you and your loved ones within minutes if you breathe high concentrations of it. At low levels, it can make you sick.

Dizziness, headaches, fatigue, confusion, nausea, shortness of breath.

These are the symptoms of CO poisoning, and you're right – they resemble those of the flu and other common illnesses, so it can be hard to diagnose. Suspect mild CO poisoning if the symptoms disappear when you leave your house and reoccur when you come home.

CO quickly enters your blood stream and prevents it from delivering the oxygen your body needs to function. People with anemia, heart or lung problems, children and unborn babies are particularly susceptible to its deadly effects. Don't take any chances if the symptoms come on quickly and you've reason to suspect CO poisoning. If you hesitate, you could lose consciousness and die. Get everyone out into fresh air immediately and go to an emergency room. There's a blood test to check for CO poisoning. Make sure you contact a qualified heating contractor to check your fossil fuel appliances before re-entering your house.

Fuel-burning appliances emit carbon monoxide

Small amounts of CO are produced whenever fossil fuels such as gas, oil, kerosene, charcoal or wood are burned. When these fuels burn efficiently and are exhausted properly, CO is not produced. But trouble comes quickly when the burn is incomplete and exhaust accidentally leaks inside your house. Sometimes when a fossil fuel appliance is operating at the same time as a powerful exhaust vent, combustion gases can be sucked out of the appliance or pipe and enter the house. This scary event is called appliance backdrafting. You can protect your household by having a trained professional perform a safety inspection on all fuel-burning appliances. Call a heating contractor for an appointment. This is the most important step you can take! These appliances include gas or oil furnaces, water heaters, ranges, ovens, cooktops, clothes dryers, portable kerosene or gas space heaters, wood or coal stoves and fireplaces.

The contractor should check to make sure:

- Appliances are installed and operating properly.
- All burners are getting enough outside/fresh air for complete combustion.
- No appliance is producing a dangerous level of CO.
- All vents, chimneys and flues are clear and well-connected. An inspector can make sure your chimney is clear and safe.

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While prevention of CO should be your first priority, you can also install digital CO detectors. Plug-in and battery-powered detectors are designed to sound an alarm when they sense harmful CO levels. Make sure the detectors you buy meet American Gas Association or Underwriters Laboratories (UL2034) standard and use them only as a back-up measure, not as a substitute for common sense and an annual appliance inspection and maintenance. When you purchase the detector, note the life expectancy of the sensor cell located inside the detector – the cell may not last forever and may have to be replaced according to the manufacturer's recommendations. If your detector is battery-powered, the battery should be tested monthly and replaced annually (just like a smoke detector). Install detectors on the wall or ceiling outside your bedroom.

Carbon monoxide metector
Ivo.N - Own work. CC BY-SA 3.0
Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Detektor_CO.jpg

When using fossil fuel appliances, look for these warning signs:

- A gas appliance with a yellow flame (it should burn blue).
- Soot build-up on or around your appliance.
- Rust stains and corrosion on vents or chimneys.
- Increased condensation on windows.
- Furnace running longer and not heating as well.
- Unfamiliar smells or sounds coming from appliances.

Please follow these safety tips:

- Never use an oven or range as a space heater.
- Never let the car run in an attached garage.
- Never use an unvented heater unless it is equipped with an oxygen depletion sensor and has proper combustion air.
- Never sleep in a room with an unvented gas or kerosene space heater.
- Always make sure unvented space heaters operate in rooms with a window cracked and the door open. (Better yet, avoid using them entirely!)
- Always follow operating and maintenance instructions for combustion appliances.
- Never operate gasoline-powered engines (generators, chain saws, etc.) in enclosed spaces.
- Never use a barbecue grill indoors.

While some CO detectors may look like smoke detectors, their function is completely different. For a safe home, you should have smoke AND carbon monoxide detector.

Energy-efficiency alert!

If your home is energy-efficient – if it's insulated and air leaks are sealed with caulking and weatherstripping – you must be extra careful. Please be sure all combustion appliances are operating properly, because CO levels can build up rapidly in a tight home.

