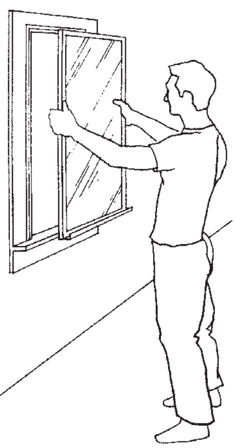
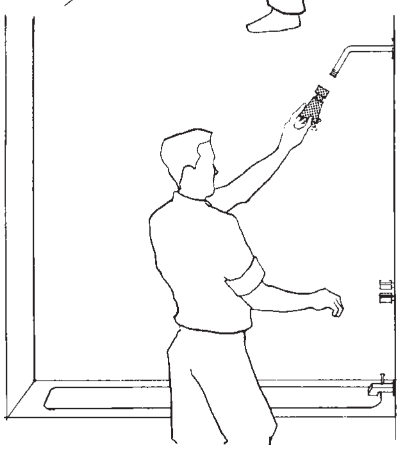
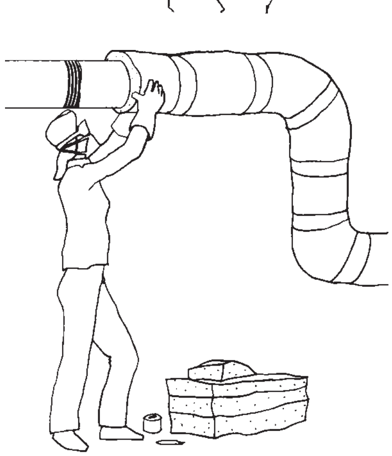
Home Energy Projects

An Energy Conservation Guide for Do-It-Yourselfers

Southface

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An Energy Conservation Guide for Do-It-Yourselfers

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2004

Credits

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INTRODUCTION

How to Use This Book

This book is divided into the following sections:

Chapter 1: **Home Energy Project Checklist** - a quick method for selecting energy conservation measures to install.

Chapter 2: **The Basics** - explains some of the theory of energy conservation and describes basic energy conservation practices.

Chapter 3: **Getting the Job Done Correctly** - discusses contracting, scheduling, tools and safety measures for doing the job right.

Chapter 4: **Energy Conservation Measures** - describes in detail how to implement twenty-five energy conservation measures.

Chapter 5: **Replacement Measures** - describes options available for replacing windows, doors, heating and cooling systems, fireplaces, etc.

The Residential Energy Code for Alabama - illustrates the climatic zones of Alabama and describes how energy conservation measures work together as a package.

Construction Terminology - shows the parts of a house via diagrams.

The *Checklist,* which begins the book, enables readers to develop a prioritized list of conservation measures for their homes. Those having little familiarity with today's energy conservation options may want to start with *Chapter 2: The Basics*.

In planning the work itself, the reader should review *Chapter 3: Getting the Job Done Correctly*. The reader can then review the detailed discussions in Chapter 4 and 5 on how to prioritize the measures.

CHAPTER 1

Home Energy Project Checklist

The Home Energy Project Checklist will help you decide which energy conservation measures to adopt. It lists "Current Conditions" in your house which call for improvement via an "**Energy Conservation Measure**" or "**Replacement Measure**." The Energy Conservation Measures are projects such as insulating and sealing air leaks. These projects are appropriate for many do-it-yourselfers. The replacement measures dictate greater skill levels and usually require a licensed plumber, heating and air conditioning contractor, or another home improvement professional.

The measures themselves are categorized according to four **Priority Levels**:

URGENT	These measures should be undertaken at once. They all will pay back your investment in less than three years. Most will pay back in one year.
ESSENTIAL	These measures are critical for energy conservation and savings. They will pay back your investment within five years.
IMPORTANT	These measures are what all energy-efficient new homes should have. Their paybacks are up to eight years, but they can significantly reduce energy bills and improve comfort and health.
OPTIONAL	These measures are for the energy-conservation enthusiast. You may not recover your investment before 15 years, but you may find the increased comfort and health benefits worth the money spent.

The installation cost and energy savings are estimated for each measure. Your savings may be greater or lower depending on the number of people in your household, the size of your home, your current level of energy efficiency, how you regulate your heating and cooling system, and other factors. Also, the total savings from several measures will most likely be less than the sum of the energy savings for each.

Once you determine which conservation measures are appropriate for your house, you can begin planning your energy conservation activities. See Chapter 3 for more information on scheduling these various conservation measures.

Exceptions

Attic insulation may already be installed in your attic, then again you may have none. Project 2 covers the whole topic of adding insulation to an attic with the objective of reaching a minimum installation of R-30, up to a maximum value of R-38.

For example: If you have R-24 insulation installed correctly in your attic you may want to do other projects first that could bring you greater savings and comfort.

Trade-offs

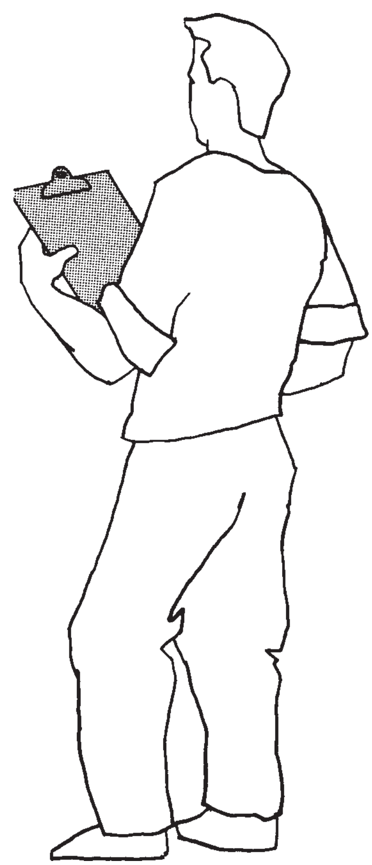
A discussion of the Residential Energy Code for Alabama on page 80 gives a reference to additional resouces that can help determine energy-saving strategies. Trade-offs in approaches to improving the energy-efficiency of your home could very well be dictated by your particular situation and resources.

For example: A homeowner in Mobile may improve comfort in the home by installing a radiant barrier in the attic as opposed to more attic insulation. Whereas a homeowner in Huntsville in a similar situation, but different climate zone, would benefit from additional insulation.

Energy Efficiency Checklist

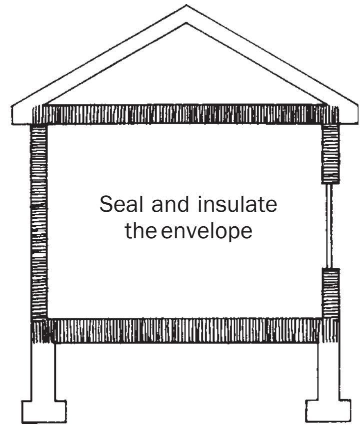
Energy Conservation Measures

Replacement Measures



CHAPTER 2

The Basics



This chapter describes how energy is used in homes, gives an estimated breakdown of annual energy bills, and suggests how to achieve the greatest energy savings. In addition, insulation, vapor barriers, infiltration, caulking, weatherstripping, shading, ventilation and other energy conservation practices are discussed.

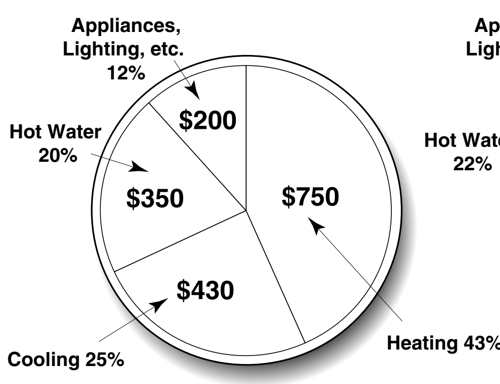
The Importance of Energy Conservation

For many Alabama residents, the costs of heating and cooling homes, providing hot water, and operating major appliances are difficult to afford; they can exceed mortgage payments. However, energy costs can be controlled through basic energy conservation measures.

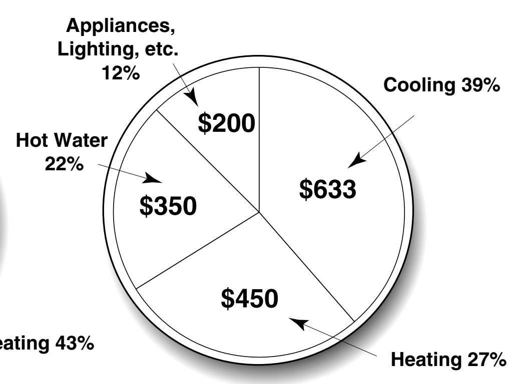
Some of the most effective ways to conserve energy cost little or nothing. Simply cleaning the filters on your home's furnace or air conditioner, setting back the thermostat at night, and proper scheduling of energy-consuming activities such as laundry, cooking, and dishwashing can save you energy and money.

Energy-saving improvements to your home, such as increasing insulation in the attic and floor, sealing off unwanted drafts, and buying energy-efficient models when replacing appliances may cost several hundred dollars. However, they pay for themselves in energy savings within a few years. Most of the energy conservation measures that save on heating bills will also keep your house cooler in summer. Conservation will make your home more comfortable by moderating temperature swings and eliminating drafts. Some measures will also reduce maintenance needs for your home and add to its value.

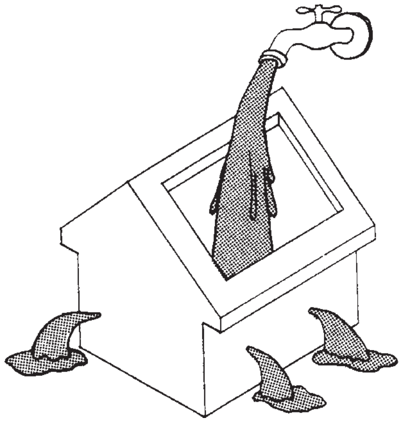
The energy costs for any home depend on many factors including local climate, size of the home, and lifestyle of the occupants. However, the most important factors are the design and construction of your home—the quantity of insulation in the ceiling, walls, and floor, the tightness of construction (how well it prevents drafts), and the efficiency of heating and cooling equipment and major appliances such as the water heater, refrigerator, and dishwasher. The following chart shows estimated energy costs of typical 1,800 sq.ft. Alabama homes with a family of four.



Home Energy Use
Birmingham



Home Energy Use
Mobile



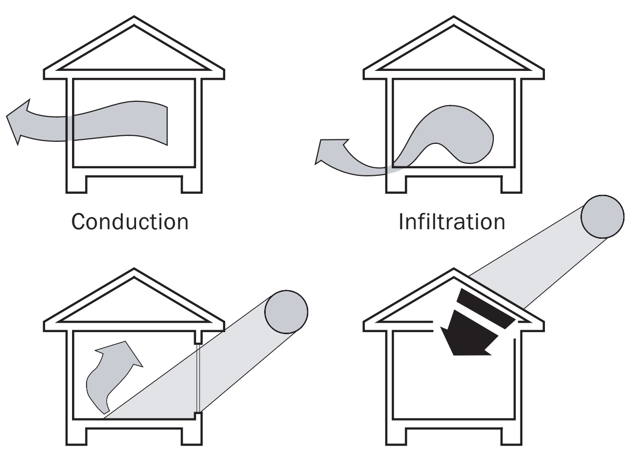
The energy bucket

Your home's energy bills may vary from the estimates in the chart. Often, local utilities will be able to help you determine your specific energy use.

In considering energy conservation measures to reduce energy bills, think of your house as a bucket and the energy used to heat and cool it as water in the bucket. If there is a hole—no matter how small—the water will drain out.

If there is a hole in the insulation, weatherstripping or caulking of a house, heat escapes in winter or leaks inside in summer. In an energy-efficient home, these leaks are minimized by insulating the ceiling, walls, and floor and by sealing air leaks.

Before investing in energy conservation, think about how energy is used in a home. Heating, cooling and hot water are primary energy needs. Energy conservation can help the most in these areas.



Energy Conservation in Buildings

The energy needed for heating and cooling is determined by the movement of heat into and out of your home. Heat travels by conduction, convection, and radiation and always moves from hot to cold. The speed at which heat moves is determined by the difference in temperature between the hotter area and the cooler—the larger the difference in temperature, the faster heat flows.

Conduction is the movement of heat through a solid object such as the ceiling, walls, and floor of a home. Insulation is used to stop the flow of heat by conduction and will reduce your heating and cooling costs.

Convection is the transfer of heat caused by the movement of air. As air is heated, it becomes lighter and rises. As air cools, it becomes heavier and falls. Convection causes air to circulate between warm areas and cool areas inside a home.

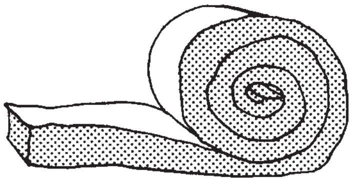
Infiltration is the convective flow of heat in and out of a home through air leaks. Weatherstripping, sealing holes, caulking cracks, and other infiltration control measures can reduce total heating and cooling bills over 30 percent.

Radiation is the movement of heat by long waves from a warm to a cold surface. For example, radiation heat flow occurs in the summer when sunlight strikes a roof and the roof radiates heat to the attic floor below. You can use reflective materials to block the flow of radiant heat.

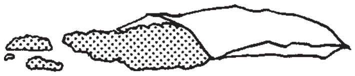
In winter, your home loses heat by conduction through the building envelope—the walls, windows, ceilings, and floors that form the barrier between heated and unheated areas; by infiltration around the baseboard or sill plate, windows, doors, and wall penetrations for plumbing and wiring; and by radiation from people and warm interior surfaces to cold outer walls and windows.

Heat gain in the winter from sunlight and internal heat sources—the heat given off by appliances, lighting, and people—helps offset the losses from conduction, infiltration, and radiation. In homes designed to capture and store sunlight, called "passive solar" homes, heat gain from sunlight can provide over 50 percent of the total heat required.

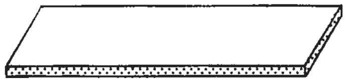
In summer, unwanted heat enters your home primarily through conduction from the outside, through sunlight passing through windows, and from internal heat sources. Air leaks bring in outside humidity which causes moisture problems as well as higher bills. Radiation can be important in houses with little ceiling insulation.



Batt or roll insulation



Loose-fill insulation



Rigid board insulation

Insulation Materials

Insulation blocks the flow of heat by forming thousands of pockets which trap air or other gases. These pockets, called dead air spaces, must be kept intact for the material to maintain its insulating value.

Many different insulation products are available. When choosing one, always consider the R-value, a measure of effectiveness (R means resistance to heat flow). The higher the R-value, the better the insulator. Labels on some products, such as windows and doors, may list the U-value, which is simply the inverse of the R-value ($U = 1/R$). The lower the U-value, the greater the resistance to heat flow.

Compare insulation materials by the cost per R-value. Some insulating materials have a high R-value per inch of thickness, but are more expensive per R-value than other products. For example, fiberglass batts have an R-value of about 3 per inch and cost around 1.5¢ per R-value per square foot. Rigid foam insulation boards have a higher R-value per inch but cost about 5¢ per R-value per square foot. If space is not a problem, such as when insulating a ceiling with an attic above, fiberglass is a better buy.

Careful installation of insulation and weatherstripping is critical. In a study conducted by the Naval Civil Engineering Laboratory, a 5 percent gap in the coverage of ceiling insulation, such as the area above your attic access, reduced the overall insulation effectiveness of the ceiling by over 40 percent. Similar findings were reported for gaps in the wall and floor insulation.

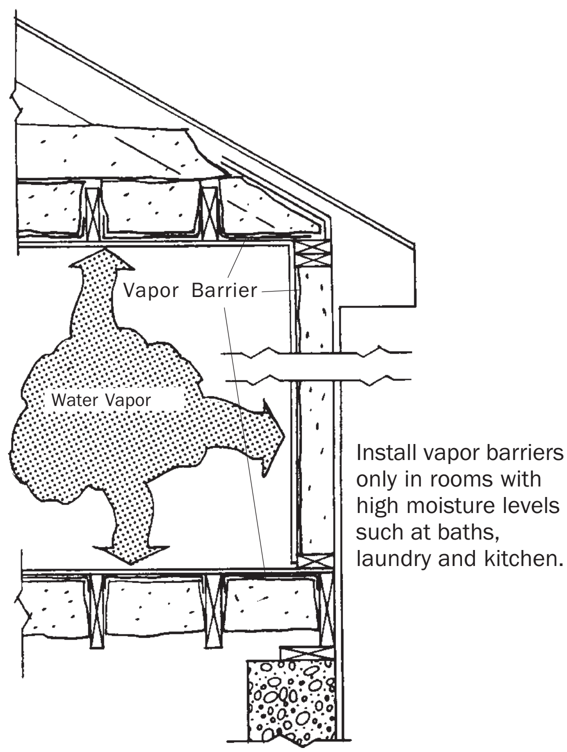
Water Vapor

Water vapor occurs naturally inside a home, especially in kitchens, baths, and laundries. A vapor barrier prevents the flow of moisture from inside the house into the insulation. If insulation gets damp, its insulating value decreases. Where severe condensation occurs, the moisture produced may cause deterioration of materials or rotting of wood.

Most of the moisture that moves from inside the house into the insulation is carried by air leaks rather than by diffusion through interior finish materials. Therefore, to control moisture, it is more important to seal openings in walls, ceilings, and floors.

Some types of insulation have an attached vapor barrier, for example, fiberglass batts with asphalt-impregnated kraft paper or metal foil. Other types, such as unfaced batts, loose-fill cellulose, fiberglass, or rock wool that come in bags, have no built-in vapor barrier. For these products, polyethylene plastic installed on the interior side of the insulation or a vapor barrier paint can be used to stop moisture flow.

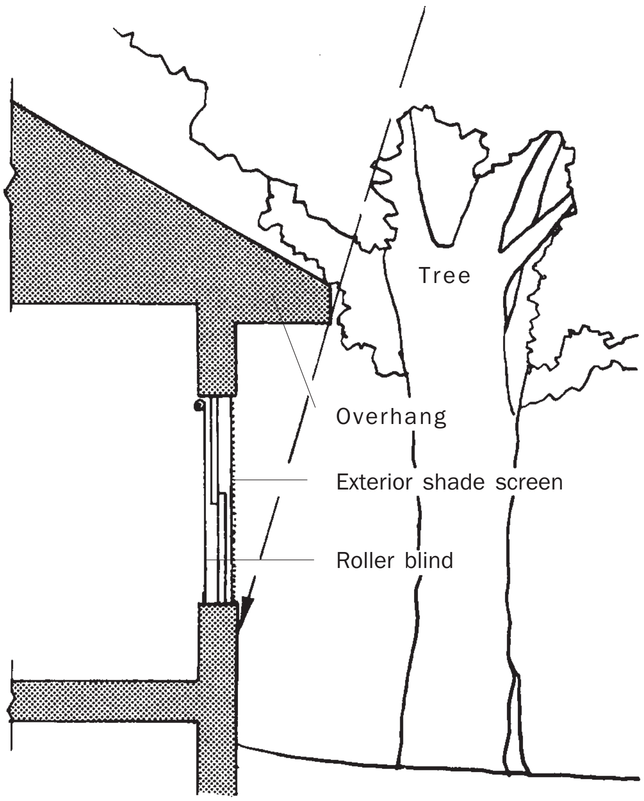
The vapor barrier should be located between the insulation and interior of the home. If you are using insulation without a built-in vapor barrier, either install polyethylene plastic on the interior side of the insulation, or apply a vapor barrier paint on the ceiling and walls of rooms with *high humidity, such as baths, laundry, and kitchen*. An exhaust fan to vent heat and humidity to the outside should also be included in these rooms. Paints which help prevent the flow of moisture are available at hardware stores.



Weatherstripping and Caulking

Weatherstripping is a strip of metal, plastic, rubber, or fiber that blocks air leaks around doors, windows, and other openings in the building envelope. Caulking, which is a pliable material, or foam sealants are used to seal gaps. They are also used to seal the seam where different buildings materials meet, such as between the window jamb and siding.

When choosing weatherstripping and caulking products, consider cost and longevity. The caulk should have at least a 25-year life. Acceptable options include acrylic latex caulk with silicones, silicone caulk, and urethane caulk.



Natural Cooling

The same conservation measures that keep heat inside your home in winter will also help keep heat outside in summer. By relying on conservation and other natural cooling techniques, you should be able to minimize the need for air conditioning. If your home does not have air conditioning, natural cooling measures become even more important as they can keep the house comfortable for much of the summer.

The keys to staying comfortable inexpensively in Alabama's hot and humid summers are to keep windows shaded from direct sun, provide adequate ventilation in the house, avoid activities that produce heat or humidity, and use air conditioning as efficiently as possible.

Daily activities inside the home, such as cooking, washing dishes, laundry, and bathing are a major source of heat and humidity in the summer. By minimizing these activities and scheduling them for cooler morning and evening hours, your home will stay more comfortable.

Shading—In winter, the south side of your house receives almost three times more sunlight than the east or west sides. However, in summer, the east and west windows receive the bulk of the sun's rays—almost three times more than the south side. Therefore, summer shading of the east and west windows, and, to a lesser degree, the south windows, is of paramount importance. Use trees, shrubs and trellises to shade unshaded windows where practical.

Overhangs provide some shading for windows facing south. For most residences, they should be two feet wide and located at least 6 inches above the top of the window to allow the low winter sun full access to the south glass area. However, overhangs do not provide much shade for east and west windows because of the low summer sun angles in the morning and afternoon. Awnings that extend over the windows are better for these applications.

While landscaping and overhangs offer some protection, additional shading for windows should be provided by exterior or interior treatments. Of course, it is better to block the sun before it enters the windows. Exterior shade screens, which block up to 70 percent of sunlight, accomplish this and serve as insect screens also. However, they do darken the view somewhat and should be removed in winter to let the sun help heat the home.

Interior treatments include roller blinds, light-colored drapes, venetian blinds, and shutters. They should have a reflective or glossy white exterior to bounce incoming sunlight back out of the window.

Radiant Barriers—If the attic is properly insulated and ventilated, little of the heat that is conducted through a solid roof enters the living area. However, some radiant heat from the hot roof does warm up the insulation, which increases heat gain into the house. A reflective foil or other reflective material located between the roof and insulation can reduce this flow of radiant heat.

Ventilation—In addition to shading, ventilation is an effective strategy for helping maintain comfort indoors in summer with minimal use of air conditioning. Whenever the temperature outside is lower than that inside, open windows to ventilate the house. Place fans in windows or use whole house fans to draw air into the house during cooler morning or evening hours.

As temperatures increase during the day, close windows and shades to block the heat, and use interior fans to circulate air. Keep room and ceiling fans on while the air conditioner is running, too. By moving the cooled air with fans, you will feel as comfortable with the air conditioner thermostat set at 80 to 85 degrees as at 75 degrees with no air movement. For each degree that the thermostat is raised, air conditioning costs will be lowered three to eight percent. Always close windows when the air conditioner is on.

The attic of the home should be fully ventilated. Air flow in the attic helps remove moisture throughout the year and keeps attic temperatures cooler in summer. Avoid use of powered attic ventilators which may cause home depressurization problems.

Domestic Water Heating

Energy costs for heating water can be as great as those for heating or cooling an entire house. An average family of four in Alabama will spend about $400 each year for electric water heating or about $200 for natural gas. However, several simple energy conservation measures can cut that bill by more than half.

Reducing the temperature setting on the water heater from high to low (160 degrees to 120 degrees) will save energy and still provide enough hot water. Electric water heaters usually have two thermostats which can be adjusted with a screwdriver. Make certain that the flow of electricity to the heater is disconnected before adjusting the thermostat. Gas water heaters usually have a temperature setting dial near the burner. This dial can easily be turned to set the temperature.

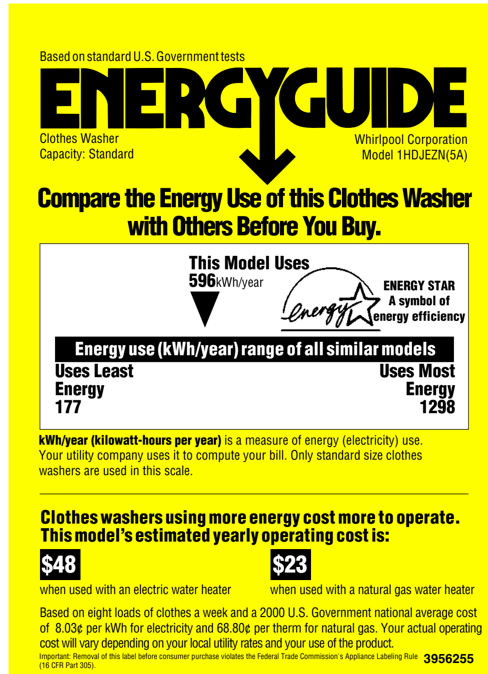
If you have to buy a new water heater, make certain it is an energy-efficient unit with foam insulation inside the metal shell. Install "heat traps" to reduce standby losses in the lines from the tank. For your current water heater, installing an insulating tank jacket will quickly pay for itself in energy savings. In addition, insulate the first three feet of all pipes extending from the tank. If the water heater is located inside the living area, increasing the insulation levels will keep your home cooler in summer.

Flushing sediment from the water heater helps to save energy as well as to extend its life. Drain a gallon of water from the bottom of the tank every few months to remove any sediment that has accumulated. Replace the anticorrosion rod to prevent deterioration of the tank.

Low-flow showerheads, which release water at the rate of two to three gallons per minute instead of the usual five gallons, save energy and water. Well-designed fixtures will reduce only the quantity of water and not the force at which it is delivered. They can cut water use up to 60 percent.

Energy-Saving Appliances

Energy-efficient appliances can also save you money on utility bills. Refrigerators, freezers, and dishwashers are the biggest energy users and together can cost several hundred dollars a year to operate. High efficiency models can save over 50 percent of these costs.



When selecting an appliance, consider its estimated energy costs, which are given on the Energy Guide tag. This yellow tag is required by law to be attached to most major appliances and compares the energy use of a particular product to that for similar models. The Energy Guide also shows the estimated yearly cost of operating the appliance. Energy Star® labels guarantee efficient appliances.

In addition to saving energy, efficient appliances give off less waste heat than standard models so that they save on air conditioning costs, too. Their higher cost is usually recovered within the first few years.

CHAPTER 3

Getting the Job Done Correctly

This chapter considers the practical issues involved in working on your home:

- Should you hire a contractor to do the job?
- How should you decide what conservation measures to install with your limited time and money?
- In what order should the measures be applied?
- Do you have the skills necessary to do the work?
- What are the basic rules for using tools?
- What are effective safety guidelines?

Should You Do It Yourself?

The energy conservation measures described in this publication have a common goal—saving money and energy. Your skills will be perfectly suited for some tasks, while other tasks will require a contractor. Be sure to judge accurately your own capabilities before embarking on a project by yourself. Even when hiring a contractor, read the instructions in this book to ensure quality work.

Questions to answer:

1. If I make a mistake, what would be the worst possible consequence? How much would the repair cost? How likely is the mistake? Can I really afford the risk?
2. Do I really have the skills to do an acceptable job on this project? Do I have the necessary tools? Can I rent the tools?
3. Do I really have enough time to do the project? If the project takes two times (three times, four times, etc.) longer than I anticipate, what would be the consequences? Will the house be without heating, cooling, hot water, any water, or electricity? Can I call in a contractor quickly enough to avoid a serious inconvenience for my household?

If, after reviewing the questions, you are still confident and ready to proceed, go ahead. But first, read the sections in this chapter that describe the basic things to consider when working on energy conservation measures. If you realize that you need to hire a contractor, read the next section.

Hiring a Contractor

Weatherization and renovation contractors vary widely in cost, skill level, knowledge and quality. The guidelines listed below should be followed when dealing with any contractor:

1. Always check references for contractors and look at their previous jobs. Talk at length with former clients about the quality of the work.
2. Write a bid request that describes the project fully and includes drawings of unusual construction details.
3. Get bids from at least three contractors.
4. Write a contract with the contractor to help minimize costly misunderstandings for both parties. The contract should spell out all phases of the project in detail. For example, when hiring someone to insulate the floor, specifically write into the contract whether you want a plastic vapor barrier installed on the floor of the crawl space, pipes insulated, or dryer vents extended.
5. A contract for insulation work should specify what R-value you want installed. Always check to make sure the proper number of bags or batts is used.
6. Never pay the contractor until the job is completed. If necessary, you can work out a payment plan so that as parts of the job are completed, payment can be made.
7. If the contractor does not live up to the contract, make her/him correct the deficiencies. Be firm and straightforward when working with contractors.

Scheduling the Job

Often your bank balance will restrict you from implementing as many measures as you would like. Schedule the jobs wisely. Start with the highest priority (urgent priority) tasks first and work down to those having less importance. For example, do not do a lower priority job, such as installing storm windows, when a high priority task, such as insulating the attic, has yet to be done. See Chapter 1 for a list of conservation measures in priority order.

The detailed descriptions of the different measures in Chapters 4 and 5 include cost estimates. Determine your maximum budget and identify, in priority order, a set of jobs whose total costs will not exceed the budget.

Skills Required

For each conservation measure described in this book, the relative skill level needed by the do-it-yourselfer is indicated. The main categories used are:

Simple handiwork—competent using basic hand tools, such as hammer, screwdriver, utility knife, tape rule, putty knife, and handsaw.

Basic carpentry—comfortable working with both hand tools and power tools, such as circular saw, electric drill, reciprocating saw, and saber saw.

Skilled carpentry—proficient with hand tools and power tools. Able to make difficult angled cuts and do finished carpentry. Knowledgeable about most elements of residential construction.

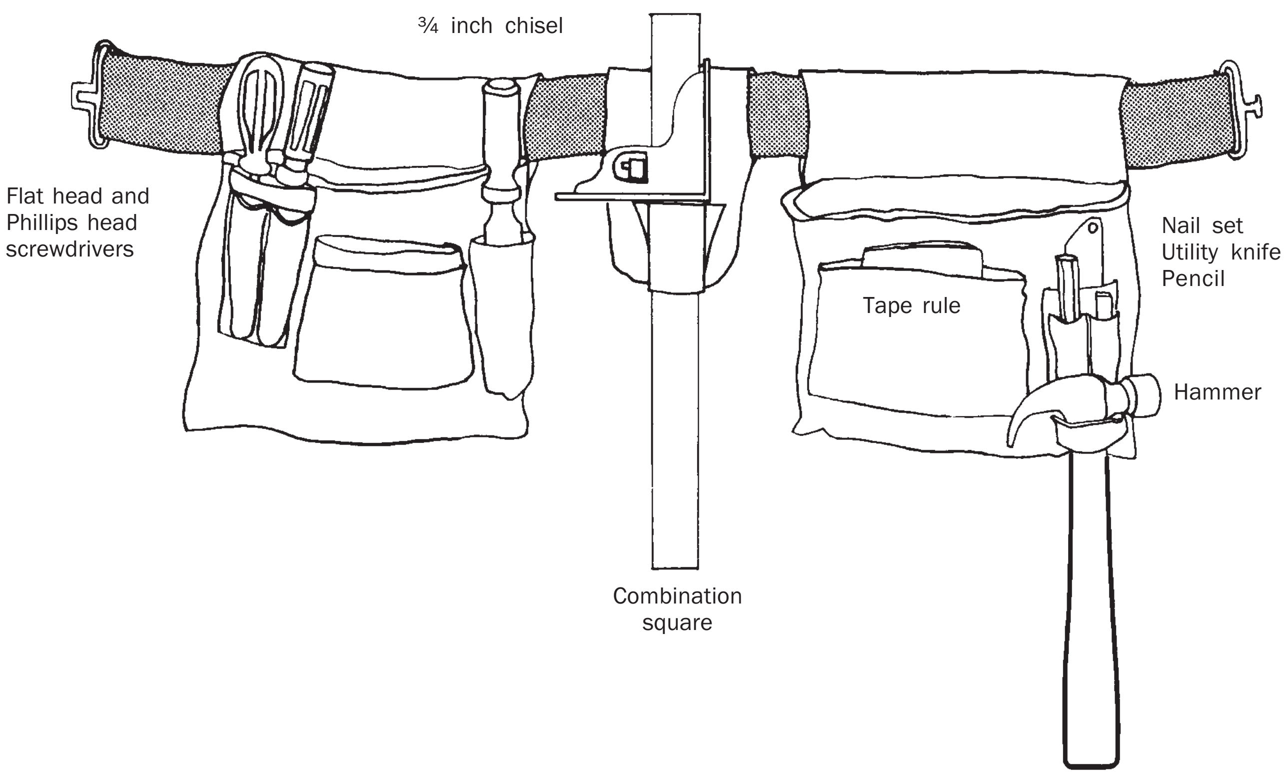
Rules for Tools

Tools are intended to make our work easier. Too often, inexperienced do-it-yourselfers use the wrong tools or poorly maintained tools and make simple jobs difficult. Some general guidelines for tool use are:

1. Use the right tool for the job.
2. Always keep tools in good condition—chisels and cutting blades sharp, paint brushes clean, etc.
3. Never muscle or rush your work.
4. If a job requires more muscle than you have, there is probably a tool to make it easier. Often, expensive tools can be rented for reasonable prices.

