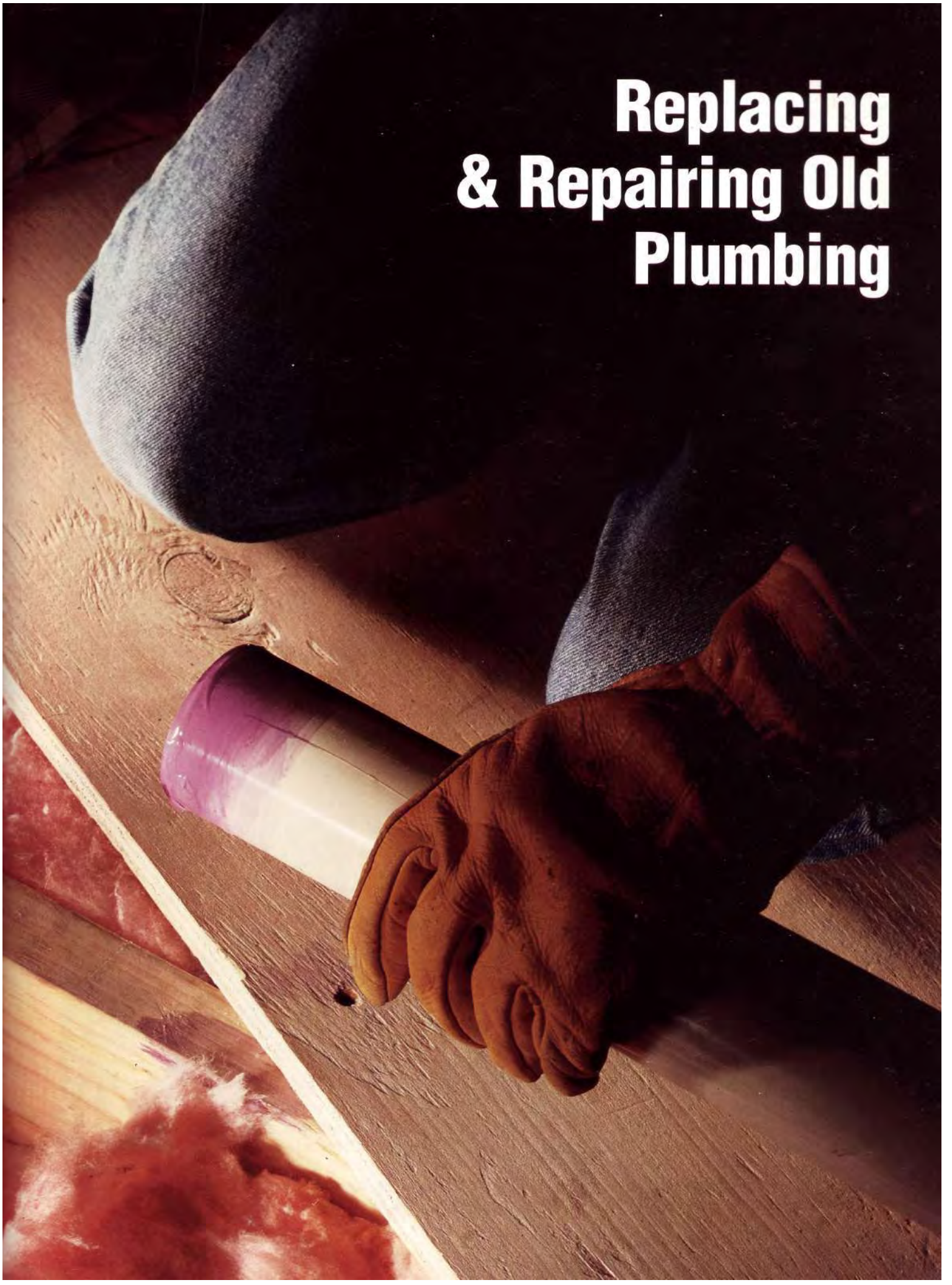


Replacing & Repairing Old Plumbing



Leave old plumbing pipes in place, if possible. To save time, professional plumbing contractors remove old plumbing pipes only when they interfere with the routing of the new plumbing lines.

Replacing Old Plumbing

Plumbing pipes, like all building materials, eventually wear out and have to be replaced. If you find yourself repairing leaky, corroded pipes every few months, it may be time to consider replacing the old system entirely—and soon. A corroded water pipe that bursts while you are away can cost you many thousands of dollars in damage to wall surfaces, framing members, and furnishings.

Identifying the materials used in your plumbing system can also tell you if replacement is advised. If you have galvanized steel pipes, for example, it is a good bet that they will need to be replaced in the near future. Most galvanized steel pipes were installed before 1960, and since steel pipes have a maximum life expectancy of 30 to 35 years, such a system is probably living on borrowed time. On the other hand, if your system includes copper supply pipes and plastic drain pipes, you can relax; these materials were likely installed within the last 40 years, and they are considerably more durable than steel, provided they were installed correctly.

Unless you live in a rambler with an exposed basement ceiling, replacing old plumbing nearly always involves some demolition and carpentry work. Even in the best scenario, you probably will find it necessary to open walls and floors in order to run new pipes. For this reason, replacing old plumbing is often done at the same time as a kitchen or bathroom remodeling project, when wall and floor surfaces have to be removed and replaced.

Replacement Options



Partial replacement involves replacing only those sections of your plumbing system that are currently causing problems. This is a quick, less expensive option than a complete renovation, but it is only a temporary solution. Old plumbing will continue to fail until you replace the entire system.



Complete replacement of all plumbing lines is an ambitious job, but doing this work yourself can save you thousands of dollars. To minimize the inconvenience, you can do this work in phases, replacing one branch of the plumbing system at a time.

Evaluating Your Plumbing

By the time you spot the telltale evidence of a leaky drain pipe or water supply pipe, the damage to the walls and ceilings of your home can be considerable. The tips on the following pages show early warning signals that indicate your plumbing system is beginning to fail.

Proper evaluation of your plumbing helps you identify old, suspect materials and anticipate problems. It also can save you money and frustration. Replacing an old plumbing system at your convenience before it reaches the disaster stage is preferable to hiring a plumbing contractor to bail you out of an emergency situation.

Remember that the network of pipes running through the walls of your home is only one part of the larger system. You should also evaluate the main water supply and sewer pipes that connect your home to the city utility system and make sure they are adequate before you replace your plumbing.

Fixture Units	Minimum Gallons per Minute (GPM)
10	8
15	11
20	14
25	17
30	20

Minimum recommended water capacity is based on total demand on the system, as measured by fixture units, a standard of measurement assigned by the Plumbing Code. First, add up the total units of all the fixtures in your plumbing system (page 26). Then, perform the water supply capacity test described below. Finally, compare your water capacity with the recommended minimums listed above. If the capacity falls below that recommended in the table above, then the main water supply pipe running from the city water main to your home is inadequate and should be replaced with a larger pipe by a licensed contractor.

How to Determine Your Water Supply Capacity



1 Shut off the water at the valve on your water meter, then disconnect the pipe on the house side of the meter. Construct a test spout using a 2" PVC elbow and two 6" lengths of 2" PVC pipe, then place the spout on the exposed outlet on the water meter. Place a large watertight tub under the spout to collect water.



2 Open the main supply valve and let the water run into the container for 30 seconds. Shut off the water, then measure the amount of water in the container and multiply this figure by 2. This number represents the gallons-per-minute (gpm) rate of your main water supply. Compare this measurement with the recommended capacity in the table above.

Symptoms of Bad Plumbing



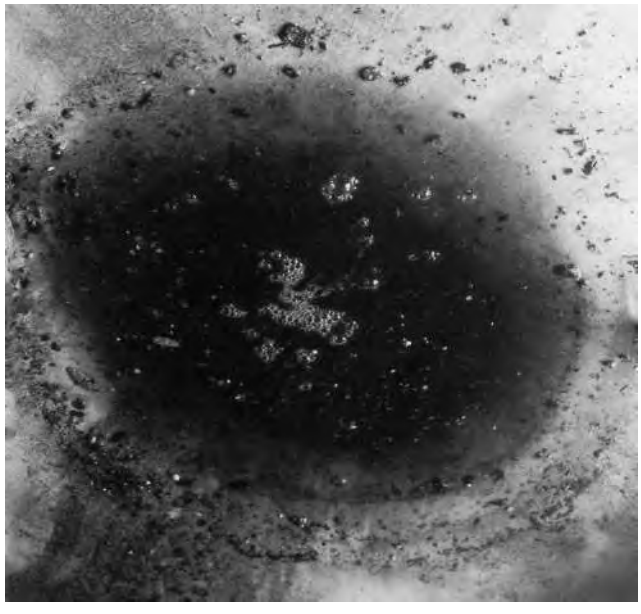
Rust stains on the surfaces of toilet bowls and sinks may indicate severe corrosion inside iron supply pipes. This symptom generally means your water supply system is likely to fail in the near future. NOTE: Rust stains can also be caused by a water heater problem or by a water supply with a high mineral content. Check for these problems before assuming your pipes are bad.



Low water pressure at fixtures suggests that the supply pipes either are badly clogged with rust and mineral deposits, or are undersized. To measure water pressure, plug the fixture drain and open the faucets for 30 seconds. Measure the amount of water and multiply by 2; this figure is the rating in gallons per minute (gpm). Vanity faucets should supply 13/4 gpm; bathtub faucets, 6 gpm; kitchen sink faucets, 41/2 gpm.



Slow drains throughout the house may indicate that DWV pipes are badly clogged with rust and mineral deposits. When a fixture faucet is opened fully with the drains unstopped, water should not collect in tubs and basins. NOTE: Slow drains may also be the result of inadequate venting. Check for this problem before assuming the drain pipes are bad.



Backed-up floor drains indicate that the main sewer service to the street is clogged. If you have this problem regularly, have the main sewer lines evaluated by a plumbing contractor before you replace your house plumbing. The contractor will be able to determine if your sewer problem is a temporary clog or a more serious problem that requires major work.

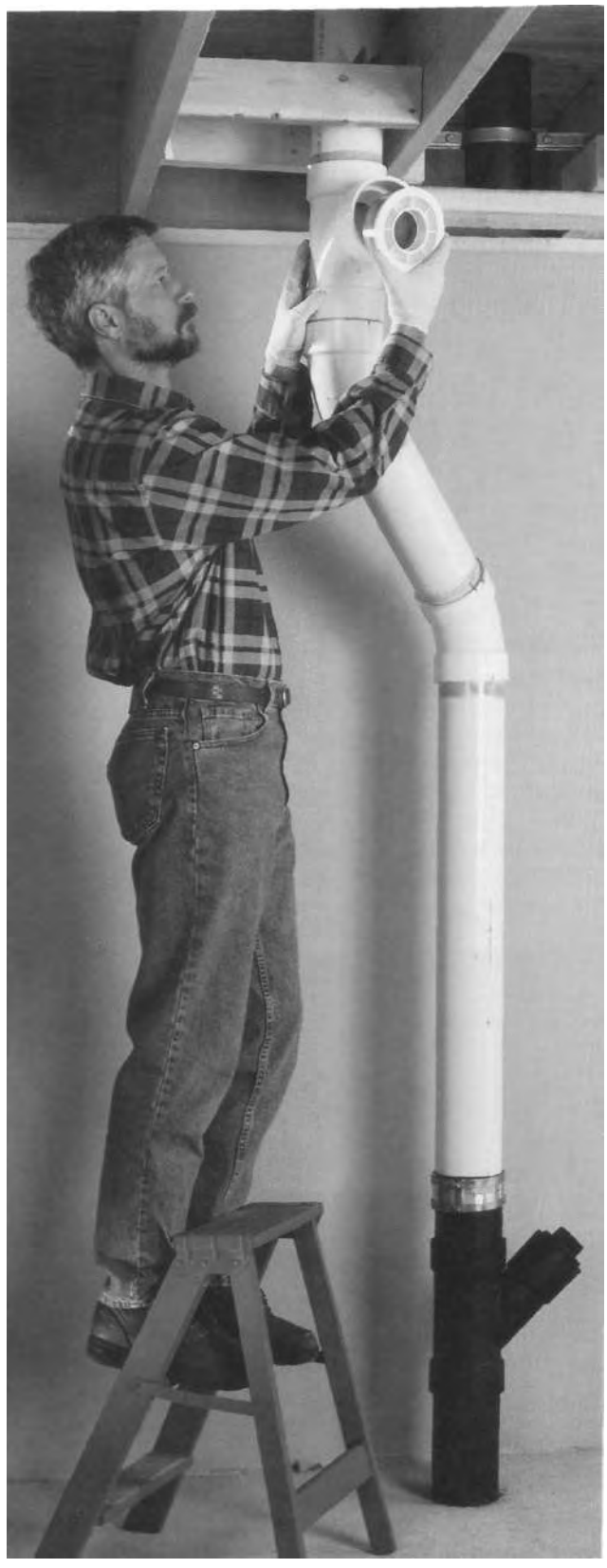
Replacing Old Plumbing: A Step-by-step Overview

The overview sequence shown here represents the basic steps you will need to follow when replacing DWV and water supply pipes. On the following pages, you will see these steps demonstrated in complete detail, as we replace all the water supply pipes and drain pipes for a bathroom, including the main waste-vent stack running from basement to roofline.

Remember that no two plumbing jobs are ever alike, and your own project will probably differ from the demonstration projects shown in this section. Always work in conjunction with your local plumbing inspector, and organize your work around a detailed plumbing plan that shows the particulars of your project.



1 Plan the routes for the new plumbing pipes. Creating efficient pathways for new pipes is crucial to a smooth installation. In some cases this requires removing wall or floor surfaces. Or, you can frame a false wall, called a *chase* (page 156), to create space for running the new pipes.



2 Remove sections of the old waste-vent stack, as needed, then install a new main waste-vent stack running from the main drain in the basement to the roof. Include the fittings necessary to connect branch drains and vent lines to the stack.



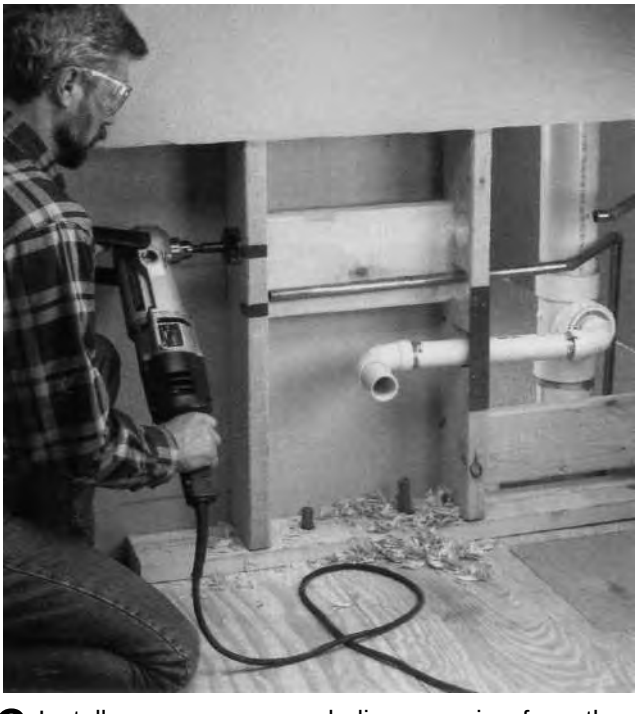
3 Install new branch drains from the waste-vent stack to the stub-outs for the individual fixtures. If the fixture locations have not changed, you may need to remove sections of the old drain pipes in order to run the new pipes.



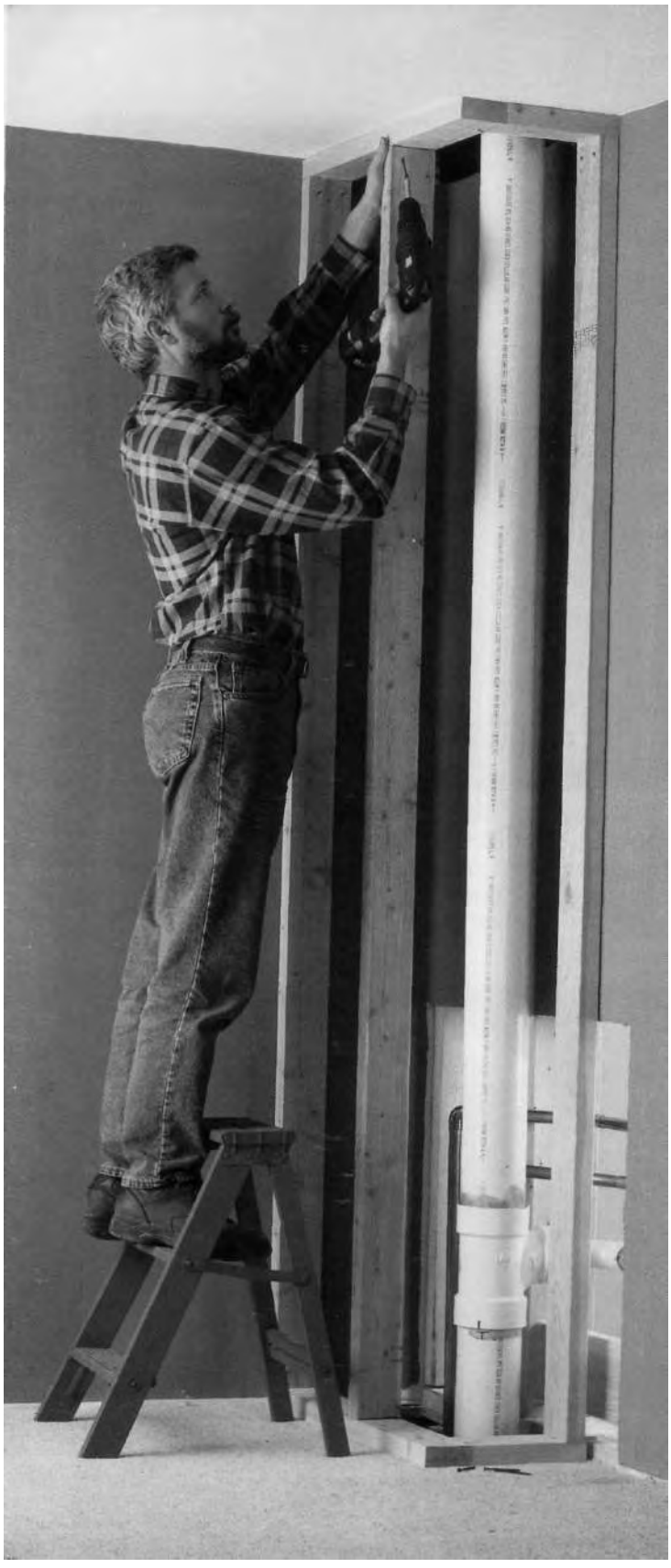
4 Remove the old toilet bend and replace it with a new bend running to the new waste-vent stack. This task usually requires that you remove areas of flooring. Framing work may also be required to create a path for the toilet drain.