Notes

E3A: Energy Management for Home

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ENERGY EFFICIENT LIGHTING

Here's an amazing energy fact: Only about 10 percent of the energy used by an incandescent light bulb goes toward producing light. The rest of the energy is wasted as heat! Energy-efficient light bulbs, on the other hand, produce more light than heat with the electricity they use. As a result, they provide the same amount of light as incandescent bulbs while using much less energy. And since lighting can account for up to 20 percent of a home's electricity use, making it more efficient provides a big opportunity for saving money.

"Reduced wattage" and "long-life" incandescents are widely available. They may last longer than a standard incandescent bulb, but they typically produce less light and are not always more energy efficient.

Halogen bulbs are a type of incandescent bulb that contains an inert gas. They are more energy efficient than incandescent bulbs and provide a brighter white light that is constant (does not dim with age). They operate at a higher temperature than incandescent bulbs and the tubular type (often used in torchiere lamps) can cause fires if it makes contact with combustible materials. These bulbs last 2,000 to 4,000 hours.

High-Intensity Discharge (HID) bulbs include metal halide, mercury vapor, and high- and low-pressure sodium. They are more energy efficient than halogen bulbs and can last up to 20,000 hours. They are mainly used in commercial and industrial buildings with high ceilings and for outdoor lighting.

Compact Fluorescent Light Bulbs (CFLs)

CFLs use the same technology as the long, fluorescent white tube lights you're used to seeing in offices and schools. Manufacturers developed ways to place the energy benefits of fluorescent lighting into products that fit into conventional light sockets – hence, the name compact fluorescents.

CFLs use 75 percent less energy than incandescent bulbs to produce the same amount of light. That means you can select a bulb with a much smaller wattage requirement to get the light you need.

A 13-16 watt compact fluorescent =
a 60 watt incandescent in terms of light output (around 900 lumens)

A 20 watt compact fluorescent =
a 75 watt incandescent (about 1,100 lumens)

A 23-28 watt compact fluorescent =
a 100 watt incandescent (about 1,750 lumens)

A 39 watt compact fluorescent =
a 150 watt incandescent (about 2,800 lumens)

CFLs also last up to ten times longer than incandescent bulbs (10,000 hours compared to 1,000 hours). Compact fluorescents need a few minutes to reach full power after they're turned on. CFLs are available in warm, cool, and natural daylight colors. Most of today's CFLs (and tubular fluorescents) use electronic ballasts that eliminate the humming noise and flicker associated with older fluorescent lights.

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CFL "Do's and Don'ts"

Compact fluorescents may not be appropriate for all home lighting needs. For example, a CFL works most efficiently when it is left on for at least 15 minutes. Look at the CFL packaging to find those compatible with 3-way fixtures and dimmer switches. There are also CFLs made for outdoor light fixtures. Simple rules of thumb for their selection and maximum energy efficiency:

DO use compact fluorescents in light fixtures and lamps that remain on for more than 15 minutes.

DO use them in hard-to-reach fixtures to save yourself some precarious trips up a ladder.

Do use CFLs developed specifically for outdoors or cold spaces.

Do use CFLs developed to be used with three way light fixtures.

Do use CFLs developed to be used with dimmer light switches.

DON'T use them in fixtures and lamps that are turned on and off frequently (and left on for only several minutes).

Compact fluorescents are commonly available for $2.00 to $5.00 each, and often less per bulb in bulk packaging. Specialty CFLs typically cost more. Although their purchase price is more than incandescence bulbs, CFLs cost less over their lifetime because of the significantly reduced energy use.

CFL Purchase and Disposal

Most hardware and home improvement stores carry them. Also check the Yellow Pages under "lighting" or call your electric utility. CFLs are designed to screw into standard sockets and they come in a variety of shapes and sizes. Be sure to select models that will work with your light fixtures.

These lights will last for years, but when they do finally wear out, don't throw them away with your regular garbage because they contain small amounts of mercury. Some communities sponsor household hazardous waste collection days to ensure the proper recycling or disposal of items like these. Contact your city's public works department to find out about options in your area. Home improvement stores that carry them often provide drop-off recycling bins.

If you accidentally break a fluorescent bulb, follow these EPA approved steps.

Before Cleanup

- Have people and pets leave the room.
- Air out the room for 5-10 minutes by opening a window or door to the outdoor environment.
- Do not touch/handle mercury drops with bare hands.
- Shut off the central forced air heating/air-conditioning system, if you have one.
- Collect materials needed to clean up broken bulb:
  - stiff paper or cardboard;
  - sticky tape to pick up visible mercury particles;
  - damp paper towels or disposable wet wipes (for hard surfaces); and
  - a glass jar with a metal lid or a sealable plastic bag.