Accompanying the conservation measures described in Chapter 4 of the book are lists of the tools needed for each project. Because of their frequent use, the tools listed to the right are referred to throughout the text as **"Carpenter's Tool Belt."**

Carpenter's Toolbelt



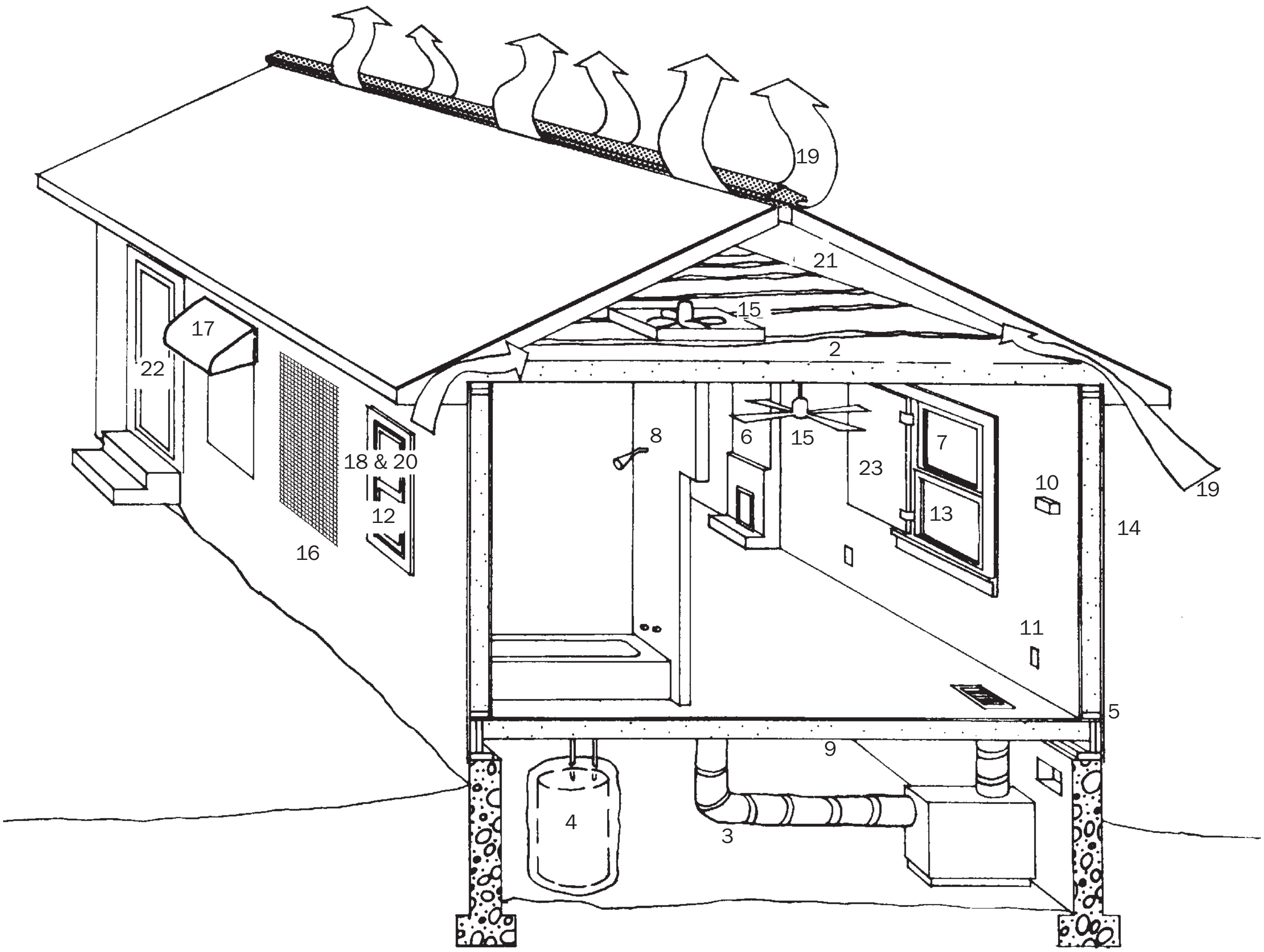
Safety First!

Safety should be a predominant concern of the occasional carpenter. When working sporadically, such as on weekends, you often forget to pay attention to basic safety rules in your rush to finish the job. A reasonable set of common sense safety measures follows:

- Don't wear loose clothing; tie back long hair. Wear protective gear—earplugs, heavy shoes, hats, goggles, and gloves. Wear a dust mask when working around sawdust, insulation, etc.
- Provide plenty of light on all sides of the work. Clean up any mess around you. Clear your path before carrying lumber or other large or heavy objects. Remove all obstructions and distractions; even something far away can become surprisingly distracting once you have started the job.
- Before you switch on a power tool, STOP, THINK, AND CHECK! Where is everything? Are your hands clear? Are you well balanced? Is all of your body well out of the path of action? Is your support stable? Is the tool going to run into anything? Reconsider for a moment (this also applies to hand tool use).
- Switch ON a tool only when ready to use it immediately. Switch it OFF immediately after use—if you get accustomed to the sound you may forget the machine is active.
- Unplug power tools when changing blades.
- You are never so skilled that you can become casual around power tools; always observe basic safety rules.
- Maintain a respect for more "passive" tools. Keep fingers back from points of chisels, screwdrivers, awls, and hand saws. They can cause surprisingly large cuts.
- Use clamps to secure the work.
- Use only clean, dry, unfrayed extension cords. Beware of water puddles. Observe proper grounding practices.
- Never place tools on a step ladder, even for a moment. When you later move the ladder, tools can fall on your head!
- Follow common sense rules about tools (see previous section).
- When you are tired, stop. If confused, unclear, perplexed or hungry, stop. A little time goes a long way in solving a problem—trying to rush a solution often causes mistakes.
- Provide adequate ventilation when working with paints, adhesives, and other materials with harmful fumes or vapors.
- Familiarize yourself with first aid practices. Know the location of the nearest telephone and hospital. Keep a first-aid kit nearby.

CHAPTER 4

Energy Conservation Measures



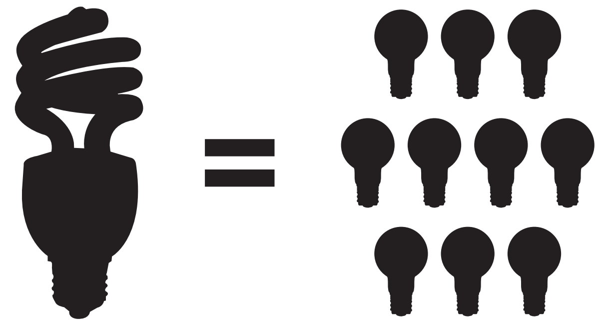
The key to reducing annual energy bills is not just thinking about all the possible energy conservation measures you can adopt, but actually getting down to work. This chapter includes 25 energy conservation projects that can reduce your energy bills up to 70 percent. It is organized into groups of projects having different priorities, as described at the beginning of Chapter 1.

Estimates of the cost of materials, the cost of hiring a contractor, and the approximate annual energy savings are shown for each measure. The do-it-yourselfer should approximate costs using just the materials figure. The contractor cost either includes: materials, labor, overhead, and profit; or an estimate for hourly rates. The cost and energy saving estimates can vary considerably and should be used only as a guideline. The total energy savings from installing several measures will most likely be less than the sum of the energy savings from each.

PROJECT 1

No-Cost, Low-Cost Measures

Priority: ★★★★



Initial requirements and procedures

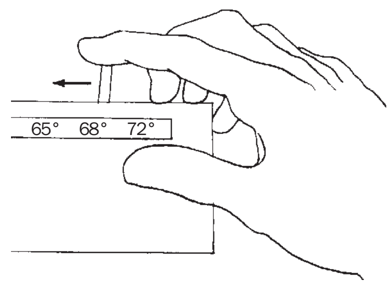
Many opportunities for saving energy are available at the tip of your finger—switching off lights, adjusting thermostats, switching on fans, etc. However, simple, no-cost measures are often overlooked.

Materials

Furnace filters need changing every 90 days. Choose pleated filters, that are a step up from the low-cost filters, to do a better job at filtering particles. Compact fluorescent light bulbs have come down in price in recent years - these are a bargain at most any price because of the electricity they save.

Saving on heating bills

- Set the thermostat back to 55 or 60 degrees at night, or lower as comfort allows. If you have a heat pump, setting your thermostat back may not save you money. Check with your local utility for recommendations for your home.
- Leave the thermostat at a maximum of 65 to 68 degrees during the day, if the house is not occupied.



- Keep the fireplace damper closed whenever fires are completely extinguished (if you do not have a damper, install a fireplace cover—**Project 6**).
- Use kitchen, bath, and other vent fans sparingly on cold days.
- Do not use the fireplace when the furnace is on unless the fireplace has glass doors.
- If the heating system is in use, never open a window in a room that is too hot; reduce the thermostat setting instead.
- Install a clean filter for the heating system every month or two during the winter.
- Wear a sweater—a light, long-sleeved sweater makes the room feel two degrees warmer, a heavy sweater makes it feel about four degrees warmer, and two lightweight sweaters make it feel five degrees warmer.

☑ *Checklist*

Typical Costs and Savings
- Materials: Minimal
- Contractor (materials, labor, and overhead): None required
- Annual energy savings: Up to several hundred dollars

Average Time Required
- 2 to 3 days

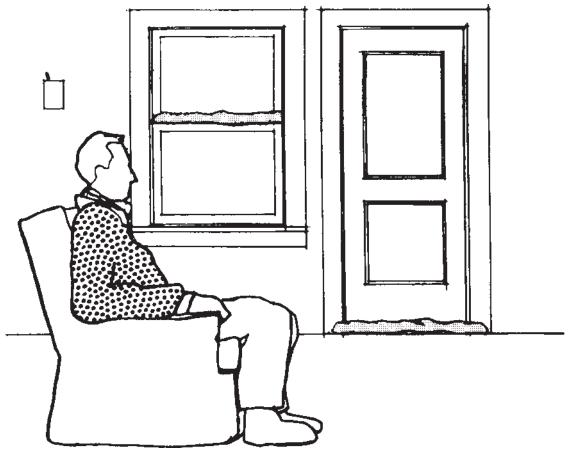
Skills Required
- Simple handiwork

Tools

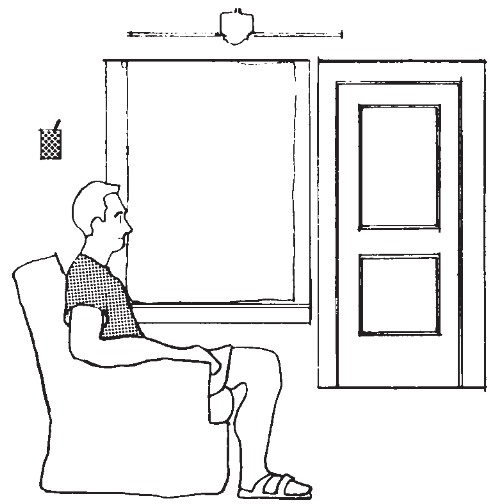
Tape rule
Utility knife or heavy-duty shears
Scotch tape

Safety

No special measures



Dress for Winter



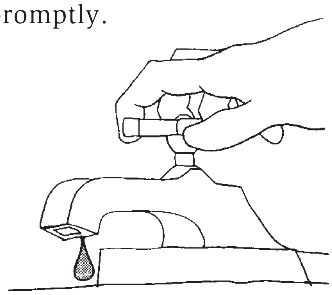
Dress for Summer

Saving on cooling bills

- Set the air conditioner thermostat at 78 to 85 degrees and run fans to keep the room comfortable.
- Set the fan speed for a window air conditioner on high except in very humid weather. When it is humid, use the low fan speed setting.
- Keep air conditioner filters clean.
- Turn off the air conditioner when you leave for several hours.
- Keep shades and curtains drawn over windows to help block sunlight.
- Do cooking, dishwashing, and laundry in the early morning or later evening to decrease heat build-up during the hot part of the day.
- On mild days, open windows to cool the house instead of using the air conditioner.
- During the hot part of the day, close windows to keep the heat out. Have ceiling fans blow downward.
- Dress for warmer temperatures—shorts or skirts, and light sleeveless blouses for women; shorts and short-sleeved shirts for men.

Saving on water heating

- Repair leaky faucets promptly.
- Set the water heater thermostat down to 120 degrees (or to the low setting) unless you have a dishwasher that requires 140-degree water.



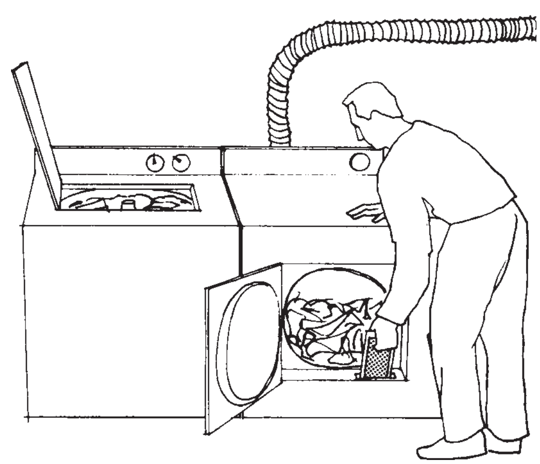
- Do not allow faucets to run continuously while rinsing dishes, shaving, or washing hands.
- Use cold water for rinsing the kitchen sink and for using food disposals.

Saving on appliances

- Use toaster ovens, pressure cookers, or other small appliances instead of the oven when possible.
- When buying appliances, read Energy Guide labels describing comparative energy use carefully. Buy Energy Star labeled appliances when you can.

Clothes washing tips

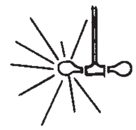
- Wash full loads for best efficiency
- Wash clothes in cold water
- Air dry clothes whenever possible
- Keep the dryer's exhaust vent clean and make sure it runs to the outside.



Wash and dry full loads

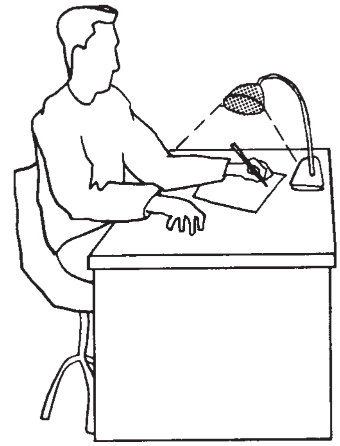
Automatic dishwasher tips

- Run your dishwasher with a full load. Most of the energy used by a dishwasher goes to heat water.
- Avoid using the heat-dry, rinse-hold and pre-rinse features.
- Use your dishwasher's air-dry option. If your dishwasher does not have an air-dry option, prop the door open after the final rinse to dry the dishes.



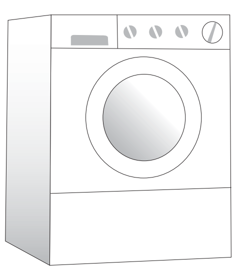
Saving on indoor lighting energy use

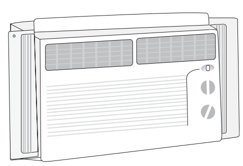
- Turn off lights in unused rooms.
- Use higher lighting levels in work areas.
- Reduce overall lighting levels for room illumination.
- Use fluorescent bulbs whenever possible.
- Keep all lamps and lighting fixtures clean.

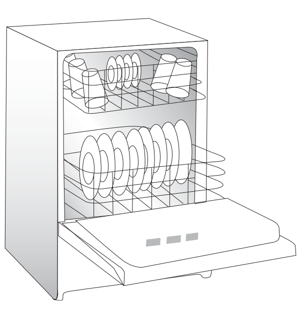


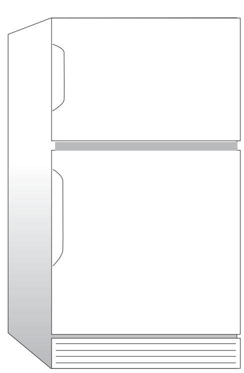
What is ENERGY STAR?

Energy Star® is a government-backed program helping businesses and individuals protect the environment through superior energy efficiency.









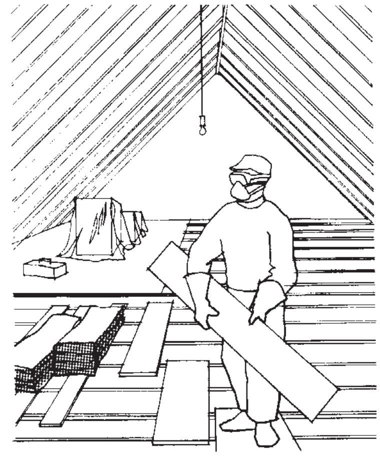
For the home

When buying an appliance, remember that it has two price tags: what you pay to take it home and what you pay for the energy and water it uses. Energy Star qualified appliances incorporate advanced technologies that use 10-50% less energy and water than standard models. The money you save on your utility bills can more than make up for the cost of a more expensive but more efficient Energy Star model.

- If looking for new household products look for ones that have earned the Energy Star. They meet strict energy efficiency guidelines set by the EPA and US Department of Energy.
- If looking to make larger improvements to your home, EPA offers tools and resources to help you plan and undertake projects to reduce your energy bills and improve home comfort.
- Replacing windows is rarely cost-effective based soley on energy-savings. However, if you are planning to replace your windows because of maintenance or aesthetic reasons, make the most of the opportunity and consider Energy Star rated windows. You'll get new windows, comfort, and energy cost savings.

PROJECT 2

Install R-30 to R-38 insulation in non- or partially-insulated attics



Priority: ★★★★

Initial Requirements

All insulation is rated by R-value. R-value is a measure of the resistance to conductive heat flow of a material. Insulation materials have high R-values while conductive materials, such as metal, have very low R-values.

If your attic currently has no insulation or a small amount of insulation you need to insulate to a minimum of R-30 with the preferred level at R-38. These amounts of insulation are sufficient in the southeast region* of the United States. *Note that some insulation is better than no insulation and that insulation can be layered on top of previous installations.*

If the attic does not have adequate ventilation (the net free vent area should equal 1/150 of the attic floor area), consider installing more passive attic ventilation—see **Project 19** for details.

Materials

- Insulation—if installing roll or batt insulation, see sidebar on *How to Order Roll or Batt Insulation* on page 20. If installing loose-fill insulation, see the section entitled *Blowing Loose-Fill Attic Insulation*.
- Foam sealant—one to three cans used to seal around wiring, plumbing, ducts, and other penetrations between attic and heated area
- Air sealing materials, such as plywood, insulation boards, and caulking as required
- Weatherstripping—for attic access doors
- Sheet metal and screws—for supporting insulation blocking around chimney

☑ *Checklist*

Typical Costs and Savings

- Materials: \$.35 to \$.55/sq ft fiberglass/mineral wool roll; or, \$.28 to \$.35/sq ft blown cellulose; or, \$.28 to \$.38/sq ft blown fiberglass/mineral wool
- Contractor (materials, labor, and overhead): \$.43 to \$.77/sq ft fiberglass/mineral wool roll; or, \$.35 to \$.60/sq ft blown cellulose; or, \$.35 to \$.60/sq ft blown fiberglass/mineral wool
- Annual energy savings: \$.13 to \$.22/sq ft of attic floor

Average Time Required

- ½ to 1 day/1,000 sq ft

Skills Required

- Simple handiwork for installing batt or roll insulation
- Blown insulation is usually installed by a contractor, but a person who is handy can usually do the job

Tools

Utility knife
Heavy-duty shears
Drop light and extension cord
Tin snips
Tape rule
Heavy-duty stapler and staples
Dust mask

Basic Procedure

Two approaches for installing attic insulation are addressed in this section:

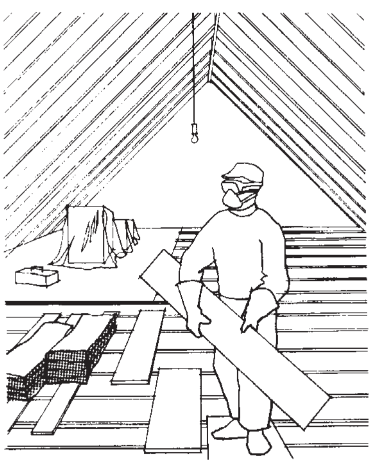
1) installing your own batt or roll insulation, and

2) blowing in loose-fill insulation. Batts and rolls are relatively easy to install, and using them to insulate an attic is an ideal project for the occasional do-it-yourselfer.

Loose-fill insulation should always be installed with a mechanical insulation blower which mixes air in with the insulation and increases the R-value. Blowing insulation is a more complicated job than installing batts or rolls. It is appropriate for skilled do-it-yourselfers. However, sometimes the cost for a contractor to put in the insulation will be less than the materials cost for the insulation itself, whether it is in batt, roll, or loose-fill form. Therefore, call several contractors to get bids before deciding to install insulation yourself. Information on blowing your own attic insulation is covered later in this chapter.

Insulation Safety

When working in the attic, be careful of what is below you—a ceiling that probably will not support your weight—and what is above you—a roof deck that likely has roofing nails pointing toward you. Walk only on the ceiling joists, attic floor, or walkboards placed on top of the joists. Be careful not to hit the roof above with your head; you should wear a construction helmet to ensure protection.



Insulating an attic is a messy job. The attic air will be full of particles from the insulation, so wear a dust mask and goggles. Also, put on gloves, a long-sleeved shirt, long pants, socks, and good shoes to protect your skin from potentially irritating insulation.

Installing roll or batt insulation

1. **Install attic ventilation** (see **Project 19**: Increase Attic Ventilation)

2. **Check the attic and roof condition**

   a. Are there roof leaks? Look for water stains on the underside of the roof decking, on the existing insulation, or on the attic floor.

   b. Will the ceiling support insulation? If the interior plaster is beginning to pull away from the lath or the drywall or sheetrock is pulling away from nails, do not insulate unless the ceiling is reinforced, or insulate by laying rolls of insulation tightly together crosswise over the joists.

   c. Before insulating, note the location of all of the following items:
   Recessed lights
   Doorbell transformers
   Masonry chimneys
   Metal chimneys and vent pipes
   Exhaust fans
   Heat/light ventilators
   Knob and tube wiring
   Uncovered electric junction boxes
   Whole house fans
   Attic access doors

You will need to take care when insulating near these objects to reduce the danger of fire. See the section on Attic Insulation Blocking Guidelines (page 20).

3. **Prepare the attic**

   a. Run drop cords and lights into attic. Install 2x6 or 2x8 walkboards so nobody accidentally steps on the ceiling and ends up on the floor below.

   b. Move stored items downstairs; protect what is left by covering them with plastic.

   c. If possible, pull up the attic floor over any uninsulated areas.

   d. If the old insulation is damp and compressed, remove it. If the vapor barrier on old insulation faces upwards, remove it or flip the insulation so the vapor barrier is against the ceiling.

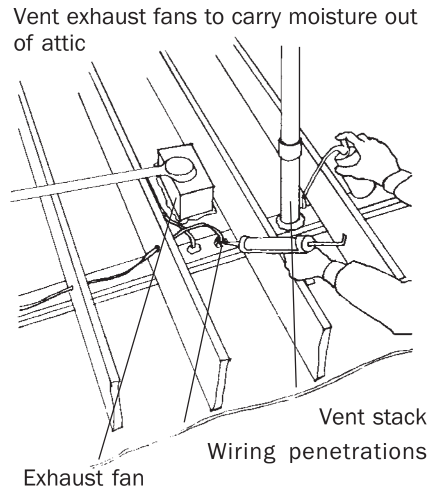
4. **Seal penetrations through the attic with foam sealant or caulking**

   Locate all wiring, plumbing, ductwork and other penetrations through the ceiling and seal using 20-year caulk, spray foam sealant or other suitable material. Pay special attention to large cracks or holes, such as those around lights, heating ducts, or electric boxes for ceiling lights.

5. **Weatherstrip and insulate the attic access door**

Install weatherstripping all around the attic access door to reduce infiltration. See **Project 13:** Weatherstrip Leaky Windows and Doors for more information on weatherstripping.

Attach a batt of insulation to the door. If the attic access is a fold-down stairway, build a lightweight, insulated box to go over the stairs. Such a box can be lowered easily over the stairs as they are closed. There are also commercial products designed to insulate over attic stairs.



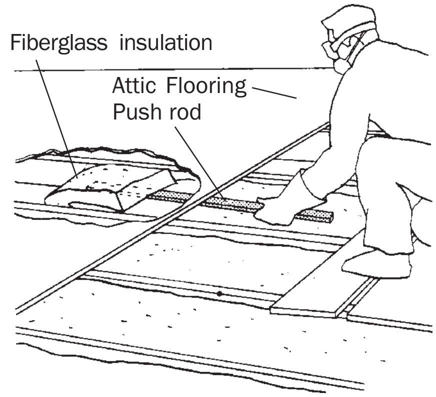
6. **Install blocking**

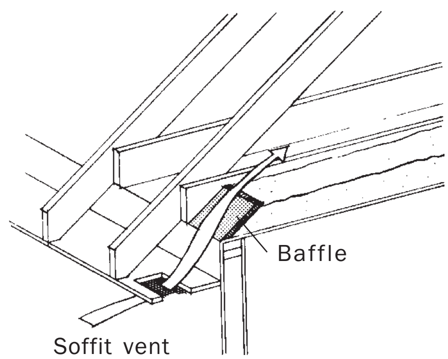
Block around potential danger areas with R-30 or R-19 roll or batt insulation as described in the section on Attic Insulation Blocking Guidelines (page 20).

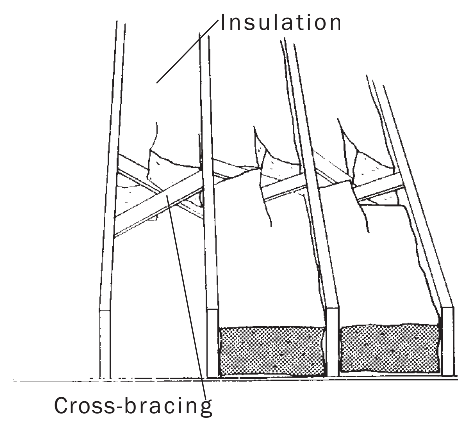
7. **Install insulation**

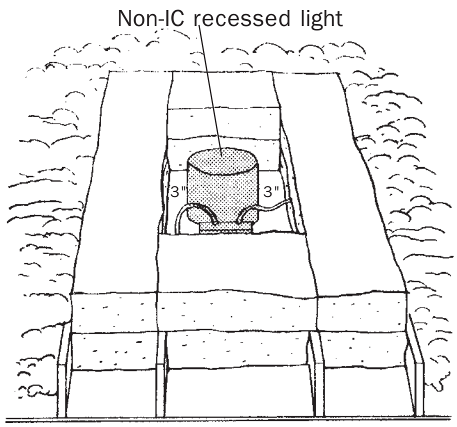
Wear long pants, a long-sleeved shirt, work gloves, a dust mask, safety goggles, and a hat or helmet for this work. When insulating, pay attention to these key elements:

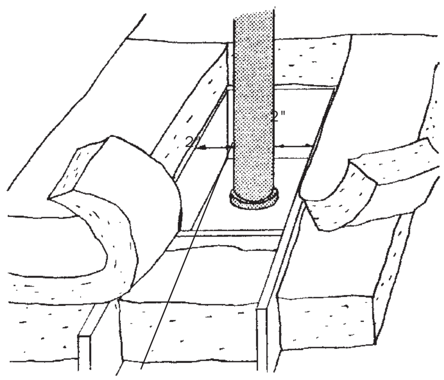
- Get total coverage—insulate under all portions of the attic floor, if present. Move boxes and stored items so you can insulate everywhere.
- Do not block air flow from soffit or eave vents—use cardboard, foam insulation, special foam baffles, or wood to keep insulation, especially loose-fill, from blocking this vital air flow.
- Start near the eave area. Place insulation with the vapor barrier—if it has one—facing down. If there is some insulation already on the attic floor, use unfaced batts which do not have a vapor barrier. To install insulation under the attic floor, use a push rod as shown on the diagram. You may have to use thinner insulation in this area—if the floor boards are installed on top of 2 x 6 joists, use 6-inch (R-19) rolls. Of course, if the floor boards are loose or easy to pull up, remove them, install insulation and then replace them. If possible, floorboards should be elevated since compressing insulation reduces its R-value. When you encounter cross-bracing, cut and weave the insulation around the braces as shown in the diagram.

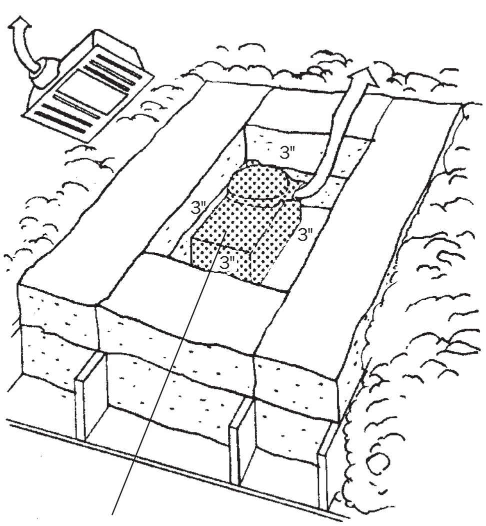












Attic Insulation Blocking Guidelines

Blocking refers to insulation rolls or batts spaced out from components of the attic that should not come in contact with insulation. Blocking is particularly important when blowing insulation. These guidelines should be used for all types of insulation:

Recessed lights

Allow a 3-inch clearance on all sides, except for the newer insulation-contact (IC) fixtures which allow insulation on and around the light . *Consider replacing older fixtures with airtight IC rated fixtures—this will help you achieve greater insulation coverage.*

Masonry chimney

The National Fire Protection Association prohibits insulation from being installed against masonry chimneys. Allow at least a 2-inch clearance. To prevent air leakage in the gap between the chimney and insulation, install sheet metal flush against the chimney and attach it to the ceiling joists.

Factory-built, insulated metal chimney

Allow a 2-inch clearance between the insulation and chimney. If the chimney is housed inside a metal support box that extends into the attic, allow a 2-inch clearance between the insulation and the metal box.

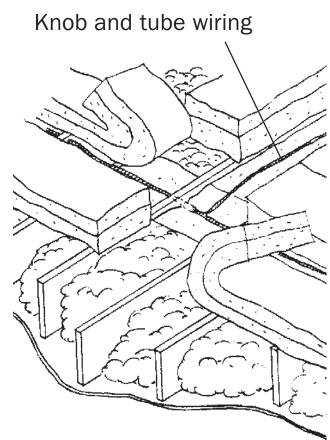
Vent pipes from heat producing appliances

Unless otherwise specified, allow a 9-inch clearance between vents for combustion appliances—such as gas or oil-fired furnaces, and water heaters—and the insulation blocking.

Heat/light/ventilator

In the case of a heat/light/ventilator combination often used in a bathroom, allow a 3-inch clearance on all sides just as you would for a recessed light and do not insulate over the top.

Knob and tube wiring



Do not cover knob and tube wiring with any insulation. The best procedure is to block around the wiring with unfaced insulation batts so that no insulation touches the wiring. If the house has been rewired, hire an electrician to identify and remove the knob and tube wiring that no longer carries live current.

Uncovered electric junction boxes

If the wiring in an electric junction box in the attic is exposed, you may install a cover and insulate over it. If it is left uncovered, keep insulation three inches from the box.

Attic trap door

Block around the trap door for the attic to keep insulation from falling when the door is opened.

Doorbell transformer

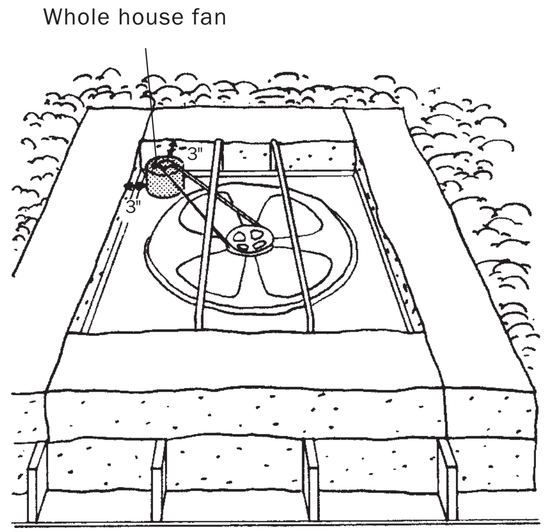
Do not cover; no clearance is required on the sides.

Exhaust fan for kitchen or bathroom

If the fan exhausts into the attic with no ductwork to the outside, a minimum 3-inch clearance is needed at the mouth of the blower. You should extend a flexible duct from the fan to the outside or to one of the attic vents.