5 Replace the vent pipes running from the fixtures up to the attic, then connect them to the new waste-vent stack.



6 Install new copper supply lines running from the water meter to all fixture locations. Test the DWV and water supply pipes and have your work inspected before closing up walls and installing the fixtures.



Build a framed chase. A chase is a false wall created to provide space for new plumbing pipes. It is especially effective for installing a new main waste-vent stack. On a two-story house, chases can be stacked one over the other on each floor in order to run plumbing from the basement to the attic. Once plumbing is completed and inspected, the chase is covered with wallboard and finished to match the room.

Planning Pipe Routes

The first, and perhaps most important, step when replacing old plumbing is to decide how and where to run the new pipes. Since the stud cavities and joist spaces are often covered with finished wall surfaces, finding routes for running new pipes can be challenging.

When planning pipe routes, choose straight, easy pathways whenever possible. Rather than running water supply pipes around wall corners and through studs, for example, it may be easiest to run them straight up wall cavities from the basement. Instead of running a bathtub drain across floor joists, run it straight down into the basement, where the branch drain can be easily extended underneath the joists to the main waste-vent stack.

In some situations, it is most practical to route the new pipes in wall and floor cavities that already hold plumbing pipes, since these spaces often are framed to provide long, unobstructed runs. A detailed map of your plumbing system can be very helpful when planning routes for new plumbing pipes (pages 18 to 23).

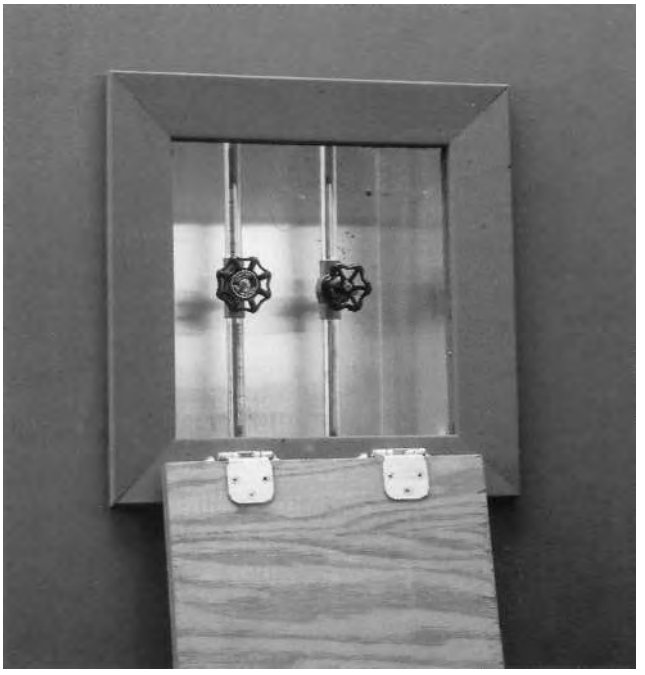
To maximize their profits, plumbing contractors generally try to avoid opening walls or changing wall framing when installing new plumbing. But the do-it-yourselfer does not have these limitations. Faced with the difficulty of running pipes through enclosed spaces, you may find it easiest to remove wall surfaces or to create a newly framed space for running new pipes.

On these pages, you will see some common methods used to create pathways for replacing old pipes with new plumbing.

Tips for Planning Pipe Routes



Use existing access panels to disconnect fixtures and remove old pipes. Plan the location of new fixtures and pipe runs to make use of existing access panels, minimizing the amount of demolition and repair work you will need to do.



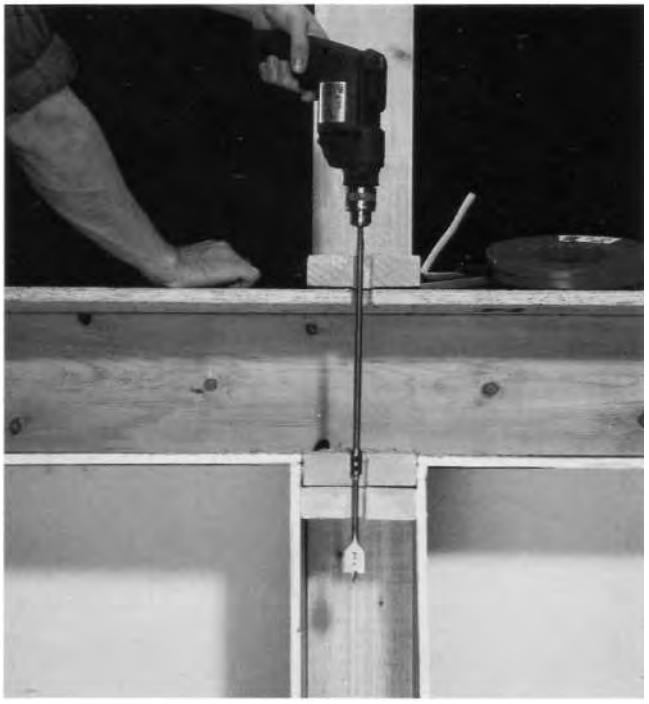
Convert a laundry chute into a channel for running new plumbing pipes. The door of the chute can be used to provide access to control valves, or it can be removed and covered with wall materials, then finished to match the surrounding wall.



Run pipes inside a closet. If they are unobtrusive, pipes can be left exposed at the back of the closet. Or, you can frame a chase to hide the pipes after the installation is complete.



Remove false ceiling panels to route new plumbing pipes in joist cavities. Or, you can route pipes across a standard plaster or wallboard ceiling, then construct a false ceiling to cover the installation, provided there is adequate height. Most Building Codes require a minimum of 7 ft. from floor to finished ceiling. '



Use a drill extension and spade bit or hole saw to drill through wall plates from unfinished attic or basement spaces above or below the wall.



Look for "wet walls." Walls that hold old plumbing pipes can be good choices for running long vertical runs of new pipe. These spaces usually are open, without obstacles such as fireblocks and insulation.





Probe wall and floor cavities with a long piece of plastic pipe to ensure that a clear pathway exists for running new pipe (left). Once you have established a route using the narrow pipe, you can use the pipe as a guide when running larger drain pipes up into the wall (right).



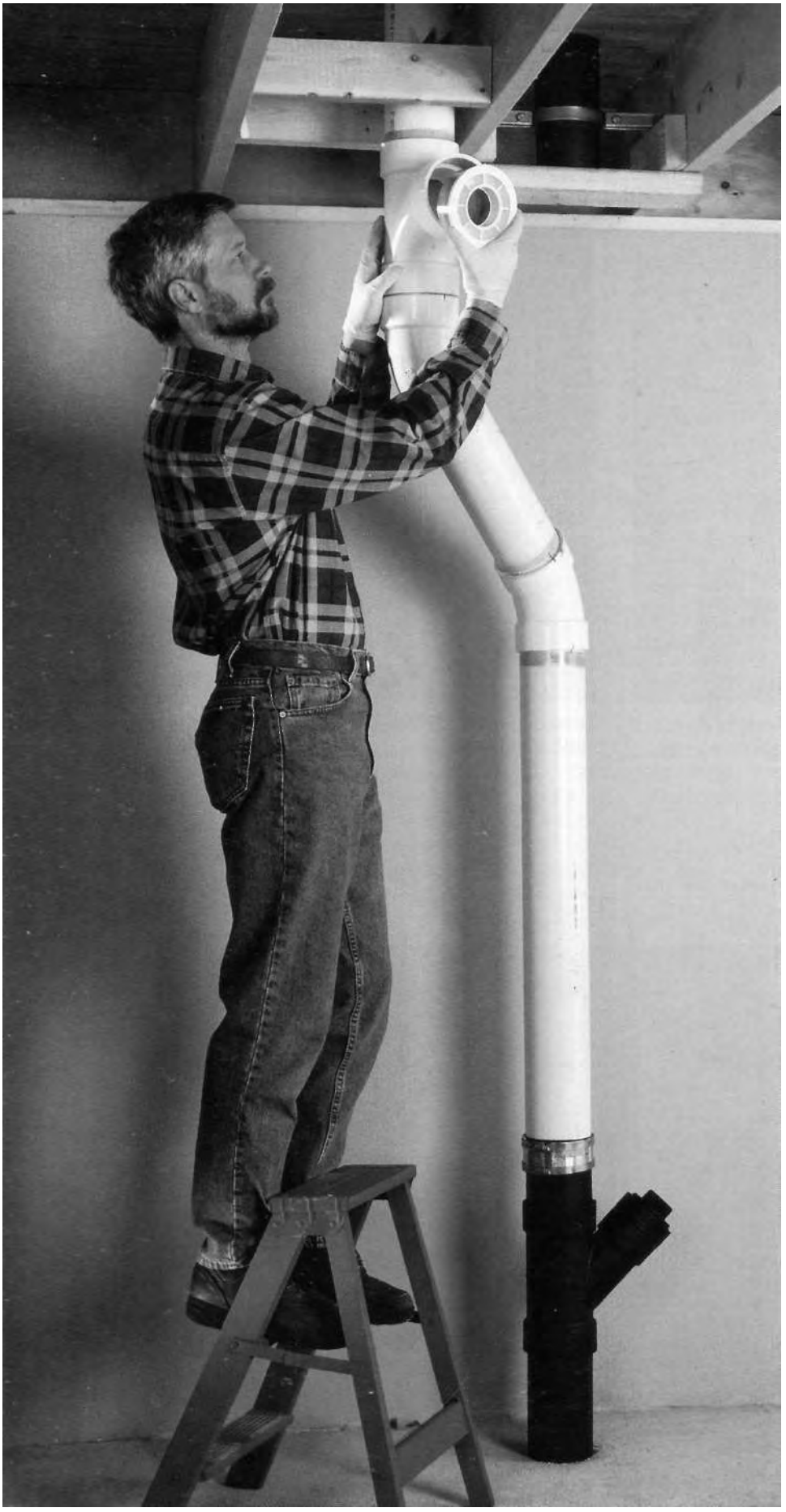
Remove flooring when necessary. Because replacing toilet and bathtub drains usually requires that you remove sections of floor, a full plumbing replacement job is often done in conjunction with a complete bathroom remodeling project.



Remove wall surfaces when access from above or below the wall is not possible. This demolition work can range from cutting narrow channels in plaster or wallboard to removing the entire wall surface. Remove wall surfaces back to the centers of adjoining studs; the exposed studs provide a nailing surface for attaching new wall materials once the plumbing project is completed.



Create a detailed map showing the planned route for your new plumbing pipes. Such a map can help you get your plans approved by the inspector, and it makes work much simpler. If you have already mapped your existing plumbing system (pages 18 to 23), those drawings can be used to plan new pipe routes.



A new main waste-vent stack is best installed near the location of the old stack. In this way, the new stack can be connected to the basement floor cleanout fitting used by the old cast-iron stack.

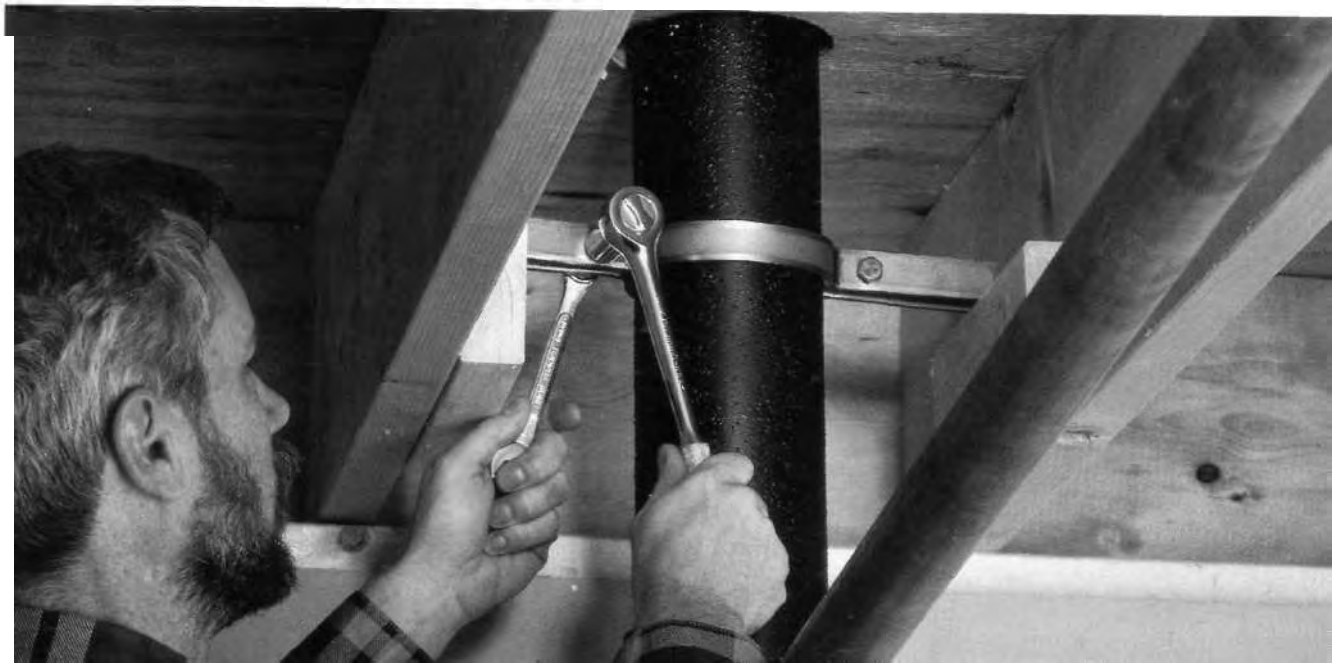
Replacing a Main Waste-Vent Stack

Although a main waste-vent stack rarely rusts through entirely, it can be nearly impossible to join new branch drains and vents to an old cast-iron stack. For this reason, plumbing contractors sometimes recommend replacing the iron stack with plastic pipe during a plumbing renovation project.

Be aware that replacing a main waste-vent stack is not an easy job (pages 69 to 71). You will be cutting away heavy sections of cast iron, so working with a helper is essential. Before beginning work, make sure you have a complete plan for your plumbing system and have designed a stack that includes all the fittings you will need to connect branch drains and vent pipes. While work is in progress, none of your plumbing fixtures will be usable. To speed up the project and minimize inconvenience, do as much of the demolition and preliminary construction work as you can before starting work on the stack.

Because main waste-vent stacks may be as large as 4" in diameter, running a new stack through existing walls can be troublesome. To solve this problem, our project employs a common solution: framing a chase in the corner of a room to provide the necessary space for running the new stack from the basement to the attic. When the installation is complete, the chase will be finished with wallboard to match the room.

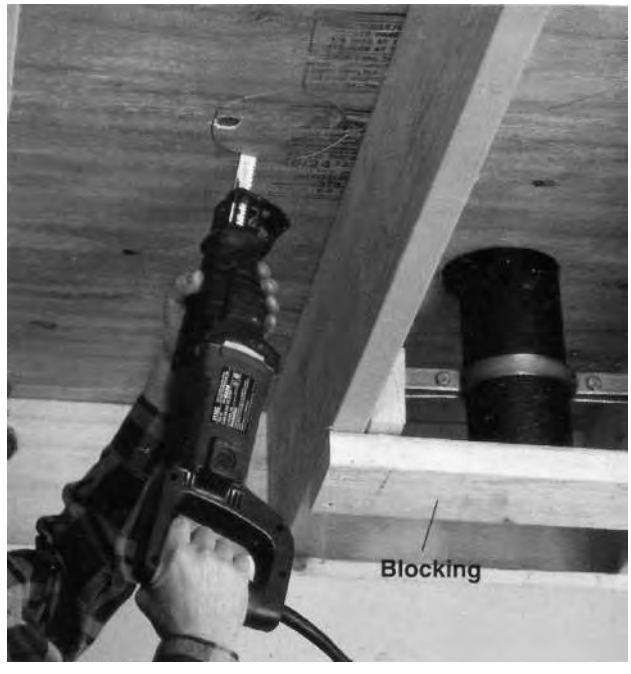
How to Replace a Main Waste-Vent Stack



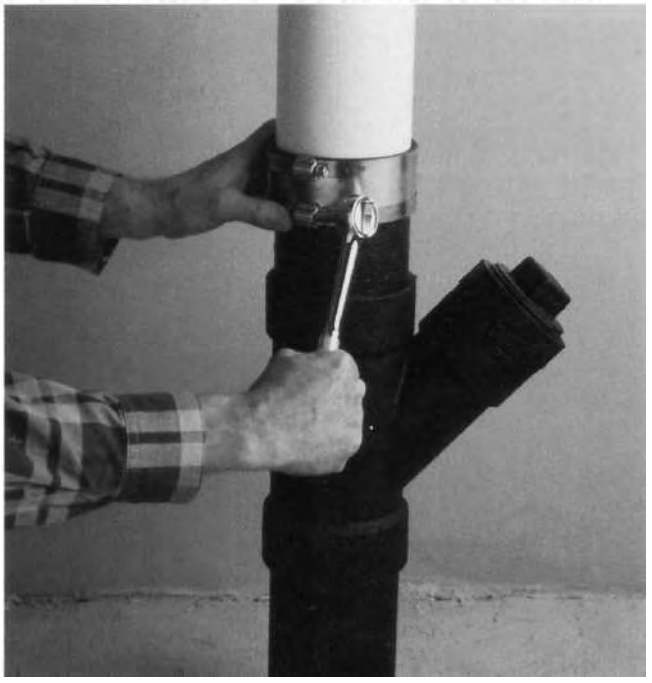
1 Secure the cast-iron waste-vent stack near the ceiling of your basement, using a riser clamp installed between the floor joists. Use wood blocks attached to the joists with 3" wallboard screws to support the clamp. Also clamp the stack in the attic, at the point where the stack passes down into the wall cavity. WARNING: A cast-iron stack running from basement to attic can weigh several hundred pound; Never cut into a cast-iron stack before securing it with riser clamps above the cut.