During Cleanup

- Be thorough in collecting broken glass and visible powder and mercury.
- Do not vacuum mercury particles.
- Place cleanup materials in a sealable container.

After Cleanup

- Promptly place all bulb debris and cleanup materials outdoors in a trash container or protected area until materials can be disposed of properly. Avoid leaving any bulb fragments or cleanup materials indoors.
- If practical, continue to air out the room where the bulb was broken and leave the heating/air conditioning system shut off for several hours.
- Avoid inhaling the mercury during the clean-up process.

Light Emitting Diodes (LEDs)

You have seen them in EXIT signs, traffic signals, holiday lights, and as the colored power button on your television or computer. They are now available for use in your home's lighting fixtures. This solid-state technology is even more energy efficient than CFLs. They produce very little heat and maintain their light intensity for up to 25,000 hours (afterward dimming to about 70 percent of their capacity). LEDs can be used as regular fixture bulbs, floodlights, and dimmable globes. They provide "directional" light and are ideal for recessed downlights and task lighting. LED bulbs are relatively new on the lighting front, so are currently fairly expensive. If you decide to try one, look for the EPA Energy Star label to ensure quality and performance.

Lighting Labels

To help make your light bulb purchasing decisions easier, new labels are now required on all products. Manufacturers must clearly show a bulb's light output (measured in lumens), how much energy it requires (measured in watts), and how many hours it's expected to last.

Note: bulb light output per wattage varies somewhat from brand to brand.

When shopping for an energy-saving fluorescent bulb, don't choose it by wattage, but instead look for bulbs with a high lumens/watts ratio. For example, a 75W incandescent

bulb produces about 1,200 lumens, for a lumens/watts ratio of 16:1. You get nearly the same light output with an energy-saving 18W fluorescent bulb that has a lumens/watt ratio of 61:1. To calculate the ratio, divide the number of lumens, printed on the package, by the bulb's wattage.

Lighting Tips

No matter what type of light bulbs you choose, you'll be guaranteed to save energy if you put into practice these common-sense tips:

- Turn lights off when you're not using them.
- Take advantage of natural light from windows whenever possible (day lighting).
- Don't use more light than you need.
- Focus the light on where it is needed most.
- Regularly dust your light bulbs and fixtures to prevent dirt build-up.
- If you normally leave outdoor lights on all night, install a motion sensor or a daylight sensor/photocell
- "De-lamp" (remove bulbs/tubes) from fixtures if not needed.

Energy Independence and Security Act (EISA) of 2007

The EISA is an energy policy that addresses energy efficiency standards for light bulbs. The first phase requires any screw-based bulb that uses between 40 and 100 watts use at least 27 percent less energy by 2014. The second phase requires that most light bulbs be 60 to 70 percent more energy efficient than today's standard incandescent by the year 2020.

Light Emitting Diodes (LEDs) are the newest lighting technology.

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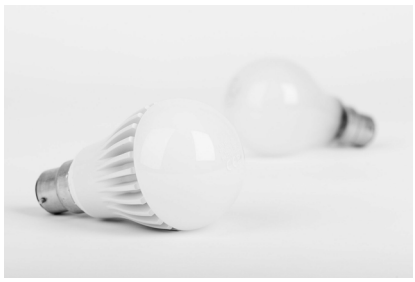

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Halogen bulbs are a type of incandescent bulb that contains inert gas.

"Wolfram-Halogenglühlampe". Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Wolfram-Halogengl%C3%BChlampe.png#/media/File:Wolfram-Halogengl%C3%BChlampe.png

Compact fluorescent bulbs come in many shapes and sizes. They cost a little more at the store, but they'll reduce your utility bill.