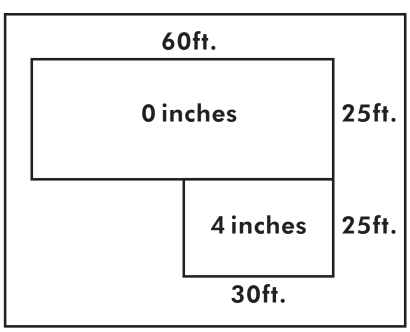
Whole house fans

Install blocking up to the whole house fan housing and allow a 3-inch clearance between the blocking and fan motor. See **Project 5** about creating a whole house fan cover.



How to Order Roll or Batt Insulation

Consider the attic area shown below:



The floor area that needs R-38 is calculated below (the portion that already has 4 inches needs only R-30):

25 ft x 60 ft = 1,500 sq ft

Roll or batt insulation is made of fiberglass or mineral wool. To obtain R-38, you can either order R-38 rolls or batts, or buy R-19 to go between the ceiling joists and R-19 to go crosswise on top of the joists. To estimate how many square feet you need, multiply the floor area of the attic by .95 to account for space occupied by the joists. In the above example, you would need:

.95 x 1,500 sq ft = 1,425 sq ft of insulation

After estimating the square footage, call the insulation supplier and specify the area and the spacing between the joists. He or she should be able to tell you how many rolls are needed. Make sure you purchase insulation that is sized to go between the joists in your attic. Most often, joists have gaps that are either 14½ inches or 22½ inches apart.

If the attic currently has insulation, you should order unfaced rolls of insulation. Unfaced insulation has no asphalt-impregnated kraft paper or metal foil vapor barrier. If the attic has no insulation, order faced batts; the ones with the asphalt-impregnated kraft paper backing work fine. The backing, which should face down towards the heated space, acts as a vapor barrier to moisture flow from the rooms below.

Calculating Loose Fill Insulation

For example, suppose your attic contains 1,500 square feet of R-8 and you wish to add an additional R-30. Assume the joists are spaced 24 inches on center. Since R-30 is not shown on the sample chart, use the sizing estimates for R-32 insulation. The chart shows that 63 bags are needed for 1,000 square feet; thus, for the 1,500 square foot insulation area:

63 bags x 1,500/1,000 = 94 bags are needed for R-32 insulation.

Therefore, order 94 bags and purchase one or two rolls of R-30 batt or roll insulation to be used as blocking material. Be prepared for storing the large number of bags you will be purchasing—they can take up an unexpectedly large volume.

A Cautionary Note on Insulation Contractors

Some contractors have fluffed insulation as a matter of practice. While most contractors are reputable, make sure that whoever is installing your insulation knows ahead of time that you plan to check the insulation chart on the bag and make sure he or she has installed the recommended number of bags.

Blowing loose-fill attic insulation

To install loose-fill attic insulation, you should follow the steps listed on the next page. Remember to get bids from several insulation contractors to make sure you will be saving enough money to justify doing it yourself. Note that many blowing machines are designed to blow only cellulose insulation; make sure you get the right blower and insulation for the job.

When ordering loose-fill insulation, you will need to know the attic floor area, the spacing between the joists, and the desired R-value. The bag in which the insulation comes will have a chart that shows how many bags are needed to provide specific R-values for a given floor area.

For most insulation, the R-value cannot be determined by the thickness of the insulation. The mechanical blowing machine used to install loose-fill insulation blows a mixture of air and insulation through a blower hose into the attic. If the mixture has an excess of air, the insulation will be "fluffed"—the thickness of the insulation will not reflect its true insulating value. Fluffed insulation settles over time and has a much lower R-value than its initial thickness indicates.

To avoid problems encountered with variable mixtures of air and insulation, never judge the insulating value of loose-fill insulation by its thickness. Instead, use the insulation chart on the bag the insulation comes in to determine how many bags to blow into your attic. See the sample insulation chart below.

Steps in Installing Loose-fill Insulation

1. Store the loose-fill insulation near where you plan to locate the insulation blower.
2. Follow steps 1 through 6 listed in the previous section, Installing Roll or Batt Insulation.
3. Set up the blowing machine (the place where you buy the insulation may loan or rent it to you). Unwind the hose and run it into the attic. The most convenient arrangement is often to keep the whole blowing operation out of the house by locating the blower outside on a covered porch or inside a cargo van, and then running the hose through an outside opening into the attic, such as a gable vent.
4. Organize your crew. It is best to have three people—one to be in the attic blowing insulation, another loading the blowing machine with insulation, and the third acting as a go-between. In the summer the attic will be hot, so start early and plan for the person blowing the attic insulation to have frequent relief. Set up a signal to tell the person loading the machine to quickly turn it off in case of problems in the attic. The go-between crew member is helpful here.

Typical Insulating Values of Cellulose Insulation

R-value at 75°F	R-40	R-32	R-24	R-19
Minimum thickness in inches	10.8	8.6	6.5	5.1
Minimum weight (lbs) per sq.ft.	2.1	1.6	.98	.67
2x6 Joists Spaced 24 inches on Center				
Sq.ft. coverage per 25lb bag	12	16	21	37
Bags per 1,000 sq.ft.	83	63	48	27
2x6 Joists Spaces 16 inches on Center				
Sq.ft. coverage per 25lb bag	13	18	23	41
Bags per 1,000 sq.ft.	77	56	43	24

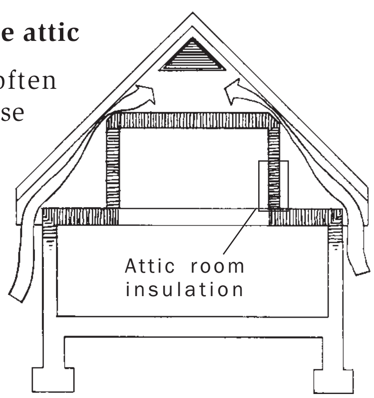
5. Plug in the blowing machine. Most machines have two plugs, one for the blower, and another for an agitator that stirs up the insulation loaded in the hopper. It is best to connect the plugs to two separate circuits to prevent blowing fuses or breaker switches.
6. Turn on the agitator. The blades should turn around inside the hopper. Never place any hands or objects other than loose-fill insulation in the hopper when the agitator is operating. Rip a bag of insulation open and dump it into the hopper. Be careful not to let any of the torn portions of the bag fall into the hopper. They can stop up the blower hose.
7. When the person in the attic signals that he or she is ready, whoever is loading the blower can turn it on. As the insulation level in the hopper declines, add additional bags.
8. Install all of the bags of insulation purchased for the job.
9. When all of the bags have been installed, let the blower run for a few minutes to clear itself of all insulation. Then clean up.

Other Conditions

In many houses, attic areas may include heated rooms or attics may not even exist because of cathedral ceilings or flat roofs.

Heated rooms in the attic

Attic rooms are often uncomfortable because of improper air sealing and insulation. Remember, you want to insulate and seal the entire envelope of the house.



Cathedral ceilings and flat roofs

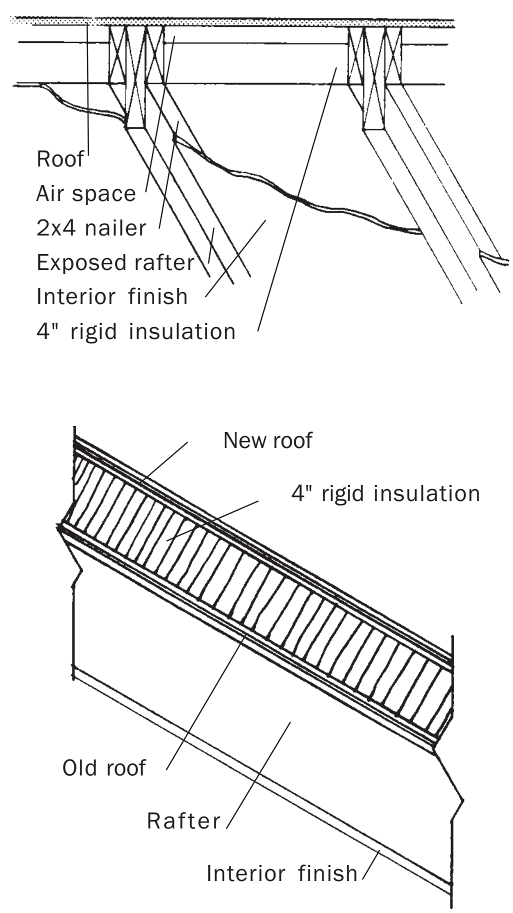
These areas present special problems for the home insulator. No access exists to the enclosed cavity so insulation cannot be added easily. The most common methods for adding insulation require considerable building skills that typically call for a carpenter or building contractor. Some options are described in the following paragraphs.

If you have an exposed beam ceiling, the contractor can insulate between the rafters and install a new interior finish of wood or drywall. If you want to preserve the look of the exposed beams, but still insulate, thinner pieces of insulation, such as two to four inches of rigid foam insulation board, can be installed and covered with an interior finish that fits in between the still exposed portions of the rafters as shown in the diagram. With rigid foam insulation, the contractor should use an interior finish with a 15-minute fire rating, such as ½-inch drywall. Attach 2 x 4 nailers to the sides of the rafters as nailing surfaces for the interior finish.

When the rafters for a cathedral ceiling or flat roof are enclosed within the interior finish, insulating becomes even more difficult. If the interior finish needs replacing, two approaches can be followed: 1) remove the existing finish, install insulation leaving an air space above for ventilation, install ridge and soffit vents, put in a vapor barrier, and apply the new interior finish or 2) attach two inches of rigid insulation to the interior side of the old finish and screw the new finish into the rafters through the insulation and old finish.

If reroofing, your contractor can install rigid insulation board over the existing roof, nail 1 x 4 or 2 x 4 spacers through the insulation into the existing rafters, attach a new roof deck to these spacers, install the new roof, and put in ridge and soffit vents for ventilation.

Cathedral Ceiling Details

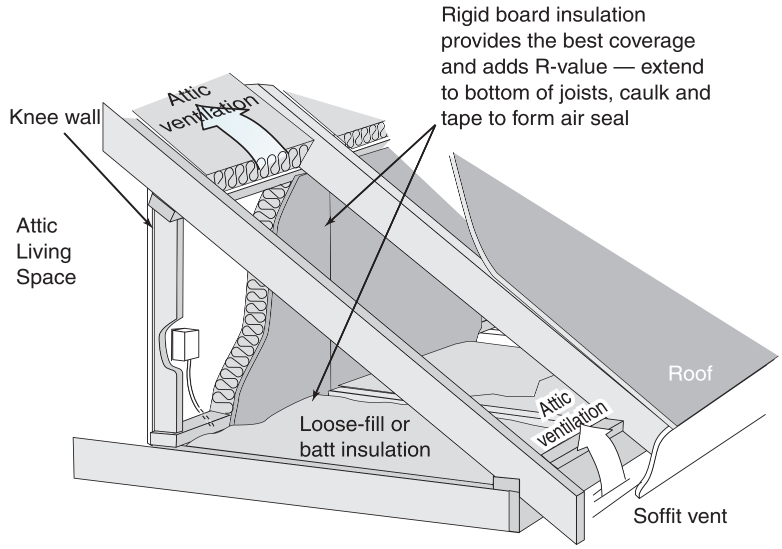


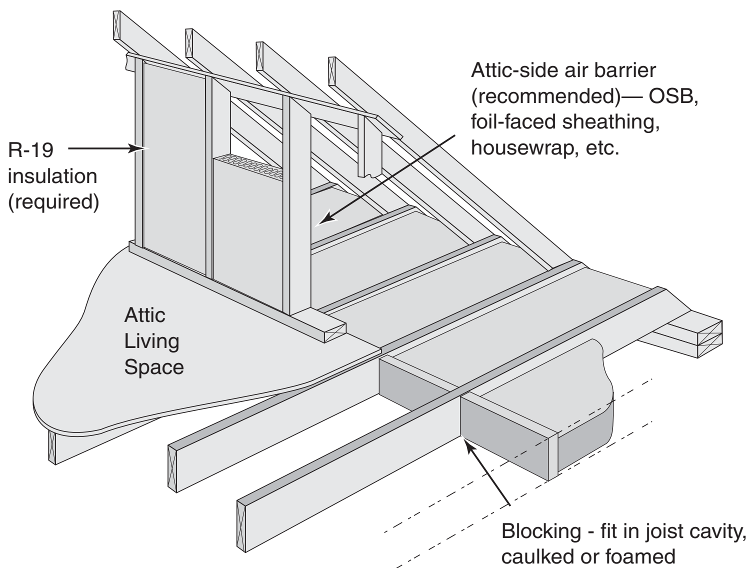
Special Conditions for Knee Walls

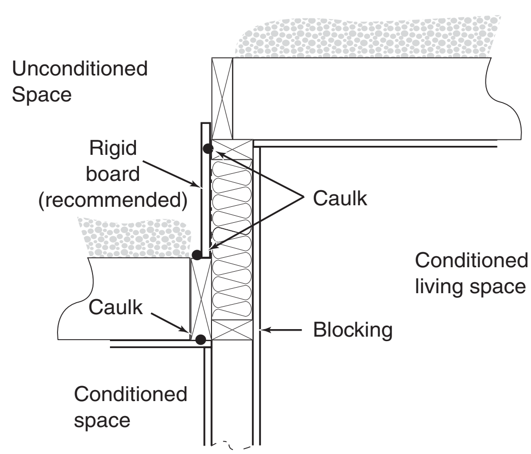
Knee walls are vertical walls with attic space directly behind them. Typically, builders insulate the knee wall and the attic floor in the attic space. Unfortunately, the kneewall often receives only R-13 insulation with no protective cover. Heating and cooling systems and ductwork are often located in the spaces behind the knee wall. Mechanical equipment and ducts suffer leakage and efficiency losses due to the extreme temperature range found in this unconditioned space.

For energy efficient renovation of an existing home, effort should be devoted to adding more insulation and air sealing the knee wall. Knee wall insulation should be a minimum of R-19; installing and sealing the seams of rigid insulation achieves this plus helps to prevent attic air from infiltrating into the house.

In new construction, a better approach is to insulate and air seal the rafter space along the sloping ceiling of the knee wall attic space. The rafters should receive R-19 to R-49 insulation, depending on the RECA. They should be covered with a sealed air barrier, such as drywall or foil-faced hardboard. The barrier must be caulked to the top plate of the wall below the attic space and to the top plate of the knee wall itself. All other cracks and holes must be sealed as well. The advantage of this technique is that all ductwork is now located inside the conditioned space and benefits from the more even temperatures.



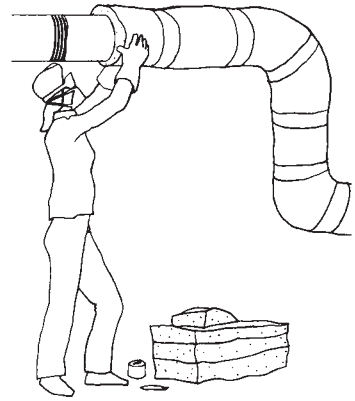




PROJECT 3

Seal and Insulate Ductwork

Priority: ★★★★



Initial Requirements

Ducts and other components of your heating and cooling system should be airtight so that they do not waste energy or create health and safety problems. Poorly sealed ducts can cause 10 to 30% of your home's total heating and cooling costs. Duct leaks can draw air which is laden with toxic chemicals, pollen, mold, excess humidity, dust, and other contaminants into your home from attics, crawl spaces, and basements .

In addition to being airtight, the ducts should be well insulated to reduce energy losses and prevent condensation. All surfaces of the ductwork should be insulated, including the boot connections to the floor or ceiling. Duct insulation does not form an airtight seal, so a contractor usually must remove it to seal ducts, then reinstall the insulation.

Typical residential heating and cooling systems can lose additional heating and cooling energy as a result of conduction between ducts and the unconditioned spaces, such as attics, crawl spaces, garages or unheated basements. In winter, the difference in temperature between heated air in the ducts and the cold air surrounding them results in much heat being lost through conduction when it is distributed in to the home. In summer, air-conditioning efficiency can be seriously reduced when cool air in the ducts is exposed to very hot temperatures, especially in an attic.

Materials

The best material to use to seal ducts is mastic, a thick paste which can be applied to all types of ductwork. Avoid using duct tape. Even quality tapes do not stick well to ducts. Only use tapes to provide a temporary seal, such as over an opening for the filter, which must be changed periodically.

☑ *Checklist*

Typical Costs and Savings

- $10 a gallon for mastic
- Sealing ducts has one of the best cost-to-benefit ratios of all energy-saving projects. Cost savings are dependent on the efficiency of the equipment and cost of fuel consumed.
- Contractor (labor/hour): $15 to $25 hour

Average Time Required

- ½ to 1 day

Skills Required

- Simple handiwork

Tools

- Utility knife
- Drop light and extension cord
- Rubber gloves
- Brush for mastic

Safety

If you have old duct insulation or tape, it may contain asbestos, a potential carcinogen. Have an expert tell you what type it is. If it is asbestos, get recommendations on the best course of action. Applying mastic on top of the asbestos may be the best approach.

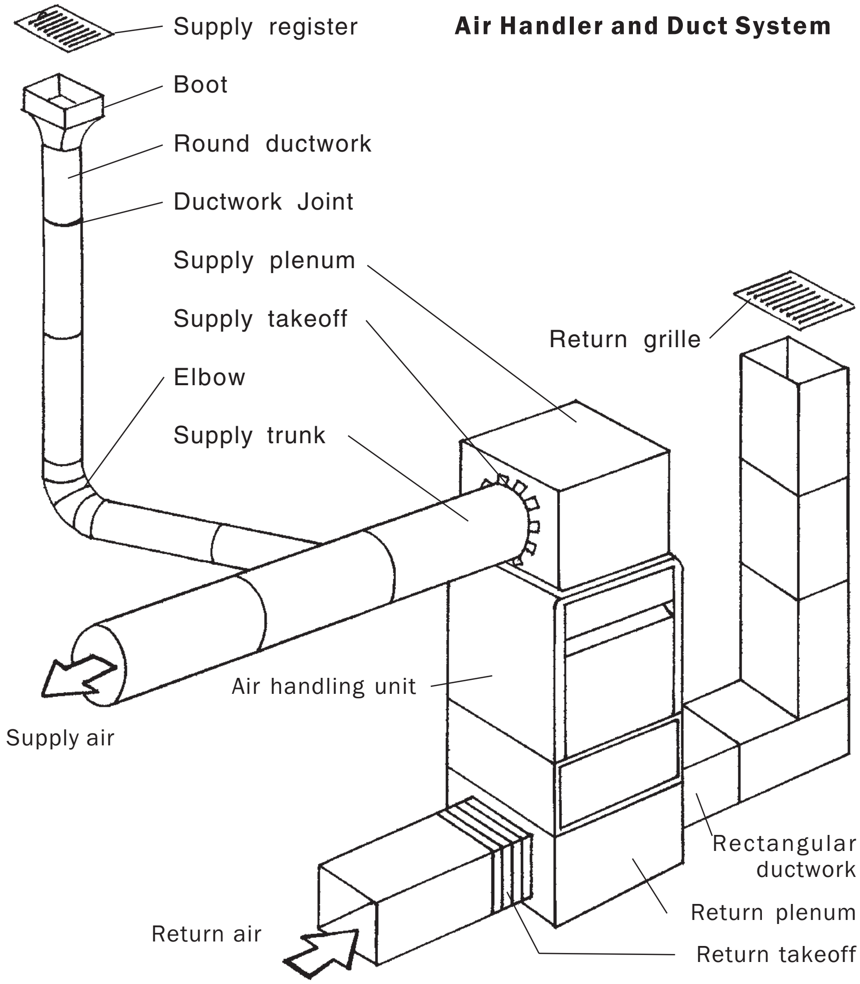
Basic Procedure

Duct Sealing

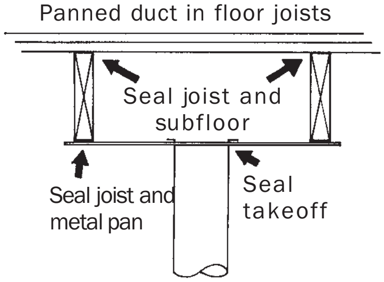
Every seam in the ductwork should be airtight. For an existing home, reaching some leaks can be difficult. The following list prioritizes the most important sites to seal:

1. Disconnected components, including breaks in metal duct, tears in flexduct, and dislodged duct board connections.
2. All of the seams in the air handler (the cabinet that houses the fan). Be sure to check that seams in hard to reach areas have been sealed. Sealing these areas may require partial disassembly of the air handler.
3. The supply and return plenums which sit on top of or beside the air handler. These boxes should be completely airtight.
4. The main ducts, called the supply and return trunk lines. Seal the seams perpendicular to the flow of air and all connections for branch ducts .

Air Handler and Duct System

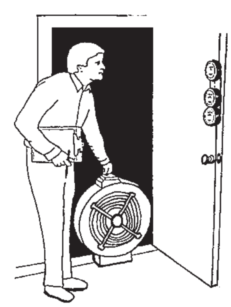


Panned duct in floor joists



5. Panned ducts. These ducts are formed by wood or other parts of the building and are usually responsible for significant duct leakage .
6. The connections where the ductwork turns to meet the floor or ceiling, called the boots and elbows. Sealing and insulating these areas is especially important to prevent condensation on building materials which can lead to deterioration.

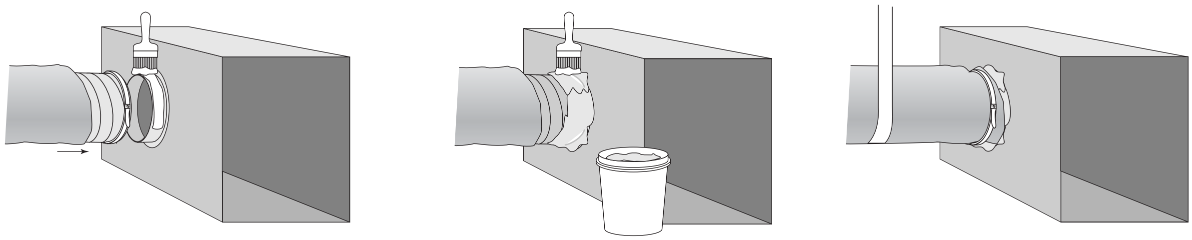
Finding Duct Leaks



You can not see air leaking from a duct, and often can not even feel it, so finding duct leaks can be difficult. However, using special tools to pressurize the ducts lets a contractor measure how leaky your ducts are, and pinpoint the leaks. A blower door is a common tool to measure duct leaks. The equipment consists of a temporary door covering which is installed in an outside doorway and a blower which forces air into or out of the building. The blower door measures how leaky the building and ductwork are, and can be used to find the location of the major leaks. A similar device, called a duct blower, is also used.

More and more, heating and air conditioning professionals are using tools such as a blower door to find and seal duct leaks. Studies nation-wide indicate that over 70% of both new and older homes have significant duct leakage.

How to seal flex-duct joints



Roll back outer cover and insulation on flex duct and spread mastic on connector and plenum

Slide inner liner over connector, install compression strap, apply mastic over liner and strap

Secure outer cover with compression strap, provide support strap within one foot of connection

7. The joints between sections of the branch ductwork.
8. Seal flex duct connections.

Duct Insulation

The flexible blanket-type insulation is available in rolls and is easy to install to round or rectangular ducts. This type of insulation easily conforms to irregular surfaces. Rigid insulation comes in pre-formed boards for ducts used with air conditioning, and works best on rectangular ducts. For complex duct installations it would be wise to consider a professional installer.

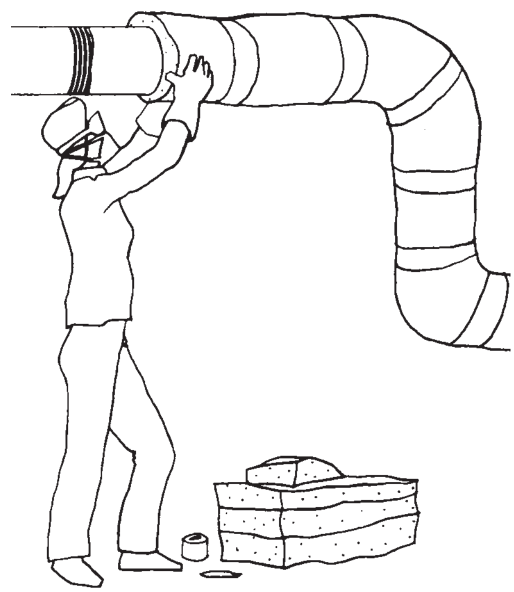
All duct insulation should have a foil or vinyl facing on the exterior side to prevent moisture from being absorbed into the fiberglass and maintain insulation effectiveness. If any existing insulation has become wet, it should be replaced.

Basic Procedure

Installing Duct Insulation

Seal all observable leaks and loose joints in the ducts with duct mastic or foil tape before installing the insulation. The ducts can then be wrapped with the insulation, ensuring that the vinyl or foil backing (if any) faces outward. Care should be taken during installation to minimize compression. Be sure to seal all seams with duct mastic or foil tape to prevent leakage of heated or cooled air into unconditioned areas of the home.

Do not use cloth “duct tape.” Either duct mastic or foil tape will form a tighter seal and last longer, particularly in humid areas.

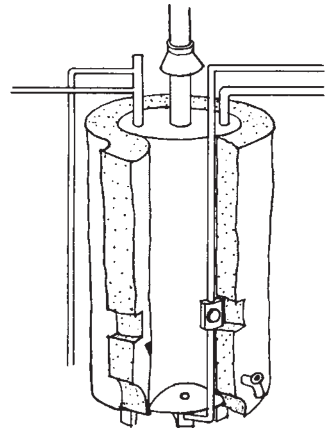


Observe all safety considerations when installing insulation and sealing ducts. Crawlspaces and attics are often less-than-ideal conditions, be sure to provide adequate light and work methodically.

PROJECT 4

Install Insulating Jacket on Water Heater

Priority: ★★★★



Initial Requirements

Current water heater is standard rather than high efficiency. Some older, cabinet-type units that are usually located in the kitchen may be inappropriate to insulate.

Materials

- Insulating jacket—use an insulating jacket large enough for your water heater.
- Vinyl tape—to secure the jacket to the water heater; it often comes with the water heater jacket.
- Pipe insulation—enough to wrap about 15 feet of pipe. Make sure it is the right size for your piping (usually ¾-inch copper or galvanized)

Basic Procedure

For an electric water heater:

1. **Turn off electricity to water heater.**
2. Remove the door covering the thermostat and set thermostat to low setting (120 degrees). If you have a dishwasher, use thermostat setting recommended for it. Replace the door when you finish. Many electric water heaters have two thermostats, both of which should be adjusted.
3. Wrap the insulating jacket around the sides, cut to size, and tape in place.
4. Cut a "window" through the insulation to provide access to the thermostat. Put the insulation you cut out back in the window so the water heater remains insulated.

☑ Checklist

Typical Costs and Savings

- Materials: $7 to $15
- Contractor (materials, labor, and overhead): $15 to $25
- Annual energy savings: $25 to $65

Average Time Required

- ½ to 1 hour

Skills Required

- Simple handiwork

Tools

Utility knife
Heavy-duty shears

Safety

Wear work gloves and a long-sleeved shirt—most water heater jackets contain fiberglass or mineral wool insulation which can be irritating to the skin.

Read the instructions on the water heater jacket carefully.

Safety considerations for fuel-fired water heaters

Gas, propane, or fuel oil water heaters should be insulated only on the sides—not the top. Never block the cover for the pilot light and burner, or the exhaust vent at the top of a gas or propane water heater. Also, do not block the pressure-temperature relief valve (also called the "pop-off" valve) for any type water heater. In addition, do not cover the drain valve at the bottom of the water heater.

5. Cut insulation for the top of the water heater. Cut holes in the top piece to allow the pipes and the pressure-temperature relief valve to protrude.
6. Install the insulated cover over the top and tape the seams.

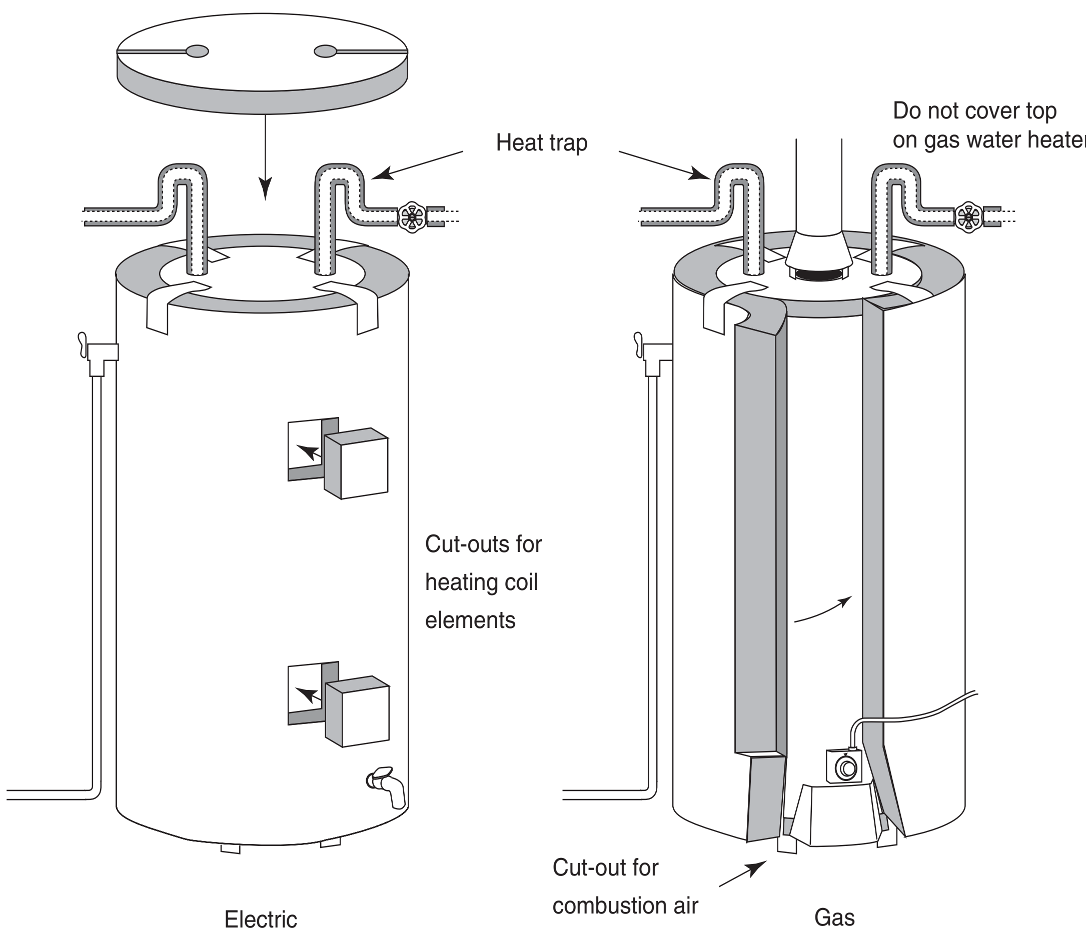
For a gas, propane, or fuel oil water heater:

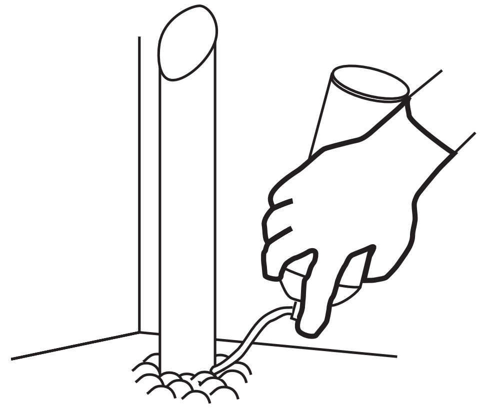
1. Reduce the thermostat to the low setting.
2. Wrap the insulating jacket or insulation rolls around the sides, cut to size, and tape in place.
3. Cut insulation away from the pressure-temperature relief valve, pilot light and burner area. Make sure insulation can not possibly drop in front of these areas. These actions are critical for your safety.
4. **Do not install insulation on the top of a gas, propane or fuel oil water heater.**

Pipe insulation

Pipe insulation is inexpensive and easy to install. Add it to hot and cold water pipes in unconditioned spaces such as garages, attics, and crawlspaces and for a distance of at least six feet from the tank.

Heat traps prevent heated water in a storage tank from mixing with cooled water in pipes, a process called thermosiphoning. Some new water heaters have built-in heat traps, although they can be added to new or existing water heaters. Flexible connectors with a loop in the vertical line offer an effective, inexpensive, do-it-yourself alternative to plumber-installed heat traps.