2 Use a cast iron snap cutter to sever the stack near the floor of the basement, about 8" above the cleanout, and near the ceiling, flush with the bottom of the joists. Have a helper hold the stack while you are cutting out the section. NOTE: After cutting into the main waste-vent stack, plug the open end of the pipe with a cloth to prevent sewer gases from rising into your home.



3 Nail blocking against the bottom of the joists across the severed stack. Then, cut a 6"-diameter hole in the basement ceiling where the new waste-vent stack will run, using a reciprocating saw. Suspend a plumb bob at the centerpoint of the opening as a guide for aligning the new stack.



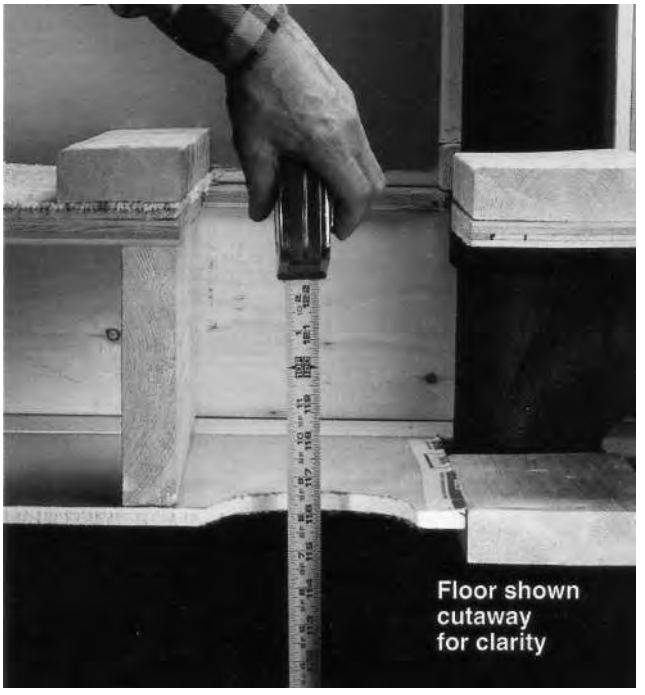
4 Attach a 5-ft. segment of PVC plastic pipe the same diameter as the old waste-vent stack to the exposed end of the cast-iron cleanout fitting, using a banded coupling with neoprene sleeve (page 70).



5 Dry-fit 45° elbows and straight lengths of plastic pipe to offset the new stack, lining it up with the plumb bob centered on the ceiling opening.



6 Dry-fit a waste T-fitting on the stack, with the inlets necessary for any branch drains that will be connected in the basement. Make sure the fitting is positioned at a height that will allow the branch drains to have the correct 1/4" per foot downward slope toward the stack.



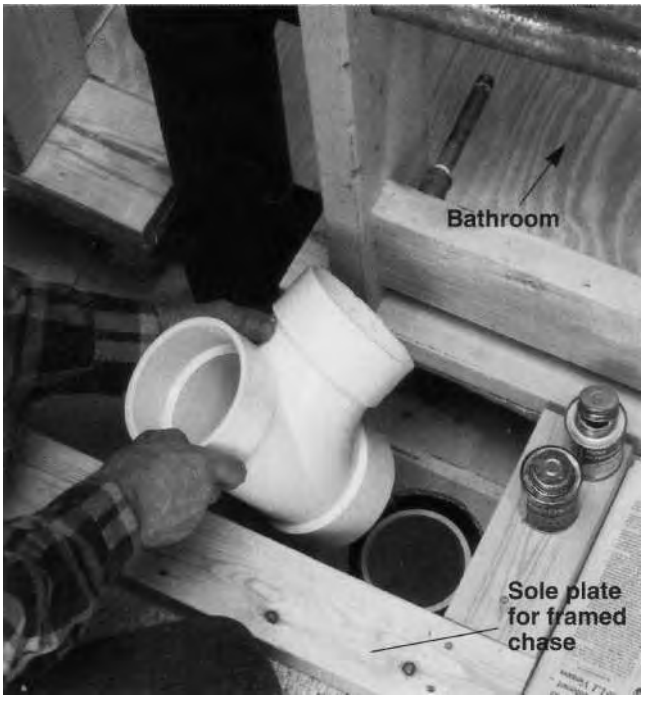
7 Determine the length for the next piece of waste-vent pipe by measuring from the basement T-fitting to the next planned fitting in the vertical run. In our project, we will be installing a T-fitting between floor joists, where the toilet drain will be connected.



8 Cut a PVC plastic pipe to length, raise it into the opening, and dry-fit it to the T-fitting. NOTE: For very long pipe runs, you may need to construct this vertical run by solvent-gluing two or more segments of pipe together with couplings.



9 Check the length of the stack, then solvent-glue all fittings together. Support the new stack with a riser clamp resting on blocks attached between basement ceiling joists.



10 Attach the next waste T-fitting to the stack. In our demonstration project, the waste T lies between floor joists and will be used to connect the toilet drain. Make sure the waste T is positioned at a height which will allow for the correct 1/8″ per foot downward slope for the toilet drain.



11 Add additional lengths of pipe, with waste T-fittings installed where other fixtures will drain into the stack. In our example, a waste T with a 1 1/2″ bushing insert is installed where the vanity sink drain will be attached to the stack. Make sure the T-fittings are positioned to allow for the correct downward pitch of the branch drains.



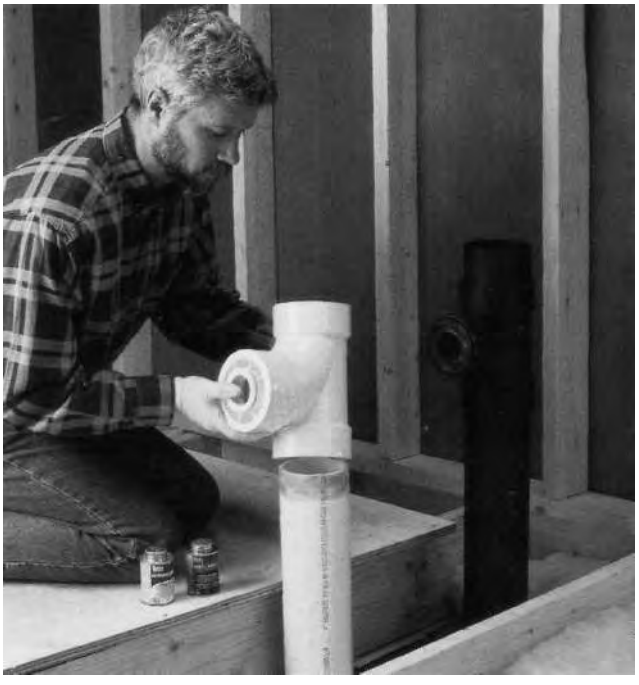
12 Cut a hole in the ceiling where the waste-vent stack will extend into the attic, then measure, cut, and solvent-glue the next length of pipe in place. The pipe should extend at least 1 ft. up into the attic.



13 Remove the roof flashing from around the old waste-vent stack. You may need to remove shingles in order to accomplish this. NOTE: Always use caution when working on a roof. If you are unsure of your ability to do this work, hire a roof repair specialist to remove the old flashing and install new flashing around the new vent pipe.



in the attic, remove old vent pipes, where necessary, then sever the cast-iron soil stack with a cast iron cutter and lower the stack down from the roof opening with the aid of a helper. Support the old stack with a riser clamp installed between joists.



15 Solvent-glue a vent T with a 111/2" bushing in the side inlet to the top of the new waste-vent stack. The side inlet should point toward the nearest auxiliary vent pipe extending up from below.



16 Finish the waste-vent stack installation by using 45° elbows and straight lengths of pipe to extend the stack through the same roof opening used by the old vent stack. The new stack should extend at least 1 ft. through the roof, but no more than 2 ft.

How to Flash a Waste-Vent Stack



1 Loosen the shingles directly above the new vent stack, and remove any nails, using a flat pry bar. When installed, the metal vent flashing will lie flat on the shingles surrounding the vent pipe. Apply roofing cement to the underside of the flashing.



2 Slide the flashing over the vent pipe, and carefully tuck the base of the flashing up under the shingle. Press the flange firmly against the roof deck to spread the roofing cement, then anchor it with rubber gasket flashing nails. Reattach loose shingles as necessary.



Remove old pipes only where they obstruct the planned route for the new pipes. You will probably need to remove drain and water supply pipes at each fixture location, but the remaining pipes usually can be left in place. A reciprocating saw with metal-cutting blade works well for this job.

Replacing Branch Drains & Vent Pipes

In our demonstration project, we are replacing branch drains for a bathtub and vanity sink. The tub drain will run down into the basement before connecting to the main waste-vent stack, while the vanity drain will run horizontally to connect directly to the stack.

A vent pipe for the bathtub runs up into the attic, where it will join the main waste-vent stack. The vanity sink, however, requires no secondary vent pipe, since its location falls within the critical distance (page 29) of the new waste-vent stack.

How to Replace Branch Drains



1 Establish a route for vertical drain pipes running through wall cavities down into the basement. For our project, we are cutting away a section of the wall sole plate in order to run a 111/2" bathtub drain pipe from the basement up to the bathroom.



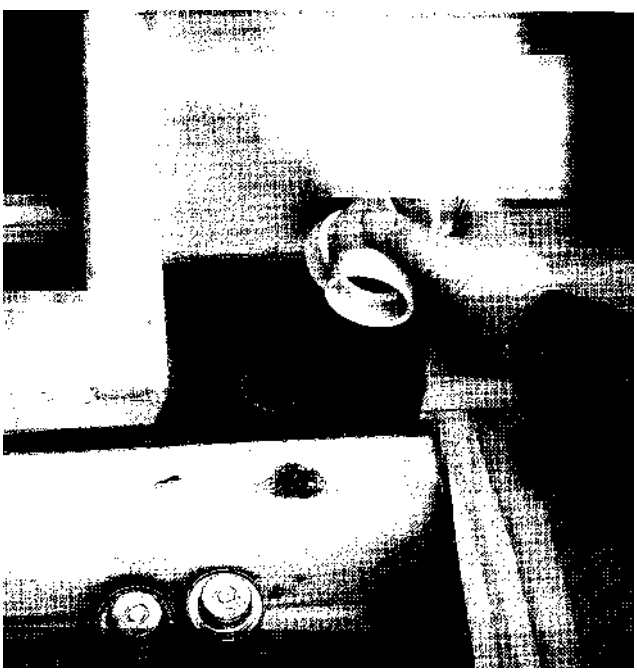
2 From the basement, cut a hole in the bottom of the wall, below the opening cut (step 1). Measure, cut, and insert a length of vertical drain pipe up into the wall to the bathroom. A length of flexible CPVC pipe can be useful for guiding the drain pipe up into the wall. For very long pipe runs, you may need to join two or more lengths of pipe with couplings as you insert the run.



3 Secure the vertical drain pipe with a riser clamp supported on 2 x 4 blocks nailed between joists. Take care not to overtighten the clamps.



4 Install a horizontal pipe from the waste T-fitting on the waste-vent stack to the vertical drain pipe. Maintain a downward slope toward the stack of 1/4″ per foot, and use a Y-fitting with 45° elbow to form a cleanout where the horizontal and vertical drain pipes meet.



5 Solvent-glue a waste T-fitting to the top of the vertical drain pipe. For a bathtub drain, as shown here, the T-fitting must be well below floor level to allow for the bathtub drain trap (page 108). You may need to notch or cut a hole in floor joists to connect the drain trap to the waste T (page 76).



6 From the attic, cut a hole into the top of the bathroom wet wall, directly above the bathtub drain pipe. Run a 11/2 vent pipe down to the bathtub location, and solvent-glue it to the waste T. Make sure the pipe extends at least 1 ft. into the attic.



7 Remove wall surfaces as necessary to provide access for running horizontal drain pipes from fixtures to the new waste-vent stack. In our project, we are running 11/2" drain pipe from a vanity sink to the stack. Mark the dram route on the exposed studs, maintaining a 1/4″ per foot downward slope toward the stack. Use a reciprocating saw or jig saw to notch out the studs (page 76),



8 Secure the old drain and vent pipes with riser clamps supported by blocking attached between the studs.



9 Remove the old drain and water supply pipes, where necessary, to provide space for running the new drain pipes.



10 Using a sweep elbow and straight length of pipe, assemble a drain pipe to run from the drain stub-out location to the waste T-fitting on the new waste-vent stack. Use a 90° elbow and a short length of pipe to create a stub-out extending at least 2" out from the wall. Secure the stub-out to a 3/4″ backer board attached between studs.



11 Protect the drain pipes by attaching metal protector plates over the notches in the studs. Protector plates prevent drain pipes from being punctured when wall surfaces are replaced.



12 In the attic, use a vent elbow and straight length of pipe to connect the vertical vent pipe from the tub to the new waste-vent stack.



Replacing a toilet drain usually requires that you remove flooring and wall surface to gain access to the pipes.

Replacing a Toilet Drain

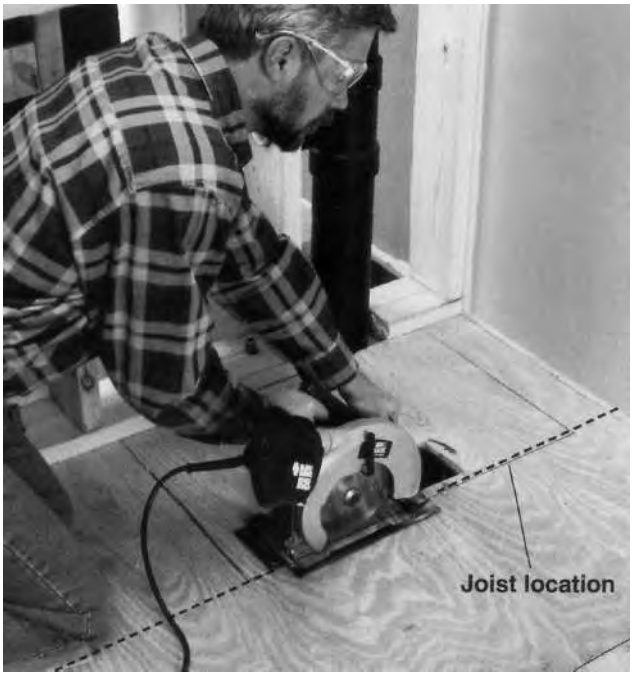
Replacing a toilet drain is sometimes a troublesome task, mostly because the cramped space makes it difficult to route the large, 3" or 4" pipe. You likely will need to remove flooring around the toilet and wall surface behind the toilet.

Replacing a toilet drain may require framing work, as well, if you find it necessary to cut into joists in order to route the new pipes. When possible, plan your project to avoid changes to the framing members.

How to Replace a Toilet Drain



1 Remove the toilet, then unscrew the toilet flange from the floor and remove it from the drain pipe. NOTE: If the existing toilet flange is cast iron or bronze, it may be joined to the toilet bend with poured lead or solder; in this case, it is easiest to break up the flange with a masonry hammer (make sure to wear eye protection) and remove it in pieces.



2 Cut away the flooring around the toilet drain along the center of the floor joists, using a circular saw with the blade set to a depth 1/8" more than the thickness of the subfloor. The exposed joist will serve as a nailing surface when the subfloor is replaced.



3 Cut away the old toilet bend as close as possible to the old waste-vent stack, using a reciprocating saw with metal-cutting blade, or a snap cutter.



4 If a joist obstructs the route to the new waste-vent stack, cut away a section of the floor joist. Install double headers and metal joist hangers to support the ends of the cut joist.

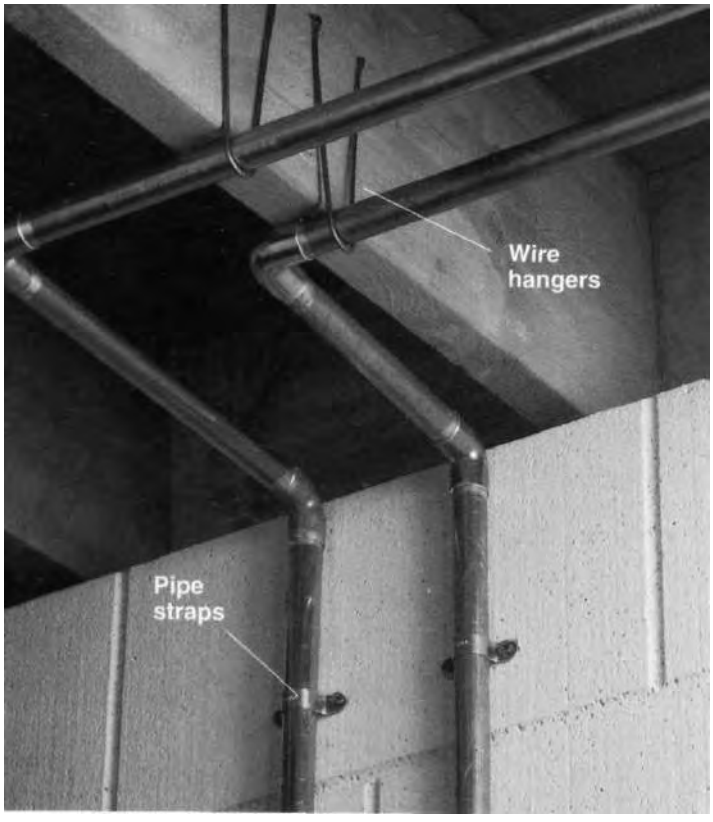


5 Create a new toilet drain running to the new waste-vent stack, using a toilet bend and a straight length of pipe. Position the drain so there will be at least 15" of space between the center of the bowl and side wall surfaces when the toilet is installed. Make sure the drain slopes at least 1/8″ per foot toward the stack, then support the pipe with plastic pipe strapping attached to framing members. Insert a 6" length of pipe in the top inlet of the closet bend; once the new drain pipes have been tested, this pipe will be cut off with a handsaw and fitted with a toilet flange.