Photo Leuchtstofflampen-chtaube050409" by Christian Taube. Licensed under CC BY-SA 2.0 de via Commons - https://commons.wikimedia.org/wiki/File:Leuchtstofflampen-chtaube050409.jpg#/media/File:Leuchtstofflampen-chtaube050409.jp

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Notes

E3A: Energy Management for Home

Sarah Hamlen, Mike Vogel and Milton Geiger eds. E3A Program

Attic and Ceiling Insulation

Because warm air naturally rises, the attic or roof area of your home is your first priority for insulating. Insulation reduces the upward flow of heat, keeping it inside your home longer. That means you'll stay warmer, and your heating system will not come on as often – reducing your utility costs! In Montana's cold climate, insulating existing attics to an R-value of at least 49 is recommended. R-value is the measure of an insulation material's ability to resist heat flow. It's measured per inch of material. For example, glass fiber batt or blanket insulation has an R-value of around 3.2 per inch, and the R-value of loose-fill cellulose is about 3.7 per inch.

Both of these insulation types are commonly used to insulate attics. Twelve inches of the glass fiber batt insulation achieves R-38, and about 10½ inches of cellulose will achieve the same R-value. How much insulation is in your attic?

Attic/Roof Types

How your attic should be insulated depends on how your roof is built. Common attic/roof types are:

Unfinished Attic.

In these homes, the attic is not part of the living space. You can often get into the attic by ladder through a hatch usually located in a hallway or closet ceiling. Unfinished attics are generally the easiest type to insulate; the insulation goes between the framing members (joists) of the attic floor, which is also your living area's ceiling. Capable do-it-yourselfers can tackle this job with advice from a professional. Rolls of glass fiber or loosefill cellulose have been the insulation of choice for most do-it-yourself jobs. This fact sheet primarily deals with steps you can take to add insulation to your unfinished attic.

(Photo Community Services Consortium, NREL 17430 http://images.nrel.gov/viewphoto.php?imageId=6318114

Finished Attic.

A portion of these attics are living spaces. As a result, insulation should be placed in the exterior walls (called kneewalls), the entire ceiling and the outer floor areas – those not part of the living space. An experienced professional should be called upon for this job since it often requires the use of several insulation products and use of special insulation blowing equipment.

Flat, Vaulted or Cathedral Ceilings.

These types of ceilings don't have attics above them, and due to little or no space to add insulation, it may be impossible to add insulation to this roof type. If there is space, the insulation must be blown or placed between the interior ceiling and the exterior roof. It's very important that these construction types be well-ventilated and sealed to prevent moisture problems. They, too, usually require the expertise of a insulation contractor.

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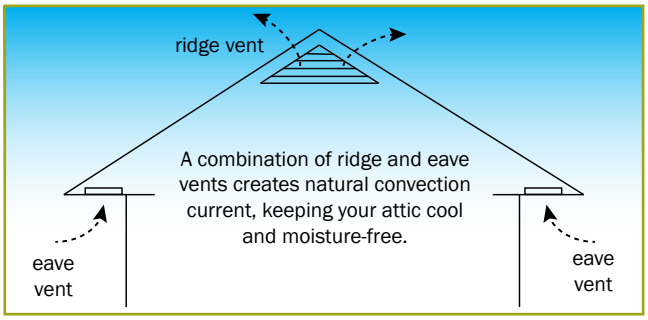
Adding Insulation to Your Unfinished Attic

Here are the steps either you or an insulation contractor should take to insulate or add insulation to your unfinished attic:

1. **Be an Attic Detective.** Go up into your attic with a flashlight and a dust mask to investigate. *CAUTION! If you find vermiculite insulation in your attic, DO NOT PROCEED. Since Vermiculite may contain asbestos, always have it tested by a professional testing service or contractor before continuing (www.epa.gov/asbestos/pubs/verm_questions.html).* Construct a makeshift walkway by laying boards on top of the joists, because the ceiling below won't support your weight. Measure the amount of insulation present and determine its type – it's most likely mineral or rock wool, glass fiber or cellulose fiber. If it is not vermiculite, you can take a sample to your Extension office or building materials supplier if you are unsure. If there is already insulation up there and it's dry and evenly spread out, you can leave it alone and add more insulation on top if needed.

   You can put glass or cotton fiber batt insulation over existing loose-fill or vice versa. As a rule of thumb, when adding more insulation, stay with the same type and/or weight of insulation. Heavier insulation will pack down your existing insulation and ultimately reduce the R-value of what was already in place. Just make sure that the new insulation doesn't have a vapor barrier, which would trap moisture inside the old insulation. (More on that later.) If the existing insulation is or has been wet, find and correct the moisture problem. It could be a leaky roof, or it may be caused by too much air leaking up from your living space. When warm air from your house rises into the attic, it carries with it large amounts of moisture, too. When the moisture hits the cold surfaces of your attic, it can condense and cause a number of problems:
   - wet insulation does not insulate well,
   - mold growth and damage to sheetrock and other building materials.