PROJECT 5

Seal Holes, Cracks, and Penetrations

Priority: ✪✪✪✪

Initial Requirements

Holes, cracks, or unsealed penetrations through walls, ceilings, and floors are common in many homes.

Air leaks cause high heating and cooling bills and can make your home uncomfortable. Air leaks bring in outside moisture, dust, pollen, radon and other pollutants. Even though your home is well insulated, it can still have excessive air leaks. Standard loose-fill, batt or roll insulation materials do not stop air leaks, and can lose their insulating values if air seeps through them. Be sure to seal all bypasses before you insulate.

Materials

Spray foam and caulk are commonly available at home improvement and hardware stores. Choose the right material for the application:

- Inexpensive painters caulk with a 20 year rating is good for most air sealing applications, whereas a premium caulk would be better in high-moisture environments like a bathroom.
- Spray foams are distinguished in expanding rigid foams to lesser-expanding soft foams. Read the labels to determine the best product for the application.
- Backing material, such as foam backer rod, is used to fill large cracks and gaps before applying foam sealant or caulk.
- Sheet materials such as insulation board, plywood, or cardboard are used to cover large holes.

Basic Procedure

1. Use caulk or spray foam sealant to seal cracks or holes smaller than a pencil width in the ceiling, floor, or exterior walls. Seal holes on both the inside and outside surfaces of walls.
2. For larger openings, use spray foam sealant or fill the crack with backing material and caulk the surface.
3. Use sheet materials, such as cardboard, insulation board, or plywood, to cover large holes. Seal the edges of the sheet materials with caulk or spray foam sealant. Be sure to seal openings between the attic and house, and between the crawl space or basement and house.

☑ *Checklist*

Typical Costs and Savings

- Materials: $2 to $7/caulk tube, $5 to $10/can of spray foam sealant, $5 to $30 for sheet materials to seal large holes, $2 to $5/package of backing material
- Contractor (materials, labor, and overhead): Up to $300/house
- Annual energy savings: $40 to $120/house

Average Time Required

- Varies widely

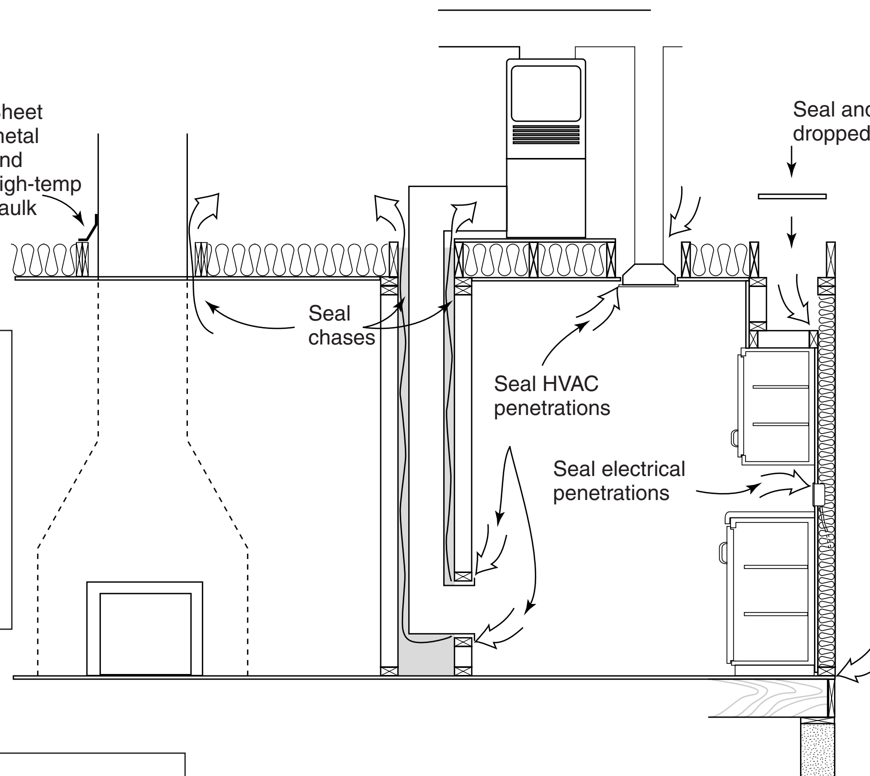
Skills Required

- Simple handiwork, perhaps some basic carpentry

Tools

Caulk gun
Utility knife
Optional Tools
Carpenter's tool belt
Saw

Air Seal Bypasses
Air seal the big holes first



Safety

Spray foam sealant is flammable, so it should not be used near a heat source such as a furnace flue.

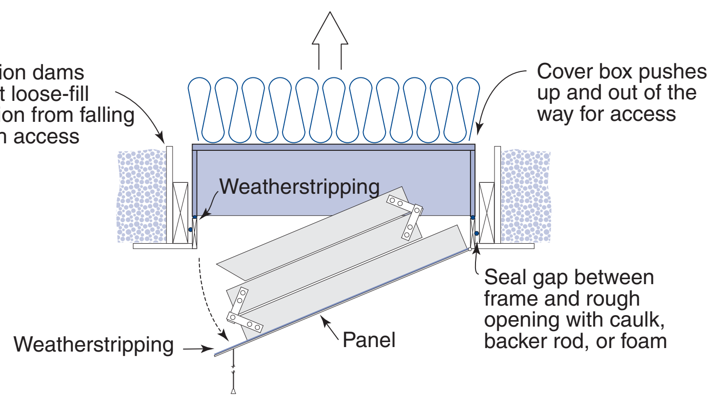
Using Spray Foam Sealants

Spray foam sealants come in cans and are dispensed much like shaving cream. However, some sealants, such as the polyurethane ones are difficult to tool or shape when wet. Therefore, they come with a straw-like tube for reaching into tight places.

The product oozes, rather than sprays, out of the straw. It will stick to anything it touches. When it dries, it can be trimmed easily with a sharp utility knife.

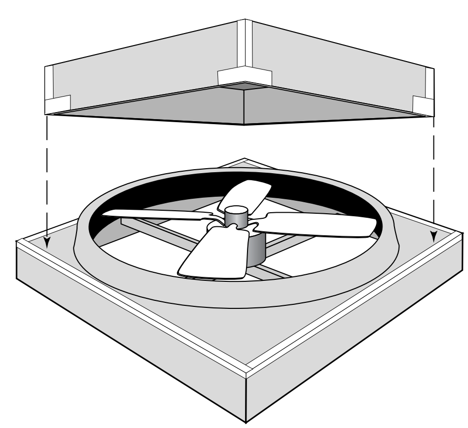
Fill larger cracks or holes in multiple passes. The foam expands considerably, so fill the crack two-thirds full, then come back in a while to finish it off.

Never plan to use a container of the sealant more than twice. Often, you will obtain only one use because the material will set and clog up the applicator and nozzle. Plan to seal as many holes and cracks at one time as possible. Consider newer, latex-based spray foams that are low expanding and clean up with water. Spray foam sealant must be protected from exposure to sunlight because it will otherwise degrade.



Rigid insulation box forms lid for pull-down attic staircase

An attic access is one of the biggest "intentional" holes between living space and non-conditioned space. Add weatherstripping and an insulated cover.

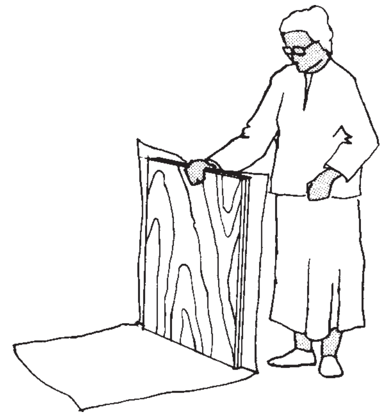


Build an insulated cover for whole house fan.

PROJECT 6

Build Fireplace Covers

Priority: ★★★★



Initial Requirements

If a house has undampered fireplaces that are seldom used, build and install fireplace covers. Other options include:

- Using an inflatable flue pillow
- Installing glass doors on a fireplace that has no dampers.
- Consider purchasing and installing a fireplace insert, or a woodstove.

Materials

- ¾-inch rigid insulation board

  or
- ¾-inch plywood
- Fabric or self-sticking wall paper to cover insulation board or plywood.

☑ Checklist

Typical Costs and Savings

Fireplace cover

- Materials: $15 to $40/cover
- Contractor (materials, labor, and overhead): $25 to $80/cover
- Annual energy savings: $15 to $40/cover

Glass doors

- Materials: Vary widely according to style
- Contractor (materials, labor, and overhead): $90 to $250 for standard designs
- Annual energy savings: Vary widely—up to $100

Fireplace inserts

- Materials: $200 to $600 for standard designs
- Contractor (materials, labor, and overhead): $250 to $800
- Annual energy savings: Vary widely—up to $250

Wood stoves

- Materials: $200 to $600 for standard designs
- Contractor (materials, labor, and overhead): $250 to $800
- Annual energy savings: Vary widely—up to $300

Average Time Required

- 1 to 3 hours/fireplace cover
- Contractor usually can install glass doors, fireplace insert, or wood stove in a day's time

Skills Required

- Simple handiwork for fireplace cover

Tools

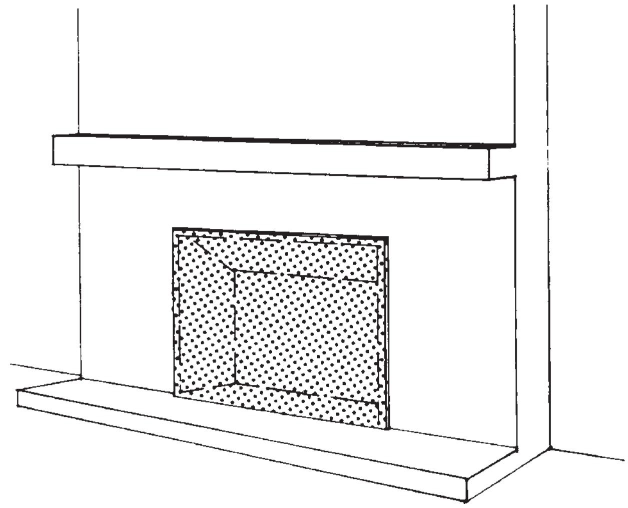
Tape rule
Utility knife
Fabric shears
4-foot straightedge (yard stick, metal bar, or thin lumber that is not warped)

Optional Tools

Circular saw

Basic Procedure

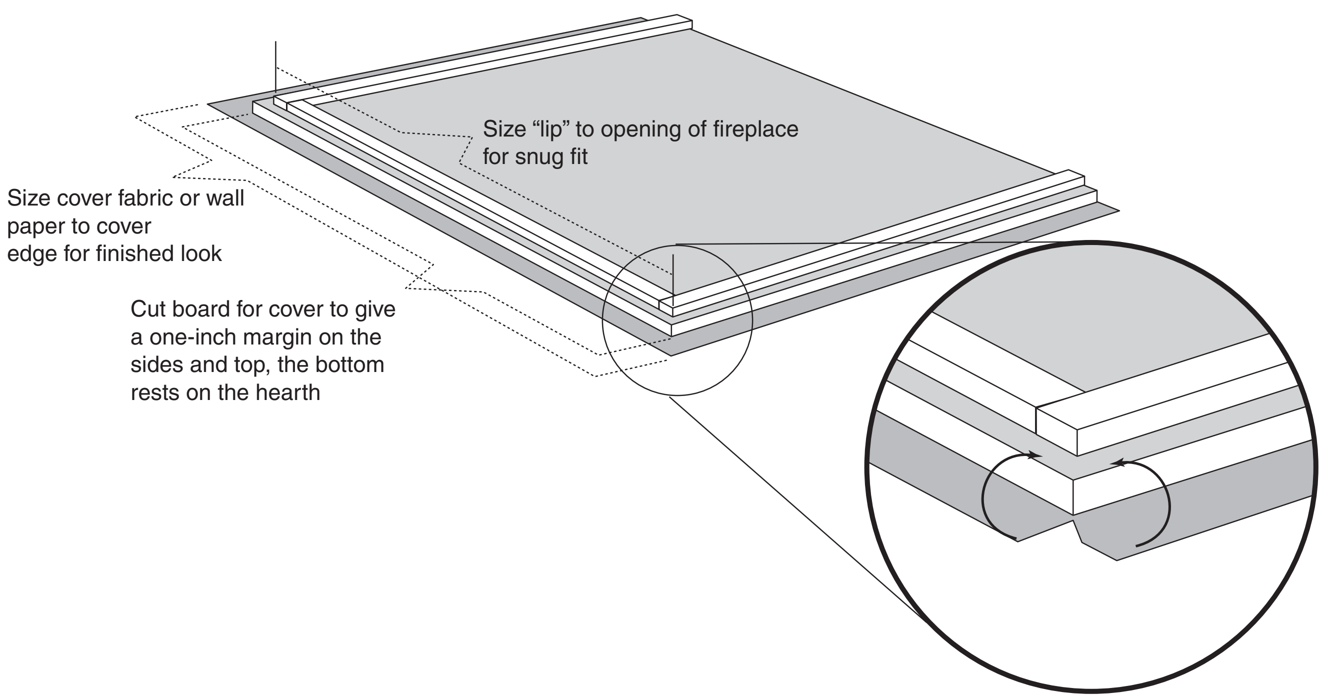
1. Check to determine which fireplaces do not have dampers; order glass doors for undampered fireplaces that are used often.
2. To make covers for those undampered fireplaces that are seldom used, first measure the size of the fireplace opening.
3. With a utility knife, cut the rigid insulation board at least two inches wider and one inch taller than the opening or use a circular saw to cut plywood similarly.
4. If you are covering the cut board with fabric, wrap it around the board and cut it ¾ inch wider on the three sides with exposed edges. Then, either sew the edges to enclose the board, or glue the fabric in place.
5. If using adhesive wall paper, cover the insulation board or plywood neatly.
6. Set the cover in front of the fireplace and mark the exact outline of the fireplace opening on it. Cut thin pieces of the rigid insulation or plywood, and attach them to the cover so it fits inside fireplace opening. This inside edge provides a good seal between the cover and the fireplace and helps keep the cover in place.



Safety

The fireplace cover discussed in this chapter should not be installed on a frequently used fireplace due to the danger of fire.

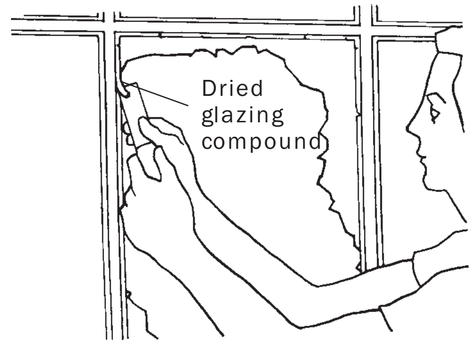
Never install the fireplace cover before the fire is completely out. Red embers or other signs of fire should not be present. In other words, the fire should have been stone cold for several days.



PROJECT 7

Repair and Reglaze Windows

Priority: ★★★★



Initial Requirements

Some windows are broken or have cracked or are missing glazing compound. This is an open leak for conditioned air to escape your home and it represents a house in poor repair.

Materials

- Glazing compound that contains linseed oil—for sealing windows in place; do not use caulk.
- Quick-drying primer, linseed oil, or wood sealer—if glazing compound has no linseed oil. Sealing unpainted wood will make glazing compound last longer.
- Glazier's points—to hold panes in place during installation
- Window panes—measure the size of the opening for broken panes and cut the glass ⅛ inch smaller along both dimensions. When buying the glass, take a piece of the broken window pane with you to match the type of glass.
- Exterior paint to match window trim
- Paint thinner—for cleanup

Safety

Be careful when working with glass to avoid cuts, particularly when removing pieces of a broken window pane. Use work gloves when removing glass.

☑ Checklist

Typical Costs and Savings

Repair

- Materials: $.80 to $2.00/sq ft
- Contractor (materials, labor, and overhead): $4 to $8/sq ft
- Annual energy savings: Vary widely

Reglazing

- Materials: Minimal
- Contractor (materials, labor, and overhead): $2 to $4/sq ft
- Annual energy savings: Vary widely

Average Time Required

- Repair: ¼ to 1 hour/window pane
- Reglazing: ¼ to 1 hour/window

Skills Required

- Basic carpentry

Tools

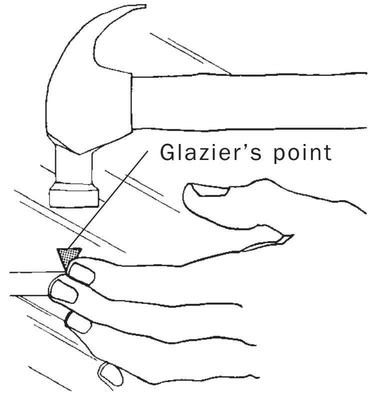
Putty knife
Tape rule
Paint brush
Hammer
Gloves

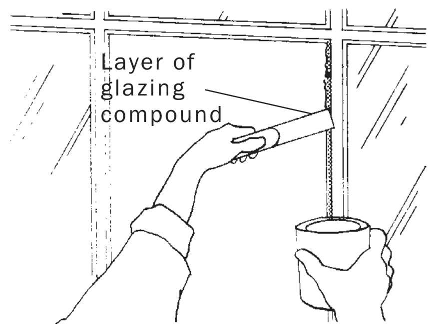
Basic Procedure

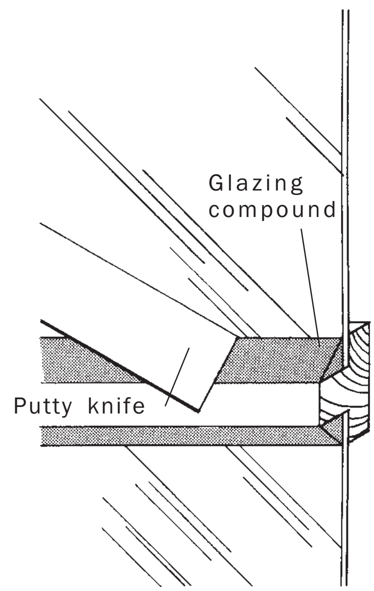
Replacing broken window panes

(If the window does not use glazing compound, see Replacing panes sealed in place with gaskets).

1. Measure opening for broken panes and order new panes 1/8 inch smaller in height and width.
2. Remove old pane carefully—use work gloves and work from the top down to prevent glass from dropping on your hands. Wiggle glass back and forth (like loosening a child's tooth) to help pull it out. Also, remove all of the old glazing compound.
3. If using a glazing compound that does not contain linseed oil, seal the unpainted wood mullions with quick-drying primer, linseed oil, or wood sealer.
4. After the sealant dries (read directions on the can for an estimate of how long drying takes), use a putty knife to spread a 1/8-inch layer of compound evenly around the frame in which the glass will rest.
5. Set the new pane in the frame and push in two glazier's points along each side of the window with the putty knife or hammer.
6. Apply a sealing bead of putty at an angle as shown in the diagram. Press firmly for a good seal, and trim the excess putty as you work. Dip the putty knife in the linseed oil to help smooth out the putty.
7. After the putty has dried (usually seven to ten days after installation), paint the putty to match the window. The paint should extend 1/16 inch onto the pane to ensure a good seal.







Reglazing windows

1. Scrape all loose or cracked glazing compound out of the mullion frame. Make sure that only firmly attached glazing compound remains.
2. If using a glazing compound that does not contain linseed oil, seal the unpainted wood with quick drying primer, linseed oil, or wood sealer.
3. After the sealant dries, follow steps 6 and 7 from the previous procedure for replacing broken panes.

Replacing panes sealed in place with gaskets

Most metal windows and some wood units use rubber gaskets, rather than putty, to seal the glass in place. If the frame is held together by screws, you may be able to replace broken panes yourself.

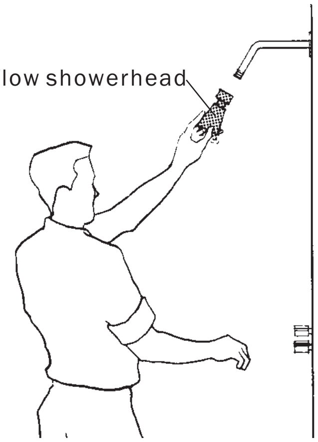
Some metal windows, especially sliding windows, are built of single-section, molded sashes which cannot be disassembled by a do-it-yourselfer. The glass is held in place by a neoprene rubber gasket. These need to be reglazed by professionals.

To replace panes in frames held together by screws, first remove all large pieces of glass. If screws hold the frame together (and hold the broken glass in place) take them out. The rubber seals should remain attached to the sash. Be careful as you loosen the frame because the remaining broken glass will fall. Buy a matching pane 1/8 inch smaller than the frame and lay it in the disassembled sash. Screw the two halves of the sash together and mount it back in its frame.

PROJECT 8

Use Low-flow Showerheads

Priority: ✪✪✪



Initial Requirements

You have an existing standard showerhead and it can be removed. This is your opportunity to install shower flow controls for your shower—options include a completely new energy-conserving showerhead or an flow-restricting insert into your existing showerhead.

Low-flow showerheads provide a forceful spray of water, while reducing water consumption from six gallons per minute down to two or three. Flow-restricting inserts in your existing shower are less expensive than an entire new showerhead, but may reduce the forcefulness of the spray.

Materials

- Low-flow showerhead(s), or
- A flow-restricting insert(s)

In both cases, it is best to remove your existing showerhead and take it to the store with you to ensure the product you buy will fit.

- Teflon tape—for wrapping the threads of the shower to prevent leakage

Basic Procedure

1. Remove the existing showerhead with an adjustable wrench. Cover the joint with cloth to prevent marring the surface with the wrench.
2. Take the showerhead to the hardware store or building supply and purchase an appropriate shower flow control.
3. Wrap teflon tape around the threads of the shower pipe. Start at the end of the pipe and wrap clockwise one or two layers thick.
4. If using a flow control insert, follow installation instructions. Then replace the old showerhead.
5. If using a new energy-conserving showerhead, tighten it onto the taped pipe threads using the adjustable wrench.

Safety and Other Considerations

If the old showerhead is locked on because of corroded pipes, you should reassess the job carefully before proceeding. Do not use brute force and damage the house's plumbing because the job can then become expensive and may leave your household without water until repairs are made.

☑ Checklist

Typical Costs and Savings

- Materials: $1 to $15/ showerhead
- Contractor (materials, labor, and overhead): $25 to $50/ showerhead
- Annual energy savings: $30 to $60/showerhead

Average Time Required

- ¼ to 1 hour/showerhead

Skills Required

- Minor plumbing (using an adjustable wrench)

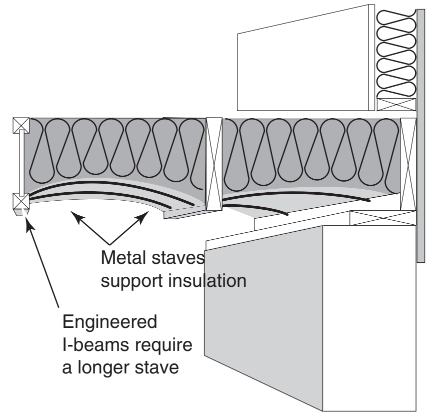
Tools

Adjustable wrench
Pipe wrench may be necessary

PROJECT 9

Insulate Floors

Priority: ★★★



Initial Requirements

A do-it-yourselfer can insulate the floor of a house if it has an accessible crawl space (at least 18 inches of headroom) or an unheated basement under the floor. If your crawlspace does not have a plastic ground cover/vapor barrier, you will find that installing this first will provide two benefits, one in controlling the amount of moisture in your crawlspace, and two, making it an easier and cleaner space to work in. The less moisture in a crawlspace reduces the chance of mold, mildew and rot in the home and increases the effectiveness of the insulation.

Materials

- Staples for heavy-duty stapler
- R-19 insulation is recommended. Order R-19 rolls of insulation with a vapor barrier on one side for the specific spacing between joists (usually 14½ or 22½ inches). See section on Floor Insulation Sizing for more information.
- Tiger claws or other rigid wire supports designed to hold insulation between the floor joists firmly against the subfloor-order for the specific spacing between joists. You will need about 50 to 60 supports per 100 square feet in floors with joists spaced 14½ inches apart, or 35 to 40 per 100 square feet in floors with joists spaced 22½ inches apart.
- 6- to 10-mil polyethylene plastic-only for houses with crawl spaces or basements over bare earth.
- Pipe insulation for hot and cold water pipes
- Baling wire and U-nails to hold insulation in place (see Special conditions)

☑ Checklist

Typical Costs and Savings

R-19 Floor Insulation

- Materials: $.22 to $.35/sq ft of floor to be insulated
- Contractor (materials, labor, and overhead): $.32 to $.55/ sq ft of floor (up to $.05/sq ft more for a low crawl space)
- Annual energy savings: $.04 to $.07/sq ft of floor

R-11 Floor Insulation

- Materials: @ $.14 to $.18/ sq ft of floor to be insulated
- Contractor (materials, labor, and overhead): $.20 to $.40/ sq ft of floor (up to $.05/sq ft more for a low crawl space)
- Annual energy savings: $.03 to .06/sq ft of floor

Average Time Required

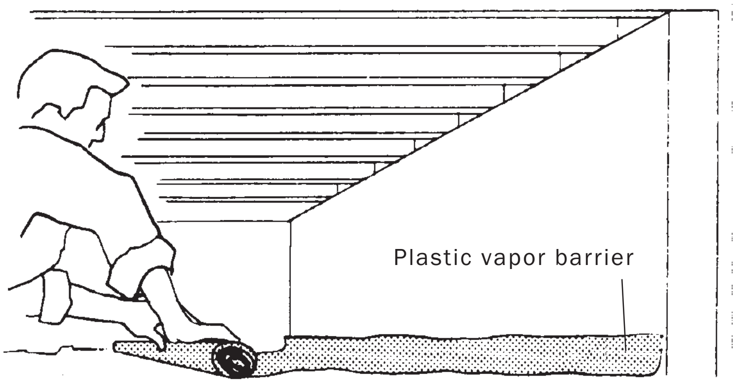
- 1 to 2 days/1,000 sq ft

Skills Required

- Simple handiwork

Tools

Utility knife
Heavy-duty shears
Drop light and extension cord
Tin snips
Tape rule
Heavy-duty stapler



Install Vapor Barrier
If the crawl space or basement has an earth floor, install a plastic ground cover. Find a friend who can help stretch out the plastic. Remove all stored materials from the crawl space. Roll out the polyethylene plastic and overlap the pieces about two feet and tape the seams. Hold the plastic in place with bricks or stones. Lap the plastic about two feet up the side walls—these outer edges can be sealed to the foundation wall with caulk.

Floor Insulation Sizing

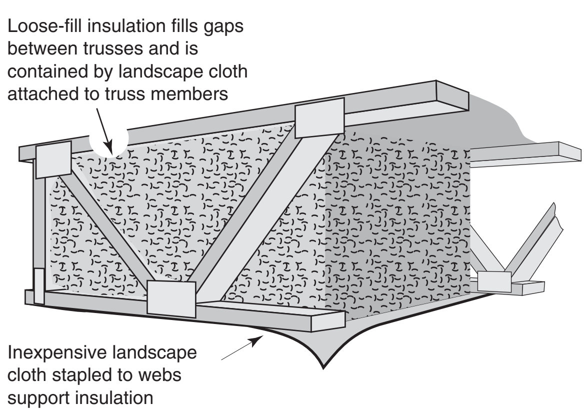
Floor insulation can be sized either by determining the area of the floor to be insulated, or by finding the total length of joist spaces in which insulation will be installed. For example, consider a floor that has 1,600 square feet with joists spaced on 22½-inch centers. Allowing 5 percent for framing, the insulation area should be 95 percent of the floor area:

Insulation area = .95 x 1,600 = 1,520 sq ft

Specify 1,520 square feet of R-19 insulation that is 22½ inches wide. Also order 40 to 50 tiger claws per 100 square feet of floor-about 800 total tiger claws.

You could also have measured the length of the joist spaces and counted their number. If the above floor had 40 joist spaces 20 feet long, you would need:

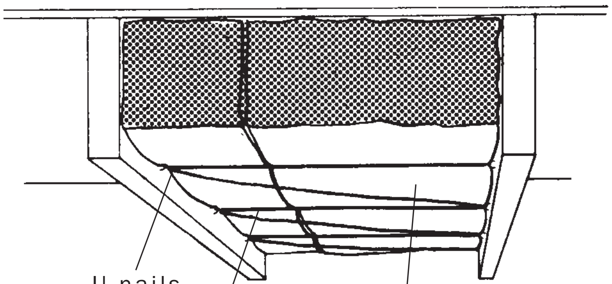
40 x 20 = 800 linear feet of 22½-inch R-19 insulation.



Insulating Truss Floor Systems
Instead of batt insulation, a better approach is to install netting or rigid insulation to the underside of the floor trusses and fill the space created between the netting or insulation and subfloor with a loose-fill insulation.

Basic Procedure

1. Set insulation, tiger claws, and tools in a protected place (e.g., on boards in crawl space) near the area of use so they will not get lost or dirty.
2. Install insulation as follows:
   a. Begin in the corner of the crawl space or basement farthest from the entry. Start with short lengths of insulation and build up to longer ones. Lay the first piece on the ground with the vapor barrier facing down. Note that you will be flipping the insulation over as you install it so that the vapor barrier will face up.
   b. Press the insulation against the band or ribbon joist of the exterior walls as shown and roll it up against the subfloor above. Make sure the vapor barrier of insulation faces up against the subfloor. Push a tiger claw against the insulation so that it fits snugly but does not overly compress the insulation.
   c. Push the next two to three feet of insulation in place. Install another tiger claw no more than 18 inches from the first one.
   d. Continue pressing this first piece of insulation in place; space the tiger claws about 18 inches apart.
   e. Install the next piece of insulation. Press the different sections of insulation together tightly so that no gaps result.
   f. Continue until you have insulated the entire floor. Note the special conditions at the end of this section.
3. Insulate exposed water pipes. Now that you have insulated under the floor, the house will not be losing heat to the crawl space. Unfortunately, the crawl space will now be colder in the winter; therefore, plumbing pipes located under the house will be more likely to freeze. To help prevent freezing, you should insulate both hot and cold water pipes under the floor.



Special conditions

Joist spacing too wide for insulation

Measure the total width of joist spacing and subtract the width of roll insulation (14½ or 22½ inches) to find out how wide the extra piece needs to be to provide total coverage. For example, if you are using 22½-inch insulation and encounter a 35-inch space, the extra piece will need to be:

35 - 22½ = 12½ inches wide.

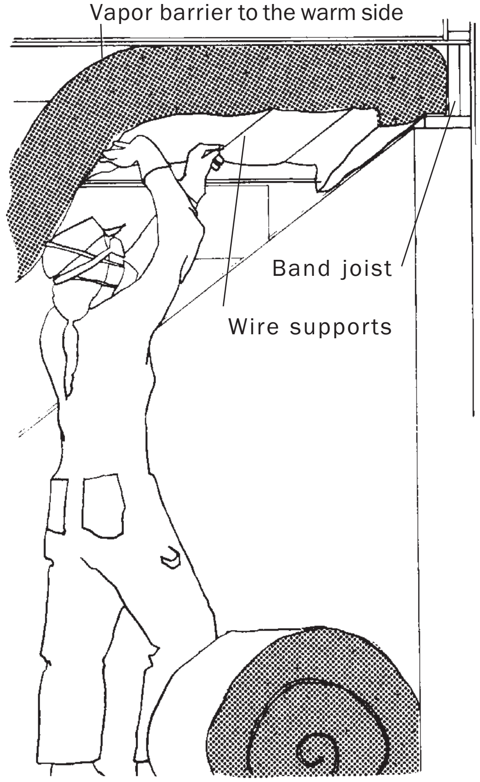
Cut as much insulation of this width as is needed. Make sure you conserve insulation. Cut several widths out of the same piece of insulation if possible.

Hammer U-nails into both sides of the joists 5½ inches below the subfloor (3½ inches if using R-11 insulation). Space the U- nails every 20 inches and stagger them as shown.

To insulate this wide space, press the regular width insulation against one side of the joist and staple the exposed tab of the vapor barrier every foot. You will have to compress the insulation a little to allow the stapler access to the vapor barrier. Continue stapling for the length of this piece. Install the narrower section beside the one just installed using the same technique. Now lace the metal wire back and forth between joists through the U-nails, pushing the insulation snugly in place as you go.

Joist spacing too narrow for insulation

Using shears or the utility knife, cut the insulation the width of the joist space plus one inch (to allow a snug fit). Cut the tiger claws the same length with tin snips or with a steel or masonry cold chisel and a mallet or heavy hammer. Once the insulation is cut, follow the regular sequence for installing floor insulation (step 2 on previous page).