6 Cut a piece of exterior-grade plywood to fit the cutout floor area, and use a jig saw to cut an opening for the toilet drain stub-out. Position the plywood, and attach it to joists and blocking with 2" screws.

Replacing Supply Pipes



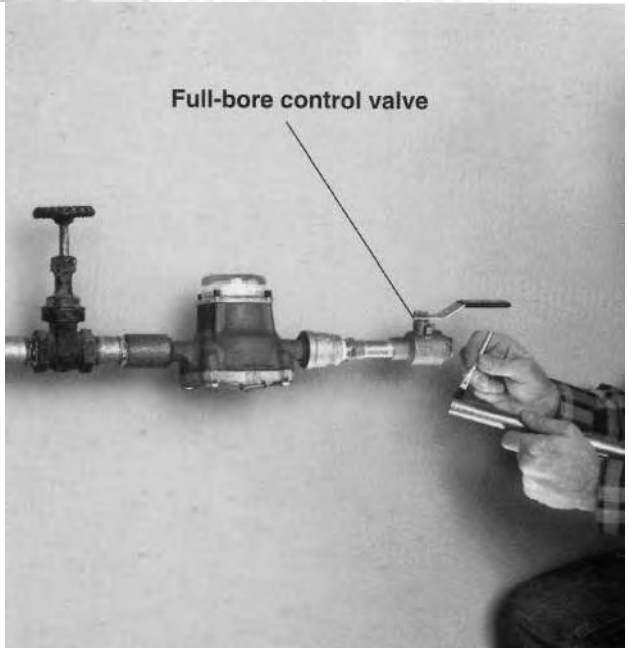
Support copper supply pipes every 6 ft along verti cal runs and 10 ft. along horizontal runs. Always use copper or plastic support materials with copper; never use steel straps, which can interact with copper and cause corrosion.

When replacing old galvanized water supply, pipes, we recommend that you use type-M rigid copper. Use 3/4″ pipe for the main distribution pipes and 1/2" pipes for the branch lines running to individual fixtures.

For convenience, run hot and cold water pipes parallel to one another, between 3" and 6" apart. Use the straightest, most direct routes possible when planning the layout, because too many bends in the pipe runs can cause significant friction and reduce water pressure.

It is a good idea to removed old supply pipes that are exposed, but pipes hidden in walls can be left in place unless they interfere with the installation of the new supply pipes.

How to Replace Water Supply Pipes



1 Shut off the water on the street side of the water meter, then disconnect and remove the old water pipes from the house side. Solder a 3/4″ male threaded adapter and full-bore control valve to a short length of 3/4" copper pipe, then attach this assembly to the house side of the water meter. Extend the 3/4″ cold-water distribution pipe toward the nearest fixture, which is usually the water heater.



2 At the water heater, install a 3/4″ T-fitting in the cold-water distribution pipe. Use two lengths of 3/4" copper pipe and a full-bore control valve to run a branch pipe to the water heater. From the outlet opening on the water heater, extend a 3/4" hot-water distribution pipe, also with a full-bore control valve (page 245). Continue the hot and cold supply lines on parallel routes toward the next group of fixtures in your house.



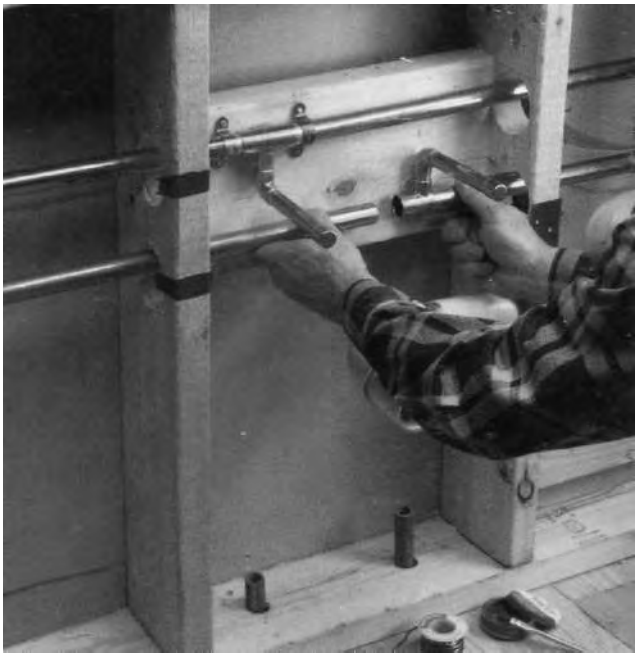
3 Establish routes for branch supply lines by drilling holes into stud cavities. Install T-fittings, then begin the branch lines by installing brass control valves. Branch lines should be nnade with 3/4″ pipe if they are supplying more than one fixture; 1/2" if they are supplying only one fixture.



4 Extend the branch lines to the fixtures. In our project, we are running 3/4" vertical branch lines up through the framed chase to the bathroom. Route pipes around obstacles, such as a main waste-vent stack, by using 45° and 90° elbows and short lengths of pipe.



5 Where branch lines run through studs or floor joists, drill holes or cut notches in the framing members (page 76), then insert the pipes. For lone runs of pipe, you may need to join two or more shorter lengths of pipe, using couplings as you create the runs.



6 Install 3/4" to 1/2" reducing T-fittings and elbows to extend the branch lines to individual fixtures. In our bathroom, we are installing hot and cold stub-outs for the bathtub and sink, and a cold-water stub-out for the toilet. Cap each stub-out until your work has been inspected and the wall surfaces have been completed.

Repairing Old Plumbing

Every homeowner eventually deals with plumbing problems. Most can be repaired with basic skills, tools, and instructions and require no professional help. This section will help you recognize and fix problems with all types of common household plumbing fixtures.

On the following pages you'll find directions for repairing faucets, including shutoff valves, supply tubes, diverter valves, sprayers, and aerators. The information on tub and shower plumbing includes directions for repairing tub and shower faucets, plus shower heads. For problems with an outdoor water supply, see the directions for repairing valves, hose bibs, and sillcocks.

Toilet problems, too, are easily remedied. We'll show you how to adjust and replace toilet parts and how to stop a toilet from running or leaking.

The section on clogs includes detailed instructions for clearing all types of drains and for fixing separate drain system parts.

Because water heaters are usually out of sight, they are easy to ignore—until something goes wrong. This section shows how water heaters work, and how to repair or replace them. The section ends with advice on fixing burst, frozen, or noisy plumbing pipes.

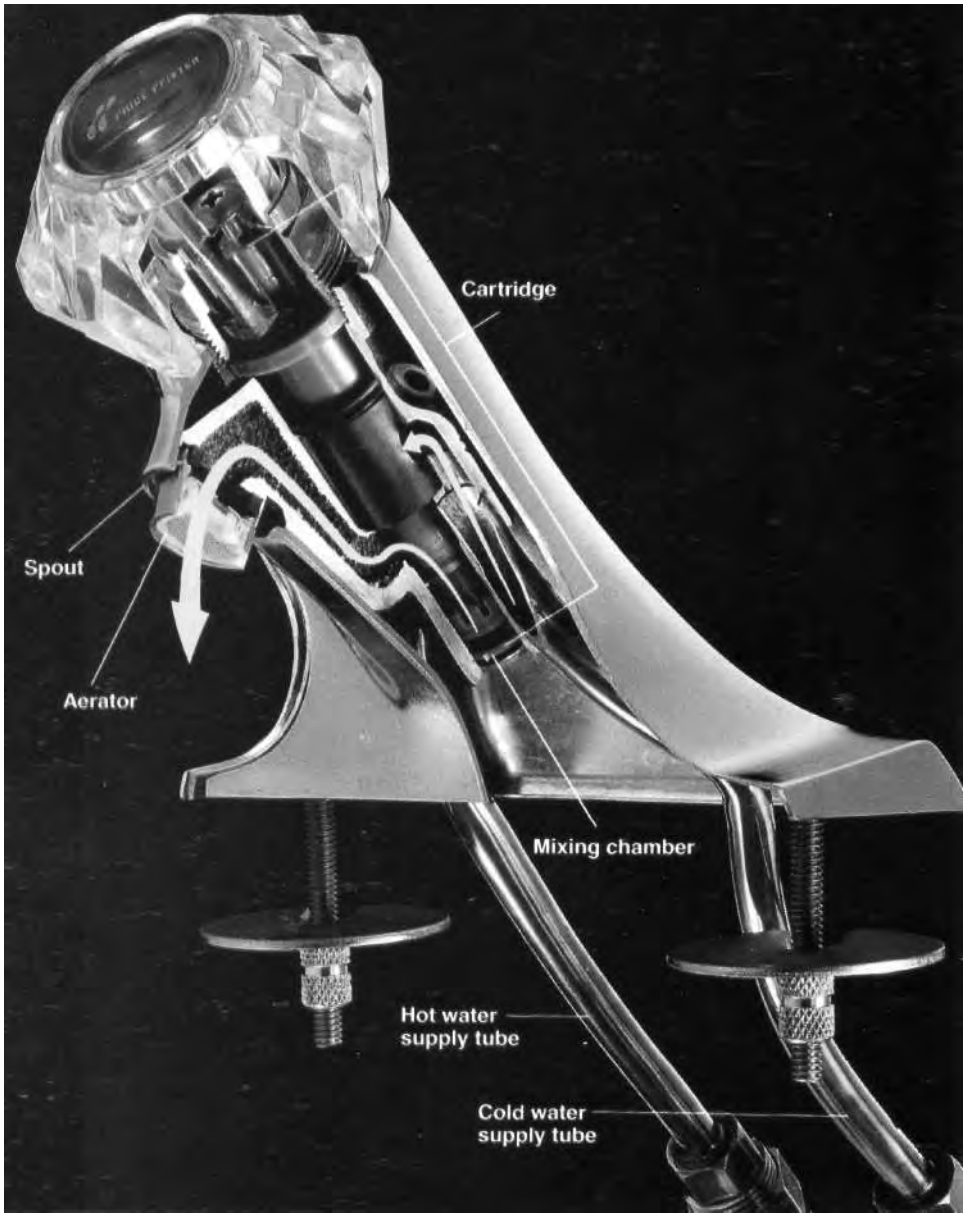
Faucet Problems & Repairs

Most faucet problems are easy to fix. You can save money and time by making these simple repairs yourself. Replacement parts for faucet repairs usually are inexpensive and readily available at hardware stores and home centers. Techniques for repair vary, depending on the faucet design

If a badly worn faucet continues to leak, even after repairs are made, the faucet should be replaced. In less than an hour, you can replace an old, problem faucet with a new model that is designed to provide years of trouble-free service.

Problems	Repairs
Faucet drips from the end of the spout, or leaks around the base.	Identify the faucet design (page 177), then install replacement parts, using directions on following pages.
Old, worn-out faucet continues to leak after repairs are made.	Replace the old faucet (pages 188 to 191).
Water pressure at spout seems low, or water flow is partially blocked.	1. Clean faucet aerator (page 194). 2. Replace corroded galvanized pipes with copper (pages 46 to 55).
Water pressure from sprayer seems low, or sprayer leaks from handle.	1. Clean sprayer head (page 194). 2. Fix diverter valve (page 195).
Water leaks onto floor underneath faucet.	1. Replace cracked sprayer hose (page 195). 2. Tighten water connections, or replace supply tubes and shutoff valves (pages 192 to 193). 3. Fix leaky sink strainer (page 225).
Hose bib or valve drips from spout or leaks around handle.	Take valve apart and replace washers and 0-rings (pages 206 to 207).

Fixing Leaky Faucets



Typical faucet has a single handle attached to a hollow cartridge. The cartridge controls hot and cold water flowing from the supply tubes into the mixing chamber. Water is forced out the spout and through the aerator. When repairs are needed, replace the entire cartridge.



Turn off water before starting any faucet repair, using shutoff valves underneath faucet, or main service valve found near water meter (page 6). When opening shutoff valves after finishing repairs, keep faucet handle in open position to release trapped air. When water runs steadily close faucet.

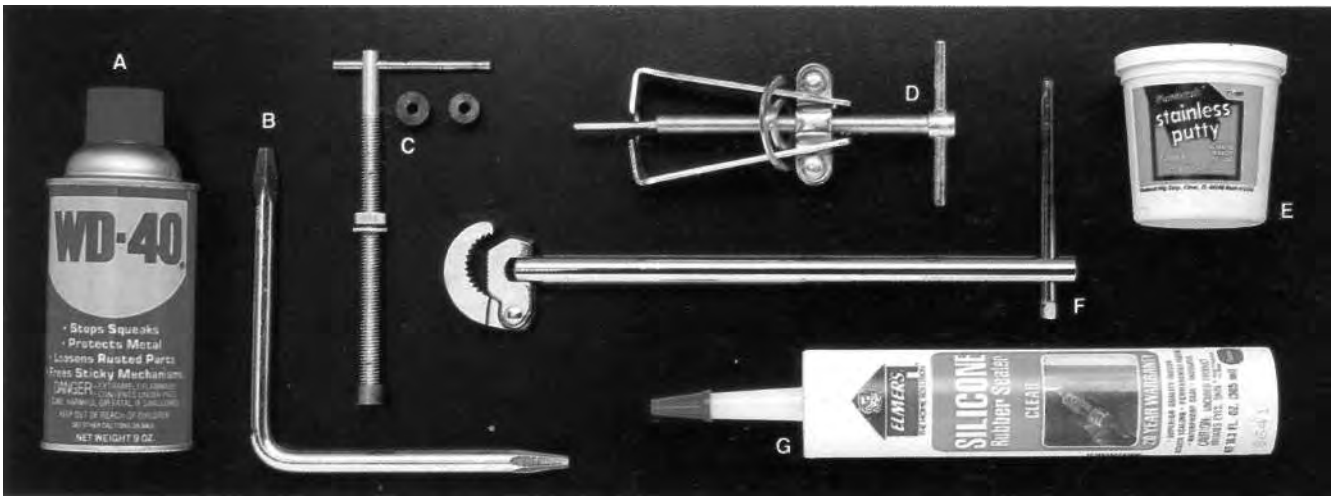
A leaky faucet is the most commori home plumbing problem. Leaks occur when washers, 0-rings, or seals inside the faucet are dirty or worn. Fixing leaks is easy, but the techniques for making repairs will vary, depending on the design of the faucet. Before beginning work, you must first identify your faucet design and determine what replacement parts are needed.

There are four basic faucet designs: ball-type, cartridge, disc, or compression. Many faucets can be identified easily by outer appearance, but others must be taken apart before the design can be recognized.

The compression design is used in many double-handle faucets. Compression faucets all have washers or seals that must be replaced from time to time. These repairs are easy to make, and replacement parts are inexpensive.

Ball-type, cartridge, and disc faucets are all known as washerless faucets. Many washerless faucets are controlled with a single handle, although some cartridge models use two handles. Washerless faucets are more trouble-free than compression faucets, and are designed for quick repair.

When installing new faucet parts, make sure the replacements match the original parts. Replacement parts for popular washerless faucets are identified by brand name and model number. To ensure a correct selection, you may want to bring the worn parts to the store for comparison.



Specialty tools and materials for faucet repairs include: penetrating oil (A), seat wrench (B), seat-dressing (reamer) tool (C), handle puller (D), plumber's putty (E), basin wrench (F), silicone caulk (G).



Ball-type faucet has a single handle over a dome-shaped cap. If your single-handle faucet is made by Delta or Peerless, it is probably a ball-type faucet. See pages 178 to 179 to fix a ball-type faucet.



Cartridge faucets are available in single-handle or double-handle models. Popular cartridge faucet brands include Price Pfister, Moen, Valley, and Aqualine. See pages 180 to 181 to fix a cartridge faucet.



Compression faucet has two handles. When shutting the faucet off, you usually can feel a rubber washer being squeezed inside the faucet. Compression faucets are sold under many brand names. See pages 182 to 185 to fix a compression faucet.



Disc faucet has a single handle and a solid, chromed-brass body. If your faucet is made by American Standard or Reliant, it may be a disc faucet. See pages 186 to 187 to fix a disc faucet.



Ball-type faucet has a hollow ball that controls the temperature and flow of water. Dripping at the faucet spout is caused by worn-out valve seats, springs, or a damaged ball. Leaks around the base of the faucet are caused by worn 0-rings.

Fixing Ball-type Faucets

A ball-type faucet has a single handle, and is identified by the hollow metal or plastic ball inside the faucet body Many ball-type faucets have a rounded cap with knurled edges located under the handle. If your faucet leaks from the spout and has this type of cap, first try tightening the cap with channel-type pliers. If tightening does not fix the leak, disassemble the faucet and install replacement parts.

Faucet manufacturers offer several types of replacement kits for ball-type faucets. Some kits contain only the springs and neoprene valve seats, while better kits also include the cam and cam washer.

