

Home Repair MANUAL

TIPS,
TOOLS &
TROUBLESHOOTING



An essential guide
to the repair
and maintenance
of your new home

Let us be among the first to congratulate you on the purchase of your new home. AmeriSpec is proud to have been able to advise on the condition of the house and its various systems.

Over the years our highly trained, certified inspectors have examined more houses than any other home inspection company in North America. In the process, we've come to know a great deal about the benefits of conscientious house maintenance and about the kinds of problems that tend to crop up in even the best-maintained homes. We've now combined all our experience and now present what we've learned in the pages of this book.

Use this book in conjunction with your AmeriSpec report. The report clearly indicates any areas of the house that need immediate attention, and the book can help you decide whether to make the necessary fixes yourself or hire a professional. In the years to come, keep the book nearby for year-round advice on seasonal maintenance and for quick instructions on everything from freeing clogged drains to replacing damaged exterior siding.

We hope you'll take great pleasure in your new home.



AMERISPEC®
HOME INSPECTION SERVICE



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Note to readers: Almost any do-it-yourself project involves risk of some sort. Your tools, materials, and skills will vary, as will conditions at your project site. Sunset Publishing Corporation and the editors of this book have made every effort to be complete and accurate in the instructions. We will, however, assume no responsibility or liability for injuries, damages, or losses incurred in the course of your home improvement or repair projects. Always follow the manufacturer's operating instructions in the use of tools, check and follow your local building codes including applicable electrical code, and observe all safety precautions.

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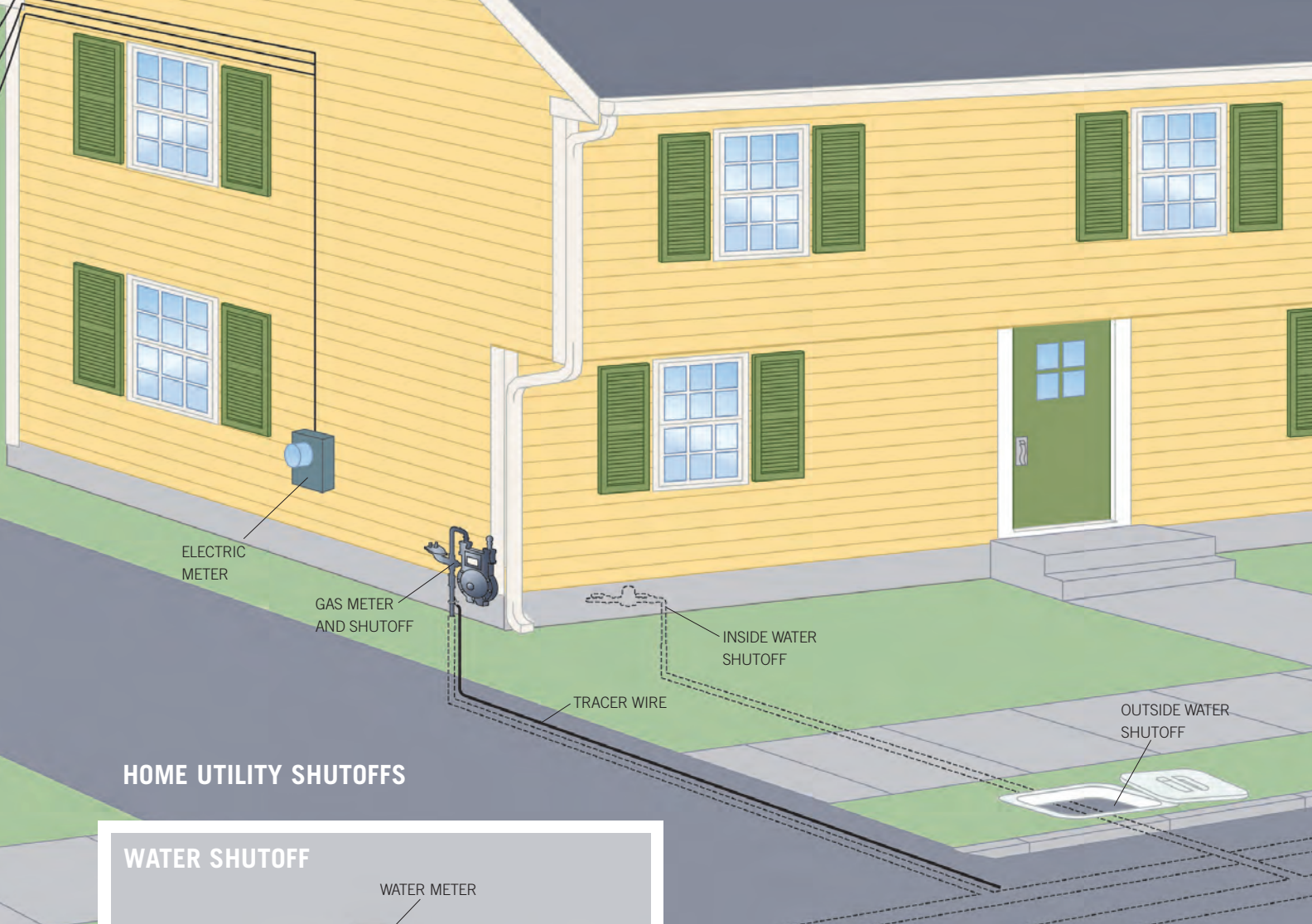


taking care of your new home

This book will help you diagnose and solve many common household ailments that can be repaired by a determined homeowner. You may not be able to work as quickly as a professional carpenter, plumber, or electrician on some projects, but many minor repairs are just as quick to perform yourself. Even if you do decide to hire a pro, understanding the causes of problems and knowing your repair options will enable you to save money by avoiding unnecessary work and to ensure an effective job.

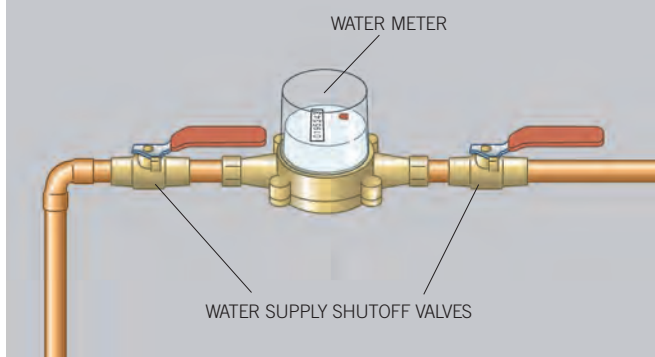
You may face an emergency that requires you to shut off the supply of water, gas, or electricity to all or part of your home. The illustrations at right give a quick overview of these shutoffs. See pages 8–9 for more specific information on how to locate and use them. In this chapter, you'll find tips for making your home safer, as well as effective methods for handling specific emergencies, from a sudden grease fire to an overflowing toilet. Finally, a seasonal maintenance chart will help you keep track of routine measures that can prevent major repairs later on.

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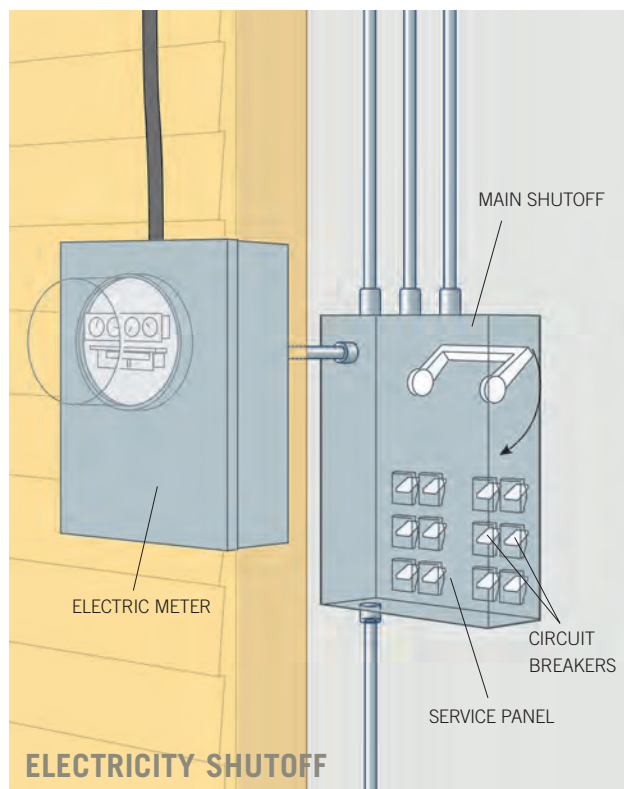
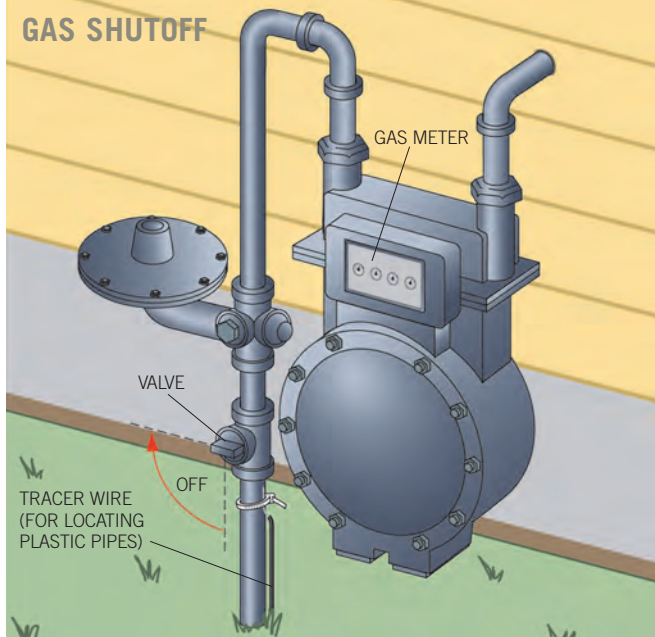


HOME UTILITY SHUTOFFS

WATER SHUTOFF



GAS SHUTOFF



ELECTRICITY SHUTOFF



BUILDING CODES AND INSPECTORS

Your local building department has codes covering every aspect of your home, including wiring, plumbing, structural elements, insulation, and safety. Inspectors enforce those rules. Building codes may seem confusing and heavy-handed at times, but they exist to ensure your safety and the continued stability of your house.

In general, codes and inspectors come into play whenever you install something new and substantial. If you are replacing an existing fixture or appliance—such as an overhead light, a toilet or sink, a dishwasher—you most likely do not need to go through the inspection process. The same is true if you are building a small structure (usually 200 sq. ft. or less) that is not attached to the house, such as a shed or a playhouse. However, any time you install a fixture where there was none before, add onto the house (a deck or a room, say) or build a substantial structure that is not attached to the house, you will need to pull a permit and schedule inspections. You will certainly need an inspection when you run new electrical cable or plumbing pipes. A patio will probably not need an inspection; a deck certainly will.

Codes change over time, generally to improve safety and incorporate new technologies. In most cases, existing structures are not required to meet new codes, but any additions, repairs or replacements must meet the latest requirements. However, if an inspector sees an unsafe existing installation, he or she may demand that it be fixed.

Local codes are based on national standards, but they can vary greatly from town to town.

the responsibilities of homeownership

A home inspection report will give you plenty of essential information about the structural integrity and safety of your home. It's important to spend some time studying the report, both to get to know your home and to learn ways to minimize problems in the future. Ask your AmeriSpec home inspector questions if you are unsure of any part of the report. Be aware, however, that an inspection does not guarantee that everything in your home will work for years. You may have problems inside your walls that are not visible to the inspector, and new problems can always arise after the inspection. This book will help you deal with most of them.

REPAIR COSTS

While many repairs can be accomplished by a homeowner for a small cost, others need to be done by a professional and can be very expensive. To avoid home-repair

sticker shock, it's a good idea to set up a savings account for future repairs. To prepare for a new roof or another major project, some experts suggest that homeowners deposit 1 to 2 percent of the house's value every year into such an account. An older or run-down home may need more than 2 percent. If your inspection report indicates that you will need, for instance, a new roof or exterior painting in the next five years, start saving now.

SHUTTING OFF UTILITIES

Every adult family member and older child should know how to:

- Shut off water to individual faucets and fixtures, and to the entire house.
- Shut off the gas to the house.
- Turn off electricity to individual circuits and to the entire house.

The following pages show you how, and subsequent chapters on plumbing and wiring provide additional information.

Even adjacent towns may have very different requirements. For some jobs, codes may require that a licensed contractor do the work or at least supervise it.

By law, it is your responsibility to learn and follow codes, and it is definitely contrary to your interests to violate codes. Not only is out-of-code work potentially dangerous to you and your family, but an inspector who sees such work can make you redo it. Also, any work performed without a permit may be discovered when you sell your house (or you may be asked to disclose it), which can seriously delay a sale. So find out ahead of time what your town's requirements are, get your plans approved, and schedule inspections. Be sure that all of the required work is done before the inspector shows up, and don't cover up anything that the inspector needs to see (for example, by installing drywall over wiring or plumbing that has not been inspected).

ZONING AND SETBACK REQUIREMENTS

You may have a survey or official property map that shows your property lines. Take the time to locate them as precisely as possible. Local regulations likely have setback requirements, which state that

certain structures must not be too close to the boundaries.

Your town, development or homeowner association (HOA) may also have requirements for the exterior appearance of your home. Some of these get surprisingly specific. Make sure any changes in siding, windows, doors, roofing, and even paint color will not violate these rules.

WHEN TO HIRE A PRO

Before you plunge into a project yourself, make an honest assessment of your abilities and your time. If you do need to hire a pro, choose carefully and be sure to get a good contract.

DO YOU HAVE THE TIME? If a repair must be made immediately to protect people or property, such as fixing a broken step or unclogging a backed-up toilet, call a professional if you can't do it right away.

When timing is not critical, consider the size and scope of the work. A project that might take a professional a day or two could take you weeks of working in your spare time—if you can find it. Weigh the inconvenience of living with a repair in progress against the cost of having the work finished quickly.

TOOLS AND EQUIPMENT Compare the cost of buying or renting any special tools required for a job, particularly if you don't expect to use them again. To repair your roof, for example, you must have safety equipment. Clearing a clogged main drain calls for an electric drain auger. A pro has already invested in special tools and includes those expenses in his fee.

YOUR SKILLS Be realistic about your knowledge and abilities. If you

aren't sure how to make a particular repair after reading about it, or if you feel unsafe tackling the job, it probably makes sense to have it done professionally. When appearance counts, such as with finish carpentry or repointing bricks, it may pay to call in an expert if you have no woodworking or masonry experience.

CHOOSING A PROFESSIONAL The best way to find a competent professional is to ask friends or neighbors for recommendations. You can also seek referrals from a hardware store, a home center, or an online service. The phone book lists professional repair services under specific categories, such as "Electrical Contractors," "Glass," or "Roofing Contractors." Be sure that plumbers and electricians are licensed and insured.

THE CONTRACT For a small job, you can hire a handyman on an hourly basis, but for a substantial job—especially one that calls for wiring, plumbing, structural work, or roofing—it's a good idea get a written contract. It should be very specific about what will be done and which materials will be used. Drawings may be attached showing the shape and dimensions of a project. Installation methods should be described in detail. There should be assurances that your property will not be damaged while work is in progress. The contractor should have liability insurance; make sure you will not be responsible for accidents. The timetable for the work should be clear. It is often reasonable to pay a deposit before work begins, especially if the contractor must buy materials. However, structure the remaining payments so that the contractor has plenty of incentive to do a good job and do it on time.

PREVENTING DAMAGE TO UTILITY LINES

Know where your utility lines run and how they connect to your home. Never dig a hole in your yard unless you are sure you will not damage a water, gas, or electrical line. If you are at all unsure, contact the appropriate utility company, which should send out a service person for free.

plumbing, gas, and electrical emergencies

Here are some tips for dealing quickly with sudden problems. For more solutions, see the plumbing and wiring chapters.

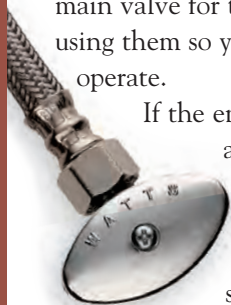
PLUMBING PROBLEMS

In a plumbing emergency, you'll need to stop the flow of water quickly before it seeps into floors and walls. To do this, you and your family need to know the location of the shutoff valve for every fixture and appliance, as well as the main valve for the house. Practice using them so you know how they operate.

If the emergency involves a specific fixture or appliance, look for its shutoff (often called a stop valve) and turn it clockwise to close it. The valve is usually underneath a sink or toilet, or behind an appliance such as a clothes washer, at the point where water supply pipes connect to it. Tubs and showers usually don't have their own shutoffs, so you'll have to use the main valve, unless you have a newer house with PEX piping. In that case, all the fixtures

will have shutoffs on the manifold, which will be in the basement or utility room.

If the problem is with the pipes, or if there is no shutoff valve for the fixture, you will need to turn off water to the entire house. You'll find the main valve on either the inside or the outside of your house where the main supply pipe enters. Often there is a main shutoff or two near the water meter. Turn the valve clockwise to close it. If the valve requires a wrench, keep one nearby so it's always handy.



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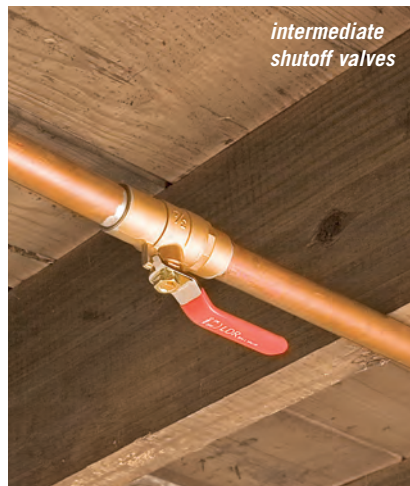


main water shut-off valve

If your house is on a municipal water system, rather than a well, there is often another way to shut off water to your house, with an underground valve located outside. The valve is likely encased inside a housing that is sometimes called a Buffalo box. The cover may be obscured by plants. Once you remove the cover, you may find a valve that can be turned by hand, or you may need a special tool, often called a key.



buffalo box



intermediate shutoff valves

PLUMBING EMERGENCIES

LEAKING OR BURST PIPE If a pipe leaks, turn off the intermediate or main shutoff valve and open a nearby faucet to drain the pipe. Make temporary repairs to stop the leak (see page 152).

OVERFLOWING TOILET If your toilet bowl is overflowing, don't panic. Lift off the cover of the tank, reach inside (this water is clean), and push the rubber ball or flapper down into the flush-valve seat. Turn off the water at the fixture shutoff valve. If there is no valve there, turn off an intermediate valve or the main shutoff. Unclog the toilet (see page 146).

STOPPED-UP SINK Shut off any faucet or appliance that's draining into the sink. Unclog the sink using a plunger or auger (see pages 142–143). Note: chemical drain cleaners only work on sluggish drains and can be dangerous to use on a blocked drain.

A FAUCET WON'T SHUT OFF Immediately turn off the water at the shutoff valve under the sink, at an intermediate valve, or at the main shutoff. Repair or replace the faucet (see pages 132–139).



ELECTRICAL EMERGENCIES

You and other adult family members should learn how to turn off the house's electrical power during an emergency, as well as when you need to make electrical repairs. The main breaker should be labeled "MAIN" or "SERVICE DISCONNECT." Never work on a live circuit of any fixture, appliance, receptacle, or switch. Shut off power to the circuit or to the house first and test the circuit carefully with a voltage tester to be sure it's not live. See pages 172–173 for more information.

Keep the area around the service panel clear so that it can be reached easily at all times. Keep the door closed. If the panel is in a place where children can reach it, you may choose to padlock the door. Have a flashlight with extra batteries as well as candles and matches handy in case of an electrical emergency or an outage.

POWER FAILURE If the electricity fails suddenly, first determine whether it's just in your house or throughout the neighborhood. If the outage affects the neighborhood, notify the utility company. To prevent food spoilage, avoid opening the refrigerator or freezer during the outage. If the problem is just in your home, check for tripped circuit breakers or blown fuses. (If your service panel does

not have an index identifying the circuits, see page 175 for instructions on making such an index.) Replace any blown fuses or reset any tripped breakers and test for a short circuit or overload (see page 173). Once the problem has been corrected, restore the power.

A SMOKING OR SPARKING APPLIANCE

Immediately unplug the appliance or shut off the wall switch that controls it. Do not touch the appliance itself. Turn off the power to the circuit if you can't unplug the appliance. When the appliance cools off, take it to a repair shop or arrange for a service representative to come to your home and make any needed repairs. If the appliance catches fire, get everyone out of the house and call the fire department from a neighbor's house or a cell phone. Do not use water on an electrical fire. If the fire is small, you may attempt to put it out using an extinguisher with a Type C rating.

A SMOKING OR SPARKING APPLIANCE PLUG

At the service panel, cut off power to the receptacle. Unplug the appliance by the cord and allow the plug to cool off. Check the plug and cord for signs of damage and replace them if they're defective (see pages 178–179). Once the plug is repaired, check for and replace any blown fuse or reset a

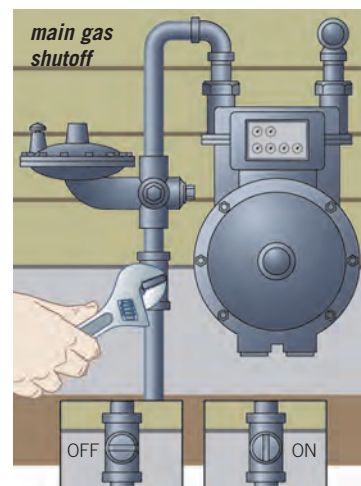
tripped circuit breaker. If the cord and plug are in good condition, the receptacle may be faulty. See pages 182–183 if you need to replace it.

GAS LEAKS If you ever smell gas anywhere in your house, take the following precautions:

- Get everyone outside the house immediately.
- Use a neighbor's phone or a cell phone to call your gas company or the fire department.
- Do not light a match and do not turn any electrical switch on or off. The danger of fire or explosion is severe. Leave as many windows and doors open as possible to help clear the gas from the house.

Once everyone is safely out of the house, turn off the gas supply at the main valve, or wait for the utility company to do it. The shutoff is usually on the inlet pipe next to the gas meter. To close the valve, use an adjustable wrench or a large pair of pliers to turn it 90 degrees in either direction so that the valve head is perpendicular to the pipe, as shown in the illustration at right.

Do not turn the gas back on until you've corrected the problem. In a natural disaster, you may be asked to turn off the gas supply to your home. Make sure all family members know the location of the shutoff valve and how to operate it. To identify the valve, attach a tie-on tag and label it. Leave a wrench in an accessible location so it will be nearby in an emergency.



home safety

The following pages help you minimize hazards in your home and show you how to deal with common emergencies. Every family member should know the steps to take in a fire, and everyone should be familiar with the switches and valves that control the flow of water, electricity, and gas. If a special wrench is required to turn a valve, keep one close by.

In a natural disaster, you may need to shut off the gas, electricity, and possibly the water. It's an excellent idea to have some basic emergency supplies on hand at all times. Your kit should include bottled water, nonperishable food, a portable radio, a flashlight with extra batteries, and a first-aid kit with instructions.

FIRE SAFETY

There are three elements to a fire safety strategy:

- Plan an exit strategy in case of a house fire.
- Install smoke alarms and fire extinguishers.
- Learn how to extinguish minor fires yourself.



safety ladder

AN EXIT STRATEGY In the event of a large fire in your home, immediately take the following steps:

- Get everyone out of the house.
- Call the fire department from a neighbor's house or from a cell phone.

Develop a household fire exit plan. It's even a good idea to have a fire drill now and then. With your family, map escape routes from the house, particularly from bedrooms, and designate a central meeting area outside the home so



smoke alarm

that everyone can be accounted for quickly. If your home is more than one story high, make sure you have safety ladders in upstairs bedrooms. If any windows are barred, ensure that the emergency releases are fully functional. If you have a double-keyed lock on any exterior doors, be sure a key is nearby so anyone inside can open the door quickly.

SMOKE ALARMS These provide excellent early warning of fire. They are your first line of defense against fires that break out at night. Install one or more alarms on every floor of your house, near exits, and adjacent to bedrooms. Install them near the center of a room or hallway.

A photoelectric smoke alarm sounds when its internal light beam senses smoke or steam. An ionization alarm can sense the



fire extinguisher

presence of fire even when there is little smoke. Both types work well. Battery-operated smoke alarms can be screwed to the ceiling, so you can mount them yourself. A hard-wired alarm should be installed by a professional electrician. It should have a battery backup so it can work if a fire damages wiring.

Check your alarms every month by pushing the test buttons. Replace batteries yearly, even if they test OK.

FIRE EXTINGUISHERS Keep a fire extinguisher handy in a kitchen, garage, workshop, and any other location where a small fire may occur. Extinguishers are labeled according to the type of fire they can put out. Type A can extinguish ordinary fires involving wood, cloth, and paper. Type B is for fires fueled by gasoline, oil, kitchen grease, solvents, and other combustible liquids. Type C can handle electrical fires. The higher the UL number (1-A, 2-A, etc.), the larger the fire the unit can put out. Type C extinguishers, however, aren't rated by number.

Check an extinguisher's gauge monthly to be sure the unit is fully charged. Some models can be recharged, while others should be replaced.

HOW TO PUT OUT A FIRE

First, get everyone else out of the house. Then grab a fire extinguisher and follow the PASS method:

- P** Pull the safety pin.
- A** Aim the extinguisher at the base of the flame.
- S** Squeeze the handle.
- S** Sweep the nozzle from side to side to cover the entire base of the fire.

In addition to following these general instructions, be aware of the peculiarities of some types of fires:

KITCHEN GREASE If the fire is in a pan, turn off the heat and cover the pan with a lid. Pouring water on a grease or oil fire will cause the fire to spread.

OVEN Turn off the heat and let the fire burn itself out. Do not open the oven door. This will let in more air, feeding the fire and causing it to grow.

CHIMNEY A chimney fire occurs when soot and creosote deposits ignite inside the flue, making a loud roaring noise and causing flames and sparks to shoot out of the chimney. The sparks may ignite the roof as well. Get everyone out of the house and call the fire department. Do not try to put it out. To prevent a chimney fire, keep the chimney clean and install a spark arrester at the top (see pages 96–97).

ELECTRICAL If a fire is caused by a light or appliance cord, pull out the plug or shut off the power at the wall switch or the service panel. Use a C or ABC extinguisher. Never use water, which can spread the fire and can also cause electrical shock. If you don't have an extinguisher, cover the fire with a non-flammable cloth. If the fire continues, get out of the house and call the fire department immediately.

DRYER If a fire occurs inside a clothes dryer, keep the dryer door closed. Shut off the gas or electricity. If the fire continues, get out of the house and call the fire department immediately.

SECURITY AGAINST INTRUDERS

Certain precautions can greatly reduce the chances that a burglar will break into your home.

- Exterior doors should be 1¾-in. thick fiberglass, wood, or steel (steel is the strongest). Install high-quality deadbolts with 1-inch throws. The strike plate (the socket where the bolt inserts) should be installed with 3-inch or longer screws that penetrate the house's framing, not just the jamb. See page 72 for more information.

- Windows should be locked. See page 54 for locking options. If you have jalousie windows (with open horizontal glass slats), replace them with windows that can be locked.
- Provide ample lighting with motion sensors outside your home. Intruders will be surprised by bright light that comes on when they approach the house.
- A dog—the louder, the better—is an excellent deterrent against most intrusions.
- An alarm system is the ultimate measure of protection. Most sys-

tems have a network of sensors that sound an alarm when a door or window is opened, controlled by a keypad that allows you to turn the system on and off. The alarm may sound a siren and/or alert the local police.

- Consider adding a peep-hole in the front door if windows don't provide a view of the entry.

CHILDPROOFING

Here are some simple ways to make a home safer for small children:

- Keep hazardous materials—such as cleaning products, paints, and solvents—locked away, tightly sealed, and on high shelves.
- Move small appliances to where children cannot get at them, and keep them unplugged when they are not in use. Keep sharp knives out of reach, as well. Cook on back burners when possible and keep children well away.
- Make sure large pieces of furniture and appliances—especially televisions—are placed so they will not tip.
- Hang mirrors and large pictures securely.

Childproofing products address other potential hazards. Here are just a few:

- Cabinet-door safety latches
- Install quickly and keep children out.



■ Sharp table corners can be dangerous. Cushioned protectors take the edge off.

■ Children like to turn knobs. Install safety covers on your stove's burner controls.

■ Safety gates keep small children from exploring up or falling down stairs, or entering unsafe rooms.

Accordian-style gates work only if you install them tightly. Gates with parts that screw to stair railings or walls work better.

■ If a child licks an electrical receptacle or pokes it with a wet hand, a dangerous shock could result. Cover unused receptacles with safety plugs or install tamper-resistant receptacles (now required by code in new and renovated homes). Also install covers so kids can't get at cord plugs.

■ Use window guards or other measures to prevent kids from falling out of windows.

AIR AND WATER QUALITY

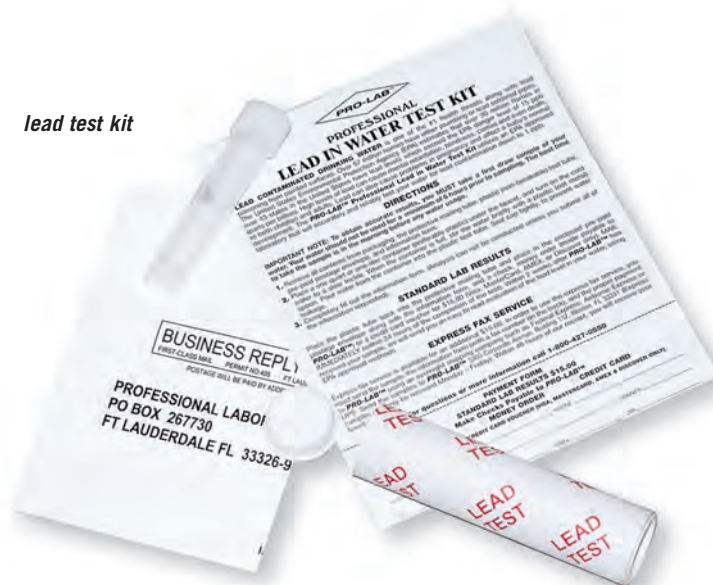
You may decide to hire someone to test whether the water and air in your house are safe. If they are not, find out how serious the problem is and how much it will cost to fix it. The major issues are carbon monoxide; lead in water and paint; radon; asbestos; and mold.

CARBON MONOXIDE This gas, often referred to as CO, results from the incomplete burning of gas, oil or other combustibles. In a home, it is usually caused by the improper ven-

CO alarm



lead test kit



tilation of a combustion appliance—gas water heater, gas- or oil-fired furnace or boiler, gas range, wood-burning stove, or fireplace.

CO is colorless and odorless, but it's very dangerous. Low levels cause headaches, drowsiness, and nausea. Higher levels can lead to an oxygen deficiency that causes respiratory problems and even death. Sleeping people are most at risk.

Install a CO alarm on each floor of your house, especially in or near sleeping areas. A good alarm will have a peak level memory, which tells you the highest readings attained over a given period. Keep the alarm equipped with a battery, as you would a smoke alarm.

If you get a high CO reading, call your gas or oil company for a free inspection. In many cases, the solution will be to provide outside combustion air or to reconfigure a flue so that all fumes are sucked out of the house.

Never operate an emergency generator inside a house or in an attached garage.

LEAD The two main sources of lead are drinking water and old paint. Lead paint was common prior to 1950 and was officially banned for residential use in 1978. If

your house was built before 1978, get a copy of an Environmental Protection Agency (EPA) pamphlet titled, "Protect Your Family From Lead In Your Home" (available online) and make sure anyone you hire to work on areas containing lead paint is lead-safe certified by the EPA. Dust from lead paint is especially dangerous for small children. You can use a home testing kit to find out for sure if you have lead paint. It is usually not a danger on walls as long as it does not chip or peel off. But paint on windows and doors, where two surfaces rub against each other, will create harmful dust. If you have lead paint, covering it with a good primer and new paint will certainly help. To get rid of it completely, contact a certified lead-abatement contractor.

Some older municipalities and homes have lead pipes. Your building department can tell you if the pipe leading from the street to your house is lead. Prior to 1986, many copper water supply pipes were joined with a solder that contained lead. To deal with these sources of lead, many municipalities add a tiny amount of phosphate to the water to coat the pipes and keep lead from leaching into the water

supply. If a test reveals that you have lead in your water, you may want to install a purifier for your drinking water. Contact your local health department or water supplier for more information.

RADON This is another odorless gas, caused by natural radioactivity in many soils. It is harmless outdoors, but it can create a hazard indoors. Breathing high levels of radon for 10 to 15 years increases the risk of lung cancer and other serious ailments.

Test for radon when windows have been kept closed. This is when levels are highest. A long-term test is best, since radon levels can vary greatly from week to week. In addition to having a test performed during your house inspection, you can purchase a home testing kit or hire a company to test for you. If you get your water from a well, test the water for radon.

Solutions to high radon levels are often low-tech. Seal all the places where radon might enter your house, including water pipes, cracks in basement floors, gaps in siding, and around a sump pump. Also increase your home's ventilation. If these measures do not solve the problem, call in a professional who specializes in radon abatement.

ASBESTOS Asbestos was often used in home construction—especially for pipe insulation—before the late 1960s. Inhaled asbestos fibers, even if microscopic, can cause various types of cancer and respiratory problems.

If you have old pipes or a furnace wrapped in cloth-covered insulation, it may be asbestos. Asbestos is light gray and looks like corrugated cardboard. Loose attic insulation may contain asbestos. It will appear fluffy. Textured “cottage cheese” ceilings installed

before 1970 may contain asbestos. Older acoustic ceiling tiles also may contain asbestos.

What to do about it? Opinions vary and have changed over the years. Many experts feel that most asbestos should be tightly wrapped in tape or otherwise encapsulated. Others believe that the best solution is to hire an asbestos removal company. The latter option will cost quite a bit. Contact your local health department to learn the method it recommends.

MOLD Mold is not a problem in small quantities; in fact, it is all around us. However, there is increasing evidence that large quantities of mold in homes may cause asthma attacks in some

protective clothing, scrape away as much mold as you can. Often mold can be effectively removed by washing with a solution of bleach, vinegar, or Borax and water. You can also try aiming a hair dryer at the mold until it dries out. If those strategies don't work, remove and replace surfaces (such as drywall) where mold has attached itself.

Then ensure that the area will remain dry. You may need to remove nearby shrubs, seal exterior holes with caulk, or repair a roof leak, for instance. Wait a week or so before finishing the area to make sure the mold does not regrow.

If you suspect that mold is present in your heating or air conditioning system, do not run the heater or air conditioner. Consult a



asbestos pipe insulation

people. Mold can also irritate the eyes, skin, nose, throat, and lungs.

In most cases, mold is an isolated problem that you can solve by cleaning the area and then keeping it dry. If a moldy area is less than 10 square feet, you can handle it yourself. Consult the health department or hire a contractor if you have larger areas of mold. Wearing gloves, an N-95 respirator (available in many hardware stores or over the Internet), goggles, and

professional, who may recommend cleaning the ducts. Very rarely, large amounts of mold develop inside walls. (This may happen in a home that is tightly sealed and highly insulated but not properly ventilated) If family members suffer from persistent asthma-like symptoms, or if you see or smell mold in places that are not wet, contact your building department or a mold-abatement specialist.

seasonal maintenance

Preventive maintenance is the best way to keep your home in good repair and to avoid expensive problems in years to come. The chart below lists common procedures, but they are merely a starting point. If you notice a problem developing, take care of it immediately.

The repairs indicated are discussed throughout the book. Appliances vary in design, so the final authority should be the owner's manual.

CAUTION Before inspecting or working on the electrical system or on any device connected to it, shut off the power and use a voltage tester to make sure power is off, or unplug the appliance. For maintenance of or repairs to plumbing fixtures or water-using appliances, you may need to shut off the water (see page 8). To turn off the gas, see page 9.

When	Where to Check	What to Do
Every Month	Fire extinguisher	Check that it's fully charged; recharge or replace if needed.
	Smoke alarm	Test batteries and replace if needed.
	Sink and tub stoppers and drain holes	Clean out debris.
	Garbage disposer	Flush with hot water and baking soda.
	Hydronic-heating system	Check pressure gauge and drain expansion tank if needed.
	Forced-air heating system	Clean or replace air filter; vacuum registers.
	Heat pump	Clean or replace air filter; clean condenser or evaporator coils and condensate drain; remove snow and/or debris from outdoor portion of unit.
	Air conditioning system	Clean or replace filter; clean condenser and evaporator coils and condensate drain.
Every 2 Months	Wall furnace	Clean grills.
	Range hood	Clean grease filter.
Every 3 Months	Faucet	Clean aerator.
	Tub drain assembly	Clean out debris; inspect rubber seal and replace if needed.
	Floor and outdoor drain grates	Clean out debris.
	Floor drains (or any unused drain)	Add water to fill trap and maintain seal.
Every 6 Months	Basement and foundation	Check for cracks and moisture and repair as needed.
	Toilet	Check for leaks and water run-on.
	Interior caulking	Inspect caulking around tubs, showers, toilets, and sinks; replace any if it is deteriorating.
	Water heater	Drain water until it is clear of sediment; inspect flue assembly (gas heater).

When	Where to Check	What to Do
	Garbage disposer	Tighten drain connections and fasteners.
	Clothes washer	Clean water inlet filters; check hoses and replace them if they are leaking.
	Clothes dryer	Vacuum lint from ducts and surrounding areas. Check back-draft damper outside.
	Wiring	Check for frayed cords and wires; repair or replace them as needed.
	Range hood	Wash fan blades and housing.
Every Spring	Roof	Inspect roof surface, flashing, eaves, and soffits; repair as needed.
	Gutters and downspouts	Clean them out or install no-clean versions. Inspect and repair weak areas; check for proper drainage and make repairs if needed.
	Siding	Inspect and clean siding and repair if needed.
	Exterior caulking	Inspect caulking and replace any that is deteriorating.
	Windowsills, door sills, thresholds	Fill cracks, caulk edges, repaint; replace if needed.
	Window and door screens	Clean screening and repair or replace if needed; tighten or repair any loose or damaged frames and repaint if needed; inspect and clean weep holes on bottoms of screens; replace broken, worn, or missing hardware; tighten and lubricate door hinges and closers.
	Air conditioning system	Have it professionally serviced.
Every Fall	Whole-house or attic fan	Clean unit; check belt tension and adjust if needed; replace a cracked or worn belt; tighten screws and bolts; lubricate motor.
	Roof	Inspect roof surface, flashing, eaves, and soffits; repair if needed.
	Gutters and downspouts	Clean out; inspect and repair weak points; check for proper drainage and repair if needed.
	Chimney or stovepipe	Clean flue (more frequently if needed); repair any cracks in flue or any loose or crumbling mortar.
	Siding	Inspect and clean siding and repair if needed.
	Exterior caulking	Inspect caulking and replace any that is deteriorating.
	Storm windows and doors	Replace any cracked or broken glass; tighten or repair any loose or damaged frames and repaint if needed; replace damaged hardware; tighten and lubricate door hinges and closers.
	Window and door weatherstripping	Inspect and repair or replace if it is deteriorating or if it does not seal.
Annually	Heating system	Have it professionally serviced.
	Septic tank	Have a professional check the tank (watch for backup throughout the year). In many areas, it is recommended that the tank be pumped every year.
	Water heater	Test temperature pressure relief valve and replace if needed; clean burner and ports (gas heater). Replace the thermocouple (gas heater).

walls and ceilings

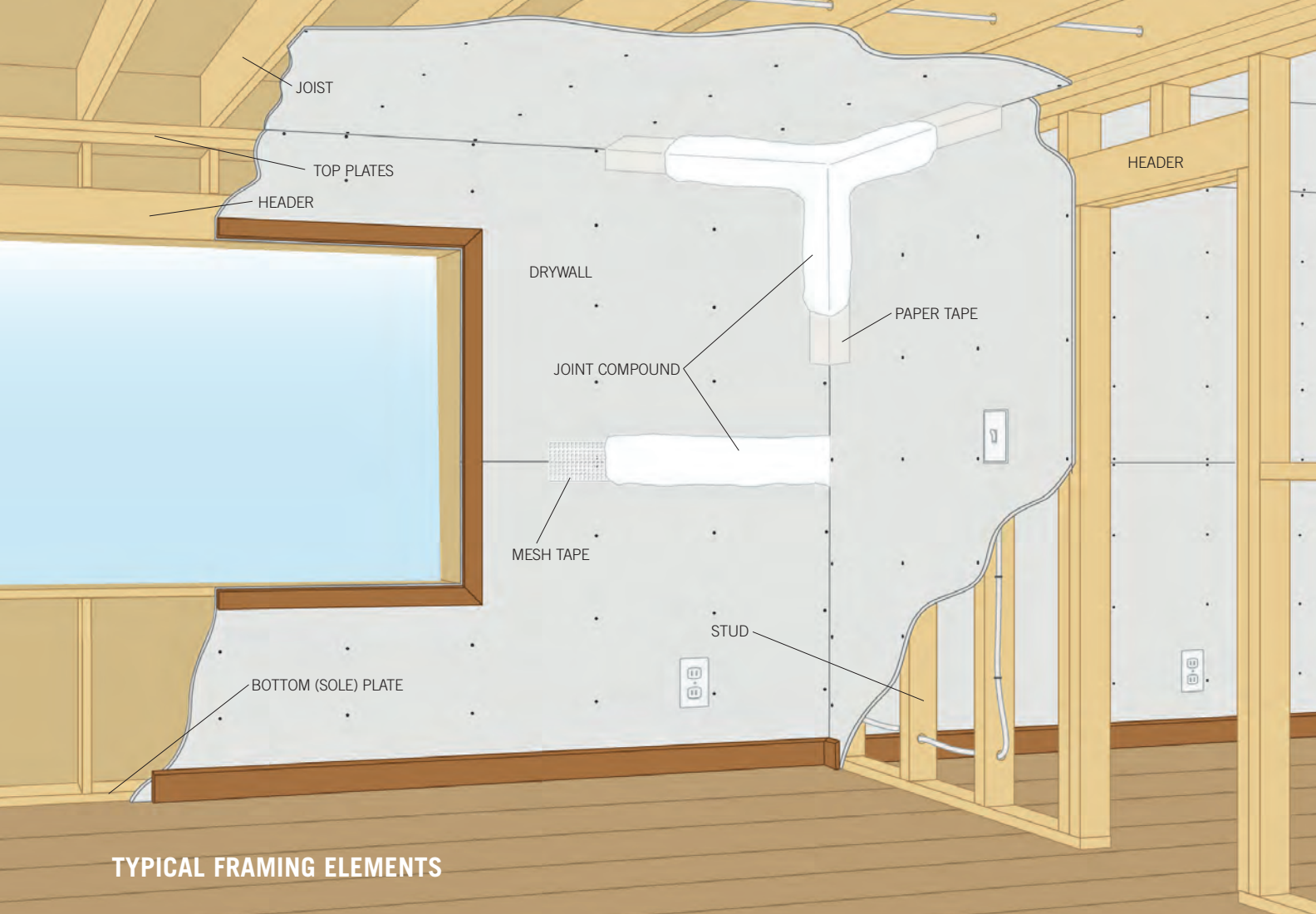
Most homes built before 1940 have plaster walls. The plaster is usually attached to horizontal strips of wood lath that have gaps between them. The rough coat of plaster seeps into the gaps to create a strong attachment, and a smooth finish coat is applied over the rough coat. Often there are three coats, including a middle coat for extra strength. Lath is generally $\frac{3}{8}$ inch thick, while the plaster itself may be anywhere from $\frac{3}{8}$ to $\frac{3}{4}$ inch thick. Sometimes a thick wire mesh, called metal lath, is used instead of wood.

Since the 1940s, most homes have been finished with sheets of drywall, also called wallboard (Sheetrock® is a common brand name). Drywall has a gypsum core that is covered with paper on both sides. It is usually $\frac{1}{2}$ inch thick, but thinner and thicker versions are not uncommon. Drywall is attached to wall studs and ceiling joists with nails or screws. The joints between sheets are sealed with a paper or fiberglass mesh tape and covered with several layers of joint compound, which can be textured or sanded smooth. In some areas, it is common for drywall ceilings to be coated with a texture that looks like popcorn or cottage cheese.

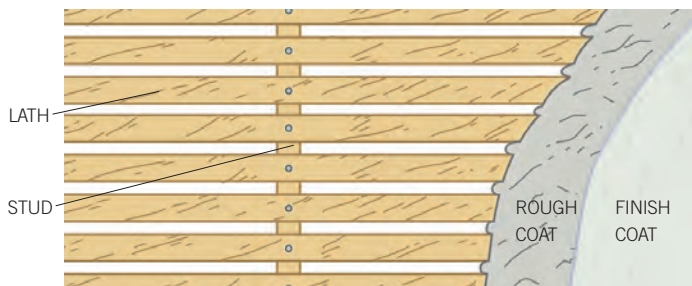
<i>Repairs to Plaster</i>	18
<i>Repairs to Drywall</i>	20
<i>Replacing Sheets of Drywall</i>	22
<i>Wall Tile and Grout Repairs</i>	24
<i>Repairs to Textured Ceilings and Walls</i>	26
<i>Repairs to Wood Paneling</i>	28

**AMERISPEC® TIP****WATCH FOR CABLES, PIPES, AND DUCTS**

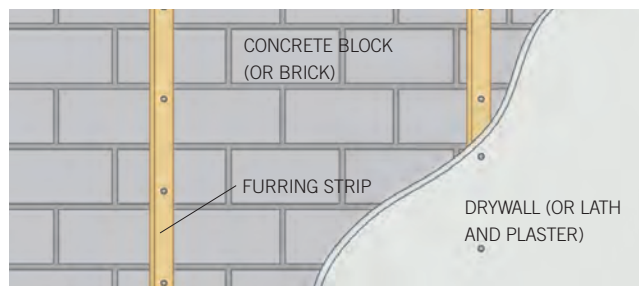
Most walls have electrical cables running through them, and many have plumbing pipes or metal ducts, as well. Always be cautious when cutting into a wall, because cutting into these lines can be dangerous and can seriously damage you or your home. Unless you are certain the cavity is empty, use a small handsaw rather than a power saw. Open a small area and peer inside with a flashlight or explore with a thin board before making a larger cut.



TYPICAL FRAMING ELEMENTS



PLASTER WALL



FINISHED MASONRY WALL

The large illustration above shows typical framing elements under a drywall or plaster wall. Walls are built of studs, which are typically 2 by 4s or 2 by 6s. Ceilings are framed with joists, which are 2-by-6 or wider boards. Framing members are usually spaced 16 or 24 inches apart, but

in some homes (especially those with plaster), the spacing may not be regular. You'll likely find fairly wide headers above every door and window. Most walls have top and bottom plates, and often the top plate is doubled up. In some homes built before World War II (WWII) with "balloon framing,"

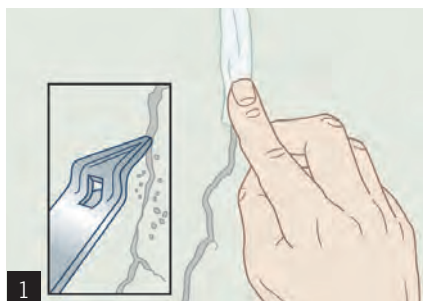
wall studs run from the foundation to the roof and are not interrupted by the floor framing. A finished masonry wall is likely to have vertical 1-by-3 boards called furring strips, which are nailed or screwed to the bricks or blocks to support lath and plaster or drywall.

repairs to plaster

Plaster is commonly applied over wood lath (see page 17), but it may also be applied over metal lath, over a special wallboard similar to drywall, or directly onto a masonry surface. These pages show repairs to small areas. Fine cracks, nail holes, and small gouges in plaster can be repaired with premixed (drying-type) joint compound. Larger areas can be finished with setting-type joint compound (which comes in bags of dry powder) or with patching plaster, as shown on these pages. If you use joint compound, you'll need to apply fiberglass mesh tape to the joints between the patch and the surrounding wall.

REPAIRS TO LARGE SECTIONS If a very large area is damaged, you may choose to remove the plaster between studs or joists and then install drywall, as shown on page 21. Purchase drywall that is the same thickness as your plaster and lath, attach it, and tape the joints between the new drywall and the old plaster, as shown on page 23.

FINISHING THE PATCH The patch should match the texture of the surrounding wall. For a smooth surface, apply several coats of joint compound, sanding each, until you achieve a finish that looks and feels smooth. To match a textured surface, use a paintbrush, stippling brush, sponge, whisk broom, or trowel—whatever will give you the desired finish. Daub or swirl the joint compound to create the desired pattern.



Patching fine cracks

1 Widen the crack to about $\frac{1}{4}$ inch with the tip of a lever-type crack opener (inset). Blow out dust and debris. With your finger or a putty knife, fill the crack with joint compound.



2 Once it's thoroughly dry, sand the joint compound. Use a block wrapped with fine-grade sandpaper and work in a circular motion. Prime the patch, then paint it.

Repairing a small hole

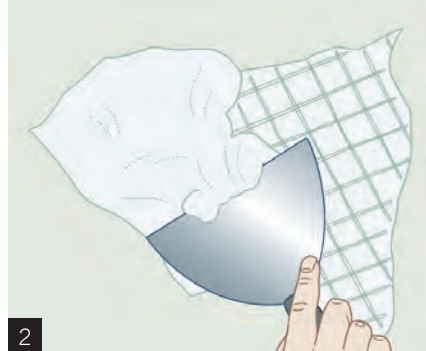
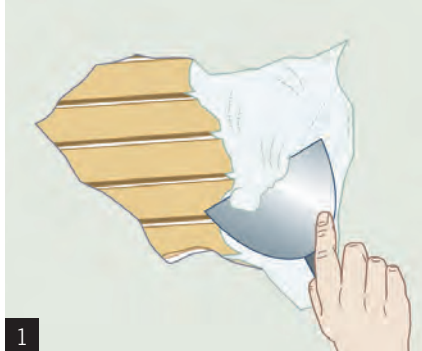
1 Gently tap out any loose plaster. Clean out the plaster from the lath to create a surface that the patching plaster can adhere to. Brush the area clean and dampen with a sponge.

If the hole is smaller than 2 inches across (but larger than a fine crack, nail hole, or small gouge), fill it with patching plaster and finish. Larger holes need several layers. Apply the first layer with a 6-inch taping knife.

2 Score the patch with a nail, then allow the surface to dry. Moisten the patch and then apply a second layer of patching plaster, coming to within $\frac{1}{8}$ to $\frac{1}{16}$ inch of the surface. Score the patch and let it dry.

3 Apply the final coat, feathering the edges an inch or so beyond the edges of the hole. Scrape a wide taping knife across the wet finish. When the patch is dry, sand smooth.





Patching a larger hole

1 Chisel the edges, tap out loose plaster, and dampen the lath with a sponge. Using a 6-inch tapping knife, fill a little more than half the hole's depth with patching plaster. Force it through the gaps in the lath. When the plaster is firm, score it with a nail and let it dry.

2 Dampen the patch again and apply a second layer of plaster to within $\frac{1}{8}$ to $\frac{1}{16}$ inch of the surface.

Score the plaster, let it dry, and apply a third coat. Feather the edges of the plaster an inch or more beyond the edges of the patch.

3 Use a wide tapping knife to remove excess plaster. For a smooth finish, dip a metal trowel in water and, holding the trowel nearly flat against the wall, draw it down from top to bottom. When the plaster is dry, sand and prime it.



PLASTER THAT'S COMING LOOSE

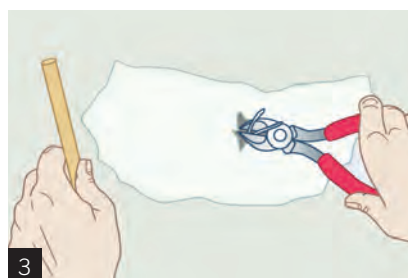
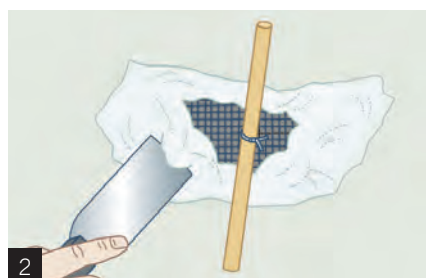
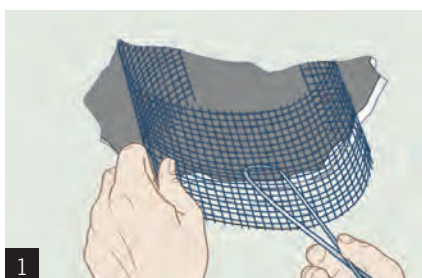
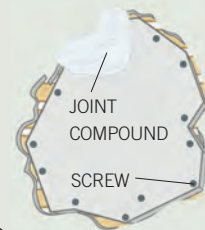
If a wall or ceiling feels spongy when you press on it, the plaster has come loose from the lath. You can fix a small area of loose plaster by using screws and plaster washers, available at some hardware stores. If an entire ceiling is loose, you can cover it with a layer of drywall right over the plaster, driving long screws into the joists. This will save you the trouble and mess of removing the old plaster. You can do the same on a wall, but because the drywall increases the wall's thickness, you may have to remove moldings and build out window and door jambs and then reinstall them.

PATCHING WITH DRYWALL AND JOINT COMPOUND

For a large patch, this method is usually easier than filling the entire area with compound or patching plaster. Chip away the edges of the hole and remove all debris. Cut a piece of drywall the same thickness as the plaster to roughly fit in the hole.

Then attach it with $\frac{1}{4}$ -inch drywall screws driven into the lath and 2-inch screws driven

into studs or joists. Fill gaps between the patch and the wall with joint compound, apply fiberglass mesh tape, and spread joint compound over the tape. Allow the compound to dry and then sand it. Repeat until you achieve a smooth patch.



Patching a hole without a base

1 After removing loose plaster from around the hole, loop a wire through a piece of metal mesh. Roll the edges of the mesh, insert it into the hole, and flatten the mesh by pulling the wire.

2 Attach the wire to a stick so it holds tight against the wall. Dampen the hole's edges with a sponge. Using a putty knife, fill just over half the hole's depth with patching plaster, forcing it through the mesh.

3 Unwind the wire, then remove it and the stick. When the plaster is firm, score it with a nail. Apply two additional coats of patching plaster and finish the patch.

repairs to drywall

Drywall is a gypsum core between two layers of paper. Regular, moisture-resistant and fire-resistant are the most common types. Drywall can be attached with nails or screws, and sometimes with adhesive, too. Joints between the sheets are covered with tape and joint compound.

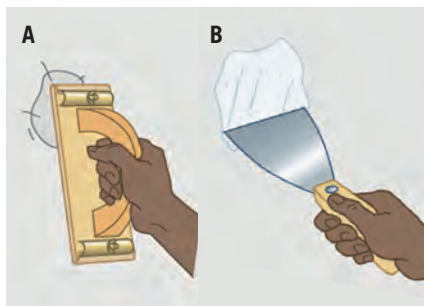
Drywall repairs range from fixing minor dents to replacing an entire panel (see pages 22–23). When a patch is made, finish the section to match the rest of the wall. If the wall is textured, experiment with a trowel, whisk broom, sponge, or other tools until you can achieve a pattern that blends with its surroundings. It is sometimes necessary to paint the whole wall to ensure the repair blends in fully.

Dents, small holes, popped nails, and loosened joint tape all can be easily repaired with joint compound, as shown below. For a patch, you will need wood or other backing to provide solid support.

Several methods are shown on the next page. When cutting a hole, first score the paper facing with a utility knife, using a straightedge as a guide. Then cut to the inside of the score line using a drywall saw, making a clean cut that is easier to patch. At a home center you will find a number of kits that make it easy to patch drywall. One type is shown on the opposite page, lower right.

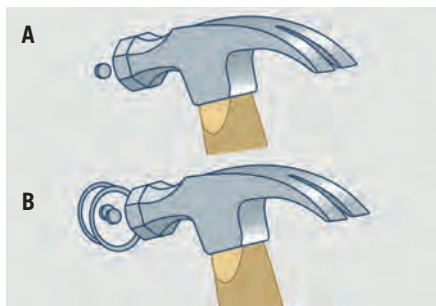
TAPING AND SANDING This step, the key to blending the repair with the surrounding surface, is done in stages. Apply fiberglass-mesh tape or paper tape (it's stronger) to the flat seams and paper tape on inside corners. Use 90-minute (or longer) setting-type (dry-mix) joint compound for the first coat because it is strong. Use drying-type joint compound (which comes premixed in a bucket) for subsequent coats because it is easy to sand. You'll need 6- and 10-inch tapping knives

and 120- or 150-grit sandpaper or a drywall sanding screen. Use a drywall-type sanding block, which may be either handheld or attached to a pole. To apply joint compound, dip the edge of a clean taping blade into the compound, loading about half the blade. Apply the compound across the joint with the blade held nearly flat to the wall. Then hold the blade at a 45-degree angle to the wall and draw it along to smooth the joint. With practice you will gain proficiency in smoothing. Once each coat has dried, scrape away any ridges and sand it smooth, being careful not to sand through the tape. Wear a dust mask and eye protection when sanding. Avoid sanding the drywall itself, as sanding can damage the drywall's paper. To keep the dust down, use a sanding tool that attaches to a shop vacuum cleaner. It will take three or more coats and sandings to achieve a very smooth surface. The compound should both look and feel smooth. Apply a primer, then examine the wall again for imperfections before you paint.

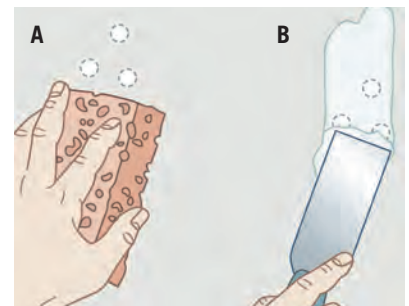


Minor repair

DENT If necessary, gently sand the area around the dent (A) to remove any burrs and protrusions, but don't damage the drywall paper. Fill the dent with ready-mix joint compound (B). Allow each layer to dry before applying the next. When the final layer is dry, sand and prime it.



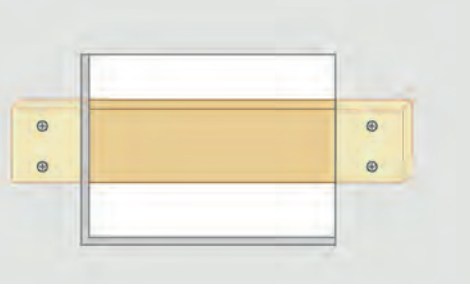
POPPED NAIL OR SCREW If a nail is loose, pry it out and drive another nail to one side that hits solid wood. If the popped nail is fairly solid, hammer and dimple it (A), then drive another nail right beside it. (B). If a screw is popped, dig out the compound and tighten it. Finish with several coats of joint compound and sand smooth.



SMALL HOLES Brush the holes clean and dampen them with a sponge (A). Use a flexible putty knife to fill the holes with several coats of ready-mix joint compound (B). When the filler is dry, sand and prime it.



1



2



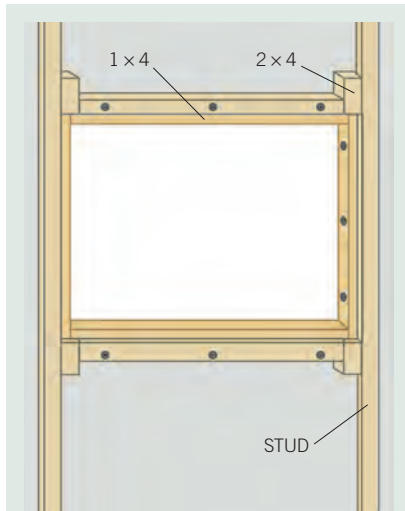
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Larger holes

1 For holes or damaged areas larger than 3 inches in diameter, use a framing square and a utility knife to slice through the paper, forming a rectangle around the damage. Then cut out the rectangle using a drywall saw or by cutting repeatedly with the knife.

2 Cut a piece of 1 by 3 about 8 inches longer than the hole and place it behind the wall. Hold the wood firmly as you drive 1/4-inch screws on each side of the hole and into the 1 by 3. Drive the screws slightly below the surface of the drywall so they create a dimple but not so deep that they tear the paper.

3 Cut a piece of drywall the same thickness as the wall's drywall to fit the hole. Set the patch in place and drive screws into the 1 by 3 to secure it. Apply mesh tape to the joints, then spread and sand several coats of joint compound.



PATCHING A LARGE AREA

If the damage is larger than 12 inches across, you'll need boards on all four edges that you can screw the patch to. Cut out a rectangle of drywall that spans from the edge of one stud to the edge of the next. Then use 3-inch deck screws to attach a 2 by 4 to each of the studs. Use drywall screws to install 1 by 4s at the top and bottom of the opening that span between the 2 by 4s and overhang the edge of the patch. Now install a piece of drywall, tape it and apply three coats of joint compound. This same technique works for ceilings, too.

AMERISPEC® TIP

REPAIRING A CRACK

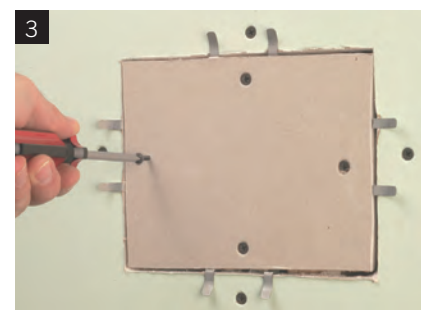
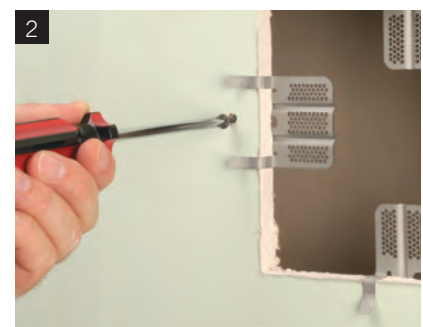
A crack—commonly above a door, at the joint between walls, or between the wall and ceiling—can be permanently repaired with fiberglass mesh tape and several coats of joint compound. To avoid the hassle of all those coats and sandings, you could instead apply latex-silicone caulk, though you may need to repeat the application every few years.

Drywall patch kit

1 Purchase a repair kit that includes drywall clips. Cut out the damaged area with a utility knife, then a drywall saw.

2 Slip the clips onto the edges of the hole and screw them into place. Drive the screw heads slightly below the surface of the drywall (but don't tear the paper).

3 Cut a piece of drywall to fit. Drive screws through the patch and into the clips. Bend protruding tabs back and forth until they break off. Apply mesh tape to the joints, then apply three coats of joint compound, sanding each coat as necessary.



replacing sheets of drywall

When drywall is damaged by water or has large holes or cracks, you may need to remove one or more full sheets and cut new drywall to fit.

REMOVING A DAMAGED SHEET

Sheets may be installed vertically or horizontally. Sometimes it is easy to see the outline of a sheet, but often you can't tell where a sheet ends until you start demolition. Start by removing the cover plates on any electrical receptacles or switches. Then punch through the drywall with a hammer or pry bar and pull off pieces as large as possible. Check for cables or pipes as you work. Use a flat pry bar to tear the panel off the studs. Once you see where a sheet ends, use a utility knife to slice through the taped joints. That will allow you to pull the sheet off cleanly.

When the sheet is removed, remove any nails or screws left in the framing. If you remove drywall that was attached with lots of fasteners spaced closely together, it may be part of a shear wall and critical to the strength of the house. Either install the new sheet exactly the same way, or seek advice from an expert.

INSTALLING A NEW SHEET

Measure the opening and, following the directions on the next page, cut a new sheet $\frac{1}{4}$ inch shorter to accommodate the ragged edges of the cuts. To fit drywall around doors, windows, electrical receptacles, switches, or other openings, measure from the vertical edges of the opening to the edge of the

nearest sheet or to a corner. Then measure from the horizontal edges to the ceiling or the sheet above. Transfer your measurements to the drywall and cut with a drywall saw.

Mark stud locations on the floor and on the wall or ceiling above. Position the sheet over the opening, supporting it with a 1 by 4 and a pry bar. Nail or screw the sheet to the studs. Around the perimeter of the drywall, fasteners should be 6 to 8 inches apart and at least $\frac{3}{8}$ inch from the edges. Along the middle studs, space the fasteners 12 to 16 inches apart. If you're nailing, use ringshank dry-

wall nails, and drive them in pairs ($1\frac{1}{2}$ to 2 in. apart) every 12 to 16 in. in the middle of the sheet. Make sure all fastener heads are below the surface of the drywall, creating a dimple.

Unless the drywall is a backing for paneling, you will need to tape joints and cover fastener heads with joint compound. Sanding joint compound creates a dusty mess, so seal off the room and aim a fan out the window. It will take at least three coats of joint compound—each of which will likely need to be sanded—before you achieve a smooth surface.

AMERISPEC® TIP LOCATING STUDS OR JOISTS

To find studs or joists hidden inside your walls or ceilings, use an electronic or magnetic stud finder. Or drill a small hole in an inconspicuous place, insert a bent wire, and probe to find a stud on each side. Drive a small nail into the stud to make sure. Studs are often, but not always, spaced 16 inches apart.



Hanging a replacement sheet

1 Punch through the center with a hammer or pry bar, check for wires or pipes, and pull off pieces. Use a utility knife to slit the taped joints between the damaged sheet and adjacent sheets. Working from the center, pry the sheet's edges off the studs with a pry bar.

2 Cut the new sheet to fit and support it as shown in the inset. First drive nails or screws into each stud near the top of the panel to hold it. Then space fasteners 6 to 8 inches apart at the perimeter, 12 to 16 inches apart in the middle.

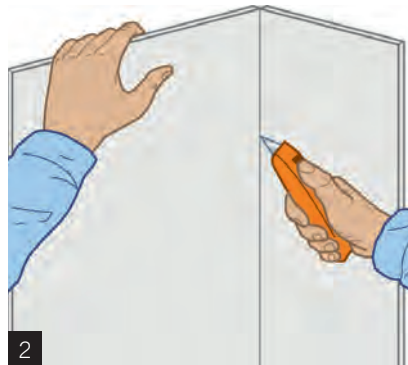
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Cutting drywall

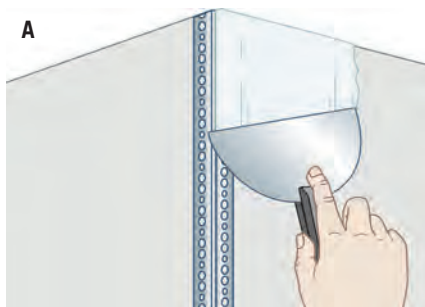
1 Measure the opening and mark the drywall sheet. Hold a drywall square (or other straightedge) firmly with your hand at the top and wedge your foot against the bottom, then score a line that cuts through the surface paper.

2



2 Bend the cut piece back until it snaps. Then cut through the paper on the back side of the sheet. To cut a hole or a notch, use a drywall saw for one or more sides of the cut.

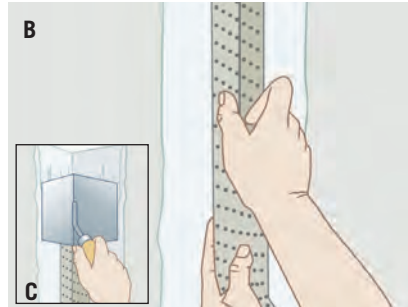
A



Taping drywall corners

For an outside corner, nail or screw a metal or plastic corner bead over the corner, taking care to keep it straight. Use a 6-inch tapping blade to apply joint compound across one side and smooth it vertically (A). Repeat on the other side. Apply subsequent coats with a 10- or 12-inch knife. For an inside corner,

B



C

apply joint compound on each side with a 6-inch tapping blade. Cut a piece of paper tape to fit, crease it down the middle, and press it into the compound (B). Using a corner tool or a 6-inch knife, press the tape into the compound and add a layer of compound over the tape (C).

Taping flat seams

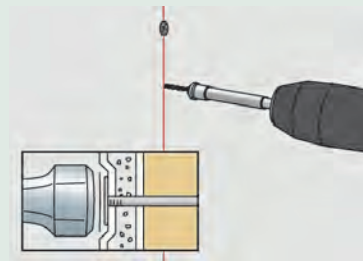
Apply fiberglass mesh tape, which is self-adhesive, over the seam, then spread setting-type compound



over it with a 6-inch tapping knife. With paper tape, you have to put down a layer of compound first (either setting type or drying-type), embed the tape in it, and apply another thin layer on top. Once it dries, apply two more layers of compound, each a little wider than the previous, feathering the edges and sanding between coats as necessary.

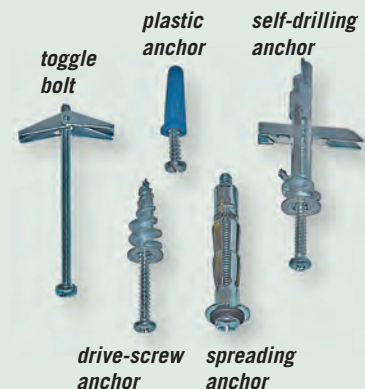
FASTENING DRYWALL

To attach drywall with screws, buy a dimpler attachment for your drill; it will enable you to drive screws to just the right depth so that they are recessed below the surface of the drywall but not so deep that they tear the paper. If you attach the drywall with nails, be sure to dimple the nails by pounding them just below the surface (inset).



FASTENING TO DRYWALL OR PLASTER

The best way to attach something to a wall is by driving a screw into a stud. But if you need to attach at a point where there is no stud, there are a number of wall anchors that will provide reasonable strength even though they grab onto only the drywall or the plaster. A toggle bolt or a spreading anchor (also called a molly bolt) grabs onto the back side of the drywall as you tighten the screw. Tap a plastic anchor into a hole that you drill in the drywall, then drive a screw into it. A drive-screw anchor is the easiest to install. Simply screw it into the wall.



wall tile and grout repairs

When ceramic tiles, especially around a bathtub, come loose from the wall, remove any tiles that pry off easily and check the condition of the underlying surface. If the tile substrate is crumbling, remove a section of tiles between studs and repair it. Moisture-resistant drywall (greenboard) should not be used for tubs and showers, so you'll want to use cement backerboard, or another product designed for wet locations. Clean the tiles of grout and adhesive, reinstall them, and apply grout as shown at right.

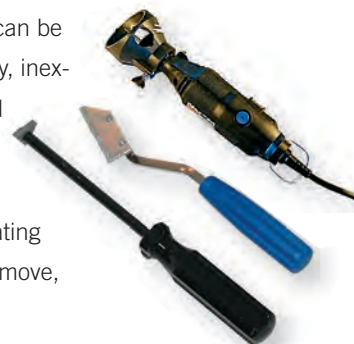
Call in a professional if the tiles have been set in a thick mortar bed. This is typical in older installations but is still practiced by some pros today.

If you have even a small hole or gap in your bathtub-surround grout, fill it immediately, before moisture can seep behind the tiles and loosen them. If your grout is developing cracks or gaps, if it is stained beyond cleaning, or if you just want to change the color (see the tip on the opposite page), remove it and apply new grout. Use unsanded grout for joints that are $\frac{1}{8}$ inch or narrower; use sanded grout for wider joints. For strength and durability, mix grout powder with latex additive, not with water. Once the grout has hardened, apply sealer to keep it clean-looking and scrubable.

Inside corners, especially the joint between the tub and the wall, should be sealed with silicone or bathtub caulk rather than grout. Grout will crack, while caulk is more flexible.

AMERISPEC® TIP GROUT REMOVAL TOOLS

Removing grout from an entire tub surround can be tedious and time-consuming work. Fortunately, inexpensive power tools make the job quicker and easier. One setup features a guide and bit that attach to a rotary tool (far right). You can also buy a grout-removal blade for a reciprocating saw. If you have a small amount of grout to remove, use a hand grout saw (left and middle).

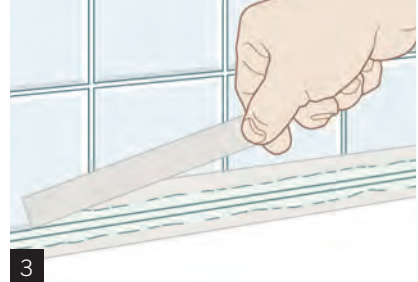


Regrouting

1 If grout is recessed, don't apply a thin layer on top, as it will likely flake off. Remove the grout all the way to the wall. To use a hand grout saw, use slow, deliberate strokes to avoid damaging tiles. Apply only moderate pressure, letting the saw do most of the work. When the going gets rough, replace the saw blade.

2 Pour some grout powder into a clean bucket. If the grout is fortified with polymer, mix it with water. Otherwise, use latex additive. Slowly add the liquid and mix with a margin trowel or a paint stirrer until the grout is the consistency of toothpaste and is free of lumps. Wait 10 minutes, then mix again. Add a little more liquid if it's needed.

3 Using a grout float, scoop some grout out of the bucket and smear it onto the wall. Working in sections about 4 feet square, push the grout into the joints. Hold the float nearly flat and sweep it diagonally across the surface so it does not dig in. At all points, press the grout in by moving the float in at least two directions.



Recaulking a bathtub

1 Remove all the old caulk first. Use a scraping tool that holds a straight razor blade. First scrape down the face of the tiles, then scrape along the bathtub rim. Some types of caulk can be softened with a heat gun. Finish by scrubbing the area with an abrasive pad.

2 You could simply apply caulk and smooth it with a wet finger, but here's a technique that will produce an extra-neat joint. Apply a piece of masking tape along both sides of the joint. Caulk the joint (see page 111), then smooth the caulk with your finger.

3 While the caulk is still wet, pry up one end of a piece of tape and pull it away, taking care not to smear caulk on the tub or wall. Do the same with the other piece of tape. Allow the caulk to dry for a full 24 hours before taking a shower or bath.

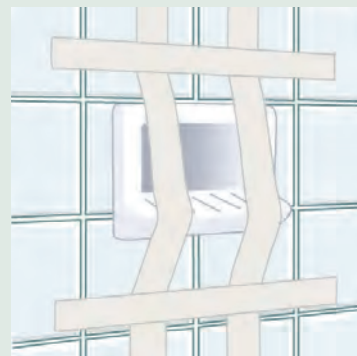
4 Tilt the float up and use it like a squeegee to wipe away most of the grout from the face of the tiles. Scrape diagonally so the edge of the float cannot dig into the grout lines. Once you have pressed and scraped one section, move on to the next. If the grout in the bucket starts to harden, throw it out and mix another batch.

5 When the grout has begun to set up (but long before it hardens), dampen a sponge and wipe the tiles gently to remove excess grout. Rinse the sponge frequently with clean water. If you see a gap, push grout in with your finger. Pay close attention to the grout lines and aim to make them consistent in width and depth. Wipe the surface three or more times. Allow the grout to dry, then buff the tiles with a dry cloth.



INSTALLING A TUB ACCESSORY

Some tub accessories, such as soap dishes, are attached to the surface of a tiled wall, but others are set into an opening in the tiles. Some installers prefer to attach a soap dish using a weak adhesive so the dish will pop out in one piece rather than break if it is pulled hard. If you are installing a new accessory, get one that will fit into the existing opening. Otherwise you will need to remove and cut a tile or two to make room for it. Clean the wall surface and allow it to dry. Spread construction adhesive, tile adhesive, or thinset mortar onto the back of the accessory. Push it into place and hold it there using pieces of masking tape or duct tape until the adhesive sets. The next day, caulk the joint between the accessory and the tiles.



AMERISPEC® TIP COLORING EXISTING GROUT

At a tile or home center you can find products that permanently change the color of old grout. First clean the grout with a special solution. Apply the colorant with a small paintbrush or an applicator that comes with the product. Let it soak for the recommended amount of time, then wipe the tiles. It may take two or three coats to achieve the color you desire.

repairs to textured ceilings and walls

Many homes have ceilings and walls that are textured rather than smooth. Patching these surfaces is not as difficult as it may seem.

POPCORN CEILINGS Some ceilings are covered with an “acoustic” surface that resembles popcorn or cottage cheese. This finish saves time for installers, who spray it on rather than applying and sanding several coats of joint compound. It does have a slight sound-dampening effect, which vanishes once the surface is painted.

A small number of popcorn ceilings in older homes contain asbestos. You can send a sample to a testing agency (there are several on the Internet) for an inexpensive test. See page 13 for more information on asbestos.

If your popcorn ceiling is in good condition you can repaint it. Be careful that the texture does

not come loose while you paint. A textured paint roller works better than spraying. First, apply a coat of alcohol-based primer (also known as white shellac), which will dry quickly and seal any stains. Then paint, taking care not to make any area overly wet.

If an area 4 feet square or smaller is damaged or has come loose, you can patch it using any of the techniques shown below. If the texture is coming loose in several areas, you probably need to remove it from the entire ceiling.

To remove a popcorn finish, clear out or cover everything in the room. Have a helper use a small pump sprayer filled with water to dampen a 4-by-4 foot ceiling area. Wait 5 minutes or so for the texture to soften, then use a 6-inch tapping knife to scrape off the texture. (Ceiling paint is fairly porous. If the ceiling has been painted with semi-gloss, however, the water will likely

not soak through to the texture.) Hold a bag under the scraper to catch debris. Proper wetting is the key, and it may take some experimenting to achieve. You want the texture to be dampened, but you don't want to wet the drywall, as that could seriously weaken it.

Once the texture is removed, you will probably find drywall that has received only one coat of tape and joint compound, so it is not smooth enough to paint. For a smooth finish, sand and apply a second and third coat. Or apply a wall texture (see opposite page). Paint with drywall primer followed by ceiling paint.

WALL TEXTURES If you have an old home with textured plaster walls, duplicating the texture is a job for pros. However, if your walls are made of textured drywall, patching is simply a matter of practice and finding the right technique. In most cases, using a hopper and perhaps a trowel will do the trick. If the wall has swirls, try duplicating them with a whisk broom. Many other textures are created with a trowel.



Patching a popcorn ceiling

DAB APPLICATOR To patch a very small area, buy a tube of popcorn ceiling patch equipped with a foam applicator. Gently scrape away any loose texture. Squeeze the tube as you press it against the ceiling. Use dabbing rather than sweeping motions to spread the texture.



SPRAY CAN You can buy an aerosol can of acoustic patch or spray devices that you load yourself. Scrape away a rectangular section of the ceiling. Protect the surrounding area with a cardboard box with its bottom removed (above) or by pinning up sheets of plastic. Spray until you achieve the desired texture.



ROLLED TEXTURE You can purchase acoustic ceiling patch in dry bags that you mix with water, or in premixed buckets. For a heavier texture, apply the patch first with a trowel, then go over it gently with a texture-paint roller. For a lighter texture, use the roller to apply texture paint.

Texturing walls

TEXTURE GUN A texture gun has a hopper on top, into which you load joint compound. It often is recommended that you first water down the compound. Adding a bit of sand increases the strength and produces a slightly grainy effect. With a texture gun, you can



achieve an orange peel texture, which is only slightly bumpy, or a spattered texture, which has more pronounced globs. Make sure you cover the floor and furniture before using the machine. Then fill the hopper and use the gun to spatter the walls until you have the desired effect.

KNOCKDOWN TEXTURE A classic knockdown texture has a combination of flat and rounded areas. First spatter the wall using a hopper gun as shown at left. Before the compound starts to dry, gently run a large taping blade or flat trowel



over the surface to flatten some but not all of the bumps. A pool trowel (shown above) helps you avoid streaks.

AMERISPEC® TIP

DEALING WITH STAINS AND MILDEW

If a stain cannot be cleaned away, cover it with alcohol-based stain-killing primer, then paint over it with latex paint. Treat mildew first by removing its cause, which is persistent moisture. Once the area is dry and you are certain it will stay dry, clean it with a commercial mildew-cide or with a solution of 3 parts water to 1 part chlorine bleach.

CEILING TILES

Prefabricated ceiling tiles are attached either to an existing ceiling or to furring strips. Staples or nails (with or without adhesive) or adhesive alone secures the tiles.

If ceiling tiles develop stains, paint with stain-killing primer, then with latex paint. Be aware that when you paint over ceiling tiles you lessen their ability to dampen sound.

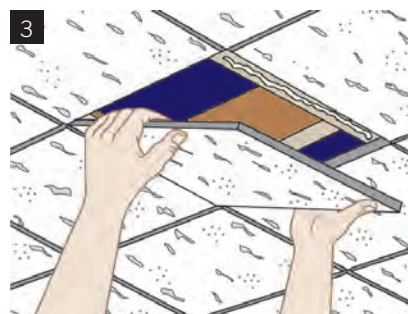
If a tile is dented or chipped, follow the steps at right for removing and replacing it. You will need to remove one tongue and the back sides of two grooves in order to slip the new tile in.

Replacing a ceiling tile

1 Use a sharp utility knife to cut through all four joints around the damaged tile. Use a flat pry bar to remove the tile, then remove one of the tongue pieces left in an adjoining tile.

2 Using a straightedge and the utility knife, cut off one tongue and the back sides of both grooves on the replacement tile. Take care not to damage the visible portion of the tile. Test that the tile will fit.

3 Apply adhesive to the framing or furring strip. Slip the remaining tongue into an adjacent tile's groove, press the other side of the tile into place, and temporarily brace the tile until the adhesive dries.



repairs to wood paneling

REPAIRING SOLID-BOARD PANELING

Solid-board paneling is made of $\frac{3}{8}$ - to $\frac{3}{4}$ -inch-thick hardwood or softwood boards, or plywood strips ranging from 3 to 12 inches wide. Most are milled to overlap or interlock. Paneling is attached to studs, furring strips, or drywall.

If you can't repair damaged paneling to your satisfaction, you may want to replace one or more boards (see instructions below). Be sure to carefully match any new paneling and its finish with adjacent surfaces.

MINOR SCRATCHES AND GOUGES One of the most common ways to conceal shallow scratches and gouges is to fill them with a putty stick, then wipe away any excess putty with a clean cloth. Choose a color that matches the finish of your paneling. You can also conceal minor scratches on paneling with furniture polish or wood color-match sticks.

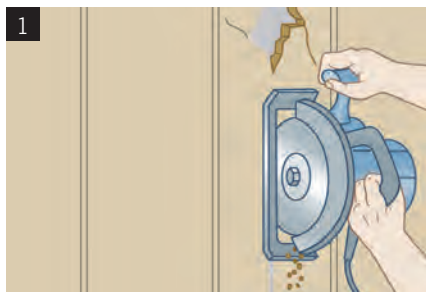
DENTS AND DEEP GOUGES You may be able to restore dented wood fibers by removing all the finish from the dent site, then placing a damp

cloth and a hot clothes iron over the dent until the wood fibers rise to the level of the surrounding surface. Let the wood dry thoroughly before sanding it smooth and refinishing the area to match.

To repair a deep gouge or a nail hole, fill it with a matching wood putty, using a flexible putty knife to apply the putty. Let it dry, then sand the patch smooth with fine-grade sandpaper wrapped around a sanding block. Finish it to match the surrounding area.

Replacing a damaged tongue-and-groove board

1 Remove the baseboard (see step 1, opposite page). Adjust the blade depth of a circular saw to the damaged board's thickness. Saw up the board's center and then split the ends with a chisel.



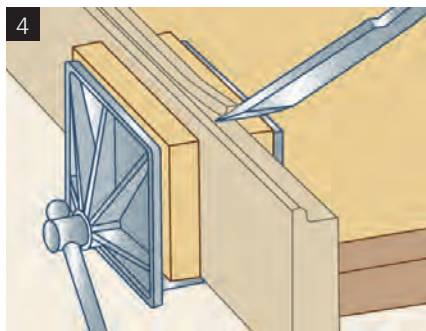
2 Wedge a flat pry bar or wide chisel between the sawn edges. Pry the sections away from the wall one at a time. (You may find "blind" nails driven into the tongues.)



3 Place the damaged board over the new board and mark the correct length with a pencil and combination square. Use a power saw to cut the replacement board to length.



4 Remove the back of the new board's groove with a wood chisel (beveled side down) and a mallet, holding the board in a vise and using wood blocks to protect the board.