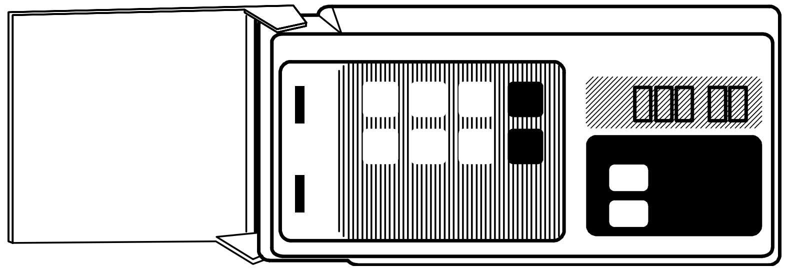
Safety

Wear hard-soled shoes, dust mask, safety glasses or goggles, long-sleeved shirt, hat, and work gloves for full protection—you will be working with fiberglass or mineral wool insulation.

PROJECT 10

Connect Programmable Thermostat

Priority: ★★★



Initial Requirements

You are willing to let the temperature of your house drop in winter at night and when no one is home. Also, you are willing to increase the temperature when no one is home during the summer.

Materials

- Programmable thermostat (or clock thermostat)
- **Important:** If your house has a central heat pump, it requires a special programmable thermostat that is designed for your particular brand system. Call the local distributor or manufacturer for recommendations on the best product to buy.

Basic Procedure

1. Read the directions for installation and operation of the programmable thermostat.
2. Disconnect the fuse or turn off the breaker switch for the heating and cooling system in the service entrance panel.
3. Remove the old thermostat by taking off the cover and unscrewing the unit from the wall—make sure the wires do not fall back inside the wall. Caulk the hole through which the wires extend.
4. Follow the directions that come with the thermostat to connect it to the wiring from the heating and cooling system.
5. Attach the thermostat to the wall or other location.
6. Reconnect electrical service to the heating and cooling system; program the thermostat and monitor its performance to make sure it is working properly.

☑ Checklist

Typical Costs and Savings
- Materials: $45 to $90
- Contractor (materials, labor and overhead): $80 to $200
- Annual energy savings: $60 to $200

Average Time Required
- ½ hour to install

Skills Required
- Simple handiwork

Tools

Screwdriver

Needle-nosed pliers

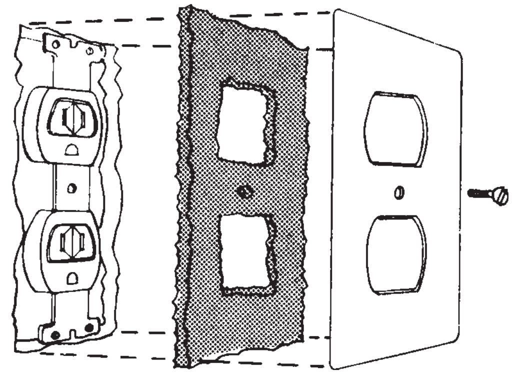
Safety

Although the risk of an electric shock from low-voltage thermostat wires is minimal, always be careful around electricity. Never touch bare wire; handle it by the insulation. Always disconnect the electrical service by removing the fuse or turning off the breaker for the heating or cooling system.

PROJECT 11

Install Gaskets on Electrical Outlets

Priority: ★★★



Initial Requirements

Electrical outlets can leak air if they are not sealed. Use ready-made gaskets to seal these obvious holes in the building envelope.

Although switches and outlets on exterior walls have priority, gaskets should be installed under all cover plates. Cold air leaks from the attic, basement, and crawl space into interior walls.

Materials

- Gaskets for both switches and outlets—enough to cover the switches and outlets for the house. Gaskets are available for double switches and outlets as well. Also, get plastic safety plugs for those outlets that are seldom used.

Basic Procedure

1. Disconnect the fuse or turn off the breaker switch to the outlet or switch being worked on (use a loud radio plugged into the outlet or light controlled by the switch to tell which fuse shuts off the circuit).
2. Unscrew the coverplate—do not lose the screw.
3. Install the gasket carefully—there may be live wires inside the box. For best results, caulk the gasket to the wall finish material.
4. Replace the coverplate.
5. Continue for the whole house.

Safety

This task can be extremely dangerous as you will be working around 120-volt electricity. Always disconnect the fuse or turn off the breaker switch to the different outlets and switch boxes as you proceed.

Be careful when removing coverplates from electrical outlets and switches. Even when you have made every effort possible to turn off the current to the box being worked on, there is a chance it may still be live. Never insert any object, especially fingers and metal tools, inside the electrical box.

☑ Checklist

Typical Costs and Savings

- Materials: $5 to $15/house (about $2 for 8 gaskets)
- Contractor (labor, materials, and overhead): $15 to $40/ house
- Annual energy savings: $5 to $10

Average Time Required

- 1½ to 3 hours

Skills Required

- Simple handiwork

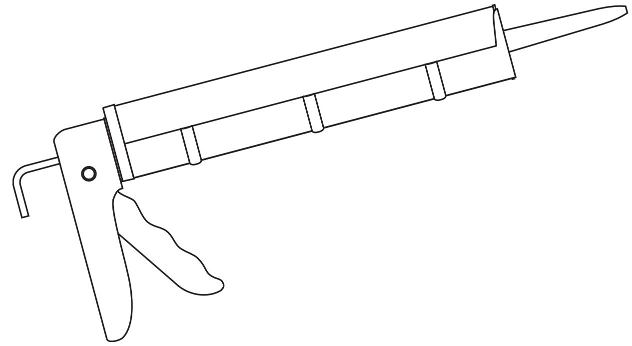
Tools

Flat head screwdriver sized for electrical switchplate covers

PROJECT 12

Caulk Window and Door Frames

Priority: ✪✪✪



Initial Requirements

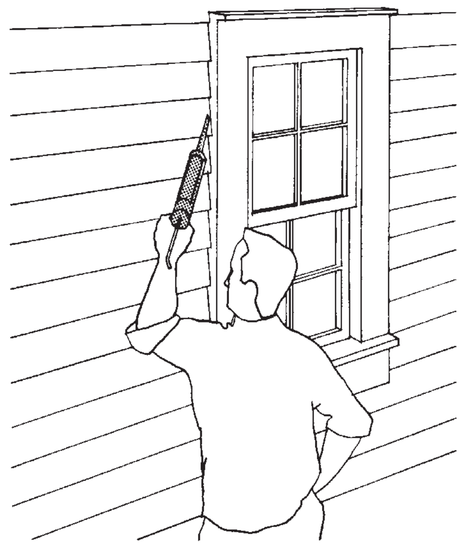
This is a good afternoon project if caulk is missing or cracked between the window or door frame and the exterior or interior wall finish. This will help keep out drafts and help weather-proof your wall system.

Materials

- Acrylic latex caulk with silicones, silicone caulk, 1-part urethane, or other durable caulk.
- Backing material, such as foam backer rod.

Basic Procedure

1. Clean old, dried caulk out of the crack between the wall and window or door frame.
2. Apply caulk to the crack. If the crack is wider than ¼ inch, use backing material to fill the gap, then cover with caulk.



Safety

If this task involves a ladder, use caution and make sure the feet of the ladder are stable before working from it.

Use appropriate eye protection when scraping any building materials.

☑ Checklist

Typical Costs and Savings
- Materials: $2 to $7/tube of durable caulk, $2 to $5/ package of backing material
- Contractor (materials, labor, and overhead): $8 to $20/ unit
- Annual energy savings: Vary widely

Average Time Required
- About ¼ hour/window or door

Skills Required
- Simple handiwork

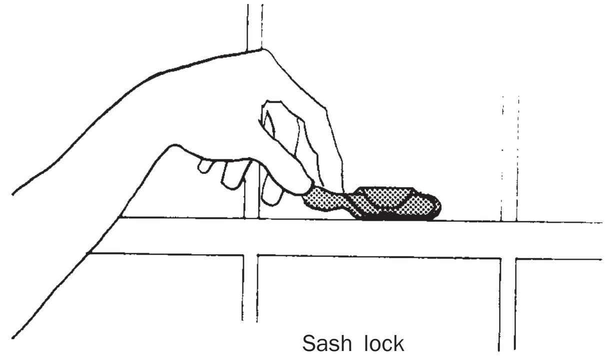
Tools

Caulk gun
Putty knife

PROJECT 13

Weatherstrip Leaky Windows and Doors

Priority: ★★★

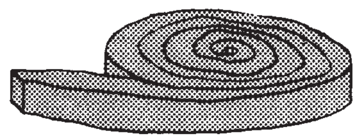


Initial Requirements

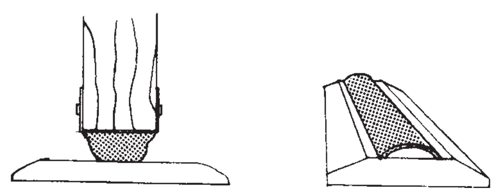
If you do not have weatherstripping, especially in homes with older windows and doors air will flow readily around the edges and cracks at joints in windows and doors into the house. Weatherstripping is an effective means at stopping this infiltration. In addition, good-fitting locks and closures help to make sure these openings can close securely.

Materials

- Sash locks where missing or damaged—these locks pull together the upper and lower sashes on double-hung windows and reduce air infiltration.
- Weatherstripping for windows and doors that have none. Weatherstripping comes in either long rolls or in sections appropriate for single doors or windows. If you are buying a longer roll, allow an average of 17 feet per door or window. For example, a 50-foot roll would seal about three openings (3x17 = 51 ft). See section on Infiltration Control Products.
- Energy-conserving thresholds or door sweeps for leaky door bottoms. See section on Infiltration Control Products.
- Fasteners to nail, screw or otherwise attach weatherstripping if not included in the package.
- 20-year caulk for sealing under energy conserving thresholds.



Weatherstripping



Thresholds

☑ Checklist

Typical Costs and Savings

- Materials: \$2 to \$6/window or door for weatherstripping, \$4 to \$14/door for energy-conserving threshold
- Contractor (materials, labor, and overhead): \$25 to \$40/window; \$35 to \$60/door
- Annual energy savings: Vary widely

Average Time Required

- *Weatherstripping*—½ to 2 hours/opening
- *Threshold*—½ to 1½ hours/door

Skills Required

Weatherstripping—Simple handiwork

Threshold—Basic carpentry

Tools

Weatherstripping

Tape rule
Screwdriver
Hammer
Utility knife

Threshold

Above tools plus:
Hack saw
Drill

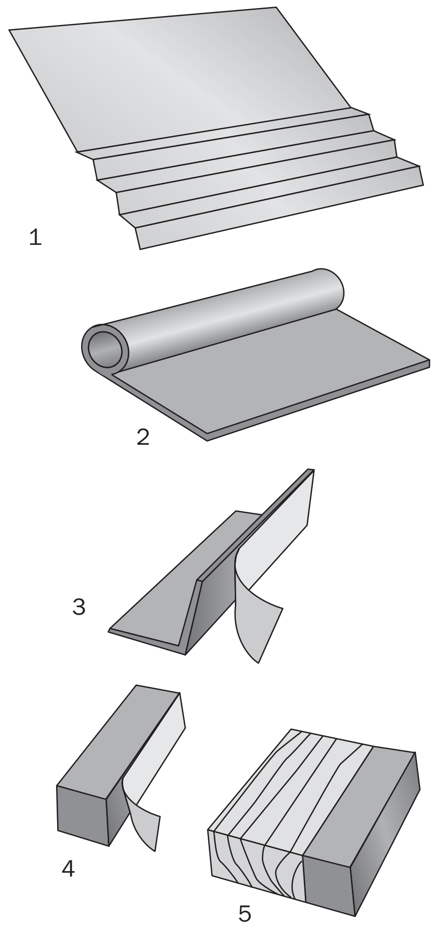
Infiltration Control Products

Types of weatherstripping:

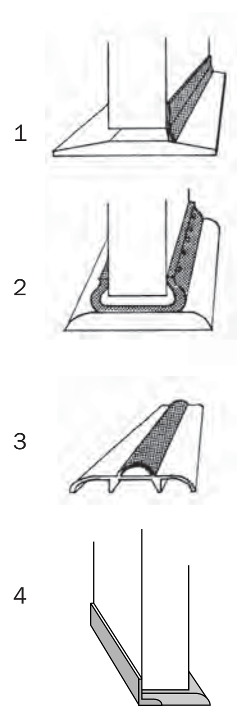
1. Thin spring metal—comes in rolls and is nailed or screwed in place. It is the most durable and can be used in a variety of applications.
2. Rolled vinyl gasket—comes in rolls and can be obtained with a metal backing. It is durable and has many different applications.
3. Adhesive-backed vinyl V-strip—works well for sealing doors and hinged windows and between the two sashes in double-hung windows.
4. Adhesive-backed foam strip—recommended only for short-term situations, such as helping a leaky window make it through a winter. Use closed cell foam which lasts longer—the surface is smooth and the individual pores in the foam do not show—unlike the open-cell foam which wears out very quickly.
5. Foam rubber with wood backing—easy to install but not very durable.

Types of thresholds:

1. Plain door sweep—can simply be screwed onto the bottom of the door and adjusted vertically so that it seals the crack between the closed door and the threshold. It is easy to install, somewhat durable, and fairly inexpensive, ranging in cost from $1.50 to $3.00. Door sweeps are most useful for flat thresholds. Flip sweeps are similar products that swing out to avoid interference with carpeting or rugs.
2. Door shoe—durable option that is somewhat difficult to install. It is especially useful when the existing threshold is not worn. As with the door sweep, you can adjust the shoe to form a solid seal for a door bottom that is not parallel to its threshold. Door shoes are more expensive than plain sweeps, ranging in price from $4.50 to $11.
3. Vinyl gasket threshold—usually comes as an aluminum threshold with a vinyl gasket inserted in a middle track. The door bottom seals against the vinyl gasket. Due to foot traffic, the gasket will wear out over time, but can be replaced. A vinyl gasket for a door parallel to the floor usually ranges in price from $4 to $7. An adjustable threshold of this type for a door that is not parallel to the floor is more difficult to install and costs $10 to $14.
4. Interlocking metal threshold—very durable and provides an excellent seal. However, it is difficult to install.

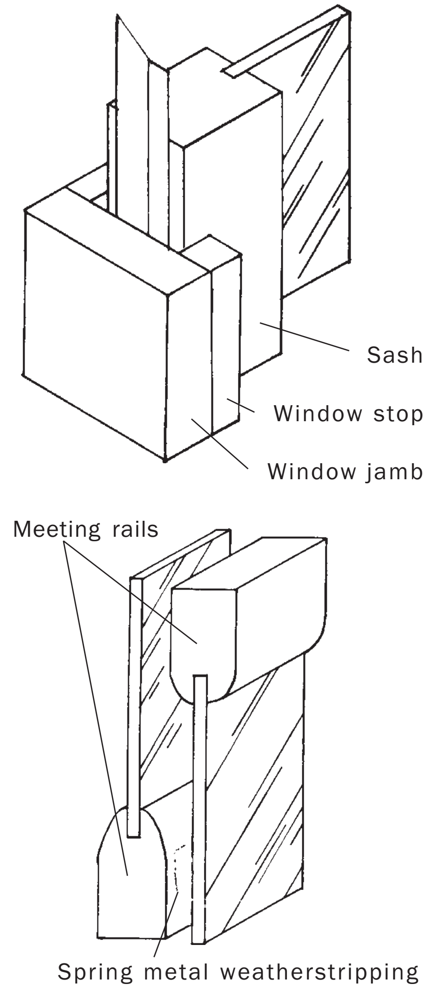


Types of weatherstripping

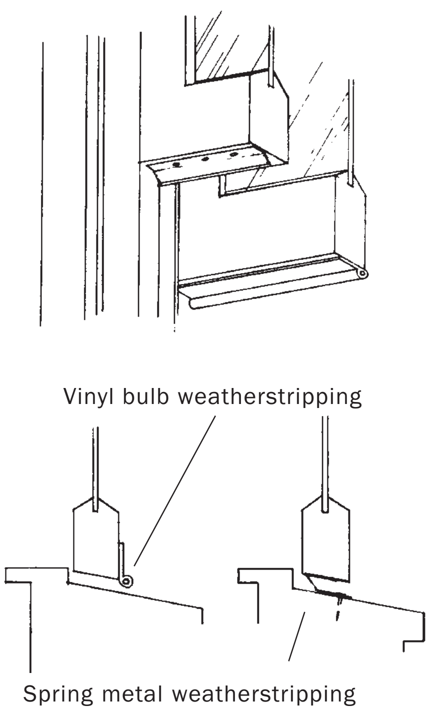


Types of thresholds

Weatherstripping sashes



Weatherstripping the bottom rail



Basic Procedure

Double-hung windows—using spring metal weatherstripping

For some window units, the metal weatherstripping can be inserted between the sashes and window jamb without disassembling the window.

1. Open the lower sash fully and slide the metal weatherstripping between the jamb and sash on one side. Mark where the weatherstripping meets the window seat. Repeat for the other side.
2. Cut weatherstripping to length and tack into place between the jamb and lower sash. Close the lower sash.
3. Open the upper sash fully and follow the same procedure to weatherstrip it as for the lower sash.
4. Install a piece of weatherstripping along the bottom edge of the lower sash and top edge of the upper sash to seal the units when closed. Also weatherstrip the meeting rail (where the two sashes meet when closed).

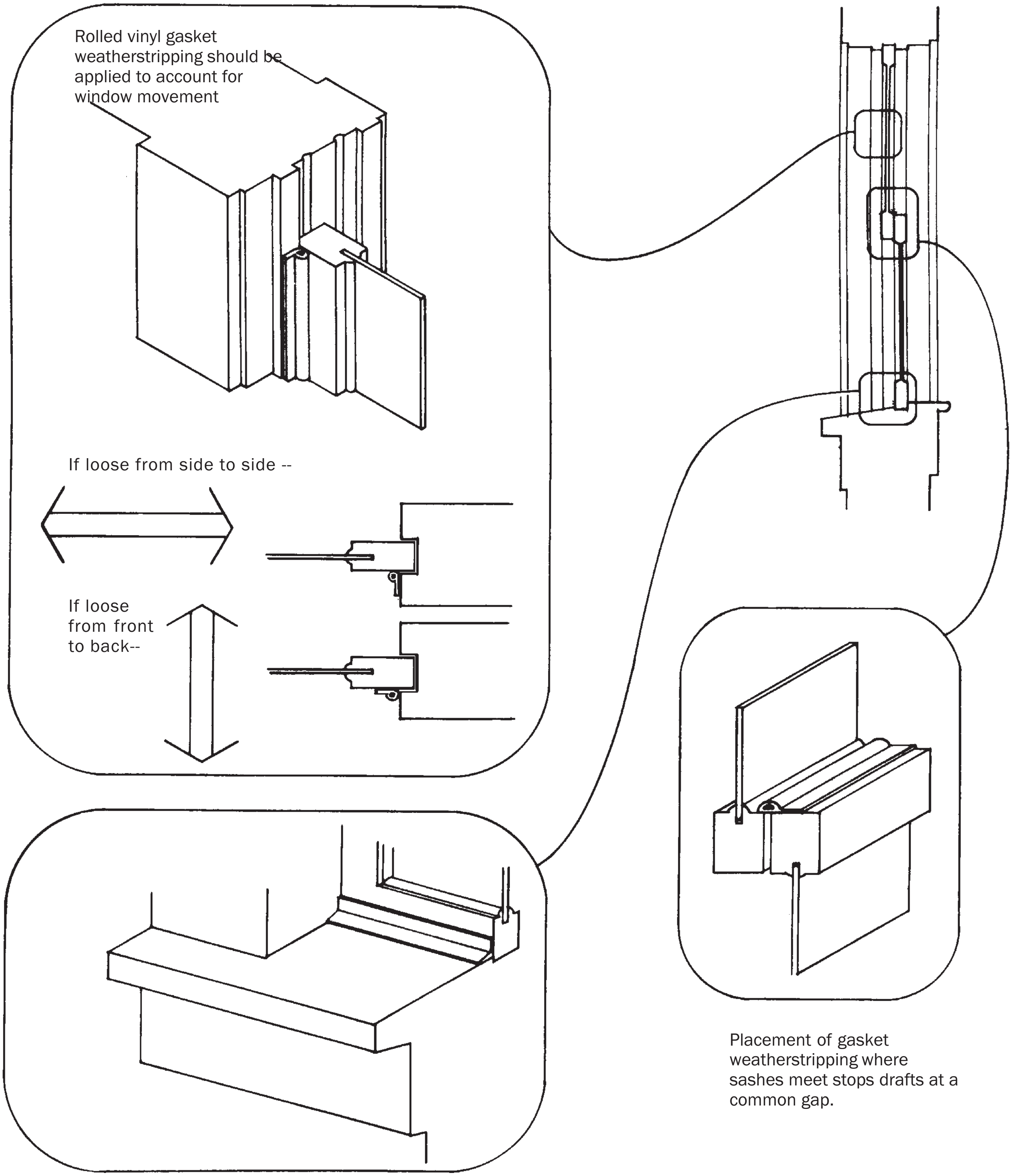
If the weatherstripping cannot be inserted between the sash and jamb, then the window may have to be disassembled for proper installation, as described in the following steps.

1. Remove the window stops carefully; it may be difficult to find replacement stops that match, particularly in an older home.
2. Pull the sashes out of the jamb and install spring metal weatherstripping against the jamb. Also, install weatherstripping on the outer surface of the lower sash's top rail so that the two sashes will seal together tightly.
3. Replace the sashes and install the window stop so that the window fits snugly but can easily be opened and closed.
4. If the window does not lock tightly, replace or adjust the sash lock.
5. Install weatherstripping along the bottom edge of the lower sash and top edge of the upper sash to seal the units when closed.

Double hung window—using vinyl weatherstripping

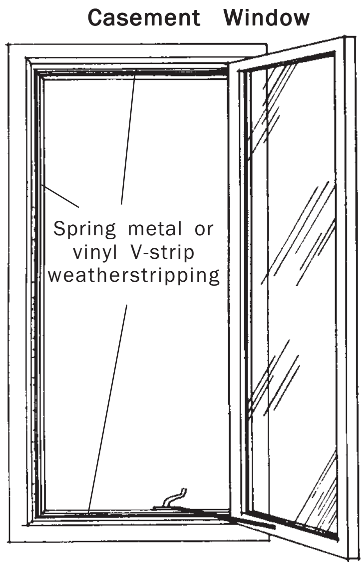
1. If you do not have to remove the stops and sashes, seal the sides of the window with rolled vinyl gaskets. Note that these weatherstripping materials may be visible.
2. Also, seal the meeting rail with rolled vinyl gaskets. Seal the bottom rail with vinyl V-strip or rolled vinyl gasket weatherstripping.

Weatherstripping double-hung windows

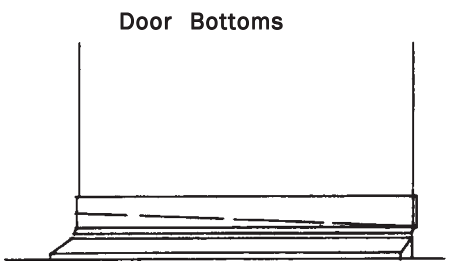


Placement of gasket weatherstripping where sashes meet stops drafts at a common gap.

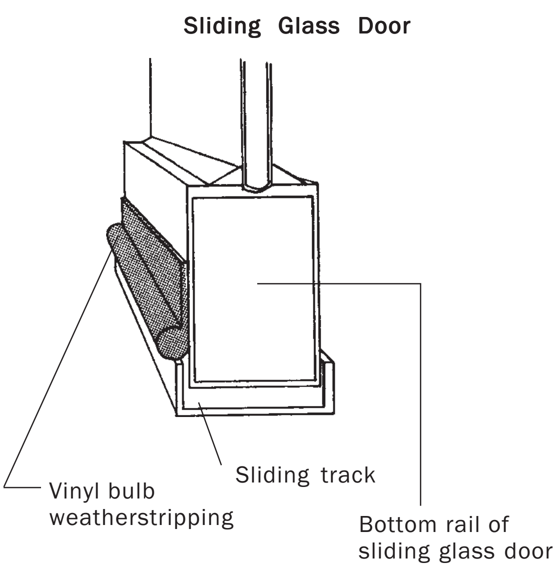
"V" type weatherstripping seats on the outter sill creating a seal to stop drafts.



Weatherstripping casement windows



Adjustable door shoe



Casement windows

Install spring metal or vinyl V-strip weatherstripping around the jamb just beside the window stops.

Metal windows

Although not recommended for other windows, use closed cell, adhesive-backed foam to seal the bottom rail and meeting rails of these windows. You may have to replace this weatherstripping annually, but it is inexpensive and easy to install.

Conventional swinging doors

Use spring metal, vinyl-V-strip, or rolled vinyl weatherstripping around the top and sides of the door frame.

Swinging door bottoms

If the door bottom is not square with the threshold, attach a door shoe or plain sweep; adjust it vertically to provide a good seal. If the door has no threshold, install an adjustable threshold with a vinyl gasket instead.

If the door is square and needs a threshold, install a simple (nonadjustable) threshold with a vinyl gasket. If it is square and already has a threshold, install a door boot or plain sweep. See the sidebar on *Checking for Square* in **Project 22:** Put In Storm Doors. Be sure to seal walk-in attic storage doors as well as exterior doors.

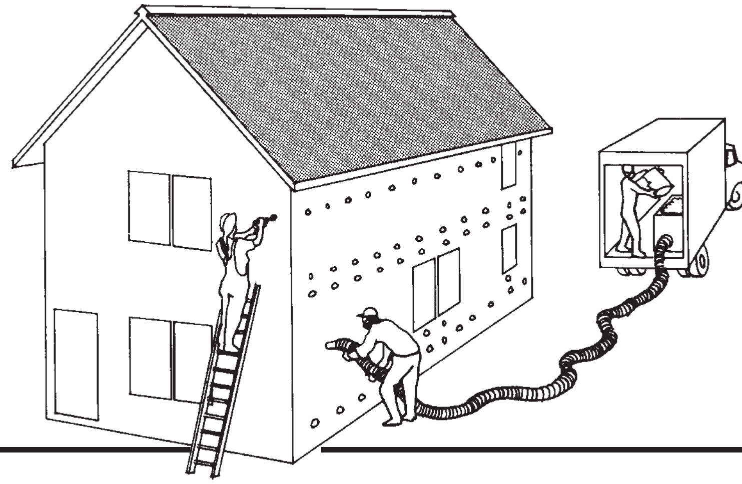
Sliding glass doors

Many units are already weatherstripped with a replaceable brush like "pile" weatherstripping or with a neoprene gasket. If not weatherstripped, a skilled carpenter can screw rolled vinyl weatherstripping with a metal backing into the frame using sheet metal screws.

PROJECT 14

Install Wall Insulation

Priority: ✪✪



Initial Requirements

Blowing cellulose insulation into wall cavities is one of the easiest ways to insulate walls in a home with no wall insulation, but the task itself is not easy. Cost out having a professional perform this project and weigh their costs against your skills, abilities and budget.

Materials

- Loose-fill insulation—When filled with insulation, the insulating value of most wall cavities increases by about R-13. A 25-pound bag of insulation will fill about three wall cavities—about 25 square feet of coverage per bag.
- Siding or other materials to replace damaged areas
- If holes are to be drilled, 1- to 2-inch wall plugs to cover holes
- 20-year paintable caulk to seal plugs in place
- Paint may be required

Basic Procedure

If the walls in your home do not have insulation, blowing in loose-fill insulation can both insulate and air seal wall cavities. Cellulose insulation usually provides the best job of sealing air leaks and adds about R-13 to the wall.

To gain access to the stud cavities, you can either drill holes into the wall from outside or inside, or remove a piece of exterior siding. If the house does not have sheathing under the siding, you may only need to pry the siding up a few inches in order to get the hose for the insulation blower into the wall. If you have to drill holes, you will need to patch them. Patching holes in the plaster or sheetrock on the inside is relatively easy to do but the patch and wall will need to be painted. Holes drilled on the outside have to be patched as well. Wood or plastic plugs can be used to fill these holes. The plugs must be caulked and painted carefully to match the exterior finish.

Blowing the insulation into the wall through a flexible tube compacts the insulation and can dramatically

☑ Checklist

Typical Costs and Savings

- Materials: \$.20 to \$.35/sq ft of wall
- Contractor (materials, labor, and overhead): \$.40 to \$1.00/sq ft of wall for blowing through interior wall or exterior wood siding, \$.70 to \$1.50/sq ft of wall for blowing through exterior brick veneer
- Annual energy savings: \$.06 to \$.20/sq ft

Average Time Required

- Contractor can often finish an average size home in one full day

Skills Required

- In most cases, a contractor should be hired for this job

Tools

Insulation blowing machine

10-ft, 1½-inch diameter flexible plastic tube

Ladders

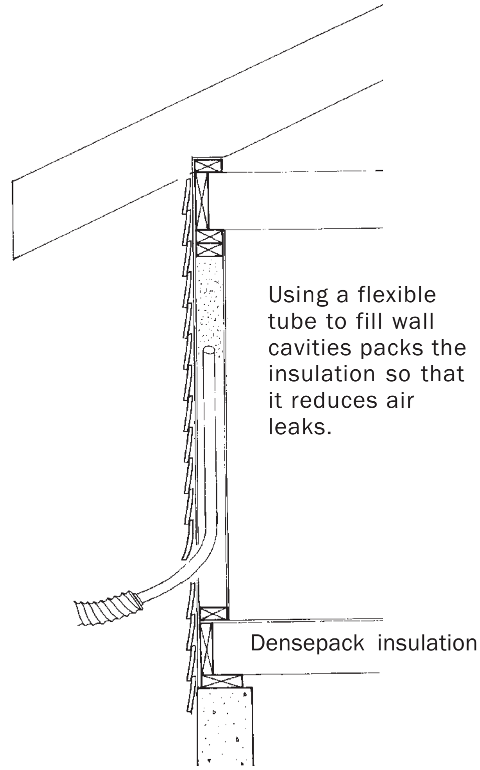
Power tools, such as saws, drills, as required

Carpenter's tool belt

Safety

Exceptional care is needed to avoid damaging electrical wires and plumbing inside the walls. The electrical circuits for the wires running through the walls that are being insulated should be turned off.

Blowing wall insulation can be a delicate operation. The insulation blowing machine pressurizes the wall with its high air flow. Under certain conditions, the interior wall finish can be strained and potentially loosened from its support. An observer should be stationed inside the house watching the wall. If the interior wall is shaking or billowing considerably, the observer can tell the installer to turn off the blowing machine.



reduce air leaks. Known as densepack wall insulation, this method packs about three times more insulation material into the wall and so seals air leaks while insulating. At the density typically applied without using the densepack method, wall insulation does not significantly reduce air leakage.

Most exterior walls have electrical wires, plumbing and other materials that can be life threatening or damaging to the building if improperly handled. Be certain that whomever is insulating the walls is knowledgeable of how to perform this work safely and efficiently. Never work on walls that have live electrical current or faulty wiring. Be sure to know where cutoff valves are located for water lines.

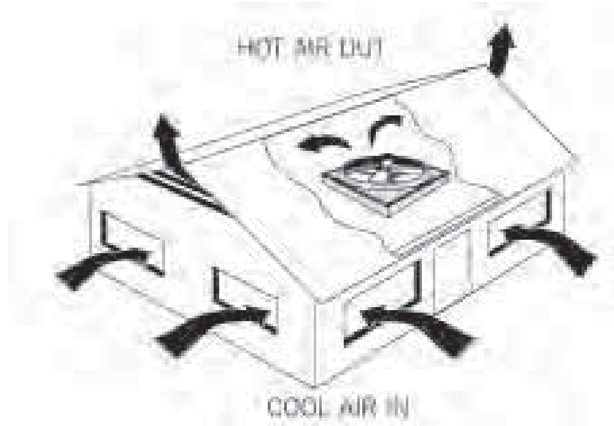
The basic steps in densepack wall insulation for a house with siding are:

1. Pry the lower course of siding away from the wall about two inches, being careful not to crack the siding and to keep its top edge nailed to the wall so it can easily be renailed. If the house has sheathing beneath the siding, remove the siding and drill a 2-inch diameter hole in the sheathing at an upwards angle to allow the tube to be shunted to the top of the wall without a sharp bend.
2. Pry or remove siding as required to work-around horizontal blocking in the wall, above window and door framing, and for diagonal corner bracing.
3. Adjust the insulation blower so that it will blow insulation at a sufficient pressure to compact the loose-fill cellulose to a density of about three pounds per cubic foot of wall area (the insulation should be compressed tightly such that poking it with your finger feels like poking a kitchen sponge.) *be careful that the pressure is not so great that the interior wall surface bows or cracks.*
4. Blow insulation into each stud bay by shunting the tube to one foot from the top of the wall. As the bay begins to fill with insulation and the insulation compacts around the end of the tube, pull the tube down in 1 foot increments allowing the insulation to become tightly packed. Densepacking the entire stud bay for an 8-foot high wall should take three to five minutes. If filling a stud bay is taking longer, stop and check to ensure that the insulation is not flowing inside, or into the attic or crawl space.
5. Be sure to insulate the entire exterior wall above windows and doors, where porch roofs or balconies attach to walls, and where there are uninsulated floors above garages or open areas. Densepack cellulose insulation is also effective at sealing air leaks between floor joists for attic bonus rooms. Many of these areas will require insulating from above while standing on a ladder. Follow strict safety guidelines as the blower can become clogged or drills obstructed and jerk against the installer.
6. After the stud bay is insulated, close the wall by renailing the siding. Plug any drill holes in the wall sheathing with pieces of fiberglass insulation, then renail the siding. Repair and paint pieces of siding if necessary.