Replace the rotating ball only if it is obviously worn or scratched. Replacement balls are either metal or plastic. Metal balls are slightly more expensive than plastic, but are more durable.

Remember to turn off the water before beginning work (page 176).

Everything You Need:

Tools: channel-type pliers, Allen wrench, screwdriver, utility knife.

Materials: ball-type faucet repair kit, new rotating ball (if needed), masking tape, 0-rings, heatproof grease.



Repair kit for a ball-type faucet includes rubber valve seats, springs, cam, cam washer, and spout 0-rings. Kit may also include small alien wrench tool used to remove faucet handle. Make sure kit is made for your faucet model. Replacement ball can be purchased separately but is not needed unless old ball is obviously worn.

How to Fix a Ball-type Faucet



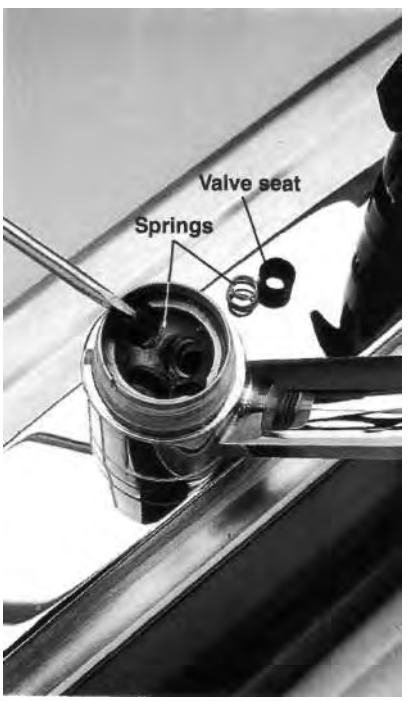
1 Loosen handle setscrew with an Allen wrench. Remove handle to expose faucet cap.



2 Remove the cap with channel-type pliers. To prevent scratches to the shiny chromed finish, wrap masking tape around the jaws of the pliers.



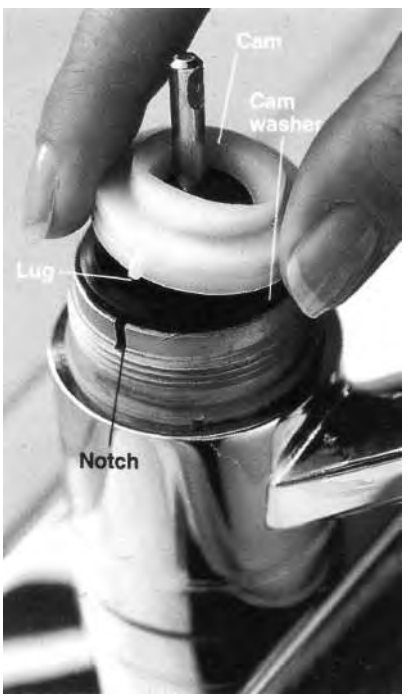
3 Lift out the faucet cam, cam washer, and the rotating ball. Check the ball for signs of wear.



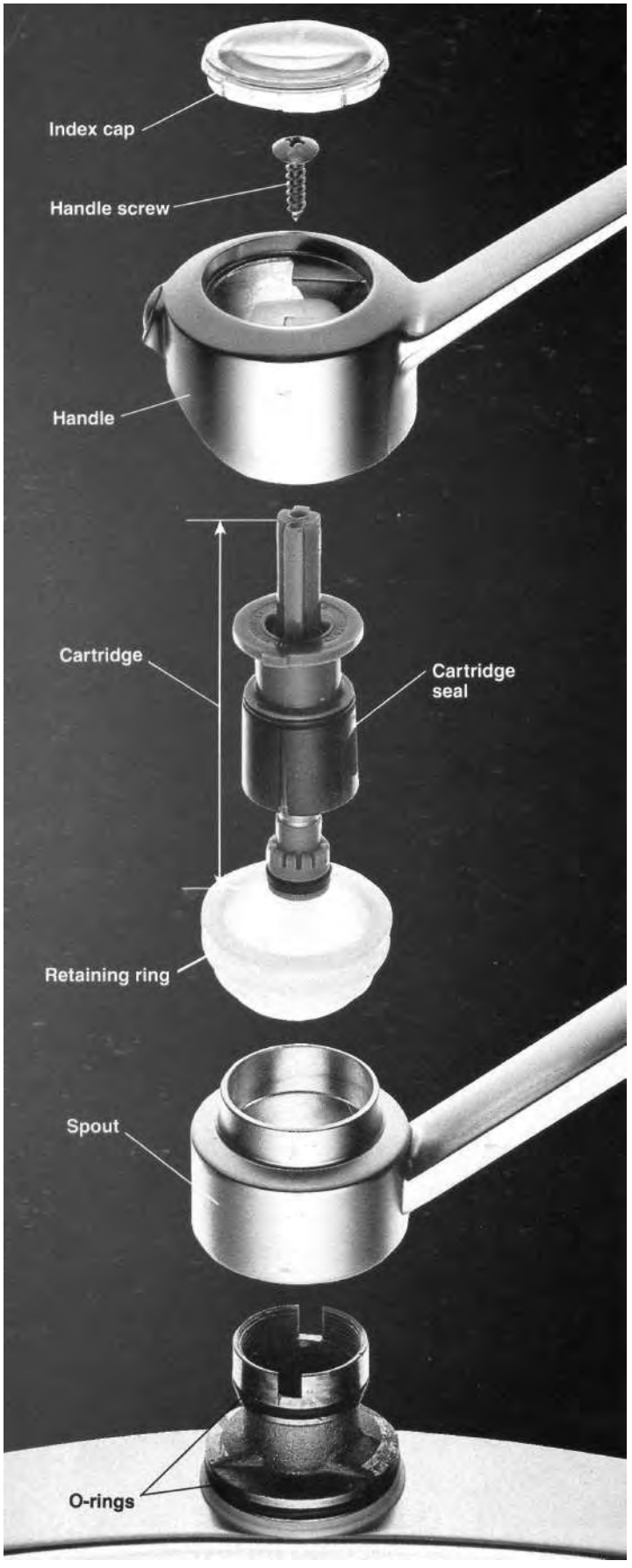
4 Reach into the faucet with a screwdriver and remove the old springs and neoprene valve seats.



5 Remove spout by twisting it upward, then cut off old 0-rings. Coat new 0-rings with heatproof grease, and install. Reattach spout, pressing downward until the collar rests *on plastic* slip ring. *Install new springs and valve seats.*



6 Insert ball, new cam washer, and cam. Small lug on cam should fit into notch on faucet body Screw cap onto faucet and attach handle.



Cartridge faucet has a hollow cartridge insert that lifts and rotates to control the flow and temperature of water Dripping at the spout occurs when the cartridge seals become worn. Leaks around the base of the faucet are caused by worn 0-rings.

Fixing Cartridge Faucets

A cartridge faucet is identified by tine narrow metal or plastic cartridge inside the faucet body. Many single-handle faucets and some double-handle models use cartridge designs.

Replacing a cartridge is an easy repair that will fix most faucet leaks. Faucet cartridges come in many styles, so you may want to bring the old cartridge along for comparison when shopping for a replacement.

Make sure to insert the new cartridge so it is aligned in the same way as the old cartridge. If the hot and cold water controls are reversed, take the faucet apart and rotate the cartridge 180°.

Remember to turn off the water before beginning work (page 176).

Everything You Need:

Tools: screwdriver, channel-type pliers, utility knife.

Materials; replacement cartridge, 0-rings, heat-proof grease.



Replacement cartridges come in dozens of styles. Cartridges are available for popular faucet brands, including (from left): Price-Pfister, Moen, Kohler. 0-ring kits may be sold separately

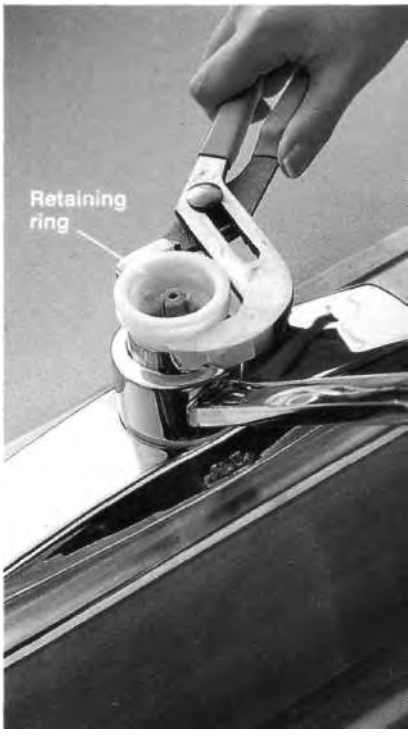
How to Fix a Cartridge Faucet



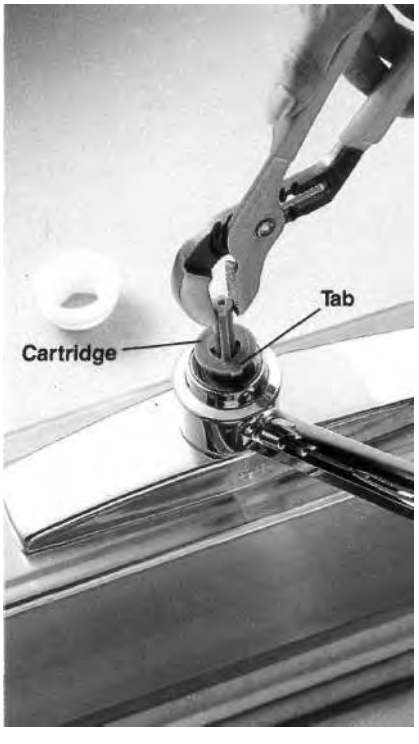
1 Pry off the index cap on top of faucet, and remove the handle screw underneath the cap.



2 Remove faucet handle by lifting it up and tilting it backwards.



3 Remove the threaded retaining ring with channel-type pliers. Remove any retaining clip holding cartridge in place.



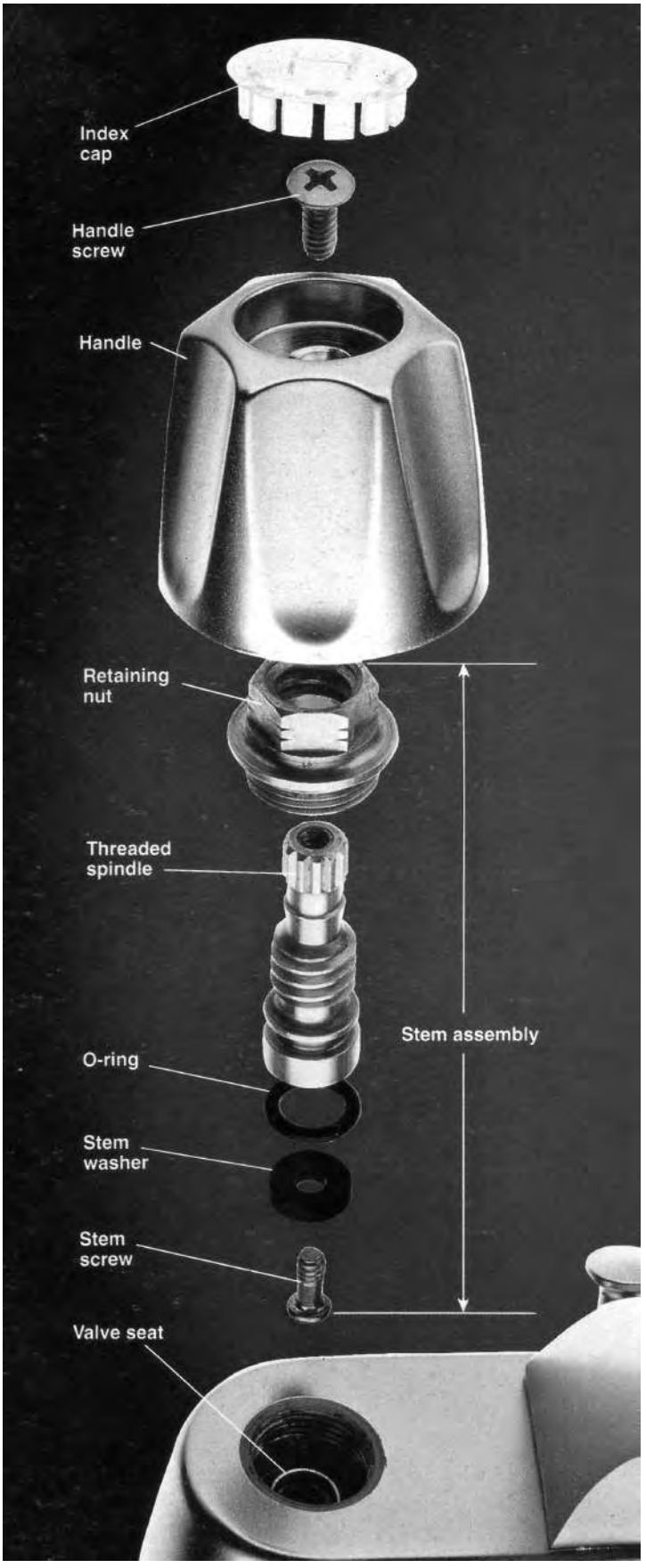
4 Grip top of the cartridge with channel-type pliers. Pull straight up to remove cartridge. Install replacement cartridge so that tab oh cartridge faces forward.



5 Remove the spout by pulling up and twisting, then cut off old O-rings with a utility knife. Coat new 0-rings with heatproof grease, and install.



6 Reattach the spout. Screw the retaining ring onto the faucet, and tighten with channel-type pliers. Attach the handle, handle screw, and index cap.



A compression faucet has a stem assembly that includes a retaining nut, threaded spindle, 0-ring, stem washer, and stem screw. Dripping at the spout occurs when the washer becomes worn. Leaks around the handle are caused by a worn 0-ring.

Fixing Compression Faucets

Compression faucets have separate controls for hot and cold water, and are identified by the threaded stem assemblies inside the faucet body. Compression stems come in many different styles, but all have some type of neoprene washer or seal to control water flow. Compression faucets leak when stem washers and seals become worn.

Older compression faucets often have corroded handles that are difficult to remove. A specialty tool called a handle puller makes this job easier. Handle pullers may be available at rental centers.

When replacing washers, also check the condition of the metal valve seats inside the faucet body If the valve seats feel rough, they should be replaced or resurfaced.

Remember to turn off the water before beginning work (page 176).

Everything You Need:

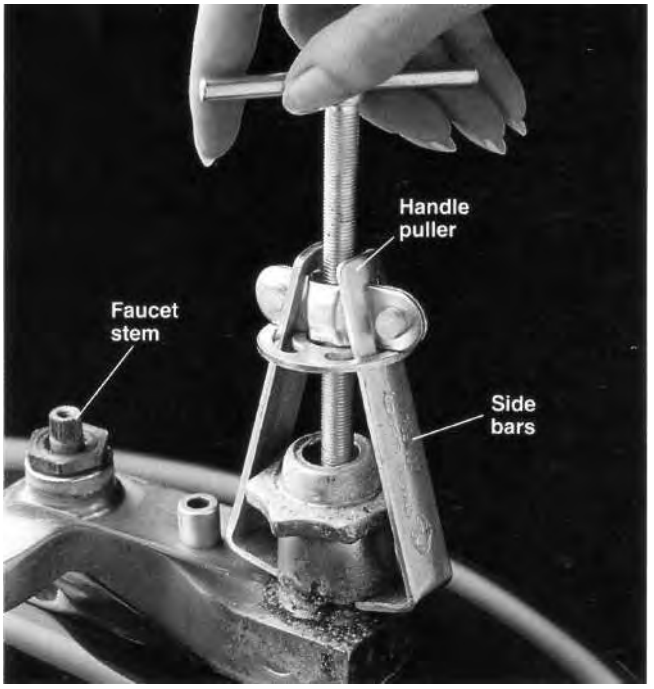
Tools: screwdriver, handle puller (if needed), channel-type pliers, utility knife, seat wrench or seat-dressing tool (if needed).

Materials: universal washer kit, packing string, heatproof grease, replacement valve seats (if needed).

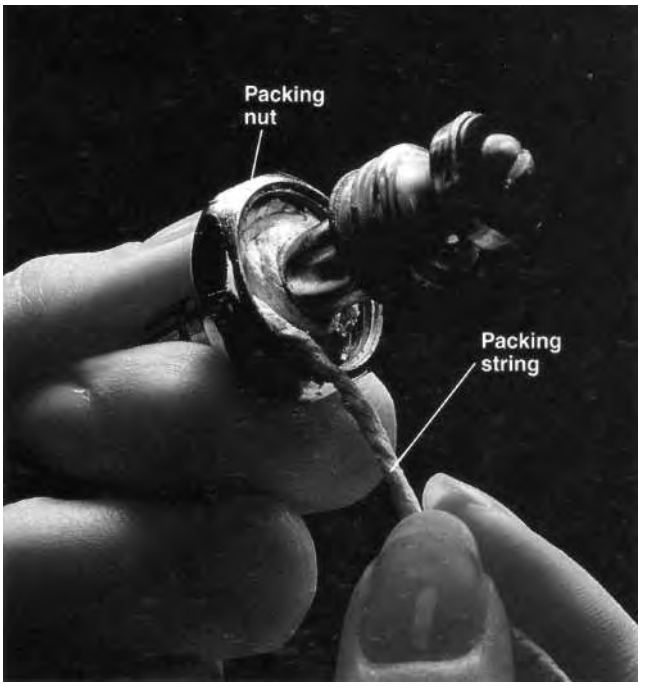


Universal washer kit contains parts needed to fix most types of compression faucets. Choose a kit that has an assortment of neoprene washers, 0-rings, packing washers, and brass stem screws.

Tips for Fixing a Compression Faucet



Remove stubborn handles with a handle puller. Remove the faucet index cap and handle screw, and clamp the side bars of the puller under the handle. Thread the puller into the faucet stem, and tighten until the handle comes free.