5 Align the replacement board with the adjacent one, starting at the ceiling. Fit the tongue of the new board into the groove of the adjacent board and slip it into place.



6 Tap the board into place with a hammer and a padded block. Drive finish nails at the top and bottom, sinking their heads with a nail set. Fill the holes and finish the wood, then replace the baseboard.



REPAIRING WOOD-VENEER SHEET PANELING

Sheet paneling may have a veneer of wood, simulated wood, or even fabric or vinyl. Of these, wood veneer responds best to repair, though even your most careful efforts may show.

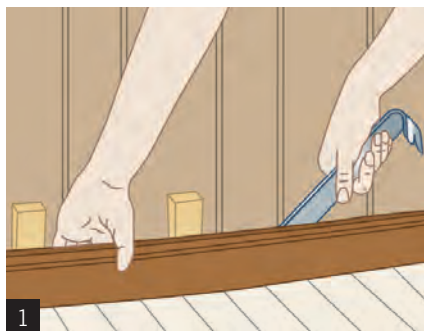
Panels usually measure 4 by 8 feet and are fastened to either wall studs or furring strips with adhesive and/or color-matched nails. If you can't conceal the damage to your satisfaction or if the paneling has holes, you may want to replace a panel, as shown at right.

MINOR SCRATCHES AND NICKS The simplest way to conceal a flaw is to draw over it with a colored putty stick. Wipe away any excess putty with a clean cloth. Putty sticks come in a variety of colors to match finished wood paneling. You can also hide scratches and nicks with shoe polish or floor wax.

For a more thorough repair, lightly rub the damaged area with fine steel wool or fine-grade sandpaper, applying less pressure toward the edges. Wipe away residue. Apply wood stain with a cotton swab.

After the stain is dry, lightly buff the area again with a fine abrasive and wipe away the sanding residue. Spray a light coat of varnish on the area and let it dry, then lightly buff it with a fine abrasive and wipe. If the original panels were waxed, wax the entire panel and buff it to a sheen with a clean cloth.

DEEP GOUGES AND CRACKS Use a putty knife to fill deep gouges and cracks with wood putty. Sand smooth when dry. Use a small brush to stain or paint the putty so it matches the finish of the panel.

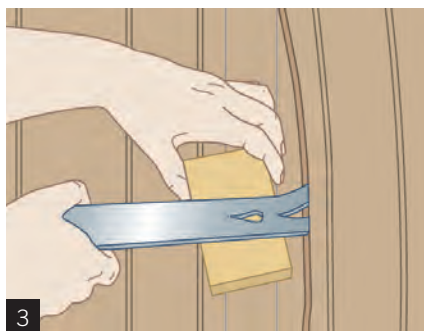


Replacing a damaged wood-veneer panel

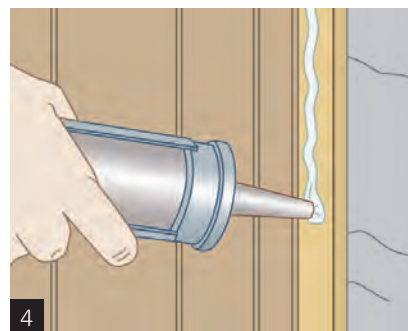
1 Insert a pry bar between the baseboard and paneling, placing wood wedges in the gap. Pry off the baseboard and remove the remaining nails with pliers or a hammer.



2 Split the panel near one edge (not on a stud), using a hammer and chisel. The split should be large enough for you to insert a pry bar to peel the panel off the studs.



3 Pull the panel off the studs with a pry bar, being careful not to damage adjacent panels. Wedge a pry bar between the panel and studs to break any adhesive bond.



4 After pulling off the old paneling and scraping off any adhesive (or removing nails), apply a bead of adhesive along the length of the studs to hold the new panel.



5 Position the new panel. Drive four finish nails near the top of the panel to secure it. Then pull out the base of the panel, holding it away with a wood block until the adhesive gets tacky.



6 Remove the block and press the panel into place. With a padded block, hammer along edges and over studs. Remove the finish nails if they are not needed. Replace the baseboard.

floors and stairs

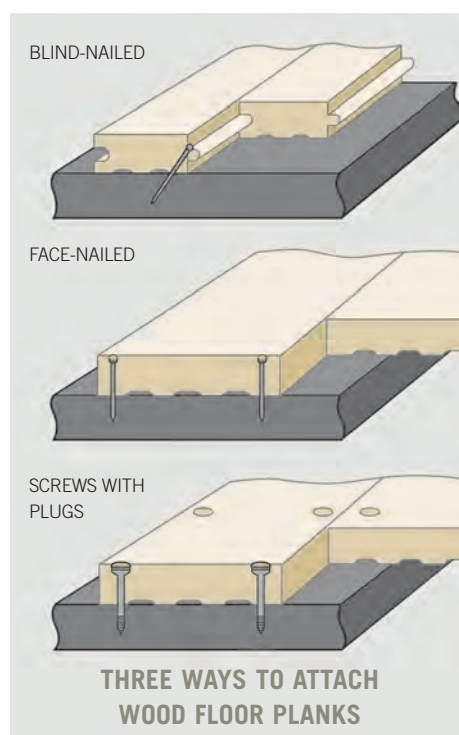
Before you make repairs or improvements to wood, vinyl, carpet, or tile floors, make sure you understand the substructure.

A FLOOR'S SUBSTRUCTURE The joists that support the floor are typically 2 by 8 or wider, and they are usually spaced 16 or 24 inches apart. The subfloor is nailed to the joists and sometimes also glued with construction adhesive. The subfloor is typically

constructed of one or two layers of plywood or OSB (oriented strand board). In some older homes, diagonally laid 1-by-4 or 1-by-6 planks were used instead.

If your house is built on a concrete slab, the floor may be laid over 2-by-4 “sleepers” spaced every 16 inches or so, or on a base of plywood that is attached to the concrete with concrete fasteners.

If your home has a crawl space or basement, you may be



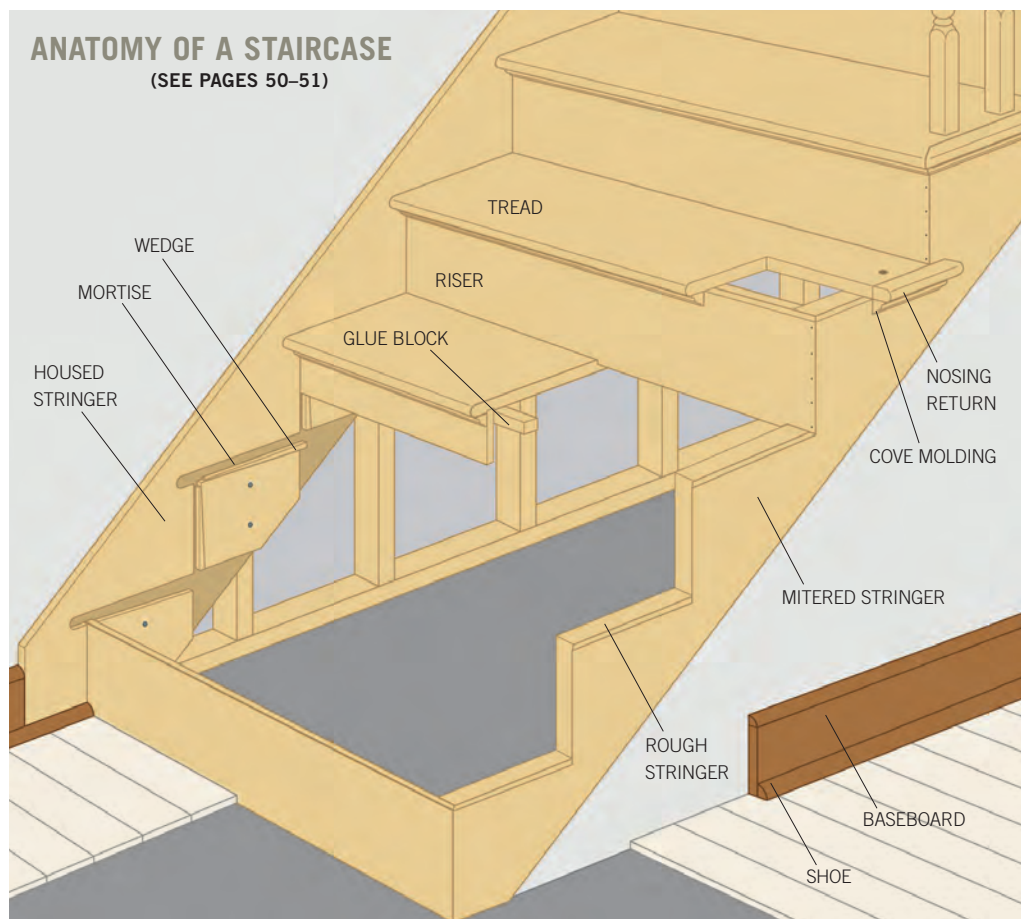
able to check out the subfloor from underneath. If you can tell that it is plywood or OSB, look for a grade stamp that designates the thickness. Or look for a hole in the floor (perhaps for a pipe) and measure there.

FINISH MATERIALS Most wood flooring has a tongue on one edge and a groove on the other so that the boards interlock. Tongue-and-groove flooring is usually attached with nails driven at an angle through the

<i>Fixing Squeaky or Warped Wood Flooring</i>	32
<i>Replacing Wood Flooring</i>	34
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tongue, making the nail heads invisible. Less common plank flooring, which has no tongues or grooves, is fastened with nails or screws driven through the face of the boards. The fasteners may be left exposed for a rustic look, or the heads are sunk below the surface and covered with putty or wood plugs.

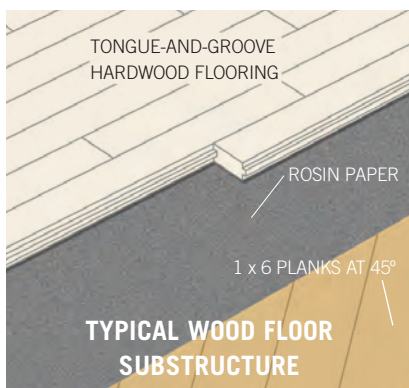
The thickness and stiffness of the subfloor determine the types of finish materials that can be put on top. If your house is built on a concrete slab, the slab can support almost any type of flooring. But with a plywood or plank subfloor, it's important to check out the type and thickness of the material to determine its limitations. A floor that is slightly flexible or springy would need to be stiffened to support ceramic or stone tile; otherwise the grout or tiles would likely crack. Wood flooring, laminate flooring, or carpet can be installed



on a subfloor that is slightly springy and less than smooth. Vinyl tiles and sheet flooring can be installed on a springy floor, but the surface must be very smooth.

FLOOR PROBLEMS A few minor dips in a floor caused by the house settling are common. But if a floor sags more than 1½ inches or feels mushy when an adult jumps on it, the house could have a serious structural problem. Look for evidence of rot or termites. Discolored areas on the joists or subfloor usually indicate a plumbing leak. If you are faced with any of these problems, call a contractor.

You can repair most minor surface damage yourself. If your wood flooring squeaks or has separated, split, or warped boards, you can often reattach them and make the floor straight. Often, but not always, a moderately scratched or stained wood floor can be sanded and refinished. This chapter will also show you how to repair floor tile, vinyl, and carpeting.



fixing squeaky or warped wood flooring

Squeaks on a wood floor occur when pieces of wood rub together or rub against metal, such as nails, joist hangers, or ductwork. Squeaks usually originate in the finished flooring, but they can also occur in the subfloor or even the joists.

DIAGNOSING THE PROBLEM Have an adult walk on the squeaky area while you lie on the floor and watch closely. If you see boards moving against others, the solution is to reattach them to the subfloor. If a section moves up and down, the damage is likely beneath the floor-

ing. You may need to tighten the subfloor to the joists or shore up the joists, as shown on the next page.

If the joists are visible from the basement or the crawl space, watch from below while someone walks across the floor above. You might spot some slight movement between the joists and the subfloor or perhaps loose bridging between joists.

CORRECTING SQUEAKS Simple but usually not permanent remedies include squirting powdered or liquid graphite between floorboards or dusting cracks with talcum powder. Use a paintbrush to work the pow-

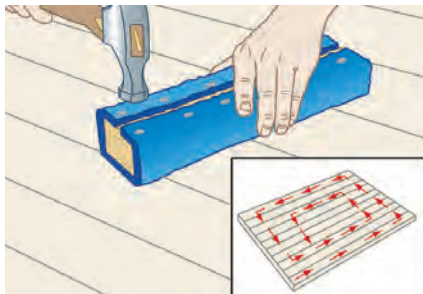
der into the gaps between boards, then sweep.

If floorboards are rubbing, securing them with face nails or trim-head screws is usually the best solution. Experiment with various shades of wood putty to find the best color match so the holes will not be too visible. If you can work from below, drive screws up through the subfloor and into the flooring.

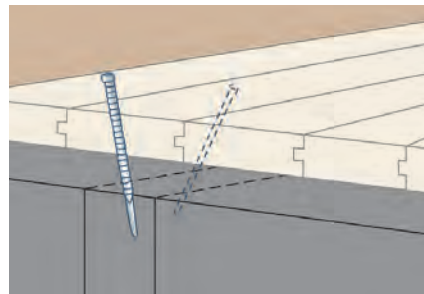
If the problem is below the flooring, drive shims into a gap between a joist and the subfloor, or add a cleat. If the joists themselves sag when the floor is walked on, stiffen them by adding a second board, called a "sister." If that does not do the trick, or if you see cracked joists or any that sag more than 1/2 inch, call a professional carpenter.

Three ways to silence squeaks from above

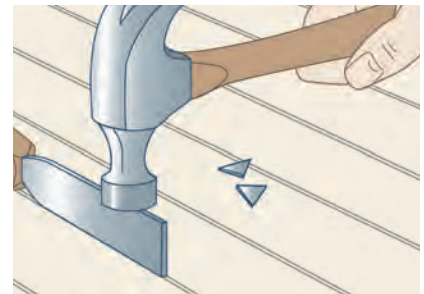
RE-SEAT To reseat loose boards before reattaching them, tap them sharply with a hammer and carpeted 2 by 4. As you tap, move in the direction shown in the inset below.



NAIL Drill angled pilot holes through the flooring, into the subfloor, and, if possible, into a joist. Drive finish nails or flooring nails, countersink their heads, and fill.



DRIVE POINTS Coat old-style triangular glazier's points with liquid graphite, then use a putty knife and a hammer to drive them between boards.

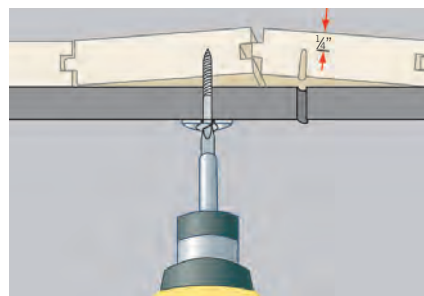


Three ways to silence squeaks from below

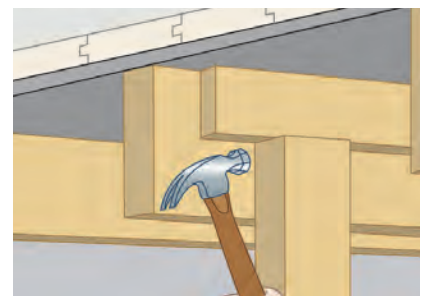
SHIM If you see a gap between the subfloor and a joist, drive shims every 3 inches or so into the gap using medium pressure only. Do not cause the floor to rise.

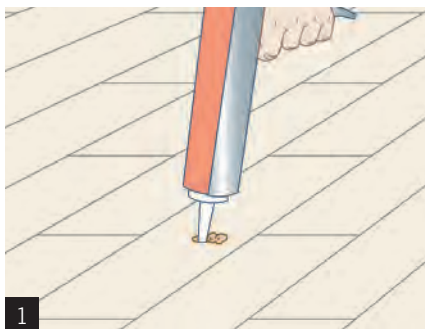


FASTEN WITH SCREWS Drill pilot holes, taking care not to poke through the flooring. Drive wood screws (1/4 inch shorter than the total floor thickness) with washers.



ADD A CLEAT Under a large loose area, mount a cleat against a joist. Wedge the cleat snugly against the subfloor and attach it to the joist with screws.





Filling with adhesive

1 If there is a gap under the flooring and face-nailing doesn't solve the problem, try gluing. Drill a $\frac{3}{8}$ -inch hole through the board and squirt flooring adhesive into the hole until it starts to ooze out.

2 Wipe away the excess adhesive. Fill the hole with a plug cut from a scrap of flooring or a short length of $\frac{3}{8}$ -inch dowel. Wipe away the squeezed-out adhesive, allow it to dry, then sand it smooth and dab it with finish.

WARPED OR BUCKLED BOARDS

If flooring boards buckle upward or are warped so they are not smooth and flat, the problem is moisture, whether from excess humidity, a damp crawlspace or an actual leak. Solve the moisture problem first and let the flooring dry completely. You may then be able to pull the

flooring down with nails or trim-head screws. If not, you need to call a flooring contractor.

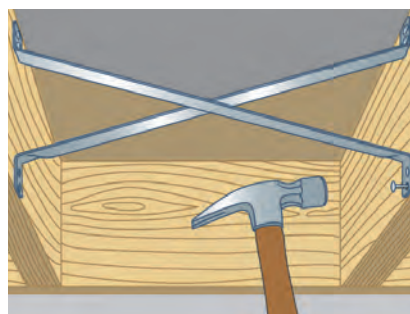
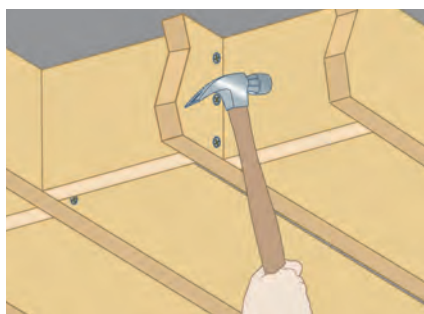
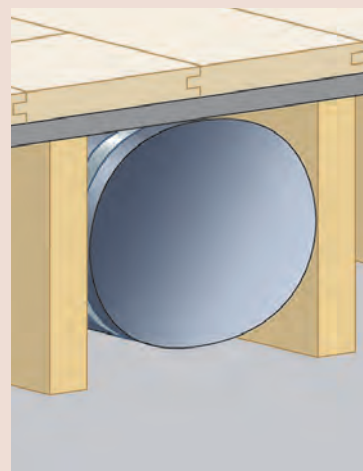
AMERISPEC® TIP

SQUEAKS UNDER CARPETING

If a carpeted floor squeaks, the solution is to drive nails or screws through the carpeting and the plywood subfloor and into joists below. Depending on the type of carpeting, you can usually drive finishing nails or finish-head screws right through the carpeting and their heads will not be visible. Otherwise, you may need to pull up the carpeting first.

LOOSE DUCTS OR PIPES

Sometimes ductwork or water supply pipes can cause squeaks. The solution may be to tighten straps, install new straps, or wedge insulation between the metal and wood surfaces.



Firming sagging or bouncy joists

ADD A SISTER To strengthen a joist, install a "sister" joist alongside it. Cut the sister out of 2-by lumber, making it as long as possible. Wedge it against the bottom of the subfloor and drive pairs of 3-inch screws every 8 inches or so.

USE BLOCKING To strengthen an entire floor, cut 2-by blocking, the same width as the joists, to fit snugly between joists. Tap the blocking into place between the joists so the pieces are offset from each other, then attach with nails or screws.

BRIDGING STEEL Bridging is not quite as strong as blocking, but is easier to install and will cut down on squeaks. Purchase bridging made to fit the spaces between your joists, usually $14\frac{1}{2}$ inches. Wedge each piece tightly, then attach with nails or screws.

replacing wood flooring

If some boards are severely scratched or stained, you may need to replace them. The instructions on these pages are for tongue-and-groove solid hardwood flooring. If you have laminate or engineered wood flooring, follow the same procedures. If you have plank flooring, you can usually pry loose a board without damaging its neighbor.

Too often, damaged tongue-and-groove flooring is repaired with a rectangular patch that stands out like a sore thumb because its joints are not staggered. Make a rectangular patch (as shown below) only if it will be covered with a rug or carpeting. A better approach is to remove boards or portions of boards so their ends are staggered in a way that blends with the surrounding floor. Because the pieces interlock, removing and patching tongue-and-groove flooring in this way is a time-consuming task that requires some skill.

PREPARING FOR THE REPAIR If you don't have any leftover flooring, buy replacement boards that match the species, width and thickness of the existing flooring. Sanding, staining, and finishing may require more work and time than the actual repair. You can try to finish the new boards before installing them, but it is difficult to achieve an exact match. It may be necessary to sand and refinish the entire floor (see pages 38–39).

If you need to replace more than one board, plan the patch so that you end up with staggered joints. You may choose to remove full-length boards. If a damaged board is very long, however, you might choose to replace only a portion of it. If you are removing a full board, skip steps 1 and 5 (opposite page).

For a professional appearance, all the cuts—both to the existing boards on the floor and to the replacement boards—should be neat and at a perfect right angle. Cut the

existing floor with a sharp chisel or with an oscillating multitool. A power miter saw works best for the new flooring, but you can achieve good results with a circular saw if you use a square as a cutting guide.

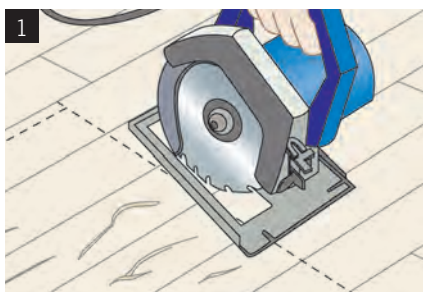


REMOVING A SINGLE BOARD

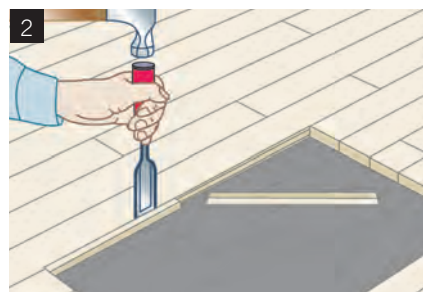
Using a circular saw, make two plunge cuts into the middle of the damaged board, cutting from one end of the board to the other. (Be careful not to cut into the adjacent boards.) Chisel down far enough to release each end. Pry out the central cutout section using the chisel. Now you can carefully pry out the grooved side and the tongue side.

Replacing a rectangular section

1 Use a framing square to mark the area to be cut. To prevent splintering, score the cross-grain pencil lines with a knife. Put a nail-cutting blade in your saw and adjust the depth to the board's thickness. Cut from the center toward the ends.

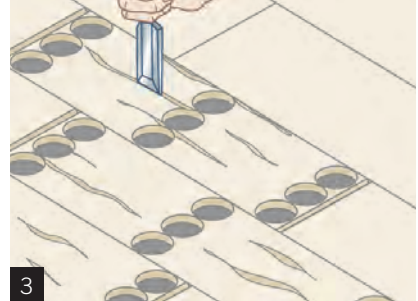
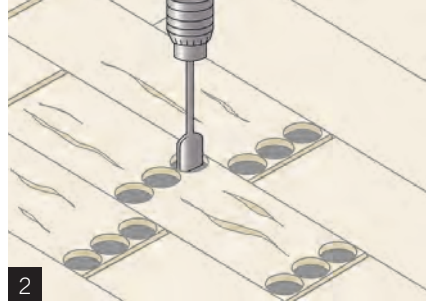
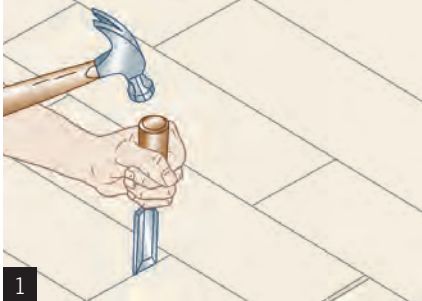


2 Finish the cuts with a chisel, then pry the interior boards up. Use a chisel to remove any stubborn remnants of old flooring. Remove or sink any exposed nails. Cut a piece of roofing felt or rosin paper to fit, then staple it into place.



3 Cut boards to fit snugly and blind-nail each into place. Remove the last board's tongue, use a woodblock to tap it down, drill pilot holes, and drive face nails. Countersink the nails, fill the holes with wood putty, and finish.



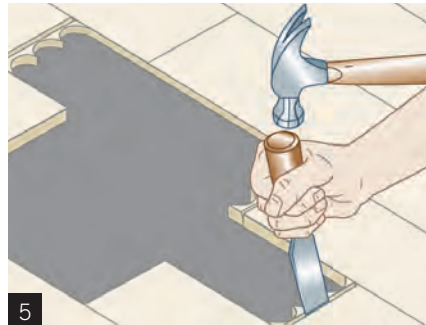


Weaving in staggered boards

1 Use a square and a knife to mark each cut line; this will prevent splintering. Hold a chisel with the bevel facing the area to be removed, then pound with a hammer, working back and forth to remove small chips until you cut about halfway through the board.

2 Bore a series of $\frac{1}{2}$ -inch holes across the width of the board just inside the cut lines. Take care that the holes do not cross the cut lines. Also bore a series of holes every 8 inches or so along the length of each board.

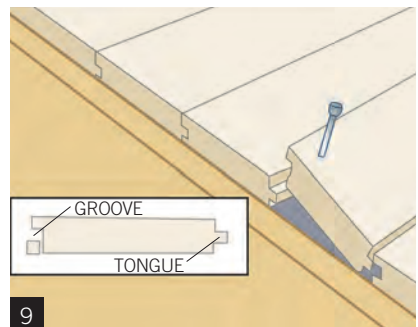
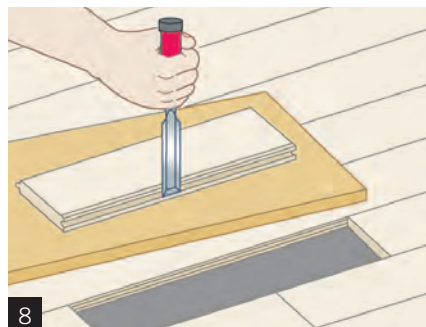
3 Use a 1-inch or wider wood chisel and hammer to split the defective areas. Pound with moderate pressure to avoid damaging adjacent boards. If the boards do not split, you may need to drill more holes.



4 Using a flat pry bar and perhaps a small woodblock for leverage, pull out the split portions of the boards. Take care that you do not split a board past the cut lines.

5 Use a wide, sharp chisel to trim the ragged edges from each cut board. If a cut is not clean or at a precise right angle, make a new cut just behind it. In some cases, you can use a circular saw to start the cut.

6 Staple roofing felt to the floor to minimize squeaks. Slip the first new board's groove over an existing one's tongue. Tap the board in place with a mallet and a scrap of flooring, then blind-nail.



7 To blind-nail, drill an angled pilot hole just above the tongue and drive a finish or flooring nail. Continue positioning boards. You will probably need to cut off portions of tongues, using a chisel or a table saw.

8 Whenever possible, install boards with tongues and grooves intact; this will allow you to blind-nail them. Where necessary, use a chisel to cut off a tongue or the area below a groove.

9 Wherever a tongue or the bottom edge of a groove has been removed, you must face-nail the board. Drill a pilot hole and drive a finish nail or a flooring nail so its head is at least $\frac{1}{4}$ inch below the surface. Fill the hole and finish.

sanding, finishing, and spot removal

Some wood floors are stained and then finished, but many have only a hard finish, which alone can change the appearance of the wood. Often this finish is an oil-based polyurethane, which tends to yellow after a year or two. In many parts of the country, oil-based poly is banned due to air-quality concerns. On some older homes, varnish was used. These factors can make color matching a challenge, so you may choose to sand and refinish the entire floor (see pages 38–39).

CLEANING AND RENEWING A WOOD FLOOR

Sometimes a dingy-looking floor can be restored to an attractive glow with a thorough cleaning, followed by an application of a finish such as polyurethane or floor wax. Whichever products you use, test them on an inconspicuous area before tackling the entire floor. If a section of the floor is bare of finish, treat it differently than the areas that have a finish; it is very easy to accidentally stain bare wood. Vacuum the floor thoroughly before

attempting any type of cleaning.

If you have a wax buildup, wash the floor with a solution of dish-washing detergent and water, or use a professional wax stripper. Work in 4-foot-square sections, cleaning and wiping up before you move on to the next section.

For minor scratches or an ugly finish, clean the floor using a product that is made specifically for hardwood floors. Some products simply clean, while others add a finish as they clean.

If the wood has a stain, sand the surface to remove any finish and get to the bare wood. Wearing gloves and protective clothing, mix a batch of wood bleach (oxalic acid) according to the manufacturer's directions. Pour the bleach over the stain, and let it sit for an hour or so. Rinse with a solution of 4 tablespoons of borax to 1 quart of water and let the wood dry. Bleach again if needed. (If bleaching does not remove it, you may have to sand the floor, as shown on pages 38–39.) Sand the area smooth, then apply a stain or finish.

AMERISPEC® TIP MATCHING STAINS

Spot-staining can be very tricky, as even slight differences in color will be apparent. Experiment on scrap pieces of flooring before applying stain to the floor. Sand the scraps as you will the floor, apply stain, wait a day, then apply polyurethane or another finish. (The finish often changes the color of a stain significantly.) Once you are sure of a good color match, you can start on the floor.



Finishing a repair

1 With wood putty, fill the gaps between the old and new boards, as well as any other gaps. Use putty that receives a stain, or a colored putty that matches the stain you will apply. Press firmly to push the putty deep into the floor.



2 Sand the patch so it is smooth and level with the surrounding floor. A vibrating sander works slowly, but it's easier to control than a belt sander. Unless the wood is very rough, start with 80-grit paper, then use 100- or 120-grit.



3 If you will use a stain, apply it with a paintbrush, wait a few minutes, then wipe away the excess. Wait a day, then apply a hard finish such as polyurethane. Let it dry, sand lightly, and apply another coat of polyurethane.

repairing laminate and parquet flooring

Many of the repair techniques on pages 34–35 apply to other types of tongue-and-groove flooring. Where you need to remove a tongue or the bottom edge of a groove, you must face-nail.

Most wood parquet tiles come prestained and sealed, so you do not have to sand and refinish

them. However, it is a good idea to apply acrylic sealer or polyurethane for added protection and to seal the joints between tiles.

LAMINATE FLOORING Laminate flooring is composed of pressed board with a hard resin coating. It is very resistant, but not immune, to scratches. Small dents and scratches may be

repaired with a touch-up kit. The planks are 4 feet long. Depending on the damage, you may choose to replace an entire plank, or make a cut and replace only a portion.

ENGINEERED FLOORING Sometimes referred to as “laminated,” this material is composed of plywood or pressed wood with a top layer of hardwood. Repairs are similar to those for a hardwood floor. Some types can be sanded and refinished once (see pages 38–39), but others have a veneer that is too thin.

Repairing a section of laminate flooring

1 Use a circular saw to cut out a portion from the middle that is about 1 inch from all edges. Complete the cuts with a sharp chisel. Pry this piece out. Next, make four short, angled cuts running from the cutout area to each of the corners. Complete the cuts using a chisel. Pry out the scraps.

2 Cut a new piece of laminate flooring to fit snugly into the cutout area. Use a circular saw or a tablesaw to cut off the edge below the groove. Test that this patch will fit. Apply glue to all the tongues and to the floor at each end. Slip the patch into place and weight it down for a day before walking on it.



PATCHING A HOLE IN LAMINATE FLOORING

Small areas of damage can be filled with laminate patching putty. Use a utility knife and a chisel to cut the hole (at least ¼ inch deep) and square up its edges. Squeeze putty into the hole. Using a putty knife, force putty down and scrape the surface. Wait an hour, then wipe the area with a damp cloth.

Replacing a section of parquet flooring

1 Set a circular saw to cut just through the tile. Make cuts in each direction across the tile. Take care not to cut an adjacent one.

2 Use a hammer and a wide chisel or a flooring scraper to pry the tile out piece by piece. Scrape the floor free of adhesive, which can be tenacious.

3 Use a chisel or saw to cut away the bottom edge of the replacement tile's two grooves, as well as one of its tongues. Trowel parquet tile adhesive onto the floor and set the tile.



sanding and refinishing a hardwood floor

A damaged or dingy hardwood floor can often be rejuvenated with sanding and refinishing. A medium-sized room can be sanded and stained in a day. Allow several more days to apply coats of protective finish. You will need to work carefully, especially when using a drum sander with heavy-grit paper, to avoid gouging the floor.

SHOULD YOU SAND Make sure your floor is a good candidate for a thorough sanding, which typically removes up to $\frac{1}{8}$ inch of wood. If the floor has only surface damage, consider an alternative to drum sanding (see tip, page 49).

Solid, $\frac{3}{4}$ -inch-thick flooring can usually be sanded up to three times. In an older home, the floor may have already been sanded once or twice. To check, examine the top

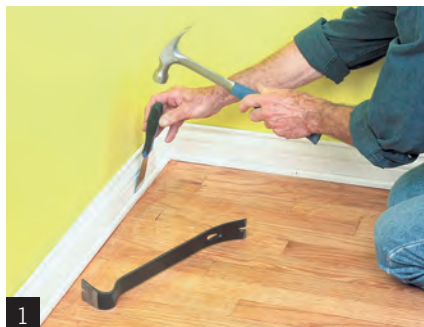
of the flooring in several places (check a damaged section or at the end of a board). If there is less than $\frac{1}{8}$ inch of wood above the tongue, there is not enough to sand.

High-quality engineered flooring can be sanded only once. Consider using a random-orbit floor sander instead of a drum sander.

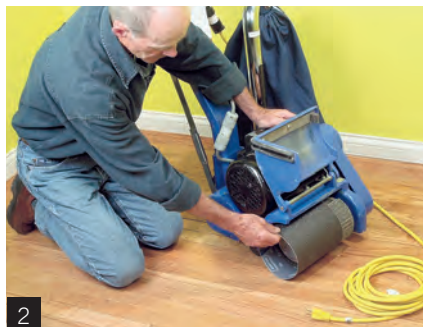
Water or pet-urine stains on a portion of the floor that is unfinished (lacking a glossy coat) are usually too deep to sand away; you will likely need to replace the flooring. Burn marks may also run too deep.

If a hardwood floor was covered with underlayment and another flooring material, removing the underlayment will reveal a grid of nail or staple holes. These holes may remain somewhat visible after the floor is sanded and finished.

THE RIGHT EQUIPMENT You can rent a drum sander that runs on 220 volts. It works quickly, but you will need to be careful to avoid damaging the floor. You will also need a 220-volt receptacle. A drum sander that runs on a standard 120-volt current is slower and safer. Buy sanding belts in three grits: typically 40, 60, and either 80 or 100. You will also need an edge sander to get near the wall and a pull-type paint scraper for tight spots and corners. The newer random-orbit floor sanders are slower, but much easier to use and don't require an edger. To clean up and prevent dust from settling in cracks, use a shop vacuum. To apply the stain and finish, use the type of brush and applicator recommended by the manufacturer. A pole sander speeds the job of sanding the finish between coats.



1 Make any necessary repairs to the floor (see pages 32–35). Remove the shoe molding and, if necessary, the baseboard. Sanding creates dust that seeps through small openings, so open a window and point a fan outside to expel the dust. Seal doors with masking tape and plastic.



2 At the rental store, ask for detailed instructions on the use of the drum sander, including how to load the sandpaper. Wear a face mask and ear protection. Equip the sander with 60-grit disks for the first sanding. It will take a few minutes to get the knack of keeping the machine flat and steady.



3 Tip the belt up and turn the sander on. Slowly lower the belt onto the floor, allowing the sander to pull forward. Do not allow the sander to remain in one place for even a second or it will dig into the floor. Overlap your passes by several inches. When the sander no longer sands effectively, change the belt.



4 Vacuum the floor thoroughly after each sanding. Examine the floor for exposed fastener heads. Countersink them to prevent damage to the sanding belt. Resist the temptation to skip one of the sandings. If you omit the medium- or fine-grit sanding, the floor will show visible sanding marks. Sand the surface a second time using the medium-grit paper.



5 Use an edge sander to sand right up to the baseboard, into the corners as far as possible and any other areas not covered by the drum sander. Wear a face mask and ear protection with this machine as well. And as with the drum sander, keep the machine moving at all times so as not to gouge the floor.



6 Where the edger cannot reach, use a paint scraper with a sharp blade. Apply strong downward pressure as you pull the scraper. Whenever possible, scrape with the wood's grain. When you must go against the grain, bear down with less force to avoid splintering the wood. Change the blade (or rotate it if you have a four-sided type) as soon as the going gets tough.



7 After the second sanding, vacuum thoroughly. Fill any holes with wood putty. Choose putty that is stainable and close to the desired finish color of the floor. If you are not going to apply stain, try to match the color of the raw wood. When the putty is dry, sand the floor one more time using 80- or 100-grit paper. At corners where you used the scraper, smooth the floor with a hand sander.



8 The floor must be dust-free. Vacuum thoroughly, wait a bit, and vacuum again. Then wipe the floor with a lightly water-dampened rag, or with a tack rag if you're using an oil-based finish. If you choose to apply stain, mix it thoroughly. Apply the stain with an applicator to an area about 10 feet square. Wipe away any excess with a rag. Work quickly and systematically so you never apply stain to an abutting area where stain has already dried.



9 After the stain has dried, apply two or three coats of polyurethane finish. Apply the finish carefully, using smooth strokes to avoid creating bubbles. An applicator (either synthetic or lamb's wool, depending on the finish) is the best tool for this job. Allow the finish to dry, then sand lightly using 220-grit paper. Vacuum thoroughly and apply one or two additional coats of finish.

AMERISPEC® TIP

ALTERNATIVES TO DRUM SANDING

If the damage or staining on your floor is not severe, consider this pair of options. To remove a floor's finish and perhaps some shallow scratches, rent a janitorial-type flooring buffer. Buy some flooring screens and a pad to hold them. Start with a heavy screen, such as 60-grit, and finish with a lighter 80- or 100-grit screen. You may find it takes a few minutes to get the hang of operating the buffer. Replace a screen once it stops removing material from the surface of the floor.

A random-orbit floor sander removes shallow scratches as well as the finish. It is safer to use than a drum sander because there is no danger of gouging the floor. Begin with 40-grit paper, then use 80-grit, and finally 120-grit.

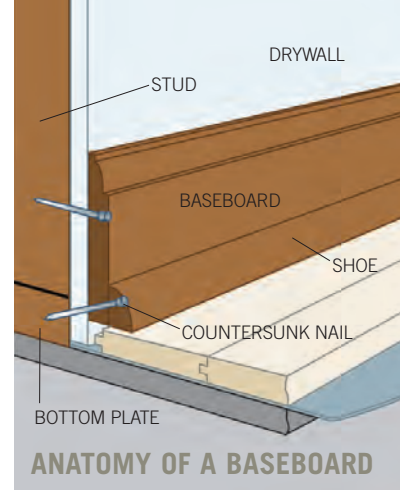
replacing baseboard and shoe molding

Installed where the floor and walls meet, baseboards (also called base moldings) and shoe moldings hide uneven floor and wall joints and protect walls from damage caused by foot traffic, furniture, and cleaning tools. Often the boards become so dented or marred that they need to be replaced for appearance's sake.

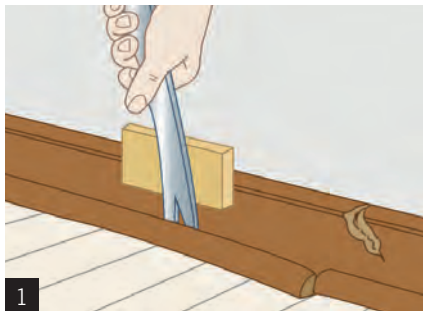
The directions below show how to remove and replace lengths of

baseboard and shoe molding that have square ends. For lengths that run into corners, you'll have to cut mitered or coped ends, as shown on the opposite page.

BUYING MATERIALS When you shop for replacement sections, take old pieces with you to ensure a good match. Many wood baseboards and shoe moldings come in standard shapes (called profiles), but some

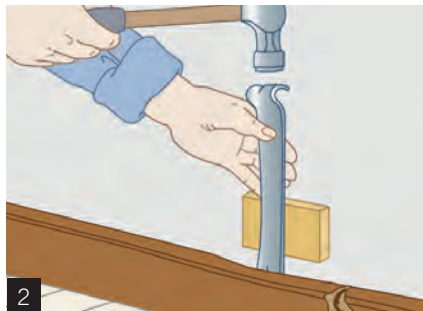


have profiles that are no longer made. If that is the case with your baseboards, either use standard moldings (perhaps combining two or more) to approximately mimic your moldings, or have a millwork shop make new pieces that match.



Replacing damaged baseboards

1 Insert the thin end of a broad-bladed pry bar between the shoe molding and baseboard. Loosen the molding by prying outward. Pull the molding free and remove the nails.



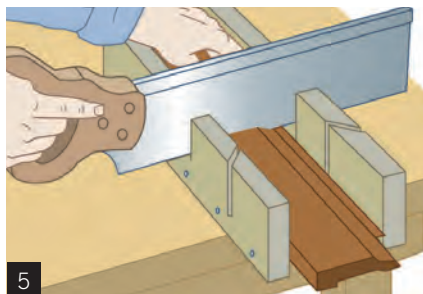
2 Place the thin end of the pry bar between the baseboard and wall and pry outward to make a gap. Use a woodblock to protect the wall.



3 Insert wooden wedges into the gap as you pry. When the baseboard is loose, pull it free. Remove any remaining nails from the baseboard and wall with pliers or a hammer.



4 Measure the replacement baseboard and shoe molding against the damaged pieces and mark cutting lines with a pencil. (For corners, see opposite page.)



5 Use a miter box and backsaw to cut the replacement baseboards and shoe moldings. Saw the pieces on the waste side of the cutting lines.



6 Position the baseboard and drive 8d or 6d finish nails at each stud location. Position the shoe molding and nail it into the floor or the bottom plate.

REPLACING BASEBOARDS AND MOLDINGS

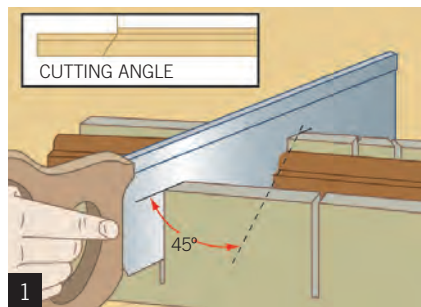
If the molding is painted, cut a line between the molding and the wall with a utility knife so paint won't chip when you pull away the molding. To protect the wall, use a wood block behind the pry bar as you work, and pry only at studs.

Wherever possible, hold a new board in place to mark it for cutting. Where necessary, use a tape measure. A power miter saw makes it easy to achieve precise cuts, but you can also get good results using a miter box and backsaw. Practice on scrap pieces until you are confident you can make straight cuts.

CUTTING AND FITTING CORNERS When replacing two pieces that meet at an outside corner, miter the ends of both pieces and install them as shown (above right). If the baseboards you're replacing meet at an inside corner, cope the end of one replacement to fit over the other (right). Cut and fit the ends of both base shoe pieces in the same way.

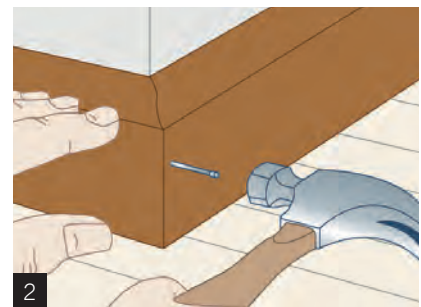
NAILING INTO FRAMING MEMBERS

Removing old baseboards will likely make it clear where the studs are. Lightly mark the wall for stud locations just above the top of the new molding. Make sure the nails will sink at least an inch into a stud or bottom plate. In most cases, 6-penny (6d) nails are long enough. However, if the baseboard is thick or if you have thick plaster walls, you may need longer nails. To prevent wood from cracking, drill pilot holes for all nails that are 3 inches or closer to the end of a piece of molding.

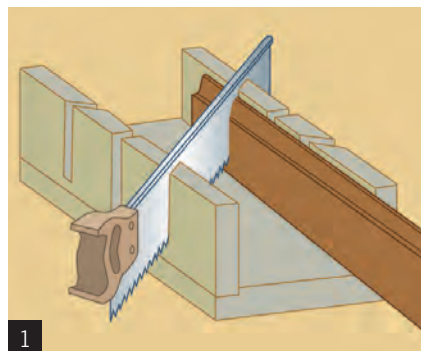


Mitering an outside corner

1 Measure for the new pieces and draw cut lines. Use a miter box and a backsaw to cut each piece of the replacement baseboard at a 45° angle.

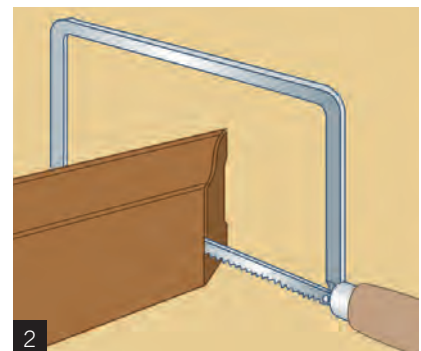


2 After nailing one new piece into place, butt the end of the second section against it, drill pilot holes, and drive 4d or smaller finish nails through the joint.

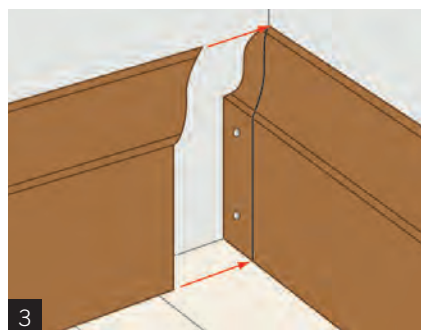


Coping an inside corner

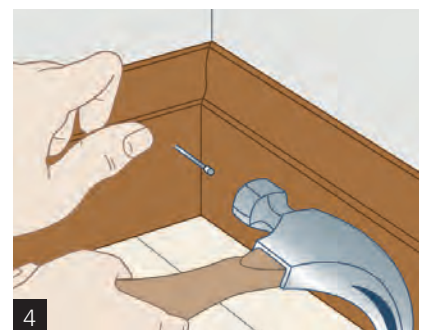
1 Cut one piece straight and install it in the corner. Cut the other piece (which will be coped) at a 45° bevel.



2 Use a coping saw to cut along the molding's profile. Hold the saw at slightly more than a right angle to the board as you cut.



3 Hold the coped piece in place and check the fit. You may need to fine-tune the cut using a knife or a rasp. Once the fit is tight, cut the other end of the board.



4 Drive 8d or 6d finish nails through the baseboard and into the studs and bottom plate. Set the nails, fill the holes, and finish.

repairs to resilient flooring

Vinyl tiles and vinyl sheet flooring are the most common resilient materials.

Others include cork, linoleum, and rubber tile. No-wax vinyl has a shiny top surface that can be tricky to repair. Commercial tile, with flecks of color that run all the way through, is a little easier. For small scratches or dents, you can buy fillers and repair kits at home centers.

Resilient flooring will telegraph even minor imperfections in the underlayment that it rests on. If you see bumps or ridges and valleys, you probably need to replace or smooth the underlayment.

If you cannot find an exact match for a damaged resilient tile or section of sheet flooring, remove a tile or cut out a section from under the refrigerator or some other inconspicuous place.

There are two types of vinyl-floor adhesive. With one type, typically used for sheet flooring,

CLEANING RESILIENT FLOORING

Regularly vacuum or sweep resilient flooring, then damp-mop it with clear water. Avoid swamping the floor, as water can seep into seams and damage the wood beneath. Keep commercial tile sealed with floor wax. When it loses its waxy sheen, stains will soak in and be difficult to remove.

No-wax flooring will in fact need no wax for a number of years, depending on its quality. Avoid one-step clean-and-wax products, which can dull the shine of a no-wax finish. But over time, the no-wax surface will erode. Apply a finish made for renewing no-wax floors.

If you encounter a stain, first try to remove it by wiping it with a clean cloth moistened with liquid

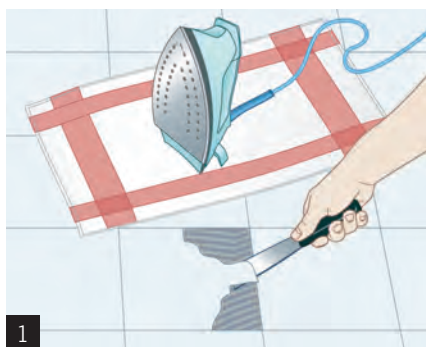
floor detergent. For heavy residue, use a soft nylon scrubbing pad. Avoid using abrasive scouring pads on resilient flooring. Before using any cleaning product, test it on an inconspicuous area.

If detergent doesn't remove a stain, try the following products one at a time and in this order: rubbing alcohol, 1:10 solution of ammonia and water, liquid chlorine bleach, turpentine or mineral spirits, lacquer thinner, and nail polish remover or acetone.

Apply each product with a clean cloth, turning the cloth frequently. Don't walk on the treated area for 30 minutes. When the stain is gone, rinse the area with water and let it dry. Apply new floor finish.

you set the material in place while the adhesive is wet, then wait a day or so for the adhesive to dry. The other type, commonly used for

tiles, is allowed to dry to a tacky finish before the flooring is applied.

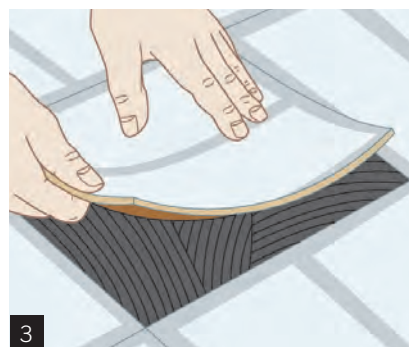


Replacing a damaged tile

1 If you cannot simply pry a tile up with a putty knife, soften the adhesive by placing a cloth on the tile, then pressing with a hot clothes iron. Scrape the floor smooth once the tile comes up.



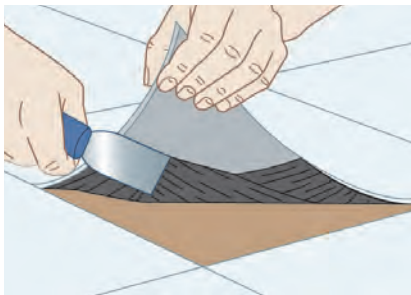
2 Spread a thin, even layer of vinyl-floor adhesive on the subfloor using a small-notched trowel of the size recommended by the adhesive manufacturer. Avoid getting adhesive on adjacent tiles.



3 Butt two adjacent edges of the new tile against two adjacent tiles, matching the pattern, if any. Press the tile into place and remove any adhesive smudges with mineral spirits.

Three repairs for surface damage

CURLED TILE Soften the adhesive with an iron and cloth as shown on the opposite page, step 1. Gently lift the corner and scrape the adhesive off the floor with a putty knife. Spread a thin coat of adhesive, let it become tacky, and press the tile corner back into place.



BUBBLE Following a line in the pattern if possible, slit the bubble edge to edge using a utility knife. With a putty knife, force a small amount of all-purpose flooring adhesive inside. Press flat and weight the area overnight.



SMALL HOLE OR GOUGE Either buy a commercial filler, or make your own by mixing dust from leftover flooring (use a food grater) and a few drops of clear nail polish. Mask the surrounding area and apply the filler. When it dries, buff it with fine steel wool.



AMERISPEC® TIP

SEAL THE SEAMS

If you have sheet flooring with a seam where two pieces join, apply seam sealer every year or so to keep the two pieces from coming apart. Sealer is available at home centers and hardware stores.

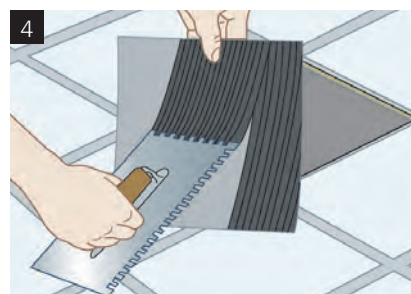
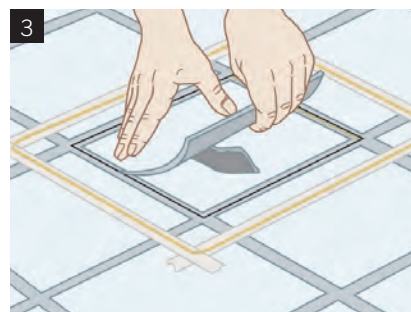
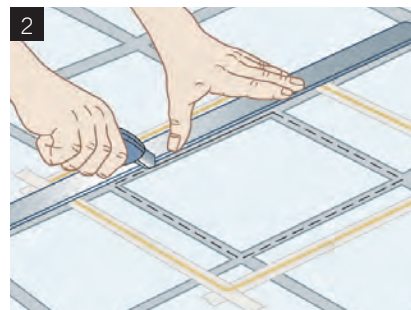
Patching sheet flooring

1 Choose a section to replace that follows a line in the pattern so the seam will be less visible. Cut a piece of leftover flooring that matches the floor pattern and is larger than the section by at least 2 inches on each side.

2 Attach the piece to the floor with masking tape, carefully matching the pattern. Using a straightedge and a very sharp utility knife, cut through both the patch and the flooring.

3 Set the patch aside and make a diagonal cut across the damaged flooring. Use a putty knife or a chisel along this cut to pry up the damaged flooring and scrape away the adhesive.

4 Test that the patch will fit snugly; you may need to trim it with a rasp or handplane. Spread adhesive on the back of the patch with a notched trowel. Press the patch into place, clean away excess adhesive, and weight the area overnight.



AMERISPEC® TIP

POPPED NAIL

If a nail head leaves an impression in a vinyl floor, first use a nail set and hammer to pound it back in. The set will leave a small hole, which you can fill with seam sealer. If the nail pops up again, slice through the vinyl and pry out the nail with a flat pry bar. Reglue the vinyl and apply seam sealer.

ceramic and stone floor tile

This page shows how to replace one or two damaged floor tiles. If more than a few floor tiles have cracked, it is likely that either the tiles are not strong enough or the substrate is not firm enough. You may need to tear up all the tiles and start again. If whole tiles are popping out, the adhesive is not strong enough. Remove the tiles, scrape away the old adhesive, and set the tiles in a bed of thinset mortar.

If the grout is cracking or chipping but the tiles are fine, the grout

was likely not mixed with latex additive, so it is brittle. Remove the grout with a power tool (see page 24). Apply new grout that is polymer or latex reinforced.

Grout that is dingy but sound can usually be restored with grout

cleaner. You can also purchase grout coloring agents that will transform the color of your grout. Once the grout is the color you desire, be sure to apply sealer regularly.



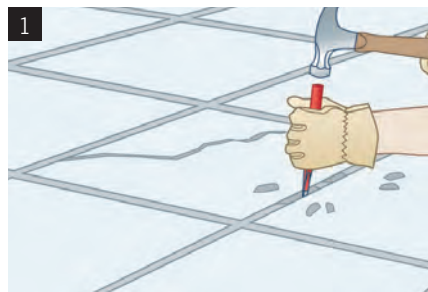
AMERISPEC® TIP

REMOVING STAINS FROM FLOOR TILE

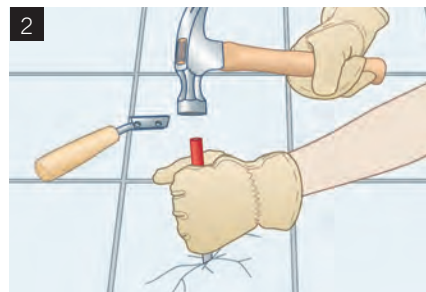
A general-purpose tile cleaner will handle most stains. To remove food or drink stains or ink, first scrub with hydrogen peroxide, then laundry bleach. For oil-based stains such as paint or tar, first try mineral spirits, then paint remover. To remove rust, scrub with rust remover, then wash with an ammonia-based household cleaner. Clean whitish mineral deposits with a lime-deposit cleaner.

Replacing a ceramic floor tile

1 To avoid cracking adjacent tiles, first remove the grout around the damaged tile. You can try a grout saw (see page 24) but will likely need to tap the grout with a hammer and a small cold chisel.



2 With a hammer and cold chisel, strike the center of the tile until it cracks. Pry out the tile shards. If the tile does not crack readily, use a drill with a masonry bit to bore holes across the tile, then chip.



3 Use a putty knife or a wide cold chisel to pry and then scrape out all the mortar and grout from the area. Vacuum up the dust, then clean with a damp cloth. It may help to use a grout saw to clean the edges.



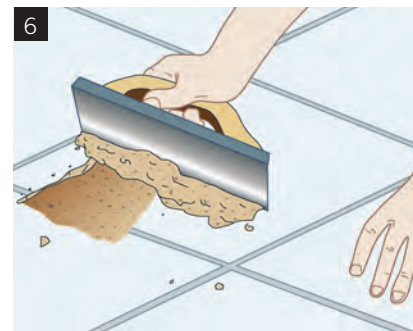
4 Test that the tile and mortar will sit at the right height. Mix a small batch of latex- or polymer-reinforced thinset mortar. Using a square-notched trowel, apply the mortar to the back of the tile.



5 Press the tile into place. Check that it is level with the surrounding tiles, then wipe away any mortar that oozes out along the edges. Make sure all the grout lines are the same width. Allow to dry overnight.



6 Mix a small batch of reinforced sanded floor grout and apply with a grout float. First press the grout into the joints, holding the float nearly flat. Then tilt it up and scrape. Clean with a damp sponge.



carpeting

Carpeting is usually attached to the floor via tackless strips (also called tack strips), which are pieces of wood installed around the perimeter of the room with barbs that grab the underside of the carpet. Carpet installers use special tools to stretch the carpet taut before tapping it to the tackless strips. You can usually pull up your carpeting (for example, to hide a telephone wire) fairly easily if you

grab it with a pair of pliers near the wall and pull up.

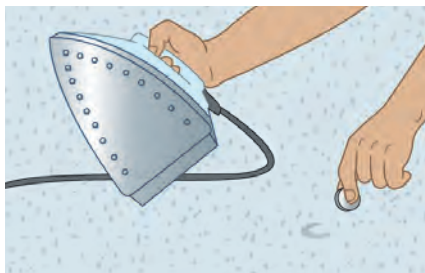
In some cases, especially in a tricky area like a stairway, carpeting is attached with carpet tacks, small nails driven through the carpeting. Heat-activated carpet tape is usually used to join two pieces of carpeting, such as at a doorway.

Most modern carpeting has a stain-resistant finish that repels stains. To remove stains, first try products made for carpet spot removal. If you have pet stains, apply a protein digester enzyme

treatment, typically sold in pet supply stores, then blot with a damp cloth. To remove pet odors, sprinkle baking soda, wait half an hour or even overnight, then vacuum.

To deep-clean a carpet, rent a rotary shampoo machine or a steam cleaner. Take care not to overwet the carpet, as that can cause discoloration or even shrinkage.

A few simple repairs are shown below. If a carpet is torn or ragged, or if it is wrinkled because it is not pulled taut, call in a professional for repairs or install new carpeting.



Three carpet repairs

INDENTATION If a furniture leg has caused a depression, try placing an ice cube on it; as it melts, the fibers will rise. Or hold a steaming iron just above the surface, then rub with a coin to raise the fibers.



LOOSE CARPETING NEAR A WALL If carpeting is loose and perhaps curled up at the edge of a room, it has likely come free from the tackless strip below. Using a rented knee kicker, pull the carpet taut, then tap it down with a hammer.



GAP AT A SEAM If carpeting has come loose at a seam, rent a carpet iron and purchase some heat-activated tape. Remove the old tape, set the new tape in place, and heat with the iron while you press the pieces together.



Piecing in at a damaged area

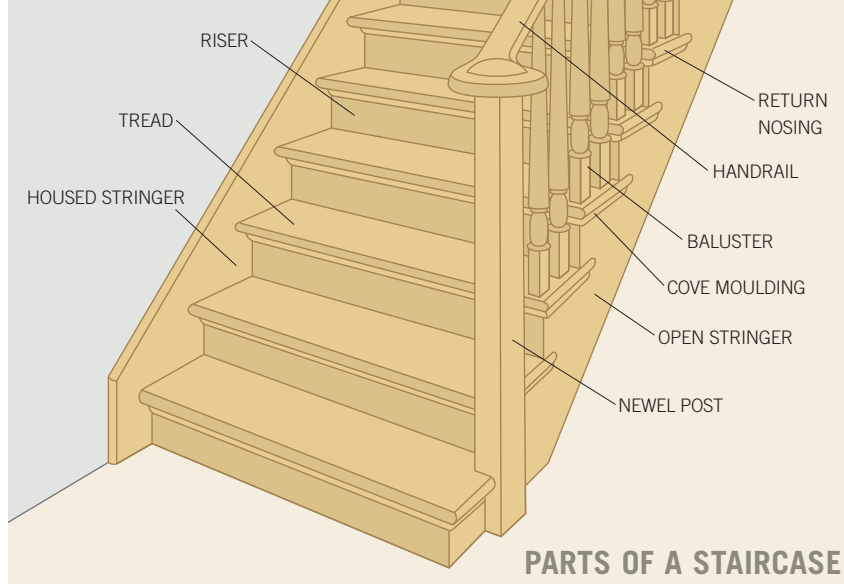
1 Place a scrap of replacement carpeting upside down on a piece of plywood and use a straightedge and utility knife to cut a patch that is a few inches larger than the damaged area in each direction.



2 Position the scrap over the damaged area with its weave in the same direction as the carpeting. Use it as a pattern to cut the carpet. Test the fit. If you need to trim the patch, use scissors.



3 Apply double-sided carpet tape around the hole so it will grab both the existing carpeting and the patch. Apply a small amount of construction adhesive along the sides, then set the patch into place.



If the stairs are accessible from underneath, work on them from below so your repairs won't show. Wear eye protection and provide yourself with plenty of light. Have a helper walk on the stairs while you pinpoint the problem areas.

BALUSTRADES

Balustrades consist of a handrail (and sometimes a lower, subrail), balusters, and one or more supporting newel posts. Wear and tear can weaken the joints, resulting in loose handrails, balusters, or posts.

Methods for tightening loose parts involve inserting shims or securing with screws. If you're using screws, drill pilot holes for them to prevent the wood from splitting.

If a newel post is loose and the measures shown do not solve the problem, call in a carpenter.

stair repairs

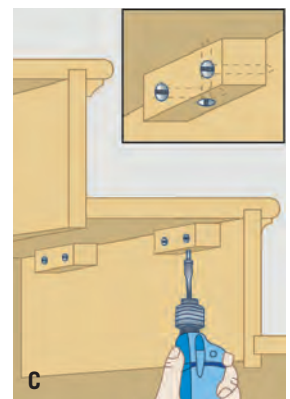
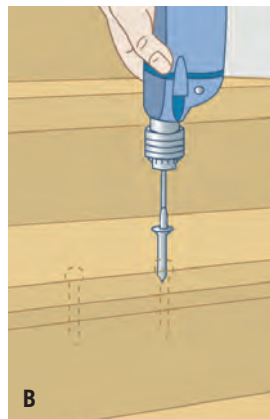
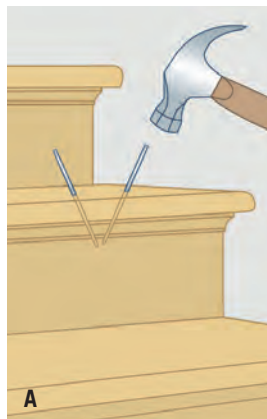
For a cutout illustration of a stairway's construction, see page 31. Squeaks are usually caused by a loose tread rubbing against a riser, a stringer, or a nail. Treads come loose when joints open as a result of shrinkage or when supporting blocks or nails work loose.

If the noise comes from where you step, concentrate your repair efforts there. If the noise comes from one side, or if it comes from the rear of the tread when you step at the front, first secure the place where you step. Then move to the apparent source of the noise.

Five ways to fix squeaky stairs

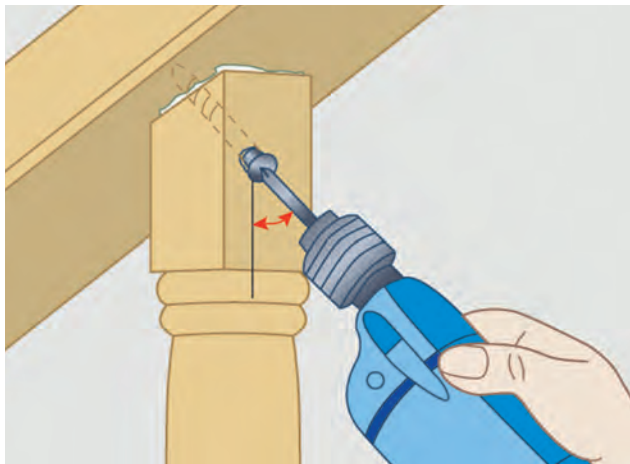
FROM ABOVE Drive and sink finish nails into angled pilot holes drilled through the tread into the riser (A), then fill holes with wood putty. If you prefer screws, use trim-head screws and drill a pilot hole first (B). Then fill the holes with putty or wood plugs.

FROM BELOW Tap glue-coated wedges between the tread and the riser, using a hammer and a small block of wood (A). Install metal brackets under the tread and riser (B). Glue and screw woodblocks under the tread and against the riser (C). Make sure screws are not too long. Their points should remain at least $\frac{1}{8}$ inch beneath the face of the tread or riser.



How to tighten loose balusters

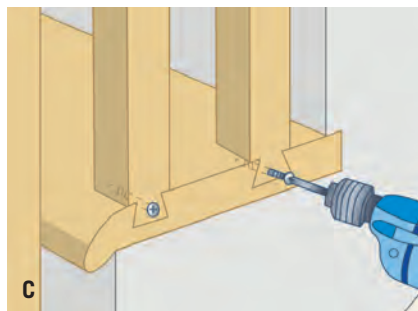
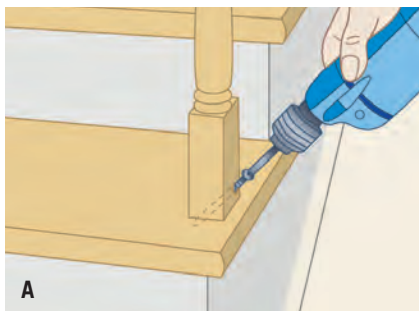
BALUSTERS NAILED TO HANDRAIL Drill an angled pilot hole through the baluster and into the handrail. Drive in a trim-head screw coated with glue. Fill the hole.



AMERISPEC® TIP SHIMS AND SCREWS

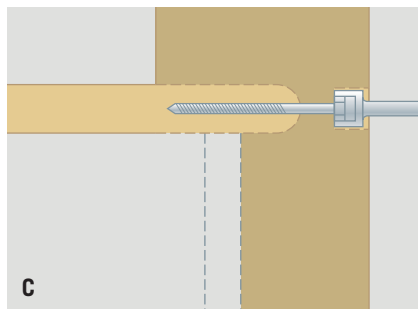
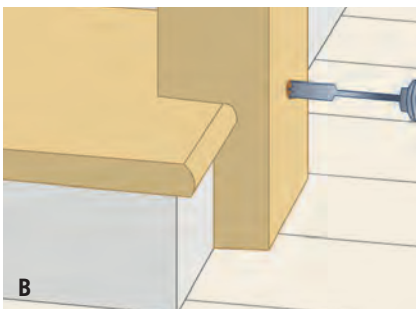
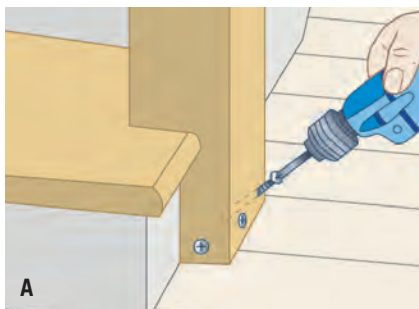
Avoid cedar shims, which are soft, and composite shims, which will not stick to glue. Use pine or, preferably, hardwood shims, often called wedges. Use carpenter's wood glue or polyurethane glue to hold them in place.

If you're installing screws through finished faces, use trim-head screws, which have a smaller head. This means a smaller hole that can be filled with putty. But you will need a special bit, or driver, for these screws. And as an alternative to lags, consider some of the high-tech structural screws now available at hardware stores and home centers. Some of these screws don't even need a pilot hole to prevent the wood from splitting. They make their own.



BALUSTERS NAILED TO TREADS Drill an angled pilot hole through the baluster and into the tread, then drive a trim-head screw tightly (A). Fill the hole with wood putty, sand smooth, and finish.

BALUSTERS DOVETAILED TO TREAD Pry off the return nosing with a putty knife or chisel (B). Drill a pilot hole through the dovetail into the tread. Apply polyurethane glue or epoxy around the dovetail, then drive a screw (C). Replace the nosing.



Tightening a loose newel post

SCREWS INTO THE FLOOR Drill a counterbore first, then drill angled pilot holes through the base of the post and into the floor. Apply polyurethane glue between the post and floor and then drive wood screws (A). Fill the holes with wood plugs, dowels, or putty, then sand and finish.

LAG INTO THE TREAD Use a $\frac{3}{4}$ -inch spade bit to drill a $\frac{3}{4}$ -inch-deep hole into the newel post (B). With a $\frac{7}{32}$ -inch bit, extend the hole through the newel into the tread. Use a $\frac{5}{16}$ -inch bit to enlarge the hole through the newel only and drive in a $\frac{5}{16}$ -by-4-inch (or longer) lag screw (C). Glue in a dowel or other plug, sand, and finish.

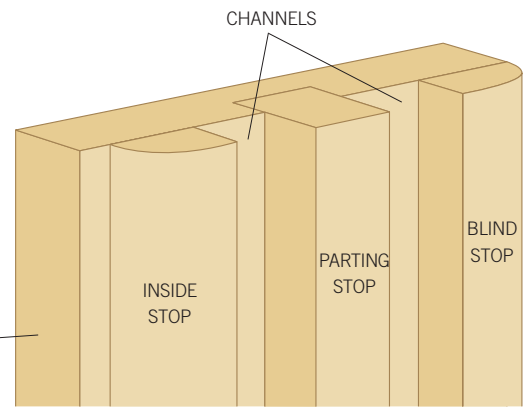
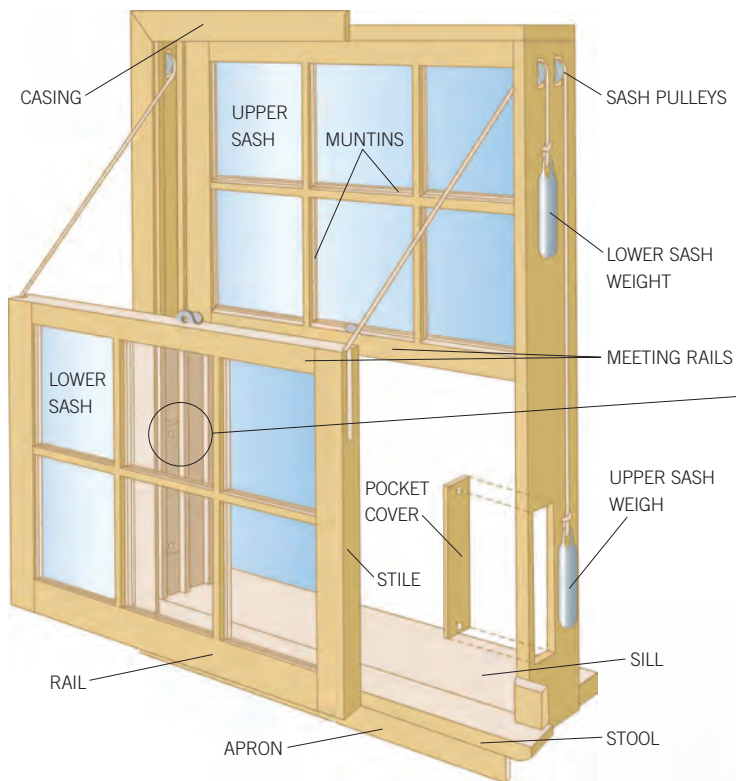
windows, doors, and cabinets

Windows and doors open to admit light, air, and people, and they must also close tightly to seal out the elements. This is a demanding assignment, so it's not surprising that windows and doors often need repairs. Moving parts that rub against each other can become worn, parts that are exposed to rain and snow can deteriorate, and hardware can wear out. This chapter will help you solve the most common window and door ailments.

MAINTAINING WINDOWS AND DOORS It is common for windows and exterior doors to leak air—and add to your energy costs. Even if you have single-glazed windows, most energy loss is probably through unsealed gaps rather than through the glass. Watch closely as you close a door or window to see if it is leaking anywhere. On a windy day, hold a piece of plastic food wrap up to a closed window or door to reveal any air movement. Small gaps around siding, trim, and drywall can be sealed with caulk; for larger gaps, use spray foam, preferably the non-expanding type. Installing new weather stripping may dramatically increase the energy efficiency of a door or window.

Keep exterior wood surfaces well sealed with paint (see pages 114–115 for complete instructions on prepping and painting exteriors). Peeling or cracks will let in moisture and damage wood siding. Take care when you paint a window or door, as buildup can cause moving parts to stick or create uneven seals. You might need to scrape or sand away existing paint before applying a new coat.

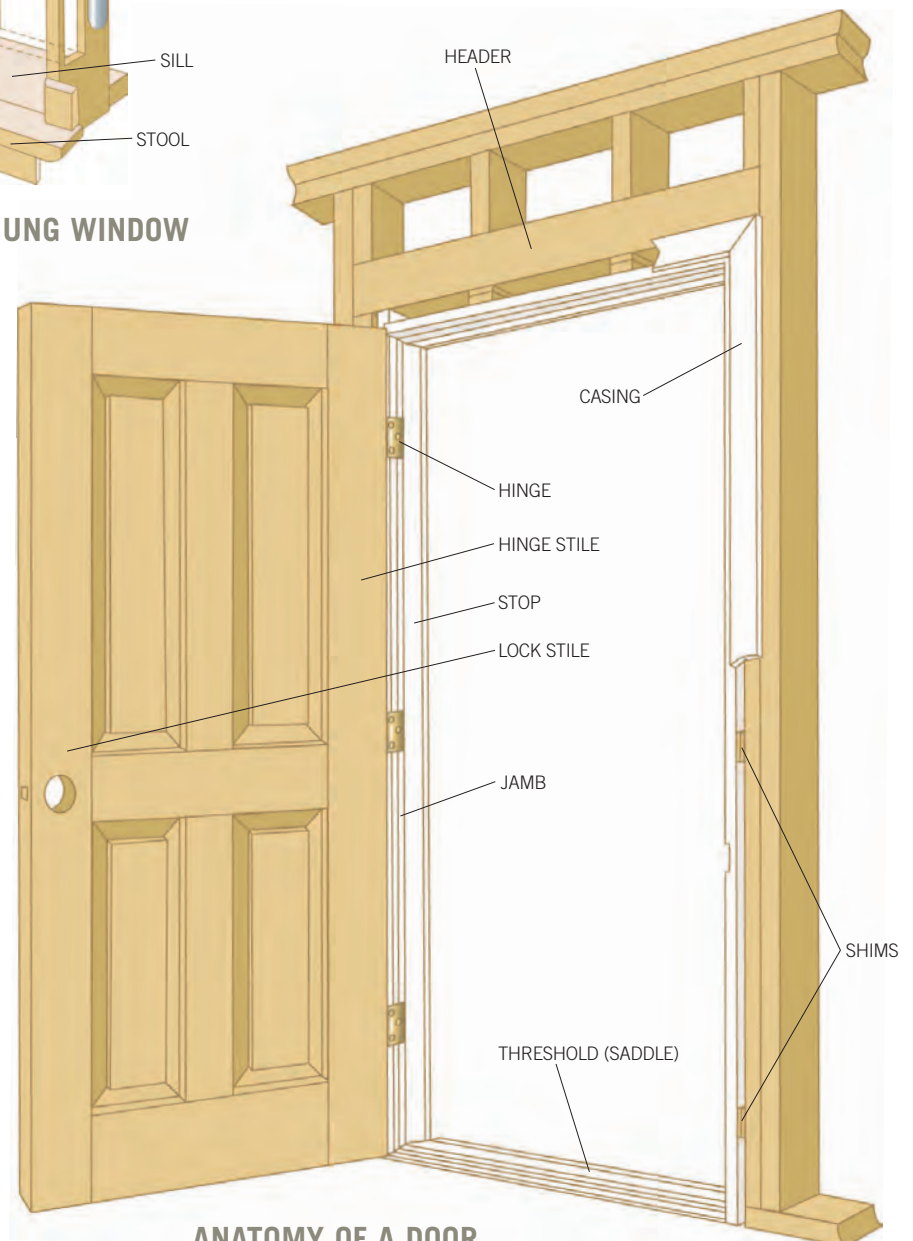
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WINDOW FRAME DETAIL

ANATOMY OF AN OLDER DOUBLE-HUNG WINDOW

REPLACEMENT DOORS AND WINDOWS If you live in a cold climate, often the best way to increase the energy efficiency of windows is to install storm windows. If a window or door is in bad shape, replacement may be the solution. You can attempt the installation yourself, if you have good carpentry skills, but first get a professional to quote you a price. Whether you buy storm windows or replacement windows (or doors), don't buy the cheapest units, as they are easily damaged and do not seal well. Get a solid warranty and monitor the installation closely.



ANATOMY OF A DOOR

replacing broken glass

Replacing small panes of broken glass in wood windows is not difficult. When handling new or broken glass, wear heavy gloves, a long-sleeved shirt, and safety goggles. Some windows (and doors) require tempered glass for safety reasons. If the broken pane shattered into many small pieces, it was probably tempered and should

be replaced with the same.

You can bed new glass in caulk, but it's usually easier to use conventional glazing compound (also called window putty). Knead the compound with your fingers to warm it up and make it easier to work. Once it's installed, let it dry for a week, then paint the glazing compound, allowing the paint to overlap the

glass slightly for a good seal.

Because panes larger than 2 by 3 feet are awkward and dangerous to handle, consider hiring a professional installer.

You can cut glass yourself, but it's easier and safer to have a hardware store or glass shop cut it for you. Order it $\frac{1}{8}$ inch smaller in height and width than the opening.



Replacing broken glass

1 Wearing safety glasses, tape the cracked pane with a crosshatch of duct tape to prevent glass shards from falling out as you work. When you're finished, you can tape newspaper to the inside of the window to help catch broken glass.



2 Use a 5-in-1 tool to remove the old window putty. If necessary, warm the putty with a heat gun, but be careful not to break adjacent panes or scorch the frame (keep a fire extinguisher nearby).



3 Remove broken glass and pry out metal glazier's points. Scrub the rabbeted area of the window frame with a wire brush. Dust it off, then use a small brush to apply a thin coat of linseed oil to the rabbet, where the glass and compound will go.



4 Glazing compound should be at room temperature or warmer. Roll it into a very thin rope with your hands and press it into place with your thumb. Use a scraping tool to press the putty firmly into place so it will seal all around the glass.



5 Install the pane and secure it by pressing glazier's points into place. Use two points on each side for small panes and one point every 4 to 6 inches for larger ones. Be careful not to push against the glass, as the pressure could crack it.



6 Roll glazing compound into a rope about $\frac{3}{8}$ inch thick. Use your thumb to press it firmly into place. Dip a putty knife in linseed oil and use it to smooth the compound. Make sure the compound is not visible from the inside.

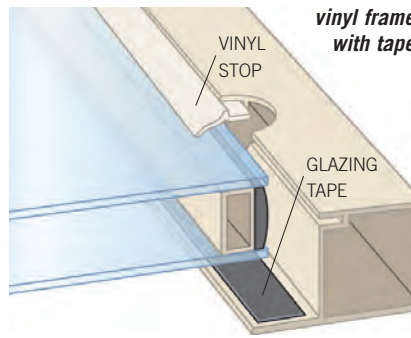
RESTORING OLD GLAZING COMPOUND If glazing compound does not touch the glass, it is not sealing out air and moisture. If compound is cracked, peeling, or missing in spots, use a putty knife or glazing knife to scrape away any that is at all loose. Apply compound to the resulting gaps following steps 3–6 on page 50. If the putty is stuck fast to the wood but there are gaps between the putty and the glass, seal the gaps with exterior caulk.

CUTTING AND CARRYING

TWO GOOD TOOLS A 2-in-1 glazier's tool has a solid scraper for cleaning out old putty and driving points, and a V-shaped blade for smoothing new compound. The groove allows excess compound to ooze out. A 5-in-1 tool also scrapes and drives points, plus it quickly opens paint cans and cleans rollers.

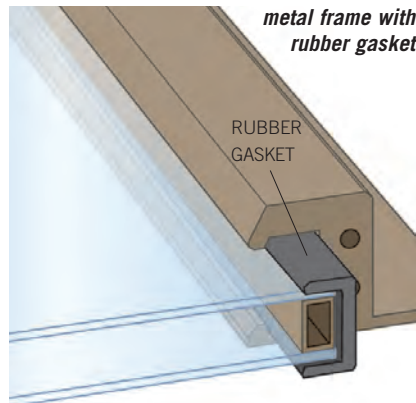


DUCT-TAPE GLASS HANDLE To easily and safely transport small panes of glass, use a strip of duct tape, about 8 inches long, to make a handle. After removing the handle, clean the glass with mineral spirits.



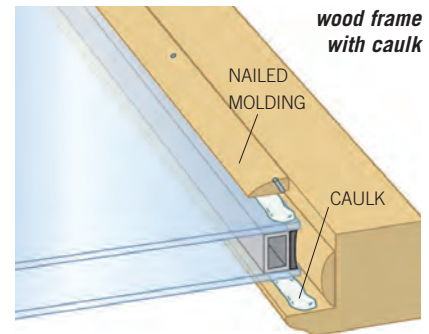
OTHER WAYS TO SEAL WINDOWS

VINYL STOP AND TAPE Many vinyl windows are held in place with a vinyl stop and sealed with glazing tape, which has a rubber surface. To reseal a window, pry out the stop and purchase replacement glazing tape. Apply the tape, set the glass on it, and press the stop back into place.

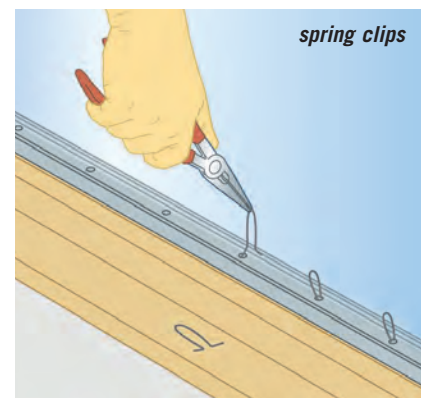


RUBBER GASKET Many metal frames have a rubber gasket that runs around the perimeter of the glass and fits snugly into the frame. To take out the glass, remove the screws and disassemble the metal frame. Buy a replacement gasket and either wrap it around the glass or press it into the frame, then reassemble.

WOOD STOP AND CAULK On some wood frames, the glass is held in place with small strips of molding nailed in place rather than with glazing compound. To remove the glass, pry out the molding strip and scrape away the old caulk. Apply a thin coat of silicone caulk, press the window into place, apply another layer of caulk, and reattach the trim. Take care not to hit the glass with a nail.



SPRING CLIPS On some metal frames, the glass is held in place by spring clips. To get at them, you may need to first pry out a thin strip of metal. Use long-nose pliers or a screwdriver to remove the clips, then replace the glass and reinstall the clips. You may choose to apply caulk to seal the window tightly.



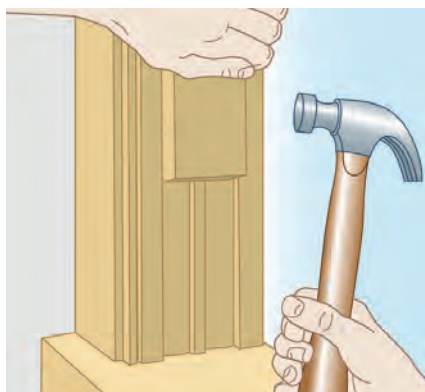
fixing old double-hung windows

A double-hung window (see page 49) has two sashes that move up and down. In many older homes, the upper sash has been painted or nailed shut, which is fine as long as you can clean the window from the outside. Windows made before WWII typically use a pulley-and-weight system.