PROJECT 15

Install Ceiling Fans and Whole House Fan

Priority: ✪✪



Initial Requirements

To effectively use a whole house fan you need a full attic with adequate ventilation. If your house doesn't qualify consider ceiling fans. Both solutions create a breeze in your home that provide cooling comfort for pennies a day.

Materials

Ceiling fan

- Multi-speed ceiling fan—use a multi-speed model sized according to the room. Make sure the post that connects the fan to the ceiling is long enough so that the fan will be located about seven feet above the floor.
- Electric wire—12 to 14 gauge, two conductor with ground.
- Wire nuts to connect wires—should be large enough to connect three 12 or 14 gauge wires. Buy six to ten.
- Cable clamps—these screw into the electric box and clamp the incoming wire in place. Buy six to ten.
- Electric box to which ceiling fan is connected—the box should connect directly to the ceiling joist and be made specifically for supporting a ceiling fan. Special supports that span and fasten to ceiling joists can be used to support standard metal electric boxes.
- Switch box, multi-speed switch, and switch cover-plate for fan—if needed (many are operated by a pull switch that hangs from the fan).

☑ Checklist

Typical Costs and Savings

Ceiling fan

- Materials: $40 to $150
- Contractor (materials, labor, and overhead): $150 to $350
- Annual energy savings: $40 to $150 (using several fans)

Whole house fan

- Materials: $90 to $200
- Contractor (materials, labor, and overhead): $300 to $500
- Annual energy savings: Up to 2/3 of cooling bill

Average Time Required

- *Ceiling fan*—1 to 3 hours
- *Whole house fan*—8 to 16 hours

Skills Required

- *Ceiling fan*—basic electrical wiring
- *Whole house fan*—basic carpentry and basic electrical wiring

  Never do your own wiring unless you have prior experience and total confidence in your abilities.

Tools

Ceiling fan

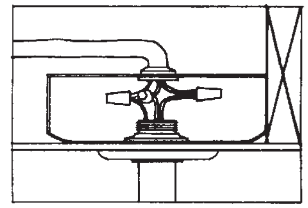
Voltage meter or circuit tester
Utility knife
Wire stripper
Needle-nose pliers
Carpenter's tool belt
Ladder

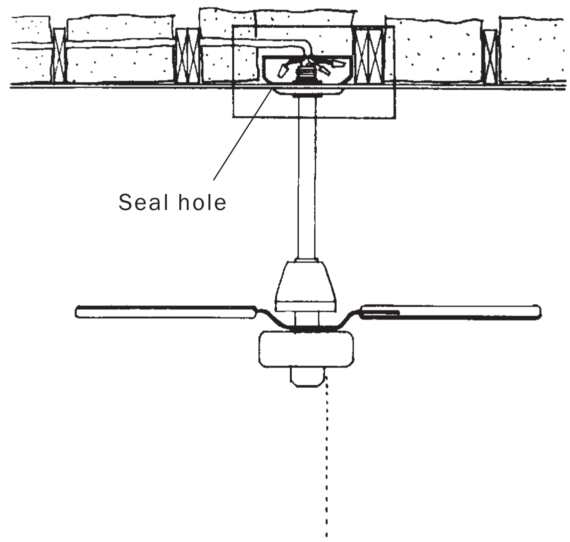
Whole house fan

Above tools, plus:
Circular saw or reciprocating saw
Framing square

Whole house fan

- Multi-speed whole house fan—size based on the volume of the area you wish to cool. For example, a house with 2000 square feet of area to cool and 8-foot ceilings would have a volume of 16,000 cubic feet. The fan should deliver ½ to 1 air change per minute; that is, every one to two minutes the volume of air in the house should be replaced. In the example, you need a fan that produces 8,000 to 16,000 cubic feet of air flow per minute, or 8,000 to 16,000 cfm. The cfm rating should be printed on the box.
- In addition to the wiring materials listed for a ceiling fan, you will need the following for a whole house fan:
- Extra wire nuts and cable clamps
- Temperature-sensitive safety switch (firestat)—to keep fan from running if a fire occurs in the house
- Timer switch—keeps you from having to get out of bed in the middle of the night to turn off the fan
- 2x8 or 2x6 lumber—for framing the opening where the fan will be mounted. The lumber should be the same size as the ceiling joists
- Nails for framing opening
- Inner tube or other rubber material (optional)—gasket for the whole house fan





Basic Procedure

Installing ceiling fan

1. Read installation instructions before you leave the store to make sure the fan is appropriate for your house.
2. Determine where you want the fan installed (e.g., center of the ceiling, over dining table, over bed, etc.). Also, determine the position of the switch to control the fan if necessary. Many fans are controlled by a pull cord just like that for a closet light.
3. Determine the path for electric wiring. If substituting the fan for an existing overhead light, you can probably use the wiring inside the electric box for the light. Otherwise, the wire can extend to the main service panel or it may be connected to an outlet box in a seldom used circuit. Provide suitable support for the electrical box and the fan by securing it to a ceiling joist or supplementing the box with a joist-spanning support.
4. If a new electric box is necessary, use a box specifically designed for ceiling fans and attach it to a joist in the attic.
5. Run wiring to the box.

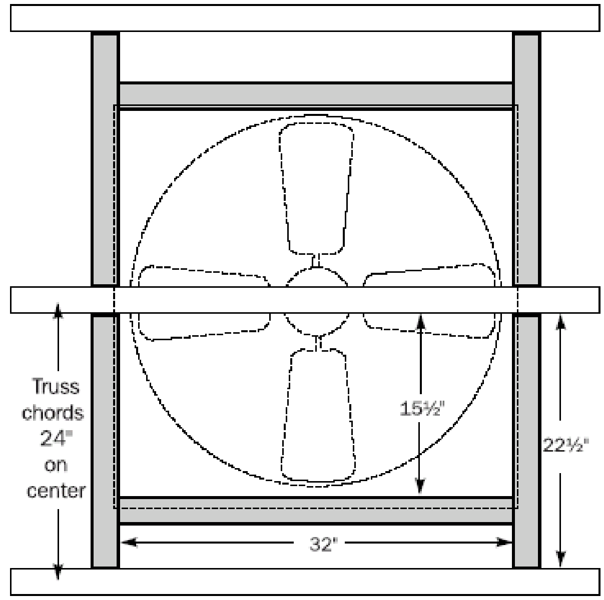
Safety

Installing fans requires substantial electrical work. Do not attempt it unless you are very sure of your abilities. Assume all wires are live until tested. Turn off the breaker switch or disconnect the fuse for the circuit on which you will be working or cut off the main breaker for the house. Always connect a temperature sensitive switch, called a firestat, in the attic when installing a whole house fan. Firestats will shut off the fan in case of fire.

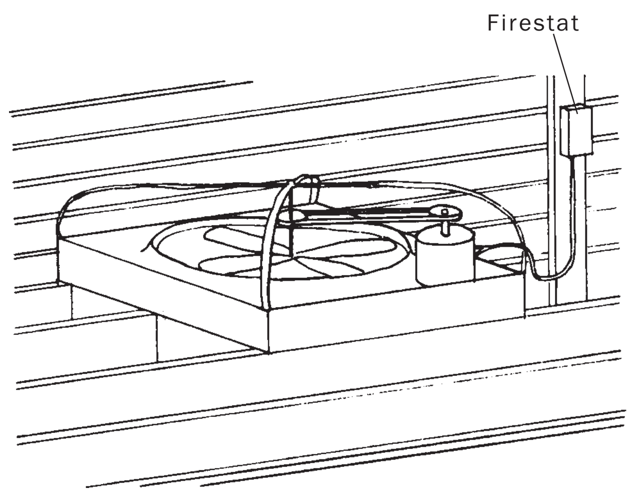
6. Keep the circuit off and follow the instructions to hang the fan and connect the wiring into the electric box.

Installing whole house fan

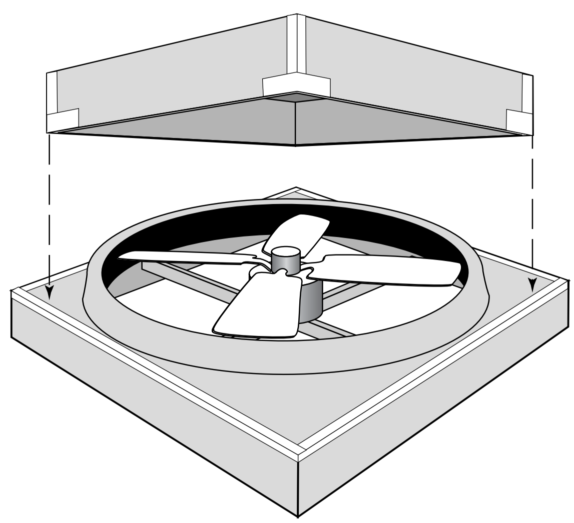
1. Read the printed instructions that come with the fan. Determine the path for the electric wire. Because you must connect a temperature-sensitive switch (firestat) and a timer switch, the wiring is usually more complex than for a ceiling fan.
2. You will need to start by framing a structure on which the fan will sit. Use the printed instructions and follow steps 3 through 7 below.
3. Use a framing square as a guide to draw lines on the ceiling for the location of the fan. Try to locate the fan between two ceiling joists. Plan the location so the fan spans one ceiling joist across the center. After checking to make sure you will not cut any wires or other objects in the attic, carefully use a keyhole saw, circular saw, or reciprocating saw to cut the opening.
4. Remove the ceiling within the opening to expose the attic. Be sure not to damage any of the interior finish outside the dimensions of the fan.
5. Never cut a joist; wood is installed between the joist to create a framed box to raise the fan to level with the ceiling joist system. Cut 2x8's or 2x6's for framing these "H" brackets.
6. Install framing.
7. Install the fan on top of the framing; consider inserting a rubber gasket, such as a piece of inner tube, between the framing and the joists to reduce vibration and noise. Be sure to seal the unit into the rough opening in the ceiling.
8. Run wiring using the wiring diagram that comes with the fan.
9. Test the fan.
10. Install the louvered cover over the fan. The louvers must be able to operate freely (open/close) and care must be undertaken to prevent binding or misalignment.
11. Use insulation board or other material to seal the louvered cover in winter to reduce infiltration, or build an insulation box to fit over the fan during the winter. There are some commercial whole house fan covers available.



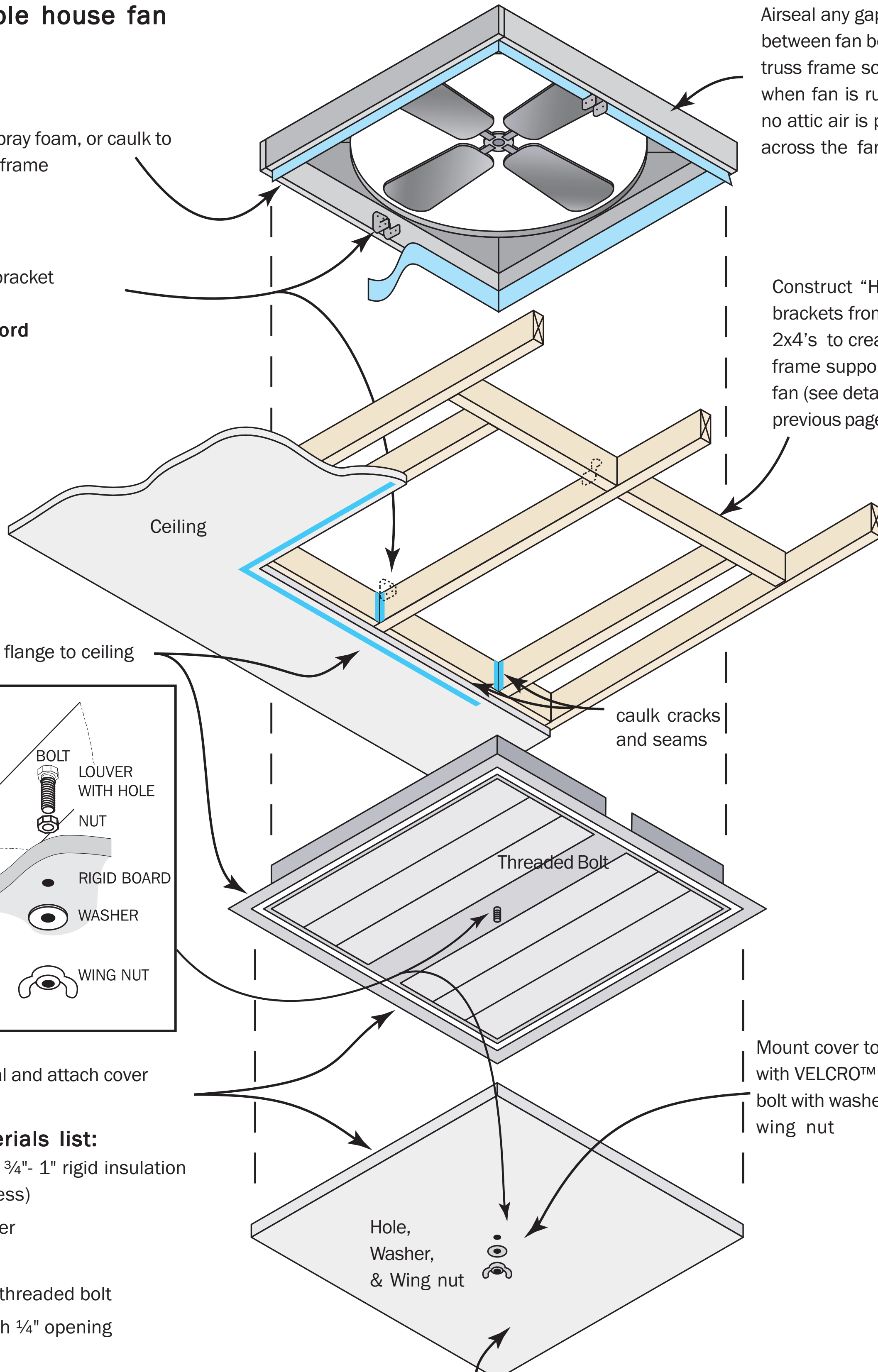
The current convention of resting the fan on "H" brackets saves cutting a ceiling joist and speeds installation.



Whole house fan with pulley drive and firestat installed


An insulated box reduces infiltration in the off-season

Installing a whole house fan



Louver cover detail

¼"-20 nut threaded all the way up to hold bolt to the louver section. Wing nut and washer hold rigid board insulation tightly against louver.

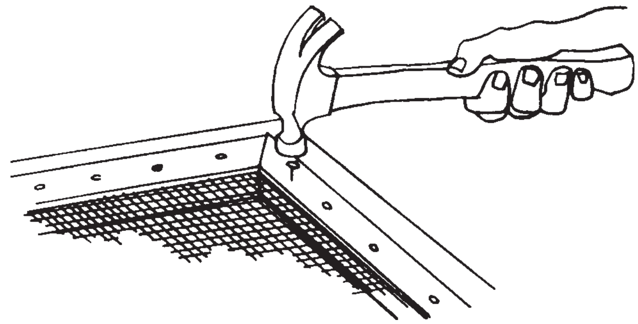
Louver cover materials list:

- 30" x 30" piece of ¾"- 1" rigid insulation (minimum thickness)
- White contact paper
- Drill with ¼" bit
- 1¼" long, ¼" - 20 threaded bolt
- Fender washer with ¼" opening
- ¼" - 20 wing nut
- VELCRO™ with adhesive fasteners

PROJECT 16

Build Exterior Solar Shade Screens

Priority: ✪✪



Initial Requirements

More than 30 percent of your home's air conditiong bill can result from sunlight streaming through windows. East- and west-facing windows are particularly bad, as they receive the most sunlight in summer.

Materials

Shade screen on wood frame:

- Solar shade screen—rated to block 60 to 80 percent of sunlight and sized at least one to two inches larger than the screen frame
- Heavy-duty ¼-inch staples for staple gun to attach the screen to frame
- ¾-inch or 1-inch brads—to attach the screen molding to frame
- Corrugated metal fasteners—to hold together new frame
- 1 x 2 lumber long enough for the frame
- Construction adhesive or glue
- Screen molding (if needed) to extend all around the frame
- Exterior wood primer
- Exterior paint to match window trim
- Hardware to attach the screen over the window

Shade screen on metal frame:

- Solar shade screen—rated to block 60 to 80 percent of sunlight and sized at least one to two inches larger than screen frame
- Rubber spline to hold the screen in the metal frame
- Hardware to attach the screen over the window

☑ Checklist

Typical Costs and Savings

- Materials: $.60 to $2.00/sq ft
- Contractor (materials, labor, and overhead): $2.50 to $4.00/sq ft
- Annual energy savings: $.27 to $.44/sq ft

Average Time Required

- ¼ to 1 hour to fabricate and install each screen

Skills Required

- Basic carpentry

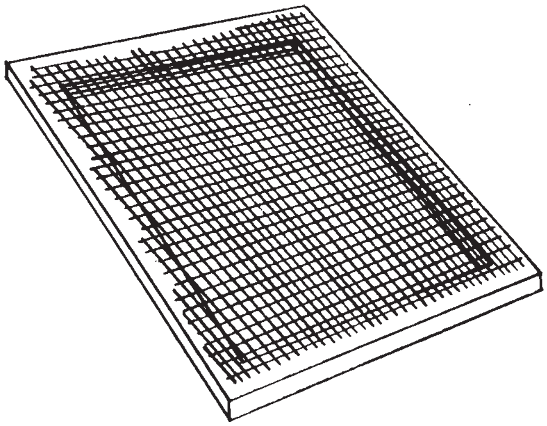
Tools

Shade screen on wood frame:

Pry bar (for installing on old frame)
Mitre box with backsaw (if installing on new frame or replacing screen molding on old frame)
Paint scraper or steel wire brush (for installing on old frame)
Heavy-duty stapler
Carpenter's tool belt

Shade screen on metal frame:

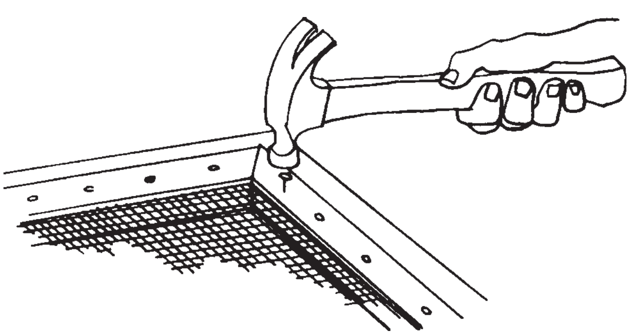
Screen spline roller
Scissors
Carpenter's tool belt (see Rules for Tools section in Chapter 3)
Electric drill and drill bits (if installing on new frame)
Mitre box and backsaw (if installing on new frame)



Basic Procedure

Replacing an insect screen on a wood frame with a solar shade screen

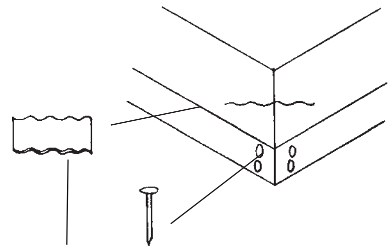
1. Remove the screen molding from the old screen. Be careful if you want to reuse the molding—it breaks easily.
2. Remove old brads and staples with a screwdriver, hammer and pry bar.
3. Clean flaking paint on the frame with a paint scraper or steel wire brush.
4. Cut the shade screen ¼-inch larger than the outside dimensions of the old screen and lay it in place on the wooden frame.
5. Staple the solar shade screen to the top of the frame—be careful to keep the screen's thick weave straight across the frame. Then, stretch the screen evenly toward the bottom and staple.
6. Staple one side down; then, stretch the other side and staple it down.
7. Trim the excess screen with a utility knife.



8. If you are reusing old screen molding, tack it in place with ¾-inch or 1-inch brads.
9. If you are replacing the screen molding, use a mitre box to cut molding with 45-degree corners.
10. Mount the screen in the window.
11. Make sure you remove the shade screen in winter.

Installing a shade screen on a new wood frame

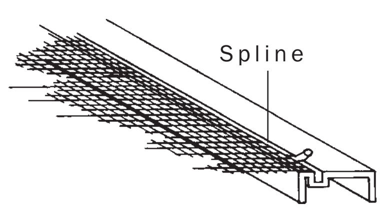
1. Measure the outside frame of the window. Be accurate; the frames of older windows may have shifted and the corners will no longer be at right angles. (see the sidebar on *Checking for Square* under **Project 22:** Put in Storm Doors)
2. Using a mitre box, cut pieces for the window frame out of 1 x 2 lumber at a 45-degree angle. Lay the pieces on a flat surface to check the dimensions and ensure the mitred edges fit tightly.



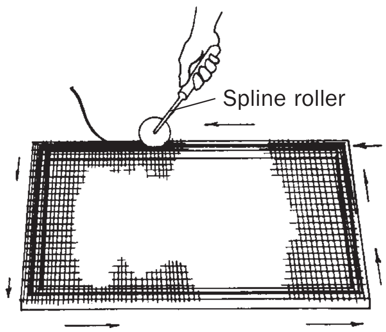
3. Glue the frame together and use the corrugated fasteners to assemble it. Drive two 1½-inch brads through the edge into each corner joint to ensure a solid connection.
4. Follow instructions 4 through 10 described in the previous section (replacing an insect screen on a wood frame with a shade screen).
5. Make sure you remove the shade screen in winter.

Replacing an insect screen on a metal frame with a solar shade screen

1. Remove the old screen from the metal frame by gently pulling out the rubber or plastic spline—be careful if you plan to reuse the spline.
2. Cut a piece of the shade screen one to two inches larger than the outside dimensions of the old screen.
3. Place the shade screen over the frame. Starting at the top left-hand corner, lay the rubber spline on top of the screen directly over the groove in the frame.



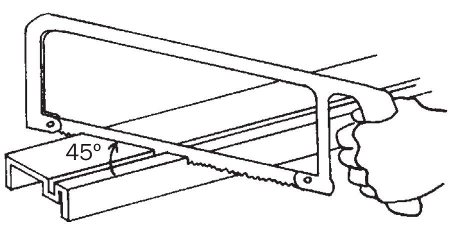
4. Roll the spline roller in a clockwise direction to press the spline and the screen firmly into the groove. Continue around the frame until you reach the starting point. As you proceed, keep the weave even in the frame.



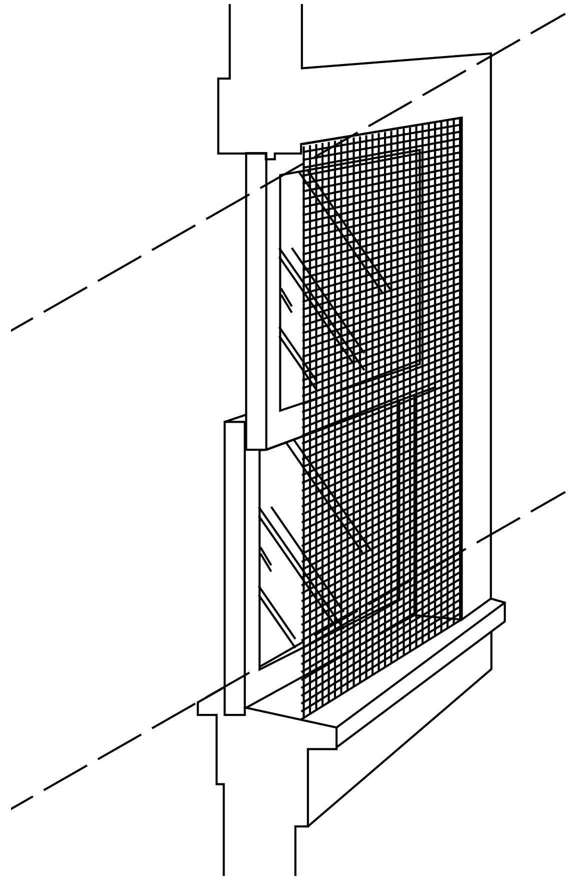
5. Trim any excess screen from the spline using the utility knife.
6. Install the shade screen frame in the window.
7. Make sure you remove the shade screen in winter.

Installing a shade screen on a new metal frame

1. Measure the outside frame of the window.
2. Cut four pieces of aluminum frame stock to form the top, bottom, and sides of the frame. For larger screens, you may also need a center support bar and clips for attaching it to the frame.



3. Slide the frame pieces onto the metal corner brackets. Set the completed frame into the window to check the fit. Make any needed adjustments.
4. Follow steps 2 through 6 for the previous procedure in this section (replacing an insect screen on a metal frame with a solar shade screen).
5. Make sure you remove the shade screen in winter.



Solar shade screens are just one of many solutions

Keep window shades and curtains closed during the day whenever possible. If your windows are bare, consider buying inexpensive white roller shades. You may also want to consider a more permanent solution. Solar film that reflects sunlight can be glued to the inside glass surface. Or place solar shade screens on the outside glass surface to block sunlight before it strikes your home's windows.

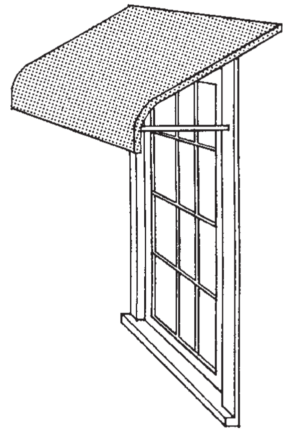
Safety

Use common-sense measures

PROJECT 17

Use Awnings and/or Interior Roller Blinds

Priority: ✪✪



Initial Requirements

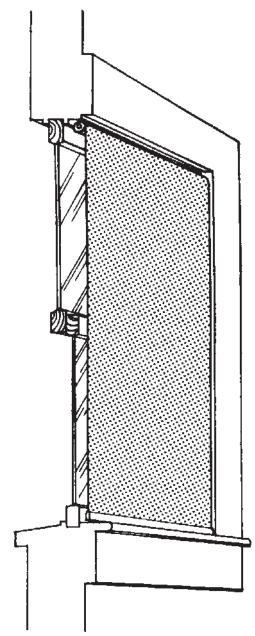
You have a house with unshaded windows facing east, southeast, south, southwest, or west. Awnings are a permanent solution that stays installed year-round and interior roller blinds are probably the cheapest shading solution. (See also (**Projects 16** and **20**).

Materials

- White roller blinds sized for the window—the white color is important to reflect incoming summer sunlight back out the window
- Awnings—should be wider than the window, extend over it in summer, and retract to allow full sunlight in winter. Also, the awning should have vent holes where it attaches to the house to keep from trapping hot air underneath.

Basic Procedure

Follow instructions that come with the products.



Roller Blind

☑ Checklist

Typical Costs and Savings

White Roller Blind

- Materials: \$4 to \$20/window
- Contractor (materials, labor, and overhead): \$10 to \$16/window

Awnings

- Materials: \$30 to \$200/window
- Contractor (materials, labor, and overhead): \$40 to \$250/window
- Annual energy savings:
  \$4 to \$8/window for roller blinds
  \$3 to \$8/window for awnings

Average Time Required

- ¼ to ½ hour/roller blind, ½ to 2 hours/awning

Skills Required

- *Roller blind*—simple handiwork
- *Awnings*—basic carpentry

Tools

Roller blind:
Screwdriver
Hammer
Tape rule
Awning:
Electric drill with bits
Carpenter's tool belt
Level

Safety

Use common-sense measures

PROJECT 18

Put Up Storm Windows

Priority: ✪✪

Initial Requirements

Existing single-paned windows are in good repair with full weatherstripping, intact glazing compound, and caulked frames and you want to improve the efficiency of your building envelope.

Materials

- Exterior storm windows for double-hung, sliding, or fixed windows (see sidebar on *Selecting Storm Windows*),
  or
- Interior storm windows for casement, awning and other windows that open outwards (see sidebar on *Selecting Storm Windows*)
- Acrylic latex caulk with silicones, silicone caulk, or other 20-year caulk (for exterior storm windows)
- ½ inch x ½ inch molding strip to form bottom mounting edge may be needed if none exists for interior storm windows
- Primer and paint to match the interior window frame (for interior storm windows that need the bottom moulding strip)

Safety

Installing exterior storm windows usually requires use of ladders, so be careful and follow common-sense tips in the **Safety** section of Chapter 3. Also, storm windows are usually built of glass, so handle them with care.

When planning storm windows, make sure each room will include an easy way of escape in case of fire. For example, if all the windows in a room have fixed exterior storm windows over them, escaping will be difficult. Use at least one operable storm window.

☑ Checklist

Typical Costs and Savings

- Materials: $1.15 to $4/sq ft
- Contractor (materials, labor, and overhead): $2 to $7/sq ft
- Annual energy savings: $.40 to $.66/sq ft

Average Time Required

- ½ to 1½ hours/window

Skills Required

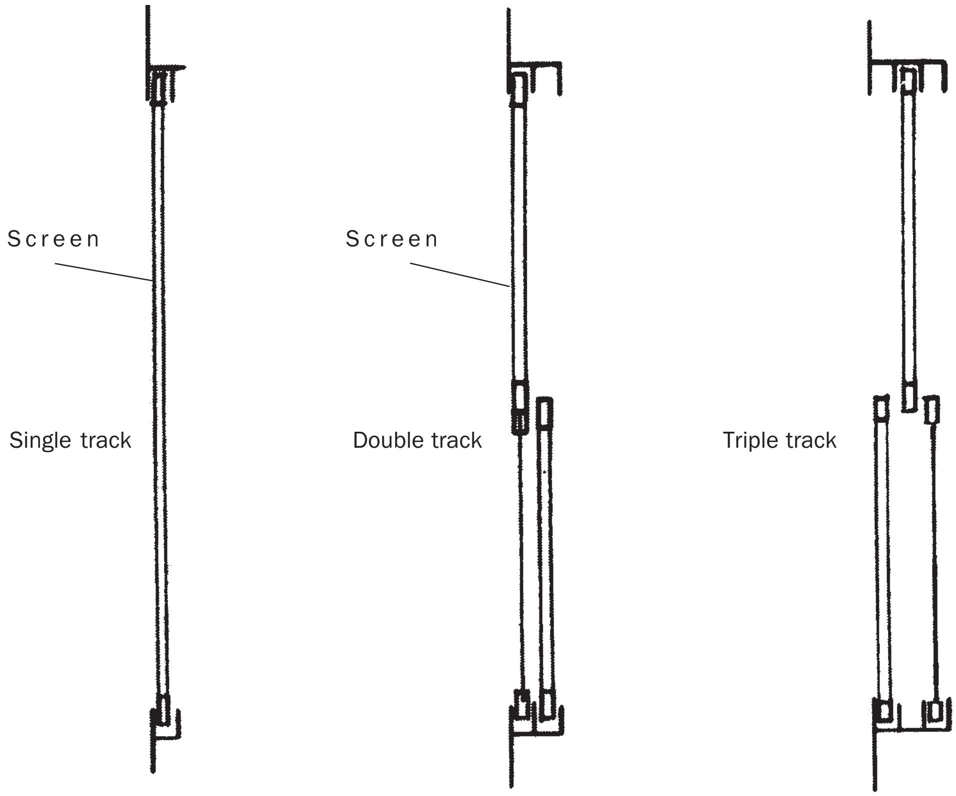
- Simple handiwork; perhaps some basic carpentry

Tools

Caulk gun
Screwdriver
Extension ladder
Paint brush
(for interior storm windows)
Pliers
Square or level
Utility knife

Optional Tools

Saber saw or reciprocating saw with metal cutting blade—needed for adjusting a storm window that is too large.



Selecting Storm Windows

Exterior storm windows

Exterior storm windows work best over double-hung windows that slide up and down, horizontal sliding windows, or fixed windows. Storm windows that fit over operable windows should have 2 or 3 tracks to allow ventilation in spring, summer, and fall. Double- track windows have an inner track for the operable bottom sash.

The insect screen and upper sash fit in the outer sash. In triple-track storm windows, the bottom sash, upper sash, and insect screen each have their own track. Fixed windows need only a single, fixed-sash storm window.

In order to reduce costs, use standard-sized storm windows instead of custom-ordered windows. You can often trim the metal flanges of standard storm windows to adjust for a nonstandard window. Quality products will be rated by the American Architectural Manufacturers Association (AAMA).