Packing string is used instead of an 0-ring on some faucets. To fix leaks around the faucet handle, wrap new packing string around the stem, just underneath the packing nut or retaining nut.

Three Common Types of Compression Stems



Standard stem has a brass stem screw that holds either a flat or beveled neoprene washer to the end of the spindle. If stem screw is worn, it should be replaced.

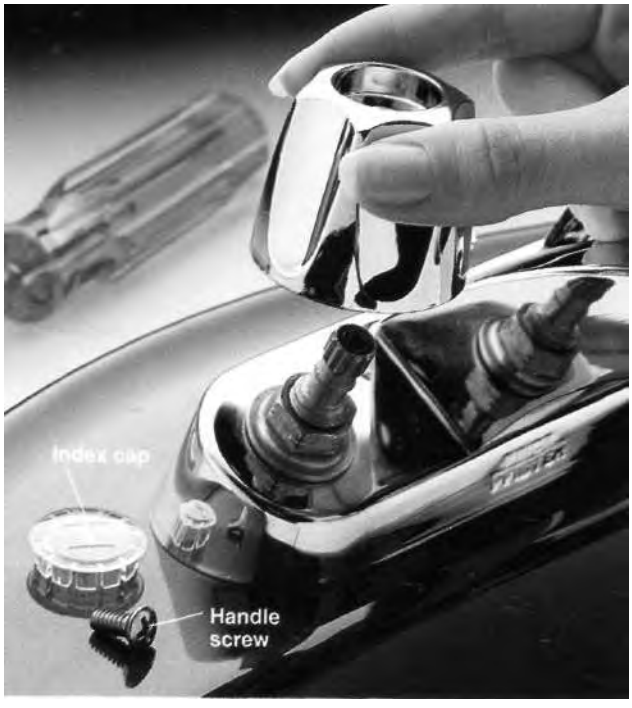


Tophat stem has a snap-on neoprene diaphragm instead of a standard washer. Fix leaks by replacing the diaphragm.



Reverse-pressure stem has a beveled washer at the end of the spindle. To replace washer, unscrew spindle from rest of the stem assembly. Some stems have a small nut that holds washer.

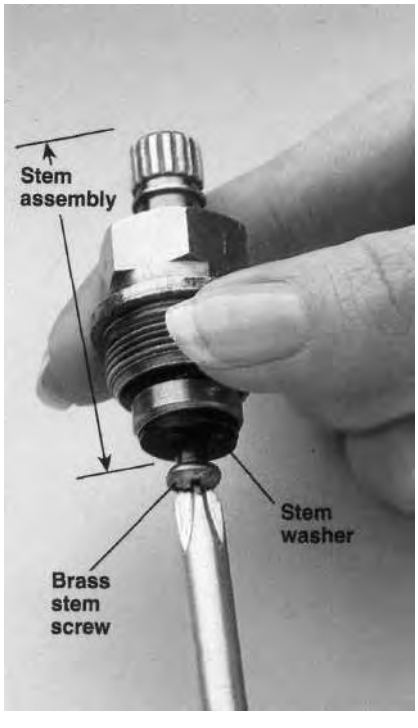
How to Fix a Compression Faucet



1 Remove index cap from top of faucet handle, and remove handle screw. Remove handle by pulling straight up. If necessary, use a handle puller to remove handle (page 183). •



2 Unscrew the stem assembly from body of faucet, using channel-type pliers. Inspect valve seat for wear, and replace or resurface as needed (page opposite). If faucet body or stems are badly worn, it usually is best to replace the faucet (pages 188 to 191).



3 Remove the brass stem screw from the stem assembly Remove worn stem washer.



4 Unscrew the threaded spindle from the retaining nut.



5 Cut off 0-ring and replace with an exact duplicate. Install new washer and stem screw. Coat all parts with heatproof grease, then reassemble the faucet.

How to Replace Worn Valve Seats

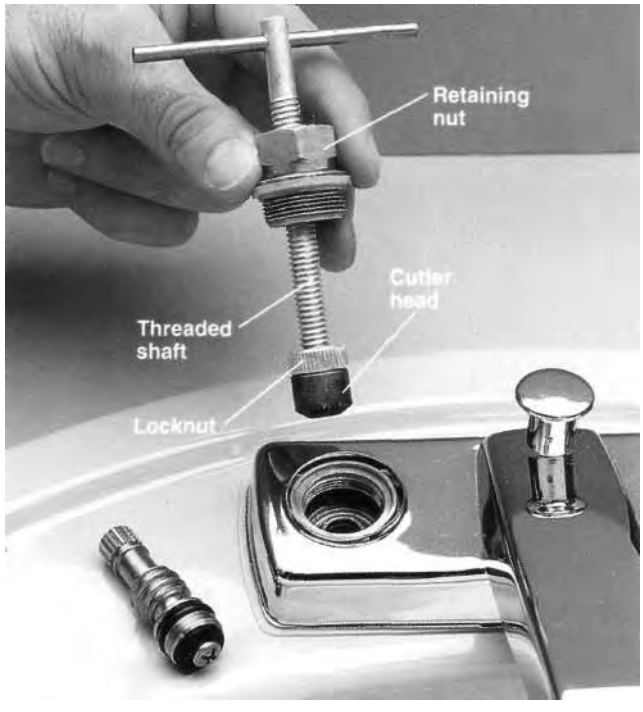


1 Check valve seat for damage by running a fingertip around the rim of the seat. If the valve seat feels rough, replace the seat, or resurface it with a seat-dressing (reamer) tool (below).

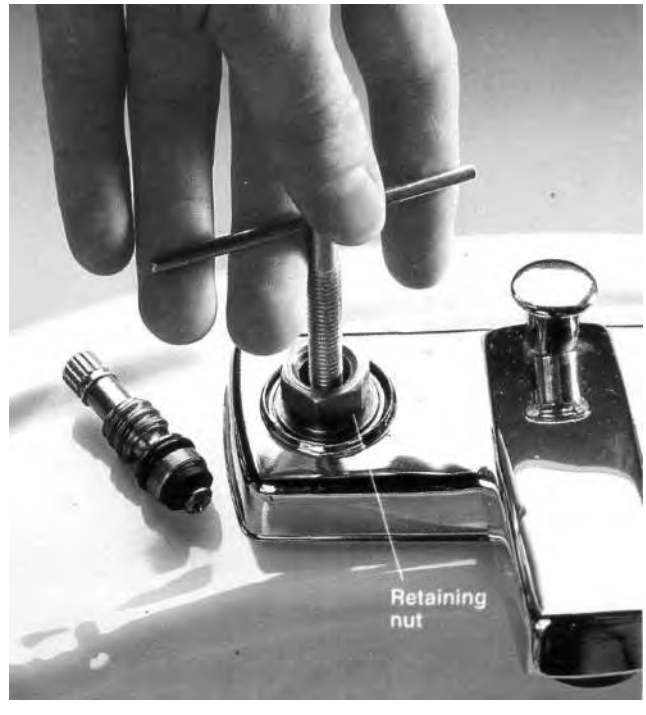


2 Remove valve seat, using a seat wrench. Select end of wrench that fits seat, and insert into faucet. Turn counterclockwise to remove seat, then install an exact duplicate. If seat cannot be removed, resurface with a seat-dressing tool (below).

How to Resurface Valve Seats

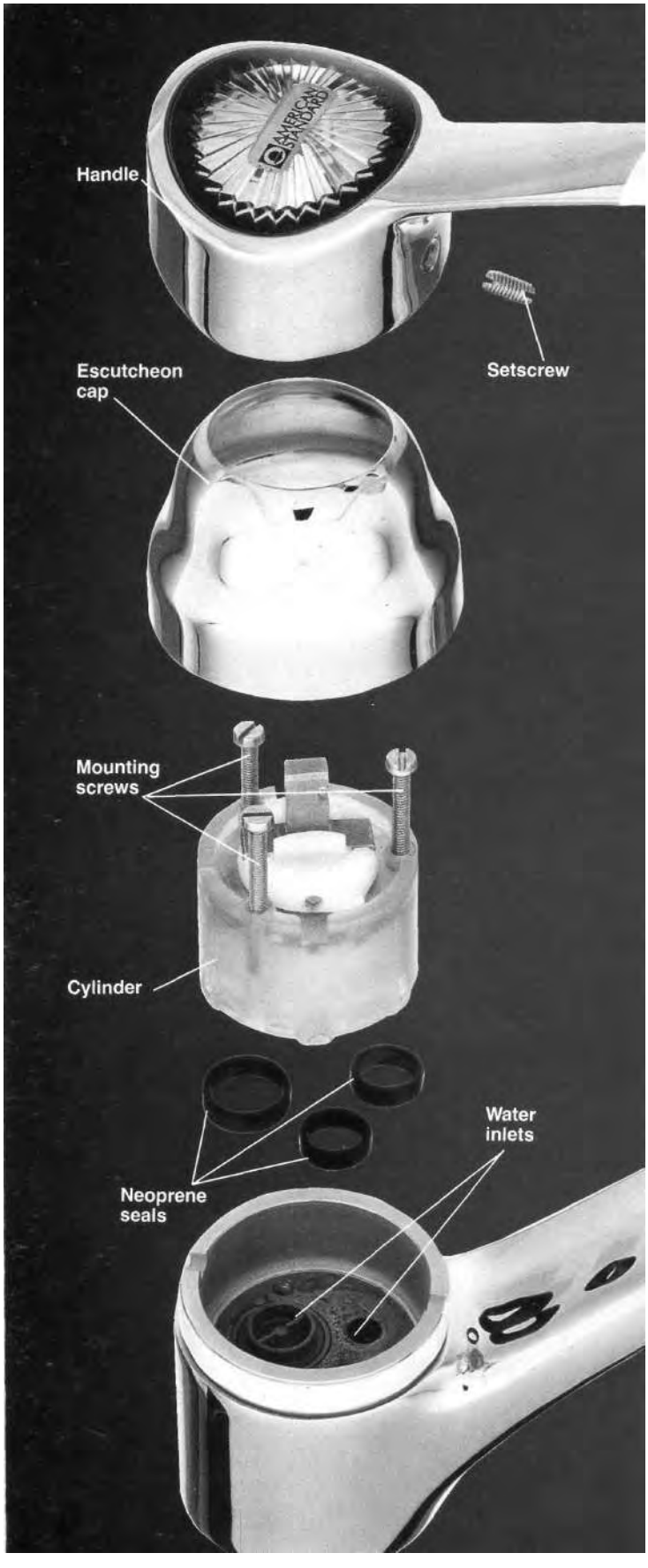


1 Select cutter head to fit the inside diameter of retaining nut. Slide retaining nut over threaded shaft of seat-dressing tool, then attach the locknut and cutter head to the shaft.



2 Screw retaining nut loosely into faucet body Press the tool down lightly and turn tool handle clockwise two or three rotations. Reassemble faucet.

Fixing Disc Faucets



Disc faucet has a sealed cylinder containing two closely fitting ceramic discs. Faucet handle controls water by sliding the discs into alignment. Dripping at the spout occurs when the neoprene seals or cylinder openings are dirty

A disc faucet has a single handle and is identified by the wide cylinder inside the faucet body The cylinder contains a pair of closely fitting ceramic discs that control the flow of water.

A ceramic disc faucet is a top-quality fixture that is easy to repair. Leaks usually can be fixed by lifting out the cylinder and cleaning the neoprene seals and the cylinder openings. Install a new cylinder only if the faucet continues to leak after cleaning.

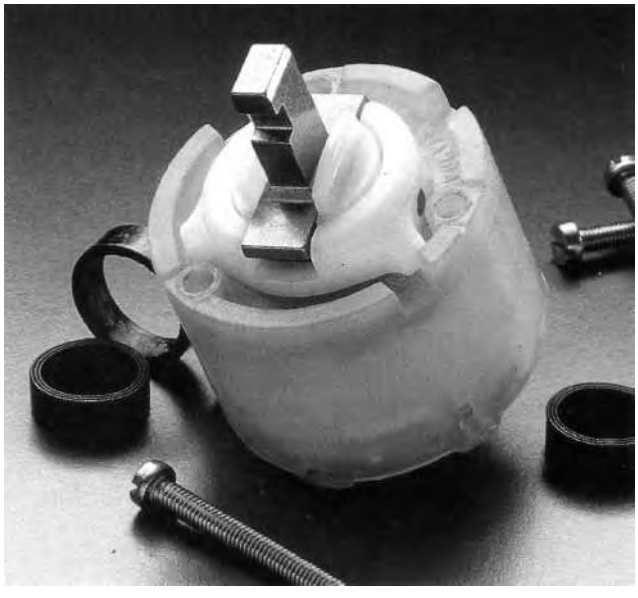
After making repairs to a disc faucet, make sure handle is in the ON position, then open the shutoff valves slowly Otherwise, ceramic discs can be cracked by the sudden release of air from the faucet. When water runs steadily close the faucet.

Remember to turn off the water before beginning work (page 176).

Everything You Need:

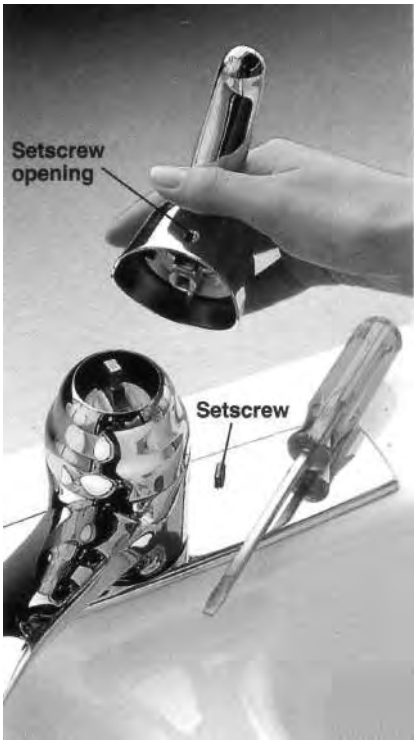
Tools: screwdriver.

Materials:-Scotch Brite pad, replacement cylinder (if needed).



Replacement cylinder for disc faucet is necessary only if faucet continues to leak after cleaning. Continuous leaking is caused by cracked or scratched ceramic discs. Replacement cylinders come with neoprene seals and mounting screws.

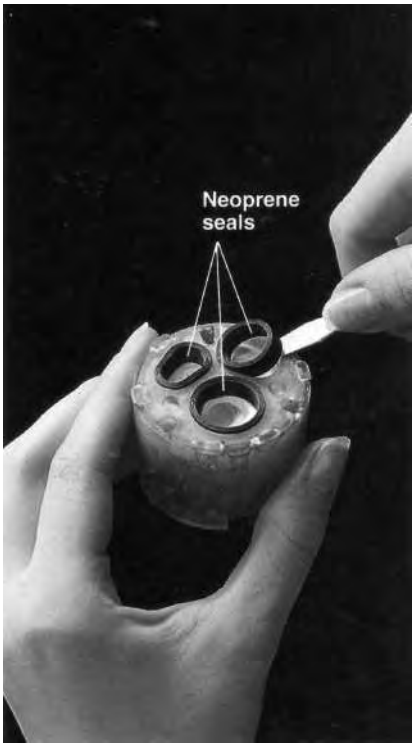
How to Fix a Ceramic Disc Faucet



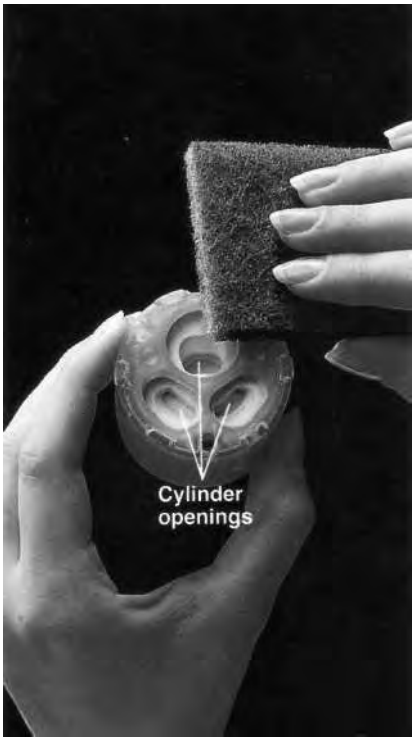
1 Rotate faucet spout to the side, and raise the handle. Remove the setscrew and lift off the handle.