As a wood sash ages, it may no longer move freely. A simple sash or stop repair can often restore a window to good working order. If a sash is temporarily stuck because of high humidity, a change of weather may correct the problem. If a sash moves reluctantly, clean its channels. Windows that have been painted shut require a little more effort, but can also be opened.

If a window will not stay open, the balance system needs repair. See the next page for pulley-and-weight system repair and page 54 for other repairs. Replace all the cords at the same time, preferably with long-lasting chains or nylon ropes.

Older windows will almost certainly contain lead paint. Contact the EPA for their guidelines on



Loosening a tight sash

If the stop is binding against the sash, tap it with a hammer and woodblock to move it slightly to the side. If this doesn't work, reposition the stop.



If the sash is too wide, remove it (see opposite page) and sand or plane each side. Check it for fit. Take care not to make the sash too loose.

lead-safe remodeling, especially if there are young children in the house. You'll learn how to protect

yourself, contain the dust, and clean up safely.



AMERISPEC® TIP DON'T PAINT IT SHUT

A few hours after you have painted a window, score the movable parts with a utility knife, then operate the window a couple of times to keep it from becoming stuck. A special saw (right), called a paint zipper or window zipper, makes quick and clean work of cutting through paint that is holding a sash in place.



Freeing a stuck sash

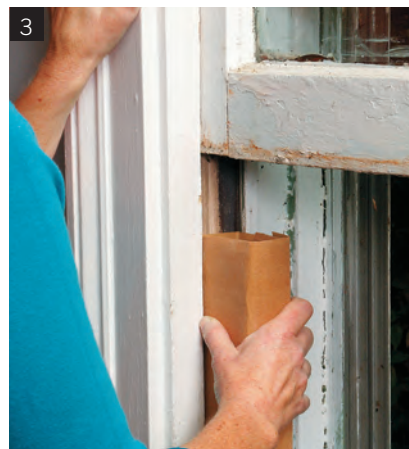
1 Score the painted edges of the sash with a saw (see above) or a utility knife. Work a wide putty knife between the sash and window frame. Tap the knife with a hammer.



2 From the outside, wedge a flat pry bar between the sill and sash. Work alternately at each corner so the sash moves up evenly. Protect the sill with a block of wood.



3 Chisel any built-up paint off the edges of the sash and the stops. Mist the sash and stops with water to keep down dust, then sand the edges smooth and apply paraffin.





Repositioning the stops

1 Score the paint between the jambs and the stops, then pry off the stops, leaving the nails in them. (Remove the screws if the stops are screwed in.)

2 Mist with water to keep down dust, then chisel or scrape any built-up paint from the edges of the sash, stops, and parting strip. Sand the edges smooth and apply paraffin or window lubricant.

3 Nail the stops back onto the jambs using a thin cardboard shim as a spacing guide. Either refasten the old nails in the old holes or drill pilot holes and drive new nails.

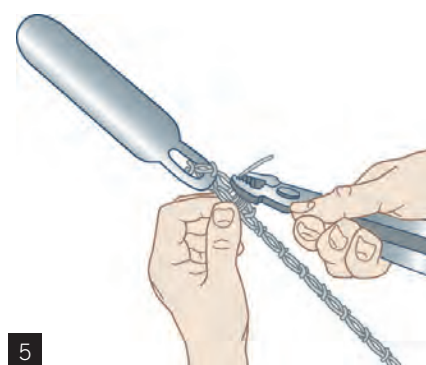
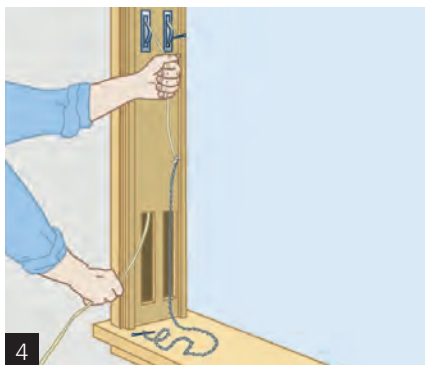


Removing wood sashes and replacing cords or chains

1 Remove the inside stops on one side, raise the lower sash and angle it out. Slip each cord or chain out of the groove. Use a nail to keep them from slipping through the pulleys.

2 Pull out the parting stop on one side with pliers, using wood strips to protect the stop. Angle the upper sash out of the frame and disconnect the cords or chains as shown in Step 1.

3 Remove the screws holding each pocket cover and pry it off. In some cases, you may need to remove some of the weather stripping to get at the covers.



4 Tape an end of each new chain or cord to an end of each old one. Slip a nail through each cord or chain's other end. Untie the weights, then pull the old lines out of the openings.

5 Loop each line through the hole in each weight. Secure chains with wire or double-knot a new cord. Clear the access openings of any debris and replace the weights.

6 Adjust chains so the weights will be 2 inches above the stool when the sash is up. Secure the chains to the sash channels with short screws. Replace the pocket covers.

BALANCE SYSTEMS

Over the years, manufacturers have designed a number of balance systems. Here we show some of the most common ones. If yours is different, look for a manufacturer's name and search on the Web for replacement parts. If a certain window was commonly installed in your neighborhood, a local hardware store may carry parts.

SPRING- OR TAPE-BALANCE SYSTEM In a spring-balance system, sometimes called a tape balance, each sash is operated by two balance units with spring-loaded drums inside. The units fit into the side jambs near the top. A flexible metal tape hooks onto a bracket screwed into a slot in the sash. A cord-balance system (not shown here) works similarly, but the balance units contain nylon cords rather than tape.

Some units have an adjustment screw, which you can tighten if the spring does not hold the sash in place. If the spring or tape breaks, replace the unit. To find replacement parts, go to a window specialty store or type "sash balances" into an Internet search engine.

To remove the balance, take out the stop and pull the sash partway out. Unhook the tape from the sash and let it wind back on the drum. Unscrew and remove the balance from the jamb. Insert the new unit into the jamb slot and screw it on. Pull down the tape (A), hook it to the sash, and reinstall the sash.



TUBE-BALANCE SYSTEM Here, a spring-loaded spiral rod encased in a tube rests in a channel in the sash. The top of the tube is screwed to the side jamb, and the rod is attached either to a mounting bracket on the bottom of the sash or to a sliding shoe in the jamb. If the sash does not stay put when raised, adjust the tension. If the balance breaks, replace it.

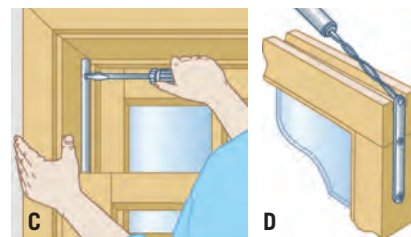
To adjust the tension, remove the covers to reveal the tube balance. Release the side catches and

tilt out the top of the sash. If the window doesn't stay open, increase the tension by unhooking the spiral rod and turning it clockwise (B) (a balance winding tool helps



with this). Turn the rod counter-clockwise if the window is hard to open.

To replace the balance, unscrew the tube from the jamb (C) and remove the mounting bracket from the sash (D). To install a new unit, attach the new tube to the jamb, tighten the spring, and fasten the new mounting bracket to the sash. Reattach the balance cover and reinstall the sash.



Window locks

SASH LOCK To replace a standard sash lock, attach the fixed catch to the upper sash. Position the rotating part on the lower sash, making sure it will tightly close the sashes together, and attach with screws.



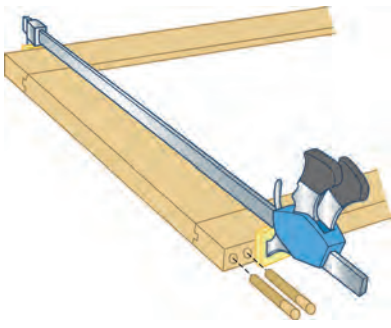
SECURITY LOCKS A spring bolt screwed to the sill will secure almost any type of window. A locking pin pokes through a hole drilled in both the bottom and top sashes. Depending on where you drill the holes, the pin can secure the sash when the window is closed or partially open. The pin hangs from a short chain when not in use. You can also buy a keyed lock, which secures both sashes.



WINDOW CHANNEL UNIT

Here, sashes slide through channels in a jamb liner that contains springs to hold the sashes up. In some cases, the channels are part of the window frame, so you must replace the entire window. If a jamb liner is detachable, remove any mounting nails or screws, as well as stops. Slide the sashes toward the middle and tilt the sashes and liners out. Buy replacement sash liners and slide the sashes in.

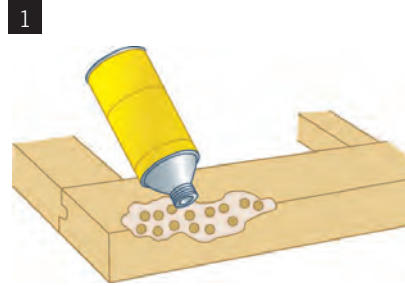




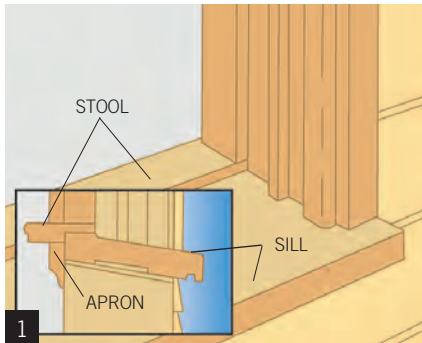
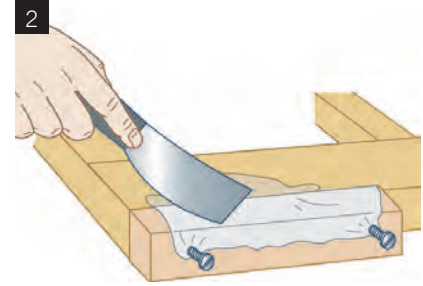
Mending a wooden sash

If a sash frame is coming apart, clamp the frame tightly together. Drill two long holes through one stile and well into the rail, using a 1/4-inch bit. Squirt in some wood glue and tap in 1/4-inch dowels. Wait a day, trim the dowels, and paint.

1 If a portion of a sash is rotted, chisel away all loose matter and drill a series of short holes in the damaged area. When you're sure the wood is completely dry, pour wood hardener into the holes and the surrounding area.

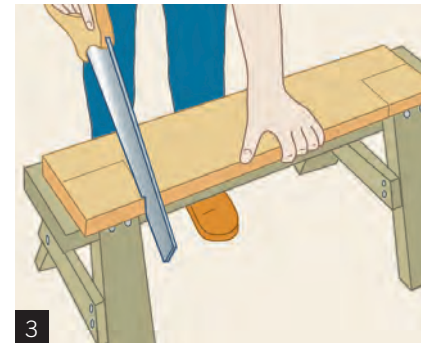


2 Wrap a scrap of wood tightly with plastic sheeting, as shown, and screw it against the damaged area to create a dam. Mix and apply two-part wood filler, epoxy, or auto body filler. When it dries, scrape, sand smooth, and paint.



Replacing a sill

1 If a sill cannot be repaired as shown above, pry off interior casings and inside stops (see page 49) and pry off the apron. Remove any nails from the stool and take it out in one piece.



2 Measure the length of the sill between the jambs. Saw the sill into three pieces. Remove the center piece, then the end pieces. Cut off any nails with a reciprocating saw or hacksaw blade.

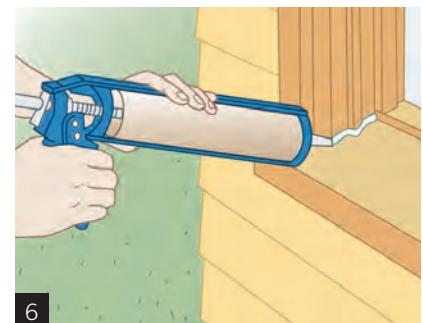
3 Using the old sill's end pieces as templates, mark the new sill to the correct length, allowing for any grooves in the jambs. Cut the new sill with a saw, beveling the ends slightly for an easier fit.



4 Tap the new sill into place from outside, using a block of wood to protect the edge. Don't force the sill. If it sticks, remove and trim as needed.



5 Add shims under the sill for a snug fit, if needed. To secure the sill, screw it to the side jambs from underneath.



6 Fill the screw head holes and apply a coat of primer. Caulk the sill's edges and paint. Inside, replace the stool, apron, sash, stops, and casings.



casement window

casement windows

A casement window, whether made of wood, vinyl, or metal, has a sash hinged at the side and is typically operated with a crank-and-gear mechanism. Clean and lubricate the mechanism regularly. If a part wears out, find the manufacturer's name and purchase an exact replacement.



REPLACING A HANDLE

If a handle spins and does not open the window, try tightening the setscrew that secures the handle to the operator shaft. If that doesn't work, remove the handle. Install an adapter and a new handle that fits tightly.

AMERISPEC® TIP

FINDING THE BINDING SPOT

To find where a casement sash is binding, hold a piece of carbon paper next to the jamb as you close the window. The carbon paper will smudge the too-tight areas, which should be sanded or planed.

RESTORING SMOOTH OPERATION If the window is difficult to operate or does not close completely, clean all moving parts and check that debris is not hindering the opening and closing of the sash.

If that doesn't do the trick, remove the cover from the operator; you may also need to remove the operator from the window. Inspect the gears. If the teeth are worn, replace the unit with a duplicate that cranks in the same direction as the old one. If the teeth are sharp but clogged with dirt, remove debris and grease with a soft wire brush or clean the assembly with a solvent, such as mineral spirits. Lubricate gears with graphite powder, silicone, or gear grease. Turn the crank to spread the lubricant. Use silicone spray on nylon gears. If the gears still malfunction, replace the assembly.

CORRECTING A BINDING SASH If a sash sags or sticks and has conventional butt hinges, adjust them as on a

door (see pages 62–63). If the sash is paint-bound, use a knife or special saw (see page 52) to free it. If a wood sash is swollen, sand or plane the part that's rubbing, then seal and refinish it. If the stop is swollen, remove it, sand as needed, and reposition it.

You can compensate for a mild warp in a wooden sash by adjusting the stops (page 53) or by adding weather stripping (pages 60–61).

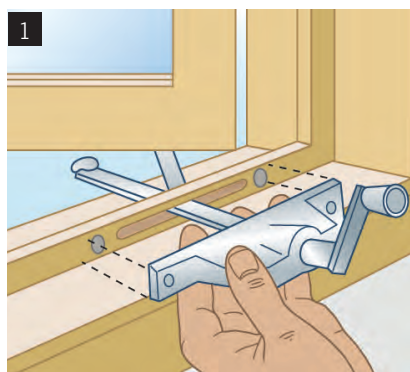
CLEANING AND LUBRICATING

Open the window and use a wire brush to clean the track. Remove any rust or mineral deposits. Treat the inside of the track with spray lubricant. As you close the window, watch to identify any spots that need further brushing or sanding.

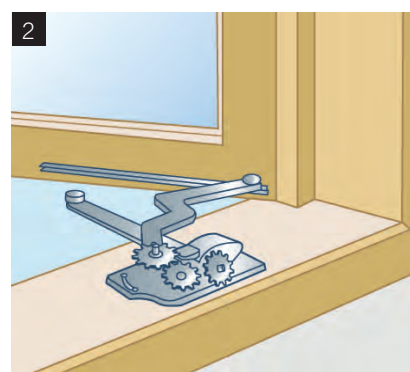


Servicing an operator

1 Open the window halfway, remove the screws, and pull the operator partway out. Slide the extension arm until it reaches the slot. Pull the assembly out.



2 Remove the cover and inspect the gears. If they look good, try lubricating. Otherwise, replace the unit with a duplicate.

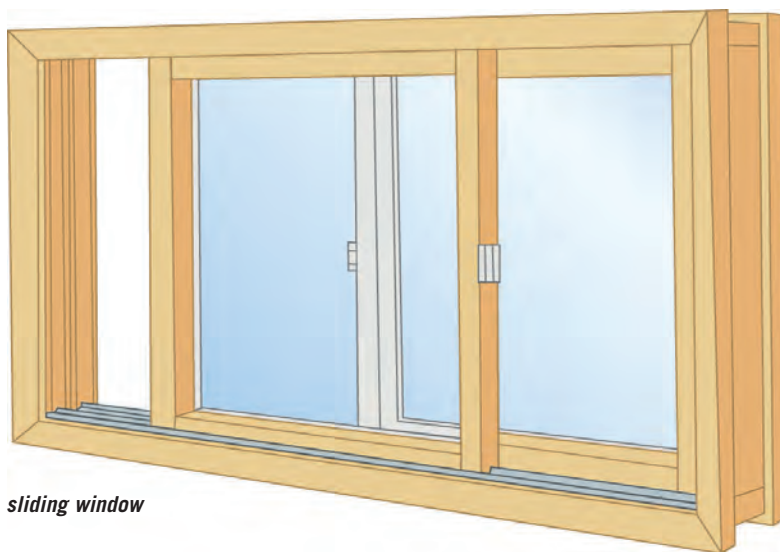


sliding windows

Sliding window sashes move along metal, wood, or vinyl tracks fitted into the window frame at the top and bottom. To ease their movement, large sashes often have plastic rollers attached to the top and bottom, or to the bottom only.

RESTORING SMOOTH OPERATION Often one sash is fixed and the other slides. You can usually remove the sliding sash by simply lifting it up and tilting its bottom out. If a sash is stuck or does not move freely, sand away any paint or finish that is rubbing against the frame. Use a wire brush to clean all the dirt from the track. For stubborn particles, use the blade of an old screwdriver to pry dirt loose. Lubricate the track with paraffin or window lubricant.

If rollers are sticking, treat them with graphite powder or spray lubricant until they move freely.



sliding window

If they're broken, you'll need to remove the sash and take it to a hardware store or glass shop to have the rollers replaced.

REPAIRING A CATCH Sliding windows are secured with a variety of catches, depending on the manufacturer and the material. If the window's catch doesn't work properly, you may need to remove the sash from the frame to fix it.

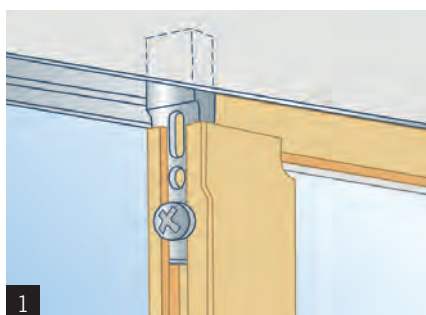
You may be able to reshape a bent catch. Note how much it will have to be reshaped, then remove the catch and clamp it in a vise. Use pliers or a hammer to bend the catch to the proper angle. Replace it and check the latch operation. It should click as the window closes, and it should need to be fully depressed for the window to open.



AMERISPEC® TIP

SLIDING-WINDOW LOCK

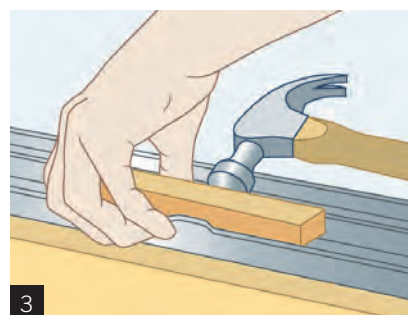
This quick-release track grip provides protection against intruders and can be positioned anywhere along a sliding door's track. Snap it into place to secure the window.



1



2



3

Straightening a bent track

1 To remove a sash, first unscrew and remove any security devices at the top. To remove a fixed sash, you'll probably need to take off corner brackets at the top and bottom.

2 Carefully lift the sash up to clear the track, then tilt the bottom out of the frame. You may need to align the rollers with notches in the frame in order to tilt it out.

3 Place a wood block in the track. Using a hammer, tap the block against the bent metal until the side of the track is straight. Replace the sash and test the glide.

storm-and-screen windows

Most combination storm-and-screen windows (sometimes called triple tracks) can be left in place all year. However, you may want to remove storm windows during hot weather, as they transmit a good deal of solar heat. Frames may be wood or metal, and the screening may be metal (usually aluminum) or fiberglass. If a room tends to get hot, consider installing dark sunshading screening.

With regular maintenance, your storms and screens should last decades. Clean screening periodically by spraying it with a garden hose. If openings are clogged after the water has dried, dab with a bristle brush. Keep wood frames well protected with paint, but check that the frame will fit after you apply another coat. You may need to sand the edges before painting.

SMALL REPAIRS To mend a very small hole or tear in metal screening, use

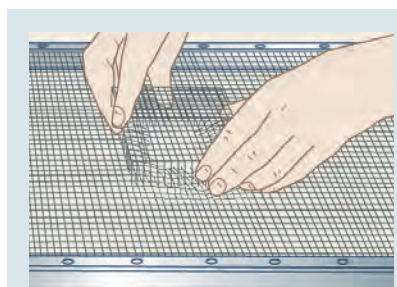
tweezers to twist the strands into shape, and then apply superglue. To repair a tear in fiberglass screening, sew it shut with a large sewing needle and clear fishing line, then seal the edges of the tear with superglue.

If screening has come loose from a metal frame, pull the screening taut and use a spline roller or putty knife to re-secure it. If screening comes loose in a wood frame, partially pry up the screen mold, pull the screening taut, and reattach the molding with nails.

REPLACING STORM WINDOW GLASS

Replace glass in a storm window as you would in permanent windows (see pages 50–51). If the frame is metal, you may need to buy replacement gaskets or other parts that fit your window model.

FRAME REPAIRS A wood frame can be patched with mending plates, screws (next page), or dowels (see page 55). Working on a flat surface, disassemble the frame only as

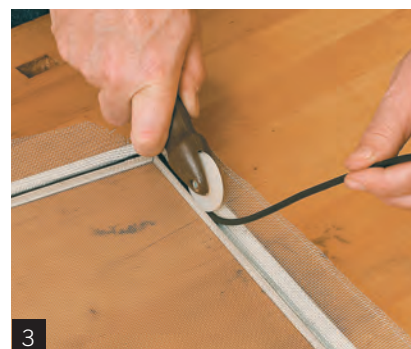


PATCH A SCREEN

To repair a small hole, cut a patch 3 inches wider and longer than the tear. Unravel each side, bend the end wires, and push them through. Bend the wires over on the other side and use superglue to secure the patch.

much as necessary and then clean any paint or debris that inhibits a tight fit. Drill pilot holes before driving any screws or nails.

Metal frames have plastic parts and rubber gaskets that vary by manufacturer. Take your frame to a hardware store for replacement parts. If you can find the manufacturer's name, you may be able to buy parts over the Internet.

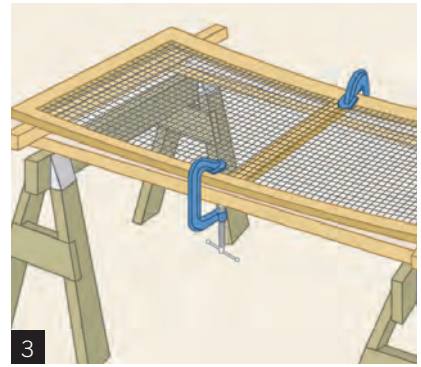
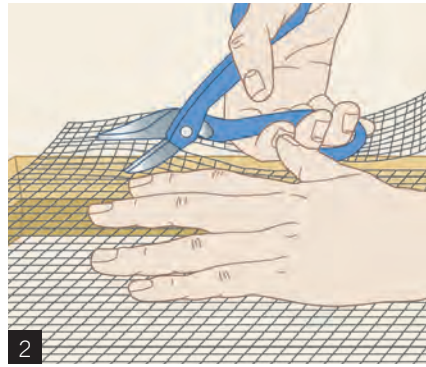
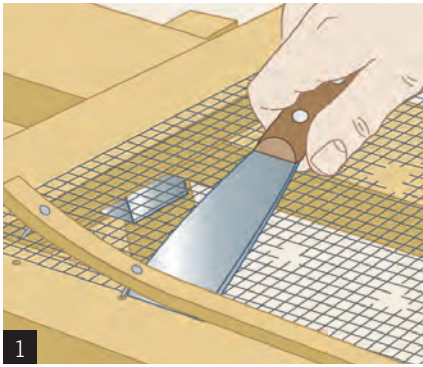


Replacing screening in a metal frame

1 Use a screwdriver to pry up the spline that runs around the perimeter of the frame. Pull out the spline and remove the old or damaged screen fabric.

2 Lay the new screen fabric over the frame. Using sharp utility scissors, trim it so that it is several inches larger than the frame in each direction. Then snip off the corners as shown.

3 Use a screen-spline roller to force the screen and spline together into the spline channel, stretching the screen fabric taut. Cut off the excess with a utility knife.

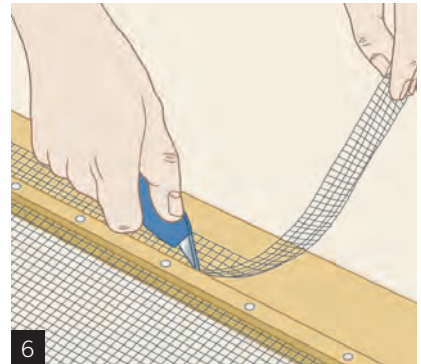
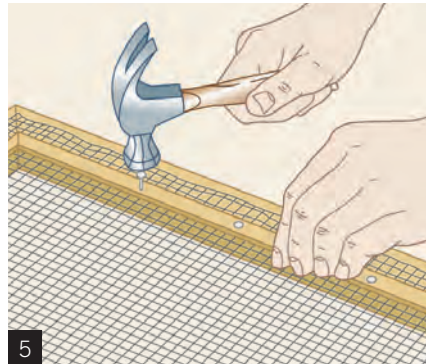
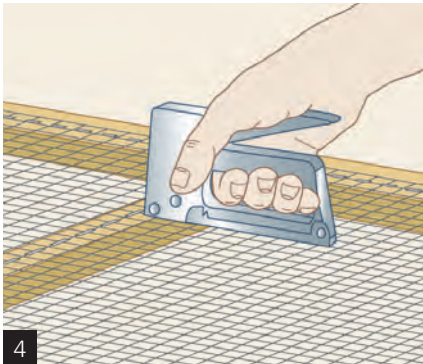


Replacing screening in a wood frame

1 Using a chisel or putty knife, carefully pry off the screen mold. Work from the ends toward the center. Remove the old screening.

2 Using tin snips, cut a new piece of screening 2 inches larger than the opening on all sides. Staple the screening along one end of the frame so the staples will be under the molding.

3 To end up with a taut screen, you need to bow the frame before stapling the other end. Place the frame on boards over sawhorses and put 1-by pieces under the ends. Clamp the middle. Staple the other end of the screening, then remove the clamps.

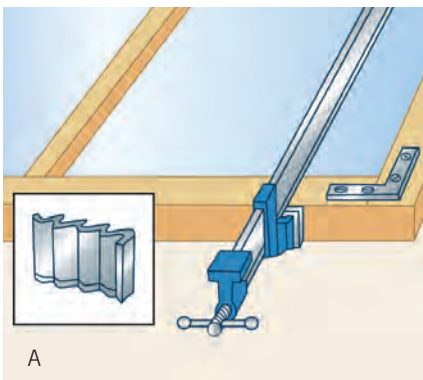


4 Working from the center toward the ends, staple each side of the screening, pulling it tight. Staple the middle rail last.

5 Nail on the molding. Pound the nails flush, or countersink them and fill the holes. Refinish any new molding to match the frame.

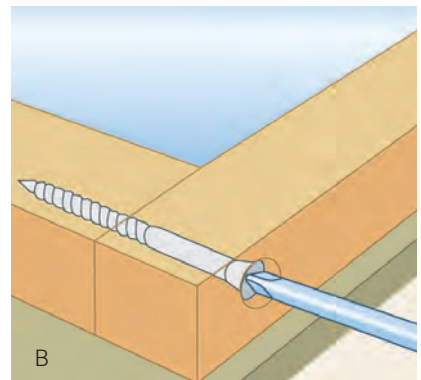
6 Use a utility knife to cut away excess screening around the molding. Cut gently so you don't slice a groove in the frame.

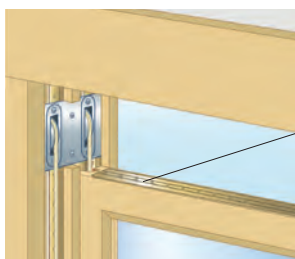
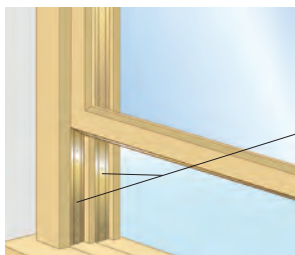
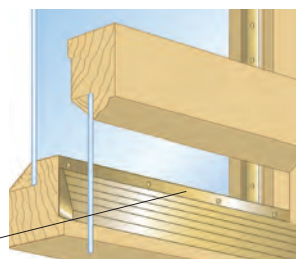
Repairing a wood frame with mending plates, corrugated fasteners, or screws



Hold one corner of the frame together tightly with a long clamp (A), and then drive screws to attach an angled mending plate at the corner. You can also hammer in a corrugated metal fastener (inset).

Or, glue the frame at the corner, then countersink a long wood screw through the corner joint (B). Cover the screw head with wood putty, then sand and paint it.



METAL STRIP
ON TOP OF
UPPER SASHSPRING
BRONZE
NAIL-ON
STRIPSMETAL STRIP
BETWEEN
TWO SASHESMETAL STRIP
ON BOTTOM
OF LOWER
SASH

weather-stripping windows

Most newer windows are weather-stripped at the factory. You can also apply weather stripping yourself.

CAULKING AND SEALING Make sure the nonmoving areas are well sealed. If you can access cavities inside the wall around the window, see that they are filled with fiberglass insulation or non-expanding spray foam. (The cavities on either side that hold the ropes and weights for an older double-hung window cannot be insulated, because the weights need to move.) Apply caulk, both outside and inside, to any cracks.

AVAILABLE PRODUCTS Self-stick tapes are a good choice for metal or vinyl windows when nailing isn't an option, especially where parts of windows press together rather than slide against one another. Choose EPDM rubber or high-density foam. Vinyl V-strips are easy to install but wear out quickly.

Use nail-on strips for wood windows because they attach firmly. Gaps less than ¼ inch are best sealed with spring bronze. This material is especially suited to filling the gaps between a window

sash and its jambs. A tubular vinyl gasket works well where the gaps are large or uneven in width. The flange is often reinforced with metal to prevent the soft vinyl from tearing. Felt strips are not durable.

WEATHER-STRIPPING STRATEGIES The trick is to provide tight seals while allowing the window to open and close smoothly. Work methodically as you apply weather stripping, constantly checking for both seal and smooth operation.



1



2

Attaching spring bronze

1 Measure the side channels for both sashes and cut spring bronze strips with tin snips. You may need to cut separate pieces on each side of the pulleys. With the nailing flange against the sash stop, slide the strips up between the sash and the jamb. Attach the strips with brads.

2 Measure and cut horizontal strips that extend the full width of the window. Attach one piece to the bottom of the lower sash so the nailing flange is flush with the inside edge of the window. Hammer gently so the window doesn't crack.


AMERISPEC®
TIP

INCREASING THE TENSION

If a bronze strip does not seal because the gap is too wide, use a putty knife to gently pry it farther open. Do this a little at a time, until it seals without binding.

Before you start, make sure the window lock pulls the sashes tightly together. If it does not, adjust its position. Check for problem areas, as you may need to apply weather stripping to only some areas and not others.

To seal a double-hung window, insert pieces of spring bronze between the sashes and the jambs, then attach pieces to the top of the upper sash, the bottom of the lower sash, and the inside face of the meeting rail on the upper sash.



loose paint, clean the surfaces with a mild detergent, and allow them to dry. Measure strips and cut them to length with scissors. Peel off the backing and press the foam into place.



TUBULAR VINYL Unlike spring bronze and plastic V-strips, tubular gaskets are applied to the sides and top of the outside of the window and are thus visible. (Painting them is not recommended, as it will inhibit their flexibility.) Measure the strips and cut them to length with scissors (or tin snips if the strips are

SEALING THE PULLEYS

To prevent air leaks around sash cord pulleys, cover the pulleys with self-adhesive pulley seals. Clean the pulley surface thoroughly, then peel off the backing from the cover and position it over the pulley



reinforced with metal). Close the window, then butt the tube section snugly against the part to be sealed while keeping tension on the strip as you drive in the brads. Finally, nail a strip on the inside to the bottom of the lower sash.

OTHER PERMANENT WEATHER-STRIPPING PRODUCTS

PLASTIC SELF-ADHESIVE V-STRIPS Take particular care to clean the surfaces so the adhesive will stick well. Cut the pieces to length with scissors. Position them as you would for spring bronze, then peel off the backing and press them into place.

SELF-STICK FOAM This is easy to apply. Choose a foam of the right thickness so it will seal but still allow the window to close. To ensure a good bond, make sure the surface is smooth and clean. Remove any



Temporary solutions

ROPE CAULK Just before the weather turns cold, press removable rope caulk into the joints between the sashes and the jamb, between the sashes and the sill, and at the meeting rails where the upper and lower sash meet. Remove it in spring.



Heat-shrink plastic

1 This effectively seals an entire window in minutes. Clean the window casing and sill and apply strips of double-faced tape all around. Peel away the protective paper. Press the plastic sheet onto the tape.

2 Use a hair dryer to heat the plastic at all points until it shrinks tight and all wrinkles are removed. Use a utility knife to trim excess plastic around the perimeter.



door repairs

A paneled door (see page 49) has a visible frame of stiles and rails that supports two or more panels. A flush door is faced with hardboard, wood veneer, metal sheathing, or a fiberglass composite. A flush door for exterior use should have a solid core of several layers of hardwood, foam-insulation fill, or particleboard. An interior hollow-core flush door has narrow interior stiles and a network of corrugated cardboard strips. The wood surface is 1/4-inch-thick plywood or hardboard.

A doorframe consists of jambs, casing, and stops. The jambs form the sides and head of the frame, while the casing trims the opening, covering the rough edges of the drywall and sheathing. The stops are wood strips that the door fits against when closed. On exterior doors, a sill fits between the jambs, forming the frame bottom. The threshold is fastened to the sill or to the floor.

REPAIRING A DOOR

Age and continual use can cause even a well-fitted door to loosen, bind, or warp. Often the latch no longer works properly. The most common repairs are covered in the following six pages. A door that's badly warped should be replaced.

LOOSE DOORS If an exterior door is leaking air, weather stripping is usually the solution (see page 73). If a door rattles or is difficult to close, you may be able to adjust the latch, or you may need to move the stop. If there is a large gap at the top or bottom, you can add a piece of wood and paint it to match the door.

BINDING DOORS Binding or sticking can have a number of causes, from a buildup of dirt and paint to a door that sags. Adjusting the fit of the door usually solves the problem.

LATCH PROBLEMS When a latch fails to work, the trouble may be with the fit of the door or with the lockset (see pages 70–71).

REMOVING A DOOR

If you're working on just one hinge at a time or on the top of a door, you need only open the door partially and wedge shims underneath the latch side to hold the door steady. But for other work, such as sanding or planing the side or bottom, you must remove the door and lay it on sawhorses or a workbench.

To remove the hinge pins, close the door securely. Using a hammer and a flat pry bar or screwdriver, gently tap on the bottom of the lowest pin or on the underside of its head to drive it up and out of the hinge barrel. Remove the middle pin, if there is one, then take out the top pin. Lift the door off its hinges.

When you reinstall the door, replace the top pin first, then the middle and bottom ones. Drive the pins home only after the hinges are correctly aligned.

BINDING DOORS

Doors bind for a number of reasons, but the most common one is

that the weight of the door causes it to sag. Quite often you can solve this problem by opening the door and removing the middle screw in the top hinge that's screwed to the doorjamb. Replace this short screw with a 3-inch flat-head screw of the same head size. This screw will reach the framing behind the jamb and pull the door into alignment. You may have to drill a pilot hole for this screw. And you may also have to tighten or loosen the screw to get the fit just right.

If a hinge leaf is loose, try tightening the hinge screws. If they spin and don't tighten, follow the steps on the next page to tighten the holes. The hinges may also have to be shimmed or set in deeper mortises (see page 64). The illustrations on the opposite page will help you diagnose the problem and determine which repairs are needed.

If the hinges are OK, identify the spots that bind by looking for scratches or worn areas on the edge of the door and on the jamb. Look for a buildup of dirt or paint. Chisel or plane off any globs of paint, then sand.

If you must remove excess wood from the door edges, plane only if necessary. Try sanding first with coarse followed by finer paper. Keep the sanding as even as possible. When sanding or planing the stiles, keep in mind that the lock side is usually beveled to allow for a tight fit.



AMERISPEC® TIP

IF THE HINGE PIN IS STUCK

If a hinge is rusted or painted tight, try squirting it with penetrating oil. If it still doesn't come loose, it may be easier to remove the screws from one of the hinge's leaves. That will allow you to remove the door, with the hinge attached to either the jamb or the door.

Diagnosing and adjusting a binding door

If the door binds as in (A), reset the upper hinge (tighten loose screws, sink a longer screw into the framing, or deepen the mortise) and/or shim out the lower hinge. If the door binds as in (B), do the opposite: reset the lower hinge and/or shim out the upper one.



If the door binds on the hinge side (C), shim out the hinges, or remove the door and sand or plane the hinge side. If it binds on the lock side (D), sand or plane that side and perhaps deepen the hinge mortises.



If the door binds along the top (E), wedge it open and sand or plane the wood along the top. If it binds along the bottom (F), remove the door and sand, plane or trim the door bottom.



Strengthening a loose hinge

1 If any hinge screw holes are stripped, remove the screws and the hinge leaf from the jamb. Coat small wooden dowels or matchsticks with glue and pack them in the holes. Wipe off the excess glue and trim the plug flush.



2 After allowing the glue to dry, hold the hinge leaf in position and drill new pilot holes for screws. Then drive in the screws. For extra strength, you can substitute longer screws for the original ones.

AMERISPEC® TIP QUIETING SQUEAKY HINGES

Silence a noisy hinge by coating it with silicone spray or light penetrating oil. If the squeak persists, remove the pin and thoroughly clean the pin, barrel, and hinge leaves with steel wool. Coat them lightly with silicone spray or light penetrating oil and replace the pin.

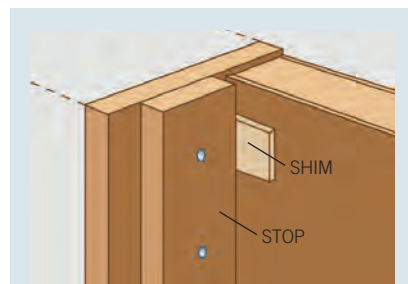
CURES FOR A WARPED DOOR

The best insurance against warping is to seal the door on all surfaces, including the top and bottom edges, to prevent moisture from swelling the wood. A badly warped door should be replaced.

If there's a slight bow on the hinge side, installing a third hinge between the top and bottom ones may pull the door into alignment.

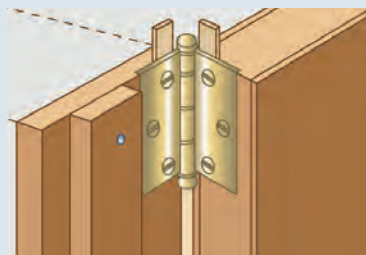
If the bow is on the lock side and the door latches only when slammed, reposition the stop as for a window (see page 53). If necessary, adjust the strike plate (see page 65).

If the top or bottom of the door does not meet the stop on the lock side, try repositioning the stop or the strike plate. You may also have to place narrow shims, as shown at right, under each hinge leaf either on the side of the leaf that's closest to the pin or on the opposite side, depending on the warp. Usually, the other hinge is shimmed in the opposite way.



ADJUSTING A WARPED DOOR

Reposition the stop (see page 53), spacing with a thin cardboard or wood shim, then nail the stop into place.



To adjust the angle of a door, loosen the hinge screws and slip a small shim of cardboard or thin wood under each hinge leaf, then retighten the screws.

techniques for working on doors



Surform tool

Techniques for repairing a door include planing edges, cutting or deepening hinge mortises, and shimming hinges. Supporting a door for planing is tricky. If you can't secure one end in a bench vise, try clamping the door to a sawhorse.

A carpenter's handplane is the best tool for shaving wood. A Surform tool is less expensive and easier to use, but it leaves a rough surface that must be sanded. If only a small amount of wood must

be removed, sandpaper wrapped around a sanding block is the best choice. Other alternatives are to use a belt sander or a power plane, but the inexperienced can easily remove too much material with these powerful tools.

You can fine-tune a door with a small block plane, but longer planes work better for cutting long, straight edges. The blade should be very sharp and wider than the thickness of the door so the cuts will be even. Though a jack plane

Planing a door

1 On both faces of the door, use a pencil to scribe a line in the area to be planed. Plane everywhere you cannot slide a dime between the door and the jamb.

2 Stabilize the door and adjust the plane to cut paper-thin slices. Place the plane flat on the surface, and push it with moderate pressure. If it digs in and gets stuck, try

planing in the other direction. At the door's top and bottom, you will plane across the grain. Plane from the corner toward the middle to avoid splitting the ends of the stiles.

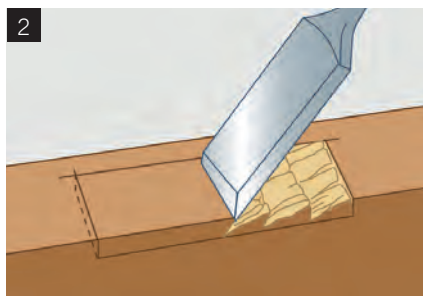


Cutting a hinge mortise

1 Using a hinge leaf as a template, mark the outline and the depth for a new hinge. Carefully score this line, first with a utility knife, then with a hammer and chisel.

2 Make shallow, cross-grain cuts to the desired depth using a hammer and chisel held almost vertically, as shown. Then lower the chisel to a 30-degree angle, bevel side down, and gently chip out the wood to the desired depth.

3 Make the final smoothing cuts from the side, holding the chisel bevel-side up, almost flat. Position the hinge leaf and check that it's flush with the surface of the door or jamb. Drill pilot holes and drive hinge screws.



(14 to 15 inches long) is preferable, a 9- to 10-inch-long smoothing plane will do the job.

To avoid gouging the wood, plane with the grain. Testing on a scrap of wood, adjust the blade to make paper-thin cuts so you don't remove too much wood.

If you're working on a binding door, plane the top or bottom rail if the door is binding there, or the hinge stile if the door binds on the hinge side. Be careful if you have to plane a binding lock stile, since it involves maintaining the beveled edge along that side and, in some cases, repositioning the lockset. Plane the hinge stile whenever possible to correct the problem.

You'll need to remove the hinge leaves before planing. Use a utility knife to cut through any paint around the leaves, then unscrew and remove the hinges. If there's a lot of paint on the door, remove it with a paint scraper to save dulling your plane. After you plane, deepen the hinge mortises as shown on the previous page.

CUTTING HINGE MORTISES Hinge mortises are recesses that allow hinge leaves to sit flush with the door and jamb surfaces. You'll need to cut mortises if you're adding a middle hinge to straighten a warped door or if you're hanging

a new door. If you're adjusting the position of the door in a jamb or you've planed the hinge stile, you may have to deepen the mortises. To do so, mark the new depth on the edge of the door or jamb and then go to Step 3 on the previous page.

MAKING SHIMS To move a door closer to the lock side of the jamb, you can insert a shim under the hinge

leaves. Use dense, hard-surfaced cardboard, such as that used for file folders.

Using a hinge leaf as a pattern, cut a shim and make the screw holes (a paper hole punch works well for this). The shim should be minutely smaller in each dimension than the hinge. Don't glue the shim in place, because you may want to remove it later.

ADJUSTING BALKY LATCHES

If a door latch doesn't catch or won't operate smoothly, the latch bolt on the door may not be lined up properly with the strike plate on the doorjamb. Repairs range from minor adjustments to repositioning of the door.

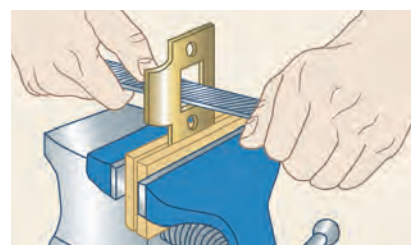
If the latch does not operate smoothly, lubricate it with graphite. If it does not catch, close the door slowly to watch how the latch bolt meets the strike plate. The bolt may be positioned above, below, or to one side of the strike plate. (Scars on the plate may give you a clue as to the degree and direction of misalignment.) The problem also could be that the door has shrunk and the latch no longer reaches the strike plate.

Once you've determined what adjustment is needed, use one of the three remedies illustrated at right. If the door has warped only slightly, adjust its angle. To do this, you can either insert shims on the side of each hinge leaf that's closest to the pin, angling the door inward, or reposition the stop closer to or farther from the door so the latch can engage the strike plate (see page 63).

If the lock is the problem, turn to pages 70–71 for information on lock repairs.

Three ways to adjust a strike plate

For less than a 1/8-inch misalignment of latch bolt and strike plate, remove the plate and file its inside edge to enlarge the opening.



For a larger misalignment, remove the strike plate and extend the mortise higher, lower or back. Replace the plate, fill the gap at the top or bottom with wood putty, and refinish.



If the latch doesn't reach the strike plate, shim out the plate or add another strike plate on top of the first. If it still won't reach, shim out the door's hinges. Replace the door with a wider one if necessary.



USING A PLANE

Use two hands when operating a jack plane, gripping the rear handle with one hand, the front knob or one edge with the other. At the beginning of the cut, apply slightly more pressure on the plane's toe. Even out the pressure as you continue the stroke, and then near the end gradually switch pressure to the heel.

CUTTING OR EXTENDING A DOOR

If you install new flooring or carpeting, you may need to cut a door's bottom so it does not scrape. Allowing a door to scrape will eventually damage both the flooring and the door. If a doorway goes out of square because the house settles, you may need to trim the top, bottom, or latch side of a door. (Before trimming a door's latch side, make sure the latch will still work after the door has been cut.) If you need to remove $\frac{1}{4}$ inch or less, you are likely better off using a handplane or a power plane rather than a circular saw.

ENLARGE A DOOR

You can enlarge a door by gluing on another piece of wood, though the difference in grain will be visible (especially on the top or bottom) unless you paint the door. Cut a piece to size, test the fit, and apply wood glue. Clamp it or drill pilot holes and drive screws that penetrate at least 2 inches into the door. After the glue dries, sand the area smooth.

AMERISPEC® TIP

PATCHING A HOLLOW-CORE DOOR

Hollow-core doors can be easily dented or cracked, even with a bare fist. You can patch a small hole or medium dent using two-part wood filler. If you sand carefully, the patch will not be visible after you paint it. If the door has a larger hole, you're better off buying a replacement.

A circular saw will cause splinters in a board's top face when cutting across the grain (the underside will be OK). Use a utility knife and a straightedge to score the cut line and prevent splintering. When cutting a significant amount from a hollow-core door, you will need to replace the bottom rail, as shown below.

REPLACING A DOOR

Hanging a replacement door in an existing frame takes a lot of patience, especially if the frame is not perfectly rectangular (and it usually isn't). If the existing jamb and casing are in bad shape anyway, consider installing a prehung door (see page 67).

Before purchasing a replacement, remove the old door and measure the opening from top to bottom on

both sides. Then measure across the opening at two or more points, checking the upper corners with a framing square. Be sure the replacement door you purchase will fit your opening (keep in mind that a hollow-core door has only a $\frac{1}{2}$ -inch trim margin). Double-check all measurements before cutting.

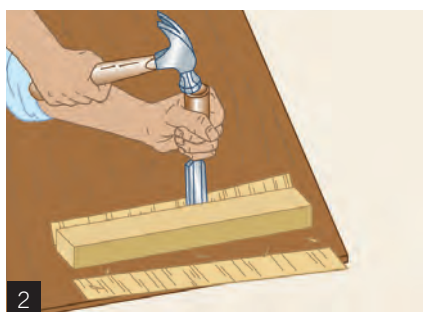
Here are some tips to make this difficult job go more smoothly:

- When cutting a door with a circular saw, clamp a straightedge to the door to act as a guide for the saw. A straight board, a length of plywood, or a store-bought cutting guide will all work.
- Leave a $\frac{1}{8}$ -inch clearance around the door on the top and sides. Bottom clearance should be at least $\frac{1}{2}$ inch (more if you need to clear carpet or a rug).
- Bevel the lock side of the door



1 Cutting a door

1 Using a straightedge, draw the cut line, then use a utility knife to score the line, which will minimize grain tearout. Clamp a straight board to use as a cutting guide, then cut the door with a circular saw. Sand the cut edges smooth.



2 If you have to cut more than an inch or so off of a hollow-core door, use a chisel to remove the veneer and glue from the cut-off piece. You can reuse it to fill the opening in the door.



3 Test that the piece fits (you may need to trim it slightly). Apply wood glue to both sides, slip it into place, and either clamp it or place weights on it to hold the parts tight. After the glue sets, sand the edges.

about 3° so the door will clear the jamb as it opens and closes. If the door is already beveled, install it so the beveled edge is on the lock side.

- When installing a hinge on the door, try to leave a $\frac{3}{8}$ -inch margin between the edge of the door and that of the hinge leaf. This will minimize the chances of splitting out the face of the door.

- If you're hanging a new door in an existing frame, use the existing hinges, if possible.

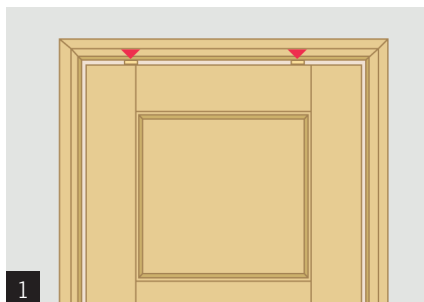
- If you're installing new hinges, place the top one about 7 inches down, and the bottom one 11 inches up. Center the third hinge between the others.

PREHUNG DOORS

A prehung door may cost more than a simple slab, but will save plenty of work and hassle. It will also probably fit together better than a slab door you install yourself, no matter how carefully you work. It comes with the door perfectly cut inside the jamb and installed on its hinges. Sometimes the casing is also supplied, and often the holes for the latch and the strike are already bored and mortised. You can buy prehangs that are hollow-core, solid-core, or panel types, for interior or exterior applications.

Some prehangs come with one-piece jambs that are 4 $\frac{5}{8}$ inches wide. This is fine for most interior walls, which are 4 $\frac{1}{2}$ inches thick. If you have thicker walls (as is often the case with plaster walls), buy a prehung with a split jamb so it can fit walls of various thicknesses.

Be sure to get a door that swings the right way for your situation. Doors are referred to as either right-hand or left-hand in the industry, but methods for determining which is which vary maddeningly. It's easy to get the wrong one, so check carefully.



Hanging a replacement door

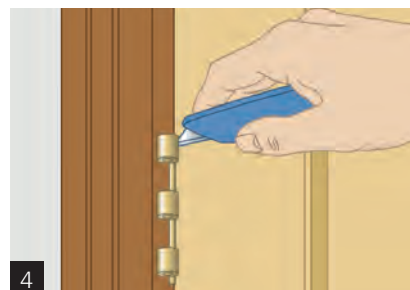
1 Check the opening with a level and a framing square, then measure carefully. Cut the new door to fit, even if the edges aren't parallel and the ends aren't square. Leave a $\frac{1}{8}$ -in. gap on the sides and top, and $\frac{1}{2}$ inch (or more) at the bottom.



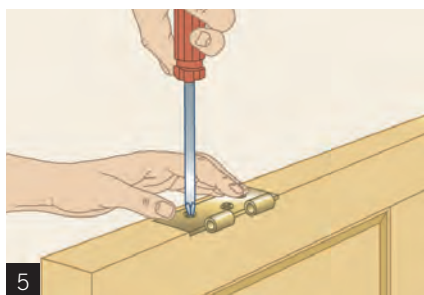
2 Set the door in the opening with $\frac{1}{8}$ -inch shims between the top of the door and the jamb (nickels work in a pinch), and drive wedges under the door to lock it temporarily in place.



3 With the door held in position, double-check the clearances— $\frac{1}{8}$ inch on the top and sides, a minimum of $\frac{1}{2}$ inch on the bottom. If necessary, lightly sand where needed.



4 With the door still wedged in the opening, push it tightly against the hinge jamb. Mark the hinge locations on the door with a utility knife, using the hinge leaves on the jamb as guides.



5 Outline the hinges using the marks made on the door. Cut mortises with a hammer and chisel (see page 64). Position the hinge leaves in the mortises, drill pilot holes, and drive the screws.



6 Slip the hinge leaves together and tap in the pins. Check that the door swings freely and install a new lockset (see pages 70–71). Coat all wood surfaces with a sealer or primer to prevent swelling and warping.

sliding doors

There are three basic types of sliding doors. A sliding patio door typically has heavy glass doors. It rests and glides on rollers at the bottom, while the top track acts only as a guide. Bypass closet doors typically hang on rollers that run in an overhead track, and a short guide at the floor keeps the doors from wandering. A pocket door works much like a sliding closet door, but the door disappears into a cavity in the wall.

PATIO DOORS

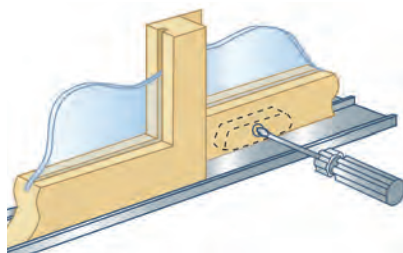
Regularly vacuum out the bottom track and brush away debris from the top track. Apply lubricant only as recommended by the manufacturer; too much can actually act as a magnet for debris. If a track gets bent, you can often tap it back into shape.

If the track is clean but the door does not slide easily, try adjusting the height. If that does not work, remove the door and inspect the rollers; clean out any debris. If the rollers appear worn and do not spin easily, replace them.

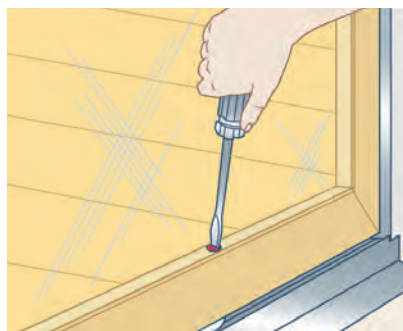
A patio screen door is often subject to abuse. Repair screening as shown on page 58. Replace rollers when they are worn. If the main door is bent or out of square, it should be replaced.

Fixes for a patio sliding door

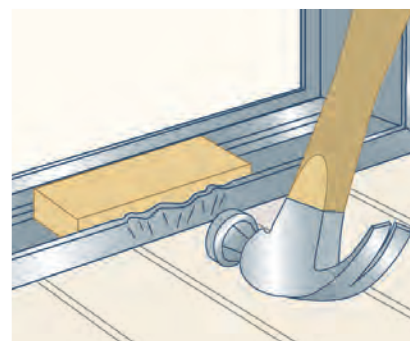
ADJUST DOOR ROLLERS Each of the two rollers can be adjusted up or down. Pry off the cap that covers the adjusting screw, then turn the screw. Adjust the door so it glides smoothly, its side is parallel to the doorjamb, and the latch operates.



ADJUST A SCREEN DOOR A screen door's rollers can also be adjusted. The screws are usually directly above the wheels. Adjust them so the screen door glides smoothly and stays securely in the track.



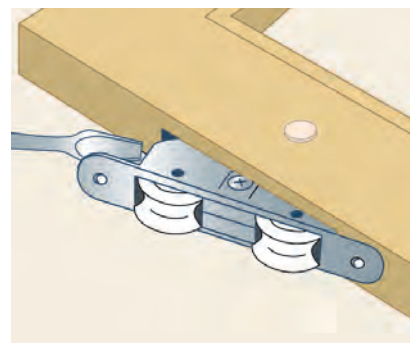
STRAIGHTEN A TRACK Use a hammer and a block of wood to straighten a bent metal track. If the track cannot be straightened, you can sometimes replace it, if it is separate from the rest of the frame.



REMOVE A DOOR The door is heavy, so work with a helper. Lower the rollers, move the door to the middle of the frame, lift it straight up, and tilt the bottom out.



SERVICE OR REPLACE ROLLERS Remove the screws and pry out the roller unit. If cleaning does not restore smooth operation, replace the assembly with a duplicate made by the same manufacturer.



AMERISPEC® TIP GARAGE DOOR SAFETY

Older garage doors with an automatic opener may pose a risk to young children. Many lack electric eyes or pressure-sensitive sensors that reverse the door when they detect an obstacle, or the sensors do not work properly. To be sure your garage door is safe, consult the owner's manual and inspect it yourself, or call in a specialist.

BYPASS CLOSET DOORS

If a bypass closet door pops out of its track, check for dirt in the track, a section that's worn or bent, or a guide that's out of alignment. Unscrew and remove the bottom guide on the floor. Reinstall the door and the bottom guide.

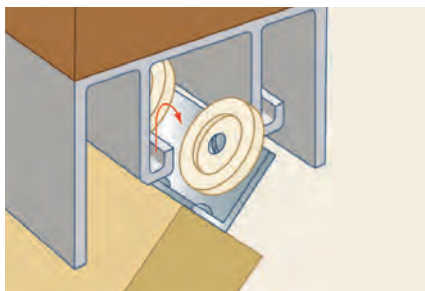
If a door is tilted so its side is not parallel to the doorjamb, adjust one or both of the top rollers.

There should be a $\frac{3}{8}$ -inch clearance between the bottom of the door and the floor or rug. If a door is tilted outward or inward, the bottom guide needs to be moved so

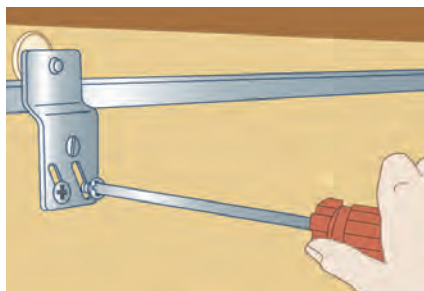
the door can hang freely.

Some bypass doors are made of inexpensive particleboard, which is subject to warping. If you cannot compensate for a warped door by adjusting the top roller or moving the bottom guide, then replace the door.

Three fixes for a bypass closet door



REMOVING AND REINSERTING A DOOR Lift the door straight up and angle it to lift the rollers out of the track. Some top-hung doors have slots on the track that you must align with the rollers before you can lift the door out or reinsert it. You may have to remove the floor guide first.



ADJUSTING DOOR HEIGHT To adjust a top roller, loosen one or two screws, move the door up or down, and tighten the screws. If adjusting the door causes it to scrape the bottom guide, you may need to trim or plane the door.



ADJUSTING THE BOTTOM GUIDE If the guide is loose, the doors will bind. Align the guide so the doors hang plumb and slide freely, then drive longer screws to ensure the guide will stay put. If the door doesn't reach the guide, install a block of wood under it.

POCKET DOORS

If you have an old pocket door that has been out of service (and perhaps sealed inside the wall), it may be possible to revive it. In most cases, the upper track is in good shape but the rollers no longer run smoothly. Remove the rollers and look for a manufacturer name. Even if you can't find the maker, you can likely find compatible rollers at a specialty hardware store or by typing "pocket door hardware" into an Internet search engine.

You can typically install rollers by screwing them to the top of the door. If the screws do not grab in the old holes, move the roller over a couple of inches, drill new pilot holes, and drive the screws.

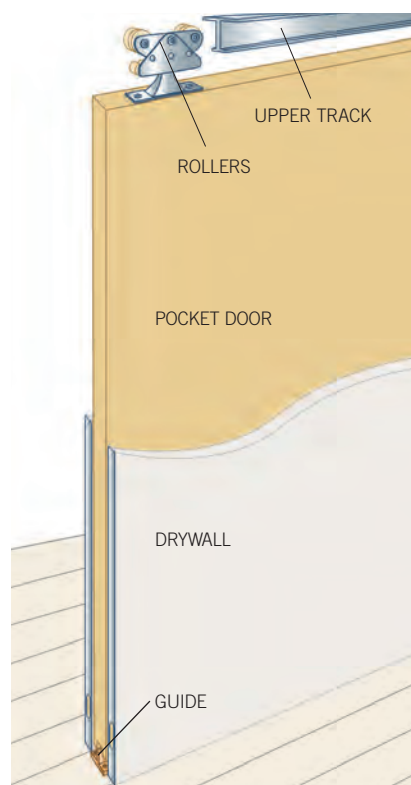
You can probably adjust the rollers up or down by turning a

screw or a nut. If you have a pair of pocket doors, set their sides perfectly parallel to each other.

At the bottom of the door, there is usually a channel that fits over a guide attached to the floor at the jamb. Less commonly, a metal guide at the bottom of the door runs through a metal channel that is set into the floor.

If the track is damaged or if you can't find rollers to fit in it, you can install a new track. You will probably first need to cut two access holes in the wall to the side of the opening so you can drive screws to attach the track.

If you have the hardware but not the door, buy a new door to fit. Install rollers at the top and cut a groove in the bottom of the door to run over the guide.



door locksets

Many exterior doors have a bored lockset of the type shown below. This variety has a round body that fits into a hole drilled through the door. In addition to the lockset, it is a good idea to install a deadbolt lock on exterior doors, as shown on page 72. Some exterior doors, especially front doors, have a mortise lockset, with a squared body that slides into a deep notch in the door's edge. A mortise lock may contain both a latch and a deadbolt mechanism. Most interior doors have knobs or levers, with or without locks. In homes built before WWII, you may find mortise latch assemblies, as shown at right.

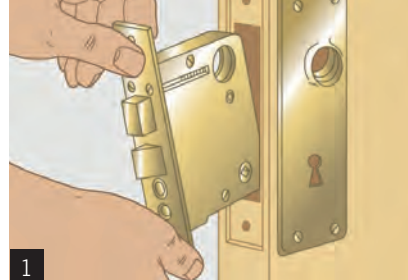
When doorknobs or latches cease to work properly, first check that the door itself is not binding (see pages 62–63). See that the latch or bolt is aligned with the strike plate on the jamb and make adjustments as needed (see page 65). Also try disassembling and cleaning the mechanism. Often, however, replacement is the easiest and fastest solution. And new hardware is a quick way to dress up a door.

If you need to drill holes to install a new lockset, be sure you have the right size hole saw and spade bit on hand (usually a 2½-inch for the lock hole and a 1-inch for the latch hole). A sharp chisel is also a must.



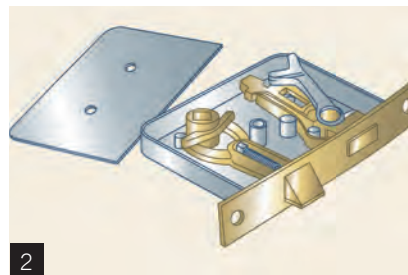
SOLUTIONS FOR A BROKEN KEY

If a key has broken off in the lock, first try using a thin but stiff wire to pry the fragment out. If that doesn't work, disassemble the mechanism and use the wire to push from the other side. Or take the mechanism to a locksmith.

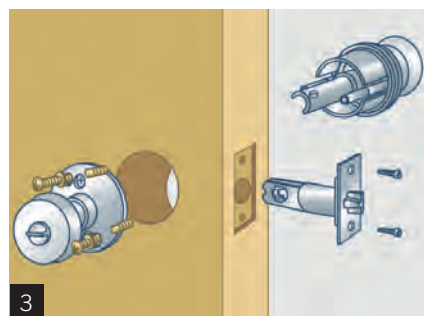


Servicing a mortise latch assembly

1 If scraping paint off the cover does not restore smooth operation, remove both handles. (You may need to loosen setscrews or unscrew a knob.) Remove two screws and pull out the latch case.



2 Lay the case on a flat surface and carefully remove the cover. Examine the inner workings closely. If the parts are in good order, clean out any debris and spray the unit with lubricant. If that doesn't work or if parts are broken, replace the case.

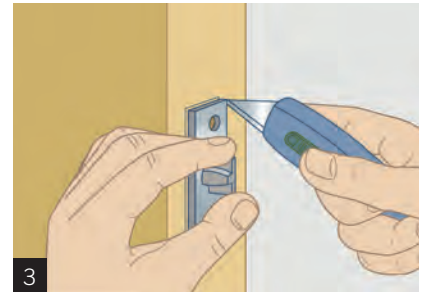
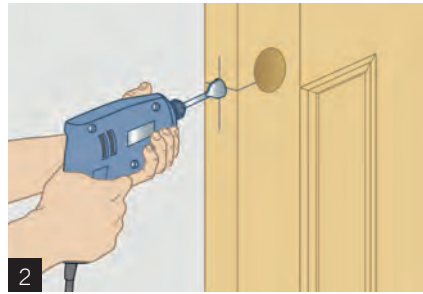
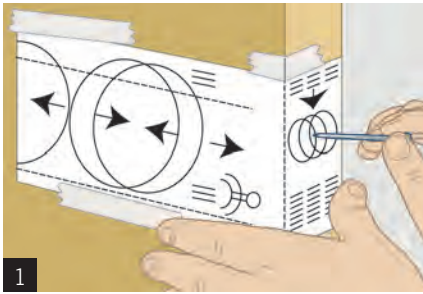


Replacing a typical lockset

1 To take out the interior knob, remove screws from the inside face. If there are none, look for a small slot in the shank. Push the tip of a small screwdriver or nail into the slot and then remove the interior knob and trim.

2 Unscrew and remove the mounting plate. Pull on the exterior handle to slip out the cylinder. Unscrew the latch plate and take out the latch assembly. Remove the strike plate from the doorjamb.

3 Insert and screw on the new latch assembly and latch plate. Holding the exterior knob and cylinder, slide the cylinder in through the latch assembly. Attach the mounting plate, handle trim, and knob. Install the new strike plate.

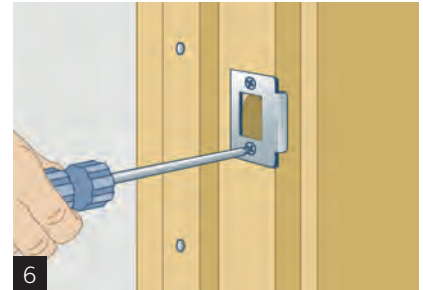
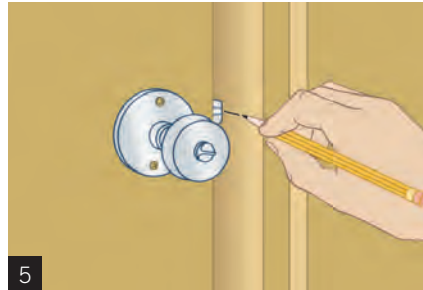


Installing a new lockset

1 A template and instructions should come with your new lockset. Place the knob 36 to 37 inches above the floor (or centered on the lock rail if there is one). Tape the template to the door, then mark the centers of the lock and latch holes.

2 Using a 2½-inch hole saw, bore the lock hole. As soon as the guide bit exits the opposite side of the door, stop and continue from the other side. Use a spade bit to bore the latch hole, as shown. Take care to drill straight, level holes.

3 Insert the latch assembly. Holding it square, trace the outline of the latch plate with a sharp pencil. Then use a utility knife or chisel to score the outline. Alternatively, trace around the latch plate with a utility knife, as shown.



4 With a chisel and hammer, cut into the wood about ¼ inch on all sides. Make a series of cross grain cuts, as if you were mortising a hinge (p. 64). Working from the center toward the ends, tap the chisel to remove the chips. Insert the latch.

5 Install the lockset as shown on the opposite page. Close the door and mark where the center of the latch contacts the jamb. Drill a 1-inch hole through the jamb, centered between the stop and the edge of the jamb.

6 Hold the strike plate in place over the latch bolt and measure how much of the plate overhangs the edge of the door. Now hold the strike plate against the jamb and duplicate the overhang. Trace the outline, cut a mortise and install with screws.

FIXING COMMON LOCKSET AND HANDLE PROBLEMS

TIGHTENING THE HANDLES If the handles on an old mortise latch set are rattling, loosen the setscrew. You may be able to simply twist the handle

to tighten it. If not, remove the knob and look for setscrew holes along the spindle shaft. You may be able to tighten the knobs by inserting the setscrews for both knobs into new holes.

IF A LOCKSET DOES NOT

OPERATE SMOOTHLY If a bored lockset or a deadbolt does not slide smoothly when the door is open, remove the handles or the cover

and watch closely while you operate the mechanism with a screwdriver. If you see a part rubbing against wood, remove the lockset and use a drill or chisel to widen the opening as needed. If the mechanism is balky even when it is out of the door, buy a replacement. If the latch operates smoothly with the door open but has trouble engaging with the strike plate, adjust the strike plate so it aligns with the latch, both vertically and horizontally.



DEADBOLTS

A high-quality deadbolt offers one of the most important measures of protection against intruders. Here we show how to install a high-security deadbolt, which drives a bolt 1 inch or deeper into a metal strike box mounted with long screws that extend into the framing, not just the jamb. This makes it very difficult to jimmy open a door.

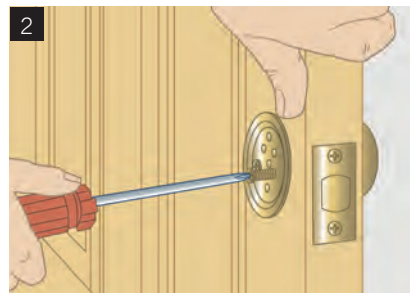
Install a single-key deadbolt with a thumbturn on the inside, unless the door has a glass pane that intruders could break to reach the thumb-screw. In that case, you may want to install a double-key deadbolt. To ensure that people can quickly exit during a fire or other emergency, keep a key nearby.

Installing a high-security deadbolt

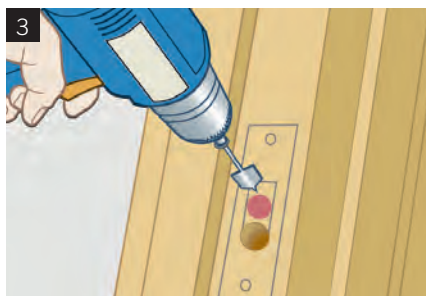
1 Unless you are replacing an old deadbolt, use the manufacturer's template as a guide (as for a lockset, see page 71) and drill holes in face and edge of the door. Mortise for the faceplate, then install the bolt assembly.



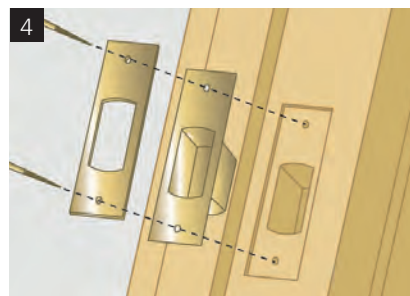
2 Following the manufacturer's instructions, insert the exterior cylinder's tailpiece through the slot in the bolt assembly. Make sure the keyhole is facing the right way. Secure a cylinder-retaining plate, as shown, and then attach the interior cylinder, which may have a keyhole or a thumbturn.



3 Dab the end of the bolt with lipstick, close the door, and turn the handle to mark the center of the strike hole. Use the strike plate to mark the doorjamb for a mortise. Drill two holes, one above the other, through the jamb (and perhaps the framing) and chisel the opening so the strike box can fit (see next step). Cut a mortise for the strike plate.



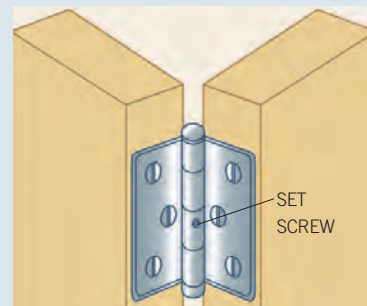
4 Check that the bolt is aligned with the center of the hole. Following the manufacturer's instructions, insert the strike box, then the cover plate. Drive long screws through the jamb and into the framing behind. Depending on the model, the strike box may or may not be attached separately. (No strike box is needed if the doorjamb is made of metal.)



MORE SECURITY DEVICES



REINFORCER PLATE A metal plate like this makes it very difficult to pry a door open, and it makes a door-handle lock much more secure. To install one, remove the handles, slip the plate into place, drive screws, and reinstall the handles.



SECURITY HINGES If your exterior door opens out, an intruder can simply pop the hinge pins and remove the door. Security hinges use studs or setscrews that make it impossible to separate the hinges when the door is closed.



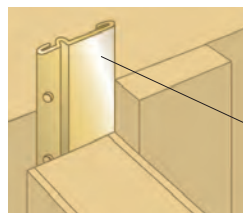
PEEPHOLE A wide-angle viewer like this lets you see who's at the door. To install one, simply drill a hole, insert the pieces from each end, and screw them together. Some models come with installation kits.

weather-stripping a door

Doors are easier to seal than windows because they have fewer moving parts. Doors use some of the same products for weather-stripping as those used for windows (see pages 60–61). Spring bronze or plastic V-strips do a good job at the top and sides. The bottom should be sealed with a weather-stripping threshold, a sweep, or a shoe.

To add weather stripping so it doesn't cause binding, it's best if you first even out the gaps around the door (see pages 62–63). As you work, check that the weather stripping is not causing the door to bind or the latch to become difficult to operate.

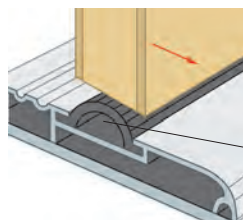
Before doing any of this work, check with your utility company to see if you qualify for a free or inexpensive energy audit (see p. 92), which may include weather stripping.



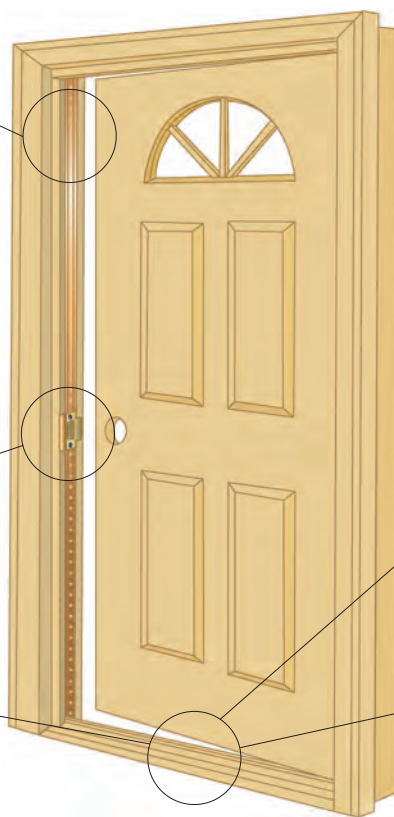
SPRING BRONZE WEATHERSTRIPPING



SPRING BRONZE AROUND LATCH



RUBBER GASKET THRESHOLD



DOOR SWEEP



DOOR SHOE

Sealing the sides and bottom

SPRING BRONZE First cut a short strip of spring bronze for the latch area, to fit behind the strike plate up against the doorstop. Then measure and cut longer strips and attach them with brads to the sides and top of the doorjamb.



TUBE GASKETS WITH METAL BACKING To add an extra measure of protection, close the door and cut pieces of tubular plastic-and-metal weather stripping. Press gently against the door and drive screws or nails to attach it.



DOOR SWEEP This is the simplest seal to apply to a door bottom, because you can leave the door on its hinges. Cut the sweep to match the width of the door. Close the door, position the sweep so it contacts the threshold, and drive screws.



DOOR SHOE Door shoes make a better seal than sweeps. You will probably need to trim the door to allow for the thickness of the shoe. Remove the door and cut it. Cut the shoe to the width of the door, slip it on, and attach it with screws.



door thresholds and sills

Exposed to the elements and to continual foot traffic, the sills and thresholds at exterior doorways may eventually need to be replaced.

The sill, which is usually wood, forms the bottom of the frame of an exterior doorway and serves the same function as a windowsill, diverting water from the door and house. The sill fits snugly against or under the jambs, and the casing rests on the sill.

A threshold (or saddle) sits on top of the sill and helps seal the air space under a door. Thresholds are usually screwed or nailed in place and are available in either hardwood or metal (usually aluminum). Some thresholds have a replaceable rubber gasket that act as weather stripping (see page 73).

REMOVING A THRESHOLD OR SILL

A threshold can usually be removed without disturbing the doorframe, either by removing screws or prying up nails. A sill must be removed carefully to avoid damaging the jambs, casing or any flashing under the sill. If necessary you can cut a sill and remove it in pieces, as you would a windowsill (p. 55)

INSTALLING A NEW THRESHOLD OR SILL

If possible, use the old threshold as a template for cutting the new one. Check that the clearance between the bottom of an exterior door and the new threshold is about $\frac{1}{8}$ inch. If it's less, mark the bottom of the door using the new threshold as a guide, then sand or trim the door to fit. If you are adding weather stripping at the door's bottom, follow the manufacturer's recommendations for clearances.



Installing a wood threshold

1 Mark the new threshold to fit between the jambs and around the stops. Cut it with a handsaw or a jigsaw. Sand all cut edges. Apply one coat of paint or varnish to all sides before installing.



2 Caulk the underside and ends, then center threshold under door. Drill pilot holes and nail it with 6d or 8d galvanized finish nails. Countersink and fill the holes. Finish the threshold as desired.



Replacing a sill

1 After removing any nails, drive out the old sill or saw it into three pieces and remove the center, then the ends. Take care not to damage any flashing underneath.



2 Using the old sill as a template, mark and cut the new sill to fit. If the old sill isn't in one piece, use the ends as patterns for the cuts, but carefully measure the opening to determine length.

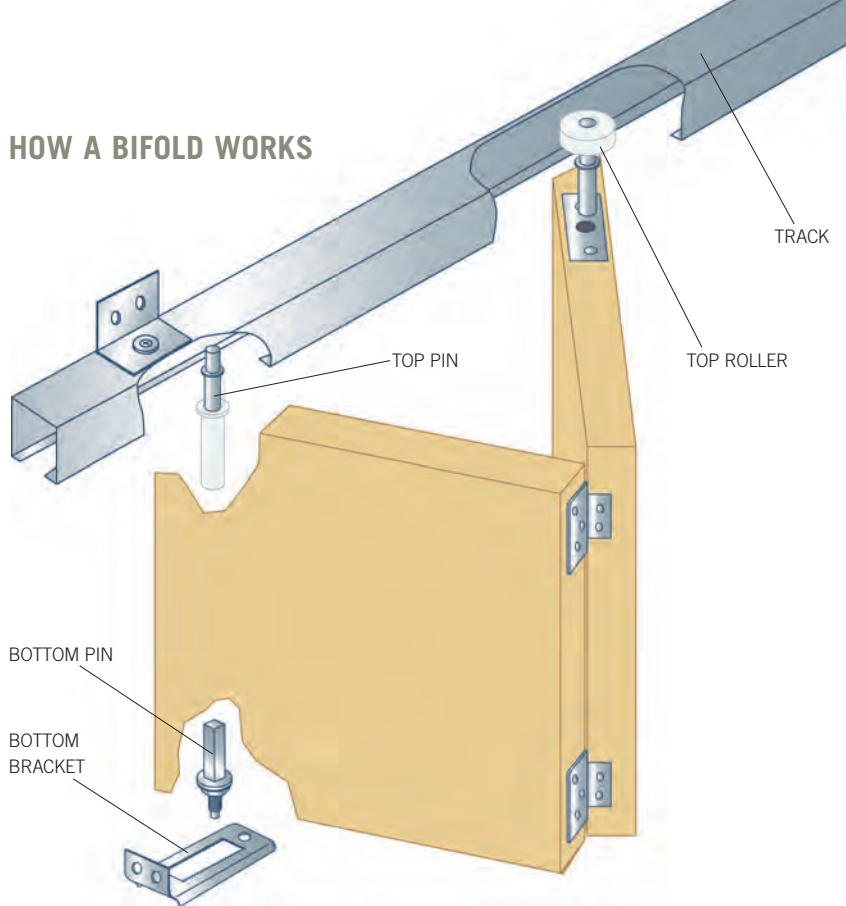


3 Finish all sides of the sill before installing and flash underneath with metal or self-adhering membrane. Tap the sill into place, using a block of wood to protect it.



4 Shim the sill if necessary. Drill pilot holes and drive galvanized nails or screws into the framing below. Sink the fastener heads and fill the holes with putty.

HOW A BIFOLD WORKS



repairing bifold doors

Bifold closet doors are usually lightweight, with light-duty hardware to match. Some are flush with hollow cores. Others are made of panels, perhaps with one or two louvered sections. Most repairs are simple. If one panel of a bifold door is damaged, buy a new set of two. It's not worth the

small amount of money you'll save by trying to assemble an old panel onto a new one.

The doors should line up parallel to the side jamb. If there are two sets of bifolds, they should meet in the middle just tightly enough to gently snap shut. If they do not, you can easily adjust the

door positions at the top or the bottom.

If a door scrapes the carpet even after it has been adjusted as high as it will go, cut the bottom following the techniques shown on page 66, then deepen the hole for the bottom pin. After the door is cut, you may need to shim the bottom bracket.

To remove a bifold set, simply grab the side of the door where the pivot pins are, pull up, and tilt the bottom out. If the door will not come out, lower the door as far as it will go, and try again.



REPAIRING A PIN OR ROLLER

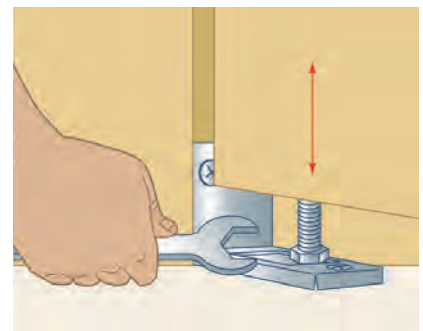
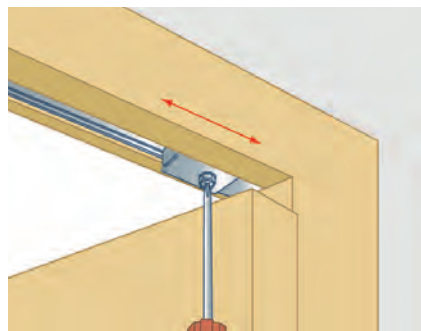
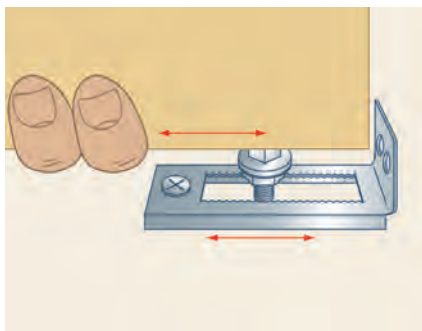
Bifolds sometimes crack around a top or bottom pin or roller. If this happens to yours, purchase a repair pin or roller, which has a bracket that spans the pinhole. To install it, drill pilot holes and drive screws.

Three bifold fixes/adjustments

ADJUST AT THE BOTTOM To move the bottom of the door to the left or right, grab the door near the bottom pivot pin, pull up until the pin disengages from the bracket, and move the pin over.

ADJUST AT THE TOP To move the top of the door to the left or right, open (fold) the door until the top bracket is accessible. Use a screwdriver to loosen the bracket's set-screw, slide the bracket over, and retighten the screw.

ADJUST THE HEIGHT To raise or lower the door, use an open-end wrench or a pair of pliers to grab the bottom pin's nut and twist it. If the door is heavy or the pin is difficult to reach, remove the door before making adjustments.



resurfacing cabinets

If your kitchen cabinets are ugly but in sound condition on the inside, and if you don't need to change their sizes or orientation, there are a number of sprucing-up strategies that can be accomplished inexpensively. The simplest is to apply a good coat or two of paint, as described on this page. If you install new hardware (see page 78) while you're at it, you could end up with an entirely new look. Applying veneer, drawer faces, and doors, as shown on the next page, will cost more but may not take much more time than applying two coats of paint.

PAINTING CABINETS

Whether you want to lighten dark and dingy cabinets or liven up your room with bold colors, paint can provide a relatively quick makeover. However, not all cabinets can be painted. Solid-wood or wood-veneer cabinets take paint well, as do metal ones. Cabinets covered with plastic laminate or thinner melamine plastic cannot be painted, as paint will not bond properly.

You can paint cabinetry with a bristle or foam brush, a roller, a pad, or a spray gun. Brushing paint on large surfaces will leave brush marks; a foam brush or a pad will leave less visible marks. Sprayers are expensive and require an enclosure to contain overspray. Rolling is fast and inexpensive, and it works exceptionally well on large surfaces. A short (4- or 6-inch) foam roller is a good choice because it lets you cover the frames with a single stroke and also quickly handle wider doors.