   To control moisture, also make sure bathroom and kitchen vents are not vented directly into the attic. They should be vented through the roof.



2. **Electrical.** Check all wiring and electrical junction boxes to assure wiring is not exposed and boxes are covered. Many old homes have a two wire system referred to as "knob and tube wiring." This type of wiring should not be covered with insulation. When in doubt, have a licensed electrician, inspect and upgrade your wiring.

3. **Seal Air Leaks.** Insulating won't save you much money or keep you much warmer unless you first seal all the air (and moisture) passageways between your living space and your attic. Common air leakage spots include the tops of interior and exterior walls, around pipes and heating ducts, light fixtures and wires. Conventional caulking methods work fine, though special care should be taken around plumbing stacks, and high temperature flues chimneys. You should also weatherstrip the attic hatch door, treating it as you would a door to the outside.

4. **Install a Vapor Barrier.** Moisture can also cause problems by traveling right up through the ceiling and into the insulation. If your attic is being insulated for the first time, to head off a potential moisture problem, you can lay down a vapor barrier (often a sheet of polyethylene plastic) on the attic floor before pouring or blowing in loose-fill insulation. Or you can purchase batt insulation with a kraft paper or foil vapor barrier attached. Be sure to install this type of vapor barrier closest to your living space.

Glass wool batt insulation
Photo by Radomil CC BY-SA 3.0
https://commons.wikimedia.org/wiki/File:Glass_wool_insulation.jpg#/media/File:Glass_wool_insulation.jpg

   If there is already insulation in your attic with no vapor barrier under it, you can paint your ceilings with vapor barrier paint – especially in high-moisture rooms such as kitchens, bathrooms, and utility rooms. If some insulation already exists, it is important that new insulation not have a vapor barrier. Preferably, the new insulation should be unfaced – manufactured without a barrier attached. If unfaced insulation is not available, use the vapor-barrier type but remove the barrier or slash it with a knife.

5. **Ensure Enough Ventilation.** Proper ventilation is another key to a successful attic insulation job. It lets your attic breathe, ridding it of moisture in the winter and keeping it cooler in summer. If you install a vapor barrier, you need one square foot of free vent area for every 300 square feet of attic floor area. Without a vapor

Bathroom and kitchen vents should be vented through the roof – not into the attic.
Photo by Waikanae CC BY 2.0, https://www.flickr.com/photos/yortw/6054887731

barrier, you need twice as much ventilation: one square foot of vent for every 150 square feet of floor.

Vents should be located on opposite ends of the attic, with some near the top and others near the bottom to allow for good cross-ventilation. Talk with a contractor about which types of vents would be best for your attic.

6. **Finally, the Insulation!** Now you're ready to either roll out the batts or pour in the loose-fill insulation. You may want to use some of both, putting batts between the rafters in the straight-aways and loose fill in the nooks and crannies. Buy batts wide enough to just fit between the attic framing. First fill the joist spaces, and then roll out a second layer on top, perpendicular to the first. Be sure to place the batts as close together as possible. If you opt for loose-fill insulation, pour it in and then level it with a rake or a board. If you plan to add loose-fill above the height of the joists, attach wooden sticks to the joists to serve as depth markers.

   As you add insulation, it's important to not block any combustion air supply source or any ventilation openings, especially in the eaves. Ventilation chutes should be installed during the insulation job to prevent vents from being blocked off. Also, keep insulation three inches away from recessed light fixtures, chimneys, fan motors and flues to reduce fire danger. Do this by surrounding the objects with a sheet metal barrier. Also, extend the barrier four inches above the finished insulation level. While it may be rare, if you have a water heater, furnace or knob and tube wiring in your attic, consult a professional for information on insulating around these obstacles.

   Whatever insulation type you choose, follow the manufacturer's directions carefully and don't unwrap the insulation until you get it up in the attic. Also, since you'll be spending time in a dusty space, wear a respirator dust mask, work gloves and protective clothing. It's a dirty job, but well worth the doing!

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