Interior storm windows

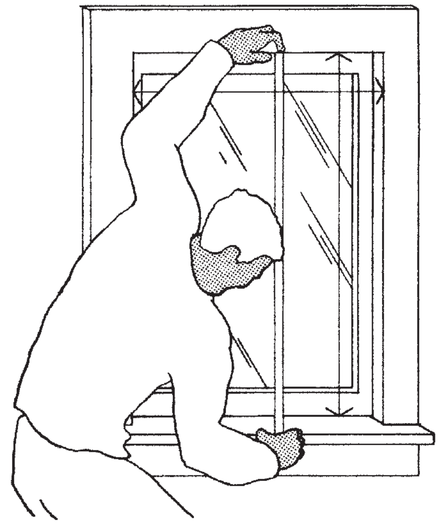
These single-sheet storm windows are usually made of acrylic plastic and attach to the existing window trim with magnetic strips or Velcro®. They are ideal for hinged windows which open out, such as casement or awning units, where exterior storm windows would be impractical as they would not allow the window to open. Some interior storm windows have a sliding sash system to allow ventilation like regular operable windows.

They should be sized to fit on the inside surface of the window casing. In some cases, you will have to remove the handle for an operable window in order to install the storm window.

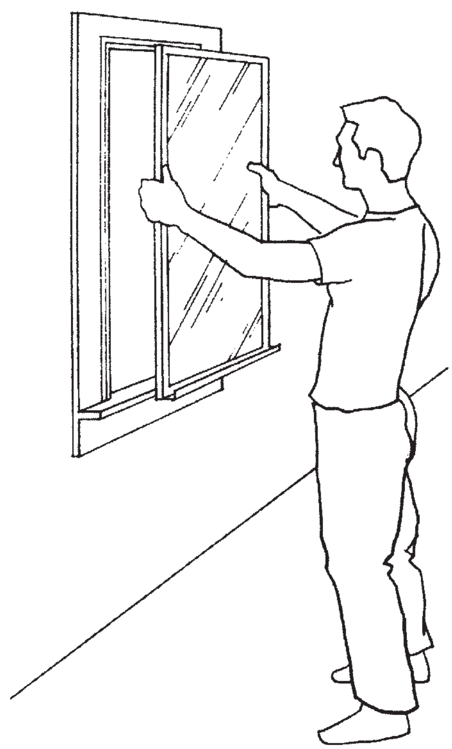
It is possible to make your own interior storm windows. Several kits are available for do-it-yourselfers. You can order sheets of plastic cut to fit from a plastic glazing supplier. Velcro® is available from fabric stores; be sure and obtain a high quality, durable cement to attach the Velcro® to both the storm window and the window frame. The window should have an inside handle or ledge for easy removal.

Basic Procedure

1. Determine which type of storm window to install: exterior (fixed, double-track, or triple-track) or interior.
2. Measure the window opening for storm windows and purchase or order the windows.
3. If installing exterior storm windows, set up a ladder and have a friend inside help to hold the unit. Then:
   a. Set the storm window in position to make sure it fits. With the window in place, mark the locations of the weep holes, which provide an outlet for moisture.
   b. If the window does not fit, adjust it by scoring the cutting lines on the flange and using pliers to bend and break off the excess. You can use a saber saw for this step, but it may be more difficult than using pliers.
   c. Caulk the portion of the window frame against which the storm window will attach. Leave gaps at the bottom where the weep holes are.
   d. Set the storm window in position and screw it into place. Make sure the window sashes slide easily and fit squarely at the top and bottom. Clean caulk out of the weep holes.



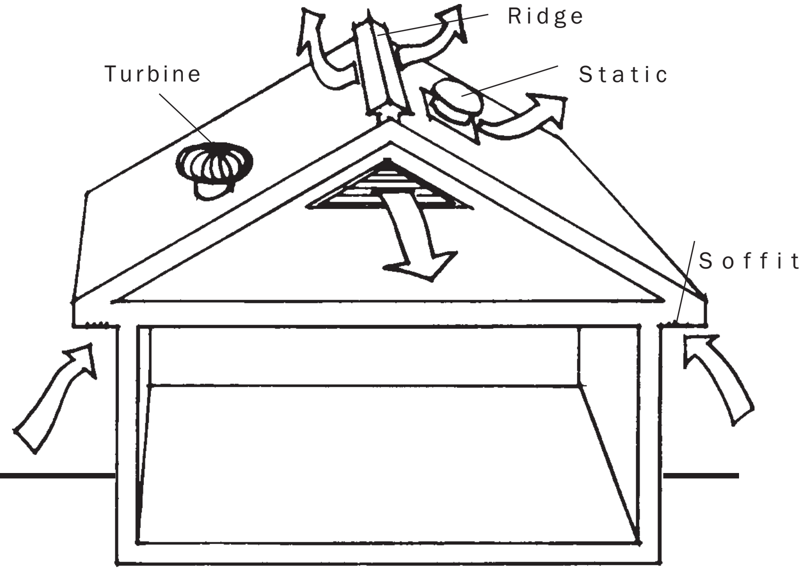
4. If installing interior storm windows, proceed as follows:
   a. Set the storm window against the window frame and mark the perimeter with a pencil.
   b. If the storm window needs a bottom molding strip and the window does not have one, attach ½ inch x ½ inch molding even with the window frame along the bottom of the window. The bottom of the storm window will attach to this. Make sure it does not block the ordinary operation of the primary window. Prime and paint it the color of the window frame.
   c. Attach the magnetic strip or Velcro® strip to the window frame so that it fits just inside the mark showing the perimeter of the storm window. Use a high quality, durable glue. Magnetic strips may also be screwed into place. Make sure the screw is countersunk so it does not interfere with the seal between the magnetic strip and the window.
   d. Attach the storm window to the sealing strip.



PROJECT 19

Increase Attic Ventilation

Priority: ⊛⊛



Types of roof vents

Initial Requirements

Attic net free vent area is less than 1/150 of the attic area (see sidebar on *Selecting and Sizing Attic Vents*).

Materials

- Attic vents—install as many as are required to achieve the desired net free vent area (see sidebar entitled *Selecting and Sizing Attic Vents*).
- Flashing—choose a product that is durable and matches the other flashing materials on the roof. Some vents come with built-in flashing.
- Roofing cement—follow the recommendations of the manufacturer about which type of material to use to provide a waterproof seal
- Roofing nails

Safety

Be careful when working on the roof. Always have someone close by in case of an accident. Work during a cool part of the day, as roof temperatures can exceed 150 degrees on hot, sunny days.

☑ Checklist

Typical Costs and Savings

- Materials: gable vents—$10 to $25 each, roof louver vents— $5 to $15 each, turbine vents— $15 to $35 each, ridge vents—$1 to $2/ linear foot, soffit vents—$.75 to $1.50 each
- Contractor (materials, labor, and overhead):
  gable vents—$30 to $50 each , roof louver vents— $35 to $55 each , turbine vents— $55 to $85 each, ridge vents— $5 to $9/linear foot, soffit vents—$8 to $12 each
- Annual energy savings: Range widely, but attic ventilation is needed for reasons other than energy conservation. It helps remove moisture from the attic throughout the year. In summer, it keeps the attic cooler and may increase the life of the roof.

Average Time Required

- 6 to 12 hours to install several vents

Skills Required

- Skilled carpentry. Be sure you have the experience needed for this job. Improperly installed attic vents can cause roof leaks. If you are in doubt, hire a contractor.

Tools

Carpenter's tool belt
Circular saw, reciprocating saw, or jig saw
Electric drill with bits
Ladder

Selecting and Sizing Attic Vents

Attic ventilation may be necessary to remove condensation from the attic. Condensation can occur when water vapor from the interior of the house rises through the ceiling into the attic. Given a high concentration of water vapor and sufficiently cool temperatures, the vapor can condense into water and potentially damage the insulation, as well as the ceiling material itself.

Attic vents should be positioned both as high and as low as possible. The best strategy is a combination of high vents spread along the ridge and low vents near the soffit area (on the underside of the roof overhang). In addition, the vents should be spread over the entire roof area to ensure that all of the attic is properly ventilated.

Outside air enters the attic through the soffit vents and is exhausted out through the high vents. For most homes, this natural convective flow of heated air and moisture out of the attic is sufficient. Electrically powered attic ventilators are not necessary and may cause house depressurization.

The type and placement of attic vents will be determined largely by the roof design.

Continuous ridge and soffit vents usually provide the most effective ventilation.

Attic vents are sized in terms of square feet of net free vent area—the size of the actual opening through which air flows. You may have a rectangular gable vent that is 2 feet tall and 3 feet wide; however, if that opening is covered by a wood louver, the actual area through which air flows will be substantially less than the size of the opening. The chart shows factors for determining the net free vent area for different vent coverings.

For example, the area of the opening for the 2-foot by 3-foot gable vent is:

2 ft x 3 ft = 6 sq ft

The vent is covered by a wood louver. From the chart, the ratio of opening area to net free vent area is 2.25. The net free vent area of the gable vent is then:

6 sq ft/2.25 = 2.7 sq ft

Reduction Factor for Vent Covers

Type of cover	Reduction Factor
Wire mesh or chicken wire	1.00
Insect screen	2.00
Metal louvers	1.50
Metal louvers with insect screen	2.00
Wood louvers	2.25
Wood louvers with insect screen	3.00

Basic Procedure

Soffit vents

1. Determine if the eave area has sufficient room for soffit vents. Generally, the vents are installed on the underside of the eave—called the soffit. If the roof does not have an eave, the vents may be placed in the fascia framing between the rafters.
2. Follow the manufacturer's instructions for cutting holes for the vents. Holes for both continuous and rectangular soffit vents can usually be cut with a power saw. Using a power saw overhead requires considerable skill and strength. Be certain that you have the experience necessary to do this job safely.
3. After the opening is cut, position the vent and secure with weather-resistant nails or screws.
4. If the vent does not have insect screening, install it before positioning the vent in the opening.
5. Make certain that soffit vents are not blocked by insulation.

Ridge vents

1. Follow the manufacturer's instructions in marking the placement of the ridge vent on the roof ridge. Generally, installing the vent will require removing the cap shingles and cutting through the roof deck.
2 Remove the cap shingles in the area where the ridge vent will be installed.
3. Follow the manufacturer's recommendations on how wide of a gap to allow along the ridge for the ridge vent. For most vents, a cut will be required one to two inches on each side of the ridge. Mark a line showing where to cut and remove any nails that may be in the way of the saw.
4. Cut through the shingles and decking using a circular saw with a carbide-tip blade.
5. Remove the loose shingles and decking material.

6. Secure the ridge vent in place according to the manufacturer's instructions.
7. Be careful not to damage the vent during installation or clean-up.

Roof louver or turbine vents

1. Choose a location between two roof rafters as close to the roof ridge as possible.
2. Follow the manufacturer's instructions for cutting a hole in the shingles and roof decking for the vent.
3. Install the vent according to the manufacturer's instructions. Be certain to follow guidelines for flashing to prevent roof leaks.
4. Repair or replace any shingles that may have been damaged during the work. Also check to make certain that the vent was not damaged during installation.

Gable vents

1. Generally, gable end walls are constructed of studs. Choose a gable vent that will fit between two studs rather than a vent that requires cutting the studs. If the vent does require cutting through the studs on the gable end, then consult with a knowledgeable professional to ensure that no structural damage occurs.
2. Most gable vents mount over the exterior wall finish and are held in place by a flange. Follow the manufacturer's instructions for positioning the gable vent and marking the area on the exterior wall finish to be cut for the vent.
3. Use a power or hand saw to cut through the exterior wall finish. Remove the cut materials.
4. Insert the gable vent and secure according to the manufacturer's instructions.

General vent-sizing rules of thumb

If your ceiling insulation has a vapor barrier, the net free attic vent area should be 1/150 of attic floor area.

If the insulation has no vapor barrier, the net free vent area should be 1/150 of attic floor area.

Use the Reduction Factor Chart to determine the total net free vent area that your attic should have.

For example, assume the floor area of an attic is 1,000 square feet. The attic has gable vents with three square feet of net free vent area. The insulation has no vapor barrier. With no vapor barrier, you need the attic vents to equal 1/150 times the attic floor area.

Vent area needed = 1,000 sq ft x 1/150 = 6.7 sq ft of net free vent area.

You have 3.0 square feet of net free vent area; therefore, you need 3.7 square feet more net free vent area

Most quality vents will indicate the net free vent area on the sales literature. Usually, the area is given in square inches. To convert this to square feet, divide by 144. Typical net free vent areas for different vents are shown in the accompanying chart.

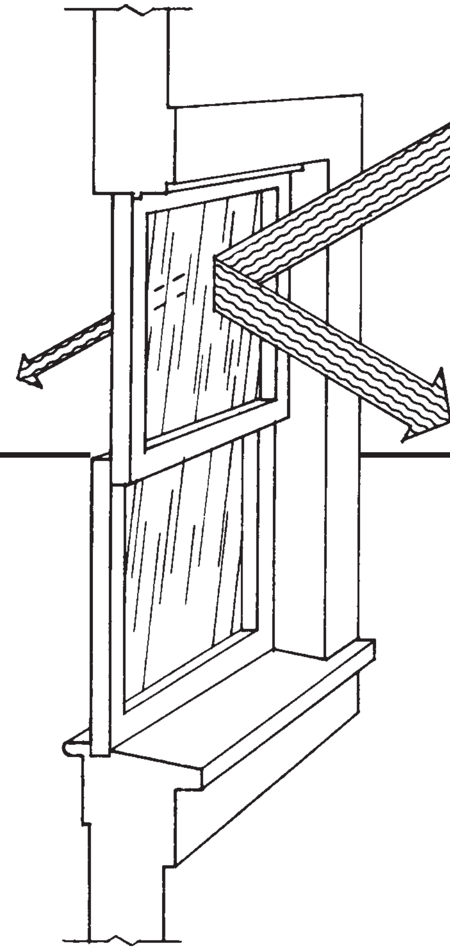
Typical Vent Requirements in Attics without Vapor Barrier

Type of Vent	Approximate net free vent area per unit	Number of vents for 1,000 sq ft attic	
		with soffit	without soffit
High Vents			
Turbine (12in diameter)	105 sq in/vent	5 vents	9 vents
Gable (25in x 120in)	60 sq in/vent	9 vents	17 vents
Roof louver, static or mushroom (8½ in opening)	50 sq in/lin ft	10 vents	19 vents
Ridge	18 sq in/lin ft	28 lin ft	53 lin ft
		No high vent	With high vent
Soffit vents	12 sq in/lin ft	80 lin ft	49 lin ft
Power ventilators		Not recommended	

PROJECT 20

Apply Reflective Window Film

Priority: ★



Initial Requirements

Unshaded windows face east, southeast, south, southwest or west, and sunlight is not needed during winter months (See also **Projects 16** and **17**).

Materials

Reflective window film sized for the window. Because the film cannot be removed intact once installed, it is not recommended for windows in rooms where winter sunlight is important.

Basic Procedure

The film should be installed according to the manufacturer's instructions.

Safety

Use common-sense measures

☑ Checklist

Typical Costs and Savings

- Materials: $4 to $10/ window
- Contractor (materials, labor, and overhead): $10 to $16/window
- Annual energy savings: $4 to $8/window

Average Time Required

- ¼ to ½ hour/window

Skills Required

- Simple but careful handiwork

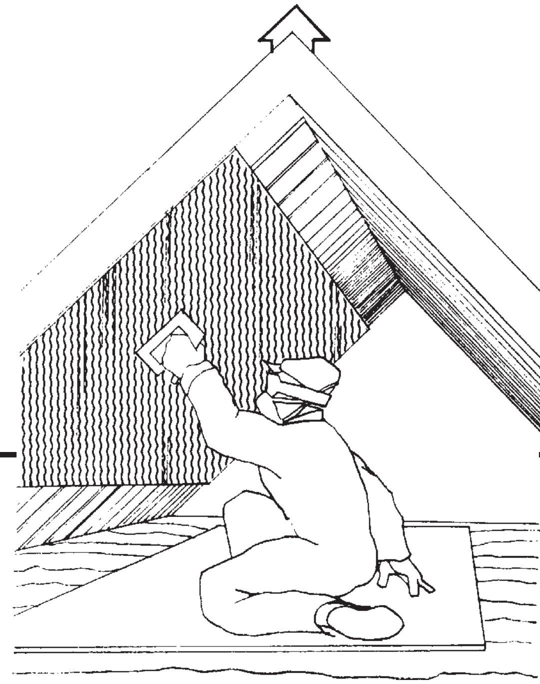
Tools

Depends on type of product; see manufacturer's instructions

PROJECT 21

Install Radiant Barrier in Attic

Priority: ✪



Initial Requirements

The roof receives direct sunlight in summer and has a full attic underneath. The roof should have a ridge vent for ventilating hot air produced between itself and the radiant barrier. The attic should already have at least R-19 insulation. Radiant heat barriers are never a substitute for insulation.

Materials

- ¼-inch staples for stapler
- An aluminum foil designed to be used as a radiant barrier. Any product should resist tearing and be fire resistant. One or both surfaces should reflect at least 95 percent of incoming radiant heat. Purchase enough to fit on the underside of all of the attic rafters.

Safety

Always follow common-sense safety measures when working in the attic. Use walkboards as walking surfaces.

Basic Procedure

1. Set up the extension cord, lights, and walkboards in the attic.
2. Most radiant barrier products come in a roll from 4 to 6 feet wide. Staple the foil either across the rafters or parallel to them, as specified by the manufacturer. The shiny side should face downward so it does not gather dust over time. As long as the surface remains shiny, it will block radiant heat whether facing upward or downward. Of course, it is best to have a reflective surface on both sides.
3. Repeat step 2 for all sections of the attic.

☑ Checklist

Typical Costs and Savings

- Materials: \$80 to \$250/1,000 sq ft
- Contractor (materials, labor, and overhead): \$150 to \$750/1,000 sq ft
- Annual energy savings: Research has shown radiant heat barriers can reduce annual cooling bills around 10 percent if the attic has less than R-30 insulation.

Average Time Required

- 4 to 8 hours/1,000 sq ft

Skills Required

- Simple handiwork

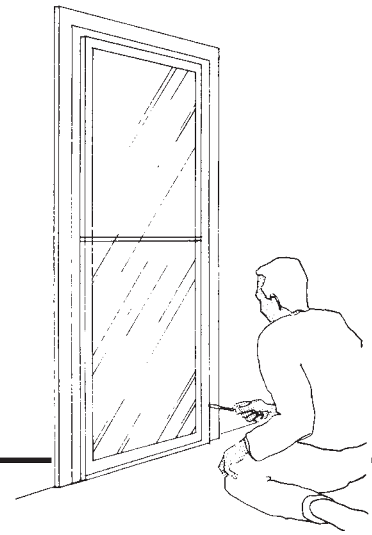
Tools

Carpenter's tool belt (See Rules for Tools section in Chapter 3)
Heavy-duty stapler
Heavy-duty shears
Drop lights and extension cords
Tape rule

PROJECT 22

Put in Storm Doors

Priority: ✪



Initial Requirements

Need a screen door for summer months; current door is leaky in winter.

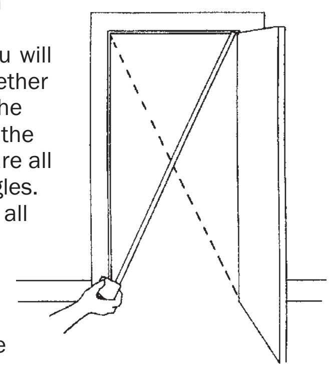
Materials

- Weatherstripped, pre-hung storm door
- 20-year caulk

Basic Procedure

1. Before purchasing storm door, make sure existing door frame is square using exhibit on Checking for Square.
2. Purchase a weatherstripped, pre-hung unit that is designed for the size of the door opening you have.
3. Place the storm door over your regular door frame and mark its position on the frame.
4. Caulk around the door frame where the storm door will be mounted.
5. Adjust the bottom of the storm door to the proper height.
6. Screw the storm door in place.
7. Install an automatic closer (if it comes with the storm door).

Checking for Square



When installing storm windows and doors or replacement units, you will need to determine whether the frame is square. The term "square" means the corners of the frame are all right (90 degrees) angles. To check for square, all you need is a tape measure. Hold the tape at one of the bottom corners and measure the distance to the opposite top corner. Write down this distance. Then place the tape measure in the same position in the other bottom corner and measure to its opposite top corner. These distances—called the diagonals—will be equal if the frame is square. Most storm doors and windows can be installed over a frame that is slightly out of square.

Safety

Use common-sense measures

☑ Checklist

Typical Costs and Savings

- Materials: $50 to $90/door
- Contractor (materials, labor, and overhead): $100 to $150/door
- Annual energy savings: $3 to $6/door

Average Time Required

- 4 to 12 hours depending on whether the door frame is square

Skills Required

- Basic carpentry

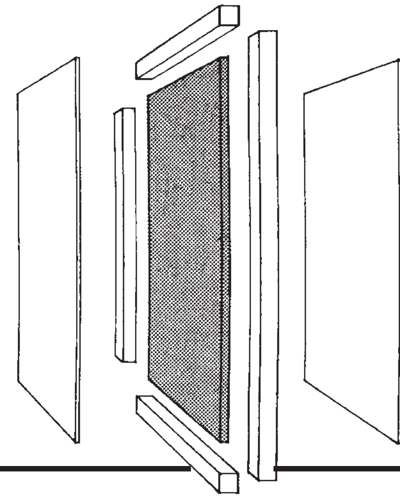
Tools

Carpenter's tool belt

PROJECT 23

Install Movable Insulation

Priority: ✪



Initial Requirements

Windows already are well sealed and homeowner is willing to operate shutters.

Materials

- 1½-inch rigid extruded polystyrene insulation
- 2 x 2 fir lumber
- Masonite
- Construction adhesive
- Corrugated fasteners
- Weatherstripping
- Handles
- ¾-inch drywall screws
- Latches and hinges (for hinged shutter)
- Exterior white paint and thinner for clean up

Basic Procedure

Pop-in shutters

1. Measure the height and the width of the interior window frame.
2. Cut 2 x 2 lumber for the frame as shown.
3. Assemble the frame keeping all corners at right angles and using corrugated fasteners.
4. Cut the masonite to fit over the top and the bottom of the frame.
5. Cut the insulation to fit inside the frame.
6. Apply glue to the bottom side of the frame and nail one piece of masonite in place.
7. Set insulation in the frame and attach the top piece of masonite.
8. If you wish, apply the decorative fabric or adhesive paper to the interior surface of the shutter.
9. Paint the outside of the shutter white.
10. Install handles for easy removal.
11. Install weatherstripping all around the shutter so that it fits tightly in the window.

Hinged insulated shutters

1. Measure the dimensions of the window frame and cut 2 x 2 lumber for the frame as shown.
2. Follow steps 3 through 9 for pop-in shutters to assemble the shutter.
3. Attach hinges and a latch to the shutter and the window as shown.
4. Install weatherstripping all around so no air can leak around the shutter when latched.

Safety

Use common-sense measures

☑ Checklist

Typical Costs and Savings

- Materials: \$2 to \$6/sq ft of window
- Contractor (materials, labor, and overhead): \$6 to \$10/sq ft of window
- Annual energy savings: \$.19 to \$.32/sq ft of window

Average Time Required

- 1 to 5 hours/window

Skills Required

- Basic carpentry for pop-in shutters
- Skilled carpentry for hinged shutters

Tools

Utility knife
Cloth shears
Carpenter's square
Paint brush
Electric drill
Carpenter's tool belt
Optional:
Mitre saw or circular saw

CHAPTER 5

Energy Conservation Replacement Measures

Many components of your house might not be energy efficient, but it may not be cost effective to replace them unless they require repair. For example, it is not usually worthwhile to replace your current water heater with a new energy-efficient model until the old one wears out. Put an insulating jacket on your present heater and wait a few years.

This section gives guidelines for replacing house components including windows, doors, water heaters, space heating systems, and air conditioners with energy-efficient alternatives.

In general, the replacement measures require a greater level of skill than the conservation measures described in Chapter 4. Usually a contractor should be hired to implement them unless you are a skilled carpenter. In many cases, a licensed plumber or heating and air conditioning contractor will be required. Discussions in this chapter concentrate on the available options rather than on specific installation procedures. Information is also included on how to evaluate the job done by a contractor.

REPLACEMENT MEASURE 1

Water Heater

Initial Requirements

Current water heater is leaking or no longer functioning. If water heater does not leak and is operating, then it is probably best to continue using it and follow the steps outlined in **Project 4:** Install Insulating Jacket on Water Heater. If an electric water heater is not producing hot water, the heating elements may need replacing.

Water Heater

The cost of heating water is based on the cost of energy and the efficiency of the water heater. An average family spends about $200 each year to heat water with gas and about $400 for electricity. These costs can be reduced by choosing a high efficiency model. A yellow Energy Guide label which provides information on the operating costs of a particular model is required by law to be attached to all water heaters .

Energy efficient gas and electric water heaters have increased insulation levels between the outer jacket and inside tank to reduce heat loss. The average extra cost ranges from $20 to $40.

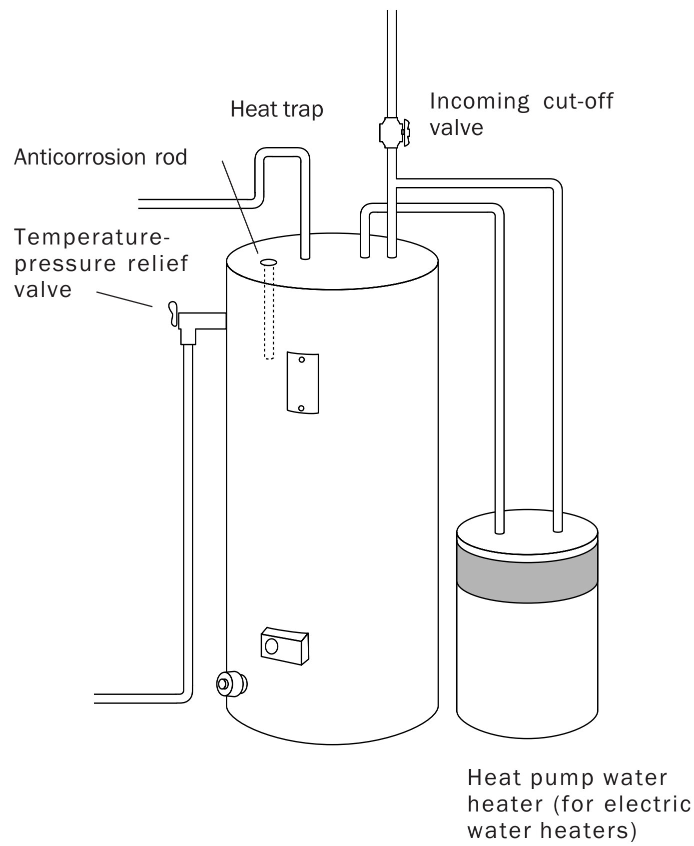
In addition, some gas models have a special design for the burner, flue, or electronic ignition that requires no pilot light. These features further increase savings; they cost $45 to $125 more than standard models.

Heat traps should be installed on the cold water inlet and hot water outlet pipes to prevent convection losses when the tank is not firing. Heat traps may be a check valve type or inverted loop.

Water Heating Alternatives

Electric resistance water heaters are expensive to operate. If you have such a unit and your house does not have a supply of natural gas, an efficient alternative is a heat pump water heater, which operates at twice the efficiency of a resistance unit. The heat pump water heater has an excellent payback on the typical $500 to $1000 investment as annual energy savings range from $100 to $300.

Water Heater Components



Heat pump water heaters must not be subjected to freezing conditions. They work best in partially heated areas, such as enclosed basements or garages. If installed inside the home, they do not save as much energy because in winter they extract some of the house's heat to heat water. However, they do have the added benefit of providing some cooling and dehumidification during warm weather.

A heat recovery device, also called a desuperheater, heats water with the waste heat from an air conditioner or heat pump. The device captures extra heat from the refrigerant as it circulates between the compressor and condenser. When used year-round on a heat pump, these units can cut water heating costs up to one-half and with an air conditioner up to 40 percent.

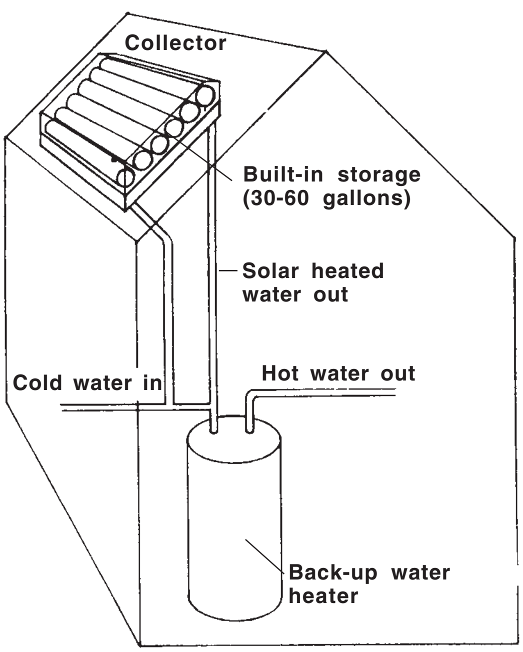
For homes which use a large amount of hot water and which receive full sun year round, a solar water heater may be economical. All types of solar water heaters work as preheat systems assisting a conventional water heater.

There are many options for using the sun's energy to heat water. In active solar water heaters, glass-covered panels absorb solar energy and transfer the heat it produces to water. Pumps move the solar-heated water to an insulated storage tank where the heat is stored.

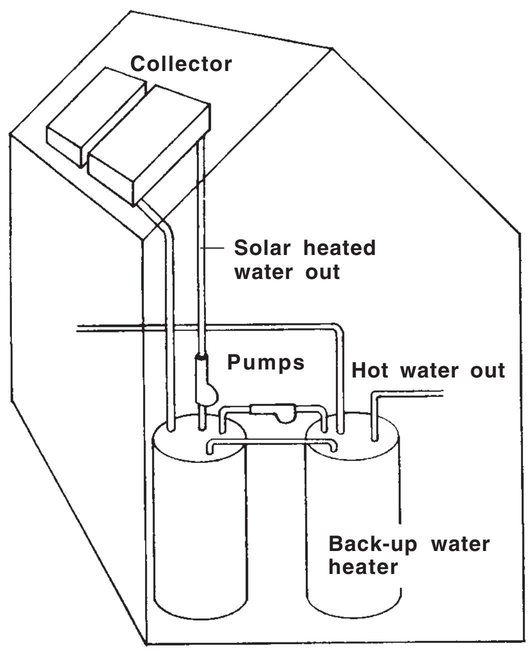
Batch water heaters are simpler but less efficient because the glass-covered collectors include the storage tank. The sun heats the water directly, and the batch heaters have no pumps or control systems. Materials for a do-it-yourself batch water heater cost between $200 to $700 and many energy-related publications and organizations have plans.

Solar water heaters installed by professional contractors cost $2,000 to $4,500. They save 25 percent to 70 percent of the water heating bills for a typical four-person family—from $60 to $280 each year.

Solar Water Heater Systems



Batch solar water heater



Active solar water heater

REPLACEMENT MEASURE 2

Windows

Initial Requirements

House has window frames or sashes that are damaged and need repair, or it has leaky jalousie-style windows.

Option A: Sash Replacement Kit

Some window manufacturers offer a special replacement system in which only the window sashes and stops, rather than the entire frame, need replacement. The kit includes airtight plastic jambs (which attach to the old jambs), two sashes with double-paned windows, and good weatherstripping.

To use this system, your window frame must be in good condition and square (all the corners must be at right angles see sidebar on *Checking for Square* in **Project 24:** Put in Storm Doors). If not square, the entire window will need to be replaced by a new unit.

The installer should follow installation instructions that come with the replacement unit.

Option B : New Window Unit

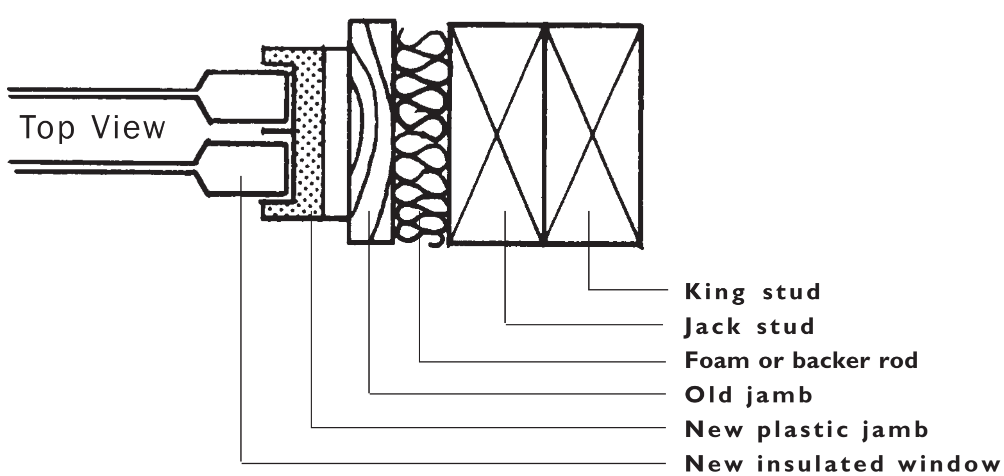
New windows vary greatly in price and quality. The key components of a durable, energy-efficient window are:

1. Two sealed panes of glass with a ½- to ¾-inch air space between panes.
2. Weatherstripping all around window sashes. A double layer of weatherstripping gives extra protection against infiltration.
3. A tight fit when closed and locked. If windows wiggle or shift when pulled, the winter wind will find a path inside.