AMERISPEC® TIP

THE RIGHT PAINT

Oil- or alkyd-based paint with a satin or semigloss sheen makes for the most scrubbable surface. If oil-based products are not sold in your area, high-quality water-based paints are nearly as satisfactory.

Painting cabinets

1 Although you can try to paint your cabinetry with the doors and drawers in place, it's a lot easier to remove them. Number the doors, drawers, and hardware first to make them easy to replace when you are done painting. Then remove all hardware—including screws, hinges, knobs, and pulls—and set aside whichever ones you will reuse. Remove the drawers.



2 Thoroughly clean all surfaces with trisodium phosphate or a TSP substitute. Rinse the surfaces completely with fresh water and allow them to dry. If you will install new hardware, fill all the mounting holes with putty and allow it to dry. Sand all surfaces with 150-grit open-coat sandpaper and then vacuum to remove any dust. Wipe with a slightly damp cloth or a tack rag (depending on the paint you'll use).



3 Mask all adjacent surfaces and use drop cloths to protect countertops and flooring. First paint the frames, then doors and drawers. You may choose to paint only the faces, as shown; the faces plus the edges of the frame pieces; or the insides of the cabinets as well. In the last two cases, you will need to use a brush. Also paint the insides of the doors.



4 If you need an additional coat, allow the first coat to dry overnight, then sand all surfaces with 220-grit wet/dry sandpaper. Vacuum thoroughly, wipe, and apply the next coat. Once the paint is dry, reinstall the drawers and doors.



RESURFACING WITH NEW DOORS, DRAWER FACES, AND VENEER

Veneering is tricky, so consider hiring a cabinet resurfacing company for this job. It will cost more but go faster and the company may have a wider range of colors and styles to choose from than you can find.

You will need to buy new drawer fronts and doors, as well as matching self-adhesive veneer for the frames and 1/4-inch plywood for any exposed cabinet sides. If a home center does not have what you want, look for

sources online or see if a refacing contractor will sell you materials.

First, cut plywood to fit over exposed cabinet end panels and make sure it fits exactly. Apply contact cement to the back of the plywood and to the surface to be covered and allow it to dry. Press the plywood into place very carefully, as you cannot move it once it's set.

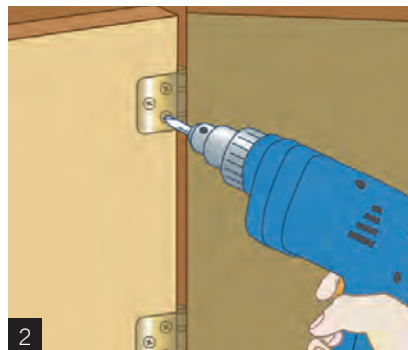
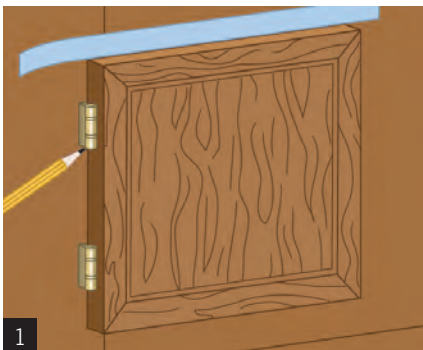


Veneering the face frames

1 Cut strips of veneer to length with a sharp knife and a straight-edge. Press the veneer into place as you peel off the backing. Cover stiles first, then rails.

2 Using the sides of the frame as guides, carefully cut away the excess veneer with a utility knife.

3 Use a hard rubber roller to press the veneer into place and activate the adhesive. Gently sand the edges smooth.



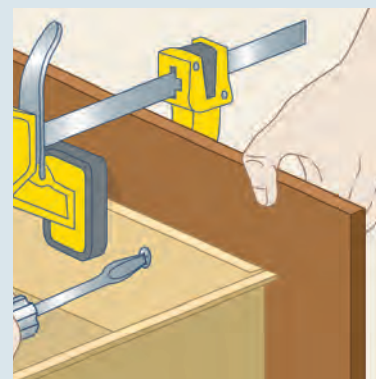
Installing new doors

1 Install the hinges on the cabinet. Apply a piece of blue painter's tape on the face frame to indicate where the top of the door should align. Hold the door in place against the hinges and even with the tape, then mark the hinge locations.

2 Use a square to transfer the marks to the back of the door. Open the hinges, align the door with the marks, and mark the screw locations. Drill one pilot hole and drive one screw into each hinge. Test the fit, then drill holes and drive the other screws.

INSTALLING A DRAWER FACE

From inside the drawer, remove the screws holding the old drawer face. Close the drawer and position the new face, using double-stick tape. Open the drawer carefully, clamp the face, and drive screws to secure it.





REPLACING HINGES, CATCHES, AND PULLS

Changing door and drawer pulls can greatly improve the look of your cabinets, and replacing hinges and catches may make them operate more smoothly.

HINGES If your cabinet doors droop or shut poorly, first see if the hinges are adjustable (many are) and adjust them with a screwdriver. If they aren't adjustable, look for loose screws and tighten them (you may need to insert toothpicks and

glue in the holes). If the hinges themselves are loose or damaged, replace them.

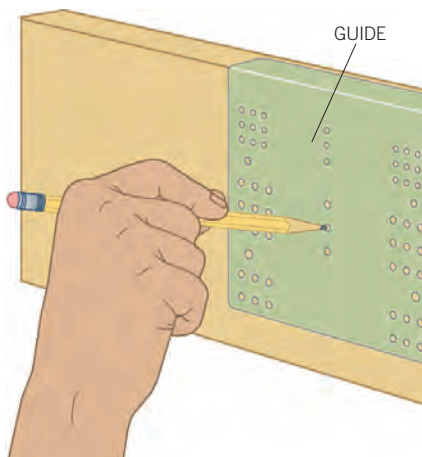
Take an old hinge with you when you buy replacements. If possible, get new hinges with holes in the same places or try to find hinges that will cover the old holes. Otherwise you will have to fill and sand some screw holes.

CATCHES AND LATCHES When catches wear out and lose their holding power, replace them. Magnetic catches don't have to be precisely

aligned. Friction and roller catches have more holding power but must be installed precisely. Push latches have a high-tech feel, as they open a door when you push on it.

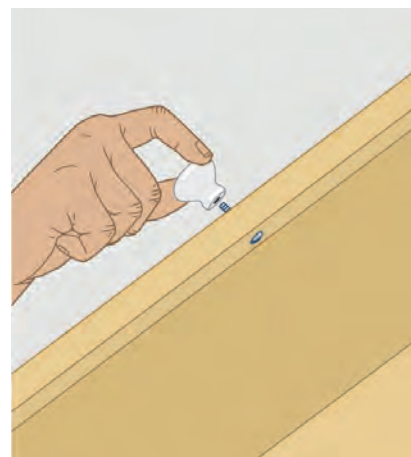
PULLS AND KNOBS A knob attaches with only one screw, so knobs are easy to replace. If you want to replace pulls, which use two screws, make sure the holes align. Otherwise you will need to fill, sand, and redrill holes.

Tips for installing knobs and pulls



Install pulls carefully; a mistake in drilling can be hard to hide. Use a template as a guide to drill new holes and ensure that all the pulls will be the same distance from the edge. You can buy a template or make your own from cardboard or plywood.

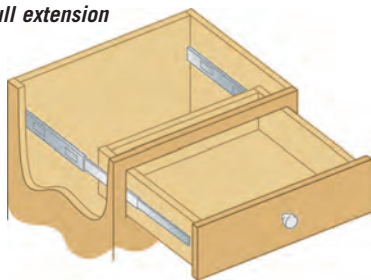
To install a door pull or knob, drill the exact hole size recommended by the manufacturer. Poke the screw through the hole. Drive the screw or screws into the pull.



REPLACING DRAWER GLIDES

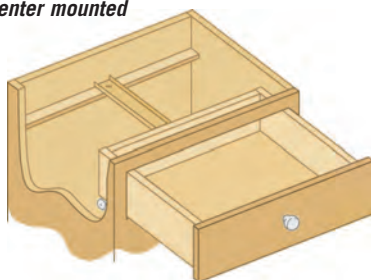
Cabinet drawers are usually mounted on metal glides, or slides. Quality glides allow drawers to be pulled out smoothly and silently. Cheaper models rattle and may let the drawer droop when extended. Solid metal glides with ball-bearing or nylon rollers are recommended. The best of the bunch have bumpers to cushion the impact of the drawer as it closes, so the drawer stays in place instead of bouncing open again.

full extension



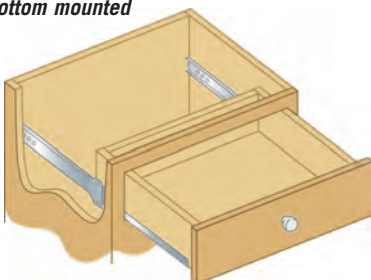
Glides can allow a drawer to open three-quarters of the way or fully. Full-extension glides are usually worth the extra cost because they make it easier to get items from the back of the drawer.

center mounted



If you have older center-mounted glides, you should replace them, as just about any newer model will work better. Drawer glides are available at hardware stores and home centers and are easy to install if you follow the manufacturer's instructions.

bottom mounted



CLEANING AND REPAIRING COUNTERTOPS

STAINS

Use a mild dishwashing solution for regular cleaning. For stubborn stains, follow these tips:

CERAMIC TILE The grout is usually the problem area. Clean it with a solution of bleach and water. Once clean, it should be sealed with grout sealer.

GRANITE If your granite is not sealed, you may need to remove stains. Make a paste by mixing a cup of flour with 2 tablespoons of liquid dishwashing soap. Apply it to the stain, cover with plastic wrap, and let it sit overnight. Scrape away the mixture with a wooden utensil and rinse. If the stain is oil-based (containing grease, oil, or milk), use hydrogen peroxide instead of dishwashing soap. For coffee, tea, or fruit stains, mix hydrogen peroxide with a couple of drops of ammonia. Use straight hydrogen peroxide to remove ink or marker stains. Once the stains are removed, apply a granite sealer and reapply it every year or two.

PLASTIC LAMINATE Avoid abrasive cleaners. For stains, apply a paste made of lemon juice and baking soda. Let the paste dry, then rub vigorously with a damp cloth. For ink, try rubbing alcohol.

SOLID SURFACE (Corian and others) Use scouring powder and a damp sponge to scrub away stains. Smooth away minor burns, scratches, and other blemishes with sandpaper. Start with 200- or 300-grit, followed by a very fine (800-grit) sanding. Apply countertop polish (see "Worn finish").

WOOD OR BUTCHER BLOCK Seal regularly with bar wax or apply a thin coat of mineral oil when the wood looks dull. Let the oil soak in for an hour and then wipe away any excess.

REPAIRING DAMAGE

For damaged counters, home centers carry products that can help you make the best of the situation. Read the fine print to be sure the product you purchase is recommended for the surface you need to repair.

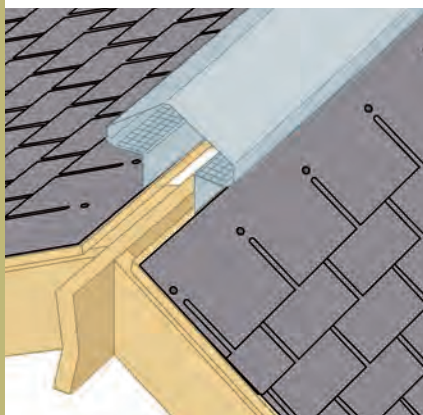
SCRATCHES AND CRACKS Look for a colored filler specially formulated to fill in cracks and scratches. It is inexpensive and easy to use. Apply it to a clean surface following the manufacturer's instructions, then wipe off any excess.

CHIPS The tricky part is matching the countertop color. Look for a kit that contains a repair compound in a variety of colors, together with a mixing chart. Once you have the desired color, apply the compound to the damaged area and let it dry. It will harden as it dries. Then sand and apply a clear finish over the repair.

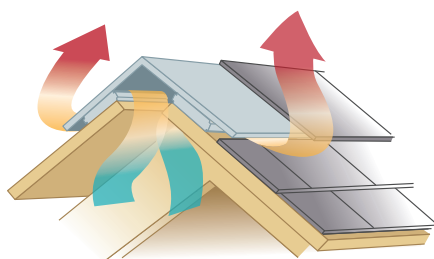
WORN FINISH If your plastic laminate counter has lost its luster in heavy work areas, look for a counter polish product that contains silicone. Clean the surface and apply the polish. Let it dry and then buff the area. Apply every few months, following manufacturer's instructions, to keep your counter looking new and clean.

LOOSE COUNTER EDGES If you have a plastic laminate counter that is peeling along the top or edge, you can glue it back in place with contact cement. Follow the manufacturer's instructions carefully. The glue needs to dry to the touch before the loose area is pushed into final position. Put a weight on the area or tape it to hold it in place. Let it dry for 24 hours and then lightly sand or file any overhanging edges.

basements and attics



RIDGE VENT DETAIL



HOW A VENT WORKS

The basement and attic are important parts of a house's structure. Keeping them well ventilated and insulated, and keeping cracks sealed, will go a long way toward making your home more comfortable and holding down energy costs.

BASEMENTS An old basement may have walls made from bricks or stones held together with mortar. Most basements have walls of concrete block or poured concrete. Basement floors are almost always made of poured concrete. If you have an old basement with a dirt floor, consider hiring a contractor to pour a concrete floor. You may be able to lower the floor at the same time, which will give you more headroom.

A basement should have at least one drain hole in the floor, preferably more. Keep the hole covered with a drain plate, and keep the area around it clear so water can easily get there in case of a plumbing leak or a flood. Run a hose to test that the drain works. It should be joined to a pipe that leads outside the building, or to a dry well (a hole in the ground filled with gravel). Many towns prohibit hooking up basement drains to their storm drains; make sure you check with your municipality, a plumber, or your local building department if you are not sure. If the drain does not

Controlling Moisture in a Basement 82

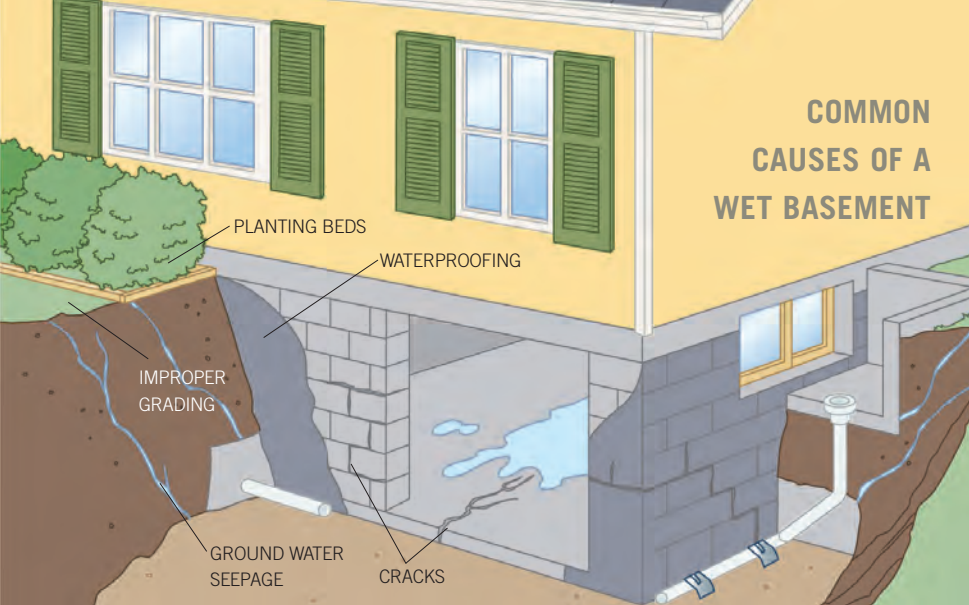
Insulating and Ventilating a Home 86

*Getting Professional Help—
An Energy Audit saves money
on home energy costs* 92

AMERISPEC® TIP

WATCH YOUR STEP IN THE ATTIC

If an attic floor has exposed joists and/or insulation, be very careful when walking around. One misstep between the joists and you could poke your foot through the ceiling below. If you need to work in the attic, or if you want usable storage space, place pieces of plywood up there and fasten them to the joists.



work, use a power auger to clear it. If that doesn't work, contact a plumber for other solutions.

The most common basement problem is water seeping through the floor or walls. This chapter shows how to keep a basement dry. In many cases, several measures should be taken, including adding a sump pump, extending gutter downspouts, improving grading around the house, and dehumidifying the basement.

If you have a crawl space instead of a basement, there are usually fewer maintenance issues. Make sure that the space is well ventilated and that no puddles of water remain after a rain. Make sure rot is not developing where the house's wooden beams or joists meet masonry supports.

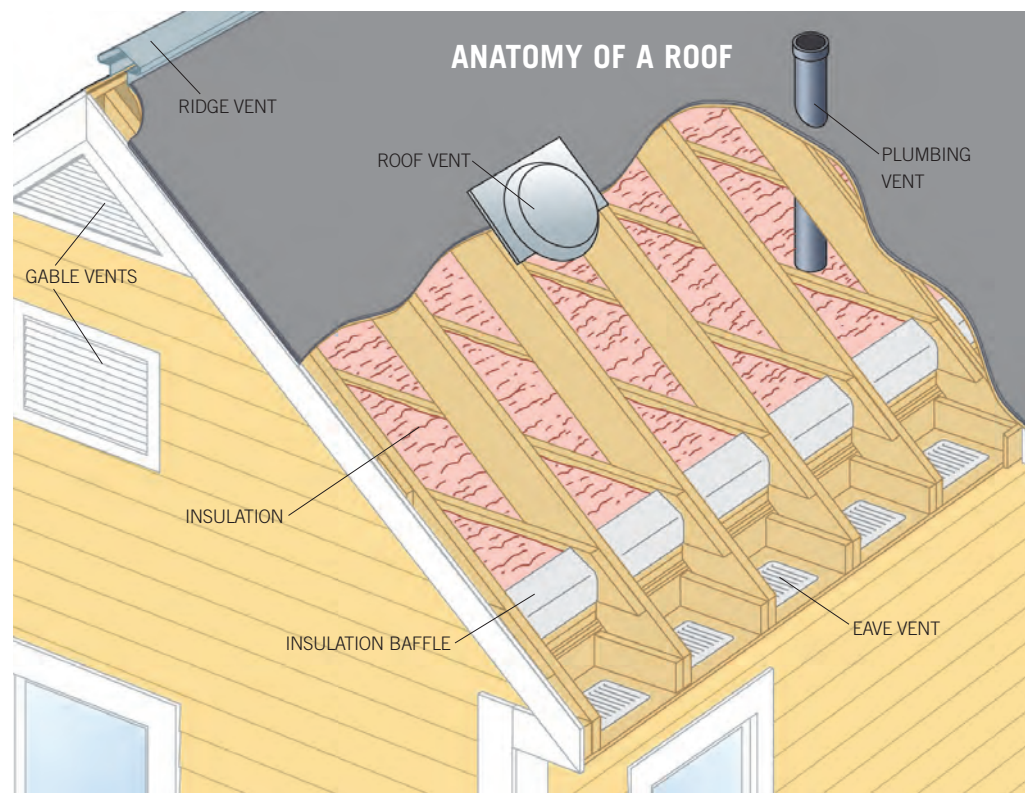
ATTICS It pays to spend half an hour periodically checking out your attic. Bring a flashlight or droplight and inspect the attic floor and ceil-

ing. A minor roof leak may not appear inside the house until it becomes a serious problem. If you notice signs of leaking, see Chapter 8 for roof repair information.

Because heat rises, insulating an attic and sealing air leaks is often the best way to make a home more energy efficient. At the same time, however, an attic must be well ventilated or moisture will collect and cause all sorts of problems. If it snows in your

area, compare your roof with others of a similar pitch in your neighborhood. If snow has melted on your roof and not on others, then you are probably losing too much heat through your roof. In summer, place a thermometer in your attic near the top of the roof. If it registers more than 20 degrees warmer than the outside air, you probably need additional ventilation.

Usually, the best approach is to add insulation to the conditioned space while making sure that air can flow freely up through eaves and out the ridge vents or the gable ends. This chapter will show you general insulation and ventilation strategies, as well as techniques for installing some of the most common insulation materials.



controlling moisture in a basement

Water problems in the basement range from damp walls and floors to water gushing from cracks and standing water on the floors. The source may be humid air condensing on cool surfaces, or groundwater finding its way in. Before you can correct the problem, you'll need to determine the source of the water.

WHERE'S THE WATER COMING FROM?

If you can see water flowing out of a crack in a wall or floor, you know the source is groundwater. Otherwise, you'll have to perform the aluminum foil test (see opposite sump) to see if water is coming from the ground outside or from moist air inside.

REDUCING CONDENSATION

When the basement air is humid, the moisture in the air may condense on cool surfaces, such as a concrete floor, plumbing supply pipes, and duct work.

The following suggestions will help to lower the air's humidity or reduce condensation:

- Check that the clothes dryer is efficiently venting moist air to the outside.
- Install a dehumidifier in the basement (either have the collected water run into a drain, or plan to empty the tray daily).
- Make sure basement windows and exterior doors are closed tight when you operate a dehumidifier. Otherwise you'll just draw humid exterior air into the basement.

- Insulate cold-water pipes (see page 153).
- Insulate basement walls (see page 89).
- Cover exposed soil with 6 mil plastic sheeting.

CONTROLLING GROUNDWATER

When water collects next to a foundation wall, or when the water table (the water level under your property) is higher than your basement floor, hydrostatic pressure can force water through joints, cracks, and porous areas in concrete walls and floors and through cracked or crumbling mortar joints in masonry walls. Poor construction practices are frequently the cause. These include easily clogged or nonexistent footing drains, poorly applied or nonexistent moisture-proofing on the foundation, through-the-wall cracks, and improper grading.

Minor problems can often be solved with some fairly simple steps. If they don't work, contact a foundation engineer or contractor for a more lasting solution.

EXTERIOR REMEDIES

Roof and surface water collecting next to the foundation can cause dampness in the basement. Use the following checklist and correct any problems you find.

- Gutters and downspouts should

be clear and should direct rainwater well away from the foundation. A splash block or downspout extension may be the solution (see opposite page).

- Check that your grading directs rainwater away from the house. The ground should drop at least 6 inches for the first 10 feet from the foundation walls.
- Planting beds next to the foundation may allow water to collect or pool there. If they do, move or modify the plants.
- Wells around basement windows should be free of debris, have good drainage, and be properly sealed at the wall. See that the surrounding ground slopes away from the well.

INTERIOR REMEDIES

Minor moisture problems can sometimes be solved from the inside.

- For a general moisture problem on basement walls, brush or roll on damp-proofing elastomeric rubberized paint or trowel on crystalline waterproofing (CWM).
- Patch cracks in walls and floors with hydraulic cement (see page 84).
- If you cannot seal a basement floor or wall crack yourself, hire a professional basement sealing company. They will likely use special equipment to inject epoxy into the crack. For homeowners who want to try this themselves, there are kits on the market that are effective and easy to use.
- Many basements have a sump pump. See page 85 for maintaining and replacing a sump pump.



AMERISPEC® TIP

WATCH THOSE CRACKS

If you see horizontal cracks in a wall that's bowing inward, or long, vertical cracks wider than ¼ inch, or a crack that's getting wider (measure it periodically), you likely have a structural problem. Call a contractor who specializes in basement repair.



SEEPAGE OR CONDENSATION?

To test whether moisture is seeping through the wall or is simply the result of humid air, tape a 12-inch-square piece of aluminum foil tightly to a basement wall in an area that tends to get wet.

After three days, peel back the foil. If the room side is wet, you have damp basement air. Lower the moisture in the air with a dehumidifier. If the wall side is wet, you've got seepage; follow the advice on the next four pages.



Diverting rainwater

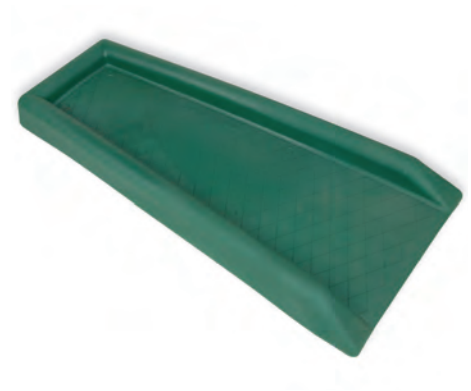
A downspout extender easily attaches to the bottom of the downspout. Some types are flexible.

A roll-up extender stretches



outward when it fills with water. It works well on smooth areas.

A splash block extends the flow of water away from the house and directs the water toward a wider area.



Make sure that the ground at the end of any downspout extender slopes away from the foundation. Otherwise, diverted water will flow back toward the building.



Efflorescence

1 A powdery white substance called efflorescence sometimes forms when bricks or other masonry materials stay moist for long periods.



2 Follow the steps above for diverting water away from the wall. Once you are sure it will stay dry, remove most of the efflorescence with a scraper and a wire brush.



3 Clean efflorescence with a masonry cleaner. Many cleaners contain muriatic acid, so be sure to wear protective clothing when working with them.

WATERPROOFING PAINT

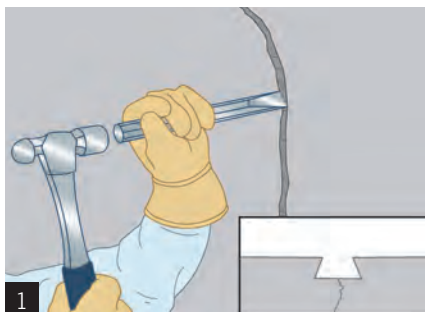
Once you have directed most of the water away from the house, apply the first coat of elastomeric masonry paint with a stiff brush, working it into the masonry. Apply the second coat using a paintbrush or roller.



Applying crystalline waterproofing (CWM)

1 Scrape away any loose matter and wire-brush the wall so the waterproofing can penetrate it. Mix a small amount and then apply it with a trowel, pushing as you spread.

2 Immediately run a stiff brush over the material to create a fairly even texture. Cover the area with plastic or occasionally mist it to keep the coating moist for two days while it cures (dries).



Patching a wall crack

1 Chisel out any crack wider than $\frac{1}{8}$ inch, undercutting it (see inset) and beveling the edges. Clean out the crack. To detect leaks, turn on a garden hose directly outside.

2 Once water starts to come through the crack, mix a small batch of hydraulic cement to the consistency of putty and roll it into a rope shape.

3 Press the cement into the hole and keep pushing until the leak stops. If it doesn't stop, pry out the patch, rechisel, and try again.



Patching a floor-to-foundation joint

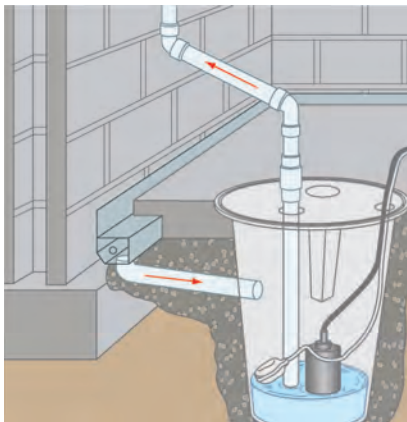
1 Wearing goggles, chip out the joint with a hammer and cold chisel to make a groove 1 to 2 inches deep. Undercut the edges.

2 Clean out the groove. Pour a soupy mixture of hydraulic cement from a bent coffee can to within $\frac{1}{2}$ inch of the top of the groove.

3 Fill the rest of the groove with a stiffer mixture of the cement, and use a trowel to cove it several inches up the wall and along the floor.

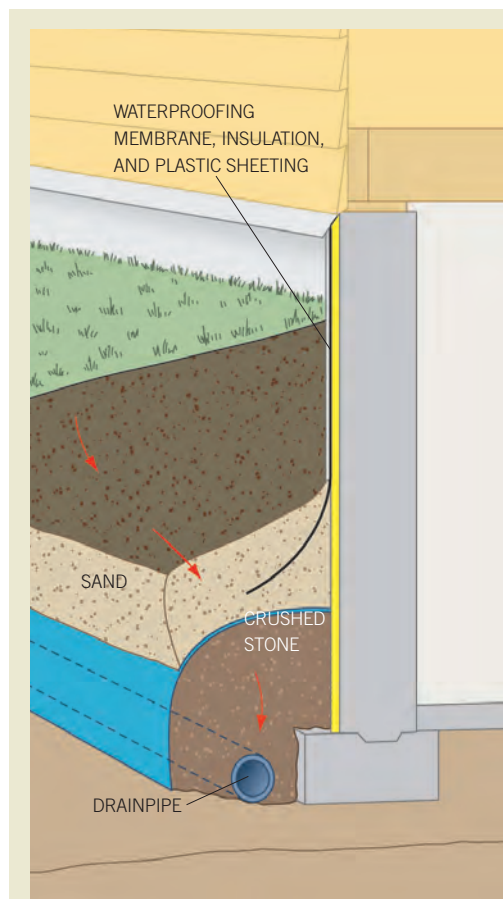
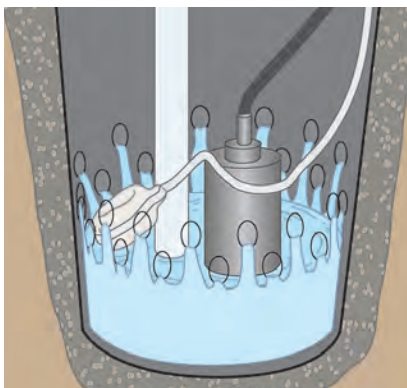
SUMP PUMP

A sump pump collects groundwater in a container mounted below the basement floor level, then pumps it out of the container and away from the house. In an older home, the pump may simply sit in a pit in the basement floor. More commonly, it rests in a plastic liner or section of flue tile.



In many cases, a series of drainpipes, which may be made of clay or plastic, bring water into the sump liner via a single pipe that runs into the liner, as shown above. In other installations, there is no drainpipe. Instead, the pit liner is perforated with a number of holes and set in a bed of gravel so water under the basement floor can seep into it from all directions, as shown below.

If you have no sump pump and often have standing water or a very moist basement floor, installing one may be more practical than



THE PROFESSIONAL SOLUTION

If the steps here do not solve a serious basement water problem, call in a specialist. The solution is often to dig a trench next to the leaking wall, then apply waterproofing membrane, rigid insulation, and thick plastic sheeting to the outside of the wall. Flashing may be installed on top of the insulation. A perforated drainpipe is typically installed near the bottom of the wall, sloped away from the house, and surrounded with crushed stone. Sand or other backfill is laid on top of that, and the plastic sheeting is embedded so it is angled away from the house. Finally, topsoil and sod or other plants are added.

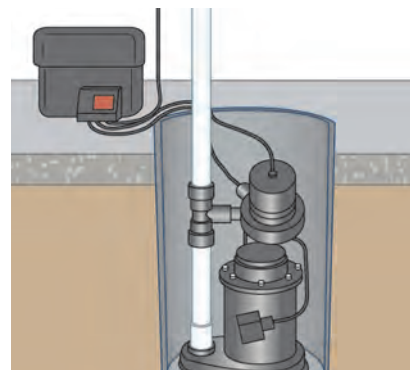
digging a trench around the house and sealing the basement walls (see box above). A professional can install a sump pump with a perforated liner in a basement that lacks underground drainpipes.

There are two basic types of sump pump. A submersible model sits in the bottom of the sump container. A pedestal pump protrudes up out of the liner. A submersible is quieter but more expensive. Both types are controlled by a float-operated switch, so they turn on when the water reaches a certain level.

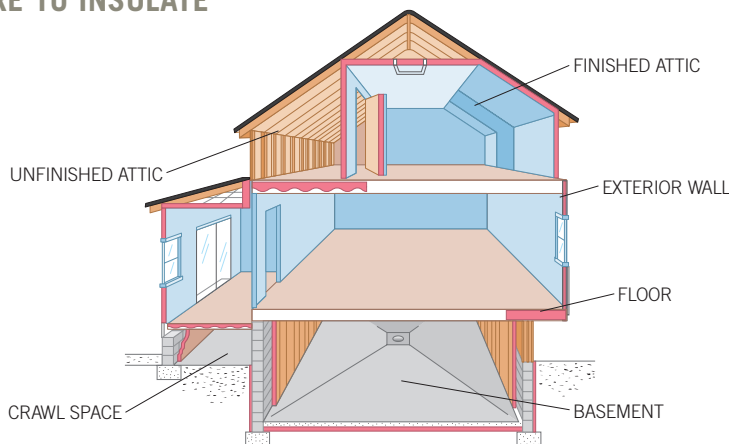
Because electrical power is often interrupted during a storm—when you are likely to need the pump—it's a good idea to install a pump that can also run on a rechargeable 12-volt back-up battery (see right).

Test a pump by running water into the liner. The pump should kick on and run without exces-

sive noise, which can indicate a pump that's on its last legs. Clean the inlet screen every year or so. Pumps typically last about 20 years, so don't be surprised if you need to replace one. Unplug the pump and disconnect it from one or two pipes, carefully noting how things are connected. Buy a replacement with the same connection points and replace any rubber connectors while you're at it. If the installation is not clear to you, hire a pro.



WHERE TO INSULATE



insulating and ventilating a home

For a home to remain comfortable and energy efficient, it must be well insulated and well ventilated. The primary focus of insulation is the attic, though the next five pages will also touch upon wall insulation.

INSULATION BASICS

Heat passes through ceilings, walls, and floors from the warm side to the cool side. Insulation slows this transfer. A well-insulated house requires less heating and cooling—and therefore lowers energy bills.

In an unfinished attic, you can easily measure insulation thickness. To check finished exterior walls for insulation, remove a receptacle cover plate near the baseboard (after shutting off power). Reach into the wall beside the box with a

coat hanger bent into a hook and fish out some insulation.

The illustration above shows where to check for or add insulation. A climate map and companion chart on the opposite page show how much insulation you need, depending on where you live.

UNDERSTANDING VENTING

In hot weather, good ventilation keeps attics from overheating and radiating heat into living spaces below (A, top right). When an attic is not well ventilated, the heat flowing from the attic causes your air conditioner to work harder. Even when attic floors are well insulated, heat can seep down into the house. Installing a series of vents will allow warm air to flow up and out of the attic, to be replaced by cooler air

THE VALUE OF FANS

Some parts of your house need to be well ventilated in both summer and winter. In hot weather, a whole-house fan mounted on the attic floor can pull cool outside air through the entire house and substantially reduce the amount you spend on air conditioning.

But before you rush out and install a whole-house fan, consider that some energy experts think a fan could draw polluted air from basements, garages, and utility rooms (all areas where you probably store gasoline, paints and other noxious chemicals) into your home's living areas.

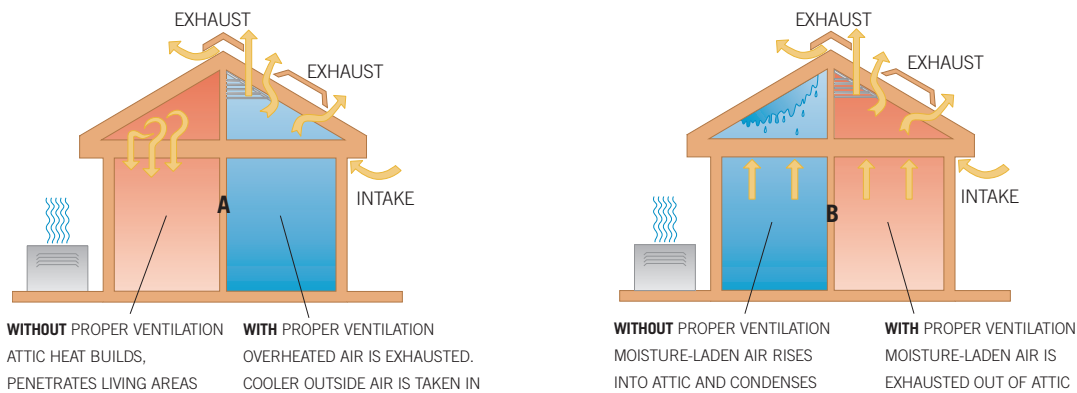
Ceiling fans that circulate air within a room also help cut cooling bills. They gently draw cool air up from the floor, where it tends to collect on hot days. Reversed in winter, a ceiling fan circulates warm air that accumulates near the ceiling.

brought in through the eaves or soffits. Ventilating an attic can easily lower its temperature from 150 to 115 degrees Fahrenheit.

In winter, ventilation clears the attic of warm, moist air that may seep up from living spaces (B, page 87, top right). Allowed to remain in the cooler attic, this humid air would deposit its moisture as condensation on joists, rafters, and attic insulation, reducing its effectiveness.

AMERISPEC® TIP DOES IT STILL INSULATE?

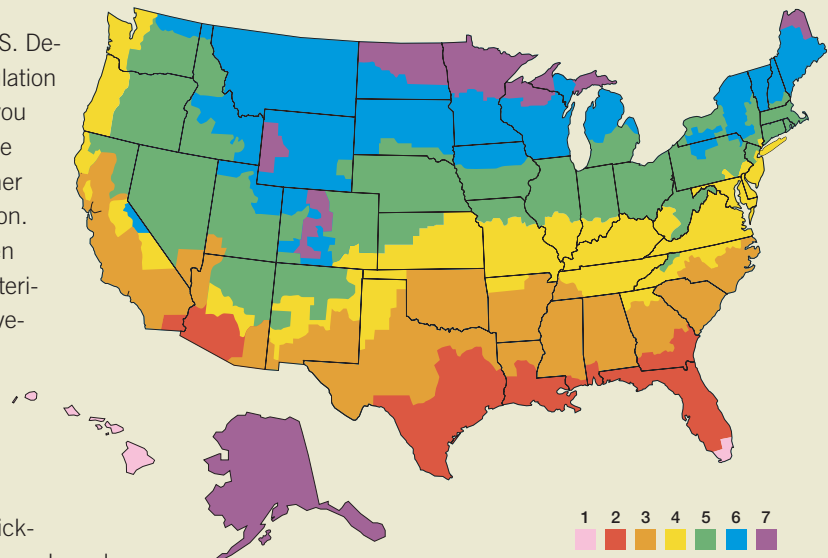
If insulation has compacted because it has gotten wet, it will lose its fluffiness and therefore its insulating value. This can happen over a period of years in an attic that is periodically damp. It is probably best to replace the insulation. If yours does not look or feel fluffy, have it checked by a professional.



HOW MUCH INSULATION DO YOU NEED?

This map and chart, developed by the U.S. Department of Energy, show how much insulation your house needs, depending on where you live. Insulation's ability to slow the passage of heat is rated as an R-value, with a higher number indicating more effective insulation. In the chart below, R-values/inch are given for different types of insulation. Some materials are more effective at slowing heat movement than others. Remember that R-values are cumulative: 3 inches of insulation with an R-value of 5 results in an insulation layer with an R-value of 15.

The map will give you an idea of the thickness of the insulation you need in your house based on its climate zone. Check local building requirements to be sure.



Zone	Heating System	Attic	Cathedral Ceiling	Wall		Floor
				Cavity	Insulation Sheathing	
1	All	R30 to R49	R22 to R38	R13 to R15	None	R13
2	Gas, oil, heat pump	R30 to R60	R22 to R38	R13 to R15	None	R13
	Electric furnace					F19–R25
3	Gas, oil, heat pump	R30 to R60	R22 to R38	R13 to R15	None	R25
	Electric furnace				R2.5 to R5	
4	Gas, oil, heat pump	R38 to R60	R30 to R38	R13 to R15	R2.5 to R6	R25–R30
	Electric furnace				R5 to R6	
5	Gas, oil, heat pump	R38 to R60	R30 to R38	R13 to R15	R2.5 to R6	R25–R30
	Electric furnace		R30 to R60	R13 to R21	R5 to R6	
6	All	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25–R30
7	All	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25–R30
8	All	R49 to R60	R30 to R60	R13 to R21	R5 to R6	R25–R30

INSULATION TYPES



Batts and Blankets Available in a variety of thickness, rolled insulation blanket and pre-cut batts are available in a variety of thickness and widths designed to fit into wall and ceiling cavities between wall studs and floor and ceiling joists. While there are pros that install blankets and batts, it's a low-skill job tackled by many homeowners to improve energy efficiency. Batts and

blankets made from fiberglass are the most common and least expensive. Needle-like glass fibers can cause skin and respiratory irritations if protective gear is not worn. Batts and blankets made from recycled blue-jean denim are available from several sources. Blue-jean insulation contains no harmful chemicals and won't cause irritations, but it's more expensive than fiberglass.

Batts and blankets: R-3.1 to R-4.1 per in.



Blown-In and Loose Fill There's a specialized machine that professionals use to blow loose-fill insulation made from fiberglass, cellulose (ground-up newspaper), or rock wool (sometimes known as mineral wool) into wall or ceiling cavities and onto the open floor joists of an attic. Some home centers will rent the machines to homeowners. Loose-fill insulation can also be spread

by hand over open attic floor joists or existing insulation. To blow insulation into closed-in walls, holes need to be drilled into each stud or joist bay. One advantage to blown-in insulation is its ability to fill every nook and cranny, which are sometimes missed with exact-width batts and blankets. For step by step instructions on how to properly install this insulation, see page 89.

Blown-in and loose-fill insulation: R-2.2 to R-3.8 per in.



Rigid Foam Sheets Adhering large panels of solid insulating foam is a good way to reduce heat and air-flow movement. (Fiberglass slows the passage of heat, but not the flow of air.) Rigid foam sheets are often installed under wall siding or roofing, particularly during a renovation. Adding a layer of foam to a building can significantly boost R-values, especially when used in

conjunction with blankets, batts or blown-in material in the existing walls and roof. Foam sheets are often used on the exterior foundation walls of new houses. They can also be used inside basement walls. There are different types of rigid foam, each with a different R-value. All rigid insulation must be sealed with special tape or caulk where sheets meet, to prevent air leaks.

Rigid foam: R-3.6 to R-6.8 per in.



Spray Foam In recent years, spray foam insulation has gotten more popular, mainly because of its high R-value and because it readily gets into the tiniest gaps, sealing air leaks and slowing the movement of moisture vapor through a building. Spraying foam insulation is a job best left to pros with specialized machines, but smaller pressurized canisters and one-use aerosol cans of spray foam are available to homeowners. Spray foam is applied by hose through a nozzle onto walls and other

cavities in the house. After the gooey substance is sprayed onto a surface, it expands and cures to a calibrated volume. Once the foam has hardened, any excess can be easily trimmed. Spray foam is used in both new construction and remodeling where it is very effective. Closed-cell foam is a vapor barrier, as well as an air barrier, and has higher R-values. It's also more expensive. Open-cell foam is not a vapor barrier.

Closed-cell spray foam: R-6 to R-6.8 per in.

Open-cell spray foam: R-3.5 to R-3.6 per in.

AMERISPEC® TIP

CONTROLLING MOISTURE

Today's homes produce lot of moisture. Multiple bathrooms, cooking, cleaning, even human respiration all add water vapor to the inside air. While today's tighter house save energy with better air sealing and insulation, problems can occur when excessive moisture levels build up inside, causing health problems, mold, and mildew growth, and even rot. How moisture is controlled depends on a house's construction, climate, insulation, and air sealing. Building scientists are professionals who study the physical workings of a house, including the best way to control moisture. As recently at 15 years ago, it was thought that moisture movement through walls and ceilings could be controlled by installing plastic sheeting, called a vapor barrier or vapor retarder, behind drywall, but recent findings have determined that this is not always the best technique for every house in every climate. We now know that air leaks are responsible for much more moisture movement than vapor diffusion. Building scientists have concluded that vapor and moisture barriers are difficult to install correctly and that efficient ventilation also plays a major role in moisture control. Make sure that any pro you hire to renovate your home knows moisture control and ventilation for the climate where you live.



VENT OPTIONS

House vents come in a wide variety of shapes, sizes, and types. Below are some of the most common ones. Intake vents should be placed as low as possible, often at the eaves. Place exhaust vents as close as possible to the peak of the roof. Natural convection draws air from the attic, and cooler, make-up air is pulled in through vents along the eaves. They're often called soffit vents.



SOFFIT VENTS (left) may be circular or rectangular. They are set into the eaves, one to each space between rafters, on two sides of the house. To be effective, eave vents must not be blocked by attic insulation. In new construction, continuous soffit vents are common. They run the full length of the soffit.

A RIDGE VENT (see page 80) is a metal or plastic extrusion that covers a gap built or cut into the roof sheathing at the ridge. Louvers in the vent allow air to escape while preventing rain from entering. The vents run the full length of the roof.

ROOF VENTS

(right) are typically small, square metal structures that let air pass but keep rain out. Some are equipped with a thermostatically controlled fan to speed the removal of hot air from the attic. Turbine vents (left) have specially shaped vanes that turn in the slightest breeze to pull hot and



humid air out of the attic.

GABLE VENTS (right)

are common on older homes and can be either rectangular or triangular to fit into the angled space at the roof's peak. Because they're located at the ends of the attic, they're not as effective as roof-mounted vents. However, gable vents are the easiest to install.



INSULATING AN UNFINISHED ATTIC

This is likely the most important insulation project you can undertake. First measure your existing insulation and then use this table to determine the R-value of any insulation you already have.

FIBERGLASS (batts/blankets)	R-3.0/in.
FIBERGLASS (loose fill)	R-2.5/in.
CELLULOSE (loose fill)	R-3.4/in.
ROCK WOOL (loose fill)	R-2.8/in.

APPLYING ATTIC INSULATION Measuring the insulation Slip a ruler between a joist and the insulation to measure the thickness. Average several measurements taken from different parts of the attic, then multiply the average by the R-value per inch of insulation (see table, above). To figure out how much insulation to add, subtract your finding from the R-value recommended on page 87. You may put new insulation over old, and you need not match types.

Before adding insulation, take these steps:

- Complete all electrical wiring so you won't have to move insulation later to do it.
- Raise any plumbing air admit-

tance valves and electrical junction boxes so they will be above the finished insulation level.

- Install a code-required insulation shield around all fuel-gas vents extending through the attic (such as those from water heaters or furnaces). Code requires a shield that will maintain a 1-in. clearance around the vent for the depth of the insulation. No insulation of any kind should be in contact with a vent from a fuel-burning appliance (this does not apply to plumbing or dryer vents).

- Insulate bathroom or dryer exhaust vents to reduce the risk of condensation in the lines during cold weather.

INSTALLING BATTS AND

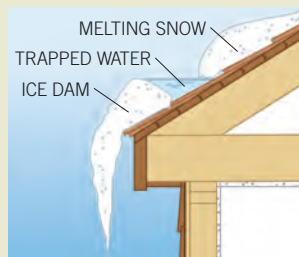
BLANKETS If the attic floor is uninsulated, use insulation with a vapor-retardant face and place the facing next to the ceiling. In hot, humid climates, or if the attic is already insulated, use unfaced fiberglass. Start at the perimeter and work toward the attic access door. Place the insulation between joists, cutting it to length as shown on page 91. For higher R-values, lay additional blankets perpendicular to the joists.



ADDING LOOSE-FILL INSULATION Rent a loose-fill insulation blower from a home center, making sure you have enough hose to reach all corners of your attic. With a helper who can load the blower with insulation as needed, start at the perimeter of the attic and work toward the attic access door. Fill every joist space completely and evenly with the insulation, leaving attic vents uncovered. You can shield vents with pieces of cardboard to avoid covering them. Level uneven spots with a rake.

CONTROLLING ICE AND SNOW ON YOUR ROOF

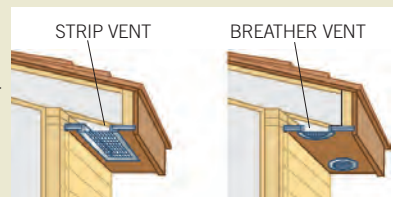
An ice dam (below) forms at the eaves and can cause water from melting snow to back up under the shingles and leak into the house. Ice dams can result from alternate thawing and freezing of snow on the roof during a period of warm days and cold nights, or from heat that moves from the living space of the house and through the roof of a poorly insulated and badly ventilated house. Either can cause the snow to melt and then when temperatures drop, to freeze again at the colder eaves area. The result can be a great deal of damage to your roof and the interior of your house when the water leaks inside.



KEEPING THE ROOF COLD The solution is usually to make sure the attic does not get too warm. Adequately insulate the attic and be sure that warm air from inside the house is not leaking into the attic. Check around

all light fixtures that penetrate the attic floor, as well as

ducts, plumbing stacks, and attic hatches. Air seal around any openings, then insulate.

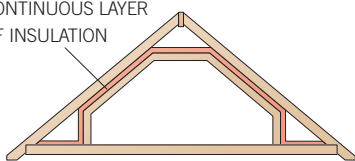


DE-ICING CABLES If you have a severe ice-dam problem, consider installing electrically heated cables along roof eaves and in gutters and downspouts. These cables, which are insulated and grounded for safety, are clipped to the shingles in a zigzag pattern or run along gutters and inside downspouts. They need to be plugged into an electrical receptacle. They create drainage channels for water that otherwise would back up behind an ice dam or freeze inside the gutters and downspouts. But remember that cables only address the ice build-up, not what's causing it. To get to the root of the problem, increase the amount of insulation in the roof and seal air leaks that allow warm interior air to make its way to the back of the roof sheathing.

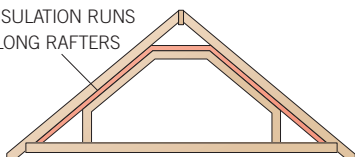
INSULATING A FINISHED ATTIC

In all likelihood, your attic living space already has some insulation. If not, or if what's there is insufficient, you can add more. But before adding insulation, you should always seal the air leaks in an attic. Air leaks can account

CONTINUOUS LAYER OF INSULATION



INSULATION RUNS ALONG RAFTERS



for approximately 30% of wasted energy dollars in a home. See page 92, Getting Professional Help.

Insulating this space before the drywall is fastened to the ceiling and knee walls (short walls near the eaves) is no more dif-

ficult than insulating exposed studs, joists, or rafters elsewhere in the house. However, once wall and ceiling coverings are in place, the task becomes much more complicated and can require tearing down the ceiling and walls. Unless you are an adventurous and accomplished carpenter, call in a professional.

WHERE IT GOES Insulation is installed above the ceiling. Below the ceiling, the insulation can follow the knee walls to the attic floor, then across toward the eaves (see illustration at left).

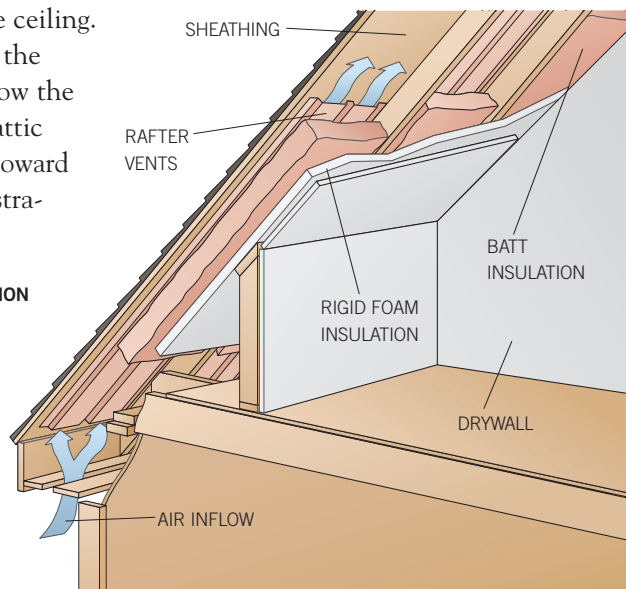
MAINTAINING VENTILATION

If your roof is equipped with soffit and ridge or roof vents, have



rafter vents

an insulation contractor check for ventilation between the insulation and the roof deck. To ensure adequate ventilation, install baffles between rafters. Stapled to the underside of the roof decking, the baffles or channels allow a continuous airflow from the eaves to the ridge, even after insulation batts have been placed over them. The vents also keep moisture that some-



times condenses on the underside of the decking from soaking the insulation. With the baffles in place, the spaces between rafters can be filled. Adding a layer of rigid foam insulation to the bottoms of the rafters increases the overall R-value of the roof and reduces “thermal bridging,” the loss of heat through the rafters themselves.

INSULATION FOR A STUD WALL

For walls with exposed studs, such as in a garage, fiberglass batts are typically the least expensive option and the easiest to install. But it's important to install them correctly. Even minor gaps significantly reduce their effectiveness.



Fiberglass batts and blankets with vapor-retardant or kraft-paper facing on one side have flaps along the edges. Tuck the insulation between studs with the facing toward you as you work (above right). Then staple the flaps to the studs.

CUTTING FIBERGLASS INSULATION Place the fiberglass batt on a piece of ply-



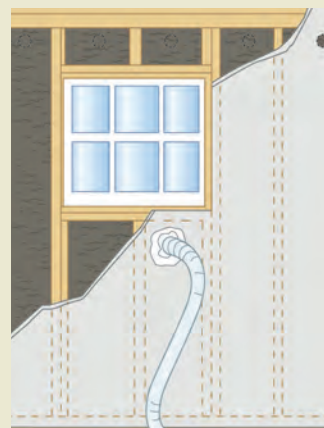
wood as a cutting board. Measure the height of the space between studs you wish to insulate and transfer it to the batt, laying a 2 by 4 or other straightedge across the batt to serve as a cutting guide (left). Compress the insulation and slice through the fiberglass with a sharp utility knife.

WORKING AROUND OBSTRUCTIONS To fit insulation behind wires or pipes that pass through studs, peel the front half of the batt away from the back half (above). Slide one half behind the obstruction, then use the other half to cover it. Around electrical boxes for receptacles and light switches, split the batt unequally so that the thinner part fits behind the box. Cut out the front section with scissors or a utility knife.



BLOWING INSULATION INTO A WALL

If the exterior walls of your house need insulation, you can blow it into the spaces between studs without removing drywall or paneling. The best choice is often blown-in cellulose, which flows past obstructions in the wall and fills cavities around existing insulation. Fiberglass also can be blown into wall cavities. Blown-in insulation does a better job of air-sealing than batt insulation, although it is not technically considered an air barrier.



The idea is to blow insulation into each space between studs, one at a time. Doing so requires that you cut a 2- to 3-inch hole in the wall between each pair of studs and as near the top of the stud space as possible. A hole saw makes short work of this part of the job. Save the drywall cutouts for repairing the holes later.

Feed the blower hose deep into each cavity while a helper operates the blower and controls the mix of air and cellulose. Plug the hole around the hose with a rag to prevent insulation from escaping. As the space fills, gradually withdraw the hose from the hole.

Many homeowners prefer to leave the job to a professional contractor, but some have achieved satisfactory results for themselves.

AMERISPEC® TIP

PROTECT YOURSELF

Fiberglass insulation can make you itch or even cause a rash. To avoid discomfort, wear gloves, long clothing, protective eyewear, and a dust mask.

getting professional help—an energy audit saves money on home energy costs

When energy costs skyrocket, homeowners pay more attention to how much it costs to heat and cool their houses. With an increased concern with the environment, it's not surprising to see the rise of the so-called green building movement. But green building is not just about natural and low-carbon-footprint products. One of the major concerns is saving energy, and this is where a home energy audit comes into play.

While there are common-sense things you can do around your house to save energy—turn off lights and lower the thermostat when you leave your house—an energy audit is a specific prescription that you can use to cut energy use and costs.

So before you start piling on the extra insulation in your attic or signing a contract with a window replacement salesman, it's a good idea to consider calling in an energy audit team to evaluate your home. Chances are, you'll be surprised at the results and more than pleased at the savings you'll realize once you implement the suggested changes.

Keep in mind that an audit (similar to a doctor's advice) isn't

what makes a difference, but rather it's carrying out the recommendations that will save energy.

Depending on your income level, the type of fuel you use to heat and cool your home, and your location, there's a chance that your state, city, or utility company may offer free or reduced-cost audits, although chances are they won't be as thorough as an audit you pay for. Go to <http://www.dsireusa.org/> for a state-by-state database to see what type of audit you might qualify for. Alternatively, search online for an auditor in your area.



An energy audit will be done by a team of professionals who will spend a day in your home, using scientific measuring tools to test your heating and cooling system, including your ductwork if your home has a forced-air system, as well as the energy use of common appliances, such as your refrigerator. They may use an infrared camera to detect inadequate or missing wall and ceiling insulation. More importantly, they'll test your house for air leaks, which typically account for up to 30% of wasted energy.

To find out how much your house leaks, energy auditors use a tool called a blower door, which is basically a fan attached to a





metering device. The auditors will temporarily mount the blower door's airtight frame in an exterior doorway. Then they'll make sure all the other doors and windows are closed tight. When the fan is turned on, it reduces the air pressure in the house by sucking air from your house and blowing it outdoors. The reduced pressure also pulls air into the building through leaks in the structure. The meter measures how much air is being pulled in.

Houses have common areas where air leaks occur, usually in attics, basements, and crawlspaces, and also where dissimilar building materials meet, such as where a chimney or foundation joins the house framing, or where a window frame is attached to a wall. An experienced auditor will use caulk and expanding and rigid foam to seal the known leaks first. Then he or she can find unknown leaks using a smoke-emitting device (or even a common stick of burning incense) to detect other leaks. The blower door fan will pull the smoke away from the leak and toward

the fan. Once the leaks have been sealed, another blower door test is taken, and if it's needed, further leak detection and sealing will be done.

It's imperative that your house be air-sealed before insulation is added. While fiberglass insulation does slow the movement of heat, it doesn't stop the flow of air. (That's one reason why most forced-air furnaces use fiberglass air filters.) Adding fiberglass insulation to a house full of air leaks is counterproductive. Plus, removing added insulation to go back and air-seal is messy and inefficient. That's why auditors always test and air-seal before insulating.

Air-sealing is always the biggest buck for your energy-efficiency dollars. Contrary to some advertisements, replacing your windows isn't usually the best way to spend your money. Most older, leaky windows can be vastly improved by air sealing around the frames and adding inexpensive weatherstripping.

A complete energy audit will also test the efficiency of your heating and air conditioning systems. Sometime a furnace will just need an inexpensive tune-up to get it running its best, but it's possible that you'll get a recommendation to upgrade an ancient, inefficient unit. Same thing is true for your water heater and air conditioning system.

Energy audits will usually include some remediation work, along with recommendations for



additional work. Remediation work can include air-sealing, weatherstripping of doors and windows, and replacement of incandescent light bulbs with more efficient compact fluorescent lamps (CFLs). One footnote: When tightening up an older house, you may want to provide combustion air for appliances that burn fuel.

An advantage to a full-blown energy audit that you pay for (and some states or towns might award partial refunds) is that you'll receive a detailed report with all the measurement made in your home. As part of the report, you'll get prioritized recommendations, along with approximate cost and payback estimates. The beauty of the report is that you can immediately see where to spend your money for the biggest energy-savings. And because you may not be able to afford all the improvement in one year, you can use the report as a way to plan for future energy saving.

Expect to pay about \$400 for an average 2,400-square-foot home. And expect to cut about 30% of your energy bills once you've made the recommended improvements.

fireplaces and chimneys

While fireplaces were used as a heating source and a place to cook in colonial times, in today's homes they are mainly used for ambience. An exception is a fireplace insert, a wood or pellet stove that can be used to heat a modern home. And so-called zero-clearance fireplaces can be an easy and relatively inexpensive way to heat up the look of any living space.

Whichever type of fireplace you have, use it with care. Don't light a fire until you are certain your fireplace and chimney are safe. This chapter shows ways you can inspect and repair a fireplace and chimney yourself, but be sure to call an expert for evaluation if you are not completely sure of your unit's safety.

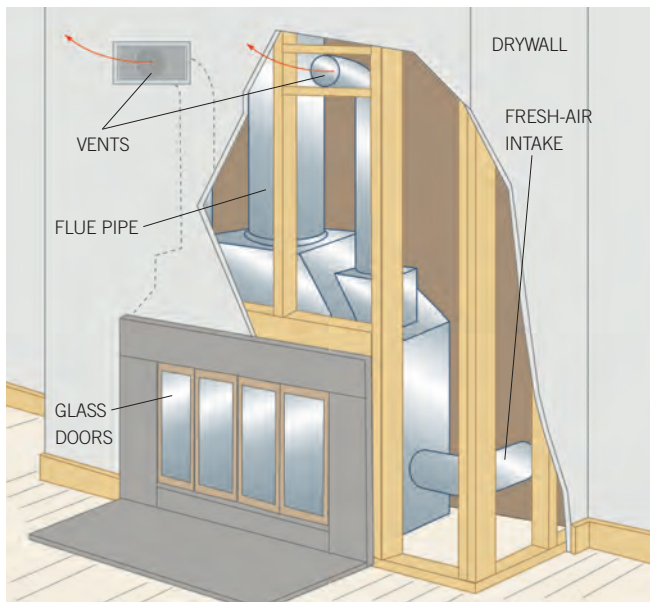
A traditional fireplace has a warm ambience but may suck more heat out of a room than it generates. See pages 100–101 for some ways to make an old fireplace more energy efficient.

Dense plumes of smoke coming from the chimneys of traditional fireplaces or older woodstoves show why home fires have come under

<i>Understanding and Using a Fireplace</i>	96
<i>Cleaning and Maintaining a Fireplace and Chimney</i>	98
<i>Common Fireplace Repairs</i>	100

**AMERISPEC® TIP****INSTALL SMOKE AND CO ALARMS**

Smoke and carbon-monoxide alarms should be installed in every home. These inexpensive battery-operated or hard-wired devices can save lives. They are particularly important for any home with a fireplace or wood or pellet stove.



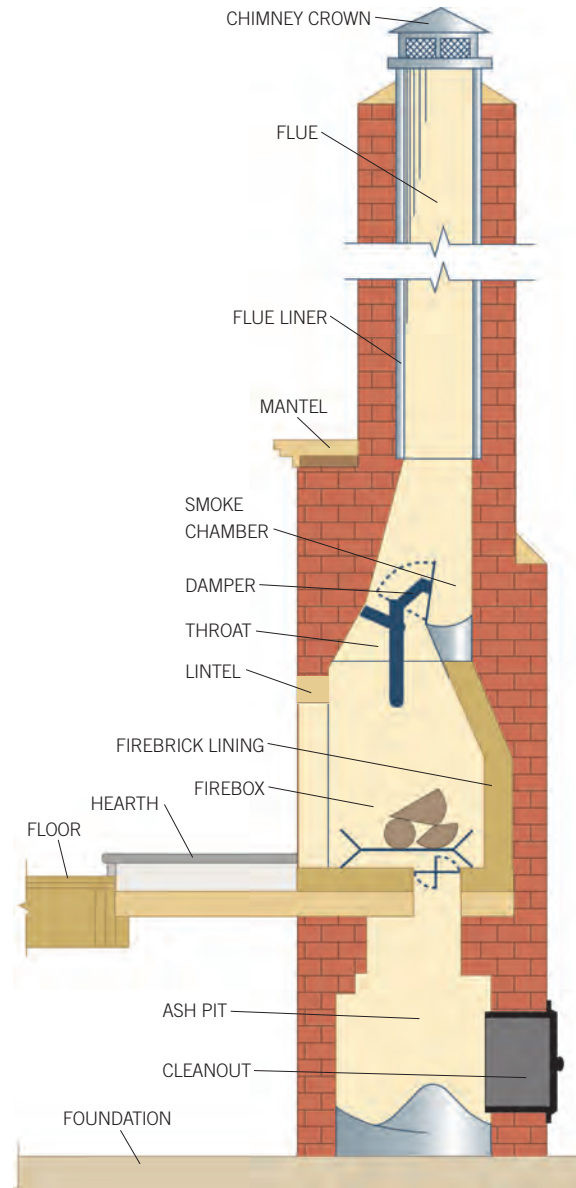
PREFABRICATED FIREPLACE

scrutiny in recent years. In certain areas, weather conditions called inversion layers trap pollutant-laden air close to the ground, generating thick, stifling, health-threatening smoke and gases. As a result, many regional air quality agencies impose burn bans that ask homeowners to limit or avoid fires.

These concerns have spawned a new generation of fireplaces and woodstoves—as well as inserts for existing fireplaces—that burn fuel so cleanly that most are exempt from limitations or prohibitions. Not only do they pollute less, but they also contribute more toward meeting a home’s heating needs. The cleanest-burning ones use natural gas or propane, though others that



VENTLESS GAS FIREPLACE



WOODBURNING FIREPLACE

burn solid fuels, such as firewood or compressed sawdust pellets, burn cleaner than their predecessors.

As a result, installing and upgrading fireplaces and woodstoves are popular home improvements.

AMERISPEC® TIP INSPECT YOUR FIREPLACE

If you’ve recently bought a house with any type of fireplace or solid-fuel burning device, you’ll probably want to light a mood-setting fire on that first cool evening, but don’t. It’s very important to have a professional inspect the device before lighting the first match.

understanding and using a fireplace

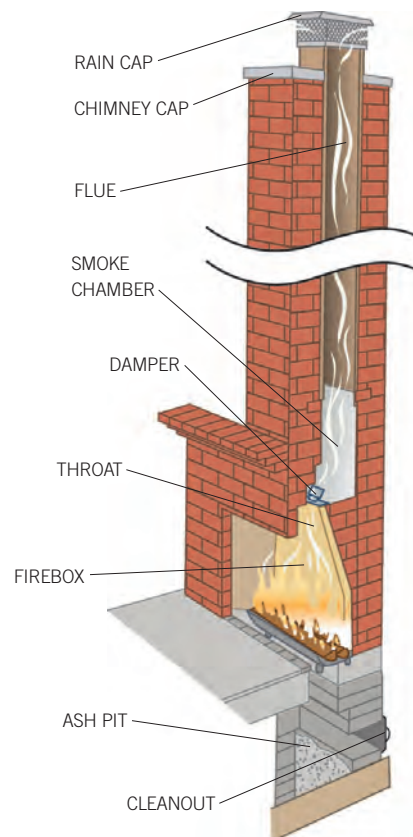
A fireplace must be built correctly so it will draw smoke out of the house yet keep most of the heat inside. Have your fireplace cleaned and serviced once a year for safe use.

MASONRY FIREPLACES A masonry fireplace has a solid firebox leading upward to a damper, a smoke shelf, a smoke dome, and a chimney. The firebox and chimney can weigh more than 5,000 pounds, requiring them to rest on a reinforced concrete foundation. The firebox is built of brick or concrete block lined with special heat-resistant firebrick or tiles. It is shaped with a narrow “throat” that holds in some heat and directs smoke into a smoke chamber just above. Natural convection draws smoke up through the chimney. The damper is a small metal door installed in the chimney’s throat that’s opened to allow

smoke to escape and closed when the fireplace is not in use. On the floor of some fireplaces, you’ll find a small metal ash door with an ash pit below the hearth.

PREFABRICATED WOOD-BURNING FIREPLACES Factory-built prefabricated fireplaces (see the illustration on page 95) come in both radiant and heat-circulating designs. Unlike masonry fireplaces, they have metal fireboxes and outer metal shells that allow them to be placed near wood framing. These models, often called zero-clearance fireplaces, are relatively lightweight (600 to 800 pounds) compared with their masonry counterparts.

These units generally have fewer safety issues than masonry fireplaces. However, creosote—a black, sticky, highly flammable substance—can build up in the flue and possibly cause a dangerous



fire (see pages 100–101). There are products designed to reduce or eliminate creosote buildup in chimneys, but flues still should be inspected and, if necessary, periodically cleaned by a professional.

GAS LOG FIREPLACES Many gas log units do a good job of imitating

GETTING A GOOD LOOK

To see the inside of your firebox, your damper, and part of your chimney, position a mirror, as shown, and hold a shop light to the side. To inspect the upper portion of the chimney, go up onto your roof (if it’s safe) and use a strong flashlight, or dangle a shop light down into the chimney. Here are some things to look for:

- An old fireplace may not have flue tiles, which are lengths of circular or rectangular clay pipe that line the inside of the chimney. Without a lining, any gaps in the chimney’s mortar can allow smoke and sparks to reach the house’s structure and interior spaces. If your chimney has no inner flue, consult several contractors to see if it can be relined with metal or tile.
- If your mantel or the wall around the firebox is sooty, the firebox may not be burning correctly, or else the fireplace has been used when the damper was closed.
- Crumbling mortar joints, inside or outside, should be

repointed (see page 112). If the bricks themselves are crumbling, call in a mason for an evaluation.



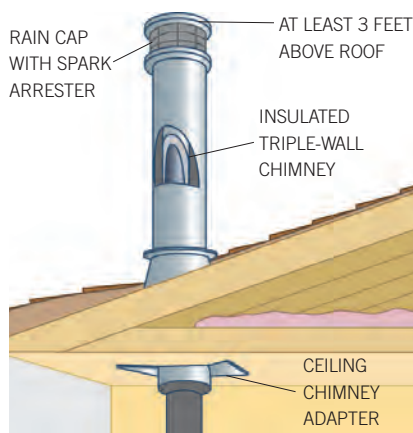
the damper is not sealing well. Consider glass doors or an insert (see page 100).

- The damper should operate smoothly and close fully. Close the damper, light a piece of paper, and hold it inside the firebox as you blow it out. If smoke readily moves upward, the damper is not sealing well. Consider glass doors or an insert (see page 100).
- The chimney top should be in sound condition. Some chimneys have a metal or stone cap, intended to keep critters or rain out of the flue. An improper cap can sometimes be the reason a fireplace doesn’t draw properly.
- Check the flue for creosote and have the chimney cleaned when needed (see pages 98–99).

the look of natural wood with far less mess and maintenance. There are three basic types: natural vent, direct vent, and ventless.

A vented gas log unit produces a great deal of heat, but it also requires a working chimney. If the chimney does not draw well, dangerous carbon monoxide may enter the living area. Direct-vented gas fireplaces also produce lots of heat, and they vent through the wall behind the fireplace. Vent-free units have more efficient burners that produce less carbon monoxide, and they have oxygen depletion sensors, which turn off the fire if too much oxygen is depleted in the room. As a result, a vent-free fireplace can be installed almost anywhere in a room, as long as it does not abut combustible surfaces. Vent-free fireplaces often do not look as realistic as vented units. If you install one, be sure to install a carbon monoxide alarm in the same room.

A byproduct of gas combustion is water. A vented gas log fireplace produces a great deal of water vapor. A vent-free unit produces less moisture but none of it gets vented to the outside, so it may produce excess moisture in the room.



WOOD-BURNING STOVES

Some older woodstoves are dangerous and inefficient, but newer versions generate a good deal of heat from only a few logs and produce little pollution. Make sure that your stove has an EPA-certification label on the back. Make sure that the chimney and the flue, as well as the fire-safe surfaces all around the stove, are installed with the clearances specified by the manufacturer.

The hearth under the stove and the wall behind it should be covered with fire-safe, non-combustible materials of sufficient size to keep the floor and walls safe. It's a good idea—and it's sometimes required by code—to provide an air vent that supplies outside air.

The chimney is usually made of double- or triple-wall construction, so it is warm rather than

PELLET STOVES

These burn small pellets made from wood byproducts or corn. A micro-processor directs air and fuel intake. An electric auger feeds the pellets from a hopper into the fire chamber.

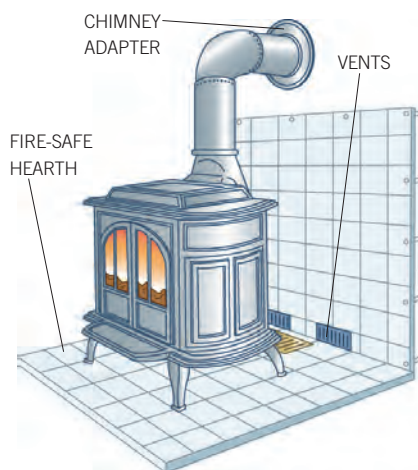
All pellet stoves require venting. Waste gases can be directed into an existing chimney or into a fire-code-approved horizontal or vertical chimney.

The outside intake is operated by an electric motor. Another small electric fan blows the heated air from the fire chamber into the room.

Pellet stoves are easy to operate and can burn for more than 24 hours without refueling. An additional advantage is that the pellets come in easy-to-store bags. Before deciding on this option, however, check the price and availability of pellets in your area.

hot. This is especially important wherever the chimney touches the house.

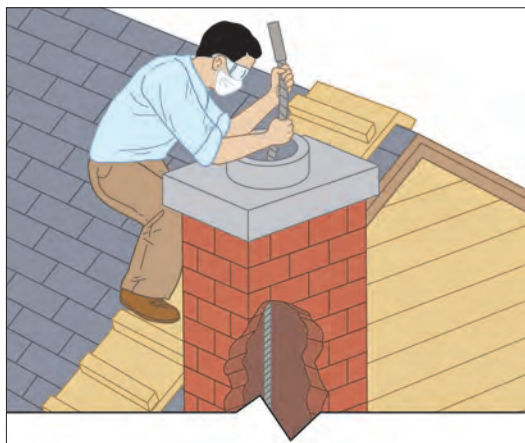
When creosote builds up, clean the chimney with a brush (see pages 98–99) or burn a creosote-removing product. A catalytic converter is a feature of many newer woodstoves. It reburns smoke to dramatically reduce pollution. Some EPA-certified stoves have catalytic converters, and some do not.



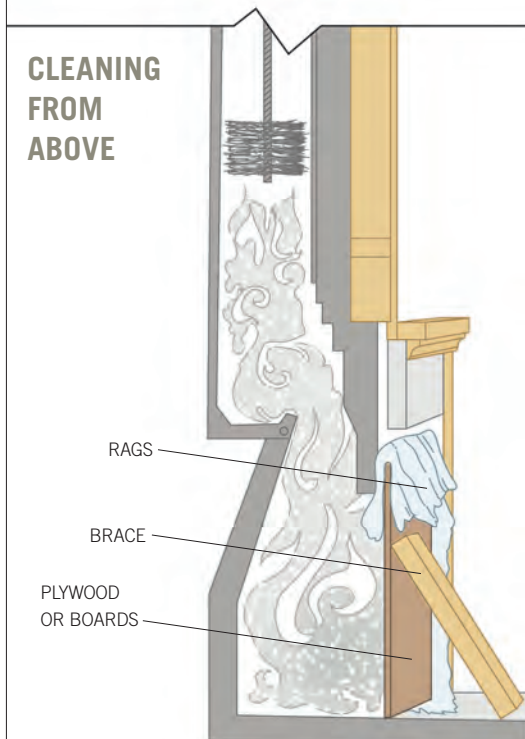
AMERISPEC® TIP

SAFE USE OF A FIREPLACE OR STOVE

- Open the damper fully before lighting a fire. Keep the damper open until the fire is completely out and no longer smoking.
- Burn only dry wood that has been aged for at least six months. Wet or green wood can cause dangerous flare-ups and quick accumulation of creosote.
- Don't use a fireplace to burn trash or pressure-treated lumber. These can produce toxic fumes. Never burn flammable liquids.
- Install alarms for smoke and carbon monoxide in the room (see page 12) and keep a fire extinguisher on hand (see pages 10–11).



CLEANING FROM ABOVE



cleaning and maintaining a fireplace and chimney

Annual flue cleaning and occasionally sealing the exterior of your masonry chimney will go a long way toward keeping it in good working order. If a chimney is leaning or if bricks are missing, consult a professional. To repair chimney flashing that is leaking or corroding, see pages 120–121.

Burning wood causes creosote to build up inside a chimney. Creosote has three forms: first-degree creosote is gray and somewhat fluffy; second-degree creosote is dark gray and forms into crusty globs that look like blackened popcorn; third-degree creosote is very stiff and fairly smooth. Third-degree creosote catches fire easily and can set the other two types ablaze as well. A chimney fire can get extremely hot and burn for a long time, creating a very dangerous situation.

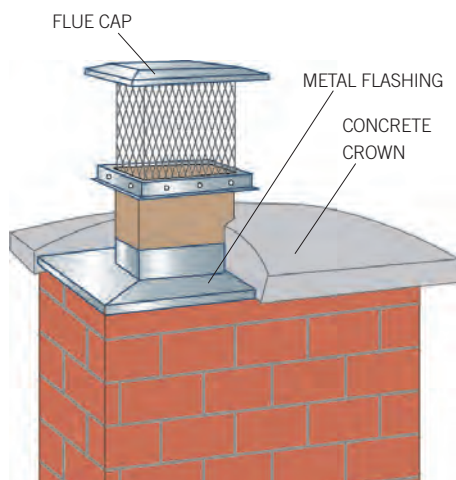
So at least once a year, or after burning a cord of wood or so, check for creosote buildup. Hire a professional to test for creosote, or test yourself. Open the damper and use a putty knife or screwdriver to scrape the ledge just above it. If creosote is more than $\frac{1}{8}$ inch thick, it's time to clean the chimney.

CLEANING A CHIMNEY You can clean first- or second-degree creosote yourself. If you have third-degree creosote, hire a pro. In any case, you may want to hire a chimney sweep to tackle this messy job.

If you do it yourself, purchase or rent steel chimney brushes, handles, and extension rods. Make sure the brush is sized to fit your flue, and have enough extensions so you can reach all the way down to the firebox.

Wear long clothing, gloves, protective eyewear, and a dust mask. Seal the interior fireplace opening with boards and rags, or duct tape and plastic sheeting. Cover the room's carpeting and furniture with drop cloths.

Unless you have a top-mounted damper, you will probably want to work from the top down. See page 119 for tips on working safely with a ladder and on the roof. Attach a rope to the brush, in case you accidentally let go while

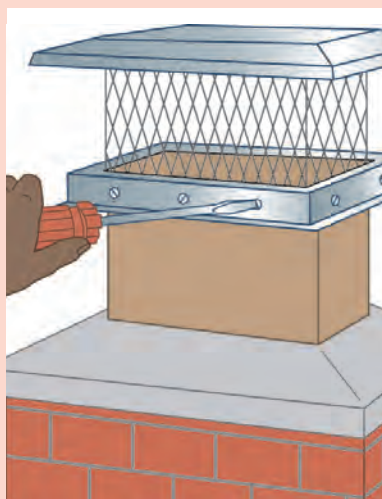
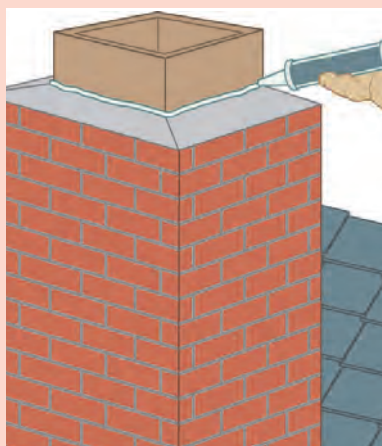


working. You may need to attach weights to the brush. Push the brush down, then scrub the chimney walls by vigorously brushing up and down. Once one section is clean, add an extension and continue cleaning until you reach the damper.

Working from the bottom up, open the damper and use plastic sheeting to seal the fireplace. Slit a hole in the sheeting, insert the brush up through the firebox, and seal the slit as tightly as possible. Work the handle up and down, adding extensions as needed until you reach the top of the chimney (see illustration, opposite page).

Once you have finished cleaning, wait for the dust to settle. Remove the plastic and vacuum up the dust with a shop vac.

UPPER CHIMNEY MAINTENANCE The part of the chimney that protrudes



above the roof is particularly exposed to weather and is a notorious trouble spot. If the crown is damaged or if bricks are failing, see page 101 for repairs.

It's a good idea to seal the upper portion of a chimney using a liquid silicone masonry sealer designed to allow the bricks to

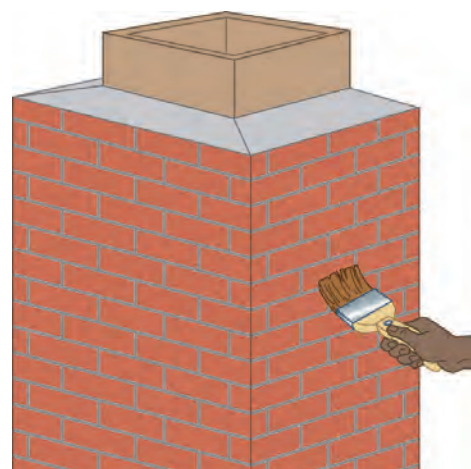
CHIMNEY TOP FIXES

IMPROVING THE DRAW If your fireplace does not draw well, the chimney may not be tall enough. Ask a fireplace expert whether extending the chimney would help pull the smoke out. Other options include installing a wind-powered ventilator or an electric fan at the top of the chimney.

CAULKING A CHIMNEY CROWN If there is a gap in the joint between the crown and the flue, seal it tightly with masonry caulk or butyl caulk (upper left). Do the same for any minor cracks in the crown.

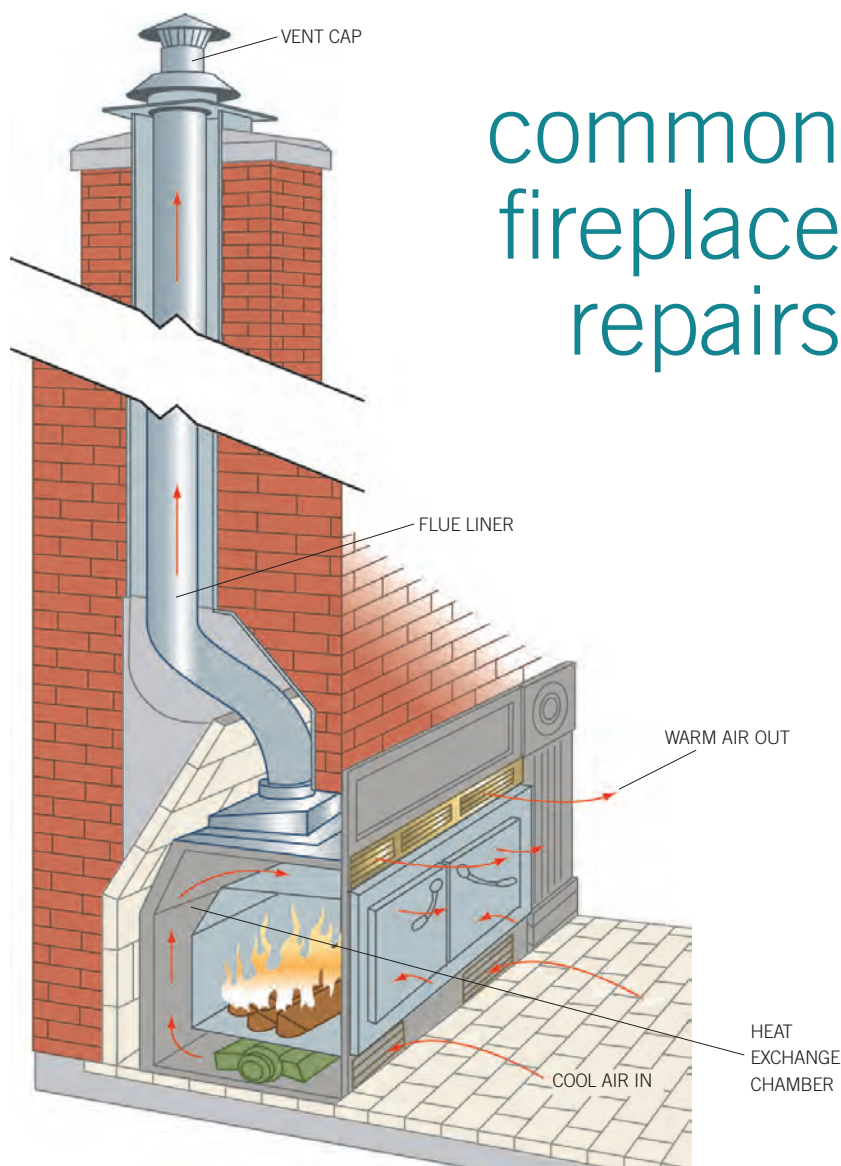
INSTALLING A FLUE CAP Rainwater can mix with creosote to produce an acid that damages masonry surfaces. An easy-to-install flue cap (left) will act as an umbrella, plus it will arrest sparks and keep out small animals. Measure your flue and buy a cap to fit; there are only a few standard sizes. Slip the cap over the flue, see that it is reasonably level, and tighten screws to hold it firm.

breathe. Apply it with a paintbrush (below) or a pump sprayer. Some sealers can stain asphalt shingles; a drop cloth around the chimney base is a good idea.