2 Remove the escutcheon cap. Remove cartridge mounting screws, and lift out the cylinder.



3 Remove the neoprene seals from the cylinder openings.



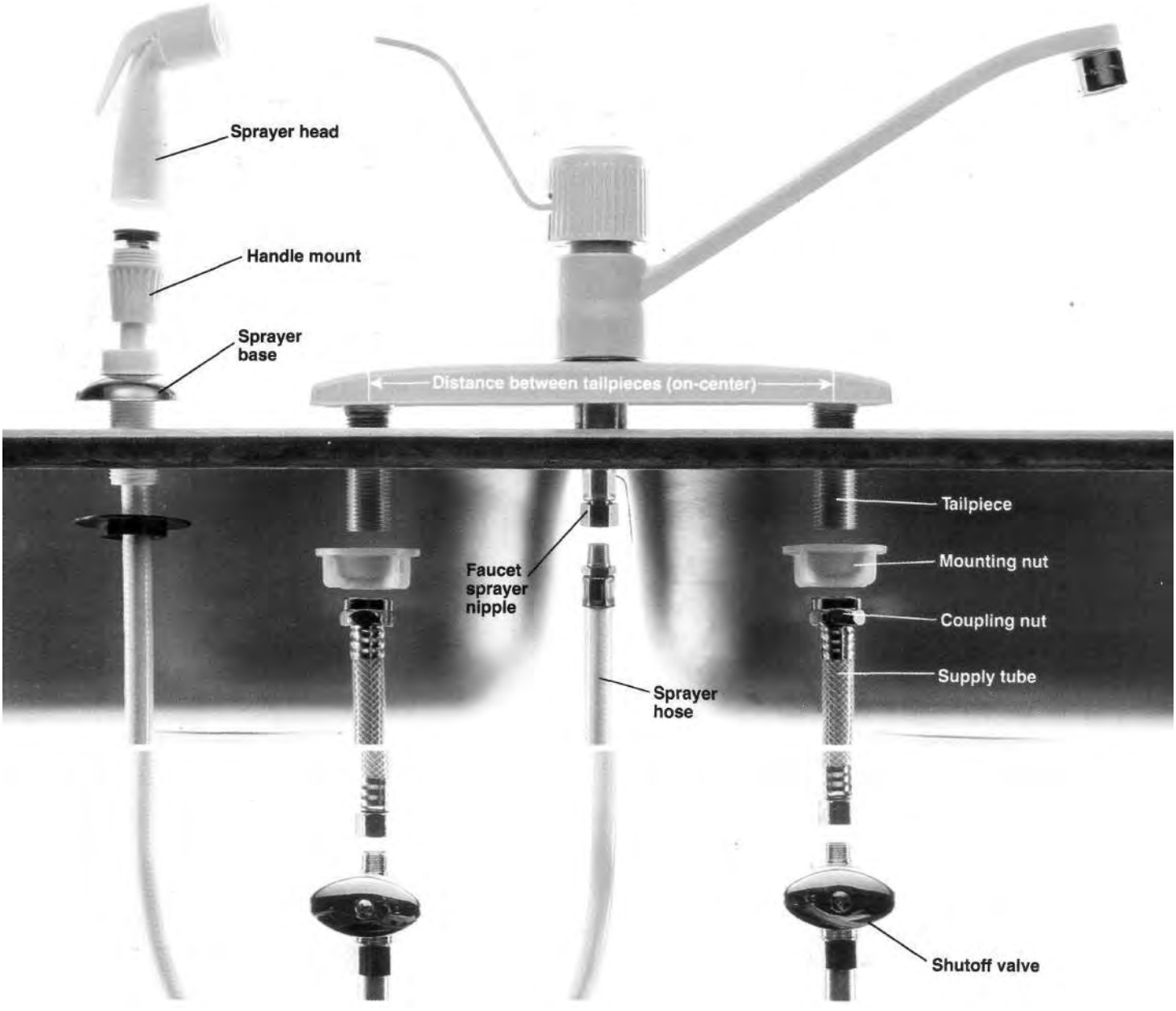
4 Clean the cylinder openings and the neoprene seals with a Scotch Brite pad. Rinse cylinder with clear water.



5 Return seals to the cylinder openings, and reassemble faucet. Move handle to ON position, then slowly open shutoff valves. When water runs steadily close faucet.



Install a new cylinder only if the faucet continues to leak after cleaning.



Replacing a Sink Faucet

Installing a new faucet is an easy project that takes about one hour. Before buying a new faucet, first find the diameter of the sink openings, and measure the distance between the tailpieces (measured on-center). Make sure the tailpieces of the new faucet match the sink openings.

When shopping for a new faucet, choose a model made by a reputable manufacturer Replacement parts for a well-known brand will be easy to find if the faucet ever needs repairs. Better faucets have solid brass bodies. They are easy to install and provide years of trouble-free service. Some washerless models have lifetime warranties.

Always install new supply tubes when replacing a faucet. Old supply tubes should not be reused. If water pipes underneath the sink do not have shut off valves, you may choose to install the valves while replacing the faucet (pages 192 to 193).

Everything You Need:

Tools; basin wrench or channel-type pliers, putty knife, caulk gun, adjustable wrenches.

Materials: penetrating oil, silicone caulk or plumber's putty two flexible supply tubes.

How to Remove an Old Sink Faucet



1 Spray penetrating oil on tailpiece mounting nuts and supply tube coupling nuts. Remove the coupling nuts with a basin wrench or channel-type pliers.



2 Remove the tailpiece mounting nuts with a basin wrench or channel-type pliers. Basin wrench has a long handle that makes it easy to work in tight areas.

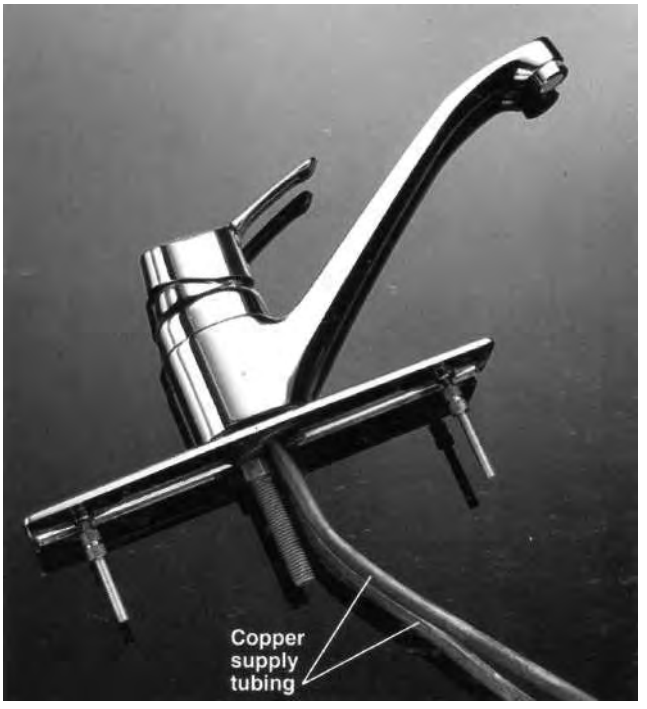


3 Remove faucet. Use a putty knife to clean away old putty from surface of sink.

Faucet Hookup Variations

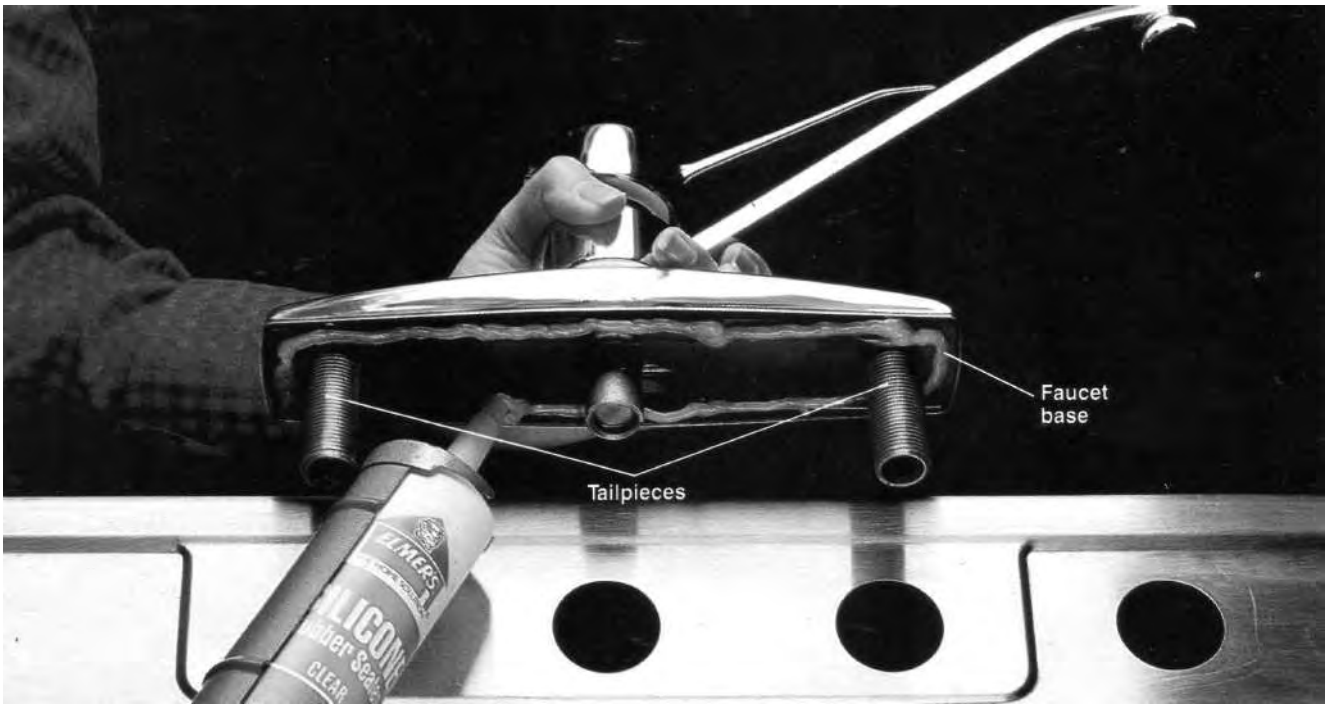


New faucet without supply tubes: Buy two supply tubes. Supply tubes are available in braided steel or vinyl mesh (shown above), PB plastic, or chromed copper (page 192).



New faucet with preattached copper supply tubing: Make water connections by attaching the supply tubing directly to the shutoff valves with compression fittings (page 191).

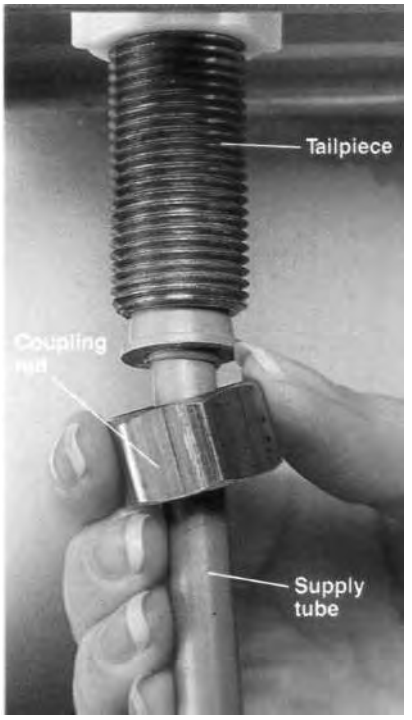
How to Install a New Sink Faucet



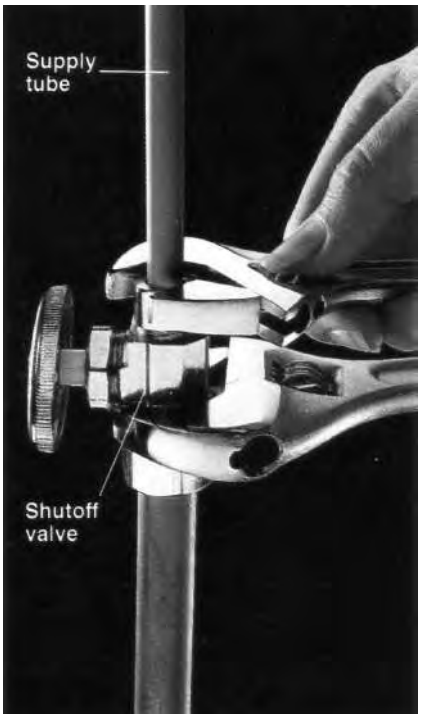
1 Apply a 1/4" bead of silicone caulk or plumber's putty around the base of the faucet. Insert the faucet tailpieces into the sink openings. Position the faucet so base is parallel to back of sink, and press the faucet down to make sure caulk forms a good seal.



2 Screw the metal friction washers and the mounting nuts onto the tailpieces, then tighten with a basin wrench or channel-type pliers. Wipe away excess caulk around base of faucet.

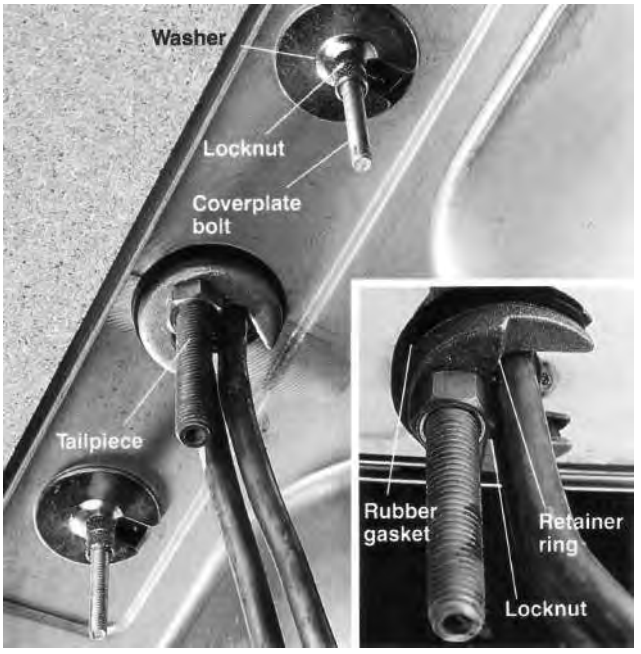


3 Connect flexible supply tubes to faucet tailpieces. Tighten coupling nuts with a basin wrench or channel-type pliers.

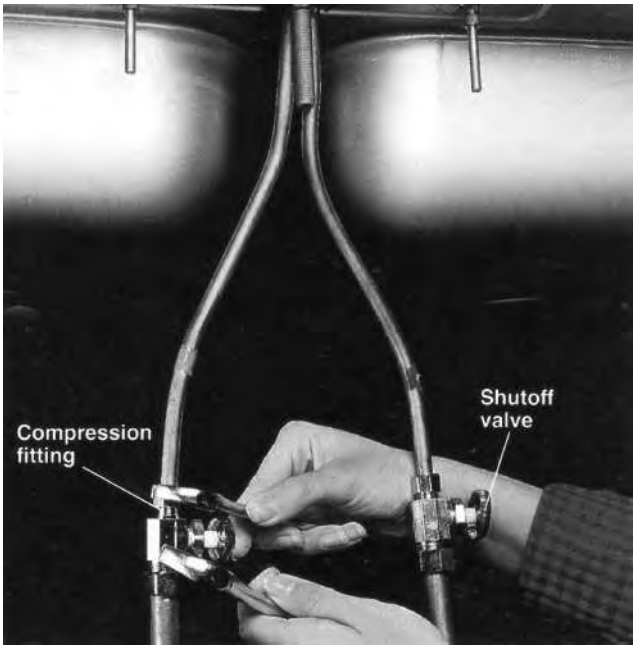


4 Attach supply tubes to shut-off valves, using compression fittings (pages 52 to 53). Hand-tighten nuts, then use an adjustable wrench to tighten nuts 1/4 turn. If necessary, hold valve with another wrench while tightening.

How to Connect a Faucet with Preattached Supply Tubing



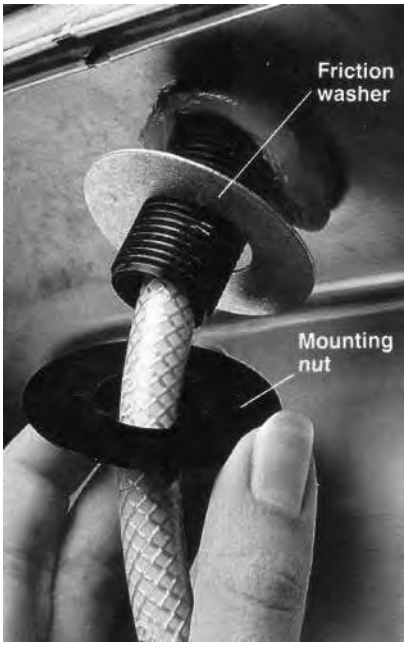
1 Attach faucet to sink by placing rubber gasket, retainer ring, and locknut onto threaded tailpiece. Tighten locknut with a basin wrench or channel-type pliers. Some center-mounted faucets have a decorative coverplate. Secure coverplate from underneath with washers and locknuts screwed onto coverplate bolts.



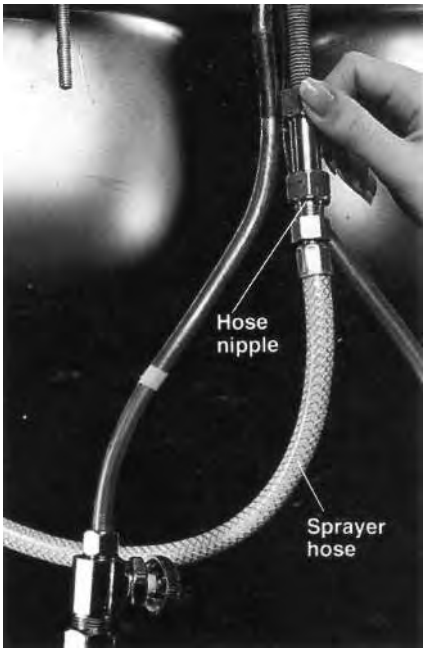
2 Connect preattached supply tubing to shutoff valves with compression fittings (pages 52 to 53). Red-coded tube should be attached to the hot water pipe, blue-coded tube to the cold water pipe.



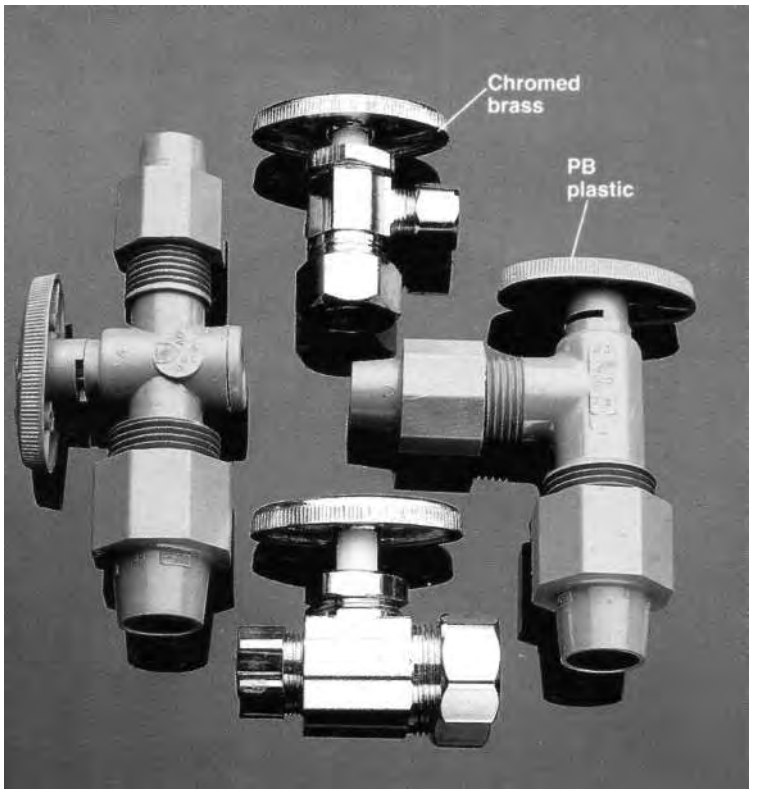
Apply a 1/4" bead of plumber's putty or silicone caulk to bottom edge of sprayer base. Insert tailpiece of sprayer base into sink opening.