Order replacement windows the same size or slightly larger than the old window. If the new window is smaller than the old one, new interior and exterior wall finishes will have to be pieced in place to fill the gaps.

If the new window is larger than the old, the contractor will have to tear out some of the old wall studs and reframe the wall slightly to create a large enough rough opening for the new window. It may be less expensive to order a custom-built window identical in size to the one being replaced.

Make sure the carpenter uses spray foam sealant or backer rod material in the gap between the window unit and the rough opening.



REPLACEMENT MEASURE 3

Doors

Initial Requirements

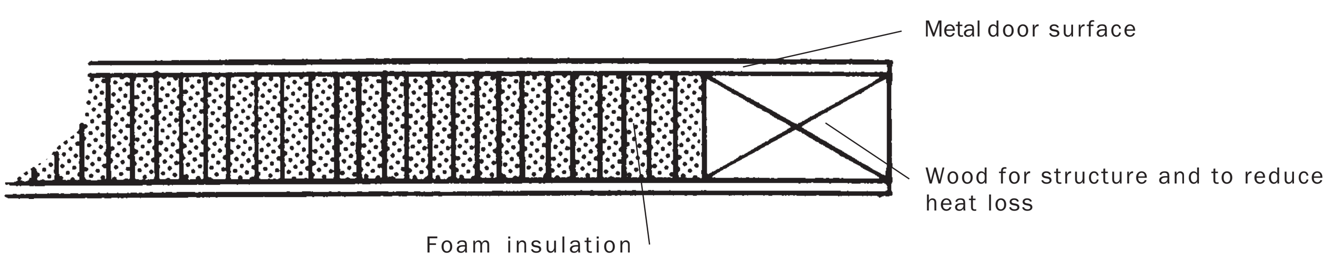
Door rotten, badly warped or otherwise in poor condition.

Replace with Insulated Door

Quality metal doors are filled with foam insulation and have insulating values of about R-7 compared to R-2.2 for conventional solid wood doors. They come in a variety of styles and can be attractive. Metal doors last longer than wood doors, do not warp easily, and provide greater security. Often, they cost no more than solid wood exterior doors. You may also consider a fiberglass replacement door. These provide energy efficiency and durability comparable to a metal door and have a wood grain appearance.

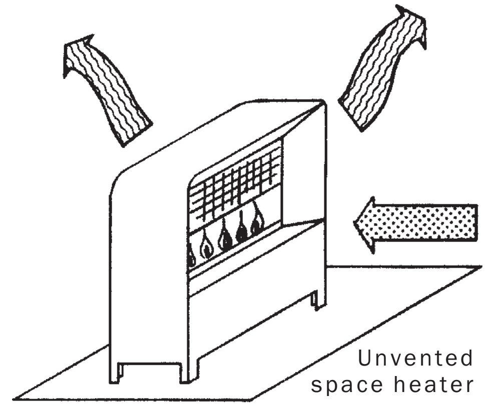
The major drawback of metal and fiberglass doors is their inflexibility. They cannot be easily trimmed, so if the door frame is not square, it may have to be rebuilt.

Make sure the installer reads the directions that come with the door before beginning. Some adjustments can be made after the door is installed, but they will require extra time. A properly installed insulated door will seal tightly for years.



REPLACEMENT MEASURE 4

Unvented Fuel-Fired Space Heaters

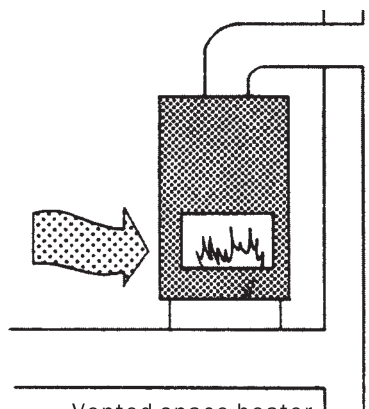


Unvented space heater

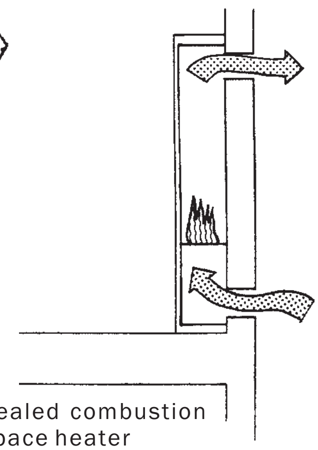
Initial Requirements

House has unvented space heaters using gas, propane, or kerosene for the major share of its heating needs. The exhaust gases given off by these unvented heaters are toxic and can reach dangerous levels inside the home, especially if air leaks in the home are minimized by basic conservation measures.

Unvented gas, propane or kerosene space heaters should be replaced with one of the options described in this section.



Vented space heater



Sealed combustion space heater

How Combustion Appliances Work

Combustion appliances such as gas or propane furnaces, water heaters, ranges or cooktops, and fireplaces and wood stoves work by burning fuel. For burning, or combustion, to occur, oxygen must be present. The air we breathe is the source of the oxygen.

When air burns, by-products such as carbon monoxide, carbon dioxide, nitrogen oxides, and water vapor result. An important consideration in energy-efficient homes is the source of the oxygen, or combustion air, and the destination of the by-products of combustion, or the exhaust gases.

Unvented appliances, such as many space heaters, use heated air inside the room as their source of combustion air. These appliances also exhaust the by-product gases to the room itself. Even low level concentrations of these gases can be harmful. Higher levels can be life threatening. Older homes may be so leaky that dangerous concentrations of pollutants do not occur. However, homes that have been insulated and sealed using the techniques described in this book can restrict infiltration to such an extent that the concentration of gases reaches dangerous levels. Always install carbon monoxide detectors.

Vented space heaters, wood fireplaces, and central furnaces exhaust by-product gases to the outside and are safer than unvented units. However, standard models use room air to vent combustion gases. The room air is replaced by outside air leaking inside your home. This infiltrating air reduces the efficiency of these appliances and can make your home too dry in winter.

Many new space heaters and fireplace inserts have sealed combustion chambers that use outside air as the source of oxygen and for exhausting combustion gases. These appliances eliminate the reductions in efficiency and comfort encountered by those that burn indoor air and exhaust it outside, and they minimize potential indoor air pollution problems as well.

Since central furnaces and water heaters usually have no provisions for outside combustion air, they are best located in unheated areas such as a basement or utility room. Insulating and sealing a house that has an interior combustion appliance requiring outside combustion air can present problems. The infiltration may be reduced so much that insufficient combustion air leaks in. With an inadequate oxygen supply, the appliance's burner will operate inefficiently. **Replacement Measure 5:** Provide Outside Air Supply for Central Furnace in Heated Area describes techniques for dealing with interior furnaces. The same techniques work for water heaters.

The following options help prevent degrading indoor air quality with unvented, fuel-fired space heaters:

- Unvented Space Heaters Using Oxygen Depletion Sensors
- Vented Fuel-Fired Space Heaters
- Air-to-Air Heat Exchangers
- Central Furnaces

Unvented Space Heaters Using Oxygen Depletion Sensors

New unvented fuel-fired space heaters should be equipped with oxygen depletion sensors. An oxygen depletion sensor detects when oxygen levels in the house have dropped, meaning levels of the by product gases may be reaching dangerously high levels. When these potentially harmful levels occur, the oxygen depletion sensor shuts off the flow of fuel to the burner which extinguishes the flame so that no additional exhaust gases can enter the house. Concern remains about the combustion gases being introduced into the house.

Most local building codes bar the use of unvented space heaters in bedrooms and bathrooms. Always hire a licensed heating contractor to install new units.

Vented Fuel-Fired Space Heaters

Vented fuel-fired space heaters reduce the health risk of unvented models and can also increase energy efficiency if the new units draw combustion air directly from outside the home. Models that use indoor air for combustion may have net efficiencies lower than 50 percent. Higher quality vented space heaters with sealed combustion chambers are recommended instead of those using interior air for combustion. The higher efficiency units are usually mounted onto an exterior wall; they draw combustion air from outside and exhaust the by-product gases outside as well.

The sealed-combustion models have options such as blowers, pilotless electronic ignitions, and programmable thermostats. Unfortunately, this sophistication translates into higher prices. Simple, wallmounted units with sealed combustion chambers cost $375 to $550. The units with more features can cost up to $750. A professional should always install a fuel-fired appliance.

Air-to-Air Heat Exchangers

Another option for preventing contamination of indoor air by unvented fuel-fired space heaters is to keep the existing units and bring in fresh air. Of course, opening windows when the heater is operating is an expensive way to heat a house. An alternative is to install an air-to-air heat exchanger. This device brings in fresh air and sends warm room air outside, much like the open window. However, its design enables the outgoing air to transfer its heat to the incoming cold air. Different heat exchangers have widely varying efficiencies. The exhibit on Air-to-Air Heat Exchangers describes the different types of systems.

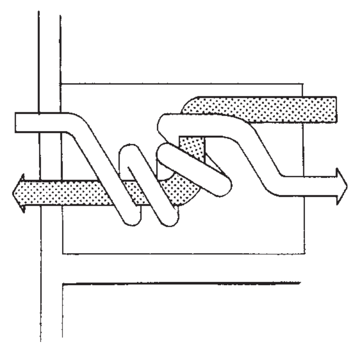
Air-to-air heat exchangers can be installed as through-the-wall units or in windows, much like room air conditioners. They are also available as central units which use the central heating system's ductwork to distribute fresh air.

Room units range in cost from $150 to $400 and can be installed by the homeowner. Central units cost from $400 to $800 and should be installed by a professional. In both cases, you should research the efficiency, durability, and capacity of the available models before selecting a unit.

Central Furnaces

You may decide to scrap space heaters totally and install a central heating system. If so, follow the guidelines in **Replacement Measure 6:** Central Heating System.

Air-to-Air Heat Exchangers



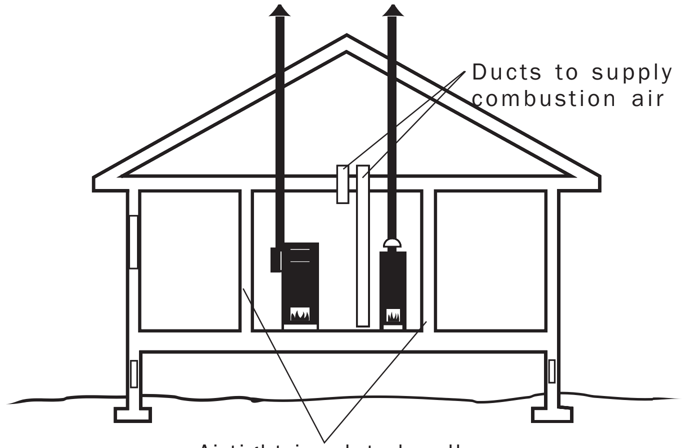
To understand how air-to-air heat exchangers differ in their operation, it is important to distinguish between sensible heat and latent heat. Picture a pot on the stove with a top on it. Assume the pot is half full of water at 70 degrees. When you turn on the burner, the water temperature will increase slowly up toward its boiling point. The heat it is gaining is measured by a rise in temperature and is called sensible heat. When the water temperature reaches the boiling point of 212 degrees, something different happens. The burner keeps adding heat, but the temperature remains at 212 degrees. The added heat is now working to evaporate water into vapor. This type of heat, called latent heat, is difficult to measure, but can be very important for both comfort levels and energy use in the home.

Some air-to-air heat exchangers capture only the sensible heat in outgoing room air. They typically operate at efficiencies of 50 to 70 percent. Only the sensible heat (that measured by temperature) is transferred from the outgoing room air to the incoming air.

Other heat exchangers transfer both sensible and latent heat. They can capture the heat contained in the water vapor of outgoing room air and achieve efficiencies of 80 to 95 percent.

REPLACEMENT MEASURE 5

Provide Combustion Air for Central Furnace in Heated Area



Initial Requirements

Central furnace is in a heated area and uses indoor air as its source of oxygen (see exhibit on How Combustion Appliances Work in **Replacement Measure 4:** Unvented Fuel-Fired Space Heaters).

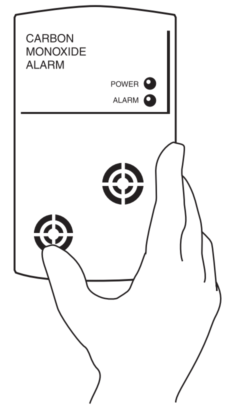
Guidelines for Supplying Outside Air

Bringing outside air into a furnace room that is part of the heated area of the house requires sizing ducts properly to supply the necessary air and complying with local building codes. The discussion in this section describes just one possible solution to the problem. Check with local code officials or heating professionals to ensure this measure is undertaken properly.

If the central furnace is in an enclosed chamber, such as a closet or mechanical room, it often draws indoor air for combustion through a louvered door. The best approach is often to supply outside air for the burner by running air intakes from the furnace room into a well-ventilated attic or crawlspace. Then, install and weatherstrip a solid door in place of the louvered door. You may also be able to insulate the walls of the furnace closet to further reduce energy losses.

The ducting that supplies combustion air should be designed by a knowledgeable, licensed heating contractor or mechanical engineer. It should be installed by a professional. If you have carpentry skills, you can install and weatherstrip the replacement door.

The cost for building a sealed combustion chamber for a furnace in a heated area as described above ranges from $100 to $400. Annual energy savings range from $40 to $100. The major benefit however, is that once you have a guaranteed source of combustion air, you can safely continue with air sealing measures that will save even more money and greatly reduce the risk of introducing combustion gasses into the living space. Also, purchase a carbon monoxide detector.



Carbon monoxide detector

CO detectors are highly recommended in homes with fuel-burning appliances. The detectors signal homeowners via an audible alarm when CO levels reach potentially dangerous levels. Some models have digital readouts of current CO levels, which are useful to the homeowner to monitor household air quality, while some less-expensive models indicate varying levels of CO with differing alarms. CO detectors are either plug in or hard-wired. They should be installed in rooms with a direct connection to combustion appliances, such as kitchens with fuel-burning stoves and ovens, areas near combustion closets for fuel burning heating systems, and rooms with fuel-burning space heaters.

REPLACEMENT MEASURE 6

Central Heating System

Initial Requirements

Current heating system is broken, is inefficient and costly to operate, does not provide sufficient heat, requires frequent maintenance, or is otherwise unsatisfactory.

Guidelines for Replacing Central Heating Systems

1. Size the system properly

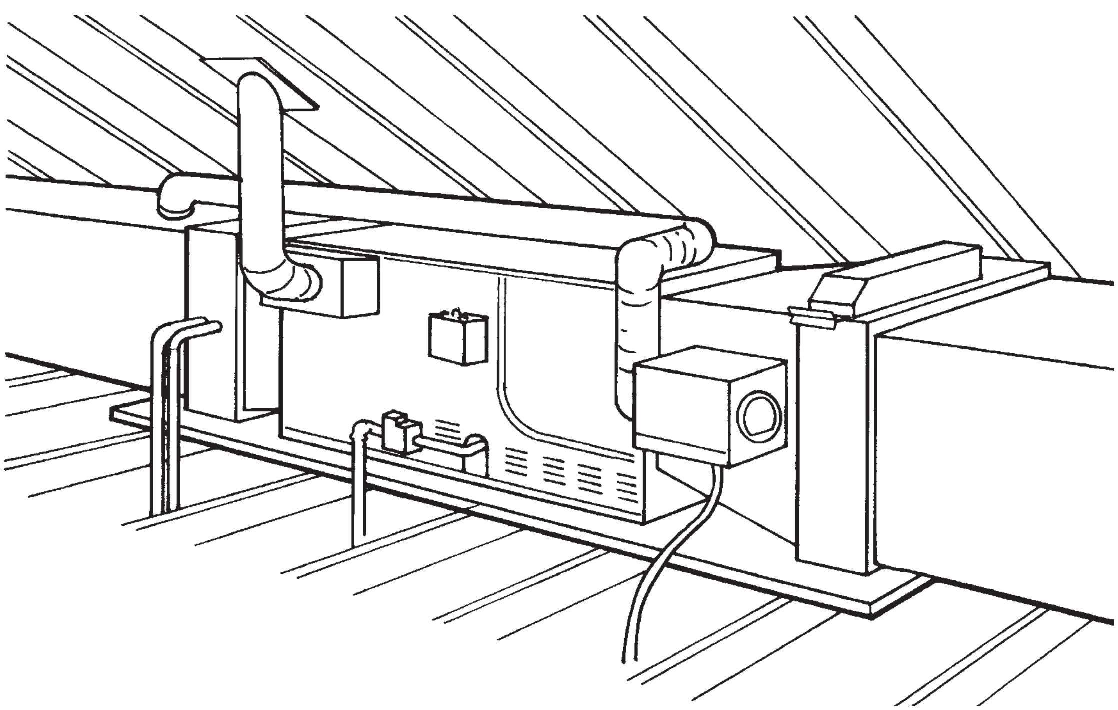
Have a licensed heating contractor, mechanical engineer, or your local utility estimate the heating requirements and size the unit using Manual J techniques. An oversized system will not run efficiently and will cost more than a properly sized unit.

2. Select the appropriate type of unit

In deciding whether to buy a fuel-fired furnace or heat pump, it is important to consider the relative comfort levels, lifetimes, installed cost, and annual energy costs of the different options. Talk about comfort and reliability to people who have different types of units in their homes.

If you wish to install central air conditioning at the same time you are putting in the new heating system, the installed and operating costs of a heat pump, which provide both heating and cooling, may be in the same range as those for a gas furnace combined with a central air conditioner. Have your heating contractor or an engineer compare the installed cost and annual energy bills for each option before making a decision. Be sure to get several bids.

If you do not have access to natural gas, you may choose propane, electricity, fuel oil or other options for heating.



3. **Fuel-fired furnaces**

   A near revolution has occurred in the efficiency of heating and cooling systems over the past decade. A minimum fuel-fired furnace has an Annual Fuel Utilization Efficiency (AFUE) of 78 percent. A mid-efficiency combustion furnace has an AFUE of 80 to 82 percent. These units usually add only a few hundred dollars to the initial cost and pay back the extra investment very quickly.

   The high efficient units have an AFUE from 90 to 97 percent. These systems are able to extract latent heat from the water vapor in the exhaust gases. (See the sidebar on *Air-to-Air Heat Exchangers* in **Replacement Measure 4** for a description of latent heat.) They are more expensive and may add from $500 to $1,000 to the cost of a standard furnace. Many homeowners can easily justify the added cost because of long-term energy savings.

4. **Heat pumps**

   For years, conventional electric resistance heating systems have used resistance coils, which grow hot when electric current runs through them. The system's blower distributes this heat throughout the house. Although resistance heating systems operate near 100 percent efficiency, they are costly to operate.

   Heat pumps use an arrangement of compressors, condensers, expansion valves, and other components to extract heat from outside air in winter. They also provide cooling, just like an air conditioner, by reversing the process and dumping heat from inside your home to the outside. On the average, heat pumps cost 40 to 65 percent less to operate than electric resistance units.

   At lower outside temperatures–typically between 30-40 degrees–heat pumps can no longer extract sufficient heat from outside air. In these circumstances, a separate electric resistance unit, called a strip heater, comes on to provide backup heating.

   Heat pumps are rated in terms of their summer Seasonal Energy Efficiency Ratio (SEER) and their winter Coefficient of Performance (COP) or Heating Season Performance Factor (HSPF). You should select a mid-efficiency unit with a SEER of 11 to 12 and an HSPF of 7.5 or better.

5. **Zoned heating and cooling systems**

   In larger homes, entire areas may not be used during different parts of the day. By shutting off the flow of heated and cooled air to these rooms, a practice called zoned heating and cooling, considerable energy savings can be realized.

   Typically, independent heating and cooling systems are installed for separate sections of the house. Multiple systems provide good comfort and closer control over the temperature in individual rooms. However, they are expensive and are usually justified only for houses having over 2,500 square feet of floor area which can be divided into separate areas with distinctive lifestyle patterns.

   You can also zone a house by closing operable floor or wall dampers that control the air supply coming from the heating or cooling system. The only problem with this measure is that the system's blower is sized to move a certain volume of air through all of the ductwork. If several dampers are closed, the blower will try to push the same volume of air through fewer ducts and will experience increased pressure working against it. By forcing the blower to work harder, you may shorten its life. Problems with duct leakage may also be exaggerated by closing off registers.

   Some heating contractors can install a dampering system that effectively zones a house with only one heating and cooling system and alleviates the increased load on the blower. These dampering systems will shut off the flow of heated air to a given area of the house, but will allow the air to flow into the return system and minimize stress on the blower.

6. **Seal and insulate ductwork**

   Make sure the heating contractor seals the joints between all ducts with mastic before installing duct insulation. Duct insulation should be used in all unheated areas. Often, problems due to poor duct systems represent the single largest waste of energy in homes.

7. **Install programmable thermostat**

   A programmable or clock thermostat can reduce heating energy use up to 40 percent. If you have a heat pump, make sure you buy a thermostat rated for your heating system. Otherwise, the heat pump may use considerable electricity because a conventional programmable thermostat may cause the strip heaters, not the heat pump itself, to warm the house in the early morning. For more information, see **Project 10:** Connect Programmable Thermostat.

8. **Consider utility incentive plans**

   Some electric utilities have programs to install load management devices on water heaters and air conditioners. These devices do not affect comfort levels in your home but allow the utility to reduce the peak load on its overall system. Often, the utility will offer you a financial incentive for installing the device. Although the device does not save you any energy directly, it does lower the utility's cost of providing power. In the long run, it could indirectly reduce your electricity cost.

REPLACEMENT MEASURE 7

Central Air Conditioner

Initial Requirements

Existing air conditioner is broken, is costly to operate, provides insufficient cooling, needs frequent maintenance, or is otherwise unsatisfactory.

Guidelines for Replacing Air Conditioners

1. **Size the air conditioner properly**

   When installing a central unit, have a licensed heating and air conditioning contractor, mechanical engineer, or your local utility estimate the cooling requirements using Manual J to size the unit. An oversized system will run inefficiently and cost more than a properly sized unit. A professional should install the system.

   A room air conditioner can be sized using general guidelines provided by the manufacturer. Use the technical data in the sales literature to ensure the unit is matched to your cooling needs.

2. **Select an efficient unit**

   A new air conditioner will have a Seasonal Energy Efficient Ratio (SEER) of at least 10.0. Consider mid-efficiency units (SEER 11-13).

3. **Follow wise practices**

   (Guidelines 5, 6 and 8 in **Replacement Measure 6:** Central Heating System).

4. **Use natural cooling measures**

   Use shading and ventilation to minimize air conditioning bills and increase comfort levels in the home. See **Projects 15, 17** and **18** for more information.

5. **Shade your air conditioner**

   Keep the outside portion of your air conditioner in the shade. By keeping it cooler, it will run more efficiently and save you money. However, be certain to allow easy air flow to the outside equipment and to keep it clear of debris.

REPLACEMENT MEASURE 8

Replace Incandescent Light Bulbs with Compact Fluorescents

Initial Requirements

One of the easiest retrofits that homeowners can do themselves is to switch from incandescent light bulbs to compact fluorescents. While incandescent bulbs are inexpensive to purchase, they are inefficient and costly to operate.

With an incandescent bulb, for every $1 you spend on electricity, you get about 10 cents worth of light and 90 cents worth of heat. The wasted energy increases lighting and air conditioning costs and is responsible for over 500 pounds of atmospheric pollution.

Compact fluorescent light bulbs (CFLs), are an alternative that is good for your pocketbook and the environment.

While CFLs cost more to buy than incandescents, they pay for themselves in energy savings. Because they last approximately 10,000 hours, compared to less than 1,000 for typical incandescents, you'll buy nine fewer CFLs. That also means less hassle changing light bulbs.

How does the light from CFLs compare with incandescent bulbs?

In most cases, the light from a CFL is just as bright and offers comparable colors and light quality. Look for a Color Rendering Index (CRI) of 80 or higher.

There are many new sizes of CFLs available. Some of them are nearly as small as an incandescent and will fit in most fixtures and table lamps. CFLs have the same screw-in base as incandescents. They are slightly larger than an incandescent bulb, but fit in many different types of fixtures.

When a CFL won't fit, "harp extenders" are often available to enable their use. CFLs can be used in virtually any fixture including recessed and track lighting, plus new dimmable CFLs are also available. There are CFLs for outdoor use, floods and spots.

The chart below shows how much you can save with CFLs. Of course, you're not only saving money, but stopping pollution and protecting the environment.

Bulb type Watts/Lumens*	**Typical bulb cost** dollars	**Rated life** in hours	**Efficacy** lumens per watt	**Energy cost** (@ 8¢/kwh) for 10,000 hrs.	**Bulb(s) + Energy** Cost for 10,000 hrs.
Compact Fluorescent 15watt/720 Lumens	$13	10,000	48	$12	$25
Incandescent 60 watt/870 Lumens	$0.50	1,000	15	$48	$53
Compact Fluorescent 27 watt/1,750 Lumens	$20	10,000	64	$22	$42
Incandescent 100 watt/1,750 Lumens	$0.50	750	17	$80	$85

***Lumens:** measure of the brightness emitted by a bulb

REPLACEMENT MEASURE 9

Intentional Ventilation

Initial Requirements

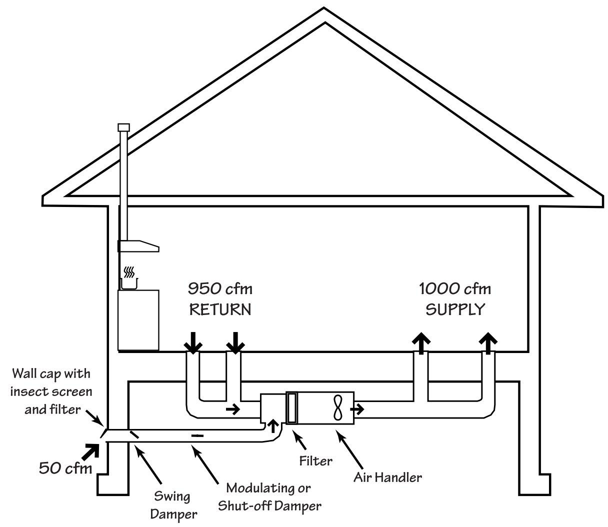
Intentional ventilation promotes better indoor air quality. The benefits are two-fold in that better indoor air quality is promoted and the building envelope is better preserved.

Simple approaches to intentional ventilation, such as vent fans in bathrooms and kitchens, remove moist/odorous air from those rooms. This is called spot ventilation, removing undesired air at the source from within the building to the outside. In most cases this approach is minimal to satisfactory; homes with more airtight construction will require additional measures.

Spot ventilation fans for the bathroom need to move at least 50 cubic feet per minute (cfm) and need to be *quiet*. Look for a sone rating of less than 2 (preferably less than 1). Fans for these applications vary in cost from over $100 to less than $30, with the more expensive units incorporating more efficient, durable, and quieter features. Make the investment in a better quality fan. Kitchen fans should be 100 cfm or greater and consideration should be given to make-up air inlets (since every cubic foot of air exhausted must be replaced by the same amount coming in). All fans must be ducted to the outside and should contain a damper.

Other intentional ventilation strategies vary in technique, but most involve introducing fresh air into the building envelope through a mechanical blower. Ventilation strategies are *positive* (blowing air into a home), *negative* (exhausting air from a home), such as the spot ventilation approach, and *balanced* (pulling in / exhausting out in equal amounts).

One positive ventilation approach, which is especially applicable to mixed climates such as North and Middle Alabama, involves connecting a fresh air intake duct at the main air handler (the furnace/central air conditioner blower). The benefit of this approach is that a slight positive air pressure, due to the introduction of cleaned and conditioned outside air, is created in the house, potentially driving air outwards from the building envelope rather than pulling air in from questionable sources (attic, crawlspace, basement, garage).



Add a 4-6" (insulated) fresh air duct to create intentional ventilation and provide make-up air.

A side effect to this strategy is a modest penalty, a slight increase in the use of energy to condition the air that is being pulled in. The payback is improved indoor air quality by offsetting uncontrolled infiltration with controlled ventilation from a known source. One of the key points discussed in this publication that works together with this strategy is the importance of air sealing, see **Project 5**.

Whole house ventilation systems can be extremely effective when properly installed but are more expensive. Cold climates would enjoy substantial savings when the energy from the exhaust stream is captured and transferred to the incoming stream via an air-to-air heat exchanger or *heat recovery ventilator* (HRV) which substantially improves the overall efficiency (see the sidebar on page 73).

The Residential Energy Code for Alabama and the Home Energy Do-it-Yourselfer

The Residential Energy Code for Alabama (RECA), a voluntary state developed code equivalent to the IECC 2000 (International Energy Conservation Code). What does this mean for existing dwellings that need energy-efficient upgrading? Answer: the RECA is a readily available framework of specifications for energy-efficiency. For example, the RECAspecifies the amount of insulation required for walls, ceilings and floors in relation to the amount installed in each one of those individual components and takes in to account the climatic zone where the dwelling is located.

Alabama Climatic Zones

Alabama has five distinct climatic zones. In general, the northern section of the state is a "Mixed Climate" moving to a "Warm Climate" in the southern portion of the state. The RECA provides guidelines for glazing, insulation and heating/cooling equipment efficiencies and where trade-offs can occur. By increasing efficiency in one area in exchange for reduced efficiency in another area; this is a *prescriptive approach*. Along with the zone specific information provided by the RECA, there are basic guidelines for all climatic zones.

Basic Guidelines

This book, *Home Energy Projects - An Energy Conservation Guide for Do-It-Yourselfers,* addresses many of the energy efficiency issues that are part of the basic guidelines of the RECA. Existing older dwellings are not required to conform to the RECA—but it is a good benchmark to follow. Many of the projects in this book will help a home conform to these basic guidelines. These projects will save energy and money too.

Residential Energy Code for Alabama

Summary of Basic Requirements

- **Air Leakage - see Project 5**: Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed. The maximum leakage rate for manufactured windows is 0.34 cfm/ft of operable sash crack. The maximum leakage rate for manufactured doors is .5 cfm/ft of door area.
- **Vapor Retarder - see Project 2**: Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors.
- **Materials and Insulation Information - see Chapter 5**: Materials and equipment must be identified so that compliance can be determined. Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided.
- **Duct Insulation - see Project 3**: Supply and return ducts for heating and cooling systems located in unconditioned spaces must be insulated.
- **Duct Construction - see Project 3**: All transverse joints must be sealed with mastic. The HVAC system must provide a means for balancing air and water systems.
- **Temperature Controls - see Project 10**: Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions of multifamily buildings must have one thermostat for each system or zone). Thermostats must have the following ranges:

  Heating Only – 55°F - 75°F
  Cooling Only – 70°F - 85°F
  Heating and Cooling – 55°F - 85°F

  A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings.
- **HVAC Piping Insulation**: HVAC piping in unconditioned spaces conveying fluids at temperatures above 120°F or chilled fluids at less than 55°F must be insulated.
- **Circulating Hot Water**: Circulating hot water systems must have automatic or manual controls and pipes must be insulated.
- **Electric Systems**: Each multifamily dwelling unit must be equipped with separate electric meters.

Notes on the State's Residential Code:

The Residential Energy Code for Alabama (RECA), a voluntary state developed code equivalent to the IECC 2000 (International Energy Conservation Code) without SHGC 0.40 (solar heat gain low-e window requirements). SHGC 0.40 is contingent upon local adoption. Four jurisdictions have adopted the International codes, including IECC 2000 without tampering with the low solar heat gain low-e window requirements.

The state has made available the RECA 2000. This voluntary code is based on the 1995 MEC (Model Energy Code). Residential designers are able to comply with RECA by following the prescriptive standards, by complying with the "Systems Analysis" approach specified in the 1995 MEC or by complying with the "Component Performance" approach specified in the 1995 Edition of the MEC. The use of alternative analysis procedures, which meet the requirements of the 1995 MEC, may be accepted in lieu of the code.

More information

Online information is available on the internet at Energy Codes of Alabama: *www.bsc.auburn.edu/aderhrw2/codes/*

You can use REScheck software to show compliance, this software is available for free at: *www.energycodes.gov*

For more information from the Alabama State Building Commission contact:

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RSA Plaza 770 Washington Ave., Suite 444
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FX: (334) 242-4182

Other Contact(s):

Alabama Department of Economic and Community Affairs
PH: (334) 242-5333

Construction Terminology

Construction terminology is used throughout this book, so it is important for the reader to have a guide to the jargon of the trade. The parts of a house often have several different names. The drawings on this page illustrate the terms used in this book.