AMERISPEC® TIP IF YOU HAVE A CHIMNEY FIRE

A chimney fire may start slowly, then suddenly burst into large flames, usually accompanied by a loud roaring sound. If you see excessive smoke coming from the top of a chimney or down through the damper, get your family out of the house and call the fire department. If possible, quickly douse the fire and close the damper (if you can safely reach it). If the fire department does not come right away, wet the roof and the chimney with a hose. Never use a fireplace or woodstove after a chimney fire until it's been inspected by a professional.



MAKING AN OLD FIREPLACE MORE EFFICIENT

Most masonry fireplaces don't supply much heat to a room. Because wood needs oxygen to burn, the fire draws air through cracks around doors and windows, displacing the warmer room air, which goes up the chimney along with flue gases. The two basic

solutions shown on this page can be installed by a determined homeowner, but it's usually well worth the extra expense to hire a professional.

GLASS DOORS AND VENTS To improve heating efficiency, you can add tempered glass doors to the front of the fireplace. These limit the amount

of warm air pulled into the fireplace and also the amount of cold air that can be pulled into the room when there is no fire. It is a good idea to install a vent that brings combustion air from the outside to the firebox.

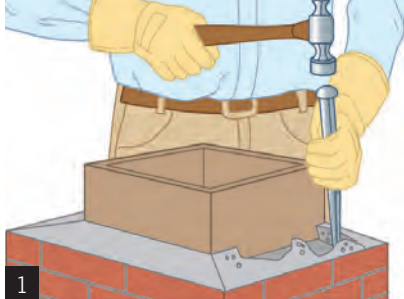
LINER AND INSERT A wood-burning insert, as shown on this page, is usually more efficient than glass doors on a conventional fireplace. An insert functions much like a wood-burning stove (see page 97) that is set into a fireplace opening. Fireplace inserts are also EPA-certified. They have a heat-exchange chamber surrounding the firebox that pulls in cool air from the bottom and sends out warm air through the top. Their flue arrangement ensures that only hot air, and no smoke, will enter the room.

First, a properly sized liner is run into the existing flue (below). Because the metal is corrugated, it can be worked up into the flue from the room below. The main body of the insert then slips inside the firebox (right, opposite page). The flue is connected to the insert's top, and flanges seal the unit to the surrounding surface.

AMERISPEC® TIP NEW CHIMNEY CROWN

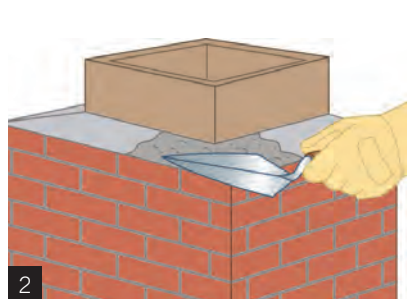
If your chimney crown is in bad shape, hire a mason to cast a new concrete crown. It should overhang the bricks on all four sides and have a groove running under the perimeter of the bottom edge to prevent rain water or snow melt from traveling to the bricks.





Repairing a chimney crown

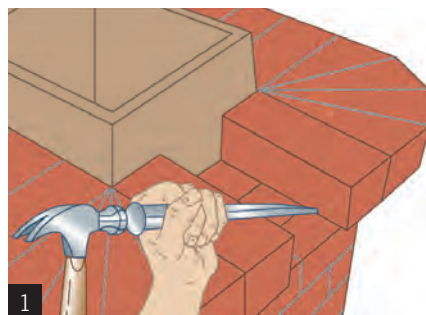
1 If a crown has a portion crumbling but is basically sound, use a hammer and cold chisel to chip away the crumbling section. Take care not to damage the bricks or the flue.



2 Mix a batch of vinyl-reinforced concrete patching compound, and apply it with a wood or magnesium float. Smooth the surface at the same slope as the rest of the crown.

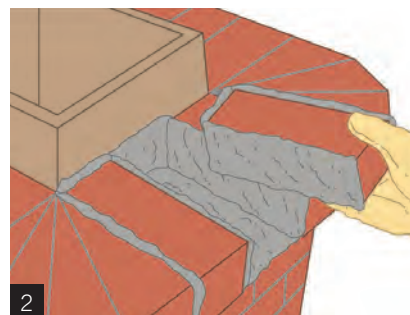
WHEN TO CALL IN A FIREPLACE PROFESSIONAL

The repairs shown on this page can be accomplished by a handy homeowner. If exterior mortar joints are generally failing, repointing is often the answer (see page 112). If a chimney is leaning noticeably, or if bricks are crumbling, call in a mason for evaluation and repairs.

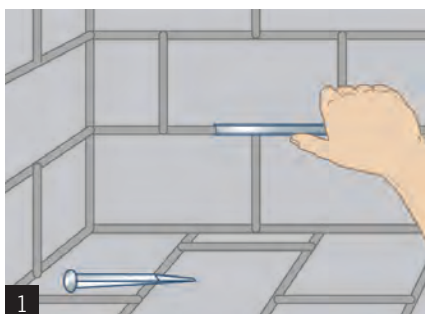


Replacing a brick cap

1 Remove any loose bricks using a hammer and cold chisel. If bricks are damaged, buy replacements, which you may need to have cut to size. Clean away any particles.



2 Mix a batch of latex-fortified mortar mix and wet the bricks. Apply mortar to the bricks and tap them into place. Use a brush to clean the joints.



Repairing firebricks

1 If some mortar in the firebox is missing or loose but the bricks are firmly attached, mix a small batch of refractory mortar, apply it with a trowel, and smooth it with a striking tool.



2 If bricks are loose or damaged, remove them one or two at a time. Use a cold chisel, then a wire brush, to clean mortar from the edges of surrounding bricks. Buy replacement bricks if needed.



3 Apply refractory mortar to the surrounding bricks and to the replacement brick, then carefully slide it into place. If mortar falls off, creating a large gap, remove the brick and start again. Smooth the joints as in Step 1.

siding

Whether it's wood, vinyl, steel, aluminum, masonry, stucco, or composite materials, the exterior wall covering on your house is called siding or, more properly, cladding. In addition to its decorative role, siding gives strength to exterior walls and protection for the inner walls. It also protects your house from the elements.

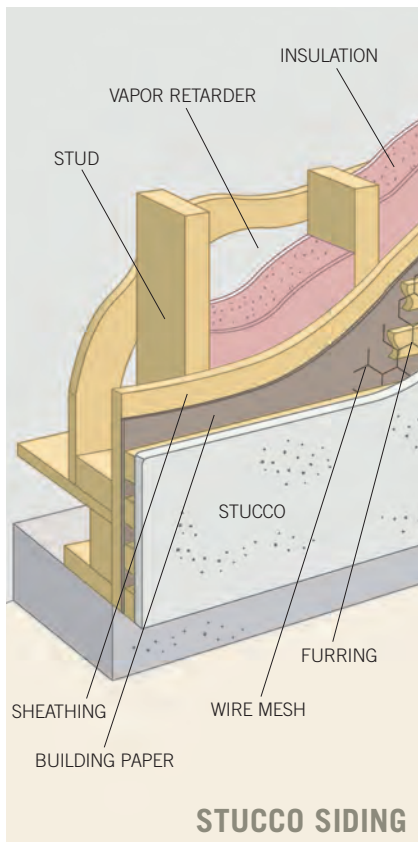
Siding may be plagued by a variety of ills, from obvious problems, like peeling paint, to less obvious insect infestation and rot. Many problems can be remedied if caught early on; regular inspection and maintenance are crucial (see pages 106–107). More modern cement-based composite sidings require little or no maintenance, so consider them if you are replacing siding.

ANATOMY OF A WALL Wood-frame walls are usually constructed from 2-by-6 or 2-by-4 studs. Insulation is placed between the studs, which are then covered with sheathing. An older home may have 1-by-6 plank sheathing, while homes built after WWII have sheathing made of plywood, oriented strand board (OSB), or a fibrous material.

The sheathing is covered with building paper. Older homes usually use roofing felt (tar paper), while newer homes are likely to have a proprietary housewrap, such as Tyvek or Tytar. The siding is typically nailed on over the building paper, but some walls use furring strips to provide a vented air space between the building paper and the siding, which helps keep the wall dry.

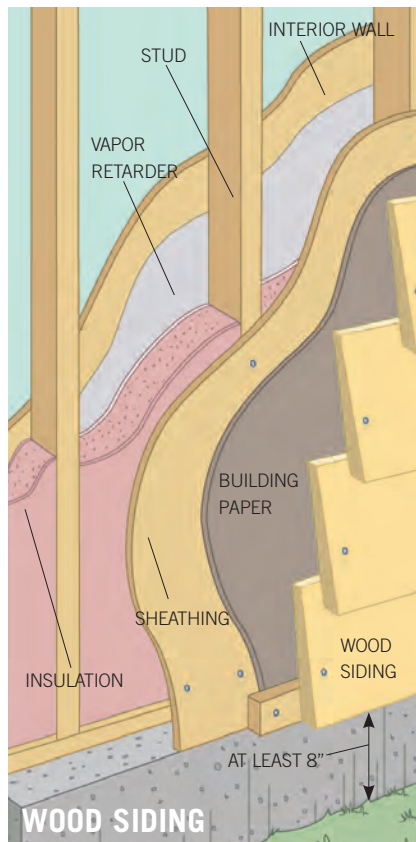
For masonry siding or cladding, a veneer of brick or stone is applied over a wood-frame wall. The masonry is attached to the wood frame with short metal strips, called ties. The bricks or stones are mortared in place.

<i>Maintaining Siding</i>	104
<i>Wood Siding</i>	106
<i>Aluminum and Vinyl Siding</i>	109
<i>Stucco Siding</i>	110
<i>Exterior Caulking</i>	111
<i>Brick Veneer</i>	112
<i>Repairing Fascia</i>	113
<i>Preparing and Painting Siding and Trim</i>	114



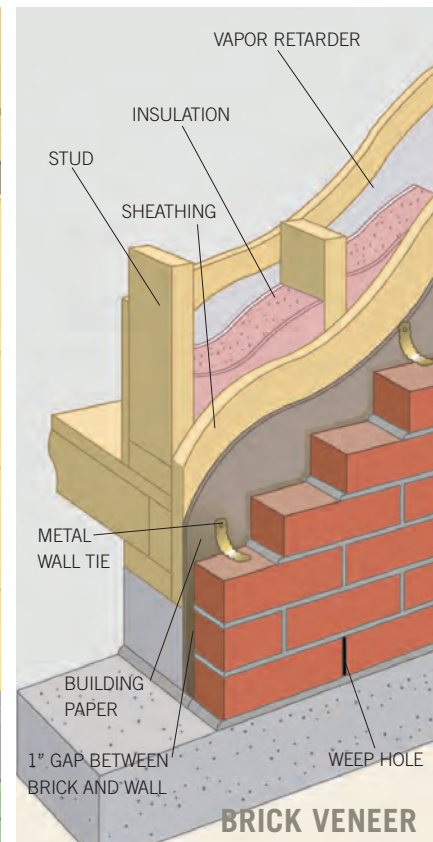
STUCCO For traditional stucco siding, wire mesh is nailed directly to building-paper-covered sheathing, or the mesh is nailed to furring, as shown above. The stucco, a cement-based plaster, is then applied over the wire mesh in three layers. It can be bought already mixed and colored. The finish coat can be tooled in several textures. Synthetic stucco is typically a two-coat system applied over rigid foam insulation.

WOOD SIDING Horizontal beveled siding, also called clapboard is the most common wood siding. But shingles and shakes are also



installed horizontally and can be applied in various patterns. Other wood siding may be installed vertically, such as board-and-batten. Plywood siding is cheaper than other wood siding and comes in various patterns and surface textures.

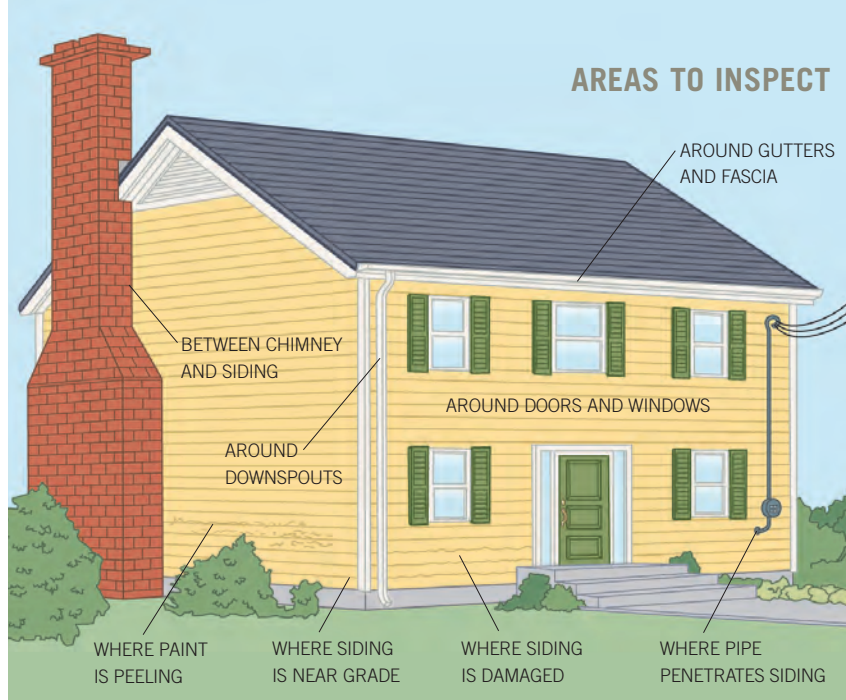
MASONRY SIDING Brick walls may be laid in various patterns, and bricks come in a wide range of sizes, colors, and textures. Stone veneer can also be laid in a variety of patterns. Mortar, a mixture of Portland cement, sand, lime, and water, holds the bricks or stones together. Gaps between the bricks and the



sheathing, in addition to a series of weep holes, allow moisture to vent out.

MANUFACTURED SIDING Aluminum, steel, vinyl, and concrete-based composite siding panels are applied either horizontally or vertically. They usually come with trim pieces into which panels are fitted, and they are available in multiple colors and textures.

AREAS TO INSPECT



maintaining siding

With maintenance, your siding should last for many years. To keep your house looking its best, inspect your siding for damage in spring and fall, make any needed repairs promptly, and clean and repaint regularly.

INSPECTING YOUR SIDING

Look for obvious problems, such as warped boards, missing or damaged shingles, holes in stucco, crumbling mortar, cracks, and defective paint (see photos on opposite page). Don't ignore less obvious interior problems, such as rot and termite damage, because they can eventually destroy your house.

Begin with a visual inspection of vulnerable areas indicated in the drawing above. When you make your inspection, let the following list of problems and solutions guide you.

DETERIORATED CAULKING Note any caulking that has dried out, and renew the seals (see page 111). Check the seals around windows and doors, around protrusions, and

where a deck or masonry fireplace adjoins the house. Also caulk any cracks in board siding.

CRACKS Long vertical cracks in masonry walls may indicate settling. Place tape over a crack and leave it in place for several months. If the tape twists or splits, consult a professional to determine whether there is a serious structural problem. Otherwise, caulk and paint the cracks.

MOLD AND MILDEW Combined heat and humidity may result in mold or mildew on wood and painted surfaces. Take steps to keep the siding dry, and see the cleaning tips at right.

EFFLORESCENCE Brick or stone veneer may become covered with a white powder called efflorescence, formed when water-soluble salts are washed to the surface. This may indicate a leak that should be fixed. Once you have taken steps to keep the wall dry, clean it (see right).

ROT AND TERMITE DAMAGE Rot only develops in wet wood. It appears

as dark or black areas that look much like burned wood. The wood becomes soft and even crumbly. If you see rot, find out why the wood is getting wet, then solve the problem. Boards that feel mushy when you poke them with a screwdriver should be repaired with epoxy or replaced.

Termites destroy wood by chewing out its interior. They can devour framing and siding so inconspicuously that they escape your notice. See page 108 for solutions.

CLEANING YOUR SIDING

To keep siding in good shape, hose it down and, if necessary, scrub it with a carwash brush that attaches to a hose. Spray vinyl panels and sponge them with a mild liquid detergent. If you use a pressure washer, be careful. You can easily damage siding or drive water behind it. For best results, lower the pressure, work from the top down and always direct the spray downward, never up, at the siding.

If brick veneer suffers from efflorescence, try scrubbing with a stiff brush. If that doesn't work, try a commercial masonry cleaner. Use a diluted solution of muriatic acid only as a last resort and be very careful with it.

You can retard the growth of mold or mildew by washing the siding with a solution of $\frac{1}{2}$ cup detergent and 1 quart household bleach in 3 gallons of water. Brush the walls, then rinse. After cleaning the siding, repair any caulking (see page 111) and paint or stain areas that are chipped or peeling.

CAUTION When working with cleaning agents, wear goggles and gloves, and cover plants with a plastic tarp.

PAINT PROBLEMS

Exterior paint ills can result from a number of causes. Daily exposure to the elements takes a toll on painted surfaces. Other factors—including poor surface preparation, incompatible paints, or sloppy application—can hasten decay. Depending on the symptoms, surfaces may need to be stripped bare or may require no more than a light sanding or scraping. Other handy painting tips are included on page 115.



INTER-COAT PEELING Applying latex finish coats over surfaces previously painted with gloss alkyd often results in poor adhesion. To treat, sand off the latex paint, prime the surface with an alkyd or alcohol-based primer, and then apply latex finish coats. Some top-of-the-line acrylic paints can be applied over old alkyd paint without primer, but thorough sanding is required first to give the surface some bite.

CHALKING Chalking is the normal breakdown of a paint finish after long exposure to sunlight. To treat, wash off the loose, powdery material and repaint.



WRINKLING Wrinkling results when one coat of paint is applied over another that is not thoroughly dry or when a coat is applied too heavily. To treat, allow the paint to dry thoroughly, sand off the wrinkles, and repaint.



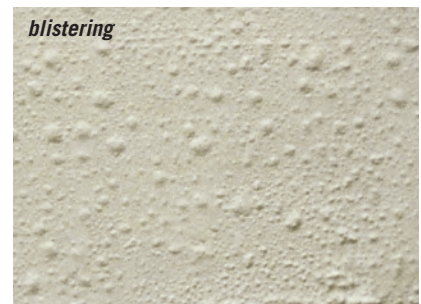
ALLIGATORING Alligatoring can result from a hard finish coat applied over a soft primer or from the loss of flexibility in thick layers of paint on wood surfaces. To treat, scrape and sand off all the old paint and then repaint the area with a primer and two finish coats.

MULTIPLE-COAT PEELING Structures that have been painted over many times, especially those finished with oil-based paints, sometimes will show paint failure down to the bare wood. This happens when the paint layers become brittle and then crack as the wood below expands and contracts with tem-

perature changes. These cracks allow moisture to enter and cause peeling. To treat, strip the surface down to bare wood and prepare the area as you would new wood before you repaint.



BLISTERING Blistering can be caused by moisture driven through the back of the siding because there is no vapor retarder in the wall or because of cracked boards, poor caulking or faulty flashing. Blistering also results when oil-based paints are applied in hot weather, which can trap solvents. In any of these cases, scrape and sand the blistered paint and seal sources of moisture. Then repaint in cooler weather.



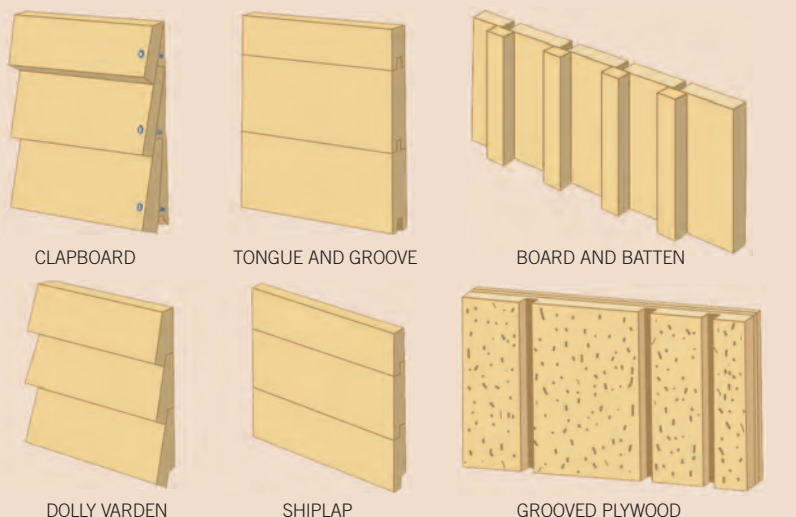
CAUTION Houses built before 1978 are likely to contain lead paint. Follow EPA guidelines for lead-safe remodeling, available at www.epa.gov/lead.

AMERISPEC® TIP

RUSTY NAIL HEADS

If you have nails that show or even drip rust stains, spray or dab them with a rusty-metal primer, then standard primer, before applying the finish coat.

COMMON WOOD SIDINGS



wood siding

With annual upkeep, wood siding should last as long as the house. To prevent deterioration, repair simple surface problems—holes in the wood, split or warped boards, and damaged paint—as soon as they appear. Severely damaged siding will need to be replaced.

Be sure to determine the cause of serious damage before replacing siding. If moisture is the culprit, find the source by checking for deteriorating roofing (page 118), bad flashing, leaking gutters or downspouts, and poor drainage. Consult a professional if you can't locate the source. If after removing damaged siding you see evidence of rot or insect infestation, call in a professional.

REPAIRING HOLES Small holes in board siding can be filled with exterior-grade wood putty. To conceal a small hole, fill it with putty and allow it to dry completely. If the

hole is deeper than $\frac{3}{8}$ inch, mix and apply two-part epoxy wood filler or auto body filler. When the final layer is dry, sand the surface smooth. Then prime and paint or apply another finish.

REPAIRING WARPED BOARDS Warped or buckled boards usually show up where they have been fitted too tightly or nailed improperly. If a board has nowhere to expand when it swells with moisture, it warps or buckles.

To straighten a warped or buckled board, try to pull it into line by drilling angled pilot holes and driving long galvanized or stainless screws through it and into the wall studs. Cover the screw holes with wood putty.

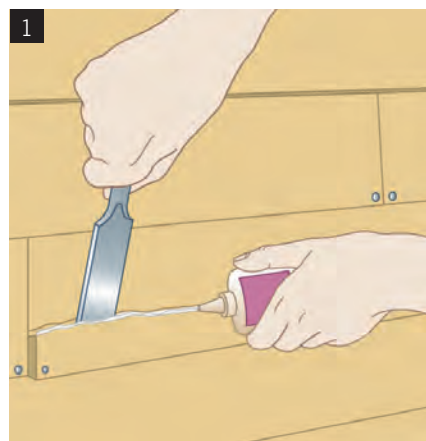
If that doesn't work, you may have to replace the board. Pull out or cut off the nails holding it in place. Carefully remove the damaged board and install a new one. If the siding is painted, make sure the new board is painted on all sides, including the back and ends.

AMERISPEC® TIP A ROTTING BOTTOM ROW

If the bottom row of siding is rotting, chances are it is too close to the ground. Dig away soil or sod so it is at least 8 inches below the siding at all points and sloping away from the house. If the siding is rotten only in spots, apply wood hardener, then primer, and cover with two coats of paint. If the siding is very rotten at the bottom only, you may be able to cut a straight horizontal line to remove the rot. Otherwise, you will need to replace the bottom boards.

Repairing a split board

1 Carefully pry the damaged board apart at the crack and liberally coat the two split edges with exterior glue.



2 Push the edges tightly together, drill pilot holes, and drive nails or screws into the sheathing.



REPLACING DAMAGED BOARDS, SHINGLES, AND SHAKES

Sometimes a board is so badly damaged that you must replace it. A damaged shingle or shake should also be replaced.

The approach to replacing board siding depends on the milling of the boards (common types are shown on the opposite page) and how they're nailed. Often the trickiest part of the job is finding a replacement that matches the original.

No matter what type of siding you're replacing, you'll have to cut the damaged piece and remove the nails in order to pry it out. Pull nails with a nail puller, or cut nails with a hacksaw blade. Repair damage to the building paper with housewrap tape or with a new piece of paper slipped under the old one, then cut the new piece of siding so it will fit snugly but not too tightly. For best results, cut out and replace a section that spans at least three studs.

TONGUE-AND-GROOVE SIDING Because the boards are locked together, the damaged piece must be split lengthwise and cut at the ends (as shown on page 108) before it can be removed. It's easiest to make the cuts with a circular saw. Set the blade depth just shy of the thickness of the siding. Finish the cuts using a hammer and chisel.

LAP SIDINGS Clapboard, Dolly Varden, shiplap, and other lap styles are face-nailed to studs or sheathing. Though the boards overlap, you can replace a damaged piece without removing the surrounding boards. You may need to pry up the board above the

one you're replacing to free the last pieces of damaged board. To replace all types of lap siding, follow the directions shown at right.

To provide a solid nailing base for the replacement board, try to center the end cuts over studs. You can cut the ends of the siding with a circular saw and finish with a keyhole saw, or use an oscillating multitool (if you're lucky enough to have one). If nails are in the way of your saw cuts, pull them out first.

BOARD-AND-BATTEN SIDING To remove board-and-batten siding, pry off the battens on each side of the damaged board. Then pull out the nails holding the damaged board. Patch cuts or tears in the building paper with a new piece or with housewrap tape. Replace the damaged piece and reinstall the battens over the joints.

SHINGLES AND SHAKES When a shingle or shake splits, curls, warps, or breaks, you'll have to replace it. The technique depends on whether the shingles or shakes are applied in single or double courses.

In a single-course application, each row overlaps the one below by at least half a shingle or shake length. The nails are concealed under the shingles or shakes of the course above. Replacement procedures are the same as for a shingle or shake roof (see pages 122–123).

Double-coursing calls for two layers of shingles or shakes. Here, the nail heads are exposed. To replace a damaged shingle or shake, simply pull out the nails, remove the damaged piece, slide in a replacement, and nail it.



Replacing lap siding

1 Mark for cuts at each end of the damaged section. Drive shims up under the board directly above the damaged one on each side of the two marked lines. Using a circular saw, a multitool or a keyhole saw, make straight cuts across both ends of the damaged board.



2 Use a small hacksaw to cut off nails holding the damaged piece in place. Alternatively, you can split the damaged section with a chisel, pull out the pieces, and then pry out the nails. Repair tears in the building paper with housewrap tape.

3 Cut the replacement piece to fit and tap it into place with a hammer and a scrap of wood. Slip felt-paper splines under the joints to flash them, and nail the new piece in place. Fill the nail holes and the board ends with caulk, then paint.

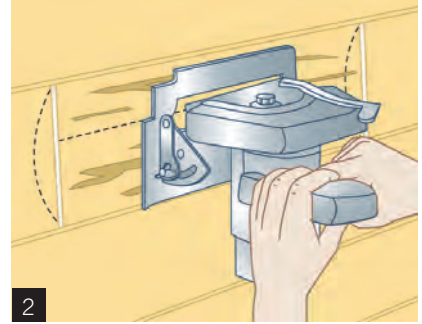
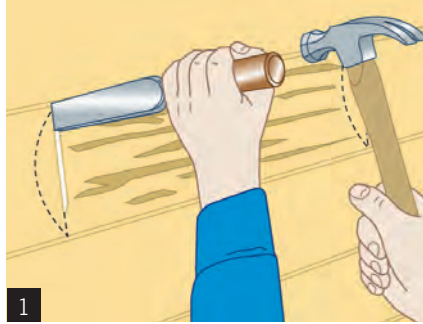


WOOD-BORING INSECTS

To detect damage by termites and other wood-eating insects, probe the edges of wood siding with a knife and look for soft, spongy spots. Pay special attention to any part of the siding that's close to or in contact with the ground.

In a primary infestation, the insects and their reproductive queen live in the ground near the house and make repeated trips into the walls to get food. In this case, the solution is to poison the colony and then make it difficult for future colonies to get into your house. In a secondary infestation, a smaller colony lives inside the wood. Here the solution is simply to destroy the bugs where they live.

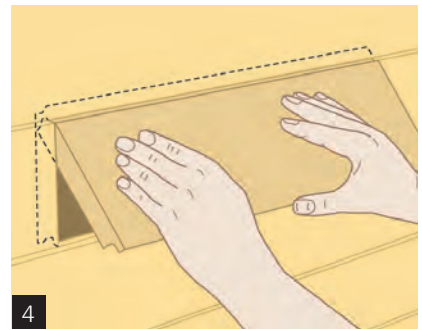
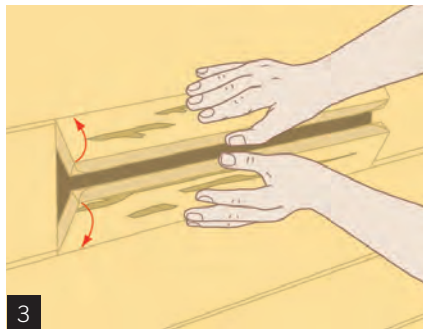
Check for visible evidence of termites. Look for their translucent ½-inch-long wings or the mud tubes they sometimes build, which are usually visible from under the house. If you find evidence of termites, consult a licensed termite inspector or pest control professional.



Replacing tongue-and-groove siding

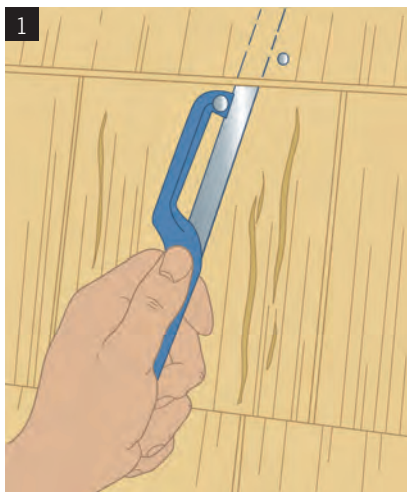
1 Pull out all exposed nails in the area to be repaired. Mark the end cut lines, then cut with a circular saw almost to the bottom and top of each mark. Finish the cuts with a hammer and chisel.

2 Adjust a circular saw to cut just through the depth of the siding, then cut along the center of the damaged section, almost to the end cuts. Complete the cuts at both ends with a hammer and chisel.



3 Cave in the board, then pull out the loosened pieces. If you find cuts or tears in the building paper, repair them with housewrap tape or a new piece.

4 Remove the back side of the groove in the replacement board. Slide the board into place, drill pilot holes, and face-nail it. Fill the nail holes and ends, then finish.



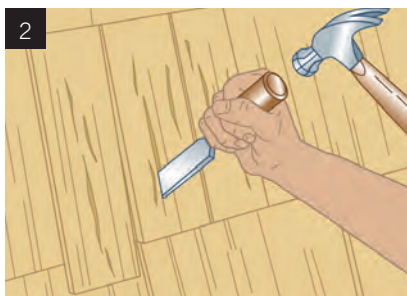
Replacing a siding shingle

1 Pry out the shingle above slightly, insert a small hacksaw or reciprocating saw, and cut away the nails that are holding the damaged shingle.

2 Use a hammer and chisel to split the shingle in two or three places. Pull the pieces out and repair any damaged building paper with housewrap tape.

3 Cut a new shingle ¼ inch narrower than the opening. Slide it up until it is ½ inch too low, then drive nails just below the shingle above at a 45-degree angle.

4 Tap the shingle up into alignment using a scrap of lumber to protect it from damage. When you do this, the nails will straighten and disappear below the upper shingle.



aluminum and vinyl siding

Aluminum and vinyl siding panels have interlocking flanges along both edges. The panels are nailed to the sheathing through slots in the upper flange, and the lower flange interlocks with the adjacent panel.

REPAIRING ALUMINUM SIDING To remove a dent, drive a screw into its center. Gently pull on the screw head with a pair of pliers. Remove the screw and fill the hole with auto body filler. When the filler is dry, sand it smooth and touch it up with matching paint.

Conceal scratches in aluminum siding with metal primer. When it is dry, coat it with acrylic house paint.

Clean corroded areas with fine steel wool. Then treat the area with rust-resistant metal primer made specifically for aluminum, and cover it with acrylic house paint.

If a section is damaged beyond a simple surface repair, replace it as shown below.

REPAIRING VINYL SIDING If vinyl siding is cracked or punctured, you must remove the entire damaged section and install a replacement. To do this, use a special “zipper” tool to separate the interlocked panels.

TYPICAL ALUMINUM OR VINYL SIDING

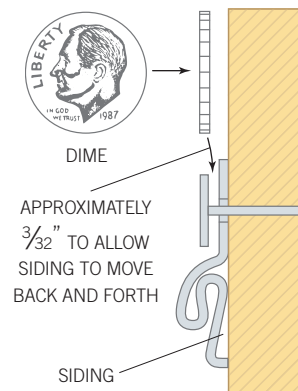


Work during warm weather, when the vinyl is pliable.

Using the zipper tool, unlock the panel above the damaged one and lift the upper panel to expose the nails securing the damaged panel. Pry out the nails. Mark cutting lines on each side of the damaged area using a carpenter’s square and a pencil. With tin snips or a utility knife, cut the panel along the lines and remove the damaged section.

Cut a replacement piece 2 inches longer than the section

you just removed. (Cut the piece only 1 inch longer if the damaged section ends at a corner or joint.) Snap the bottom edge of the new section into place and nail it with large-head aluminum nails long enough to penetrate 1 inch into the studs. Don’t drive the nails in all the way; leave them a little proud so that the siding can move back and forth. Using the zipper, snap the upper panel back into place over the new one.



AMERISPEC® TIP

REATTACHING VINYL SIDING

Sometimes vinyl siding just comes loose and the pieces disengage from each other. Shoehorn a zipper tool up under a popped-out section and slide it along as you push down, snapping the siding back into place.



A quick repair for damaged vinyl siding

1 Use a utility knife or tin snips to cut through the center of the panel to just beyond both sides of the damaged area. Make vertical cuts on both ends and then remove the lower half of the damaged section.

2 Cut the nailing strip off the replacement with a utility knife. The new piece should be 6 inches longer than the damaged section, or 3 inches longer if one end is at a joint or corner.

3 Generously apply polyurethane caulk or lap sealant to the damaged panel. Snap the new piece into place so that each end overlaps the existing siding by 3 inches. Hold or prop it there until the sealant is dry.



stucco siding

Stucco walls typically consist of three layers (or coats) applied over wire mesh.

Stucco is porous, so two layers of building paper (not plastic house-wrap) underneath are essential. The final coat is either pigmented or painted, and it can be textured in a variety of ways.

Settling and poorly applied or poor-quality stucco can cause cracks and holes in stucco. To protect the house from moisture damage, repair damaged stucco right away.

The two keys to a successful repair job are slow curing of the patched stucco and careful matching of the color and texture of the patch to the existing wall.

CRACKS To fix large cracks, use a cold chisel and hammer to undercut the edges of the crack using the same technique as for interior plastered walls (see pages 18–19). Brush away loose stucco, then apply a liquid concrete bonding agent.

With a mason's trowel or putty knife, fill the crack with stucco patching compound and pack it tightly. Use a trowel or brush to approximate the surrounding texture. Cure the stucco by covering

it with plastic and keeping it damp for about four days.

SMALL HOLES To repair a hole up to about 6 inches wide, use a hammer and chisel to remove loose stucco, and brush out dust. If the wire mesh or wood lath is damaged, staple in a new piece of mesh. Apply a liquid concrete bonding agent, pack the hole with stucco patching compound, and finish to match the surrounding area. To cure, cover with plastic and keep damp for about four days.

LARGE HOLES Holes larger than 6 inches wide should be repaired with two or three coats of stucco—a scratch coat, perhaps a brown coat, and then a finish coat.

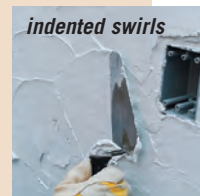
For the first and second coats, add $\frac{1}{10}$ part lime to stucco mix for easier working. Mix with enough water to make a fairly stiff paste. For the final coat, purchase a stucco mix in the desired color (unless you will paint it).

Prepare the surface as you would for a small hole. Apply liquid concrete bonding agent to the edges. Be sure to press the first coat well into the mesh for a good bond. When this coat is firm, scratch it

TEXTURE POSSIBILITIES

Stucco textures are as individual as the workers who make them, so it

may take some experimenting to mimic yours. Practice on a scrap of plywood before applying stucco to the wall. Produce swirls with a whisk broom (see Step 3 below). To make a spatter texture, dip the broom in wet stucco mix and flick it at the wall. If you then run a trowel lightly over the spattered surface, you will get a knockdown texture. You can also use a trowel to make indented swirls.



all over with a nail to provide grip for the second coat. Tape a plastic sheet over it to keep it damp and let it cure for two days. If needed to achieve the desired thickness, apply a second coat in the same way.

The final textured coat should be flush with the surrounding wall. Texture it to match while it's wet. To cure stucco, cover it with a plastic sheet and keep it damp for about four days. Wait a month before painting it.

Patching a medium-sized hole in stucco

1 Remove loose stucco from the damaged area with a cold chisel and hammer. Brush away dust, and apply a liquid bonding agent.



2 Mix stucco patch according to the label directions and apply it with a trowel. Press the patch into the wall as you smooth it.



3 Before the stucco sets up, use a whisk broom to match the wall's texture. If the wall is smooth, use a trowel.



exterior caulking

Exterior caulk prevents water from penetrating. It will eventually dry out and need to be replaced, so check for cracked, loose, or missing caulking as part of your spring and fall maintenance inspections.

TYPES OF CAULK For most jobs, use latex-silicone or acrylic-silicone caulk—not cheap latex-only caulk, which will soon shrink and become brittle. Pure silicone caulk is more flexible and washable, but some versions come loose. A high-quality type that may be labeled “Silicone II” will likely stick well and last a

long time. If you plan to paint, be sure the caulk is paintable. Butyl and polyurethane caulks are very flexible, sticky, and durable, making them good choices for areas that will often get wet. However, they are difficult to work with. For gaps wider than $\frac{3}{8}$ inch, use aerosol foam.

WHERE TO CAULK Generally, apply caulk to holes and cracks where water could get in. For example:

- Where a chimney flue tile exits a concrete crown, where pipes or wires penetrate the roof, where shingles are cracked or roofing nails exposed.

- On siding, at inside and outside corners; around window and door-frames; between badly fitting pieces of siding; where pipes and other protrusions pass through the siding; and where the siding meets the foundation.

APPLYING CAULK Dig out old caulk with a utility knife, a putty knife, a screwdriver, or a scraper. Use a wire brush to remove debris. Then wipe the surface with a cloth soaked with water or mineral spirits. If possible caulk on a warm, dry day when the temperature is between 50 and 80 degrees.

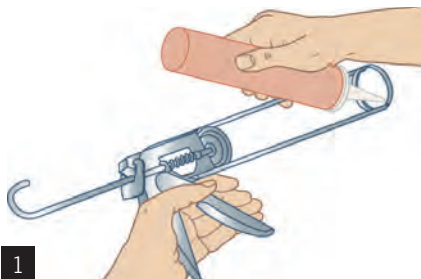
It will take practice to lay down a smooth, even bead of caulk. Gently press the nozzle of the caulking gun against the joint, pull the trigger until the caulk emerges, and slide the nozzle smoothly along, squeezing the trigger to keep the caulk flowing. Make sure the compound fills the crack completely and adheres to the surface on each side.

AMERISPEC® TIP

REPAIRING A CRACK IN STUCCO



Narrow cracks in masonry can be repaired with stucco caulk. Clean the area around the crack with a wire brush and then apply the stucco caulk according to the label directions. After the compound cures, the area can be finished with latex paint to match the wall.

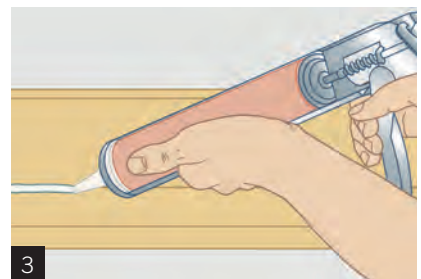


Using a caulk gun

1 To load the gun, pull the plunger all the way back. For the type of gun shown, insert the caulk tube nozzle end first. For other types, insert the bottom end first. Push the plunger until it stops, then give one gentle squeeze of the trigger.

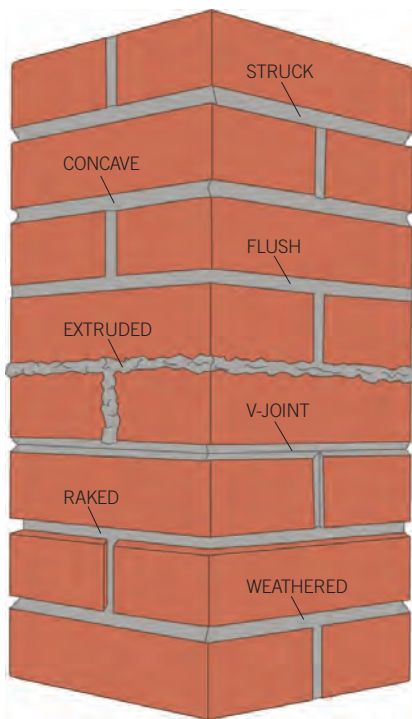


2 Use a utility knife to cut the nozzle. Some people prefer it at a 45-degree angle, while others prefer it nearly perpendicular. The closer to the tip you cut, the narrower the bead. With some tubes, you need to break a seal by poking it with a nail or coat hanger.



3 Holding the gun so the tip rests flat against the joint, squeeze the trigger until caulk starts to emerge, then slowly pull the gun along the joint as you continue to squeeze the trigger. After laying the bead, you may choose to wipe it smooth with your finger or a damp cloth.

brick veneer



TYPES OF MORTAR JOINTS

Brick-veneer siding is usually applied to a wood-frame wall over building paper. As shown at left, the mortared joints may be finished in a number of ways, some of which shed water better than others.

REPOINTING Most problems develop at the mortar joints. Sometimes the mortar shrinks, causing the joints to open, and old lime-based mortar often crumbles. Freeze-thaw cycles in cold-winter climates, excess moisture, and settling also result in mortar problems. To repair cracked or crumbling mortar, you'll have to remove the old

mortar and repoint the joints, as shown below.

Repointing a small area is not difficult, but if you have a large area to cover, consider hiring a pro, who can work quickly and neatly.



Repointing a brick wall

1 Grind while exerting moderate pressure. Wear a respirator and work carefully; a slip could cause you to damage a brick.

2 Use a raking tool, as shown, or a hammer and chisel to finish cleaning out the mortar.

3 The raking tool shown has a built-in depth gauge. Check that you have removed at least ½ inch at all points.

4 Mix a batch of mortar just stiff enough to stick to an upside-down trowel. Load a dollop of mortar

onto a large trowel, press it against the wall, and push the mortar firmly into the joints with a tuck-pointing trowel. Push more mortar into the joint than you'd like for the final result. Apply mortar to the horizontal joints first, then scoop more onto the tool and apply it to the verticals.

5 If the surrounding mortar joints are neatly tooled, smooth the joints using a striking tool (as shown below). If they bulge outward slightly, brush the new mortar to match.



Test to see that you have the right mortar color before you start. A masonry supply source will have samples (see opposite page) that you can compare with the existing mortar.

You can chip away mortar using only a chisel, but a grinder equipped with a masonry blade greatly eases the job. Wear long clothing, gloves, protective eyewear and a respirator (if you use a grinder).

REPLACING A BRICK If a brick has cracked or crumbled, use a grinder to cut away the joints as shown below and chip it out using a hammer and chisel. Clean out all the old mortar. Mix a small batch of color-matched mortar. Dampen the replacement brick and the opening. Apply a thick bed of mortar to the bottom of the opening and to the top and ends of the replacement brick. Holding the brick on a trowel, slip it straight into the opening. Scrape away excess mortar and tool the joints.

CHECK FOR MORE DAMAGE

If a fascia board is rotted, there is a good chance that the rafter ends are rotted, as well. If a rafter end is only slightly rotten, you can apply wood hardener. If the rot is more extensive, you may be able to cut a new rafter rail and attach it to the old one with screws. Otherwise, call in a carpenter or roofer.

You should also check the soffit and the roof sheathing for signs of rot. Soffit boards can usually be replaced easily, using the old board as a template. Replacing roof sheathing is more complicated; call in a roofer.

repairing fascia

Fascia boards are the horizontal trim at the edge of the roof, and they take the brunt of harsh weather, often becoming damaged or badly worn. Repairs are relatively easy on a low single-story house if you are comfortable being on a ladder and have basic carpentry skills. If your home does not

have eaves that are easy to work on, you will be better off hiring a professional.

You can repair small holes and areas of rot by chipping away loose material, applying wood hardener, and filling them with two-part epoxy wood filler.



Replacing a fascia board

1 Use a flat pry bar to pull the entire damaged fascia board loose from the eaves. Wear safety glasses and exercise extreme caution when working from a ladder. After prying off the piece, lay it across a pair of sawhorses and remove all of the nails.



2 Use a circular saw set for a 45-degree bevel to cut off the damaged portion of the board. Use a square to guide the saw and locate the cut so it will land on a rafter tail.



3 Using galvanized nails slightly bigger than the ones you removed, nail the fascia board back in place. Slip the top under the roof's metal drip edge and be sure the bottom is aligned with the soffit exactly where it was before. Then measure for a new piece to fill in where the damaged section was removed.



4 Nail the new piece in place, nailing into the rafter ends with 8d (2½-inch) galvanized nails. For nails near the end of a board, drill pilot holes first. Caulk the joints before painting to match the existing fascia. Consider repainting the entire fascia for a better match.

preparing and painting siding and trim

Sometimes you can start prepping siding and trim by scrubbing, but in many cases, simply washing the surface to be painted is not enough. Paint that has begun to fail may need to be removed completely to ensure that the new coat will adhere properly. For solutions to specific paint problems, see page 105. Prep work is tedious and time-consuming, but the reward is a great-looking, durable finish.

SCRAPING For scraping small areas of peeling paint, a paint scraper or putty knife is sufficient. To make sure you get all the loose material, scrape in all directions. Place two hands on the scraper and keep it flat to avoid gouging the wood.

POWER SANDING Power sanders can be used to smooth the edges of scraped areas or to clear an entire surface



AMERISPEC® TIP

FIXING MISTAKES

If you create gouges, fill them with a vinyl exterior spackling compound so they will not show through the new paint. If the paint that remains after scraping has high or rough edges, sand with coarse sandpaper to make them less noticeable.

of paint. For big jobs, commercial-grade specialty tools are available to buy or rent. If your house was built before 1978, you may be dealing with lead-based paint, so look for equipment that offers HEPA-quality dust collection.

Power sanding is a meticulous process that requires concentration. After donning a respirator, make sure the sander is running at full speed before you touch the wheel to the surface. Keep moving it along the surface so you do not gouge the wood. Maintain the sanding wheel at a slight angle (5 to 10 degrees) to the wall. Otherwise, the wheel will spin

out of control across the surface. Discard sanding disks as they become clogged with paint so they will not burn the surface.

ALTERNATIVES TO SANDING Use liquid paint remover when stripping paint from ornate woodwork or hard-to-reach recesses. In especially difficult areas, try a heat gun. See page 25 for tips on these techniques.

PRIME Primer seals the surface and provides a base to which the paint can adhere. Slow-drying alkyd-based primers are your best bet. To improve coverage, have your primer tinted with some of the finish color.

Preparing siding for paint

1 Begin by hosing down the siding, then scrub it with a stiff-bristle brush mounted on a pole. Clean the area with a solution of water and trisodium phosphate (TSP) or a nonphosphate substitute, following label directions. This solution is caustic, so do not use it on bare wood. Also wear

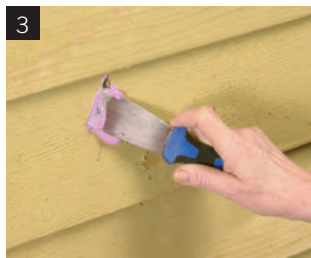
rubber gloves and safety goggles. Protect plants and shrubbery.

2 Scrape loose paint and, if necessary, use a power sander to remove large areas of paint or to smooth any roughly scraped surfaces. When using a sander, work in 3-foot sections. Move horizontally across the

top of a board, then in a wavelike pattern across the middle, then along the underside.

3 To fill holes or dents, apply exterior spackling with a putty knife or 6-inch tapping knife. Use a matching wood-toned filler if you intend to apply a semitransparent stain.

4 After the filler has dried, use a sanding block or a vibrating sander with 100-grit sandpaper to sand each patch until it is smooth. Sweep away residual dust or scrapings.





Stripping and prepping a window

1 Remove paint from flat surfaces using a power sander. For other surfaces, blister the paint with a heat gun, then peel it away with a putty knife.

2 Use a hammer and chisel or an old screwdriver to tap out old window glazing compound that is cracked or brittle. Take care not to tap the glass.

3 Once most of the paint has been removed, power-sand the window-sills with a palm sander, graduating from rough to fine paper.

4 Fill cracks and holes with a vinyl exterior spackle and sand the surface when it is dry. Fill gaps in the glazing (see page 50).

PROTECT Before you paint, protect the surrounding area with thick cotton drop cloths or plastic sheeting. Use 3-inch tape to mask adjacent surfaces that aren't being painted.

PAINT For best results, paint in fair, dry weather above 50 degrees. Lower temperatures may cause poor adhesion. Apply paint after morning dew dries, and stop at least two hours before evening dampness arrives. Avoid painting in direct sunlight. If possible, follow the sun around the house. Do not apply oil- or alkyd-based paints to cool surfaces that will be heated by the sun in a few hours, as this may cause the paint to blister.

For best results, first brush on a coat of primer and let dry. Apply the finish coat with a high-quality brush. First paint the overhangs and gutters, then the main surfaces from the top down. Wait until the siding has dried completely, then paint the trim, shutters, railings, porch, and foundation. Apply masking tape to protect the siding from the trim paint and remove the tape immediately after finishing.

CAUTION Houses built before 1978 are likely to contain lead paint. Follow EPA guidelines for lead-safe remodeling, available at www.epa.gov/lead.

Painting a house's exterior

1 On lap siding, first brush the bottom edges of horizontal boards. Dip the brush no more than 1 inch into the paint. To prevent drips and lap marks, paint all the way across three or four boards.

2 To paint the face of the siding, dip the brush about 2 inches into the paint and tap it against the side of the bucket. Turn the brush parallel to the ground as you lift it. Quickly press the brush against the siding, spreading the paint in a side-to-side motion on horizontal siding or up and down on vertical siding.

3 When painting windows, draw a lightly loaded tapered sash brush along muntins, allowing a slight bead of paint to lap onto the glass. This bead will help seal the window. To remove paint before it dries, use a rag wrapped around the end of a putty knife. You can remove dry paint with a razor blade.

4 To ensure good coverage on the face of the trim, first paint against the grain, then run the brush with the grain. When painting the sash of an operable window, open and close it several times so that it won't be sealed shut by paint.

5 Protect the abutting siding with painter's tape. First paint against the wood grain, then create an even surface by brushing with the grain. Turn the brush diagonally to the trim if it is wider than the trim. Or apply paint with a short trim roller and work it in with a brush, painting with the grain.



roofing

Knowing how your roof is constructed is the first step toward diagnosing problems. On page 118, you'll find a guide for inspecting your roof from the inside and out. If you find problems, see pages 120–127 for the most common homeowner-friendly repairs.

UNDERSTANDING ROOF STRUCTURE

A roof protects a home and the people inside from the elements, especially water and sun. Roofs are designed to shed water and direct it away from the house.

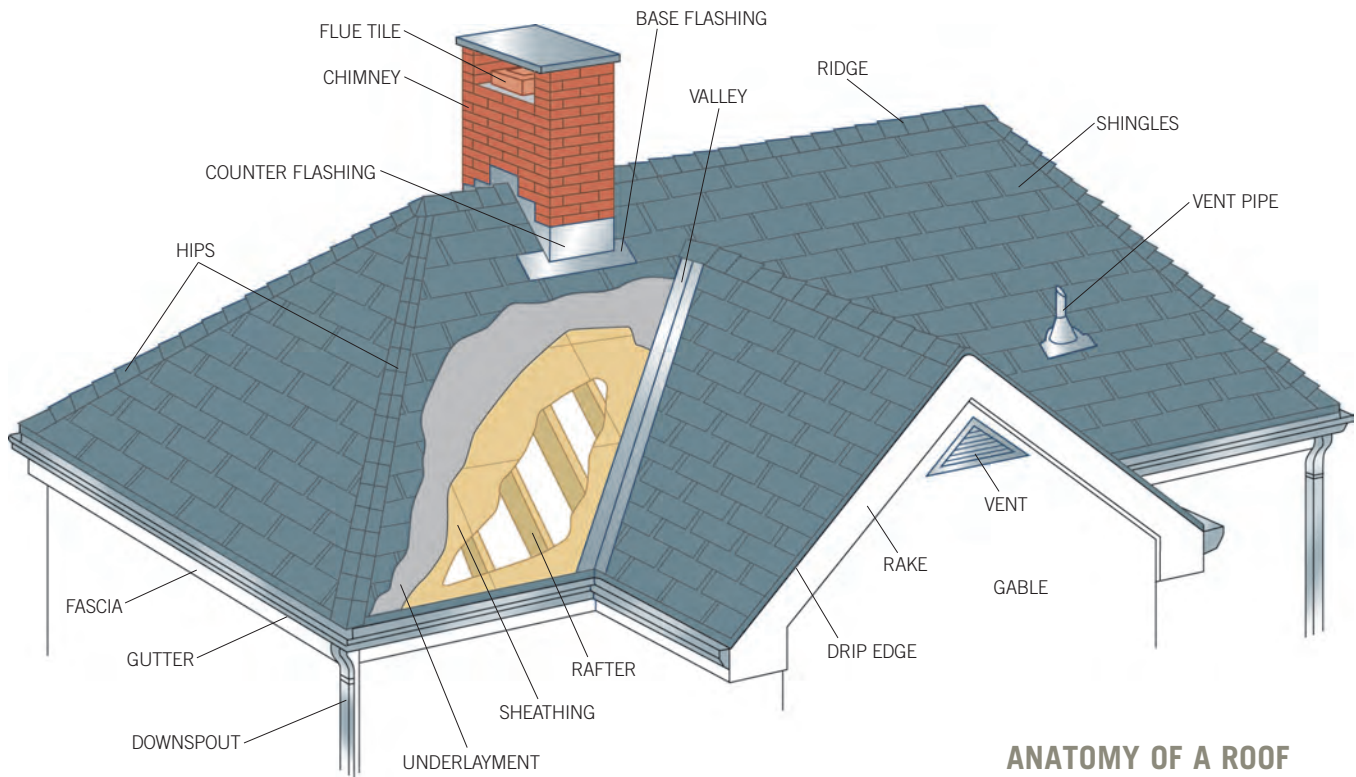
A typical roof is supported by a framework of rafters, a ridge board at the peak, and sometimes hip or valley rafters as well. Many newer roofs are made with trusses and other types of engineered framing, which combine smaller-dimensioned lumber and even plywood with special fasteners to create a structure that is straight and strong. Special framing hardware (sometimes called hurricane ties), add extra strength to critical junctures, such as where the rafters or trusses attach to the house's walls. This hardware is required in locales where there is a risk of earthquakes or high winds.

CAUTION Working on a roof is dangerous, so take special precautions (see page 119). Metal, tile and slate roofs are especially slippery, and these materials are easily broken or damaged. If your roof is slippery, icy, or wet, or if it is severely sloped, leave inspection and repairs to a professional.

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AMERISPEC® TIP ROOF INSPECTIONS

Most homeowners wait until something drastic happens to the roof, after which they are forced to take immediate action. With periodic inspections, you can spot and correct minor problems before they become serious enough to cause damage.



ANATOMY OF A ROOF

Sheathing is attached to the framing, and an underlayment is laid on the sheathing. Strips of metal called flashing are attached at the edges, along inside corners, and where the roof meets a vertical surface such as a chimney. The finish roofing material is nailed on top of the underlayment.

ROOF DECK Sheathing, the material that provides the nailing base for the roof surface material, is usually plywood or oriented strand board (OSB). A home built before WWII may have sheathing made of 1-by-6 boards. If the roofing is wood shakes or shingles, the sheathing may be a solid deck, or it may be boards with spaces between them, which is called skip sheathing.

Sandwiched between the sheathing and the surface material is the underlayment, traditionally roofing felt (tar paper), which resists water penetration yet allows moisture from inside the attic to escape.

ROOF SURFACE Sloping roofs are usually covered with overlapping layers of asphalt shingles or wood shakes. Less common roofing materials include clay or concrete tile, slate, aluminum, galvanized steel and copper.

Flat or low-sloping roofs are often surfaced with alternating layers of roofing felt and asphalt or tar, sometimes with a layer of gravel on top. These are known as built-up roofs. Some flat roofs are

covered with a synthetic membrane called EPDM, or rubber roofing.

FLASHING Flashing appears as the drip edge along the eaves of a roof, the collars around ventilation and plumbing pipes, the valleys between two roof planes, and the steps along a chimney or wall. Less obvious flashing also protects other breaks in the roof, such as skylights.

At roof edges, gutters catch water runoff and channel it to the ground via downspouts, which direct water away from the house and into the soil.

inspecting a roof

Inspect and repair your roof in fall, before cold weather hits. Then check it in spring for any winter damage.

INSPECTING FROM INSIDE Begin in the attic using a strong flashlight, a thin screwdriver, a knife, and a piece of chalk. Examine the ridge beam, rafters, and sheathing. Look for water stains, dark-colored areas of wet wood, moisture, and soft spots that may indicate rot. If you see mold or mildew, the attic may not be properly ventilated; call in a roofer or carpenter. Mark the wet spots with chalk so you can find them easily later on.

Turn off any lights. If you see sunlight coming through holes, drive nails or poke wire through them so they'll be visible from the roof's surface. (A wood-shingle-roof may show some light between the shingles, but that usually isn't a problem because the shingles swell and close up when they're wet.)

INSPECTING FROM OUTSIDE To check the structure, stand back from the house and look at the lines of the ridge and rafters. They should be reasonably straight along the plane of each roof section. If either sags significantly, your house may have a structural problem. Call in a professional roofer or carpenter for an assessment.

Next, inspect the surface. Before climbing up on your roof, read the safety tips on the next page. If you're at all nervous, make the inspection from a ladder using a pair of binoculars. Don't walk on the roof any more than is absolutely necessary, because you may damage it.

Inspect the flashings for corrosion or other damage. If you have metal gutters and downspouts, look for rust spots and holes. Then examine the roof surface for signs of wear, loose or broken nails, or curled, broken, or missing shingles.

Poke with a screwdriver to test the boards along the eaves and rakes. If the screwdriver sinks in easily, indicating rot, replace the boards and finish them to match the existing areas (see page 113 for fascia repairs).

LOCATING A LEAK

Roof leaks usually appear during storms, when you can't make permanent repairs. But you can discover the source of the leak.

Generally, leaks begin at a roof's most vulnerable spots: at flashings, where shingles are damaged, in valleys, or at eaves. But the water may show up far from its point of origin after seeping through layers of roofing and traveling down rafters to collect in a puddle where you can see it.

During a storm, trace the course of water to find where it's coming through the roof. Drive a nail or wire through the hole so you can find the hole later when you get up on the roof.

Once the roof is dry enough, look for spots that indicate a source of the leak. Remember, the point where a nail or wire is poking through may be below the actual source. Make permanent repairs as described on the following pages.

If asphalt shingles or roll roofing sheets are curling, cracking at corners, or generally losing their granular surface, you may need new roofing. See page 122 for more information.

GENERAL MAINTENANCE

Cut tree limbs back so they cannot cause damage. If leaves collect on your roof, sweep or hose them away.

To combat moss, mildew, or fungus, prune trees so the roof can receive sunlight. If that does not solve the problem, nail a strip of zinc near the ridge. When it rains, zinc will leach out and kill the moss, mildew, or fungus. When replacing shingles on a roof that is often moist and shaded, purchase zinc-impregnated shingles, which solve the problem.

On a wood shake roof, use a pump sprayer to apply preservative periodically to prevent the wood from drying and cracking.

MINIMIZING DAMAGE FROM A LEAK

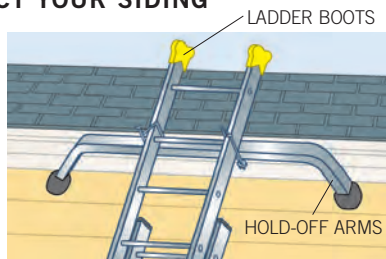
If you find a leak in the attic, drive a nail or poke a wire up into it to direct water into a bucket below. Similarly, if water is coming through a ceiling, poke a nail or an awl into the center of the leaking area so all the water flows into a bucket below.



AMERISPEC® TIP

PROTECT YOUR SIDING

The ends of a ladder can dent or scratch siding or bend gutters. Consider purchasing hold-off arms, which keep the ladder a few inches away from the house. You can also slip ladder boots onto the ladder ends.



working safely on the roof

Before climbing a ladder to repair roofing, siding, windows, or gutters, it's important that you know and observe the following safety precautions.

LADDER SAFETY

An extension ladder may be made of wood, aluminum, or fiberglass. Make sure all the rungs are in good shape. If the ladder sways alarmingly, do not use it. Here are some safety tips:

- Be very careful around overhead power lines. Aluminum ladders, and even wood ladders, will conduct electricity.
- Place the base on firm, level ground at a measured distance from the side of the house, shown at right.
- If possible, stake the bottom of the ladder and tie off the top to keep it from moving.
- Get on and off the ladder by stepping onto the center of the rung. Use both hands to grip the ladder rails, not the rungs. Reposition the ladder if it wobbles.
- Keep your hips between the ladder rails. Don't lean out to

reach an area. Reposition the ladder instead.

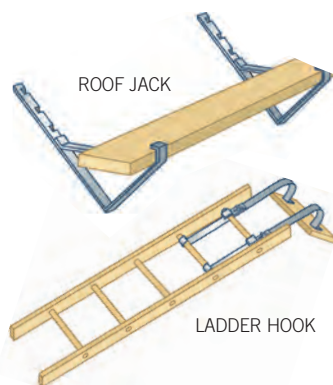
- Make sure that only one person stands on a ladder at a time.
- Install rubber safety shoes (available at home improvement centers) on the ladder feet if the ladder is to stand on a slick surface.
- Don't stand on the top two rungs. If you're repairing a roof, the ladder should extend three feet above the eaves so you can step directly onto the roof.
- Be sure that the rung hooks of an extension ladder are locked in place and that no section is extended more than three-quarters of its length.
- Pull materials up a ladder with a rope and have a place to put them at the top. Do not try to carry them up.

ROOF SAFETY

Working on a roof requires extra caution. The surface is usually slick, sloped, and well above the ground. Here are some precautions to observe when you need to make roof repairs.

- Don't walk on a roof any more than is absolutely necessary,

they can be slipped off the nails. When you're finished, set and caulk the nails to avoid leaks.



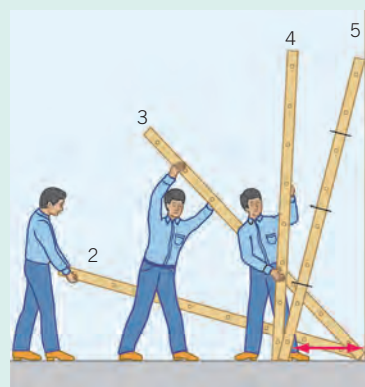
SPECIAL SAFETY EQUIPMENT

These standard safety devices, which can be rented, help distribute your weight evenly and provide secure footing.

- A metal ladder hook allows you to hook a ladder over the ridge of the roof.
- A pair of roof jacks hold a plank to provide a safe support. To install a jack, lift up a shingle, slip the jack under, and drive two nails. The jacks have notches in them so

POSITIONING A LADDER

- 1 Check for overhead power lines.
- 2 Set the base against the wall.
- 3 Walk the ladder upright.
- 4 Lean it against the house and move the base outward.
- 5 Set the base at a distance from the wall equal to one-quarter the ladder's length.



because you may damage it. Don't walk on tile and slate roofs at all; they are slippery and breakable.

- Let a professional make any repairs on a steeply pitched roof—one that slopes more than 25 degrees or rises more than 4 inches vertically for every 12 horizontal inches.
- Wear loose, comfortable clothing and nonslip rubber-soled shoes with good ankle support.
- Work on the roof only in dry, calm, warm weather. A wet roof can be treacherously slick, and a sudden wind can knock you off balance.
- Never work on the roof when lightning threatens.
- Be careful not to put your weight on brittle or old roofing materials, or rotted decking.
- Stay well away from power lines and be sure neither your body nor the equipment comes into contact with them. Keep children and pets away.

repairing flashing

Flashing protects the roof at its most vulnerable points: in the valleys, at roof/wall intersections, at vents and other penetrations, around chimneys and skylights, along the eaves—anywhere water can seep through open joints.

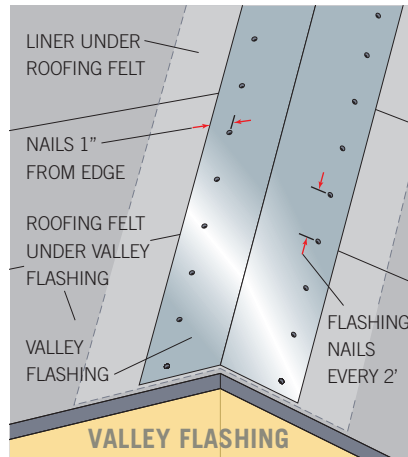
Most flashing is made of a rust-resistant metal, such as galvanized steel, aluminum, or copper, but flashing can also be made of roll roofing, roofing felt, or self-adhesive membranes. Some flashing joints may be sealed with roofing cement or a special caulking compound. But cracked or crumbling roofing cement or caulking around flashing is often a sign that the flashing should be replaced.

INSPECT FLASHING SEMIANNUALLY Re-nail or replace loose nails, and cover all exposed nail heads with roofing cement. Look carefully for holes. You can plug pinholes with small spots of roofing cement. Patch larger holes with the same material as the damaged flashing, as shown at right. Old galvanized flashing that has developed a number of rusty spots should be replaced rather than patched.

TYPES OF FLASHING

■ Valleys require particularly sturdy flashing because they carry more water than any other individual roof plane. On some roofs, the metal valley flashing is left exposed. On others, the valley is flashed with a self-adhesive membrane that is covered by the roof shingles.

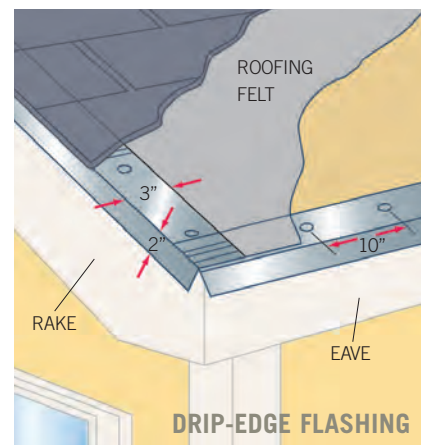
■ Drip-edge flashing helps keep water from wicking back under the shingles. It usually laps over the fascia and rake boards. Poor



or damaged drip-edge flashing can lead to rotted sheathing, trim, and even rafters. The flashing itself must be the right size and shape so water drips away from wood surfaces and does not seep under the shingles. Drip edges go under the roofing felt at the eaves and over it along the rakes. It should be shaped to resemble a “Z” in profile,

so rainwater is directed away from the trim.

■ Flashing around a chimney (see next page) can be complicated. Unless the chimney exits the roof at the ridge, there should be a cricket on the back side to shed water around the chimney. Elsewhere, base and step flashing form the first line of defense. And counterflashing, kerfed into the masonry, protects the base and step flashing.

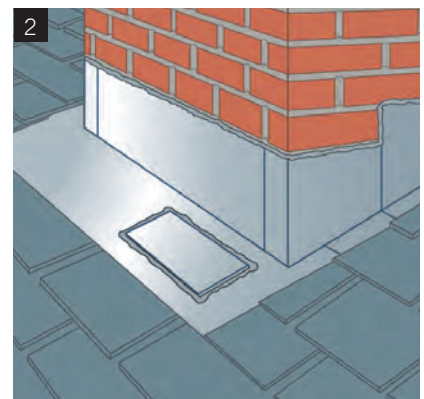


Patching a hole in flashing

1 Roughen the area around the hole with a wire brush or sandpaper, then clean the surface. Cut a patch of flashing material 2 inches larger than the hole on all sides.



2 Apply roofing cement, press the patch into place, and hold it for several minutes. Cover the patch with another generous layer of cement. If you find larger holes, seriously consider replacing the flashing.



■ Vent-pipe flashing is installed over the course of shingles directly below the pipe. The next courses of shingles will cover the upper half of the flashing.

■ Skylights that are self-flashing have built-in flanges that sit on the roof deck. A skylight mounted on a wood frame attached to the deck requires flashing much like that for chimneys, installed around the frame.

■ Dormer flashing is similar to step flashing found on chimneys. It extends under the siding on the dormer wall and under the shingles at the roof.

REPLACING FLASHING

Flashing must be installed in a precise manner or the roof will leak. Getting the flashing right is often tricky; even pros sometimes have trouble. If your roof leaks through a

piece of flashing and the flashing is obviously damaged, replace it with a duplicate installed exactly like the old piece. If it leaks and you see no damage, or if you are not certain how to install a piece, call in a professional roofer.

Sealing common trouble spots



CHIMNEY FLASHING If the mortar at the top of the counter flashing is cracked or missing, you can chip it all out and repoint with new mortar. But it's easier to seal this joint with a tube of roofing cement, or better yet, gray caulk designed for masonry.



ALONG A VALLEY Seal shingles to valley flashing and to the courses below by lifting their edges along the flashing and spreading roofing cement beneath the shingles.



AROUND VENT-PIPE FLASHING Apply roofing cement to the joint between the flashing and the pipe. Lift the side and back shingles and apply roofing cement to the joints between the flange and shingles.



ALONG DRIP-EDGE FLASHING Along the rake edge, lift the shingles and spread roofing cement on the top of the drip edge and the course below. Do not seal the drip edge along the eaves or against the fascia.

asphalt shingles

As shingles age, they can become brittle and crack, allowing water to penetrate. Some shingles can be repaired, but replacement is often necessary.

INSPECTING The first signs of aging are bald spots and a heavy accumulation of surface granules in the gutters. Check your roof's condition on a warm day, when the shingles should be flexible. Gently bend several shingles back.



SEALING A CRACK

Seal a small hole or crack with roofing cement, applying the substance with a putty knife or caulking gun. For tears or curls, liberally apply roofing cement under the pieces, press them down, and then secure them with roofing nails if necessary. Cover the nail heads with roofing cement.

If they appear gray and bloated, if the material crumbles easily, or if you see large bare spots or damaged areas, consider reroofing.

REPAIRS Cracked, torn, or curled shingles can sometimes be repaired. But if shingles are badly worn or damaged, replace them using shingles that remain from the original roof installation, or buy shingles identical in brand, color, and size. Fasten the shingles with aluminum or galvanized roofing nails that are long enough to penetrate all of the roofing layers and the sheathing.

Do not remove a damaged cap shingle along a ridge or a hip. Instead, nail each corner of the shingle in place. Apply roofing cement to the bottom of a new shingle and set it on top of the defective one. Nail each corner and then cover the nail heads with roofing cement.

Repair asphalt shingles on a warm day, when the shingles are pliable. (On a cold day, the shingles could crack, and on a hot day you could damage shingles by walking on them.) Keep the roofing cement at room temperature.



REPLACING A STARTER SHINGLE

A starter shingle runs along an eave, under a standard shingle. To make a starter shingle, use a knife or tin snips to cut off the tabs from a shingle. Apply a 3-inch-wide strip of roofing cement near the eave, then set the starter shingle in the cement with the adhesive spots along the bottom. Drive four roofing nails about 3 inches from the eave. Install the replacement shingles on top of the starter shingle.

REROOFING Asphalt shingles generally last from 15 to 25 years, depending on the climate and type of shingle. If shingles are generally failing, call a roofer for assessment.

If the roof has only one layer, you may be able to add a new layer over the old one. If you already have two layers, you will need to have the old roofing shingles torn off before installing new ones.

Replacing an asphalt shingle

1 To remove a damaged shingle, lift the shingle tab above it and pull the nails with a flat pry bar. You'll have to do the same thing with the course above.



2 Remove the old shingle and slide the new one into place, taking care not to damage the roofing felt. If the corners stick, trim them with a knife or tin snips.



3 Nail on the new shingle. If you can't lift the tab above it enough to nail underneath, place a pry bar on the nail's head and a block, as shown, and strike the pry bar to drive in the nail.



wood shingles and shakes

Wood shingles are fairly smooth and $\frac{1}{4}$ inch thick; shakes are rough-hewn and up to $1\frac{1}{2}$ inches thick. Both are typically made of cedar in 18- or 24-inch lengths.

Shingles and shakes are laid in overlapping rows. Shingles and shakes are often installed onto solid or spaced sheathing that has a continuous underlayment of roofing felt. Shakes will also have strips of felt, called “interlayment,” which overlap onto the upper portion of the shakes. Both are attached with galvanized shake nails.

Wood shingles and shakes should last from 15 to 25 years, depending on the slope of the roof and the climate. Inspect the roof for curled, broken, or split shingles and for any that have been lifted by wind. Also look for those that have thinned, especially around areas where an attic inspection reveals pinpoints of light (see page 118).

If only a few shingles or shakes are split or wind-lifted, you can repair them. But if the damage is extensive, consider having the entire roof replaced.



SPLIT SHINGLE

If a shingle is split, butt the pieces together, drill pilot holes, and drive nails in four places as shown. Cover the nail heads and the joint with roofing cement.



Replacing a wood shingle or shake

1 To remove a damaged wood shingle, use a hammer and chisel to split it apart along the grain and pull out the pieces. Be careful not to cut the roofing felt underneath. Cut the hidden nails as discussed below.

2 Hold the replacement shingle just below the spot where it will go, and mark its width. Then measure over $\frac{1}{4}$ inch and cut the shingle so there's a $\frac{1}{4}$ space on either side to allow for expansion caused by moisture.



3 Insert the replacement shingle so it protrudes 1 inch below adjoining shingles. Allow $\frac{1}{4}$ inch clearance on each side. Drive in two shake nails at an angle, as shown, just below the edge of the row above.

4 Drive the nails just flush. Do not sink the heads below the surface or the wood may split. Then nudge the edge of the new shingle even with the others using a hammer and woodblock as shown.

AMERISPEC® TIP REMOVING A HIDDEN NAIL

To remove the nails from a damaged shingle or shake that you are replacing, either rent a shingle ripper to cut them or use a hacksaw blade. To use the ripper, slide it under the shingle and around a nail (right). Then cut the shank of the nail by delivering a strong hammer blow to the ripper.



built-up roofs and roll roofing

An older built-up roof consists of several layers of roofing felt, each coated with hot- or cold-mopped asphalt. It may be topped with crushed gravel or rock. These roofs generally last from 10 to 20 years.

Newer modified-bitumen roofing may be attached with a torch, laid in roofing cement or are self-adhering. It can last 25 years or more.

Asphalt roll roofing is made of the same material as shingles and has a lifetime of 5 to 15 years.



AMERISPEC® TIP

QUICK FIX FOR A FLAT ROOF

Often you can fix minor tears and cracks in a flat roof and extend its life by applying specialized coatings. They come in 5-gallon buckets and are quickly applied with a brush or with a tool that has a broom on one side and a squeegee on the other.

Leaks in a flat roof are usually easy to locate, because they tend to be directly above the wet area on the ceiling inside. Leaks are also likely where weather and wear have caused blistered asphalt, separations between the roof surface and the drip edge, curling or splitting

of exposed roofing felt, and cracks or holes in the roof material.

Repairs are the same for built-up and roll roofing. Fill cracks with roofing cement. Avoid using nails when repairing blisters and small holes; driving nails may cause additional leaks.

Repairing a blister

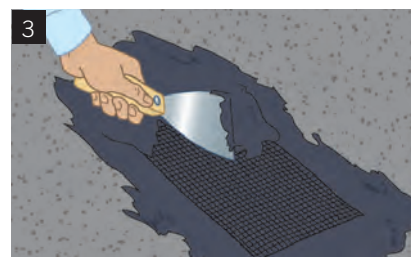
1 Sweep away gravel and debris. Use a utility knife to slice through the blister. If water emerges, wait a day for it to dry. Use a putty knife or caulk gun to slip a generous amount of roofing cement well underneath the blister.



2 Press the roofing into the cement. If needed, widen the slit so the roofing can lie flat. Apply roofing cement to the area, and lay a piece of fiberglass mesh in the cement.



3 Use a 6-inch tapping knife to embed the mesh so there are no folds. Apply another layer of roofing cement over the mesh. Smooth the cement and feather the edges so water cannot puddle.



Patching a hole

1 Sweep away any gravel and debris. Use a straightedge and a utility knife to cut out a rectangle around the damaged area. Remove the piece and use it as a template for cutting a replacement.



2 Use a putty knife to smear roofing cement inside the cut-out rectangle. Also work cement several inches under all the cut edges. Set the replacement piece inside the rectangle and press it into place.



3 Cut another patch, 6 inches wider and longer. Apply roofing cement to the area, set the second patch on the cement, and apply another coat of roofing cement over the second patch. Feather the edges.



tile roof repairs

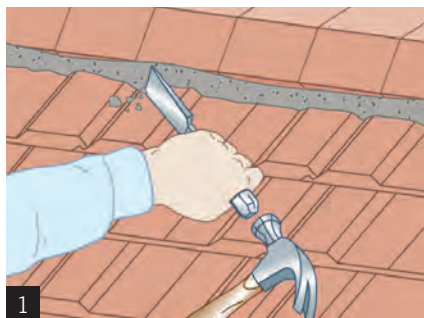
Tiles made of masonry or clay can last 50 years or more, but they can crack sooner if a branch falls on them. You may be able to handle small patches or replacements, but hire a professional roofer for major problems. A new masonry or clay tile roof is extremely expensive; newer imitation clay tiles reduce the cost and are actually more durable.

Patch small holes or cracks with asphalt roofing cement or butyl caulk, which may be available in a color that nearly matches. If a corner has cracked off, clean the area with a wire brush and glue the broken-off piece back on using butyl caulk or polyurethane glue. If the broken piece does not rest on another tile, support it with a dollop of roofing cement underneath.

The tiles that top a ridge or hip are often set in mortar, which is prone to cracking over time. If the crack is narrow and the tiles are still firmly embedded, seal the crack with roofing cement or a color-matched caulk. If the tiles are loose or the cracks are large, replace the mortar, as shown above right.

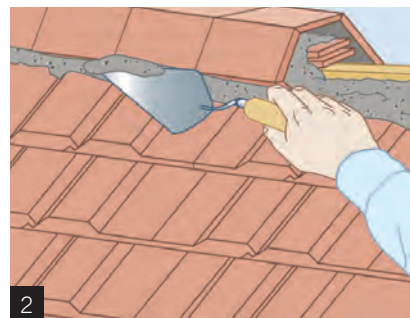
If a crack extends above the overlap of the tile below, remove and replace the tile. Finding a replacement can be difficult. Be sure it is the same shape and attaches in the same way as the old tile.

To replace a tile laid directly on sheathing, gently pry up the tile or tiles in the course above and remove the old tile pieces. Spread roofing cement on the underside of the replacement tile and slide it into position.



Replacing mortar

1 Use a chisel and hammer to gently chip away the mortar until the ridge tiles break free. Set the tiles aside and chip away most of the remaining old mortar.



2 Mix a stiff batch of type N or S mortar and trowel it where the old mortar was. Soak the tiles in water, then set them in the mortar. Make sure all the joints are sealed.



Replacing a tile

1 Pry up the tile above the damaged one using a flat pry bar. Place a short woodblock beneath the pry bar for leverage and to protect the tile below. Pull out the broken pieces. If necessary, strike the tiles with a hammer to break them into smaller pieces. Wear safety glasses and gloves when doing this.



2 Repair any tears in the roofing paper underlayment with asphalt roofing cement. Lift the tiles in the course directly above the damaged tile's position using a pry bar, as shown. Spread roofing cement on the underside of the new tile and then slip the tile into place. Press the pieces firmly to embed the replacement tile in the cement.



WORKING ON A TILE ROOF

If tiles are brittle, walking on the roof can crack them. Whenever possible, work from a ladder leaning against the house rather than on the roof itself. If you must walk on a roof of tiles that are brittle, first place a large piece of plywood on top of the tiles and then stand or sit on the plywood.

gutters and downspouts

The gutter and downspout system carries the water away from the house. Most gutters and downspouts are made of galvanized steel, aluminum, or vinyl, though you may find some made of wood or copper.

Gutters are attached to the eaves of the house with strap, bracket, or, most commonly, spike-and-ferrule hangers. Downspouts are attached to the exterior walls with straps.

In order to work efficiently, gutters and downspouts must be in sound condition, must be sloped properly, and must be free of leaves and other debris.

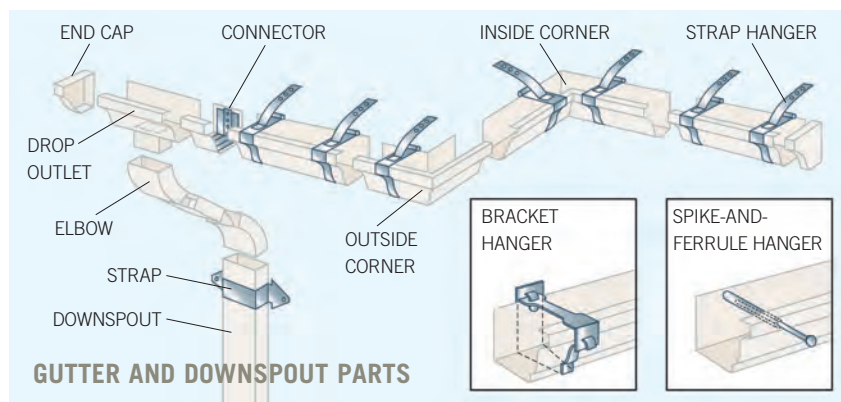
GUTTER AND DOWNSPOUT MAINTENANCE

Inspect the system in fall and spring. Clean out accumulated leaves and other debris. Check the slope of the gutters by running

water through them. If drainage is slow, reposition for correct slope. Gutters should be tight against the fascias and should slope toward the downspouts at a rate of 1 inch for every 20 feet. Correct low spots by adjusting the hangers. For appearance, some gutters are hung level, so they need more downspouts.

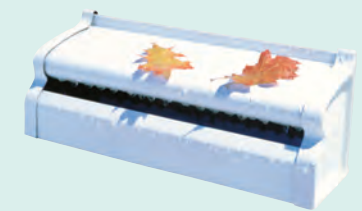
Test for weaknesses in gutters, downspouts, and fascia boards by probing with a thin screwdriver or knife. Also look for flaking or peeling paint, rust spots, broken hangers, and holes or leaky joints.

REPAIRING GUTTERS AND DOWNSPOUTS If you find rotted fascia boards, repair them first (see page 113). Tighten loose hangers and replace broken ones. Check that downspout straps are secure and that elbow connections are tight.



KEEPING LEAVES OUT

A gutter screen (above) deflects leaves and twigs. A solid cover (below) allows rainwater but not leaves to enter the gutter. Check with a local roofer to find which product works best in your area.



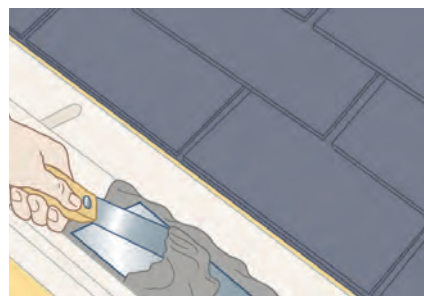
Patch any leaking joints or holes, taking care to clean them thoroughly first. Pinholes can be sealed with a dab of roofing cement. To repair a larger hole, see below. If a whole section of your gutter system is badly damaged, call several gutter installers to find a good price and a good guarantee on a new system.

Repairing leaks

LEAKY JOINT Apply gutter or butyl caulk to seal the insides and outsides of seams between gutter sections.



HOLE Cover a hole with roofing cement and embed a sheet-metal patch or fiberglass mesh (see page 124) in the cement. Apply another coat of cement over the patch.



END CAP If a cap leaks or is loose, replace it. Apply gutter caulk to the groove and push it back into place. With some types, you also need to drive pop rivets (see next page).





Supporting a gutter or downspout

SPIKE AND FERRULE If a sagging gutter is attached via a spike-and-ferrule system, hold the gutter sloped correctly and drive a new 7-inch screw or nail through an existing ferrule. Or drill a hole in the gutter's front lip and install a new ferrule and spike (above left).

HIDDEN BRACKET Some brackets are invisible from the ground and can be used as supplemental hangers. Hook a hanger onto the gutter's

front lip and rear edge, hold the gutter sloped correctly, and drive a screw through the fascia and, if possible, into a rafter (below left).

LOOSE DOWNSPOUT If a downspout is loose, fit a wall bracket around the elbow or the downspout and screw it into place (above right). Use galvanized screws long enough to penetrate solid wood by at least 1½ inches.

ATTACHING WITH POP RIVETS

Most metal gutter components are attached with pop rivets. You will need a pop rivet gun. Drill a hole of the required size, place a rivet in the gun, insert it, and squeeze the handle. Or fasten sections using sheet-metal screws.



AMERISPEC® TIP

OTHER DRAINAGE OPTIONS

In some municipalities, a downspout can connect directly to the city's storm and sewage drainage system. Contact your local building department to find out how to do this. A downspout can also be attached to a flexible extender (see page 83). If you have an extreme drainage problem, run the downspout into a dry well—a hole in the ground at least 3 feet wide and deep that is filled with rocks or loose gravel.



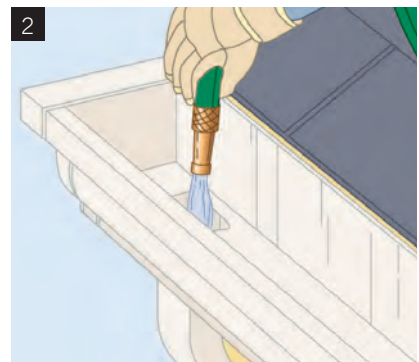
EXTENDING DRAINAGE

To carry drainage from downspouts away from the house, extend them horizontally and add splash blocks at their bases. Water that is allowed to flow from the downspouts directly into the ground may end up in your crawl space or basement and can erode the soil along the house, causing settling.

Unclogging gutters and downspouts

1 Wearing gloves, remove leaves, twigs, and other debris from gutter troughs. Loosen dirt with a stiff brush. If the dirt is very hard, purchase a trowel made for cleaning gutters.

2 Clean a blocked downspout by spraying into it from above with a garden hose turned on full force. Or feed a plumber's snake into it and then flush all loosened debris with a hose.



plumbing

When you're making plumbing repairs, it helps to understand the system hidden behind your home's walls and under its floors. To figure out what kind of pipes you have and where they go, look in the basement, attic, or crawl space for exposed pipes. Often there is an access panel on the wall opposite a tub or shower, in an adjacent room or closet. A wider than usual "wet wall" contains the house's main vent stack.

There are two main parts to the plumbing system in your house, each with its own matrix of pipes.

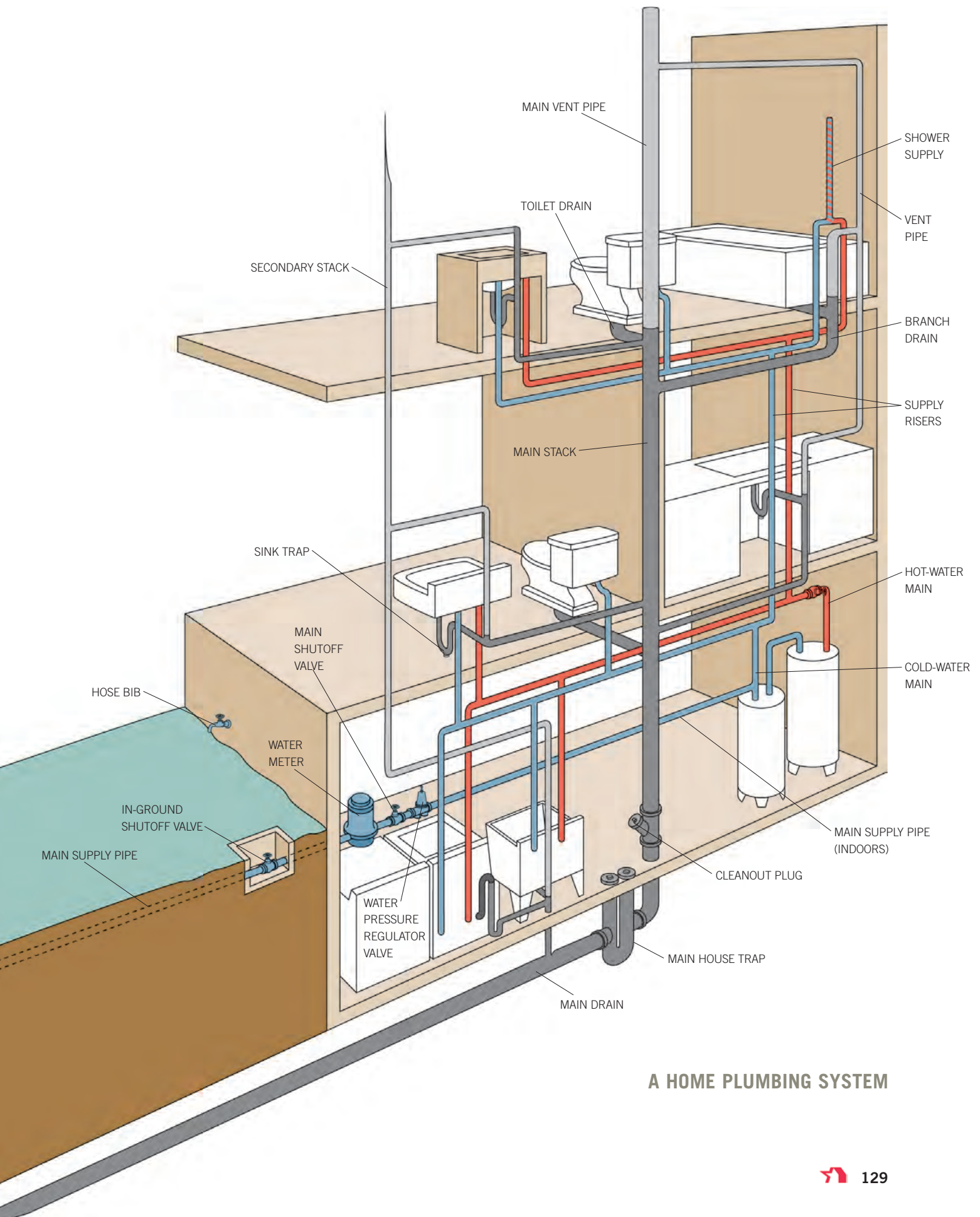
- The supply system carries water from a utility or other source into your house to all the fixtures (such as sinks, tubs, toilets) and to appliances (such as the dishwasher and washing machine).
- The drain-waste-vent system carries used water and waste out of the house into a sewer or an on-site septic system. Connected to the drain pipes are vent pipes (usually seen sticking through the roof) that allow sewer gases to escape while facilitating drainage.

SUPPLY SYSTEM

Water enters your house through a main supply pipe that is connected to a water utility main or to a well on the property. Usually, a meter monitors water usage from a utility. Newer homes may have a check valve to prevent backflow. A main shutoff valve, usually near where the supply pipe enters the house, turns the water on and off (see page 8).

Once inside the house, the main supply pipe divides into branches for hot and cold water. If there is also a water softener, it may be either on the main supply line before it divides or on the branch supplying just the water heater.

<i>Repairing Sink Faucets</i>	132
<i>Installing a New Faucet</i>	138
<i>Sink and Tub Pop-ups</i>	140
<i>Clearing Clogs</i>	142
<i>Toilet Repairs</i>	146
<i>Water Heater Repairs</i>	150
<i>Pipe Repairs</i>	152



A HOME PLUMBING SYSTEM

For most of their distance, hot- and cold-water pipes run parallel and horizontally until they reach the vicinity of fixtures and appliances. Vertical branches, called risers, connect fixtures and appliances to the water system. Risers are usually concealed inside walls. Horizontal pipes are inside walls, fastened to floor joists with pipe straps, or buried under a concrete slab.

Most houses built before 1945 have supply pipes made of galvanized steel, which is usually a dull gray color. These pipes are likely to develop leaks due to rust. They also tend to get clogged with mineral deposits, causing decreased water pressure. Whenever possible, have a plumber replace galvanized pipe with newer copper or plastic pipe, which remains virtually corrosion-free for many decades. If you have a mix of copper and galvanized pipe in your house, and these two dissimilar materials are joined directly to one another, they should be connected with a di-electric fitting to prevent corrosion.

Solid copper pipe is joined to fittings by soldering, or

Di-electric fitting



1/2" galvanized



copper



PEX



CPVC



PEX



"sweating." A good soldered joint is just as strong as the pipe itself. Unless your water is highly acidic, copper will last for many decades without degrading or building up mineral deposits.

Some newer homes have rigid plastic supply pipes. In some areas, they used to be allowed, but white PVC is now prohibited by code for water distribution within a dwelling. CPVC plastic pipe is allowed for water supply lines and is often used by builders. Check with your building department before you use any plastic pipe for supply lines.

Flexible PEX is growing in acceptance throughout the country. It can be used for both hot- and cold-water supply lines. PEX is very easy to install, since it can curve to make turns in walls and so requires fewer fittings. The best fittings are made with brass ribs that are sealed with a special crimping tool. If you want to replace old galvanized pipes, check to see whether PEX is allowed by your local building department. If so, it may be the least expensive and most durable replacement.

Some fixtures and water-using appliances have their own shutoff valves, often called stop valves. To be prepared for an emergency, everyone in the household should learn how to turn off the water supply both at the individual fixtures and at the main valve (see page 8).

ABS



PVC

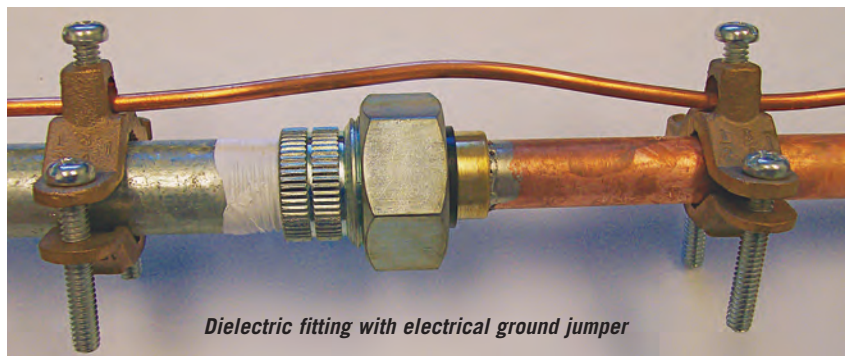


cast iron

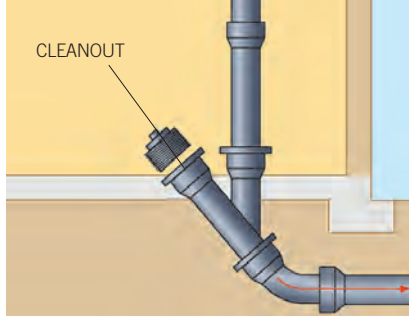


A new method of installing supply pipes is to use control centers called manifolds. Water enters the manifold from the main line, and separate pipes (usually PEX) run from the manifold to each fixture. A manifold system maintains even water pressure throughout the house, and eliminates changes in shower temperature when another faucet or appliance is turned on.

Excess water pressure—anything over 80 pounds per square inch (psi)—can damage faucets and appliances. In areas where high water pressure is a possibility, there should be a pressure-reducer valve located just after the main shutoff valve. It reduces excess pressure to a safe 40 to 70 psi. Once a year, follow the manufacturer's instructions to test this valve, or have it tested by a plumber.



Dielectric fitting with electrical ground jumper



DRAIN-WASTE-VENT SYSTEM

The drain-waste-vent system uses gravity to channel wastewater and solid waste to the sewer line. For this reason, drainpipes are installed at a slight slope leading away from all fixtures. The workhorse of the drain-waste system is the soil stack or main stack, a vertical section of 3- or 4-inch-diameter pipe. One end of the stack carries waste away from toilets and other fixtures and connects with the main drain under the house. From there, waste flows to a sewer or septic tank. The other end of the stack is open; it continues through the roof where it allows sewer gas to escape the house while at the same time facilitating drainage.

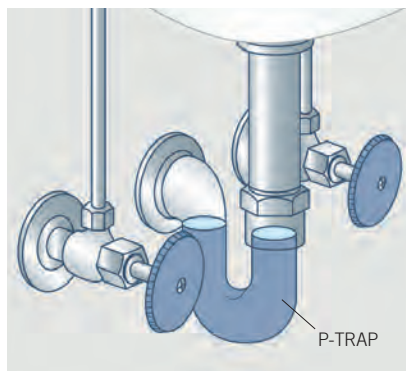
Since all types of systems will clog occasionally, cleanouts are placed in the drainpipes. A cleanout is usually a 45-degree Y fitting or a 90-degree T fitting with a removable plug.

Ideally, there should be one cleanout in each horizontal section of drainpipe. There should also be cleanouts in a main house trap, sometimes outdoors, for access to sewer or septic tank connections.

To prevent dangerous sewer gases from entering the home, each fixture's drainpipe must have a trap and must be vented. A trap is a bend of pipe that remains filled with water at all times to keep noxious gases from coming up the drain and into the house. A P-trap

(see below) is the most common configuration. Some older installations have an S-trap (see below) instead. S-traps are no longer allowed by codes, because water can sometimes be siphoned out of the trap, leaving it dry and unable to trap gases.

The vent pipes in the drain-waste system are designed to get rid of sewer gases and to prevent



pressure buildup in the pipes (see the illustration on page 129). The vents come off the drainpipes downstream from the traps and go out through the roof. This maintains atmospheric pressure in the pipes and prevents the siphoning of water from the traps.

Each plumbing fixture in the house must be vented. Usually, a house has a main vent stack (the upper part of the soil stack) with 1½- to 2-inch vent pipes connecting to it. In many homes, especially single-story ones, widely separated fixtures make it impractical to use a single main vent stack. In this situation, each fixture or fixture

black steel

CSST

older brass flex line

newer coated stainless-steel flex line

group has its own waste connection and its own secondary vent stack.

An air admittance valve (AAV) is a cylindrical valve that in some situations may augment or even take the place of a vent pipe. It may be used to vent a single fixture or several fixtures. If you have AAVs, make sure they comply with local plumbing codes.

Drain and vent pipes in a pre-1945 home are likely made of cast iron. A plumber may repair a damaged cast-iron pipe or replace it with plastic. In many areas, white PVC drainpipe is required by code, while in other areas black ABS is standard.

GAS LINES

In most areas, gas pipes are made of “black” (usually dark gray) steel with threaded fittings. Some steel gas pipes are tinted green. Copper pipe or tubing is also sometimes used. Corrugated stainless steel tubing (CSST) is growing in popularity for gas installations. Its flexibility allows for easy installation with fewer fittings, thus reducing installation errors. However, it requires more protection from physical damage than does black iron pipe. An older brass flex line should be replaced with a teflon-coated or stainless-steel line.



repairing sink faucets

If you have a leaking faucet, it is often easy to fix. If water flow is sluggish, first try removing and cleaning or replacing the aerator (see page 136).

For most repairs, it is essential that you first shut off water to the faucet, preferably by turning off two stop valves under the sink. If there are no stop valves, you will need to shut off water to all or part of the house (see page 8). After turning off the water, open the faucet to drain the pipes.

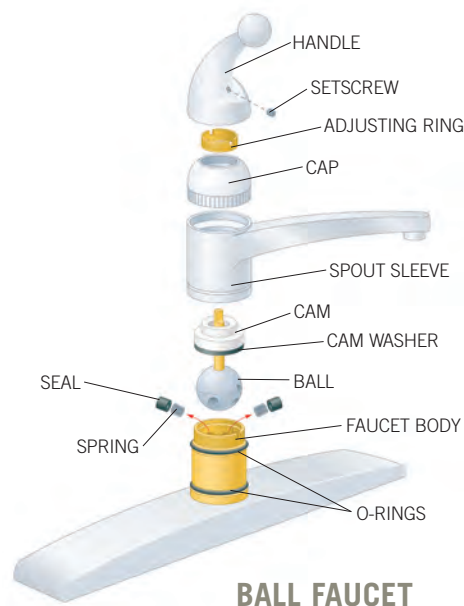
If possible, find the manufacturer's name and purchase a repair kit made for your faucet. If you can't find the brand, take parts with you to a home center or plumbing supply source and ask a salesperson for replacement parts. If parts are hard to find, or if you don't like the faucet

anyway, you are likely better off replacing it (see pages 138–139).

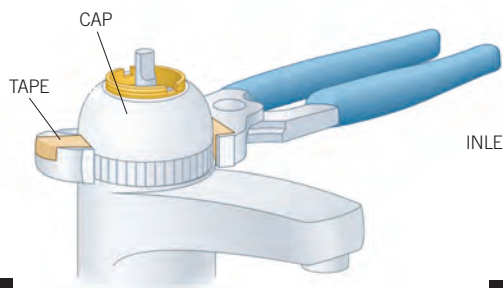
LEAKING BALL FAUCETS

Inside a ball faucet is a slotted metal ball atop two spring-loaded rubber seals. Water flows when openings in the rotating ball align with hot- and cold-water inlets in the faucet body. A repair kit will likely include a new cam and washer, seals and springs, and small tools for removing the setscrew and tightening the adjusting ring. You may also need a new ball.

If the handle of a ball faucet leaks, use a hex-head wrench to loosen the setscrew, then remove the handle. Use an adjusting-ring wrench to tighten the adjusting ring. If the leak persists, shut off water to the faucet and make



repairs as shown at right. If the leak is at the spout, you may need to replace the cam above the ball and/or the inlet seals and springs. If the leak is under the spout sleeve, replace the O-rings or the ball itself. If water flow is sluggish, you may need to flush out debris collected in the faucet body.

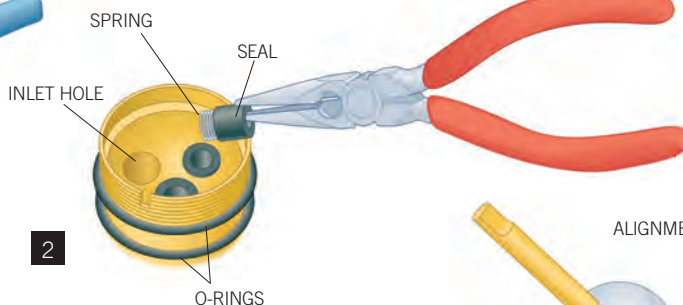


1

Replacing faucet parts

1 Unscrew the cap using tape-wrapped slip-joint pliers. Lift out the ball and cam. Underneath are the inlet seals and springs. Remove the spout sleeve to expose the faucet body.

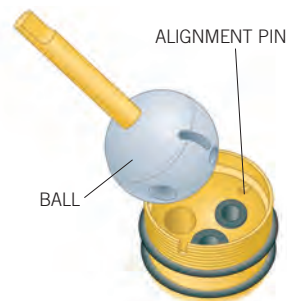
2 Lift out the inlet seals and springs using long-nose pliers. Turn on the water briefly to flush out sediment. Replace the inlet seals. Examine the O-rings and replace them if they're worn.



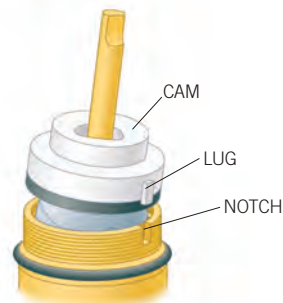
2

3 If the old ball is corroded, replace it. When you install the new one, carefully line up the slot in the ball with the alignment pin in the faucet body.

4 Fit the lug on a new cam into the notch on the faucet body. Replace the spout sleeve and cap, tighten the adjusting ring, and replace the handle.



3



4

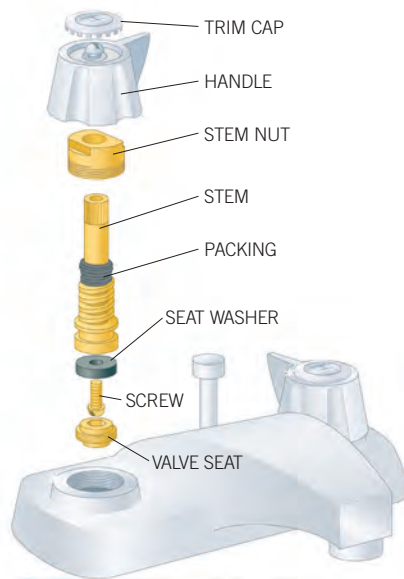
REPAIRING COMPRESSION FAUCETS

If your faucet has separate hot- and cold-water handles that come to a spongy stop, it's a compression faucet (or a two-handled disk faucet; see page 134). A compression faucet has a rubber seat washer secured to the base of a coarse-threaded stem. When you turn the handle to shut off the faucet, the stem screws down, compressing the washer against the valve seat in the faucet body. At the same time, a packing nut compresses the packing (either string packing, a washer, or an O-ring) against the stem and prevents water from leaking around it.

Leaks in compression faucets may occur around one of the handles or at the spout. Before beginning repair work, turn off the water at the stop valves or the main house shutoff and open the faucet to drain the pipes.

REPLACING A SEAT WASHER

To remedy a cracked or worn seat washer, remove the screw and washer and install a new washer. If the threads are too worn to hold a screw, snap in a swivel-head washer.



COMPRESSION FAUCET

To fix a leak around a handle, remove the handle and tighten the stem nut. If that fails, replace the packing. On some models, you can tighten the stem nut without removing the handle.

If the faucet leaks from the spout, either a washer is defective or a valve seat is worn or corroded. First find out whether the hot or cold side needs work by turning off the shutoff valves one at a time. If the spout still leaks when you turn off a valve, that's the defective side. Take off the corresponding



THREE PACKING OPTIONS

To replace worn packing, either remove the O-ring or packing washer and slide on a duplicate, or scrape off the packing string and wrap new packing clockwise around the stem.

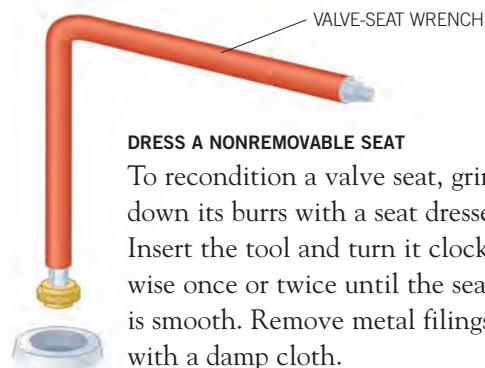
handle and remove the stem. If the washer is worn, replace it. If it looks fine or if it wears out in less than a year, the valve seat is damaged, either causing an imperfect seal with the washer or shredding it. On most compression faucets, the valve seat is replaceable. If the seat is built into the faucet, it can be smoothed with a valve-seat dresser, also called a seat grinder.

Before you reassemble the faucet, lubricate the stem threads with silicone grease. If the threads are worn or stripped, consider replacing the stem. If you cannot find a new stem, replace the faucet.

Working on a valve seat

REPLACE AN OLD SEAT

To exchange a removable seat, insert a valve-seat wrench into the valve seat and turn it counterclockwise until the seat lifts out. Buy a duplicate, slip it onto the wrench, and carefully screw it in.



DRESS A NONREMOVABLE SEAT

To recondition a valve seat, grind down its burrs with a seat dresser. Insert the tool and turn it clockwise once or twice until the seat is smooth. Remove metal filings with a damp cloth.

AMERISPEC® TIP

REVERSE-COMPRESSION FAUCET

If your two-handled faucet cranks upward rather than downward to shut off, you have a reverse-compression faucet. To repair it, purchase duplicates of the rubber washers and the metal sleeves that go over the washers. They will come in a kit.

REPAIRING A DISK FAUCET

The core of a washerless disk faucet is a ceramic assembly, sometimes called a cylinder or cartridge.

Openings in the disk line up with inlet holes to allow the flow of water. The mix and flow of hot and cold water are controlled by two disks inside a sealed cartridge. Raising the faucet handle lifts the upper disk, controlling the flow. Rotating the handle turns the lower disk, controlling the mix.

Disk assemblies seldom wear out, but if yours does, you'll need to replace the entire cartridge. More often, a worn inlet or outlet seal is the problem. If you have a leak at the base of the faucet, one seal may be worn. Take the faucet apart as shown on the opposite page and you'll find the set of seals under the cartridge. Replace them both with duplicates.

If water flow is sluggish, first check the faucet aerator for clogged holes (see page 136). If that's not

the problem, the faucet inlet and outlet holes may be obstructed by sediment buildup. In this case, flush or scrape away deposits.

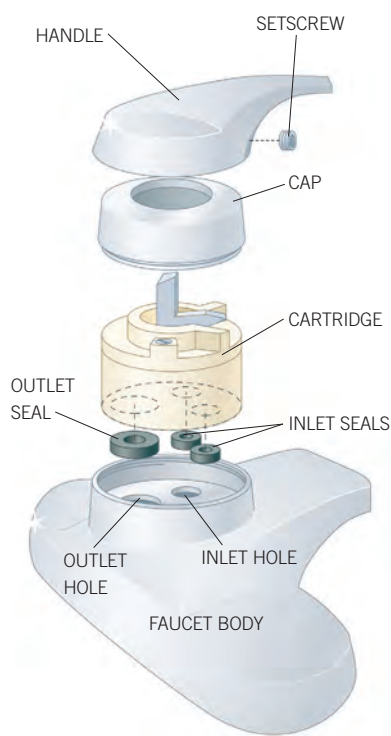
REPAIRING TWO-HANDLE DISK FAUCETS

These operate the same way as single-handle models except that they have a pair of cartridges, or stem-unit assemblies, plus a single rubber or plastic seal and a small spring on each side. The cartridges may wear out and need to be replaced. More often, an inlet seal is the culprit.

If the faucet drips from the spout, the inlet seal and spring probably need replacing. If it leaks from the handle, the O-ring or stem-unit assembly needs replacing.

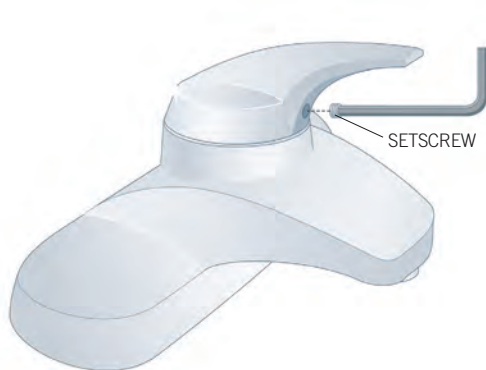
CARTRIDGE FAUCETS

These washerless faucets have a series of holes in the stem-and-cartridge assembly that align to control the mix and flow of water.



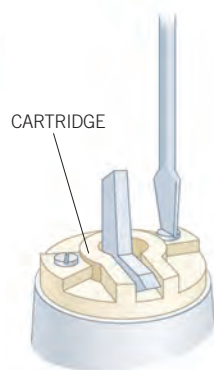
DISK FAUCET

Working on a single-handle disk faucet



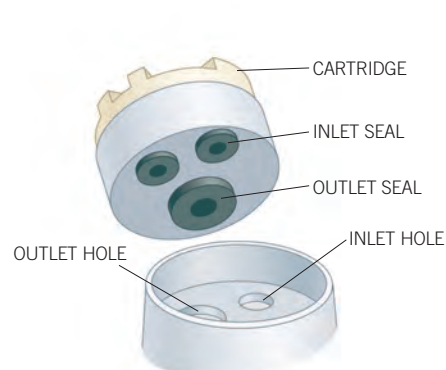
1

1 Lift the handle as high as it can go and loosen—but don't remove—the setscrew with a hex-head wrench. Take off the handle and cap.



2

2 Loosen the two screws that fasten the cartridge to the faucet body. Then lift the entire cartridge unit straight up and off the body.



3

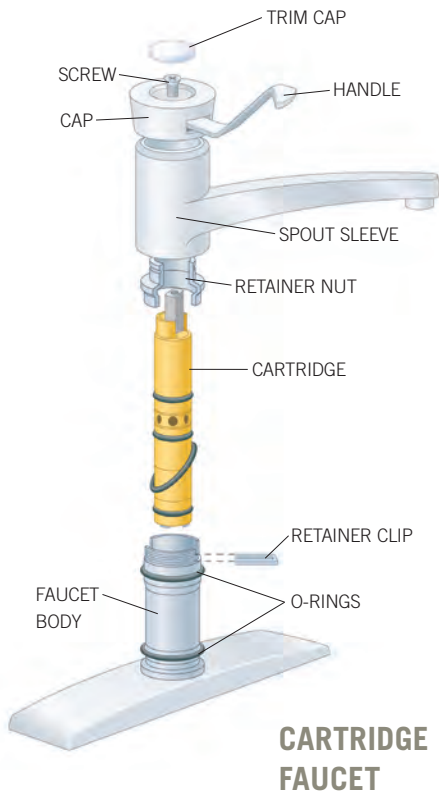
3 Check the rubber inlet and outlet seals in the bottom of the cartridge for signs of wear. Replace any worn ones. Aligning the seals on the cartridge with the holes, replace the cartridge, then the cap and handle.

Leaks usually occur because of worn O-rings or a faulty cartridge.

First look at the O-rings on the faucet body. If they're worn, replace them. If they're in good shape, remove the cartridge. If the cartridge is worn, replace it with an identical one.

If a faucet is hard to turn, lubricating the cartridge O-rings with silicone grease should fix the problem.

Before doing any work, remember to shut off the water (see page 8).



1

Taking apart a cartridge faucet

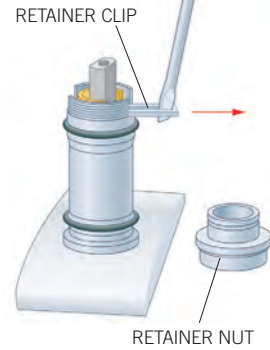
1 Loosen the handle screw with a screwdriver and lift off the cap and handle. Then remove the retainer nut.

2 Move the spout sleeve back and forth and gently pull it off the faucet body. Pull the retainer clip out of its slot in the faucet body using a screwdriver or pliers.

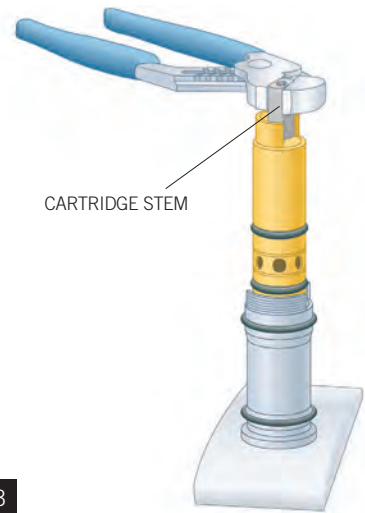
3 Grip the cartridge stem with pliers and pull it straight out. If it's stuck, you might need to use a cartridge-pulling tool made for your faucet.



2



3



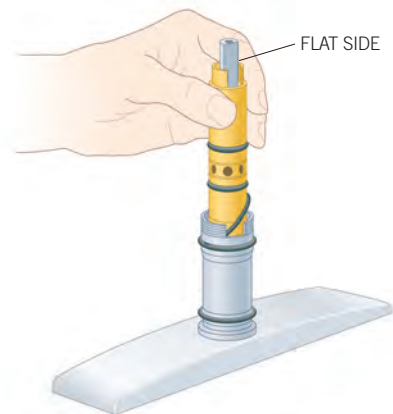
Making cartridge repairs

CHANGING AN O-RING Examine the O-rings in the cartridge and replace them if they show signs of wear (A). Apply silicone grease to the new O-rings before installing them.

REPLACING THE CARTRIDGE If the O-rings are in good shape, replace only the cartridge. Buy a duplicate and push it down into the faucet body (B). If there's a flat side, be sure it faces forward. Reassemble the faucet, making sure to fit the retainer clip snugly.



A



B



THE RIGHT PARTS AND ALIGNMENT

Cartridges vary greatly in design and shape, so read the manufacturer's instructions before installing a new one. The most common type has a flat side on the stem that must face the front. Otherwise, the hot- and cold-water supplies will be reversed. Be sure to fit the retainer clip snugly into its slot.



CLEANING A FAUCET AERATOR

If the flow from your faucet is sluggish, the trouble may be the aerator. This device, at the tip of most spouts, mixes air and water for a smooth flow. Minerals or dirt particles in the water sometimes build up on the screen and disk, blocking the flow. In an older home with galvanized pipes, it may be necessary to clean the aerators regularly.

If mineral deposits are present or if aerator parts are damaged, it's best to replace the aerator. But if dirt is the problem, you can simply clean the parts. Unscrew the aerator



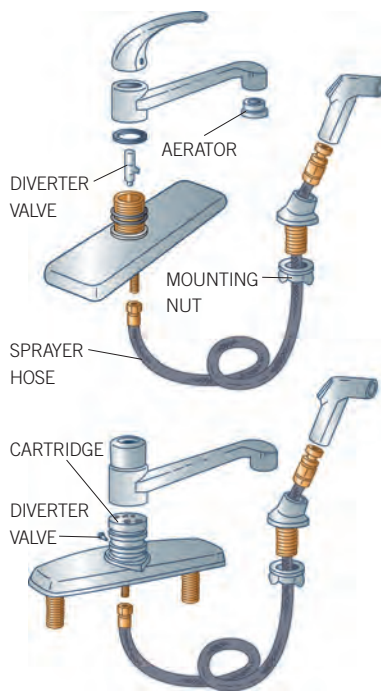
FAUCET AERATOR

from the end of the spout and disassemble it. To loosen stubborn connections, douse them with penetrating oil. Clean the screen with a brush and soapy water and use a pin or toothpick to open any clogged holes in the disk. Or just soak the aerator in a small dish of vinegar.

KITCHEN SINK SPRAYERS

Sink sprayers are notorious troublemakers, either getting clogged or leaking from the handle, the spout, or the hose. Leaks may occur in three places: the spray head, the hose, or the diverter valve inside the base of the faucet that reroutes water from the spout to the sprayer. Before doing any work, remember to shut off the water supply (see page 8).

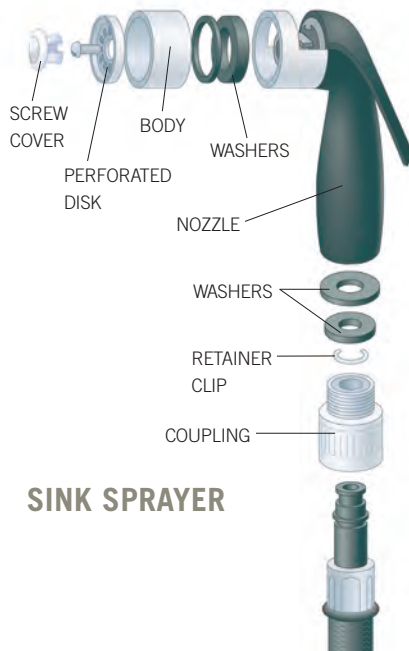
A sprayer on a cheap faucet may not be repairable. In this case, replace the entire faucet. The illustration above shows two common types of diverter valves.



On a two-handle faucet, the valve is often a vertical piece just below the handle. On a single-handle model, it may be attached to the side of the cartridge.

SPRAY HEAD If the hose leaks at the spray head, try tightening the fitting at the base. If that doesn't solve the problem, unscrew the head from the fitting. If the washer under the head is worn, replace it, then flush out the hose.

HOSE If the hose leaks where it attaches under the sink, remove the fitting from the tip of the hose by first removing the retainer clip.



SINK SPRAYER

Then unscrew the coupling nut under the sink using slip-joint pliers or a basin wrench (or unthread the hose if it connects directly into the base of the faucet without a coupling nut). Getting at the coupling nut can be awkward, as you'll need to lie on your back under the sink. If the hose is damaged, replace it with one of the same diameter. Nylon-reinforced vinyl is the most durable.

DIVERTER VALVE If the sink sprayer won't work or has reduced flow, the diverter valve may be clogged with deposits. Shut off water to the faucet and remove the spout to get at the valve. Take the valve apart and clean its outlets and surfaces with an old toothbrush and vinegar. Replace any rubber parts.



SHOWERHEAD

SHOWERHEADS

A showerhead simply screws off the shower arm, so replacing it or its internal parts is easy. If a showerhead is leaking or spraying wildly, unscrew it and tighten all connections with slip-joint pliers (wrap the jaws with tape to avoid

damaging the finish on the head). If that doesn't work, replace the washer between the showerhead and the swivel ball.

Showerheads are put together in various ways. In many areas, codes require that they have flow restrictors to save water. If flow is sluggish, there's likely a clog in the screen or faceplate. Disassemble the unit and clean clogged parts by soaking them in vinegar overnight. Or simply replace the head.

TUB AND SHOWER FAUCETS

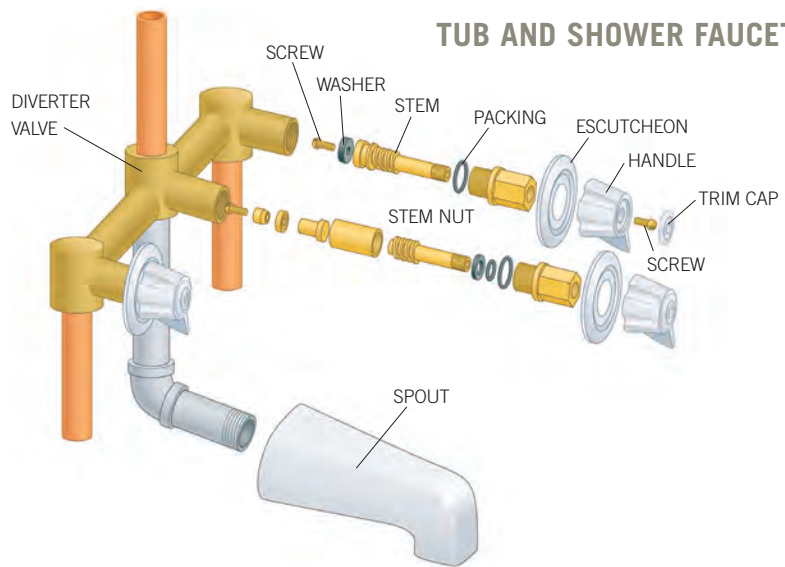
Like sink faucets, tub and shower faucets can be compression, ball, or cartridge style. A three-handle compression faucet has a diverter valve that directs water to the faucet or showerhead. A single-handle faucet does not divert water; that is done by a little valve on the tub spout. (To replace a tub spout, see page 141.)

Make repairs much as you would for a sink faucet of the same type. Before taking a tub faucet apart, turn off the water. There may be shutoff valves in an access panel on the back of the shower wall. Otherwise, shut off the main house valve (see page 8) and drain the pipes by open-

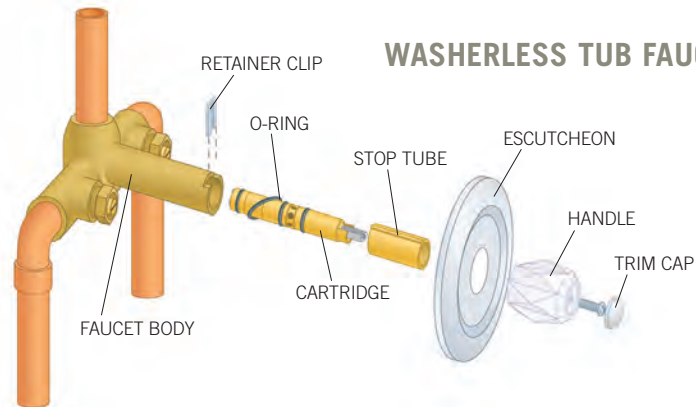
ing a faucet that is lower than the level of the tub faucet.

To work on a recessed tub faucet, first unscrew the handle and remove the escutcheon. To access the stem nut in a compression

TUB AND SHOWER FAUCET



WASHERLESS TUB FAUCET



sion faucet, you may need to chip away the wall's surface and then grip the nut with a deep shower-valve socket wrench.

MAINTAINING A WHIRLPOOL TUB

Most whirlpools have a pump that feeds water into flexible pipes, which lead to jets that point into the tub. Some models use channels in the tub itself rather than pipes. Do not let a whirlpool's motor run while it is dry, as you could damage seals or burn out the motor. To prevent scum from building up and clogging jets, minimize the use of soap and rinse the tub after using it.

To keep a whirlpool's jets, pipes, and other inner workings clear and free-flowing, do a thorough cleaning every month or so. Fill the whirlpool with water several inches above the jets. Add about ½ cup of bleach plus two tablespoons of dishwasher detergent and then turn the pump on for 10 minutes. The cleaning solution will circulate throughout the system. Empty the tub; run clear, cold water; and run the jets for another 10 minutes to rinse

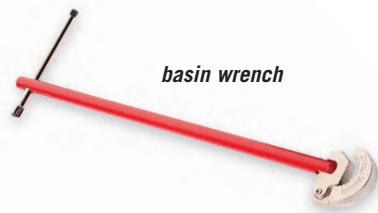
the system. If dark particles come out of the jets, you may need to clean the system several times using this method.

A whirlpool should be plugged into a dedicated GFCI receptacle or wired to a dedicated GFCI circuit breaker in the service panel. Every month or so, push the button to test that the GFCI is working. If water is leaking from the pipes or if the tub wobbles, call a plumber for an evaluation. Every few months, open the access panel and inspect the motor. Vacuum it if there is dust, and apply pump lubricant spray as directed by the manufacturer.



installing a new faucet

Looking up a new faucet is not complicated, and instructions that come with the faucet will guide you through the entire process. The difficult part is usually gaining access to the connections. You may need to crawl into a tight cabinet under the sink and then turn nuts that are hard to reach. Unless the faucet is easy to reach with slip-joint pliers, purchase a basin wrench.



INSTALLING A KITCHEN FAUCET

A kitchen faucet—either a one- or two-handle type—covers the three holes on a typical kitchen sink. If your sink does not have stop valves for the supply tubes, it is a good idea to install them. Hire a plumber if you are not sure how to make the connections.

You may choose to install a “one-touch” faucet, which has a pullout spout that doubles as a sprayer. Installation is not very different from that of a standard faucet, but you will need to thread the hose carefully underneath so it can easily slide up and down.

To remove the old faucet, shut off the water, disconnect the supply tubes, and remove the nuts that hold the faucet to the sink. Pry the old faucet off and clean the sink deck where the new faucet will go.



Installing a single-handle kitchen sink with sprayer

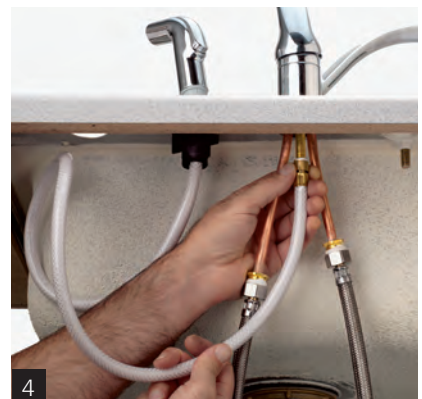
1 Roll a rope of plumber's putty between your hands. (If you have a natural stone countertop, use clear silicone caulk, because putty may stain the stone.) Shape it around the outside of the faucet body where it will rest on the sink.



2 Most faucets have one or more sets of nuts that secure the faucet to the sink at the side holes. There may also be a nut arrangement for the center hole. Hand-tighten plastic nuts, or use a wrench to tighten metal nuts.



3 Run flexible supply tubes from the stop valves to the faucet's inlets. If you have integral copper supply tubes, as shown, take care not to overtighten them or you may twist the tubes. You may need to hold the copper tubes steady with another wrench.



4 Thread the sprayer's hose through the sink hole from above and then connect the hose to the faucet body below the sink. You may need to bend the supply tubes outward to access the spray-hose threads.

AMERISPEC® TIP THE RIGHT SUPPLY TUBES

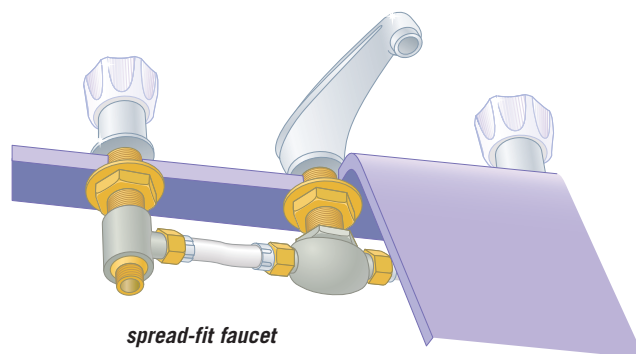
Braided supply tubes make water hookups easy. Be sure that the tubes are long enough and that they will fit onto your stop valves, which may be either 3/8- or 1/2-inch.



INSTALLING A BATHROOM FAUCET

A lavatory faucet may have integral supply tubes like the kitchen faucet on the previous page. Or it may have inlets just below each handle, as shown in the steps below. You can also buy a spread-fit faucet, which fits a variety of sink-hole configurations.

In most cases, a bathroom faucet comes with a drain body and pop-up stopper assembly, which you install at the same time as the faucet. See page 140 for an illustration of how a pop-up assembly is put together.



1



2



3

Installing a two-handle bathroom faucet

1 Roll a rope of plumber's putty and apply it to the underside of the faucet as shown in Step 1 on the previous page. (See note about putty and stone counters.) Slip the faucet into the sink's mounting holes. Align the faucet and press it down.

2 Working from below, thread the mounting nuts onto the sink's inlets or mounting bolts. Tighten plastic wing nuts by hand, or use a wrench for metal nuts.

3 Run flexible supply tubes from under-sink stop valves to the faucet's inlets, as shown, or to integral supply tubes, as shown on the previous page. Tighten the nuts with a basin wrench, slip-joint pliers, or an adjustable wrench.



4



5



6

4 From above, apply a rope of plumber's putty to the underside of the sink body's flange and then press the faucet's body down through the hole. From below, secure the drain body with a rubber gasket, metal washer, and locknut. Tighten the locknut with slip-joint pliers.

5 You will most likely need to screw a tailpiece onto the drain body. Slip one end of the P-trap onto the tailpiece and make the trap connections, as shown on page 142.

6 Install the pop-up. Slip the stopper down through the flange from above, insert the pivot rod, and secure it with the nuts. Attach the rod to the clevis and secure it with a spring clip. Secure the clevis to the lift rod that extends up through the faucet body.

sink and tub pop-ups

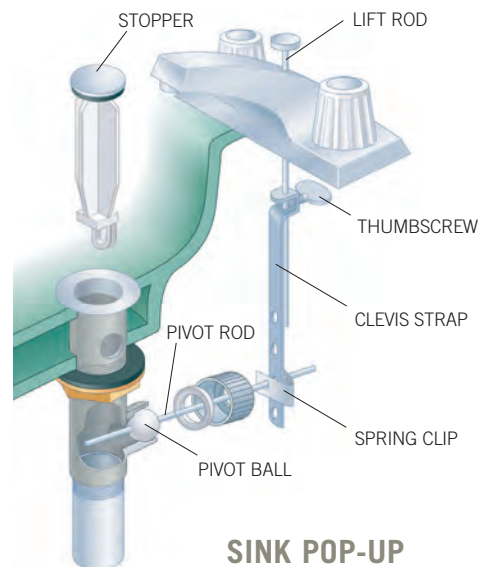
A bathroom pop-up has a lift rod that slides up or down to open or close the drain. The lift rod connects to the pivot rod to raise and lower the stopper. A bathtub's pop-up assembly (see opposite page) is not visible, but it's not mysterious and is usually relatively easy to access and repair.

REPAIRING A SINK POP-UP

Although a sink pop-up assembly is simple, its several moving parts need adjusting every so often. If the stopper doesn't open far enough for proper drainage, loosen

the thumbscrew and retighten it lower on the lift rod. If there's not enough room left on the rod, you'll need to move the spring clip and pivot rod to a lower hole.

If the pop-up stopper doesn't seat snugly, remove it. The unattached type (see below) must be pulled out. The slotted type must be twisted to be freed. For the attached type, you'll need to undo the spring clip, unscrew the pivot nut, and pull out the pivot rod to remove the stopper. Clean the stopper of hair or debris. Check its rubber seal; if it's damaged, pry it

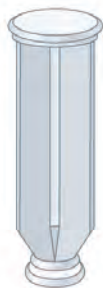


SINK POP-UP

off and slip on a new one. If the pop-up still doesn't seat correctly, loosen the thumbscrew, push the stopper down, and retighten the screw higher up. When the drain is closed, the pivot rod should slope downhill from the clevis to the drain body.

If the pop-up is seating properly but water is still leaking out of the basin, try tightening the retaining nut that holds the ball in place. Still leaking? Replace the washer behind the ball, then adjust the pivot rod so the pop-up seats properly.

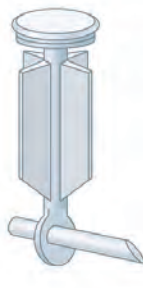
TYPES OF SINK POP-UPS



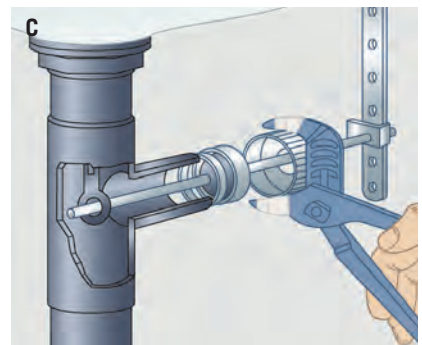
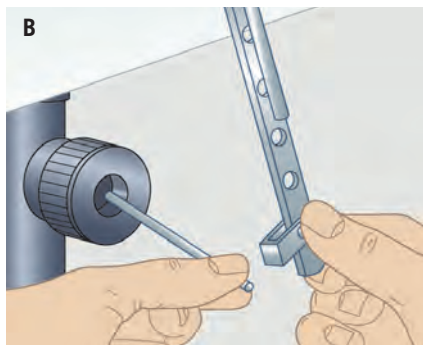
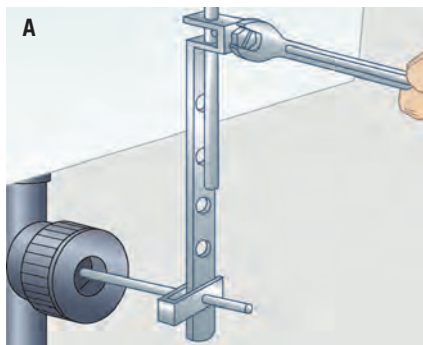
unattached



slotted



attached



Adjusting a sink pop-up assembly

If a sink pop-up doesn't seat tightly, loosen the clevis screw with a wrench, push the stopper down, and retighten the clevis screw (A). When the drain is closed, the pivot rod should slope slightly uphill from the clevis to the tailpiece.

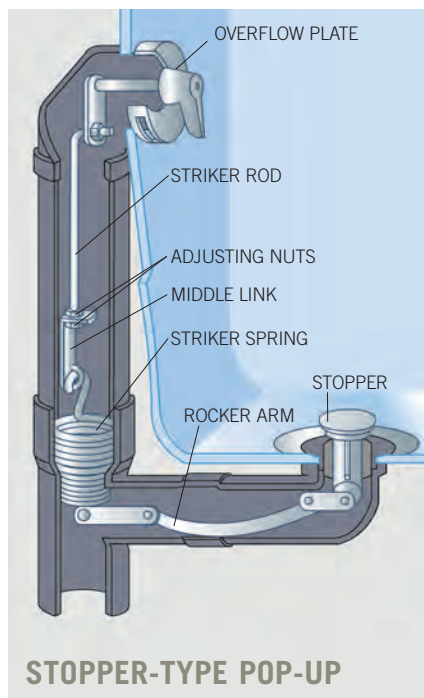
If the sink stopper is so tight that it impedes drainage and adjusting the clevis screw doesn't help, reset the pivot rod. Squeeze the spring clip and free the pivot rod (B). Move the clip up to the next clevis hole and insert the rod.

If water drips from around the pivot ball, use tape-wrapped slip-joint pliers to tighten the retaining nut that holds the ball in place (C). If the leaking continues, replace the gasket or washer (or both) inside the ball-and-rod assembly.

TUB POP-UPS

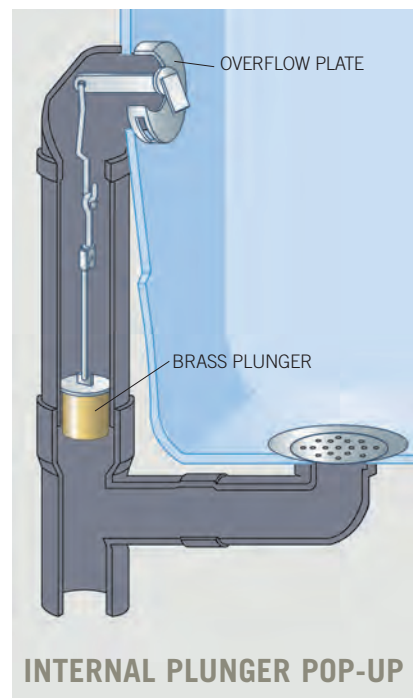
There are two basic types of tub overflow-and-stopper assemblies. In a stopper-type pop-up, a rocker arm is attached via linkage and a spring to the tub's stopper, so the arm can move the stopper up and down. In an internal plunger pop-up, a brass plunger inside the drain body moves up and down to open or close the drain.

If you have a stopper-type unit and the stopper doesn't seat properly, or if water drains slowly, remove the stopper and rocker arm by pulling the stopper straight up. Then unscrew and remove the tub's overflow plate and pull the entire assembly out through the overflow. For a stopper that isn't seating well, loosen the adjusting nuts and slide the middle link up to shorten the striker rod. The striker spring rests unattached on top of the rocker arm. For a slug-



gish drain, lower the middle link to lengthen the assembly. Before reassembling, clean the pop-up stopper.

If you have an internal plunger, the adjustments to the lift mecha-



nism are the same as for a stopper-type assembly. You may need to pull the plunger out through the overflow hole and clean away hair and debris.

REPLACING A TUB SPOUT

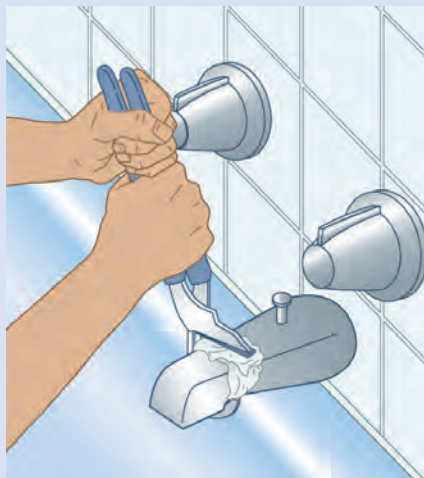
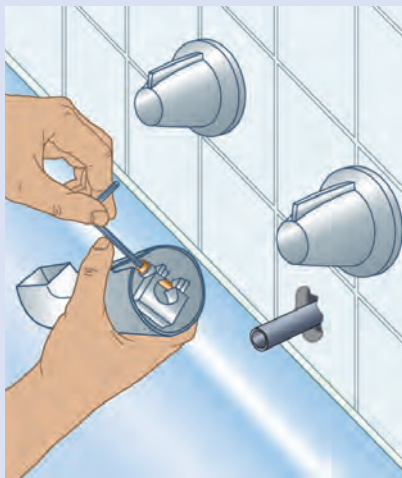
If a bathtub spout's diverter valve does not fully divert water to the showerhead, or if you don't like the way it looks, replace it. Doing so is usually a simple job.

A bathtub spout may be twisted onto a threaded pipe, which may barely extend past the wall or may protrude 6 inches or so. Or the spout may be attached to an unthreaded copper pipe by means of a setscrew. Before attempting to twist a spout off, first check underneath

the spout for a setscrew. If there is one, loosen it before proceeding (see below left).

If you will reuse the spout, wrap it with rags before using slip-joint pliers or a pipe wrench to twist it off (see below middle). With some spouts, you can insert a wood dowel into the spout's opening and twist it off.

Before installing the new spout, wrap the threads with Teflon plumber's tape to prevent leaks (see below right).



clearing clogs

Dealing with clogged sinks, tubs, showers, and toilets is one of life's unpleasant necessities. The ideal is to prevent clogs entirely. But because this isn't usually possible, at least be alert to the warning signs of a sluggish drain. It is easier to clear a slow drain than one that has stopped completely.

Usually a clog will be close to the fixture. To determine its location, you can check the other drains in your home. If only one fixture is blocked, then you are probably dealing with a clog in its trap or drainpipe.

If more than one drain will not clear, something is stuck farther along in a branch drain, the main drain, or the soil stack, causing all the fixtures above the clog to stop up. If there is a blockage in the vent stack, waste drains slowly and odors from the pipes become noticeable in the house.

PREVENTING CLOGGED DRAINS A kitchen sink usually clogs because of a buildup of grease and food particles, so avoid disposing of grease or coffee grounds down the drain. Keep kitchen drains clear by pouring a gallon of boiling water down them monthly. If you have plastic drainpipes, use hot water that's not boiling.

Hair and soap scum are usually at fault in bathroom drains. Clean out strainers and pop-ups regularly. A solution of $\frac{1}{2}$ cup baking soda and $\frac{1}{2}$ cup white vinegar can help prevent soap and hair clogs. Pour the solution in the drain every month or so, let it fizz, and then flush the drain with hot water.

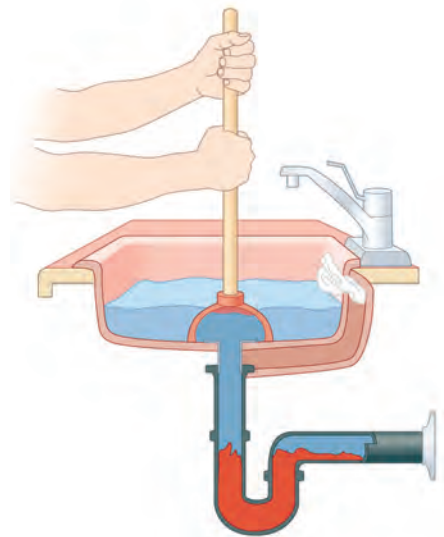
UNCLOGGING STRATEGIES If a dose of scalding water doesn't eliminate

a clog, the next step is to use a plunger or to dismantle and clean out the trap—whichever is easier in your situation. If these simple measures fail, you will need to use an auger.

PLUNGING

Use a plunger with a suction cup that is large enough to cover the drain opening completely. Fill the clogged fixture with enough water to cover several inches of the plunger cup. Then use wet cloths to block off all the other outlets (the overflow vent, the second drain in a double sink, and adjacent fixtures) between the drain and the clog. Insert the plunger into the water at an angle so that a minimum of air gets trapped under it.

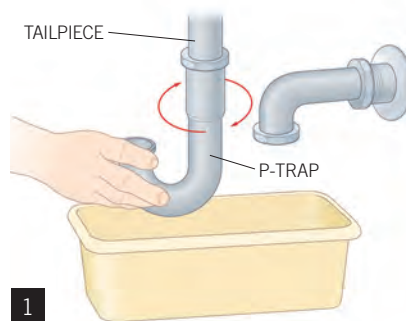
Don't make the typical mistake of pumping up and down only two or three times, expecting the water to whoosh down the drain. Holding the plunger upright, use 15 to 20 forceful strokes. You should feel a definite suction. If



you don't, try coating the rim of the plunger's cup with petroleum jelly for a tighter seal. The plunger may push the blockage through, or it may pull it up into the sink. Repeat if necessary.

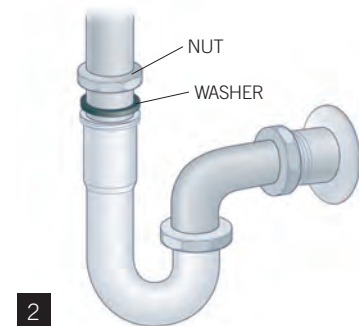
DISMANTLING A TRAP

Taking apart a trap is not difficult, but be aware that an old chrome trap may crumble or crack as you

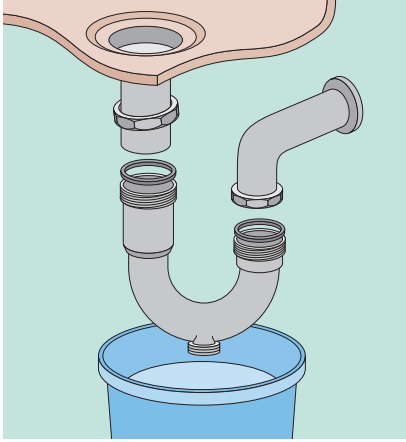


Removing and replacing a trap

1 Position a pail to catch water. Use slip-joint pliers to loosen the nuts at the tailpiece and the waste arm, then slide the nuts up or to the side. Pull off the trap and clean it of any collected debris.



2 To replace or reinstall the trap, first slide on new nuts, then washers. Slip the trap into place, slide the washers into position (make sure they are not twisted), and tighten the nuts. Test for leaks.



work on it. The rubber and plastic washers will likely need to be replaced. If you need to replace the trap, consider using plastic, which is more durable and is easier to install and dismantle.

AUGERING

If your sink has a garbage disposer and the disposer drainpipe clogs, turn off the electricity to the disposer. Disassemble the trap and then thread an auger into the drainpipe. If both basins of a double sink clog, feed an auger down the one without the disposer. If only the basin with the disposer is clogged, you will have to remove the trap to dislodge the blockage. If augering the sink drainpipe does not work, turn your attention to the main drain (see pages 144–145).

If the sink has a pop-up drain assembly, remove the stopper and the pivot rod (see below left).

Feed the auger (also called a snake) into the drain, trap, or pipe until it stops. If there is a movable handgrip, position it about 6 inches above the opening and tighten the thumbscrew. Rotate the handle clockwise to break the blockage (see below right). As the

AMERISPEC® TIP

USING CHEMICAL DRAIN CLEANER

Never use a chemical cleaner on a drain that has stopped completely, especially if the fixture is filled with water. It won't clear the blockage, and you'll face the problem of how to get rid of the caustic water that's become trapped. However, a drain cleaner may solve the problem of a sluggish drain. Take these precautions:

- Work in a well-ventilated room and do not breathe in any fumes the chemicals may give off. Wear heavy-duty rubber gloves, safety glasses or goggles, and a long-sleeved shirt and pants to protect your skin.
- Never use a plunger if a chemical cleaner is present in the drain. You risk splashing caustic water on yourself.
- Never use a chemical cleaner in a garbage disposer.
- Read labels and match cleaners with clogs. Alkalis cut grease, while acids dissolve soap and hair. Never mix these two types together, as doing so can cause an explosion.



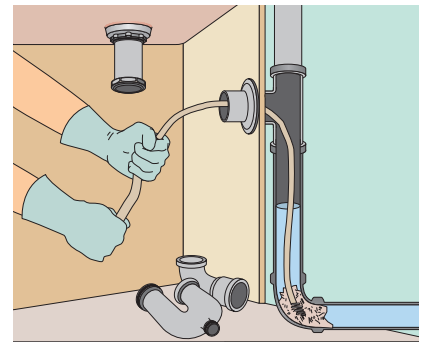
auger

cable works its way into the pipe, loosen the thumbscrew, slide the handgrip back, push more cable into the pipe, tighten again, and repeat. If there is no handgrip, push and twist the cable until it hits the clog.

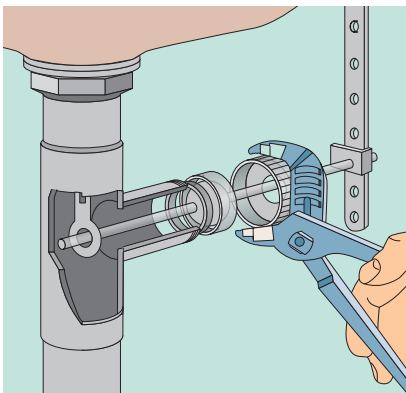
The first time the auger stops, it probably has hit a turn in the piping rather than the clog. Guiding the auger past a sharp turn takes patience and effort. Keep pushing it forward, turning it clockwise as you go. Once the head of the auger hooks the blockage, pull the auger back a short distance to free some material from the clog. Then push the rest on through the pipe.

After breaking up the clog, pull the auger out slowly and have a pail ready to catch any debris. Flush the drain with hot water.

If the clog is beyond the trap, remove the trap and insert the auger into the drainpipe at the wall (see below) and work in the same way as for augering a sink.



For a distant or particularly difficult clog, rent a power auger at an equipment rental supply, or call a drain-clearing company. They have powerful augers that can run long distances and cut through major blockages. Sometimes tree roots puncture the main drainpipe and must be ground up to restore good drainage. Many companies use sewer cameras, which travel through drainpipes and pinpoint the blockages, so they can be cleared more efficiently.

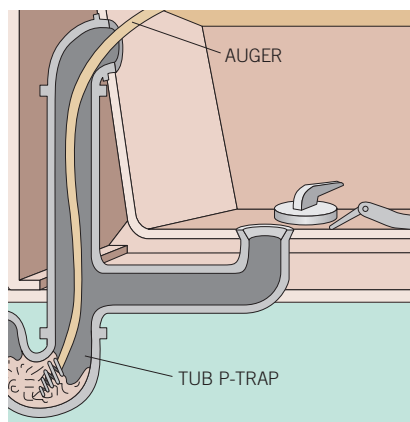


CLEARING CLOGS IN TUBS AND SHOWERS

Install a hair trap to help prevent clogs in tubs and showers. One type sits inside the drain, while another requires replacing the pop-up. Whenever a tub or shower drain does clog up, first find out whether other fixtures are affected. If they are, work on the main drain. If only the tub or shower is plugged, work on it.

Begin by plunging (see page 142), then remove the strainer or pop-up and clean it (see page 141). If this does not work, use an auger, a garden hose, or a balloon bag (see opposite page). To clear a clogged toilet, see page 146.

TUB WITH A P-TRAP To clear a tub P-trap, remove the stopper and rocker arm. Unscrew and remove the overflow plate and pull out the assembly. Feed the auger down



through the overflow pipe and into the P-trap. If this does not clear the drain, remove the trap or its cleanout plug from below (if it's accessible) or through an access panel. Have a pail ready to catch water. Then insert the auger toward the main drain.

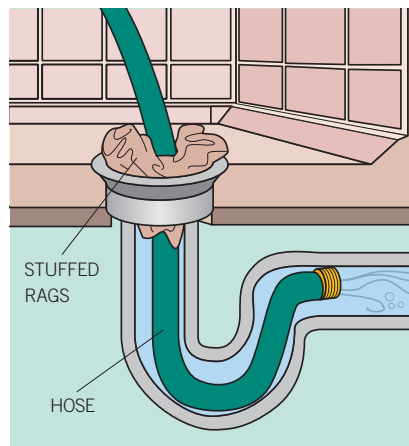
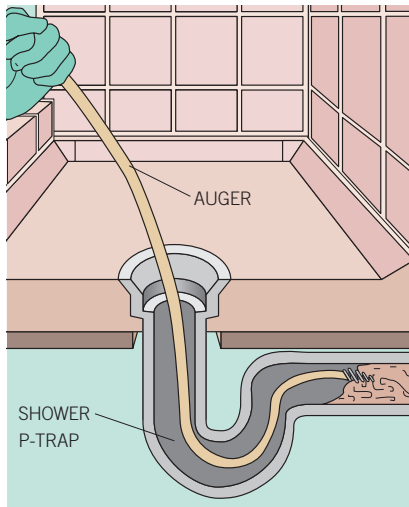
DRUM TRAP Instead of a P-trap, bathtubs in older houses may have a drum trap, recognizable by its round, usually chrome cover on the floor

near the tub. (Drum traps are no longer allowed by code, but older houses may still have them.) To clear a clog, bail all water from the tub and unscrew the trap cover with an adjustable wrench. If the cover is rusted shut, you may have to tap it with a hammer and chisel; you will then need a new cover. Watch for water welling up around the threads. Remove the trap's cover and rubber gasket and then clean



out any debris. If the trap is still clogged, work the auger through the lower pipe toward the tub and, if necessary, in the opposite direction.

SHOWER STALL Unscrew and remove the strainer of your shower drain. Probe the auger down the drain and through the trap until it hits the clog.



USING A HOSE You can also use a garden hose to clear a slow drain. Attach the hose to a faucet with a threaded adapter, or run it to an outside hose bib. Push the hose deep into the drain trap and pack wet rags tightly into the gap around it. Hold the hose in the drain and turn the hose water alternately on full force and then abruptly off. Alternatively, use the hose with a balloon bag (see “Single Cleanout Plug” below).

CAUTION Never leave a hose in a drain. A sudden drop in water pressure could siphon raw sewage back into the fresh-water supply.

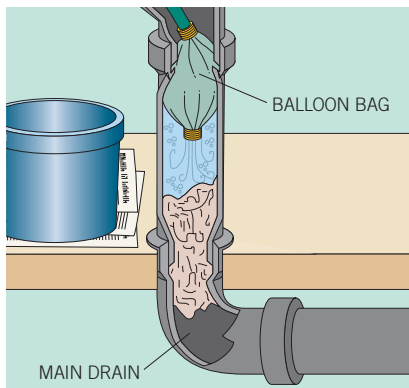
CLEARING THE MAIN DRAIN

If a clog is too deep in the pipes to access from a fixture, you can clean out the soil stack from below by working on a branch cleanout, the main cleanout, or the house trap. Cleaning the soil stack from below means working with raw sewage, so have rubber gloves, pails, mops, and rags on hand. Once you are finished, clean and disinfect all tools and materials.

SINGLE CLEANOUT PLUG Buy a balloon bag, or bladder, that matches the diameter of your drain. Attach the bag to a garden hose and then proceed as directed by the manufacturer. The balloon bag works by

AMERISPEC® TIP REPLACING A CLEANOUT PLUG

An old cast-iron cleanout plug may be difficult to remove. You may need to tap it loose with a hammer and a cold chisel. To replace it, buy a plug with a rubber washer that expands as you tighten a wing nut.

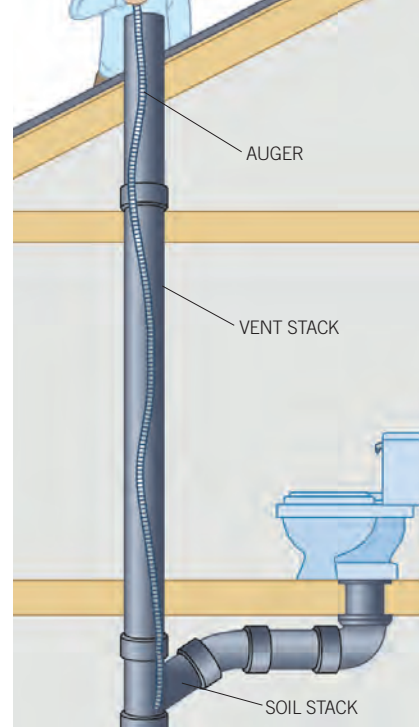
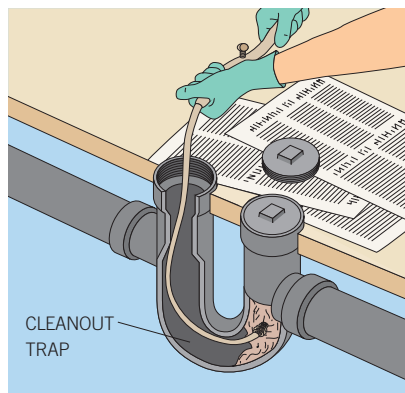


shown below, you may have a cleanout trap, also known as a house trap. These are no longer allowed by code. (However, if your house is newer, the presence of two closely spaced cleanouts could mean your house has a two-way cleanout. Ask your plumber to be sure.) Carefully unscrew one of the plugs. If sewage begins to seep out as you loosen it, retighten it and call a

plumber, as sewage may be backed up into the main drain. Otherwise, work an auger down through the drain to get at the obstruction.

If a balloon bag does not do the trick, you can rent a large power auger made for main drains, but you are probably better off hiring a professional plumber or drain clearer.

MAIN HOUSE TRAP If the main drain has two closely spaced cleanouts, as



plumber, as sewage may be backed up into the main drain. Otherwise, work an auger down through the drain to get at the obstruction.

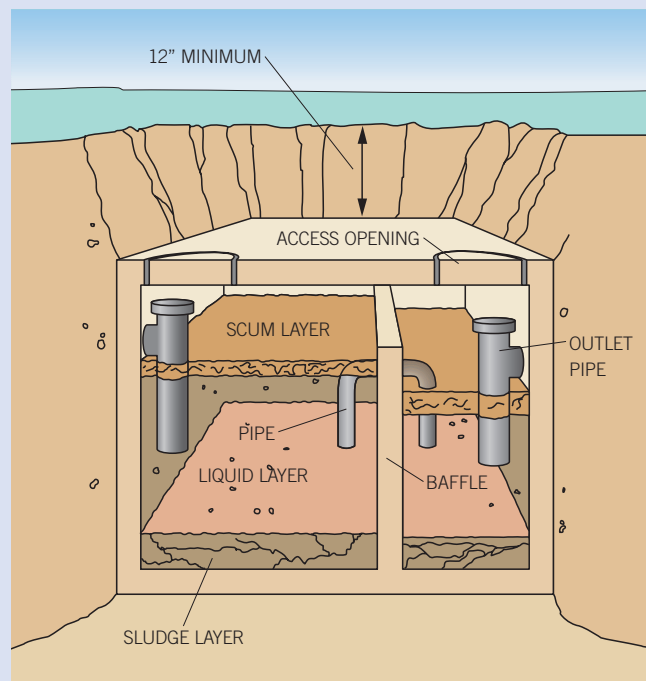
WORKING FROM THE ROOF You can sometimes get at a clog in the main stack by working from the roof (see above). If you can work safely up there, thread an auger through the vent stack to the soil stack, moving it from side to side as you go.

MAINTAINING A SEPTIC SYSTEM

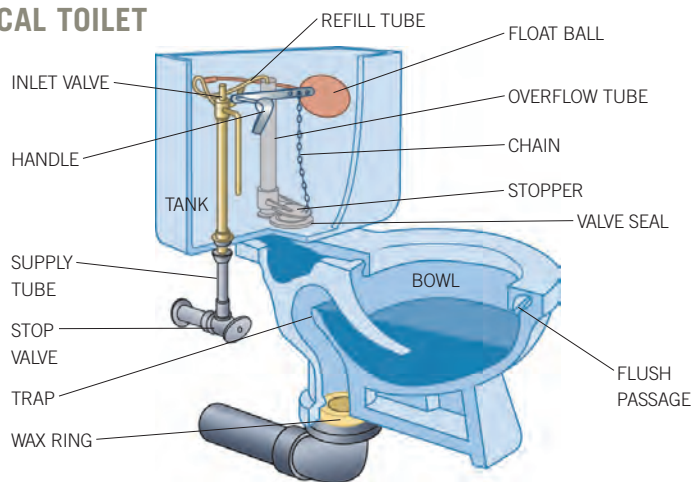
A good septic tank system does not require a great deal of care or call for many special precautions. But the maintenance it does require is crucial because a properly functioning septic system is much less likely to clog. You should have a diagram of your septic tank's layout, showing the locations of the tank, pipes, access holes, and drainage field. (Your building or health department will most likely have a map of your system on file.)

Chemicals, chemical cleaners, and thick paper products should never be flushed down the toilet or into a drain. Chemicals may destroy the naturally occurring bacteria necessary to attack and disintegrate solid wastes in the tank. Paper products can clog the main drain, making the system useless.

The tank should be pumped whenever necessary, but it's best to have it done in spring if you live in a cold climate. If you have the tank pumped in fall, it may become loaded with solid waste that can't be broken down in winter, when bacterial action slows.



A TYPICAL TOILET



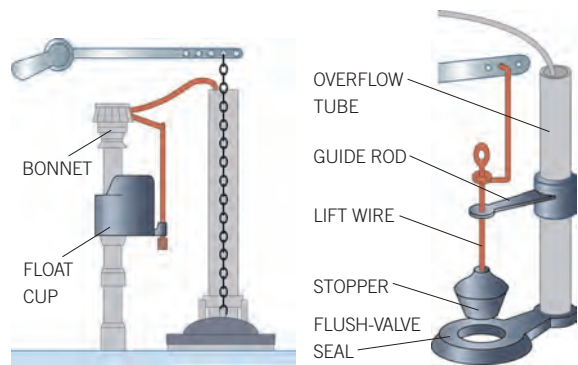
toilet repairs

Knowing how a toilet works is essential to troubleshooting. Two assemblies are concealed under the tank's lid: a flush-valve assembly, which controls the flow of water from the tank to the bowl, and an inlet-valve assembly, which regulates filling the tank with water. The toilet bowl includes a built-in trap. When the flush handle is pushed, a trip lever in the flush-valve assembly lifts the chain or lift-rod wires connected to the flapper or stopper. As the flapper or stopper goes up, water rushes through the valve seat into the bowl via the flush passages under the toilet bowl's rim. When the water in the bowl reaches a level higher than that in the trap, it is siphoned out into the drainpipe.

As the tank empties, the float ball descends and the stopper drops into the flush-valve seat. The float ball trips the inlet valve open, letting a new supply of water into the tank through the tank-fill tube. As the water level in the tank rises, the float ball also rises until it gets high enough to shut off the flow of water. If the water fails to shut off, the overflow tube carries excess water into the bowl to prevent flooding.

A variety of inlet and flush valves have been made over the

years. In most cases, newer valves can be installed in old toilets. Your toilet may have a float-cup inlet valve, an all-plastic assembly with a cup that slides up to shut off water. An older toilet may have a stopper attached to a lift wire



(see below, right). This type of toilet often needs to have its handle jiggled to stop water from running into the tank. If you have this problem, consider replacing the stopper with a flapper.

The following pages provide instructions for making toilet repairs. Before beginning any toilet repair—unless you're simply adjusting the float arm—you'll need to shut off the water at the stop valve, flush the toilet twice to empty the tank, and sponge out any remaining water.

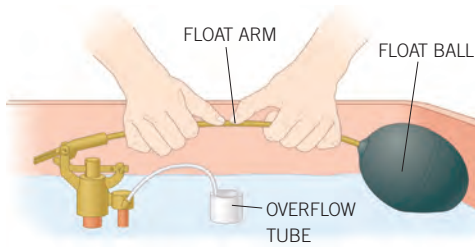
Unclogging a toilet

PLUNGING If a toilet is clogged, bail out or add water so that the bowl is half full. Use a toilet plunger, which has a funnel-cup tip to fit the bowl. Gently ease down on the plunger until all the air is out of the rubber bellows, then pull up rapidly on the plunger handle. The idea is to pull the clog up into the bowl where it can break up into smaller pieces, rather than force it down into the narrower diameter

of the trap where it can get really jammed. Repeat as needed.

AUGERING If the plunger doesn't work, use a toilet auger. It has a curved tip that starts the auger with a minimum of mess and a protective housing to prevent it from scratching the bowl. To maneuver the auger, simultaneously push it and turn the handle. The auger may push the obstruction through, or it may pull it up into the bowl.





RUNNING TOILET

If water in your toilet tank trickles constantly or intermittently, you may need to adjust or replace the float mechanism or parts of the flush-valve assembly: the overflow tube, valve seat, tank stopper, guide rod, or lift wires. Or you may need to replace the entire assembly.

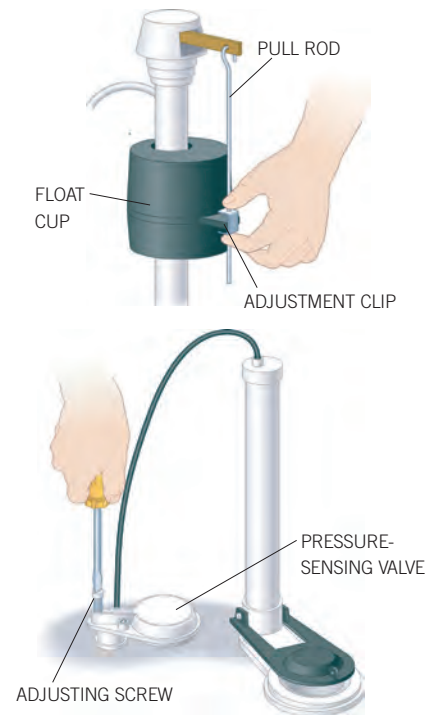
FLOAT MECHANISM If your toilet has a ball-cock inlet-valve assembly,

bending the float arm downward (see left) may stop the water from running. If the float ball is filled with water, it should be replaced.

If you have a float-cup assembly, squeeze the clips and slide it down (see above right). If your valve has a pressure-adjusting screw, adjust it (see below right).

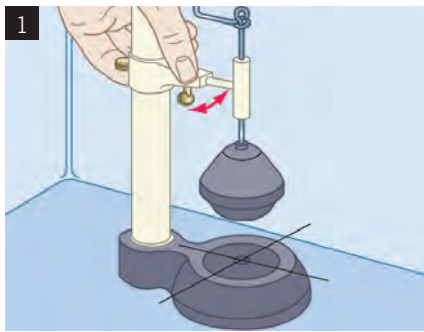
FLUSH-VALVE ASSEMBLY A defective or badly fitting valve seat or stopper may cause a toilet to run (see below for repairs).

If a metal overflow tube is cracked, replace it. If the toilet is still running, replace the entire flush-valve assembly.



Working on a stopper and seat valve

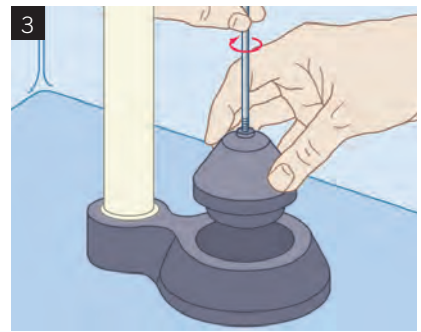
1 If the stopper doesn't seat properly, loosen the adjustment screws and realign the guide arm and rod, or bend the lift wires.



2 If the valve seat is rough and pitted or covered with debris, scour it with fine steel wool or an abrasive pad to smooth its surface.

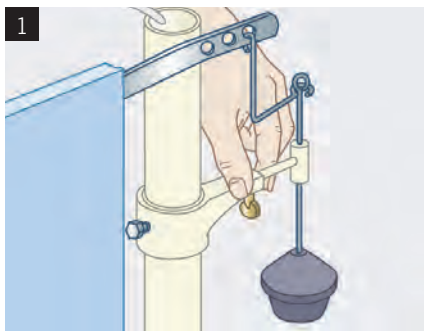


3 To replace a worn-out tank stopper, unscrew it from the lift wire and screw on a new one.

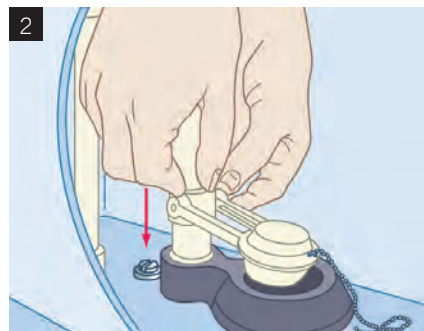


Replace a stopper with a flapper

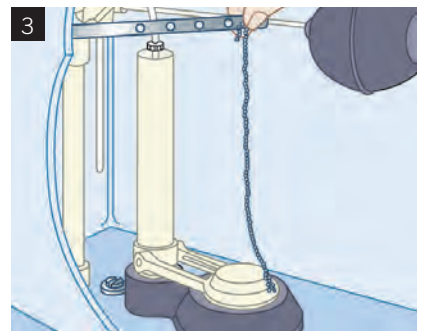
1 To remove the old stopper, unhook the lift wires and loosen the screw on the guide arm. Lift off the guide rod and stopper.



2 To install the flapper, slide its collar to the base of the overflow tube. Position the flapper over the valve seat.



3 Adjust the length of the lift chain and hook it onto the tip of the trip lever, leaving about 1/2 inch of slack.





1

Replace a flapper

1 Some flappers have ears that attach to each side of the overflow valve. Others are designed to fit flush valves that are angled, rather than flat. Take the old flapper with you when you buy a replacement, and ask a salesperson for advice if you're not sure.



2

2 Adjust the chain so that it lifts the flapper but does not tug on its ears or cause it to slide up the overflow tube when the handle is turned. Test-flush several times to make sure the chain will not keep the flapper from seating properly.

NOISY TOILETS

If your toilet whines or whistles as the tank fills with water after flushing, the problem may be restricted water flow or a defective inlet-valve assembly.

First, make sure the fixture shut-off valve is fully open. Still noisy? You may need to oil the trip lever or replace part or all of the inlet-valve assembly.

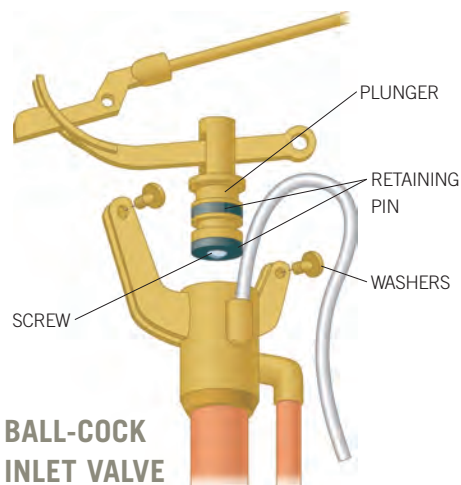
REPAIRING AN INLET VALVE

To stop ball-cock leaks, remove the retaining pins in the ball-cock lever and lift the float arm out. Remove the plunger from the ball cock and replace any defective washers. If you have a different type of inlet valve, remove it and take it to a plumbing supply source to find replacement parts.

It may be easiest to replace the entire unit.

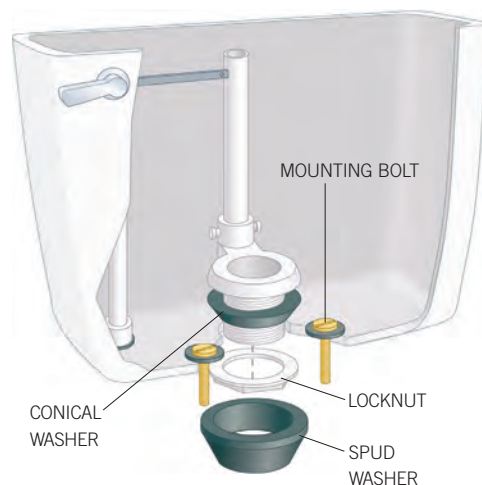
REPLACE A FLUSH VALVE

For a bowl-mounted tank, first remove the mounting bolts and gaskets and then lift the tank off. Unscrew the locknut under



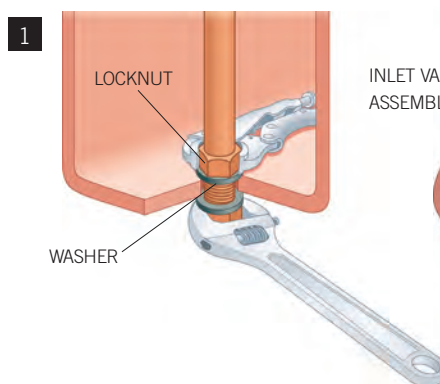
BALL-COCK INLET VALVE

the tank after removing the spud washer. Remove the conical washer and flush-valve assembly. To install the replacement, assemble the conical washer and locknut. Then position the overflow tube and tighten the nut.



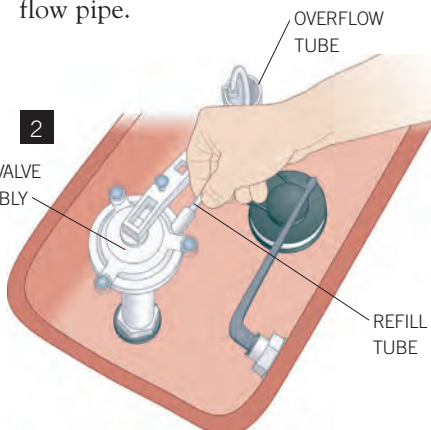
Replacing an inlet valve

1 Using pliers and a wrench, loosen the locknut holding the inlet-valve assembly to the tank. Unclip the bowl refill tube. Holding on to the base, remove the inlet-valve assembly.



1

2 Install the new inlet-valve assembly according to the manufacturer's instructions. Position the bowl refill tube in the overflow pipe.

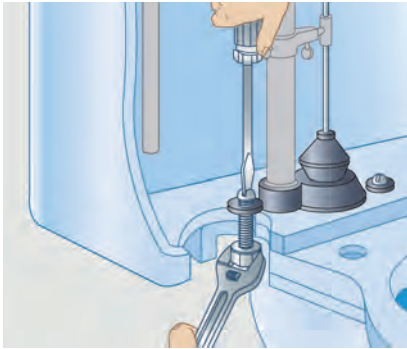


2

LEAKS AND FLUSH PROBLEMS

Other toilet problems you may need to repair include leaks, tank sweating, and certain flush problems. Some repairs require an empty tank.

LEAKS To stop a leak between a tank and bowl, tighten the mounting bolts in the tank or replace the bolt



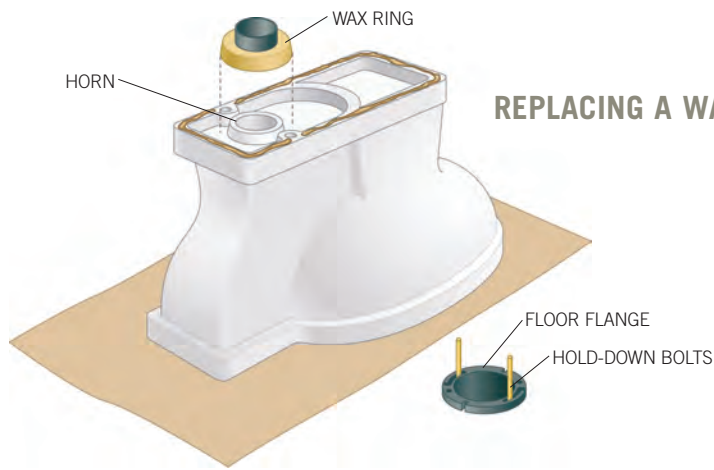
gaskets (see above). If there's still a leak when the toilet is flushed, remove the tank and replace the spud washer on the bottom of the flush valve.

When a bowl leaks around its base, first try tightening the hold-down bolts that anchor it to the floor. If that doesn't stop the leak, you'll have to remove the bowl and replace the wax ring that seals the bowl to the floor (see above right).

FLUSH PROBLEMS A loose handle or trip lever may cause an inadequate or erratic flush cycle. Adjusting a



setscrew (see above) or a mounting nut on the handle, or replacing the handle itself, often solves the problem. Clogged flush passages under the bowl's rim may also restrict



REPLACING A WAX GASKET

water flow. Clean obstructed passages with a piece of wire (see below).

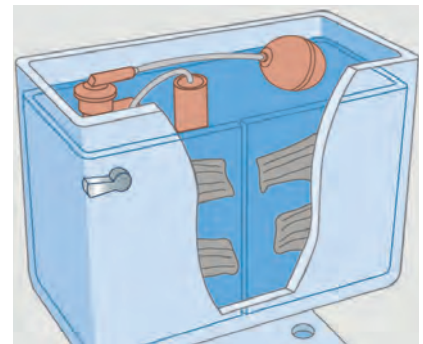
SWEATING TANK This problem occurs most often when the weather is warm. Cold water from the tank cools the porcelain, and warm, moist air condenses on the outside.



Tank sweating encourages mildew, loosens floor tiles, and rots subfloor-

ing. Some new toilets have insulated tanks that cure this problem.

An easy solution is to insulate the inside of the tank by first draining and drying it. Then glue to the inside walls a tank liner kit (see below) sold at plumbing stores or one made of foam rubber or polystyrene pads.



WATER-CONSERVING TOILETS

Beginning in 1994, Congress required that new toilets use no more than 1.6 gallons of water per flush (gpf), roughly half of the old standard. Toilets that meet newer federal WaterSense standards use even less, 1.28 gpf. Dual-flush toilets, a design popularized in Europe, use 1.6 gpf for solid waste and half of that for liquid waste. If you have an older toilet, replacing it with a newer model can mean significant water savings. Although consumers complained about early low-flow toilets, manufacturers have improved their designs. Consumers can check performance ratings of specific brands and models by visiting www.allianceforwaterefficiency.org and following the link to Maximum Performance (MaP) testing results.

AMERISPEC® TIP LEAK OR NO LEAK?

If you can't tell whether your toilet is leaking around the tank bolts or just sweating, add food coloring to the tank water. Wait an hour, then touch the bolt tips and nuts under the tank with white tissue. If the tissue shows coloring, you have a leak. If it doesn't, the moisture is just condensation.

water heater repairs

Traditional water heaters store hot water in a tank. When a hot-water faucet is turned on, water is drawn from the top of the heater's tank. The tank is refilled with cold water that is carried to the bottom via a dip tube. When water temperature drops, a thermostat activates the heat source—a burner in a gas heater or the heating elements in an electric unit.

A standard gas heater has a flue running up the center and out the top to vent combustion gases outdoors. An electric heater does not require venting. In both types, a

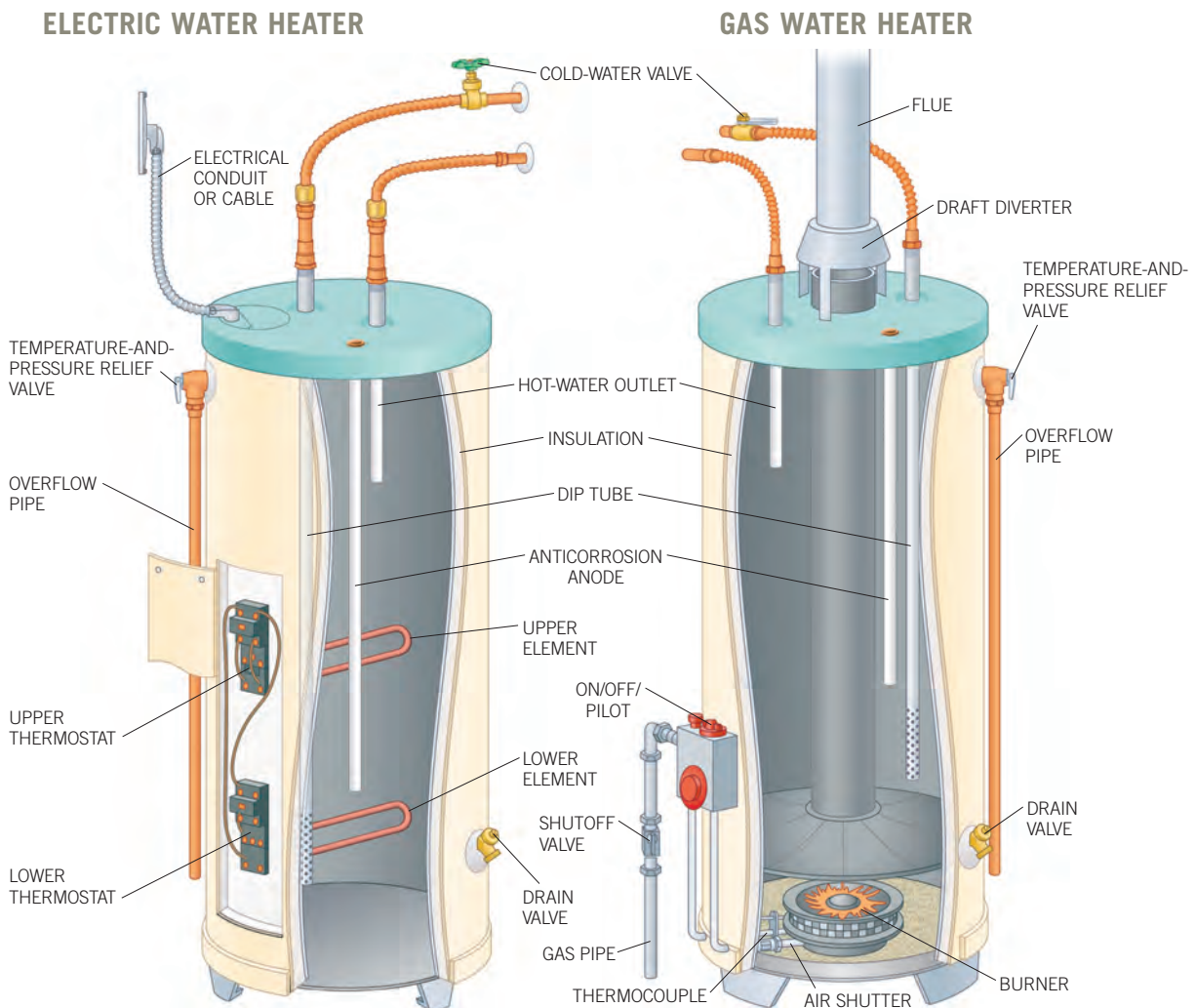
special anode rod attracts corrosive minerals in water that might otherwise attack the tank's walls.

A gas water heater may have a pilot light and a thermocouple, much like the gas burner in a furnace or boiler. See pages 162–163 for instructions on maintaining the burner, lighting the pilot, and replacing a thermocouple.

Twice a year, inspect the flue assembly to be sure it's properly aligned and its joints are sealed. Then check the flue by blowing out a lighted match, and placing it near the draft diverter with the burner on. If the smoke does

not draft up into the flue, there is an obstruction, which should be removed immediately. If you cannot find the source of the problem, call for service.

Electric water heater problems are usually caused by the heating elements, their thermostats, and the high-temperature cutoff. The two heating elements are controlled by the thermostats and the cutoff, a device that shuts off the elements should the water get too hot. The thermostats and cutoff are concealed behind an access panel on the side of the water heater. After the panel is removed, insulation may need to be cut away to provide access. If the high-temperature cutoff has tripped, the solu-



tion may be as easy as pushing the reset button. Otherwise, to have the thermostats adjusted, the cutoff reset, or any of these components replaced, call for service.

MAINTENANCE To reduce sediment accumulation, open the drain valve every six months and let the water run into a bucket or through a hose to a drain until it looks clear.

At least once a year, test that the temperature-pressure relief valve, which guards against hazardous pressure buildup, functions properly. When you lift or depress the lever, water should drain from the overflow pipe. If it does not, replace the valve, or have a licensed plumber do it.

ADJUSTING WATER TEMPERATURE Water heaters are often set at 150 or 160 degrees F, but these temperatures are intended primarily for space heating. The code limits the temperature of the domestic water line to 140 degrees F when leaving a heater used for both space heating

HEAT PUMP WATER HEATERS

Many homeowners in moderate climates use air-source heat pumps to heat and cool their homes, and the same technology can be applied to heating water. Heat-pump water heaters burn no fuel directly. Rather, they pull heat from the air around them to heat water. They can be two to three times more energy-efficient than conventional water heaters that use electricity, according to the U.S. Department of Energy. They should be installed in spaces with a temperature range of between 40 and 90 degrees F. and with at least 1,000 cubic feet of air around them. They do not perform well in cold spaces, such as unheated utility rooms or garages, but they do well in a room with excess heat, like a furnace room, the Energy Department says.



AIRGENERATE
HEAT PUMP
WATER HEATER

and domestic hot water. By lowering the setting to about 120 degrees, you can save substantially on your fuel bills. Do not set the temperature lower than that, as you risk breeding bacteria. Dishwashers require higher temperatures to clean properly, but many models are equipped with their own water-heating device.

DRAINING AND FLUSHING A TANK Turn off the gas or power, close the cold-

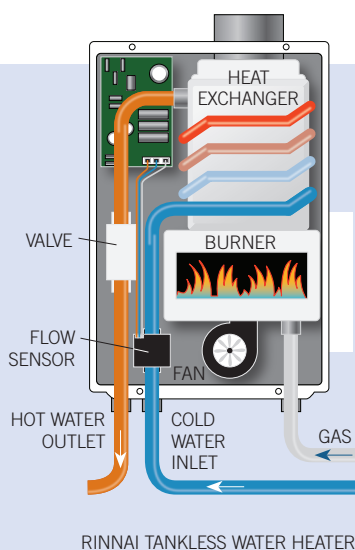
water valve, and attach a hose to the drain valve to route water into a drain or outside the house. Open the drain valve and open one hot-water faucet somewhere in the house to let air in. When all the water has drained, turn the cold-water valve on and off until the water coming out of the valve runs clear. Then close the drain valve and the hot-water faucet, open the cold-water valve, and turn the power or gas back on.

THE TANKLESS OPTION

A tankless, or on-demand, water heater supplies nearly instant hot water (either electric or gas), and it does not waste energy by storing heated water in a tank. Manufacturers predict that heating water on demand saves 30 percent in water-heating costs and accounts for a 50 percent decrease in energy consumption.

A small tankless unit may be placed under a sink to supply hot water for the faucet above. A larger unit may supply hot water to several faucets or to an entire house. Even the larger units take up far less space than a standard water heater. And a tankless model will never run out of hot water, as a water tank will.

Tankless heaters require little maintenance. Some have an inline filter connected to the cold water inlet line



that needs periodic cleaning, especially if your water comes from a well.

If you live in an area with mineral-rich water, your tankless heater may require periodic flushing with household vinegar to remove calcium buildup in the pipes. Your plumber can do this, or you can invest in a small circulating pump and do it yourself.

Disconnect the power to the heater. Attach a short length of hose to the cold water line and put the other end of the hose in a large bucket. Then, attach a second hose to the hot water line and to a small recirculating pump and then to

the bucket. Fill the bucket with white vinegar. Operate the recirculating pump for 2 hours. The vinegar will dissolve buildup in the heater.

The method for adjusting the water temperature in a tankless heater is going to vary by manufacturer. Consult your owner's manual or go online for instructions.

pipe repairs

A higher-than-normal water bill may be the first indication that you have a leaking pipe. Or you might hear the sound of running water even when all the fixtures in your house are turned off.

FINDING A LEAK If you suspect a leak and don't see spraying water, first check all the fixtures to make sure the faucets are tightly closed. Then go to the water meter, if you have one. If the lowest-quantity dial on the meter is moving, you're losing water somewhere.

To find the source of a leak, try listening through walls and ceilings with a stethoscope, or look for stains. If water has stained the ceiling or is dripping down, the leak will probably be directly above. Sometimes, however, water may travel along a joist and then stain or drip at a point some distance from the leak. If water stains a wall, the stain is most likely below the actual leak, so you'll probably need to remove a large section of wall to get at the pipe.

If you don't hear running water or see drips or stains, the leak is likely under the house in the crawl space or the basement. Search with a flashlight.

FIXING A LEAKING PIPE Once you spot the leak, turn off the water immediately (see page 8). If the leak is small, you may install a simple temporary solution until you have time for the replacement job.

A sleeve clamp is the best temporary solution for a leak in a straight section of pipe. A hose clamp with a rubber sleeve and pipe-wrap tape are less secure. For a leak at a fitting, two-part epoxy putty is often the only pos-



sible temporary solution, but don't expect it to last long.

Eventually, a leaking pipe or fitting should be replaced. Arrange for a plumber to do the work as soon as possible.

FROZEN PIPES A faucet that won't produce water is the first sign of frozen pipes. If your pipes freeze during a cold snap, warm them as

soon as possible to prevent more ice from forming. Then take steps to ensure that your pipes don't freeze in the future.

WARMING FROZEN PIPES If a pipe freezes, first shut off the main water supply (see page 8) and open the faucet nearest the frozen pipe. Cover the area with waterproof drop cloths. To warm a pipe, work from the faucet back toward the iced-up area. When using an electrical device to thaw a pipe, wear rubber gloves and plug the device into a GFCI receptacle to avoid getting shocked.

A hair dryer or heating pad will warm an exposed pipe gradually. Heating a pipe too quickly can cause it to burst. If the pipe is hidden inside a wall, shine a heat lamp 8 inches or more from the wall surface. In a pinch, wrap a pipe in rags and pour boiling water over it.

FROST-PROOF ANTI-SIPHON HOSE BIB

An old-fashioned hose bib (also called a sill cock) is a simple valve that shuts off water just below the handle. This creates two possible problems: The pipe that attaches to the hose bib is very near the outside of the house, so water in it can easily freeze in the winter; and hose water can sometimes siphon back into the house, contaminating your drinking water. To solve both problems, have a plumber install a frost-proof anti-siphon hose bib. It has an extended stem, so it actually shuts off water a foot or so inside the house. It also has a built-in anti-siphon feature that keeps outside water from siphoning back into your water supply.



PREVENTING PIPES FROM FREEZING During a severe cold snap, keep a trickle of water running from faucets throughout the house, or aim a small lamp or heater at exposed pipes. Keep cabinet doors open during the night so heat circulates around the pipes. For a longer-term solution, wrap uninsulated pipes with heat tape, then cover with foam insulation. Insulation



heat tape

helps heat tape operate more efficiently. By itself, though, insulation won't prevent pipes from freezing. The best heat tapes have a thermostat that turns the heat tape off when the temperature rises above freezing.

NOISY PIPES

Pipe noises range from loud banging to high-pitched squeaking, chatter, and resonant hammering.

WATER HAMMER The most common pipe noise, water hammer occurs when you quickly turn off the water at a faucet or an appliance. The water flowing through the pipes slams to a stop, causing a hammering sound.

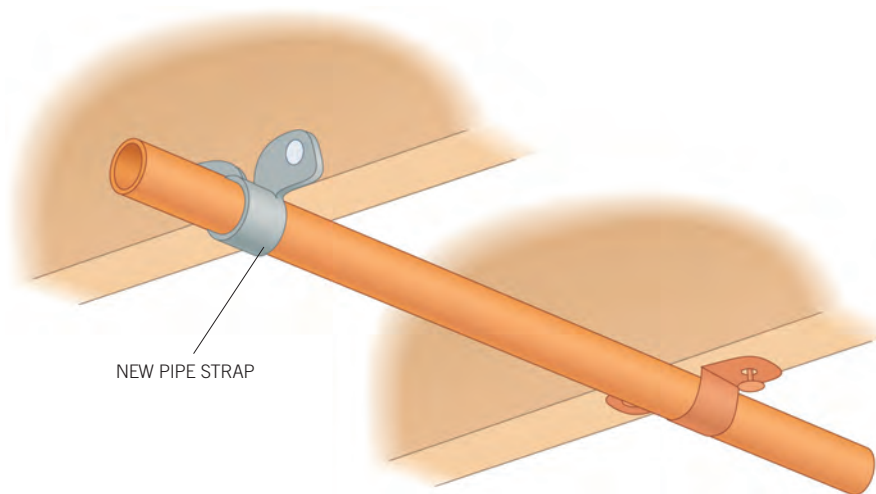
Many water systems have short sections of pipe rising above each faucet or appliance, called air chambers, which act as shock absorbers. Over time, air chambers can get filled with water and lose their effectiveness. To restore air chambers, shut off the water supply to your toilets and close the house's

main shutoff valve. Open the highest and lowest faucets in the house to drain all water. Then close the two faucets and reopen the main shutoff and the toilet valves. This will empty any air chambers in your house.

BANGING, SQUEAKING, OR FAUCET CHATTER

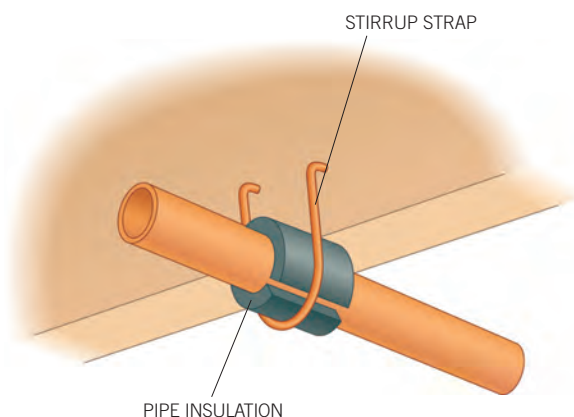
If you hear a banging noise when you turn on the water and it's not water hammer, check the way the pipes are anchored. Ideally, pipes should be held firmly in place but should not be right up against framing members or wall surfaces. Replace old hangers with new pipe supports (see above). Or wrap with a piece of pipe insulation and install a stirrup strap (see above right). You can also wrap the whole pipe with insulation. If a pipe rattles against a masonry wall, hold it away using wood blocks (see right).

Pipes that squeak are always hot-water pipes. As the pipe expands, it moves against the support and friction causes the squeak. To silence it, insert a piece of rubber or foam insulation between the pipe and the support.



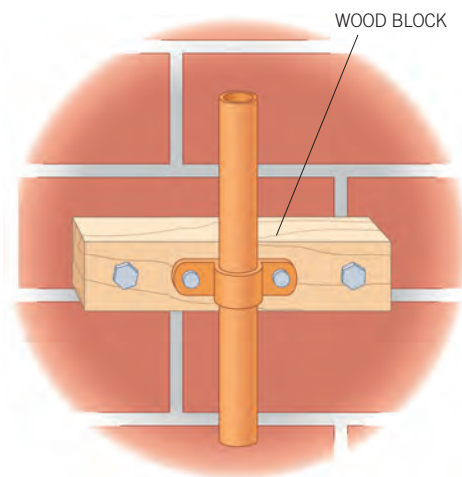
NEW PIPE STRAP

Faucet chatter is the noise you hear when you partially open a compression faucet. To correct the problem, tighten or replace the seat washer on the bottom of the faucet stem (page 133).



STIRRUP STRAP

PIPE INSULATION



WOOD BLOCK

heating and cooling systems

Heating systems vary greatly, and it pays to know yours so you can talk knowledgeably with repair technicians. This chapter provides general

overviews of the most common heating and cooling systems.

The most common types of heating systems installed in homes are gas furnaces or boilers, oil boilers, electric furnaces or electric heat-pumps. Most homes today are heated by forced air or hot water systems. Steam heat found in older homes is rarely installed today. Homes located in mild climates with favorable electrical rates may have electric heat. If your house has central air conditioning, it may use the same ducts for the cooling system as the heating system. A number of other types of heating systems have become popular in the last 20 years like radiant-floor heating, and air source and ground source heat pumps.

UNDERSTANDING YOUR HEATING SYSTEM

Heating systems that employ steam, hot water and forced air have four similar, basic components. First, a **thermostat** that controls the system and turns it on and off as needed to maintain the desired air temperature in the house. Second, is a **gas or oil burner, electric heating element or electric compressor and coil** which all produce heat. Third, a **heat exchanger** that transmits the heat produced by the burner into the water or air. Lastly the **heat distribution system** conveys the steam, water or air around the home in pipes or ducts delivering the heat via radiators, convectors and registers.

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AMERISPEC® TIP KNOW YOUR FUEL

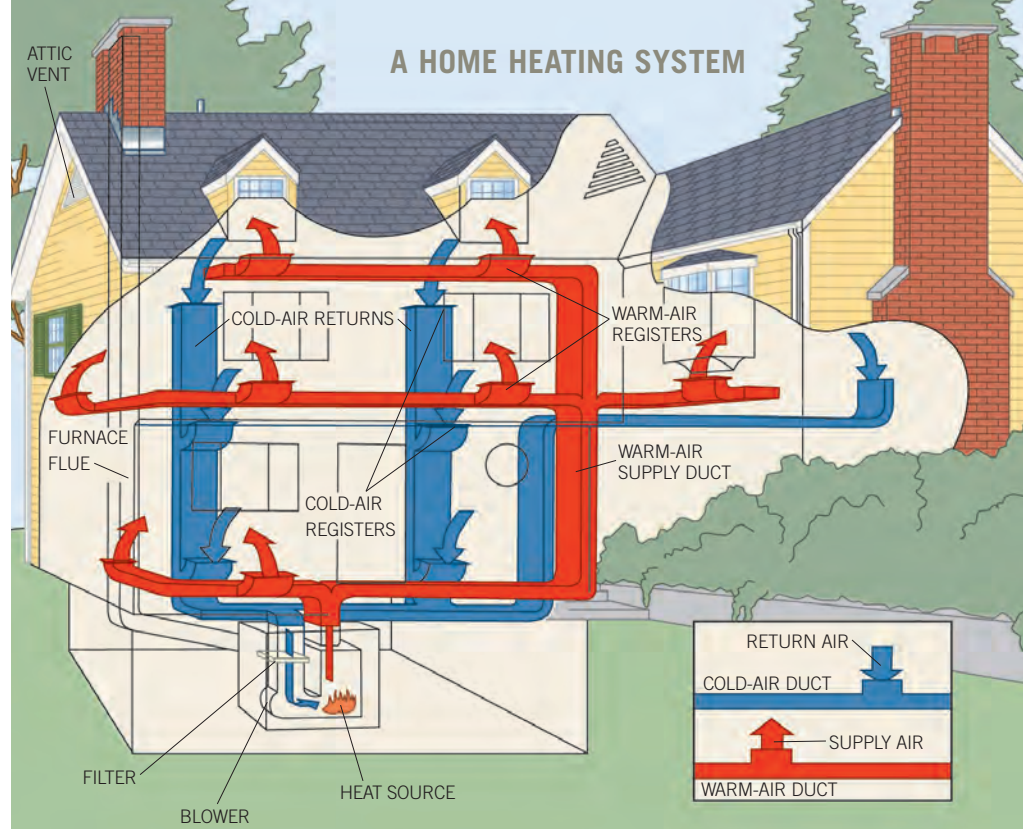
A furnace or boiler may be fueled with natural gas, liquefied gas (also called LP or propane), electricity, or oil. In most parts of the country, natural gas is the least expensive.

Know how to shut off the fuel in an emergency. Natural gas or LP usually has a shutoff valve near the boiler or furnace, or near the meter (see page 9). An LP tank has a shutoff on its top or on one end. A fuel oil tank, which may be in the basement or outside, usually has a shutoff near its bottom. If you have electric heat, learn how to turn off power at a switch near the heat source and at the service panel (see pages 9 and 172).

Typical energy sources used in forced-air heating systems are gas, oil and electricity. Steam and hot-water systems use gas and oil predominately; however, electric boilers are used where conditions require.

Heat-pump, forced-air heating systems can be both a heating and cooling system for the house. Heat pumps utilize the same system or cycle as window air conditioners, refrigerators and freezers. In the heating mode, the heat pump collects energy from the outside and releases this energy to heat the air in the house. In the cooling mode, the cycle is reversed—collecting heat in the house and releasing it outside.

The basic heating system operational sequence is as follows. The thermostat senses the air temperature in the room and when heat is needed it turns the heating system on. The system produces heat and when the heat exchanger is sufficiently warm, the fan or pump is turned on and circulates the air or water. Ducts are used for heat-pump or forced-air systems and pipes are used for water or steam systems. The heat is released into the room via registers in a forced-air system and baseboard convectors or radiators in hot-water or steam systems. In a radiant-floor heating system, hot water moves



through tubing concealed in the floor. Return ducts or pipes carry the air or water back to the heat exchanger to be warmed and flow through the system again. When the air temperature of the living area reaches the desired temperature on the thermostat, the thermostat automatically shuts the system down.

CARING FOR YOUR SYSTEM

Heating systems can operate reliably for many years, provided

they're carefully maintained. Most maintenance, minor repairs, and simple adjustments are well within the capabilities of a homeowner. But other repairs—those that are too dangerous or technical—require professional help.

Whether you're performing maintenance or trying to solve a problem, the following pages provide valuable information, as well as descriptions of the different heating systems and their major components, burners and thermostats.

USING ELECTRIC HEAT

In an area with warm winters or inexpensive electricity, electric heat often is a practical option. Here are the most common types:

BOILERS AND FURNACES In an electric boiler or furnace, the heating elements are immersed directly in the water or air to be heated. Repairs to electric heating elements should be left to a professional.

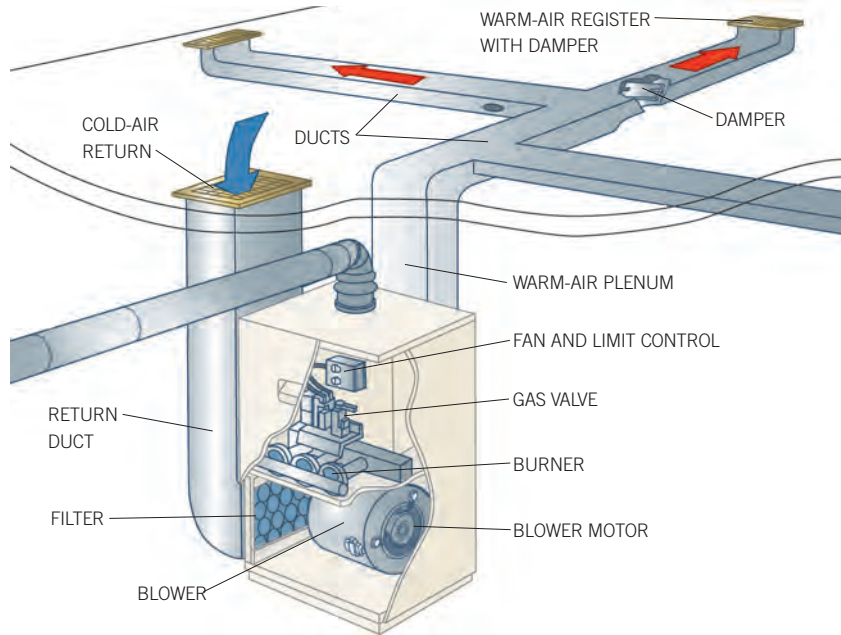
DUCT HEATERS These are installed in the ducts of an existing forced-air system. They may turn on at the same time as the blower, or they may be operated by a separate thermostat in an area that requires supplemental heat. Make sure the heaters don't turn on unless the blower is running.

BASEBOARD HEATERS These require no pipes or ducts, and they connect directly to the electrical system in the house. Baseboard heaters are often a good choice for a room addition or a hard-to-heat area. They typically have their own thermostats and safety thermal cutoff switches.

WALL AND CEILING HEATERS These are suitable for bathrooms or other small areas and are wired directly into the electrical system. Many units include a fan. Clean the heater occasionally. A defective unit usually should be replaced rather than repaired.

ELECTRIC RADIANT HEAT Electric heating panels or coils are installed in the floor or ceiling and are controlled by a thermostat.

FORCED-AIR HEATING SYSTEM



forced-air heat

Maintenance is critical for a forced-air system to perform well for a long time. Keep yours well tuned, in accordance with instructions in the owner's manual. The system should be inspected and tuned by a trained professional every year, but you can handle minor maintenance. Ask the professional how often you should clean or replace your filter; depending on your system and the amount of dust in your air, this could be yearly or monthly.



Keep the system clean and make sure the thermostat (see page 161) works properly. For typical problems, see the troubleshooting information on the opposite page.

BASIC MAINTENANCE For trouble-free operation, service a forced-air system in the following ways:

- If your furnace's cabinet contains a disposable filter, remove the old filter and replace it with one that's identical in size.
- If the filter is washable, remove it, vacuum it (see left), then rinse it with a hose or a hand shower. Let it dry completely before reinstalling it.
- Brush and vacuum the heat exchanger surfaces annually. See the owner's manual for instructions.
- Remove register covers and vacuum dirt and debris out of the boots (the small chambers behind the

ZONED HEATING AND MULTIPLE FURNACES

Some forced-air systems built in the 1960s were zoned, with multiple thermostats that controlled mechanical dampers in order to raise or lower the heat in various parts of the house. Many of those systems had reliability problems, and so the dampers were often disconnected. Newer zoned systems use more reliable mechanisms and offer an easy way to keep various parts of the house at different temperatures. (If you don't have zoned heating, you can simply close down a register to cool a room.)

Some homes have multiple furnaces, each of which has its own thermostat and supplies heat to a certain part of the house.



covers). Get into the ducts as far as the vacuum attachments will reach (see opposite page).

- Clean the blower blades at the start of each heating season.
- Vacuum debris and dust from the blower motor to prevent overheating, which may lead to fire.
- Examine the ducts annually for leaks. If you find any, seal them with duct mastic (do not use cloth duct tape).



- If the fan motor requires lubricating (typically twice a year), remove the access panel and squirt about five drops of SAE-10W-30 motor oil into each port, or follow the instructions in your owner's manual.

- If your unit includes a humidifier, you will likely need to remove its evaporative drum and clean or replace its pad at least once a year. You may also need to clean the tray below the drum.

BALANCING THE HEAT If some rooms are too hot or too cold, try adjusting the dampers in the registers and, if your system has them, the dampers on the warm-air ducts.

On a typical cold day, leave the thermostat at one setting and let the system run for three hours to stabilize the temperature. Open the dampers wide in the coldest rooms. Then adjust them until temperatures are balanced among the rooms. Wait half an

hour or so after each adjustment before checking or readjusting.

In a home that is hard to heat, achieve maximum comfort by adjusting the blower so that it runs constantly at a lower level throughout the day. To do this for a direct-drive blower, change the electrical connections (see the owner's manual) for a low blower speed.

TROUBLESHOOTING A FORCED-AIR HEATING SYSTEM

NO HEAT Check for power. See that the master switch is on and the circuit breaker is not tripped. If there is power, check the thermostat (page 161).

INSUFFICIENT HEAT Clean or replace the filter. Brush and vacuum the heat exchanger (see the owner's manual). Examine the ducts and seal any leaks with duct mastic. If the blower is operating too slowly, adjust the speed.

BLOWER DOESN'T OPERATE If the fan control is too high, adjust it. If the motor is not running, call for service.

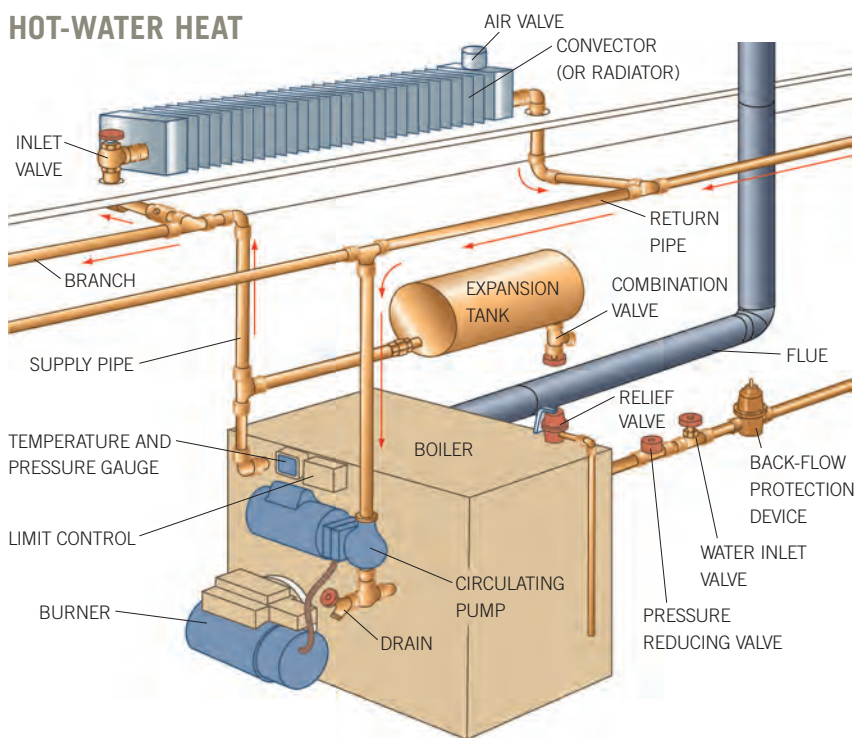
NOISY BLOWER Oil the motor ports if there are any.

BLOWER CYCLES TOO RAPIDLY If the fan differential is too low, adjust it. If the motor itself is defective, have a professional replace it.

ROOM TEMPERATURE EXCEEDS THERMOSTAT SETTING See page 161 for servicing or replacing a thermostat.

ROOM TEMPERATURE DOESN'T REACH THERMOSTAT SETTING Check the thermostat (see page 161). Clean or replace any clogged filters. If the blower is operating too slowly, adjust the speed (see the owner's manual).

HOT-WATER HEAT



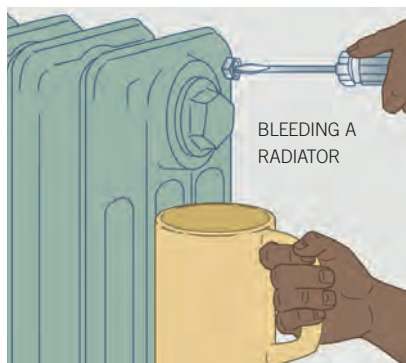
hot-water heat

In a home's hot-water system, water heated in a boiler travels through a network of pipes to radiators (in older homes) to convectors, baseboard heaters or to a matrix of tubing in the floor (a distribution system called radiant-floor heating) where the heat is given off. The cooled water then flows back to the boiler through return pipes.

In older homes, the movement of water is governed by gravity; warmer water rises. More modern

ZONED HOT-WATER HEATING

Many hot-water systems that use convectors (rather than radiators) are zoned, meaning there are several thermostats throughout the house, each of which controls the heat for part of the house. Each thermostat controls one of the pumps that are located near the boiler. The thermostats tell the pumps when to send the hot water; a device called an aquastat tells the boiler when to come on or turn off.



systems use a circulating pump to move the water under pressure. An aquastat governs the operation of the pump and burner.

An expansion tank, usually mounted above the boiler, contains air and water. The air acts as a cushion to maintain heated water at the appropriate pressure.

With proper maintenance, a hot-water system will give you many years of trouble-free service. Maintain the burner (see pages 162–163) as well as the thermostat (see page 161).

CONTROLLING THE HEAT In addition to adjusting thermostats, you can con-

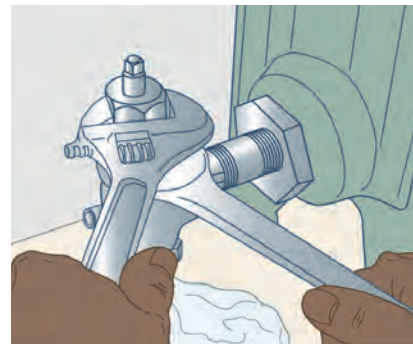
trol the heat coming from a radiator, and sometimes a convector, by opening or closing the supply valve. In a radiant-floor heating system, the temperature and flow of water through the tubing regulates the amount of heat to different zones.

BLEEDING CONVECTORS OR RADIATORS

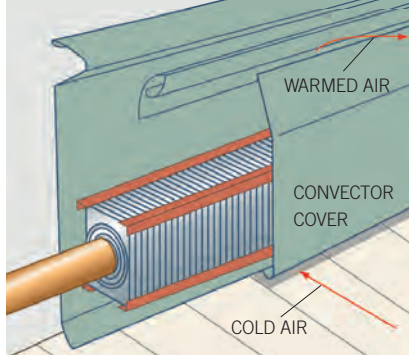
Convectors or radiators will not heat properly if air is trapped inside. If your units don't have automatic air valves, you'll need to bleed the air from them at the beginning of each heating season, whenever you add water to the system, or if a convector or radiator remains cold when it shouldn't.

Usually, the radiator or convector farthest from the boiler and on the top floor will need the most bleeding, so start there. Depending on the type of valve, use a wrench, screwdriver, or special key to open the valve. Hold a cup under it (see below left). You may hear air hissing or see water spluttering out. When the water flows without bubbles, close the valve.

RADIATOR LEAKS If a radiator leaks just under the handle at the packing nut, close the valve and try tightening the nut. If the leak is at the horizontal pipe going into the radiator, try tightening the two



nuts using two pipe wrenches (see above). If a leak persists, a plumber may need to drain the system and replace the valve.



GETTING THE MOST OUT OF YOUR CONVECTORS

A convector's or baseboard's cover is not just for show. It is configured so the right amount of cool air enters under the front plate to become heated and flow out the top (see above). Take care not to obstruct the cover or you will severely limit the convectors' heat output. If you install new flooring in the room, you may need to raise the convectors so they work properly.

CHECKING THE GAUGES Mounted on the boiler are two gauges, one for water temperature and the other for pressure (sometimes they're combined in a single housing, as shown below). Water temperature is deter-



mined by the system's design and the limit control settings on the boiler. Adjusting the boiler temperature is a job for a professional.

The pressure gauge provides a check on the water level. The fixed pointer, set when the system

TROUBLESHOOTING A HOT-WATER HEATING SYSTEM

NO HEAT Check that the electrical power is on (see page 9). Check the thermostat (see page 161). If the flame doesn't come on in a gas burner, relight the pilot or replace the thermocouple (see pages 162–163).

COLD CONVECTOR OR RADIATOR Bleed the convector or radiator.

LEAKING VALVE STEM Tighten nuts as shown on the previous page. To make other repairs (similar to those for a compression faucet, as shown on pages 133–134), you will need to drain the system first. Call in a professional.

LEAKING CIRCULATING PUMP Have a professional replace the pump or the seal.

NOISY CIRCULATING PUMP A professional should replace the pump coupling.

WATER DRIBBLING FROM RELIEF VALVE There is likely too much water in the expansion tank, so you'll need to drain it (see below).

was installed, is a reference point for water level. The moving pointer indicates current water level and should align with the fixed one when the water is cold.

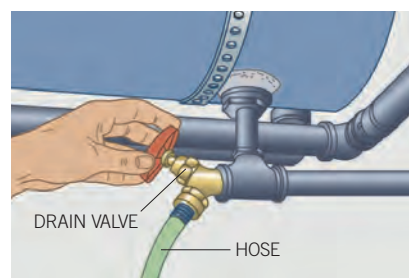
If the moving pointer reads higher, drain a little water from the expansion tank. If it's lower and you have no pressure-reducing valve, add water through the water inlet valve until the pointers are aligned.

In a system equipped with a pressure-reducing valve, the water level is maintained automatically. If draining the expansion tank doesn't work or if the water level is too low, consult a professional.

DRAINING THE EXPANSION TANK A pressure gauge that reads high or a tank that feels hot indicates there's too little air in the expansion tank. Draining some of the water from the tank, as shown at right, will restore the proper air-water ratio. To drain the tank, turn off the power and the water to the boiler and let

the water in the tank cool. Attach a hose to the combination valve and open it. Let water flow out until the pointers on the pressure gauge coincide. Close the valve, then restore power and water.

Newer heating system expansion tanks use an internal bladder to keep their water and air separated. These tanks should not need service.



BALANCING THE SYSTEM If your system has zone controls, you can adjust the temperatures of various rooms simply by turning the thermostats up or down. If you do not have zones, you may need to balance your system to compensate for overly cold or warm rooms.

Turn on the system and let room temperatures stabilize. To adjust a convector or radiator, gradually open or close the valve. It may take several days of adjustments to bring the system into balance.

AMERISPEC® TIP REPLACING A RADIATOR HANDLE

Most broken radiator valve handles can be replaced easily. Remove the screw holding the handle in place and take the broken handle parts with you when you buy a replacement. If the threads where the screw enters are stripped, buy a universal replacement handle, which attaches with setscrews driven horizontally into the stem.

steam heat

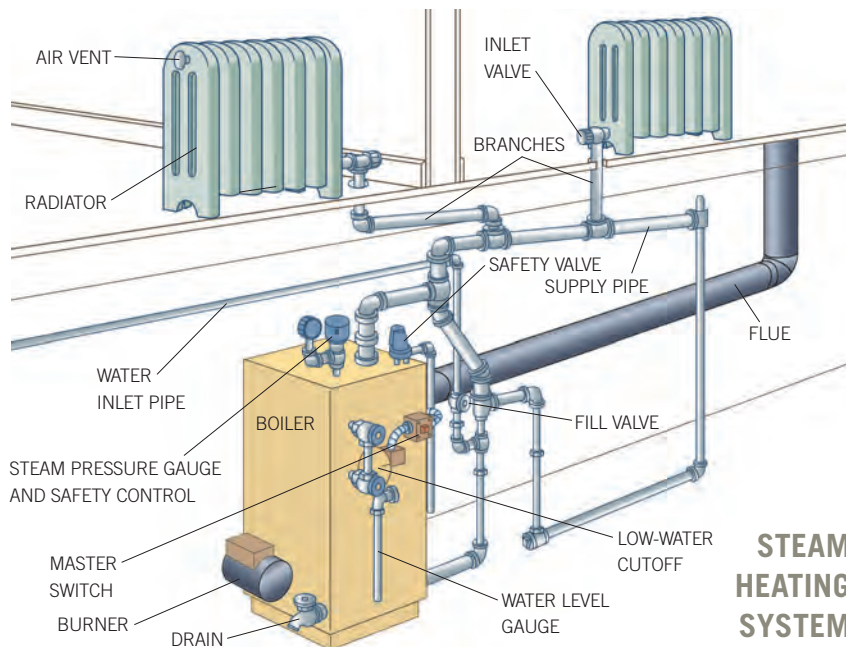
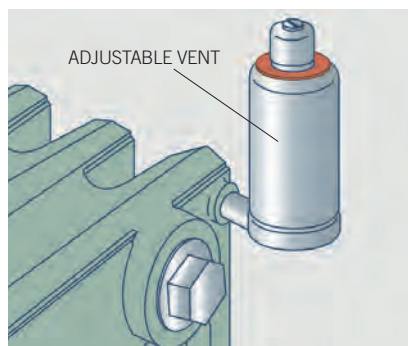
A hallmark of many older homes, steam heat begins in a boiler fueled by gas, oil, or electricity. The boiler turns water into steam, which rises through pipes to radiators or convectors. There the steam gives up its heat and condenses into water, which returns to the boiler.

To maintain a steam heating system in good working condition, periodically check the safety valve, steam pressure gauge, and water level gauge. Also, regularly inspect the burner (see pages 162–163) and thermostat (see page 161).

Unlike a hot-water system, steam radiators get very hot, then cool off fairly quickly. During the heating season, avoid placing objects on or near steam radiators.

STEAM RADIATOR MAINTENANCE If a single radiator is not producing heat, shut off the valve at the bottom and unscrew the air vent at the top. Replace the air vent.

A steam radiator can usually only be turned completely on or completely off. To make a radiator heat-adjustable, turn it off at the bottom valve. Unscrew the air vent valve near the top and take it to a plumbing store to purchase an adjustable vent that fits. Screw the new vent in. You can now turn the radiator's heat up or down by turning a screw on the air vent.



SAFETY VALVE Located on top of the boiler, the safety valve allows steam to escape if the pressure in the boiler exceeds safe levels. Test the valve every month during the heating season by depressing the handle (standing clear of the valve pipe). If steam doesn't come out, have the valve replaced by a professional.

STEAM PRESSURE GAUGE Tap the gauge lightly to make sure it's not stuck and then see that the pressure of the steam in the boiler is within normal bounds—typically 2 to 10 pounds psi (per square inch). If it's not, shut off the boiler and call for service.

WATER LEVEL GAUGE Once a month, open the valves at each end of the sight glass in the gauge. The water level should be in the middle of the glass. (Be sure to close the

valves after checking.) If water is not visible, immediately shut off the boiler and let it cool. Then add water by opening the fill valve on the water inlet pipe. If your system has an automatic water fill valve, call for service.

To remove the sight glass for either cleaning or replacement, shut off the valves and undo the collar nuts at each end of the glass. Install new gaskets when you reassemble the unit.

BOILER WATER LEVEL

A boiler for a steam radiator must have water at the correct level or it will burn out. Many boilers have an automatic feed that keeps the water at the proper level. If yours does not, check the water level every week or two during the heating season. If the level is low, open the valve to fill it.

AMERISPEC® TIP KEEPING YOUR RADIATOR HAPPY

A SIMPLE WAY TO INCREASE HEAT Much of a radiator's heat is often misspent heating the wall just behind it. Purchase a piece of sheet metal and place it behind the radiator to direct more heat into the room.

STOP THE BANGING If a radiator makes a knocking sound, this may solve the problem: Place a level on top of the radiator. Shim the legs on the non-valve side up so that the radiator tilts slightly toward the valve.

thermostats

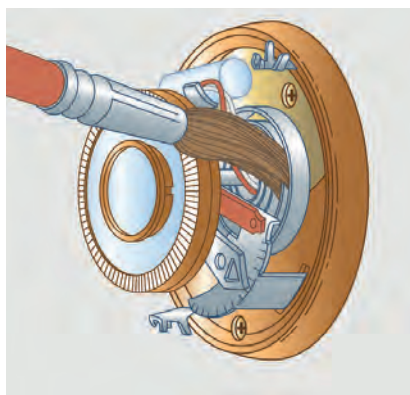
Virtually all heating systems are equipped with one or more temperature controls. These thermostats occasionally need to be cleaned or adjusted. If a thermostat is defective, replace it.

Replacing a bimetal coil thermostat with an electronic programmable allows you to set different temperatures at different times of day and the number and activity level of the occupants in the house, which can result in energy savings.

HOW A THERMOSTAT WORKS A thermostat is a switch that is turned on by a temperature-sensitive device that, in turn, activates the switch controlling the boiler or furnace operation. The sensor contracts as it cools, tripping the switch to ON, and expands as it warms, tripping the switch to OFF.

The switch may have open contacts or a mercury-filled contact enclosed in an airtight glass tube. The anticipator prevents the living area from overheating by shutting off the boiler or furnace just before the desired temperature is reached.

CLEANING A THERMOSTAT Gentle cleaning helps ensure trouble-free operation. First remove the cover (it usually just pops off). First clean while the thermostat dial is in place, then remove screws and pull the dial off. Use a soft brush or a cotton swab to clean the heat sensor's bimetal coil (as shown below).



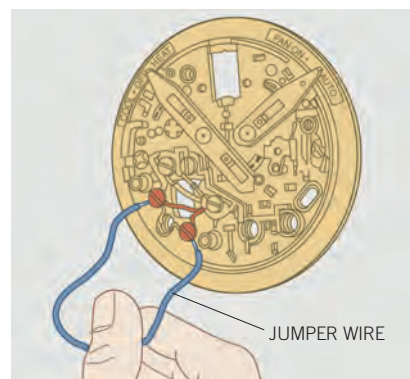
Clean any switch contacts (which are shiny metal) with a cotton swab moistened with alcohol. If



PROGRAMMABLE THERMOSTAT

contact points are nearly touching, you may need to use a thin piece of cardboard instead.

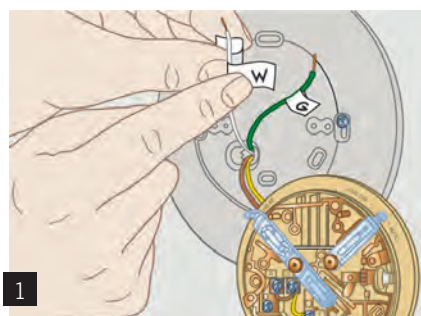
TESTING A THERMOSTAT If there is no heat even when the thermostat is all the way on, remove the thermostat's cover. You may need to



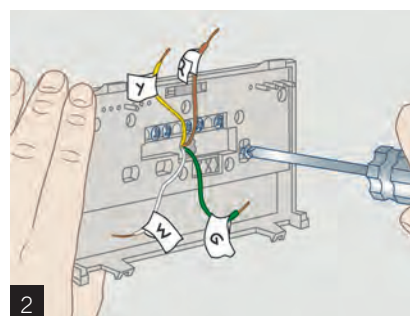
remove the dial, as well. Using a short piece of wire with both ends stripped, connect the contacts marked W and R. If you hear the burner come on, the thermostat is not functioning. If cleaning does not solve the problem, replace the thermostat. If the burner does not come on, check the burner itself (see pages 162–163).

AMERISPEC® TIP HOW MUCH JUICE?

Most thermostats run on just 6 to 20 volts carried by thin doorbell wires. There is no need to turn off the power when working on a low-voltage thermostat. However, if you see standard-thickness wires leading to a thermostat, it is a line-voltage type. Shut off the power before working on it (see page 9).



1

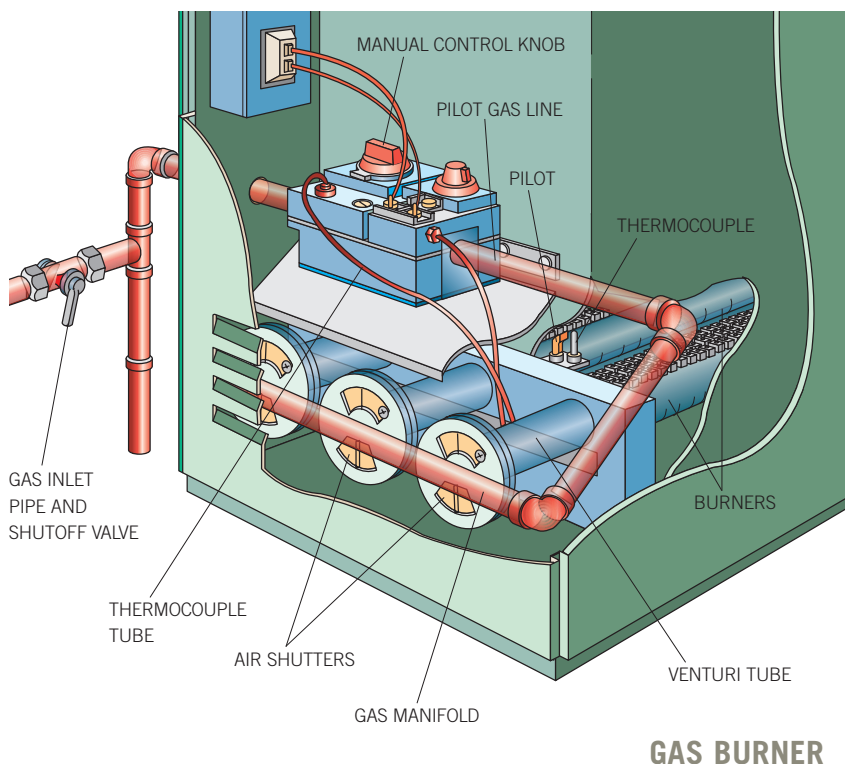


2

Installing an electronic thermostat

1 Remove the cover and detach the wires from their lettered terminals. Flag and label all wires to ensure that you hook them up to the correct terminals and that they do not slide back into their holes.

2 Attach the new baseplate to the wall with screws, checking that it's level. Strip the wire ends. Wrap them clockwise around the terminal screws and tighten the screws. Mount the cover and follow instructions for programming.



GAS BURNER

gas burner

Older gas furnaces, water heaters, dryers, and ranges all operate in a similar manner. When the thermostat calls for heat, the burner's automatic gas valve opens, allowing gas to flow into a manifold and then into venturi tubes, where it mixes with air. When the air-gas mixture emerges from the burner ports, the pilot ignites it and heat is created. A thermocouple adjacent to the pilot closes the gas valve when the pilot is not in use or is not working. Some newer units have electronic ignitions that light the flame with a spark rather than a pilot light.

Always turn off the gas and the electricity to the unit before making any repair. If in doubt about the proper procedures to take, call your gas company. Depending upon your locale, a service person may come out for free.

LIGHTING A GAS PILOT Use the manual control knob on the automatic gas valve to turn off the gas to the main burner and pilot. Allow at least five minutes for gas to dissipate. Allow ten minutes for LP gas, which does not dissipate readily.

Set the thermostat well below room temperature. Turn the manual control knob to PILOT and light the pilot, holding the knob there for a minute. Release the knob and turn it to ON. If the pilot does not stay on, replace the thermocouple (opposite page, bottom), adjust the pilot (text on this page, next col.),

SPARK IGNITION

The unit shown below has an electronic spark igniter instead of a pilot light. It lights the burners with a spark, saving you the cost of keeping the pilot light going.



or call the gas company. Remember to reset the thermostat once the pilot is relit.

ADJUSTING AND CLEANING THE PILOT ORIFICE

The pilot flame should be blue and should cover the thermocouple. To adjust the pilot, turn down the thermostat. Turn the pilot adjustment screw (often under a cover screw) clockwise to reduce the flame, counterclockwise to increase it. Reset the thermostat.

If you have trouble lighting the pilot, the orifice may be plugged. To clean it, first shut off the gas supply. Disconnect the thermocouple tube and the pilot gas line from the valve, and remove the

AMERISPEC® TIP KEEP A THERMOCOUPLE HANDY

Replacing a thermocouple is one of the most common household repairs. If you have a burner (or a water heater or dryer) that lights with a pilot, purchase extra thermocouples of the right length and keep them within easy reach so you can replace them quickly.

bracket holding the pilot and the thermocouple.

Blow out the orifice using a flexible vinyl tube. Reattach the bracket, pilot gas line, and thermocouple tube. Turn on the gas and relight the pilot.

CLEANING THE BURNERS Clogged gas burners and ports heat inefficiently. Clean them at the start of the heating season. To reach the ports, shut off the gas valve and remove the bracket holding the thermocouple and pilot. Remove any screws holding the burners in place, then maneuver them out of the combustion chamber.

Scour the burners with a stiff wire brush, and poke a wire into the openings. Reassemble the burners in the combustion chamber. Then mount the bracket holding the pilot and thermocouple. Turn on the gas and relight the pilot.

ADJUSTING THE BURNERS For maximum efficiency, burners fueled with

TROUBLESHOOTING A GAS BURNER

BURNER DOESN'T OPERATE Check that electrical power is present (see page 9). See that the gas valve is turned to ON and that the pilot is on (if there is one) and relight it if needed. Check the thermostat (see page 161).

PILOT WON'T STAY LIT Make sure there is no draft that is blowing out the pilot. Clean the orifice or replace the thermocouple.

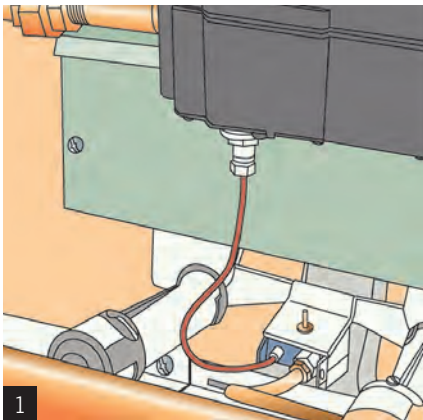
INSUFFICIENT HEAT Check the burner flame and adjust it as necessary. If flames are erratic, clean the burners and ports.

BURNER WON'T TURN OFF Immediately close the inlet valve, leaving electric power on, and call the utility company.

GAS ODOR Immediately get everyone out of the house, close the main gas supply to the house, and call the utility company from a neighbor's home or a cell phone.

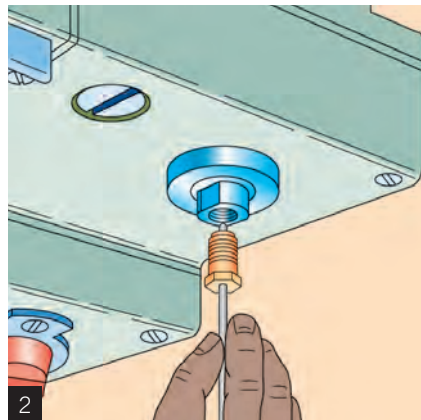
natural gas should burn with a bright blue flame that has a soft blue-green interior and no yellow tip. To correct the air–natural gas ratio, you will need to adjust the air shutters. Turn up the thermostat so the burners light, and then loosen the lock screws. Slowly open each shutter until the flames

are bright blue. Then close the shutters gradually until yellow tips appear. Make sure the flame covers the tip of the thermocouple. Slowly reopen the shutters until the yellow tips just disappear, and then tighten the screws.

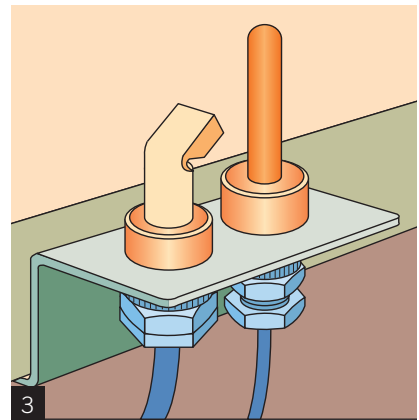


Replacing a thermocouple

1 Turn the manual control knob to OFF. Remove the cover and find out where the thermocouple is and where it travels. If it is difficult to get at the rear connection, it may be simpler to remove the burner unit before replacing the thermocouple.

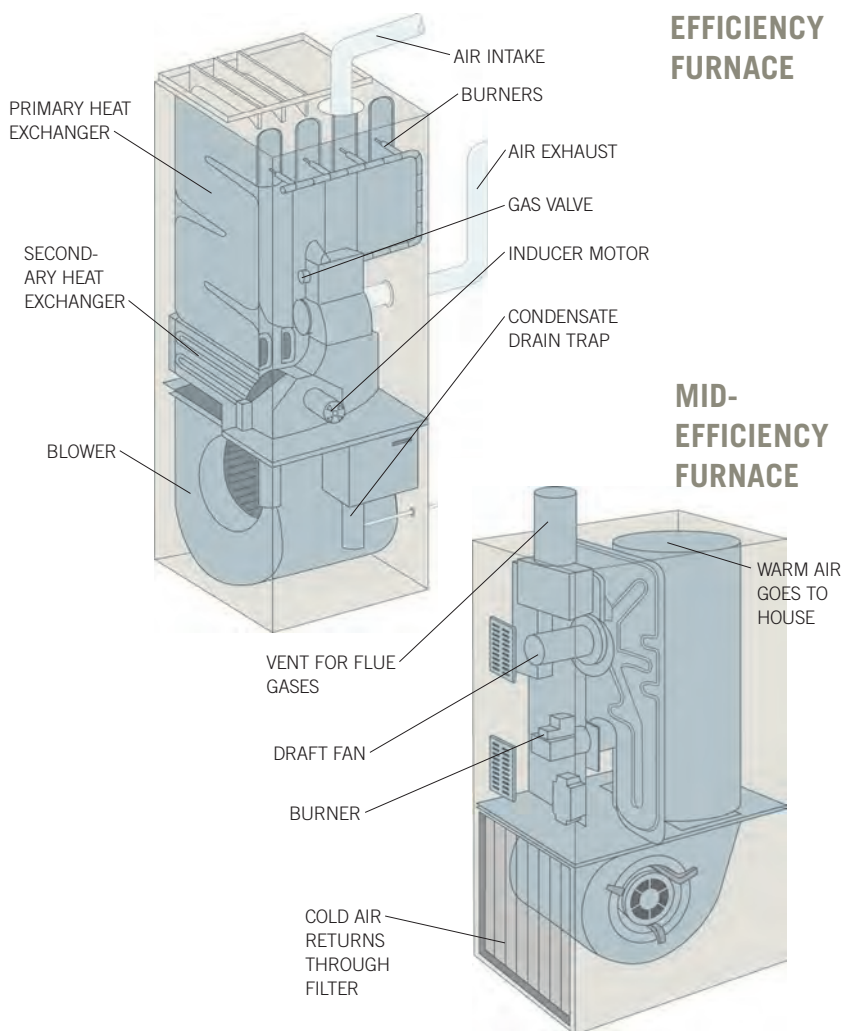


2 Unscrew the nut that secures the thermocouple tube to the automatic gas valve. Pull it out.



3 Unscrew the nut holding the thermocouple to the bracket next to the pilot. Screw in a new thermocouple at both ends. Make sure the thermocouple's tip is positioned so that the pilot flame will touch it. Relight the pilot.

modern furnaces and boilers



A central furnace or boiler's efficiency is measured by annual fuel utilization efficiency (AFUE). All new furnaces and boilers must display their AFUE. An older furnace or boiler with an AFUE of 60 percent efficiency means that 40 percent of the heat produced by the appliance escapes up the chimney and is otherwise lost.

Newer "mid-efficiency" furnaces and boilers typically have AFUEs of 80-83 percent and are equipped with electronic ignitions rather than pilot lights, so they don't

waste gas by burning when not needed. They also have high-quality burners, insulated walls, and an efficient heat exchange system that keeps heat from dissipating into the utility room. In an older unit, natural convection draws fumes—and plenty of hot air—outside; because a mid-efficiency unit has greater heat exchange, it uses an exhaust fan to blow barely warm air outside. The result is energy savings of 20 percent or more over conventional gas furnaces and boilers.

"High-efficiency" furnaces and boilers with AFUEs of 90 percent

to 97 percent, also called "modulating-condensing" units, achieve even greater efficiency. The process of extracting nearly all of the heat before it is exhausted results in water vapor due to condensation. So high-efficiency units must use many stainless-steel parts to avoid corrosion, which makes them expensive. Instead of a wide flue, a small PVC pipe exhausts to the outside, often through a sidewall instead of into a masonry or stainless steel chimney.

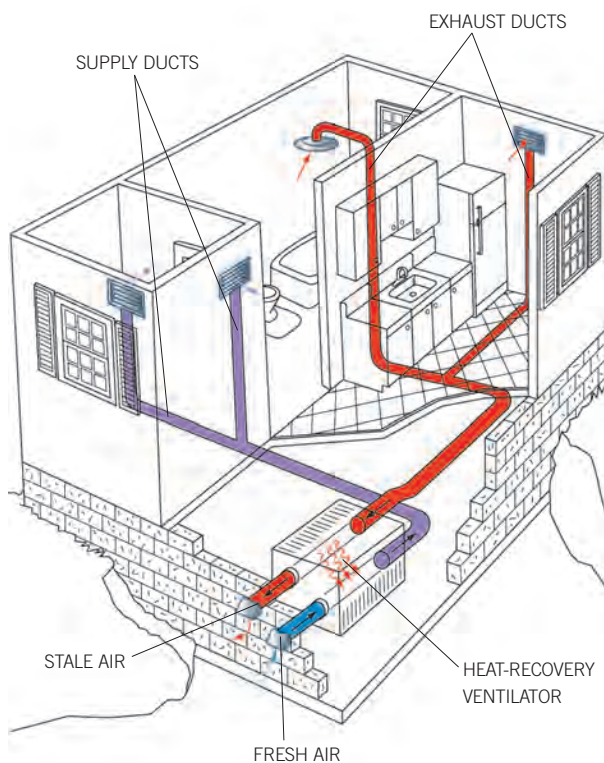
REGULAR MAINTENANCE AND INSPECTION

A furnace's filter should be changed or cleaned monthly. Some systems have aluminum air intakes connected to a nearby chimney. See that the intakes are free of debris, so fresh air can flow freely through them.

There is often a drain line for removal of condensed water that collects in the heat exchanger. Clean it yearly by running water through it. Check the vent pipes for signs of corrosion or leaks.

HEAT-RECOVERY VENTILATORS Newer homes tend to be tightly sealed and well insulated, which saves on heating costs. But the lack of airflow can lead to stagnant air, humidity, and perhaps even mold. For this reason, many newer homes in cold climates have heat recovery ventilators (HRVs, shown on opposite page), which provide ventilation without losing much heat or allowing significant cold to enter the house.

Basically, an HRV uses one fan to bring in outside air and another to blow out stagnant air. Air moving in each direction passes through a core unit, where the exhaust warms the cool incoming air. In summer, the system can work in reverse, so the air can stay fresh

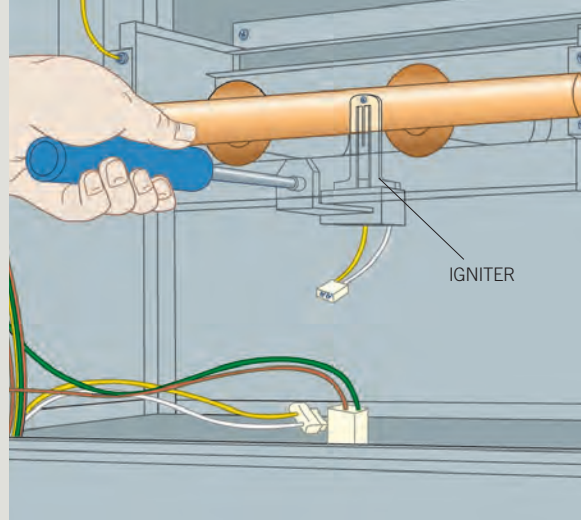


HEAT-RECOVERY VENTILATOR

while the air conditioner is running with the windows closed. You can install a large HRV to ventilate the entire house or use a smaller version to air out a room or two.

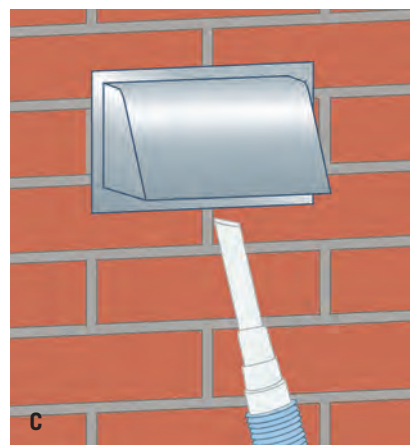
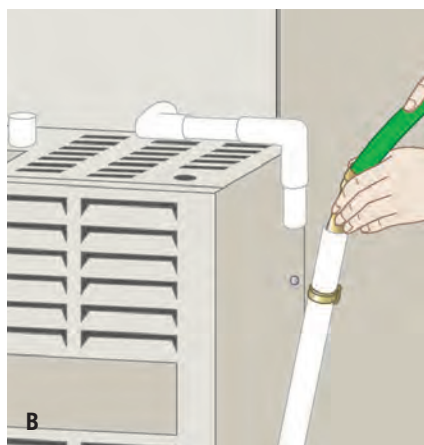
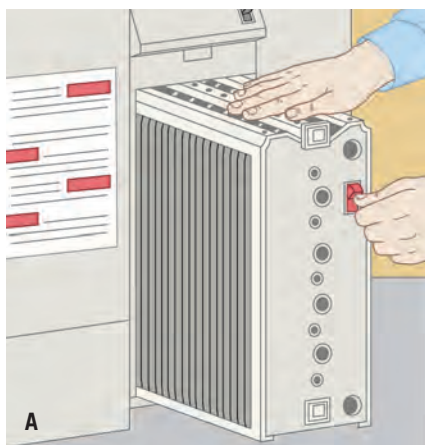
A similar device, called an energy recovery ventilator (ERV), goes one step further in saving energy by also transferring the humidity level of the exhaust air to the

intake air. This is desirable in the winter when you want to maintain a higher humidity level inside the house and in the summer when you want the interior to be less humid.



REPLACING AN IGNITER

If the furnace or boiler won't fire, have someone turn up the thermostat while you watch the igniter (there should be a little hole for observing). If the igniter does not glow, it likely needs to be replaced. Note: Never touch the igniter's heating element, as the oil in your fingers can shorten its life. Shut off power at the service panel, unplug the wires leading to the igniter, and remove it. Take it to a heating supply store and have it tested. If it tests faulty, replace it with an identical igniter. Reattach the wires, then screw the igniter in.



Three maintenance procedures

CLEAN THE FILTERS Once a month, pull out the unit that holds the electronic filters (A) and follow the manufacturer's directions for cleaning them.

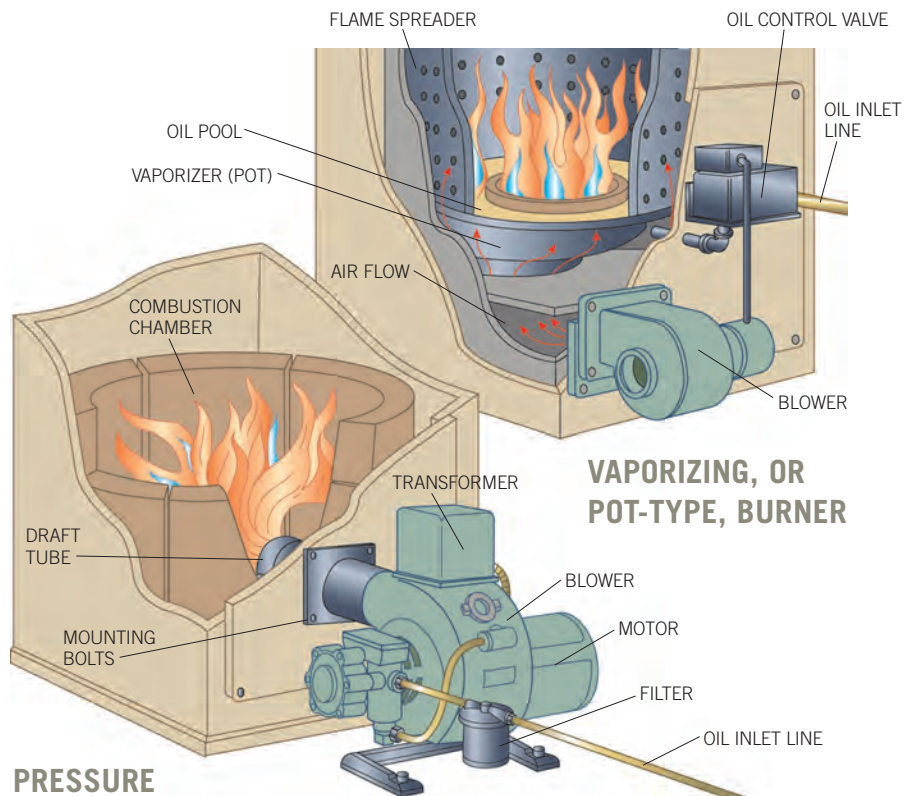
CLEAR THE DRAIN LINE Loosen a clamp or a nut to disconnect the drain line. Run water from a garden hose through the line until you see the water running freely (B). Reattach the line.

CLEAR A BLOCKED AIR INTAKE Clean away dust, spider webs, or other material that might obstruct the free flow of air through the intake (C).

oil burner

The high-pressure, or gun type, is the most common oil burner. For greatest efficiency, call in a professional every year to service your burner. To keep repair and fuel bills low, inspect and clean the burner several times between service calls.

When the thermostat demands heat, the burner motor turns on, pumping filtered fuel oil under pressure through a nozzle and forming a mist. The burner's blower forces air through the draft tube, where it mixes with the oil mist. As the mixture enters the combustion chamber, it is ignited by a high-voltage spark between two electrodes at the end of the draft tube. If the oil fails to ignite, then the burner is turned off by a flame sensor in the burner or by a heat sensor on the stack control attached to the flue.



PRESSURE (GUN-TYPE) BURNER

Turn off the power to the burner before you begin cleaning it. Clean the sensors with soapy water as shown on the opposite

page. Lubricate the motor and blower bearings by pouring oil into the oil cups, if the motor and blower are equipped with them. Clean the blower and oil strainer with mineral spirits or kerosene and, when necessary, replace the filter and gasket.

AMERISPEC® TIP KEEP IT CLEAN

Servicing an oil burner is often messy. Before you start, spread lots of newspapers on the floor to absorb drips, and use a small bucket to catch larger spills.

TROUBLESHOOTING AN OIL BURNER

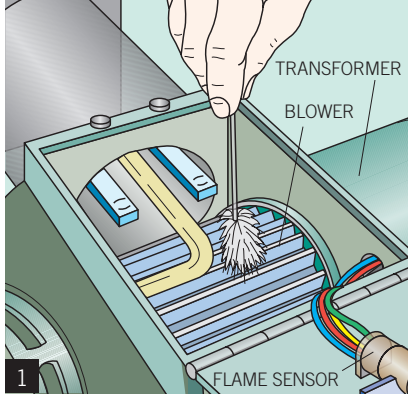
BURNER DOESN'T OPERATE Check the master switch and the service panel for power. Check the thermostat (page 161). If the stack control motor relay or furnace limit control is tripped, reset it twice; call for service if that does not solve the problem. If the motor or motor relay is defective, call in a professional.

MOTOR SPINS BUT BURNER DOESN'T LIGHT This usually causes the system to automatically shut down. Check the tank level. Shut off the power and tighten any loose electrode wiring connections. If you see cracked electrode insulators or dirty electrodes, call in a professional. Clean or replace a dirty filter or strainer (see opposite page). If a nozzle is clogged, call a professional.

BURNER RUNS INTERMITTENTLY Clean or replace a dirty filter or strainer. If you often need to bleed and prime the pump, indicating air leaks, tighten connections and valve packings in the oil inlet line. Tighten the filter and strainer covers. If the dipstick indicates there is water in the oil, or if the flame is poor, call in a professional.

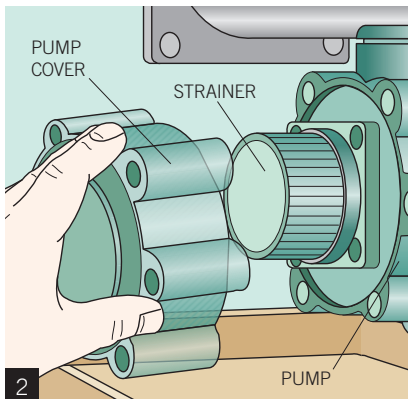
SMOKY FLAME Call a professional to adjust the air-to-oil ratio.

NOISY BURNER If there is air in the oil inlet, tighten all connections and valve packings in the inlet line. Tighten the filter and pump covers. If mounting nuts are loose, tighten them. Otherwise, call in a professional to realign the motor and pump or to replace the pump.

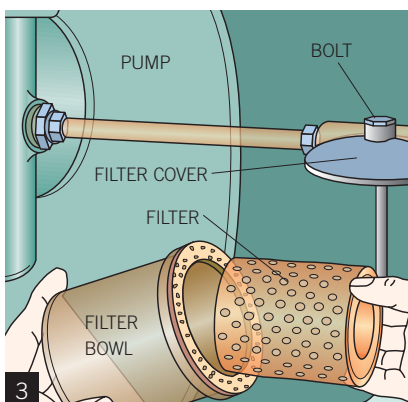


Cleaning the blower, strainer, and filter

1 Turn off the power to the heating system. Remove the cover (the transformer may be attached). Clean the blower blades with a small brush.



2 To reach the strainer, unscrew the pump cover. Remove the strainer and clean it with mineral spirits or kerosene.



3 Shut off the valve between the filter and the tank. Then unscrew the bowl from the cover and change the filter and gasket.

HEAT PUMP

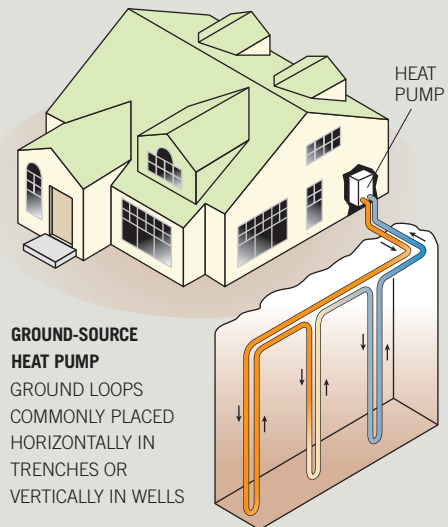
A heat pump is a device that transfers thermal energy (heat) from one location to another but does not burn fuel directly. In warm weather, a pump draws heat from the air inside the house, and transfers it to the outside. During cool weather, the flow is reversed and heat extracted from the outside heats the inside air.

There are several types of heat pumps for residential use. The simplest, called an air-source heat pump, works

like a central air conditioning system. The typical maintenance is similar, too. Keep the outdoor portion of the heat pump free of snow and debris. Occasionally check the blower and filter in the air-handling unit indoors and replace the filter monthly during periods of heavy use.

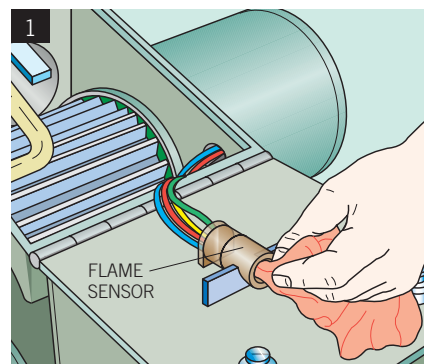
Although air-source heat pumps can be used in nearly all parts of the United States, they do not generally perform well over extended periods of sub-freezing temperatures. In regions with sub-freezing winter temperatures, it may not be cost-effective to meet all your heating needs with a standard air-source heat pump. Once the temperature dips into the 30s or 40s, standard air-source heat pumps draw on electrical resistance heaters to supplement what can be extracted from the air. That can be expensive.

A ground-source heat pump uses the constant temperature of the earth (about 52 degrees F.) as its heat source. To extract this heat, a ground-source system uses a network of liquid-filled tubes that absorb heat and transfer it indoors. Tubing can be placed vertically in a well, laid horizontally in a trench, or even submerged at the bottom of a pond. Ground-source heat pumps are expensive to install.

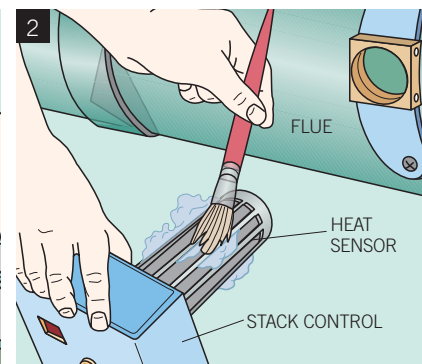


Cleaning the sensors

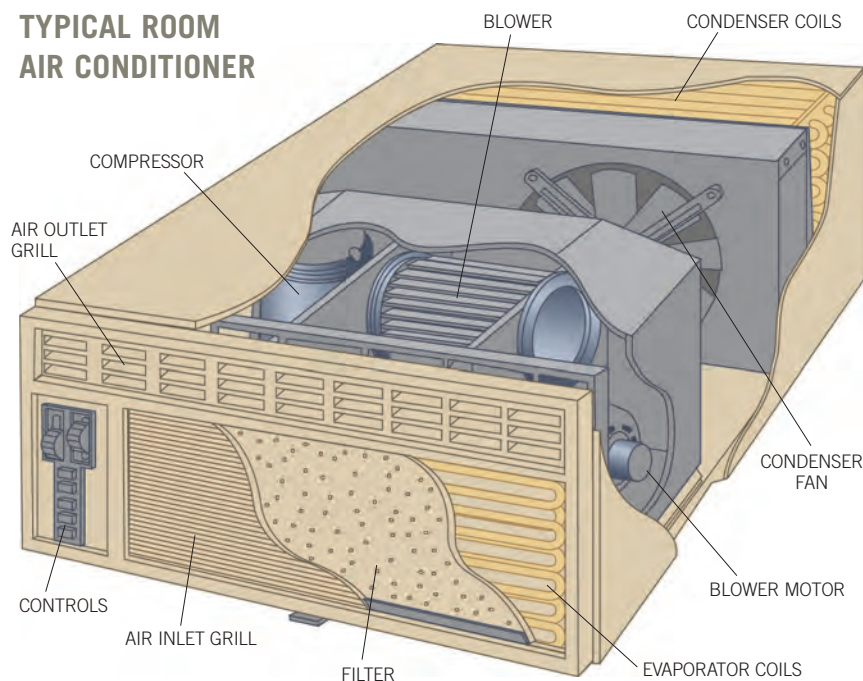
1 Lift the blower cover and clean the flame sensor with a soft cloth. If your flame sensor is at the end of the draft tube, leave this task to a professional.



2 Remove the stack control from the flue. Clean the heat sensor with hot, soapy water and a brush. Dry and replace the control.



TYPICAL ROOM AIR CONDITIONER



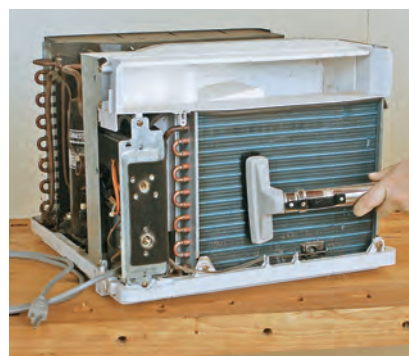
an inlet grille on the front of the unit. Cool, dehumidified air returns to the room through outlet grills. Water condensing on the evaporator coils drains outside, and a fan blows outside air around the condenser coils to dissipate heat.

During the cooling season, clean the filter and condenser coils every month and replace the filter as necessary. Regular cleaning will improve the unit's efficiency and prolong its life. You can reach the filter through a slot on either the side or top or by removing the grill. To reach the condenser, remove the back of the outside housing. Any problems with the refrigeration system are best left to a professional.

Use a screwdriver to remove the front of the unit and lift off the cover. If the filter is washable, clean it in sudsy water, rinse it, and allow it to dry. Use an upholstery or floor brush attachment to vacuum off the refrigerant-filled coils. Use the vacuum's crevice tool to clean out all areas that you can reach. Then reassemble the unit.

CENTRAL AIR CONDITIONER

Central air conditioning is generally more efficient, quieter, and less costly in the long run than individual room units.



air conditioning

All refrigerated-air conditioners, both room units and central systems, operate on the same principle. They extract heat and moisture from the room air, cool and dehumidify it, then return the air to the room. Refrigerant, the same substance that's used in a refrigerator, circulates through the system. A heat pump works on the same principle, except it reverses itself during cool weather.

HOW REFRIGERATED SYSTEMS WORK Inside a refrigerated air conditioner are a compressor, evaporator or cooling coils, a condenser, and connecting tubing. All are filled with refrigerant. Liquid refrigerant forced through a nozzle expands and par-

tially vaporizes into a gas. The gas then flows through the evaporator coils, cooling the coils so they extract heat and moisture from the room air.

The warm gas then flows into the compressor, where it is heated by compression. From the compressor, the hot gas enters the condenser. There, the hot condenser coils dissipate heat to the outside and the gas condenses into a liquid, ready to repeat the cycle.

ROOM AIR CONDITIONERS

A room air conditioner is mounted in a window or wall, and most of the unit projects outside the house. A blower sucks warm room air through a filter protected by

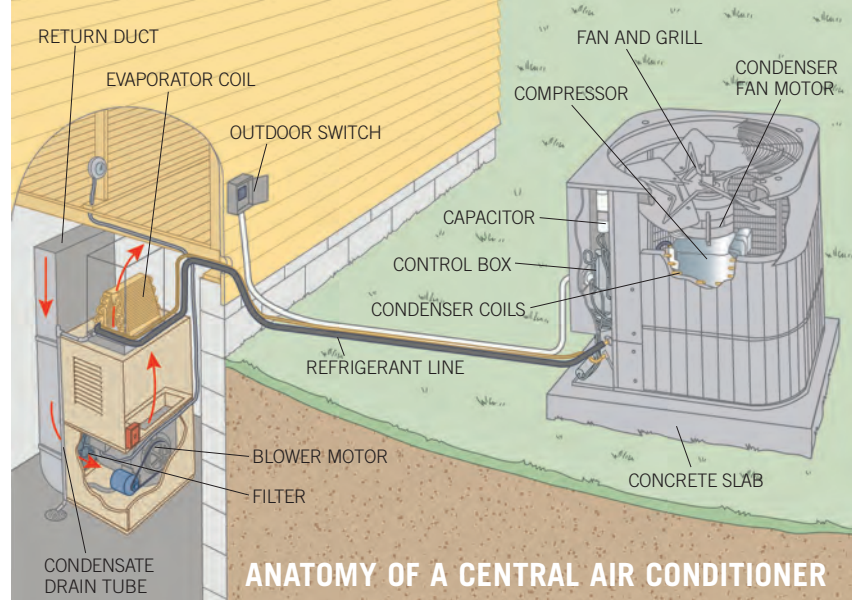
AMERISPEC® TIP CAREFUL WITH THE FINS

The fins that are exposed when you remove an air conditioner's cover are quite fragile. A gentle push with your thumb will compress them and make them less effective. Keep children away from exposed fins, and use only soft vacuum attachments to clean them. If you have bent fins, use a fin comb to straighten them.

In a house without forced-air heat, a central air conditioner can be a single unit installed next to the house, or a two-part unit, known as a minisplit, (see Heat pumps sidebar, p. 167) with the condenser and compressor outdoors and the evaporator and blower inside.

For a house heated with forced air, the most economical air conditioning installation is a split system. The evaporator is mounted in the plenum of the furnace, and the condenser and compressor are located outside the house.

To ensure efficient operation, clean the filter every month during the cooling season and replace it as necessary. Keep the area around the exterior condensing unit clear of leaves, bushes, and other obstructions. Vacuum and wipe the fan blades to keep them clean. Remove the coil guard, then clean the fins by spraying them with a garden hose from both the inside and the outside. Check that the condensate drain is clear and that



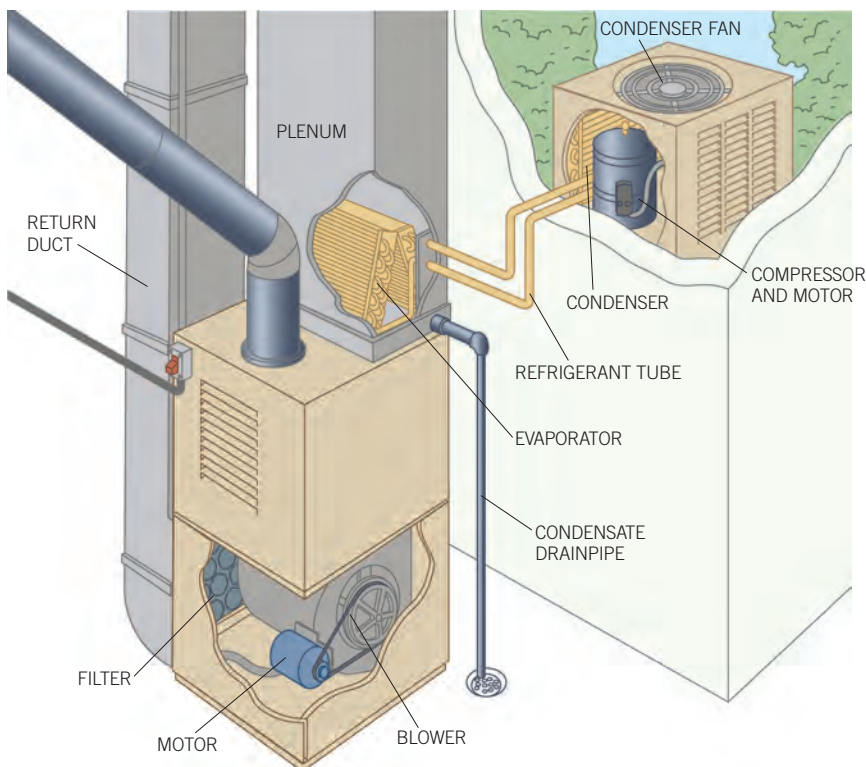
AMERISPEC® TIP A/C REFRIGERANTS

All air conditioners use a refrigerant, commonly referred to as Freon. In 1992, the production of the most common refrigerant, known as R-22, was phased out due to its contribution to ozone depletion. A less harmful refrigerant, R-410A, took its place.

If you purchase a new air conditioning system, it will use R-410A. If you have an R-22 system, it cannot use R-410A. However, licensed air conditioning technicians can still service and replenish the refrigerants in R-22 systems.

the condenser and evaporator coils are clean. When you vacuum the coils, be careful not to damage the fins. Lubricate the motor as recommended by the manufacturer.

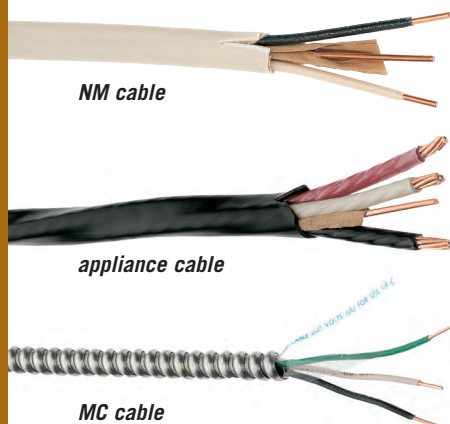
SPLIT-TYPE CENTRAL AIR CONDITIONER



13 SEER STANDARDS

SEER (Seasonal Energy Efficiency Ratio) is a measurement of efficiency for appliances. As of 2006, all new air conditioning and heat pump units in the United States must meet a tough 13 SEER standard, which is about 30 percent more efficient than the previous SEER 10. Most homeowners won't be affected by this standard change for years to come. The standards do not require you to change your existing central air conditioning units, and replacement parts and services should still be available for your home's systems. However, today's best air conditioners use 30 percent to 50 percent less energy to produce the same amount of cooling as air conditioners made in the mid 1970s. Even if your air conditioner is only 10 years old, you may save 20 percent to 40 percent of your cooling energy costs by replacing it with a newer, more efficient model.

wiring



WORK SAFELY

Working on household wiring, appliances, and lights can be dangerous. Always assume any wiring you encounter is energized until a circuit tester proves otherwise (see p. 172). Wear rubber-soled shoes or boots to minimize the risk of shock, and use safety glasses. Never work on wiring when standing in a damp or wet location. When in doubt, call a licensed electrician for help. Know and follow (or exceed) electrical code requirements for the work you're doing, and check with your local building office to see if a permit is required.

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<i>Working With Wires</i>	176
<i>Cords and Plugs</i>	178
<i>Replacing Switches</i>	180
<i>Receptacles</i>	182
<i>Doorbell Repairs</i>	184
<i>Replacing a Light Fixture</i>	186
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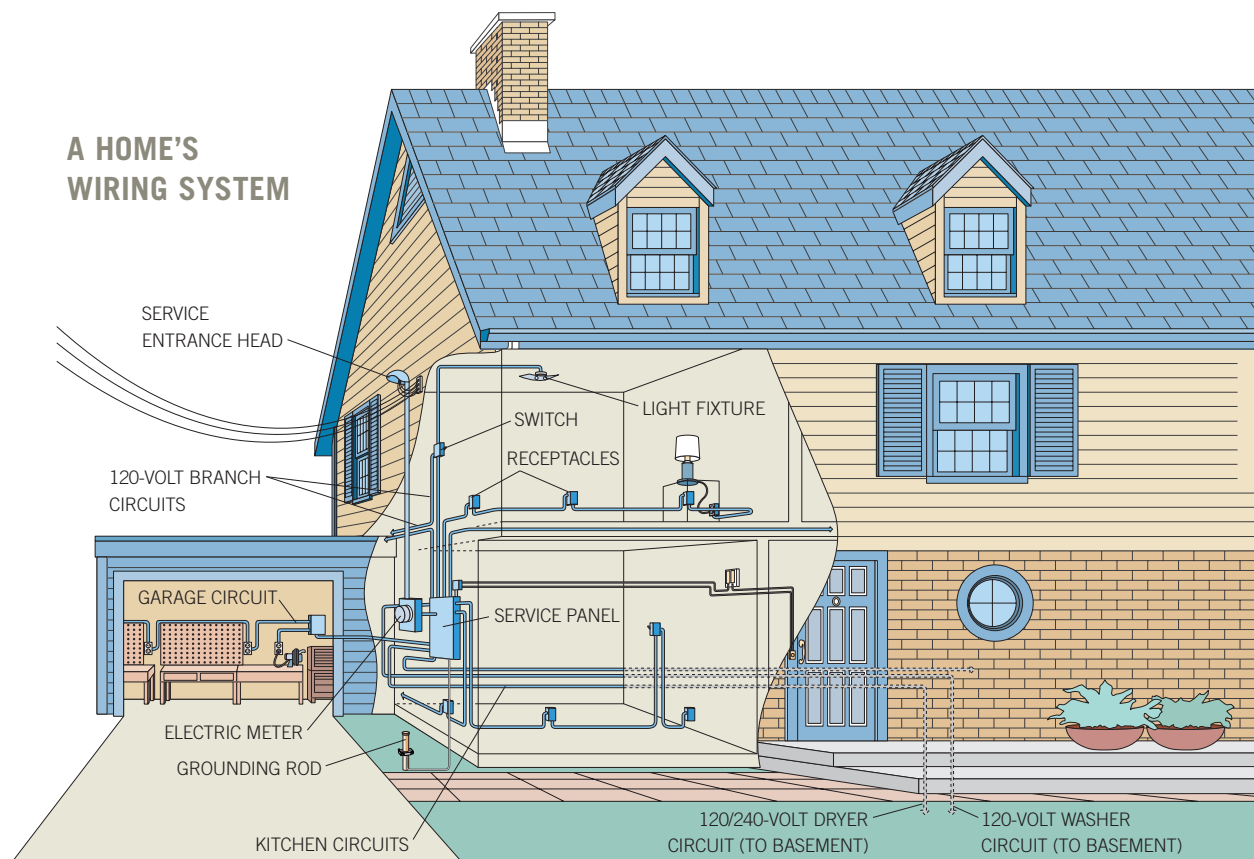
Your electrical system need not be a mystery. Even if you do not plan to work on it yourself, take the time to understand your home's wiring so you can speak knowledgeably with a repair person.

ELECTRICAL DISTRIBUTION As shown on the opposite page, electricity passes through a meter before it enters the service panel. Owned, installed, and serviced by the utility company, the meter measures the electrical energy consumed in kilowatt-hours. The service panel usually houses the main disconnect (the main fuses or main circuit breaker), which shuts off power to the entire electrical system, and the circuit breakers or fuses, which protect the individual circuits in the home.

Electricity travels in a circuit, moving from the service panel to the electrical user (such as a light, appliance, or receptacle) and back to the panel. Inside the panel, electricity is routed by cables to various branch circuits that carry power to different parts of the house. Each cable contains a number of wires, also called conductors. One (for 120 volts) or two (for 240 volts) hot wires carry current from the service panel to the points of use. Another wire, commonly called the “neutral,” carries current back to the source. If the wiring was installed according to code, you can tell which wire is which by the color of the insulation. Hot wires are typically black or red. The neutral wire is white or gray.

In most homes built since the mid-1960s, there is also an equipment grounding conductor (bare copper or coated with green insulation), which provides for grounding, an important safety feature (see pages 173–174).

THE SERVICE ENTRANCE Today, most homes have what is called three-wire service. The utility company connects three wires—two hot and one neutral—through a meter to your service panel. Each hot wire carries 120 volts, so two hot wires provide both 120-volt and 240-volt capabilities. One hot wire and the neutral wire combine to supply 120 volts, which is used for most household applications, such as lights and small appliances. Both hot wires and the neutral wire form a 120/240-volt circuit used for larger appliances.



The system is rated for the maximum amount of current it can carry, measured in amperes. The service rating is usually stamped on the main fuses or circuit breaker and is determined by the size of the service entrance equipment. Today, the minimum service rating of new homes is 100 amps. Many newer homes today have 200- or even 400-amp services. If you have an older home that has not been updated, consult an electrician to see if you need to replace the service panel with one of higher capacity.

WIRES AND CABLES

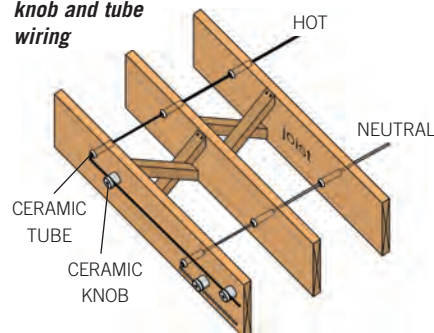
You can usually get a good look at your cables and wires at your service panel. There are regional differences, but most homes built after 1945 are wired with nonmetallic (NM) cable, which has two or three insulated wires plus a bare ground wire encased in sheathing.

In locations where wiring might be exposed to damage, a cable with spiral metal armor can be used or wires can be run in metal or plastic conduit.

An older home may have BX cable, which has a flexible metal armor or sheathing but no ground wire. The sheathing provides the grounding path.

The maximum amount of current a circuit can safely carry depends on the gauge of the wire: 14-gauge wire is rated for up to 15 amps; 12-gauge wire can handle 20 amps. Appliances that draw larger amounts of current need larger-diameter wire.

knob and tube wiring



KNOB-AND-TUBE WIRING

Many older homes still have knob-and-tube wiring, which gets its name from the porcelain knobs that support electrical conductors and the porcelain tubes, which carry conductors through joists and studs. This type of wiring is no longer installed. Although they lack a grounding conductor, these systems may still be serviceable and are not necessarily unsafe. If you have knob-and-tube wiring in your house, it would be a good idea to have a licensed electrician inspect it to make sure that splices are intact and the wire insulation is in good condition. Don't attempt to extend the system or tap into it yourself. Hire an electrician to do the work. The National Electrical Code does not permit knob-and-tube wiring to be buried in insulation, although some states allow it. If you're planning an energy upgrade that includes new insulation, check with the local building department.

shutting off power and working safely

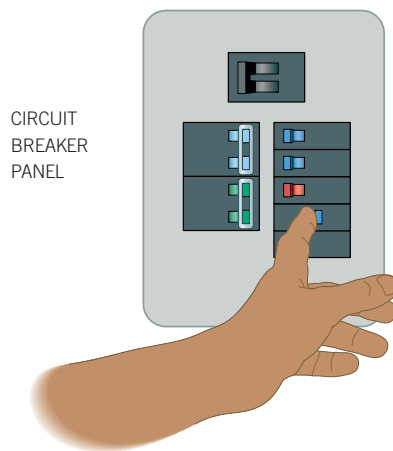
Unless it is handled properly, electricity can cause dangerous, or even deadly, shocks and fires. But with a few precautions, you can work safely on your wiring. Before doing so, be sure to shut off the power; test to make sure power is not present; and make sure nobody will inadvertently turn the power back on while you are working.

Fuses and circuit breakers guard electrical systems from damage caused by too much current. Whenever wiring is forced to carry more current than it can handle safely (usually because of too many appliances on one circuit or a problem within the system), a circuit breaker will trip or a fuse will blow, immediately shutting off power.

SHUTTING OFF OR RESTORING POWER For instructions on shutting off power to the entire house, see page 9. When replacing or testing an individual electrical device, you will probably want to shut off only one circuit. Ideally, a service panel will have an index on its door telling you which breaker or fuse goes with which receptacles, appliances, or light circuits. Otherwise, you will need to experiment to find out which breaker or fuse goes

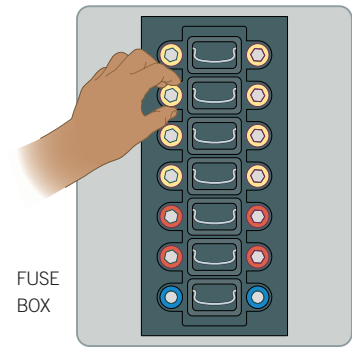
with which circuit. (Or purchase a two-part circuit finder: Plug one part into the receptacle, and it will transmit a signal that the other part can read at the service panel.) Turn off the circuits one by one and have a helper communicate when a device or appliance has shut off.

If your service panel has circuit breakers, learn how to shut them off and turn them back on. With



some breakers, you flip a lever to the left or right; with others, you push a button. If a breaker has tripped because of a circuit overload, its handle or lever will be in a position between “off” and “on,” or the button will have popped out.

If you have a fuse box, you will need to remove a large fuse block



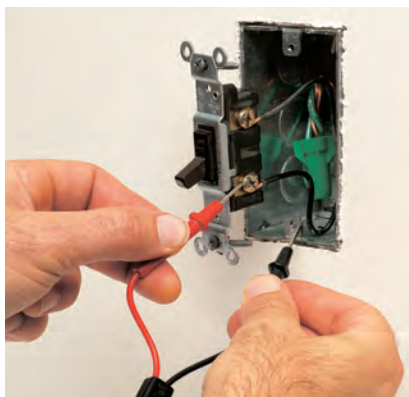
to shut off power to the house and unscrew a fuse to shut off a single circuit. A fuse has a glass window so you can see a strip of metal that melts if there's an overload or short circuit. Remember that even with the main fuse block pulled, or the main switch turned off, there is still power inside the box. Don't open it.

TESTING FOR POWER Purchase a simple voltage tester, as shown opposite page. You can test for power in several ways. With the prongs, touch the hot wire (typically black) with one probe and touch the white neutral with the other; touch the hot wire and the ground wire (bare or green); then touch the hot wire and the box if the box is metal (as shown above). Test all the combinations of wires. Color code conventions may not have been followed. If the neon light tester shows no voltage, it's important to use a non-contact voltage tester, also called a volt pen, as a final check. Remember to touch only the insulated portion of the probes and not the metal probes or other metal.

AMERISPEC® TIP AFCI PROTECTION

If a lamp or appliance cord has damaged insulation, electricity can spark (travel in an arc) from one wire to another, creating the possibility of fire or shock. An Arc-Fault Circuit Interrupter (AFCI) circuit breaker detects certain kinds of arcing and shuts off the circuit. It is now required that AFCIs be installed in circuits that supply most of the house (all 120-volt branch circuits except the kitchen counter and bathroom receptacles). Ask an electrician about installing this extra measure of protection in your service panel.





TRACING A SHORT CIRCUIT

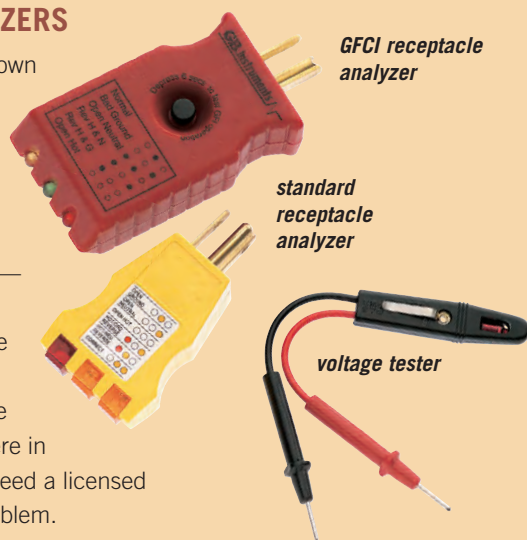
When a fuse blows or a circuit breaker trips, the cause is often easy to spot. Look for black smudge marks on switch or receptacle cover plates or for frayed or damaged cords or damaged plugs on lamps and appliances connected to the dead circuit. Replace a damaged cord or plug (see pages 178–179) and then replace the fuse or reset the breaker. If the circuit goes dead after an appliance has been in use for a short time, you probably have an overloaded circuit. Move some of the lamps and appliances to another circuit and replace the fuse or reset the circuit breaker for the first circuit.

If you find none of these signs of trouble, trace the circuit following the steps below. If these steps do not solve the problem, your wiring is faulty. In this case, call in an electrician to correct the problem.

- Turn off all wall switches and unplug every lamp and appliance on the dead circuit. Reset the tripped breaker or install a new fuse.
- If the circuit dies immediately after you turn it on, the problem may be a short circuit in a switch or receptacle. With the circuit dead, remove each cover plate and inspect the receptacle or switch and the wiring. Look and smell for charred wire insulation, a wire shorted against a metal box, or any

RECEPTACLE ANALYZERS

Every homeowner should own and learn how to use a receptacle analyzer. If the analyzer indicates that a receptacle has reversed polarity, chances are the wires need to be switched—the hot wire should be on the brass terminal, and the neutral wire on the silver terminal. If that's not it, the problem could be elsewhere in the circuit, and you may need a licensed electrician to trace the problem.



signs of damage. If no problems are obvious, call a licensed electrician.

- If the breaker does not trip or the new fuse does not blow right away, turn on each wall switch, one by one, checking each time to see if the circuit breaker has tripped or the fuse has blown.
- If turning on a wall switch causes the breaker to trip or a fuse to blow, there is a short circuit in the device controlled by that switch, or there is a short circuit in the switch wiring. With the circuit off, inspect the fixture, receptacle, and switch for charred insulation or faulty connections, and replace parts as needed.
- If turning on a wall switch does not trip the breaker or blow a fuse, the trouble is in the lamps or appliances controlled by the switch or in the wiring between the switch and the device. Test them by plugging them in one at a time. If the circuit does not go dead, it likely was overloaded. Move some of the devices to another circuit. If the circuit goes dead immediately after you plug it in or turn on a device, the problem could be in the plug, the cord, or the device itself.

WARNING If a fuse blows often, resist the temptation to replace it with a fuse of higher amperage. Doing so could cause your wires to overheat—a dangerous situation. Call a professional.

GROUNDING

Current codes require that all circuits have an equipment grounding wire. Grounding ensures that all of the metal parts of a fixture, tool, or appliance that you might come into contact with are connected directly to the system grounding reference point. If there's a malfunction or damage, the grounding wire will keep the touchable metal parts at zero voltage. During normal operation, a grounding system does nothing. In the event of a malfunction, however, grounding protects you and your home from electric shock or fire.

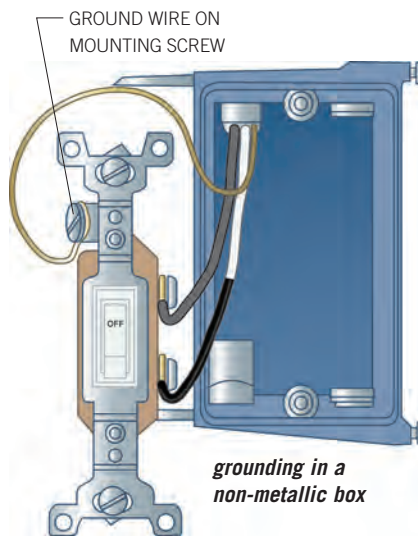
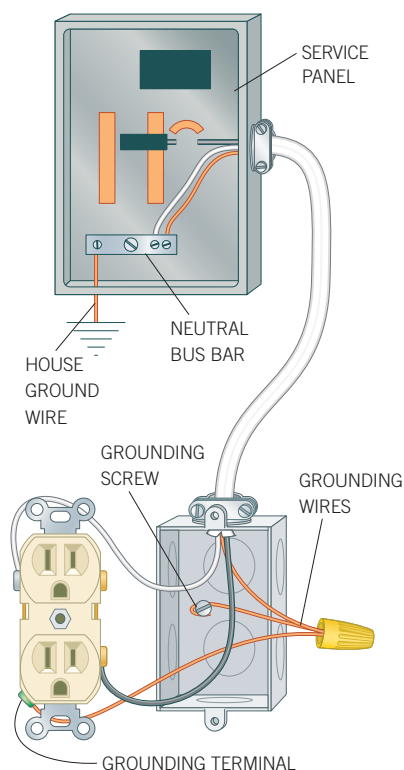
However branch circuits are grounded, the grounding path leads to the grounding/neutral bus bar in the service panel and from there to the grounding electrode system. This may be a rod driven into the earth, a metal water line leading underground or, in newer houses,

a piece of rebar in the concrete foundation. If the house has only a metal water pipe ground and a section of pipe is subsequently replaced with plastic pipe (not an uncommon event), a dangerous situation exists because the grounding path will be broken.

If an analyzer shows a number of receptacles are ungrounded but there is a grounding wire present, there could be a break in the grounding wire, or it may not lead back to the panel at all. If there is a metal box and metal conduit or metal armored cable and no grounding wire, the conduit or cable must be solidly connected to the box with the right kind of fitting. If the cause is not apparent, call a licensed electrician.

Inside the electrical box, there are several possible methods for grounding. If you have a metal box and a ground wire, it is usually required that the ground wire be firmly attached to the box

grounding with NM cable



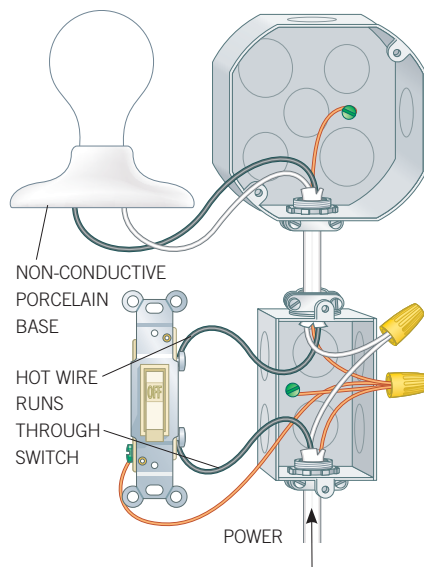
as well as to the service panel's bus bar (see below). If you have metal sheathing or conduit and no ground wire, the metal itself must be firmly attached to the box and to the service panel, and there should be no break in the line.

TWO WAYS TO WIRE SWITCHES

There are two basic ways in which a switch and fixture are wired. With through-switch wiring, the cable carrying power from the service panel runs to the switch box.

Two cables enter the box. The two hot wires connect to the switch, and the neutral wires are spliced together. With switch-loop wiring, power runs to the fixture, then a single cable runs to the switch. Both the black and the

through-switch wiring



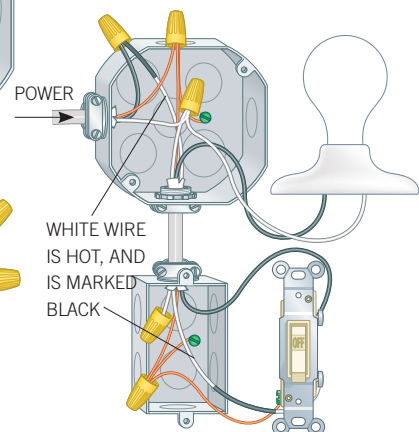
ALUMINUM WIRING

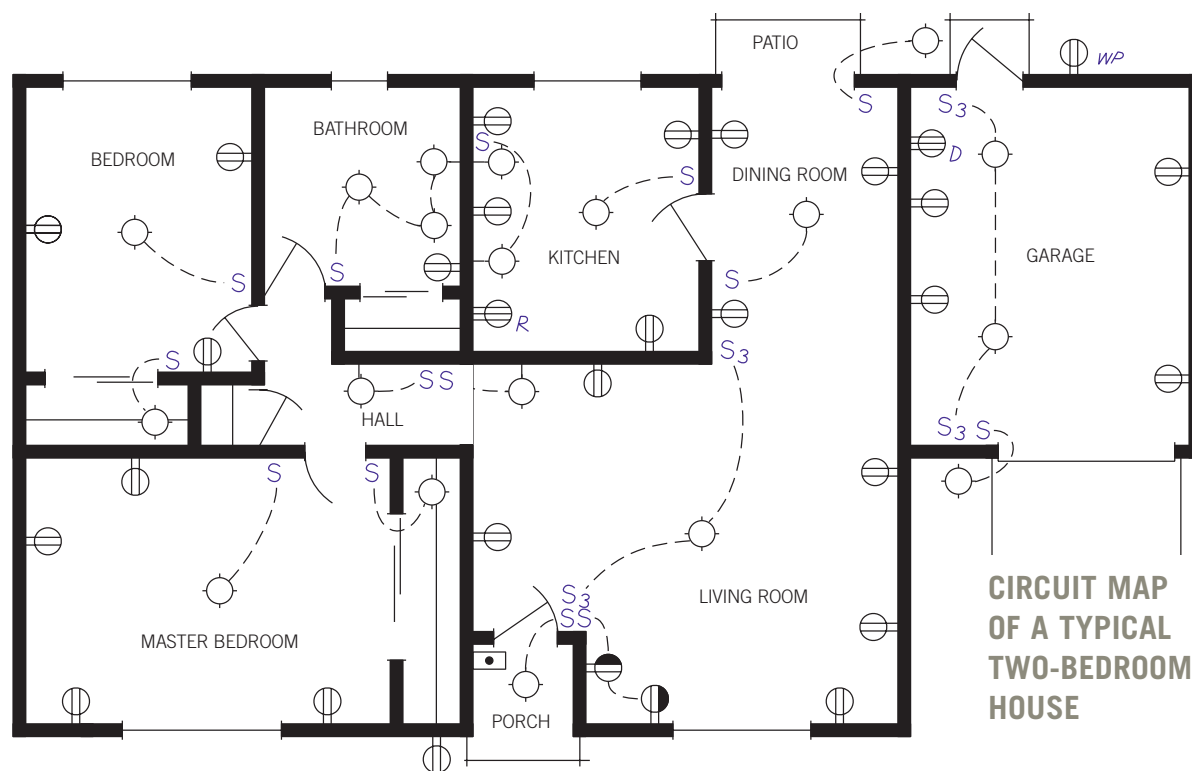
Some houses built in the mid-1960s to late-1970s were wired with aluminum rather than copper. Unfortunately, aluminum wires tend to come loose from terminals, so they were later banned. Aluminum branch circuit wiring typically has plastic insulation. The wire is a dull silver-gray in color. If you have aluminum wiring, you don't have to replace it with copper wires, but have a professional electrician inspect your wiring. Usually, the wiring is safe as long as it is connected to switches and receptacles labeled "CO/ALR."

In some cases, the electrician will use special wire connectors to attach short copper wires (called "pigtailed"), which then attach to the devices or fixtures.

white wires are connected to the switch, and the white must be marked black to indicate that it is hot. In addition, code now requires that a separate neutral (a white wire) be pigtailed with a neutral conductor in the light box and run to the switch location where it is capped with a wire nut. Although the wire isn't actually used in the switch circuit, it's there in case the circuit is extended at a later date from the switch location. Adding the wire ensures that both a neutral and a hot will be available.

switch-loop wiring





INDEXING OR MAPPING YOUR SERVICE PANEL

If your service panel does not have an index (typically on the inside of the panel door) showing which lights or appliances are on which circuit, make one so you can easily shut off or restore power to the correct circuit in an emergency or when you make a repair. First, make rough drawings of each room, indicating the location of each fixture, receptacle, switch, and hard-wired appliance. Assign a number to each circuit breaker or fuse.

Have a helper wander the house and tell you which electrical users are turned off when you turn off each circuit. (Cell phones or walkie-talkies will make this much easier.) Turn on all the lights in the house and turn off one breaker or unscrew one fuse. Note which lights have gone off. Also test receptacles and appliances and note them as well. Repeat this process for all the breakers or fuses, then make a chart indicating which circuits they control. It's also a good idea to verify any existing circuit labeling.

CIRCUIT SYMBOLS (SEE MAP ABOVE)

	LIGHT FIXTURE
	DUPLEX RECEPTACLE
	HALF-SWITCHED RECEPTACLE (ALSO CALLED A SPLIT-WIRED RECEPTACLE)
	SINGLE-POLE SWITCH
	THREE-WAY SWITCH
	120-240v RANGE RECEPTACLE
	120-240v DRYER RECEPTACLE
	SPECIAL RECEPTACLE
	DOORBELL BUTTON
	WEATHER-PROOF RECEPTACLE
	SWITCH WIRING

SAMPLE SERVICE PANEL LABELS

- 1 Range (120–240 volt)
- 2 Dryer (120–240 volt)
- 3 Kitchen & Dining Room Receptacles (20 amp)
- 4 Kitchen & Dining Room Receptacles (20 amp)
- 5 Washer (20 amp)
- 6 Dishwasher (20 amp)
- 7 Bath & Hall Lights (15 amp)
- 8 Bedroom Receptacles & Lights (15 amp)
- 9 Bedroom Receptacles & Lights (15 amp)
- 10 Living Room Receptacles & Lights (15 amp)
- 11 Living Room Receptacles, Porch Light, & Garage Receptacles (15 amp)
- 12 Garage Receptacles & Lights (20 amp)
- 13 Bathroom Receptacles (20 amp)



SERVICE PANEL SAFETY

Keep in mind that even with the main breaker turned off or the main fuse block pulled, there will still be hot wires inside the service panel. That's one reason homeowners should not remove the panel cover. If there is an apparent reason to pull the cover, call a licensed electrician.

working with wires

To wire receptacles, switches, light fixtures, and appliances properly, you need to know some basic techniques, including stripping, securing, and splicing wire. This section shows only how to strip and join wires; running and stripping new cable isn't covered.

STRIPPING When removing a switch, receptacle, or light fixture that you plan to replace, you could loosen the terminal screws and remove the wires. However, doing so will cause you to straighten and then rebend the stripped wire end, which could cause it to break. As long as the wires are long enough, you are better off cutting them just below where they are stripped. Then you can make the connection with a new section of wire.

Buy wire strippers with a series of semi-circular indentations in the front of the tool and a spring that automatically opens the jaws. Other types of strippers are more difficult to use.

CONNECTING Screw terminals are designed for only one wire. For connecting multiple wires, join them to a short piece of wire called a pigtail with a wire nut and connect only the pigtail to the terminal. Some receptacles allow back wiring. Wires are pushed into a spring-loaded hole in the back of the receptacle. This saves time but in inexpensive receptacles, this spring tension connection is not as reliable as a screw terminal. Better quality receptacles have screw-clamp connections where the wires go in the back of the receptacle. These are very reliable.

SPLICING Most often, wires are joined, or spliced, with wire nuts

or compression sleeves. Wire nuts come in different sizes to accommodate various wire combinations. Each manufacturer has its own color code to distinguish the sizes. For example, one brand uses a red wire nut to splice four No. 12 or

five No. 14 wires. Once you know how many wires of each size you will be splicing, check the wire nut packaging.

Never use electrician's tape in place of a wire nut or compression sleeve.



Stripping wire

1 To use wire strippers, position the wire in the groove that corresponds with the gauge of the wire. Squeeze the jaws closed around the wire, then release the pressure very slightly.



2 Holding the wire in one hand, pull the strippers away with the other so the insulation is pulled off in one quick motion. There should be no nicks in the copper wire.



Back-wiring a device with screw clamps

1 When back-wiring, first use the molded strip gauge on the back of the device to measure the amount of insulation to be removed. Strip the wire.



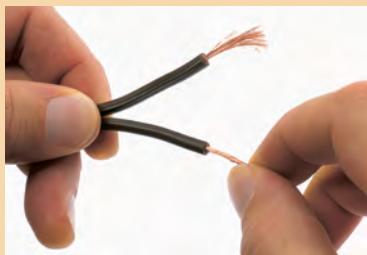
2 Insert the stripped wires into their appropriate holes and tighten the screws. Make sure they are secure. Tighten unused terminals.



AMERISPEC® TIP

DON'T NICK THE WIRE

Be careful not to nick the wire when stripping off its insulation. A nicked wire will break easily when bent to form a loop for a connection to a screw terminal. If you do nick a wire, snip off the end right below the nick and begin the stripping process again.



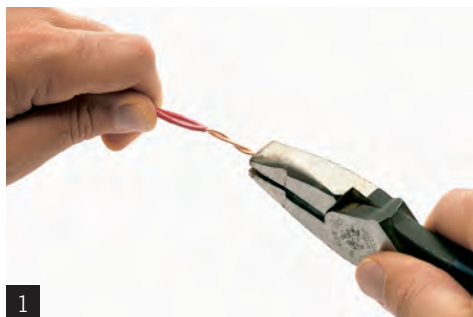
WORKING WITH STRANDED WIRE

Working with stranded wire, typically used for lamp cords, calls for a slightly different technique than single, solid wire. Begin by stripping about $\frac{3}{4}$ inch of insulation from the end. Use wire strippers—never a knife, which is likely to cut through some strands. Inspect the strands.

Use the right stripper. A stripper designed only for solid wire will nick the same-gauge stranded wire (16-gauge stranded wire has a larger diameter than 16-gauge solid wire, for example). There are strippers made for only solid wire and others only for stranded wire. Some strippers are marked for both.

If a wire end is damaged, snip off the end and begin again.

If you're splicing the wire, use your thumb and forefinger to twist the wire clockwise until the exposed strands are wound together tightly. To attach the wire to a screw terminal, twist the bare strands counterclockwise, then bend them into a loop and hook the loop clockwise around a screw terminal. Tighten the screw, making sure no stray wires are exposed. Tightening the screw will draw the strands together for a neat connection.



Splicing with a wire nut

1 Strip about 1 inch of insulation from the ends of the wires you are joining. Hold the wires side by side, grab them at the tip with a pair of lineman's pliers, and twist the stripped ends together (clockwise) two turns or more. Once the wires are tightly joined, cut them so that the wire nut will completely cover the exposed metal.



2 Screw the wire nut on clockwise until it is tight and no bare wire is exposed. Test the splice by tugging on the wires. If any come loose, redo the splice so it is secure.



Joining wires to a screw terminal

1 Strip $\frac{1}{2}$ inch to 1 inch of insulation off the wire end. Make sure there are no nicks in the copper wire where the insulation has been removed. Using long-nose pliers, form a loop in the bare wire.

2 Hook the wire clockwise around the screw terminal. (If you hook it counterclockwise, it will open up when you tighten the screw.) Squeeze with the pliers to tighten the stripped wire. Tighten the screw. Wrap electrician's tape around the device to cover the wires and terminals.



TIP SPLICING SOLID AND STRANDED WIRE

If you need to splice a stranded wire to a solid wire, as when installing a new light fixture, strip about $\frac{3}{4}$ inch of insulation from each wire. Wrap the stranded wire around the solid one with the stranded wire extending just a hair beyond the solid wire. Twist the wire nut until the connection is secure. Tug on the stranded wire to make sure the splice is solid.

cords and plugs

Cords on lamps and appliances are often pulled and twisted, and the insulation may become brittle, especially if it is exposed to intense heat. If you see frayed or damaged cord insulation or a cracked or loose plug, fix it right away. Otherwise, people could receive shocks, or a house fire may result.

lamp or fixture cord



heater cord



vacuum cleaner cord



power tool cord



REPLACING CORDS A damaged cord should be replaced rather than repaired. If the cord threads through a long tube, as with the lamp shown above right, don't pull the old cord out until you have attached its end to the new cord. That way you can pull the new cord through as you pull out the old one.

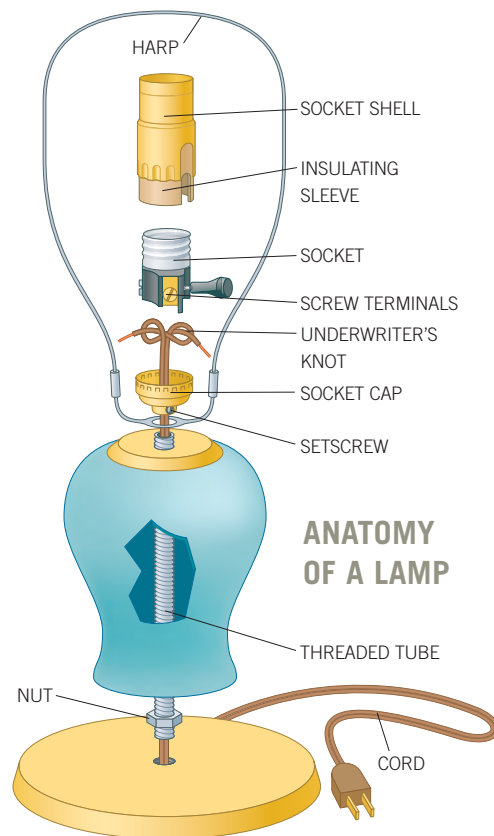
A lamp cord is typically secured at the base of the socket using an

Underwriter's Knot. The wire ends are then stripped and attached to the socket's terminals (see pages 176–177).

Detach or cut a portion of the old cord from the lamp or appliance and take it with you to buy a replacement with the same-size wires and the same insulation. Shown at left are some of the most common types of lamp and appliance cords. Replace the plug at the same time as the cord. If possible, buy a cord that has a plug already attached.

REPLACING PLUGS Any plug with a cracked shell or with loose, damaged, or badly bent prongs should be replaced. Plugs that transmit power erratically or get warm when used should also be replaced. If a plug sparks when it's pushed into or pulled out of a receptacle, examine the wires. If they're not firmly attached to the terminal screws, tighten the connections.

At a home center, you will find a variety of plugs to fit most any application. In plugs with screw terminals, the wires attach to screws inside the plug body. Many old-style plugs with screw terminals have a removable insulating disk that covers the terminals and wires. Codes now require that plugs have a fixed insulating barrier instead.



ZIPPING A CORD

To separate the strands of a lamp cord, place the cord on a piece of wood. Jab the blade of a utility knife into the groove between the two wires until it digs into the wood. Then pull the cord. If you accidentally expose any bare wire, cut the cord and try again.



AMERISPEC® TIP WORKING WITH CORDS

WATCH THOSE RIBS It's important to connect the smooth, hot wire to the brass terminal, and the ribbed, neutral wire to the silver terminal. If you get the wires switched, the lamp or appliance will have power running through much of the wiring in it even when it is turned off, creating a safety and fire hazard.

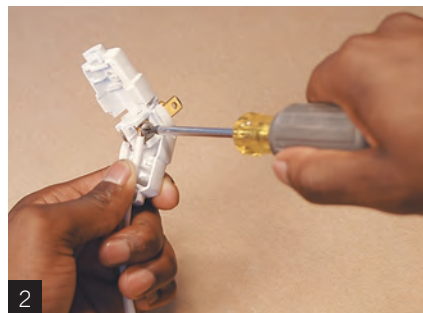


Wiring a plug with screw terminals

1 Unscrew and disassemble the plug. Use a utility knife to strip off the cord's outer sheathing and strip about 1 inch of insulation from the wires.

2 Tie an Underwriter's Knot. Make two loops with the wires, pass the loose ends through the loops, and pull.

3 Twist the wires counterclockwise until tight, form loops, and then attach the black wire to the brass terminal, the white wire to the silver terminal, and the green wire to the ground.



Wiring a snap-shut appliance plug

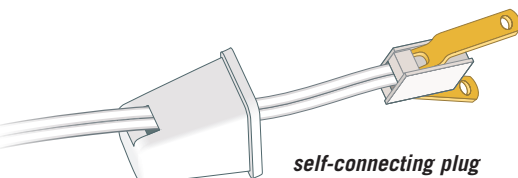
1 Loosen the screws and open the plug. Use a knife to separate the ends of the wires and then strip about ½ inch of insulation from the wire ends. Twist the wires tight (see page 177).

2 Loosen the terminal screws and insert the wires—smooth (hot) to the brass terminal, ribbed (neutral) to the silver terminal. Tighten the screws to clamp the wires.

3 Pull on the wires to make sure the connections are secure. Thread the cord through the groove in the plug body and clamp the body shut. Tighten the plug's screws.

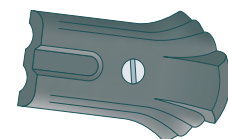
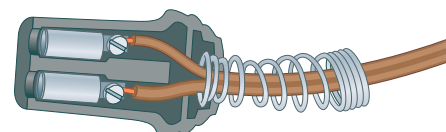
Two more replacement plugs

SELF-CONNECT To attach a self-connecting plug, push the unstripped cord through the shell and into the terminal block. Squeeze the prongs together to grip the cord and slide the shell up until it clicks into place.



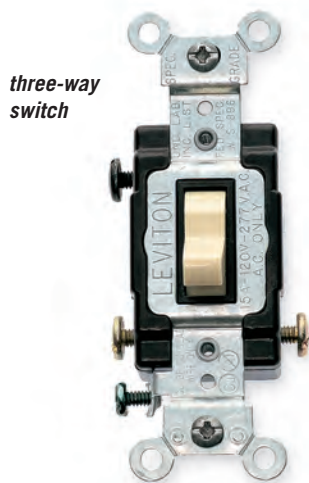
self-connecting plug

FEMALE APPLIANCE PLUG First unscrew the plug shell, then feed the cord through the spring guard. Strip the wire ends, wrap them clockwise around the screw terminals, and tighten. Reassemble the plug.



female appliance plug

replacing switches



If a switch fails to turn on and off, its toggle becomes a bit wobbly, or if it makes a popping sound that may be accompanied by a spark, it's time to replace the switch. You may choose to replace a standard switch with a dimmer or a special type of switch, shown on the opposite page.

By far the two most common types of switches are the familiar

single-pole variety (as shown in the steps below), which controls one or more lights from one location, and the three-way switch (see left), which allows you to turn lights off and on from two locations. A modern single-pole switch has two brass terminals and one green ground terminal, and a three-way has three terminals, one of them called the “common,” and a green ground terminal. Most switches have spring-type back-wiring holes (see page 176) as well as terminals.

Switches are rated for a specific voltage and amperage. Whenever

you replace a switch, check the service panel for the correct amperage, and purchase a switch to match.

Unlike receptacles, switches are wired only with hot wires (the black wires in standard household cable). See page 174 for the two basic ways of wiring a single-pole switch. Three-way-switch wiring is more complicated, so label the wires as you remove them from the old switch so you can replace them in the same configuration.

CAUTION Always shut off the power to the circuit (page 172) before beginning work. Use a voltage tester to make sure the circuit is dead before you touch any wires or terminals.



AMERISPEC® TIP

MAKE SURE YOU CAN WIRE IT

Some special switches, such as certain types of timers, can be installed only if hot and neutral wires are present in the switch box (see page 174). If there is only one cable entering the box, check to be sure you can install the switch of your choice. Also, some special switches can be used to replace three-way switches, while others can replace only single-pole switches.

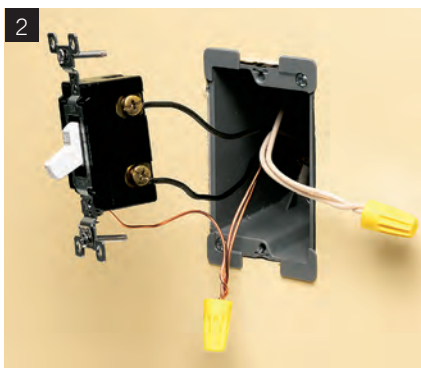
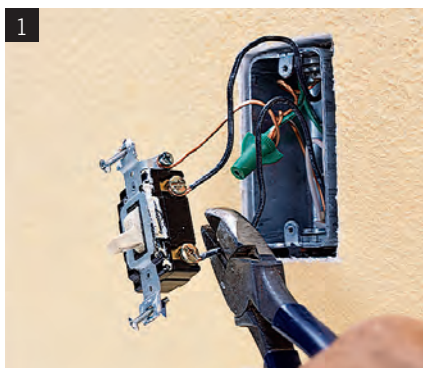
Replacing a single-pole switch

1 Shut off power to the circuit. Remove the switch cover plate, loosen the mounting screws, and pull the switch gently out of the wall. Test to see that the power is off. If the house wires are very short, loosen the terminal screws and remove the wires. If the wires are long enough to be reused after cutting, snip them as close to the switch as possible.

2 Splice the grounding wires with a short piece that runs to the switch's grounding screw and then join them with a wire nut (see pages 173–174 for various grounding methods). Strip the black wires (there may be one white wire that should be marked black), form loops, and attach them to the terminals (see pages 176–177). Wrap the terminals with electrician's tape.

3 Fold the wires behind the switch. Carefully push the wires into the box and guide the switch's screws into their holes. Then align the switch vertically and tighten the screws. Finally, screw the faceplate to the switch. Restore power to the circuit.

Note: Metal boxes must be connected to the equipment grounding conductor.





pilot switch



motion-sensor switch



dial timer



preset timer



programmable timer

SPECIAL SWITCHES

Today, switches can do more than just turn the lights on and off. Dimmers allow you to control the level of brightness and help save energy. A dimmer switch may

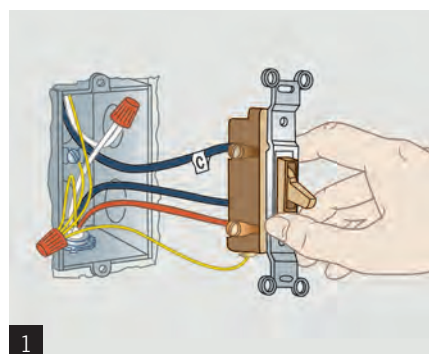
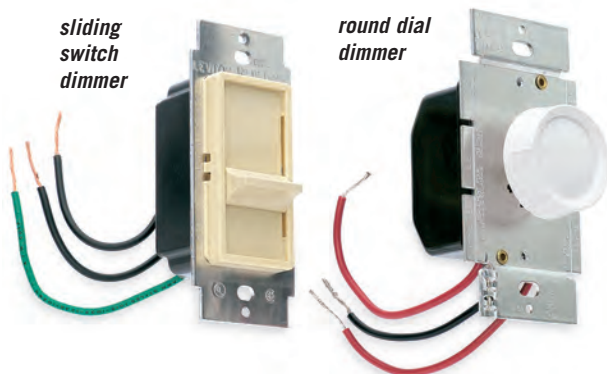
have a round dial, a sliding switch, or a toggle that looks just like a standard switch. Some dimmers have separate on-off and dimmer controls, so they retain the level of lighting you chose last time you turned them on. Others have fade controls to turn the light on and off gently.

A pilot switch has a lamp that glows when the fixture or appliance is on. It is useful for basement lights, outdoor lights, and remote appliances such as attic

fans that are out of sight and may be inadvertently left on.

Some timer switches allow you to set a light, bathroom heater, or other device to turn on and off at predetermined times each day. A programmable timer provides multiple daily settings.

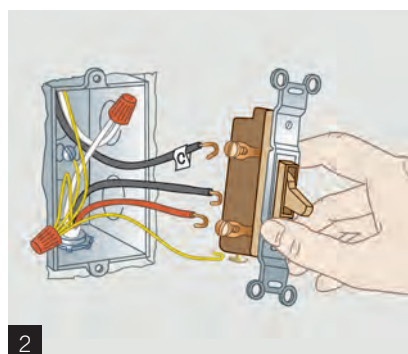
A motion-sensor switch can be used for security, convenience, or energy savings. The switch turns the light on when it detects movement in a room, then shuts off after a predetermined interval.



1

Replacing a three-way switch

1 Shut off the power, remove the cover plate, and test for power. Pull out the switch and use tape to label the wire to the common terminal, which is a different color than the others.



2

2 Cut, strip, and attach the wires as you would for a single-pole switch (see pages 176–177). Attach the labeled wire to the common terminal screw of the new switch. Connect the remaining wires and reattach the box as you would for a single-pole switch.

INSTALLING A DIMMER OR OTHER SPECIAL SWITCH

Wire a dimmer as you would a standard switch, except that most dimmers have short wires (called leads) rather than terminals. Splice the wires to the house's wires using wire nuts. Because a dimmer typically has a thicker body than a single-pole switch, you may need to work with extra care to fold the wires into a smaller space in the box.



receptacles

The most common household receptacle is the 15- or 20-amp, 120-volt grounded duplex type, which has two outlets. The larger (neutral) slot accepts the wide prong of a two- or three-prong plug. The smaller (hot) slot is for the narrow prong, and the hole is for the equipment-grounding prong. Both amperage and voltage are stamped on the front. A 15-amp-rated duplex receptacle can be used on a 15- or 20-amp circuit. The only reason

15-amp, 120-volt grounded duplex receptacle



20-amp, 120-volt grounded duplex receptacle

to use a 20-amp receptacle is if a tool or appliance has a special 20-amp plug and there is only one receptacle on the circuit. If a receptacle lacks a third hole, it is a non-grounding type. Consult an electrician to see whether you can provide grounding and install a grounded receptacle. For child safety, code now requires tamper-resistant receptacles for outlets installed less than 66 inches above the floor. These receptacles, which are widely available, are equipped with spring-loaded shutters that block the openings in the face of the receptacle. The shutters open as a plug is inserted, but not when a child attempts to push something into only one of the openings.



high-voltage 240-volt receptacle

Use a receptacle analyzer (see page 173) to test whether a receptacle is properly wired and grounded. If it's not, you may need to call in an electrician for an evaluation.

Common 120-240-volt receptacles or 240-volt receptacles have slot configurations to ensure that only the right kind of plug can be inserted. Receptacles that supply 120 and 240 voltages are used for appliances such as clothes dryers and kitchen ranges, which need higher voltage for motors and lower voltage for timers and controls.

A ground fault circuit interrupter (GFCI) is a device designed to protect you from electric shocks by shutting off power when it senses even a tiny imbalance in current. A 120-volt GFCI receptacle takes the place of a standard duplex receptacle and monitors electrical current. Whenever incoming and outgoing current are not equal, such as during a ground fault or current leakage, the GFCI opens the circuit almost

instantly, cutting off the electricity. GFCIs are required in areas such as bathrooms, kitchens, garages, all exterior areas, and in exposed areas where ground faults are most likely to occur. Correctly wired, a single GFCI receptacle can provide protection for downstream receptacles or lights.

ground fault circuit interrupter (GFCI)



two-pronged, polarized receptacle

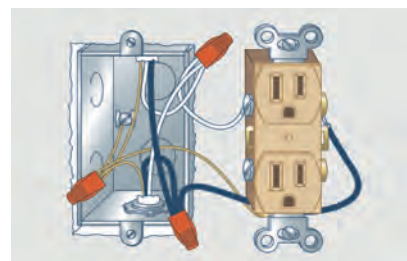
GFCI receptacles can be connected to older electrical systems that do not have a separate ground wire. They provide the same ground-fault protection as those wired with a ground, but they should be labeled "no equipment ground." In general, wire the new receptacle in the same way that the old one was wired.

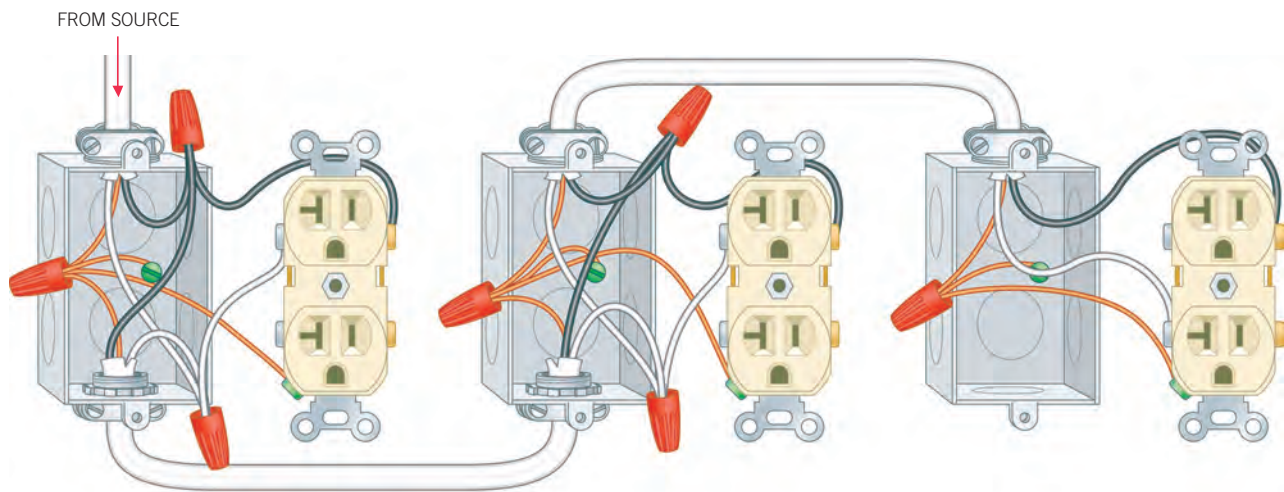
A high-quality receptacle can be back-wired (see page 176), but avoid back-wiring an inexpensive receptacle. The connections are usually not as secure as those made by screw terminals.

Replacing a grounded receptacle (middle-of-the-run)

Shut off the power, remove the cover plate, and test to make sure the power is off. As you would for a switch, pull the receptacle out, cut or unhook the wires, strip them, and connect them to the new terminals. Attach the black or colored (hot) wire to the brass terminal and the white (neutral) wire to the silver terminal. Attach the equipment grounding wire (see pages 173–174). Another way to wire a

middle-run switch is to attach the wires to all four terminals. Screw the receptacle to the box and replace the cover plate.





CAUTION Before working, turn off power to the circuit (see page 172) and test to make sure the power is off. Be extra careful when working on a 240-volt circuit. You may need to shut off two circuit breakers or remove two fuses.

RECEPTACLE WIRING If a receptacle is in the middle of a cable's run, there will be two cables entering its box, one bringing power in and one sending power down the line. The wires may be connected as shown on the opposite page, or they may be attached to both of the terminals on each side. At the end of the run, only one cable enters the box.

In some cases, a receptacle is split so each of its outlets is wired separately. To do this, remove the connecting tab joining the two hot terminals (see right). Sometimes one outlet is wired so

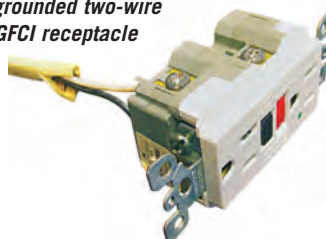
it is controlled by a switch, while the other outlet is always hot. Or each outlet may be wired to a different circuit (where both hot and neutral tabs would be removed), allowing you to plug in two high-amperage appliances without overloading a circuit.



Replacing a GFCI receptacle

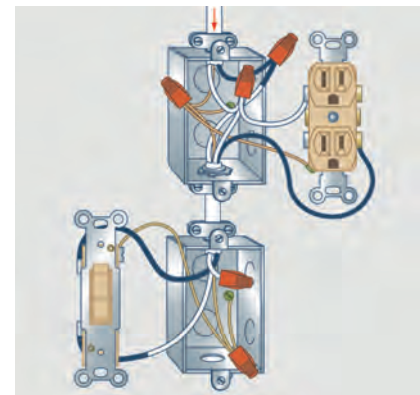
To wire a GFCI so it protects other receptacles or lights down the line, as shown, hook the wires that bring power into the box to the LINE terminals and the wires that go out to other receptacles to the LOAD terminals. As with a standard receptacle, hook the hot wires to the brass terminals and the neutral wires to the silver terminals. If the GFCI is at the end of the run, simply hook the wires to the LINE terminals.

ungrounded two-wire GFCI receptacle



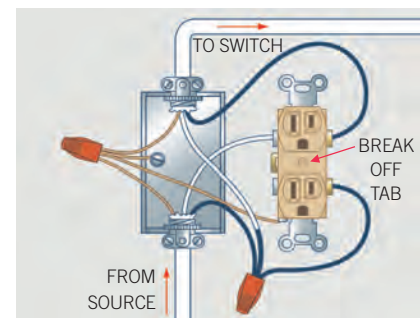
Two switch-controlled receptacles

BOTH OUTLETS CONTROLLED BY A SWITCH



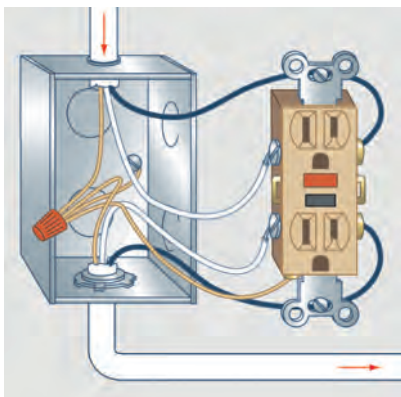
Here the receptacle is wired much like a light fixture when power runs to the fixture's box (see page 174). Note that code now requires a separate neutral from the receptacle box to the switch box. It should be pigtailed to the neutral conductor in the receptacle box and capped with a wire nut in the switch location.

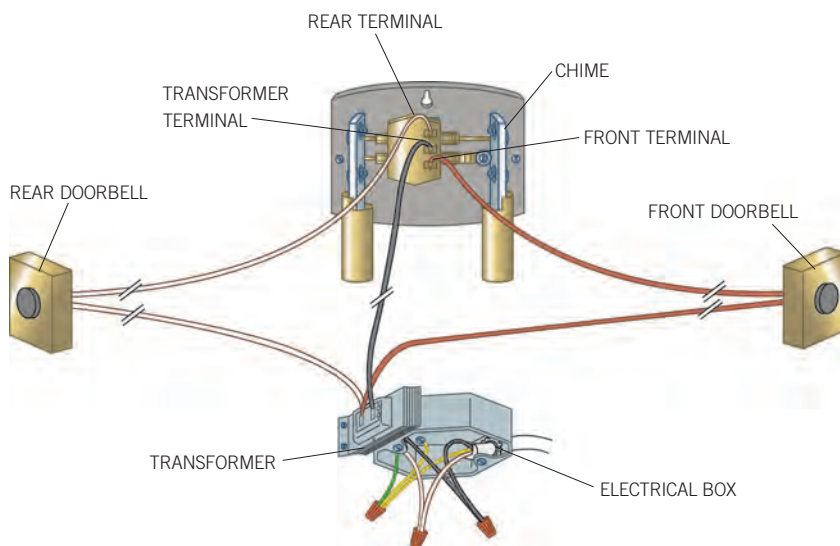
ONLY ONE OUTLET IS SWITCH-CONTROLLED



Here the tab between the two brass terminals has been broken off.

FROM SOURCE





doorbell repairs

A doorbell system consists of a push button, the bell or chime, a transformer, and the thin wires that run between the components. The transformer steps power down from 120 volts to 20 volts or less, so you can safely work on most of the system while the power is on. The exception is the electrical box to which the transformer is attached. It carries standard voltage, so shut off the power before working on it.

In a system with one button, wires run in a circuit from the transformer to the button, then to the chime, and then back to the transformer. In a two-button system, wires run in circuits through both buttons. (A single wire running from the transformer directly to the chime is used by both circuits.) In a typical chime system, the bell sounds “ding-dong” when the front button is pushed and just “ding” (or “dong”) when the rear button is pushed.

A SILENT DOORBELL

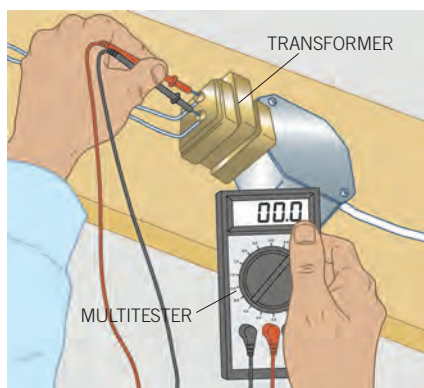
One of a variety of problems—a faulty button, chime, transformer, or wiring—can cause a doorbell not to sound. Start your investigations with the simplest possible repair: the button. If that isn’t the problem,

move on to the chime, then the transformer, then the wiring.

The transformer may be difficult to find. It will be attached to an electrical junction box, perhaps in the basement or attic, on the exterior of the service panel, inside the fuse box, or in the garage. Follow the wires as best you can, looking for same-colored wires at a transformer.

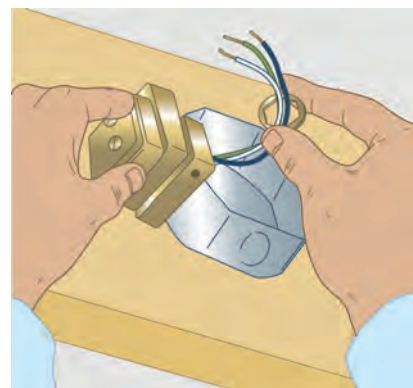
A CONSTANTLY RINGING DOORBELL

If a doorbell rings constantly (or if a chime is stuck in the chiming mode, indicated by a buzzing sound), either the button is stuck or the wires going to the button are shorted together. To test the button, remove it and disconnect one of the two wires. If the bell stops ringing, the button should be replaced. If the bell continues to ring, the problem is a short in the wires. If you can’t find the short, you need to replace the wires.



The transformer

TEST Touch the probes of a multimeter or voltmeter to the two terminals of the transformer. If you get a reading that is close to the transformer’s voltage rating, and if the button and chime are OK, then the wiring is probably the problem. Otherwise you may need to replace the transformer.

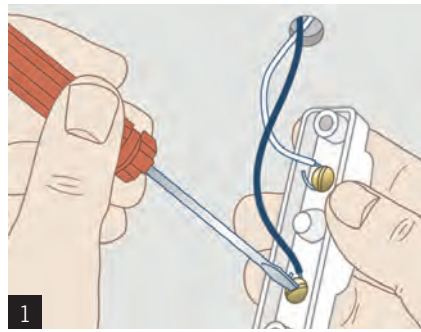


REPLACE Shut off power to the circuit, open the junction box, and test that power is absent. Pull out the wires and remove the wire nuts, restore power, and test to see that power is present in the box. If it is, shut off the power and install a transformer of the same voltage rating as the old one.

REWIRING VS. THE WIRELESS OPTION

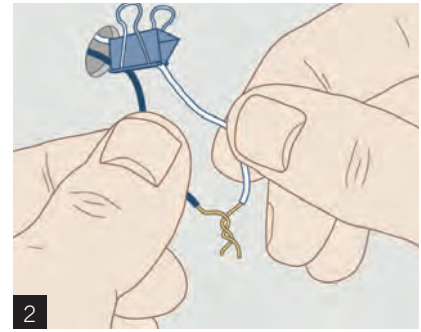
If the problem is not the transformer, the button, or the chime, the wiring is damaged. Although it's a long shot, you may be able to attach a new wire to the old and pull the new wire through. Otherwise, you will need to snake new wire.

THE WIRELESS OPTION Installing a wireless chime is a snap. The button is powered by a battery, and the chime plugs into a standard electrical receptacle. On the downside, many people find a wireless chime's tone annoying, and these units sometimes sound when nobody is pushing the button.



The button

1 Undo the mounting screws (you may need to pry off a cover, first) and gently pull the button out. Clean away debris (small cocoons are common). Make sure the terminal screws are tightly fastened. If a wire is rusted or damaged, cut it, strip it, and reattach it to the terminal.

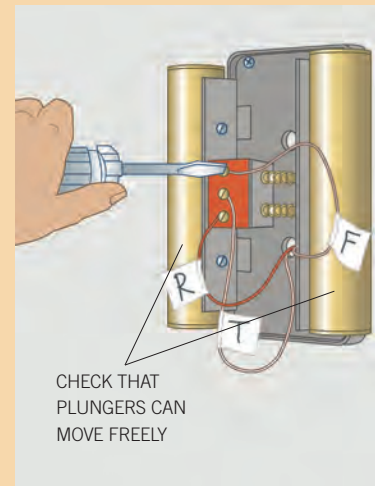
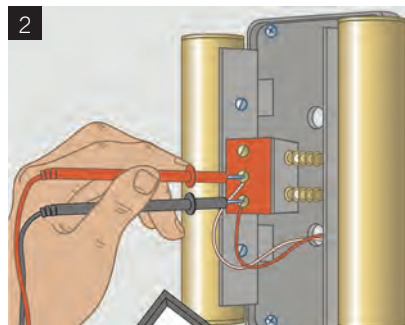
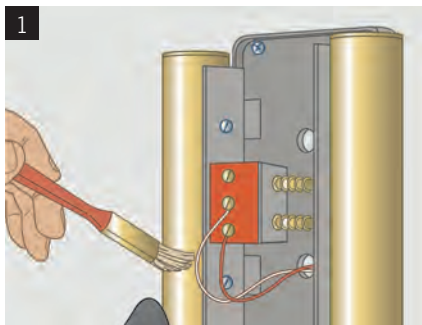


2 If the chime still does not sound, attach a clip to the wires so they cannot slip back into the hole, then remove them from the button. Touch the wires together. If the chime sounds, you simply need to replace the button. If you see a small spark but the chime does not sound, check the chime. If there is no spark there, check the transformer.

The chime or bell

1 Remove the cover and then vacuum or gently brush away dust and debris. See that the wires are tightly joined to the terminal screws. If a wire is damaged, cut it, strip it, and reattach it. Use sandpaper or a soft wire brush to clean any corrosion on the terminals. Check that the moving parts—like the plunger that strikes a chime—move freely, and clean anything that is gumming up the works.

2 Touch the probes of a multimeter to the “trans” and “front” terminals. If you get a reading that is close to the chime's voltage rating (usually printed on the cover), the chime probably needs replacing. If you do not have a multimeter, disconnect the “trans” and “front” wires and touch them together. A slight spark indicates that the right amount of power is probably getting there, so the chime needs to be replaced. If there is no power, test the transformer (see opposite page).



REPLACING A CHIME

Purchase a chime that has the same voltage and amp rating as the old one. First label the wires on the old one with tape. Loosen the terminal screws and pull the wires out. Clip the wires so they cannot slip back into the hole in the wall. Remove the chime's mounting screws and pull the chime out. Mount the new chime and attach the wires.

replacing a light fixture

Removing an existing ceiling fixture and installing a new one is usually a straightforward project. In most cases you can reuse the existing attachment hardware in the electrical box or replace it with hardware that comes with the new fixture. If

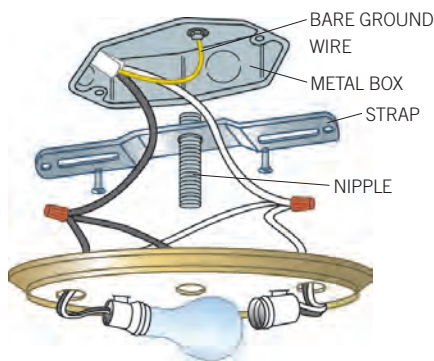
you do need special hardware, it is readily available at a hardware store or home center.

Buy a light with a canopy that is at least as large as the old one or you will probably need to paint the ceiling. Or purchase a decorative medallion to cover ceiling imper-

fections. Be sure the new fixture will be bright enough. Some can handle only low-wattage bulbs and so may be disappointingly dim. Do not exceed the manufacturer's recommended bulb wattage or the fixture and its wires could overheat, creating a dangerous situation.

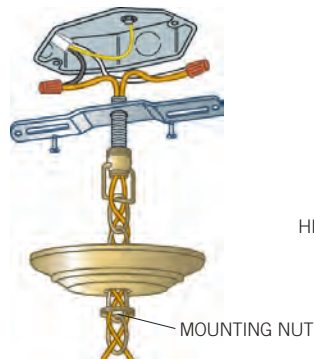
Three mounting variations

CENTER MOUNT Some fixtures attach via a single threaded pipe, called a stud or nipple. The stud is typically attached to the center of a metal mounting strap.

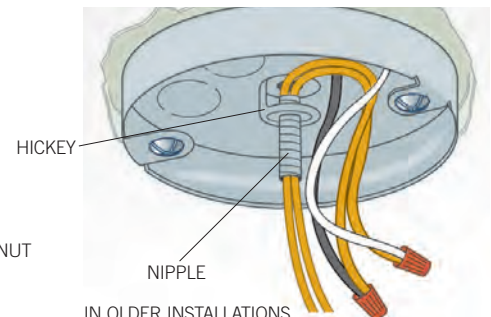


SOME FIXTURES MAY REQUIRE GROUNDING.

PENDANT FIXTURE A pendant light or chandelier usually has a decorative cord that runs up through a chain, then through a center stud and into the electrical box.



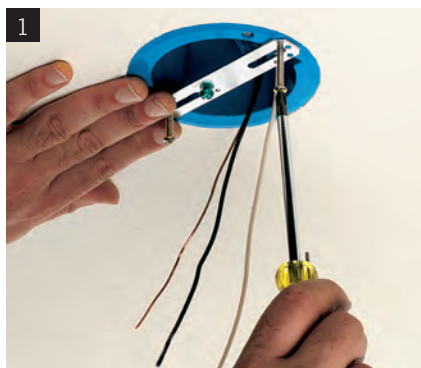
HICKEY A shallow pancake box with a $\frac{3}{8}$ -inch stud in the middle will not accommodate a strap. A hickey allows a threaded pipe called a nipple to be attached to the box so that the fixture can be attached and fixture wires be brought into the box for connection to house wiring.



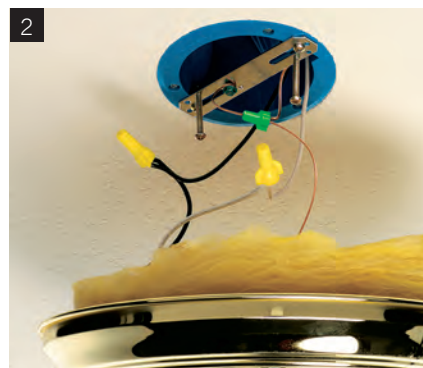
IN OLDER INSTALLATIONS, GROUND PROVIDED BY BX CONNECTION.

Installing a surface-mounted fixture

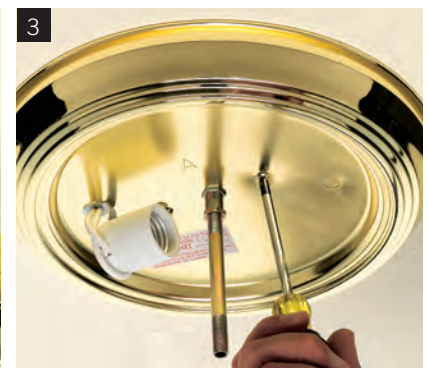
1 Shut off power to the circuit and test that the power is off. Screw a mounting strap to the electrical box. Loosely fasten mounting screws to the bar.



2 Splice the black fixture wire to the house's hot wire and the white or ribbed fixture wire to the house's neutral wire. If there is a fixture grounding wire (as shown), splice it to the house's grounding wire. If there is no fixture grounding wire, secure the house grounding wire to the grounding screw on the strap.



3 Fold wires into the ceiling box. Push the fixture canopy into place and tighten the bolts (this fixture has keyhole slots that slip over the mounting bolts). Screw in the light bulb and add the shade or globe.



fluorescent fixtures

Fluorescent lights use less energy than standard incandescent fixtures. You can choose tubes that produce a warm light. Coupled with a diffuser, this can make fluorescent lighting easy on the eyes.

There are many wiring variations. Older fixtures have starters and ballasts that wear out and must be replaced. Newer fixtures have no starters and have electronic ballasts that last a long time. So it often makes sense to replace rather than repair a fixture.

TUBES If a tube flickers, try re-installing it in the sockets. A poorly connected ground also can cause a tube to flicker. If the ends of the tube are very dark, replace it.

REPLACING A STARTER Before you replace a starter, shut off the wall switch to the fixture. Remove the tube. Rotate the starter a quarter turn counterclockwise and pull it out of its socket. Place the new starter in the socket and rotate it a quarter turn in each direction.

REPLACING A SOCKET If a tube socket is cracked or wobbly, it needs to be replaced. Shut off power to the circuit. Remove the tube and the cover plate and test to make sure the circuit is not energized. Unscrew or unsnap the socket from the end of the fixture's canopy. Cut or disconnect the wires connecting the tube holder to the fixture. To connect the wires, strip about $\frac{1}{2}$ inch of insulation from the end of

each wire and connect them using wire nuts. Attach the new holder, then install the cover plate and tube. Turn on the power. If your new tube holder has push-in connections or terminal screws instead of permanently connected wires, connect the fixture wires to those rather than using wire nuts. A new ballast will have permanently connected wires.

REPLACING A BALLAST If the fixture hums, the ballast needs to be replaced. Shut off power and test the circuit. Remove the cover plate and the tube. Cut or disconnect the wires, and remove the ballast. Attach a new ballast, and connect the wires with wire nuts. Install the tubes and test.

ENERGY EFFICIENT LIGHTING

Compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs) are far more efficient than standard incandescent bulbs. Although the initial cost is higher, both use a fraction of the electricity and last thousands of hours longer. The U.S. Department of Energy estimates that while a traditional 60-watt incandescent bulb will last roughly 1,000 hours, a 15-watt CFL will last 10,000 hours and a 12-watt LED will last 25,000 hours. The light output (in lumens per watt of electricity) is highest for LEDs, followed closely by CFLs. Both vastly outperform standard incandescent bulbs. They also produce much less heat, which can help to lower cooling costs (roughly 90 percent of the energy used by incandescent bulbs produces heat, not light).



CFLs

CFLs use about 75 percent less energy than an incandescent to produce the same amount of light. They can produce light in a range of pleasing color temperatures that weren't originally available, and some can be used with dimmers (look for that designation on the packaging). Because they contain small amounts of mercury, CFLs should be recycled rather than thrown in the trash.

LEDs use as much as 80 percent less electricity than incandescent bulbs and are available as replacements for 40w, 60w and 75 bulbs. They contain no mercury.

Energy-saving incandescent bulbs also are available. They use about 25 percent less power than standard bulbs and can last up to three times as long.



LEDs

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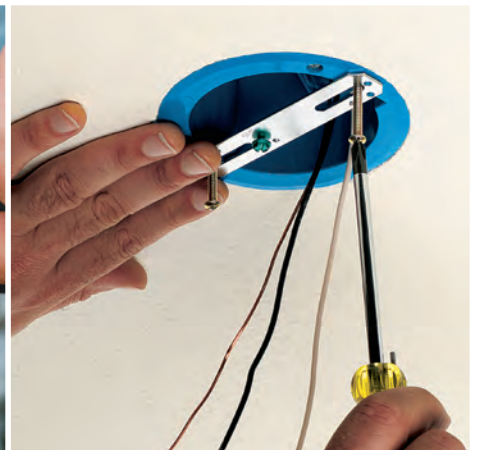
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Home Repair Manual

Get all the inspiration and know-how you need for your home improvement projects.



Essential Advice:

- Seasonal maintenance checklist
- When to call a professional
- Must-have tools to own
- Essential plumbing, gas and electrical advice
- What to do in an emergency
- Home safety guidelines

DIY Repairs:

- Fix sink faucets
- Repair broken glass
- Patch up drywall
- Fix warped wood flooring
- Control moisture in basements
- Clean and maintain a fireplace and chimney
- Inspect a roof

Step-by-Step Instructions:

- Installing a new faucet
- Sanding and refinishing hardwood floors
- Weather-stripping a door
- Preparing and painting siding and trim
- Resurfacing cabinets
- Replacing a light fixture