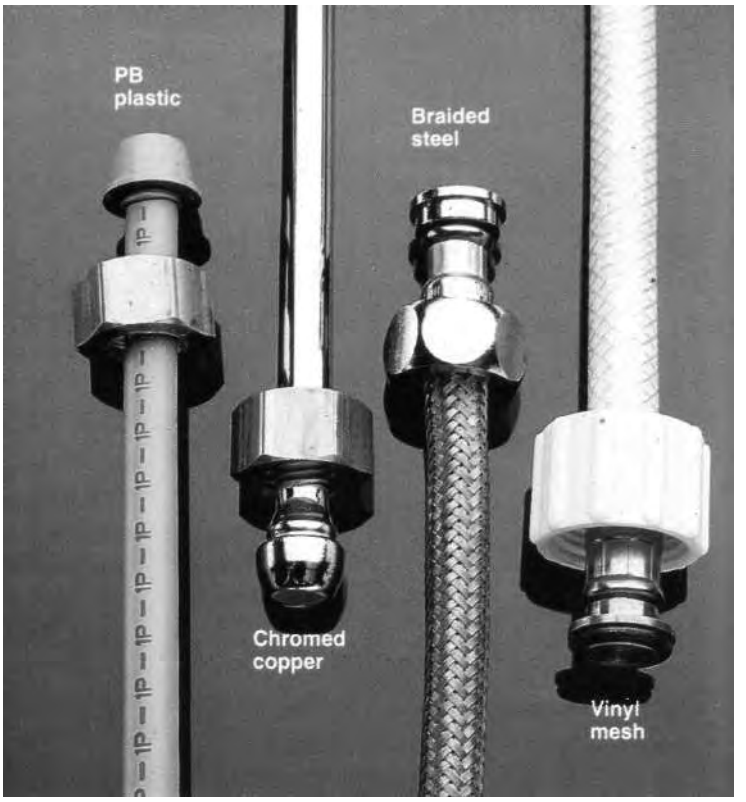
2 Place friction washer over tailpiece. Screw the mounting nut onto tailpiece and tighten with a basin wrench or channel-type pliers. Wipe away excess putty around base of sprayer.



3 Screw sprayer hose onto the hose nipple on the bottom of the faucet. Tighten 1/4 turn, using a basin wrench or channel-type pliers.



Shutoff valves allow you to shut off the water to an individual fixture so it can be repaired. They can be made from durable chromed brass or lightweight plastic. Shutoff valves come in 1/2" and 3/4" diameters to match common water pipe sizes.



Supply tubes are used to connect water pipes to faucets, toilets, and other fixtures. They come in 12", 20", and 30" lengths. PB plastic and chromed copper tubes are inexpensive. Braided steel and vinyl mesh supply tubes are easy to install.

Installing Shutoff Valves & Supply Tubes

Worn-out shutoff valves or supply tubes can cause water to leak underneath a sink or other fixture. First, try tightening the fittings with an adjustable wrench. If this does not fix the leak, replace the shutoff valves and supply tubes.

Shutoff valves are available in several fitting types. For copper pipes, valves with compression-type fittings (pages 52 to 53) are easiest to install. For plastic pipes (pages 56 to 63), use grip-type valves. For galvanized iron pipes (pages 64 to 67), use valves with female threads.

Older plumbing systems often were installed without fixture shutoff valves. When repairing or replacing plumbing fixtures, you may want to install shutoff valves if they are not already present.

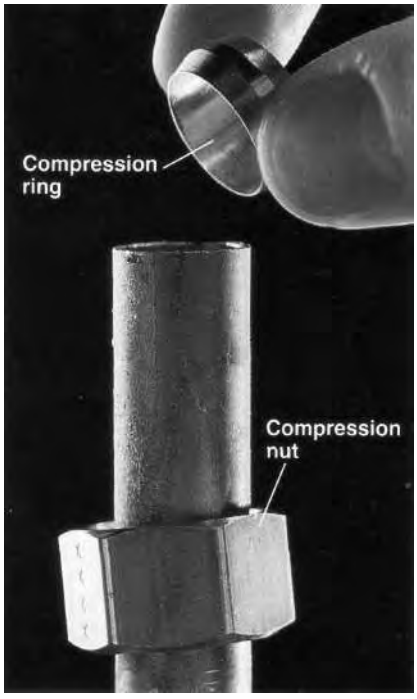
How to Install Shutoff Valves & Supply Tubes

Everything You Need:

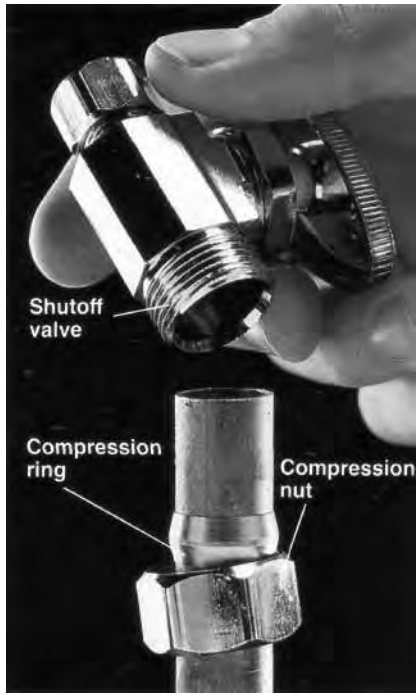
Tools: hacksaw, tubing cutter, adjustable wrench, tubing bender, felt-tipped pen.

Materials: shutoff valves, supply tubes, pipe joint compound.

Turn off water at the main shutoff valve (page 6). Remove old supply pipes. If pipes are soldered copper, cut them off just below the soldered joint, using a hacksaw or tubing cutter. Make sure the cuts are straight. Unscrew the coupling nuts, and discard the old pipes.



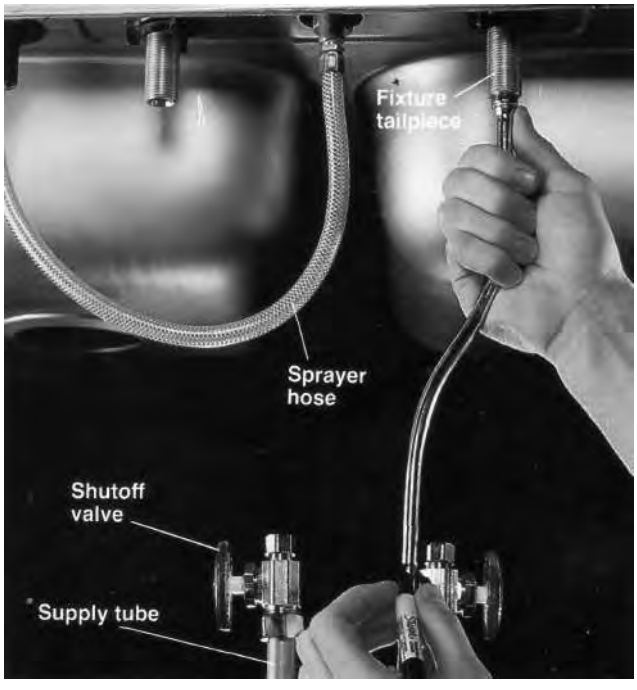
2 Slide a compression nut and compression ring over copper water pipe. Threads of nut should face end of pipe.



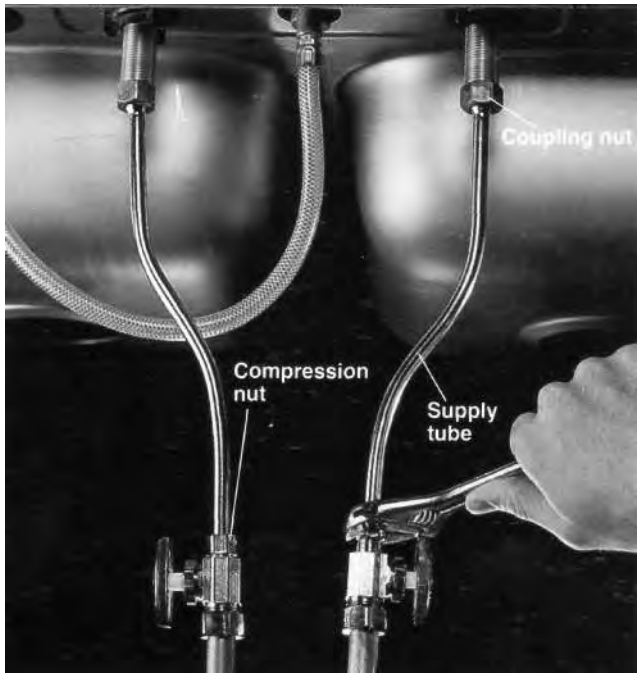
3 Slide shutoff valve onto pipe. Apply a layer of pipe joint compound to compression ring. Screw the compression nut onto the shutoff valve and tighten with an adjustable wrench.



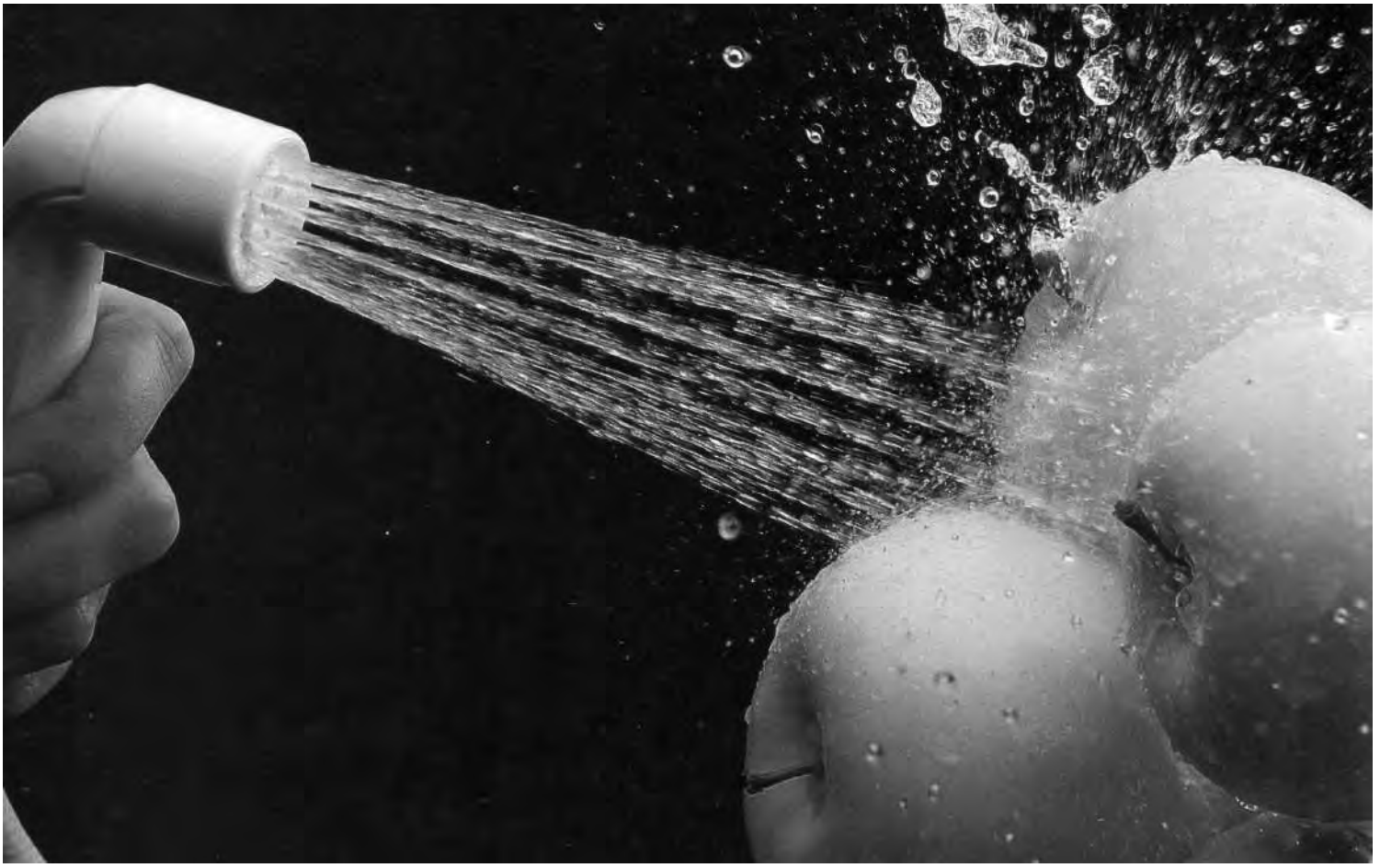
4 Bend chromed copper supply tube to reach from the tailpiece of the fixture to the shutoff valve, using a tubing bender (page 45). Bend the tube slowly to avoid crimping the metal.



5 Position the supply tube between fixture tailpiece and shutoff valve, and mark tube to length. Cut supply tube with a tubing cutter (page 47).



6 Attach bell-shaped end of supply tube to fixture tailpiece with coupling nut, then attach other end to shutoff valve with compression ring and nut (pages 52 to 53). Tighten all fittings with adjustable wrench.



If water pressure from a sink sprayer seems low, or if water leaks from the handle, it is usually because lime buildup and sediment have blocked small openings inside the sprayer head. To fix the problem, first take the sprayer head apart and clean the parts. If cleaning the sprayer head does not help, the problem may be caused by a faulty diverter valve. The diverter valve inside the faucet body shifts water flow from the faucet spout to the sprayer when the sprayer handle is pressed. Cleaning or replacing the diverter valve may fix water pressure problems.

Whenever making repairs to a sink sprayer, check the sprayer hose for kinks or cracks. A damaged hose should be replaced.

If water pressure from a faucet spout seems low, or if the flow is partially blocked, take the spout aerator apart and clean the parts. The aerator is a screw-on attachment with a small wire screen that mixes tiny air bubbles into the water flow. Make sure the wire screen is not clogged with sediment and lime buildup. If water pressure is low throughout the house, it may be because galvanized iron water pipes are corroded. Corroded pipes should be replaced with copper (pages 46 to 55).

Everything You Need:

Tools: screwdriver, channel-type pliers, needle-nose pliers, small brush.

Materials: vinegar, universal washer kit, heat-proof grease, replacement sprayer hose.



Clean faucet aerators and sink sprayers to fix most low water pressure problems. Take aerator or sprayer head apart, then use a small brush dipped in vinegar to remove sediment.

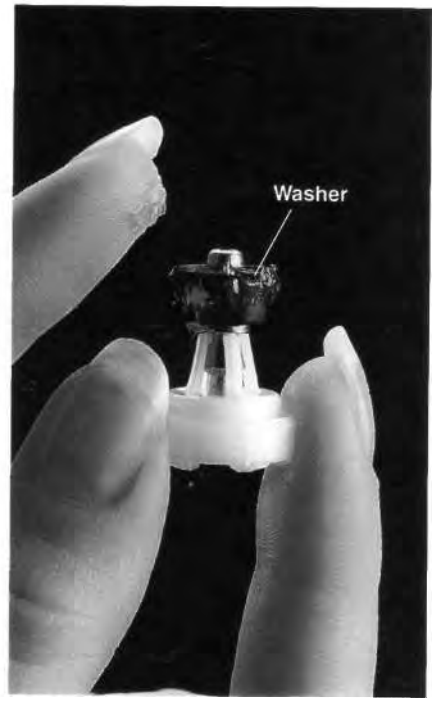
How to Fix a Diverter Valve



1 Shut off the water (page 176). Remove the faucet handle and the spout (see directions for your faucet type, pages 178 to 187).

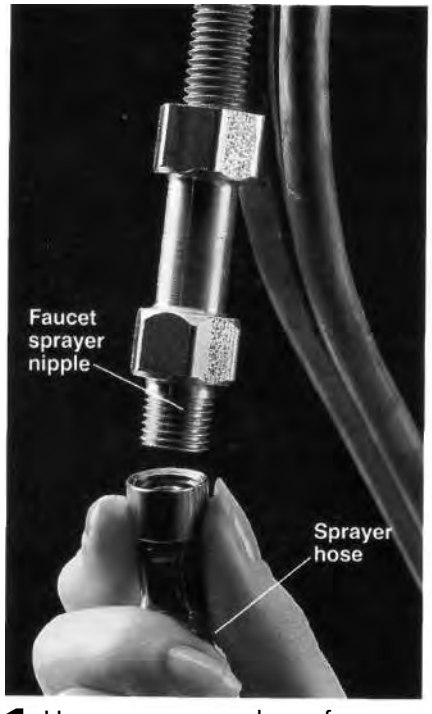


2 Pull diverter valve from faucet body with needlenose pliers. Use a small brush dipped in vinegar to clean lime buildup and debris from valve.



3 Replace any worn 0-rings or washers, if possible. Coat the new parts with heatproof grease, then reinstall the diverter valve and reassemble the faucet.

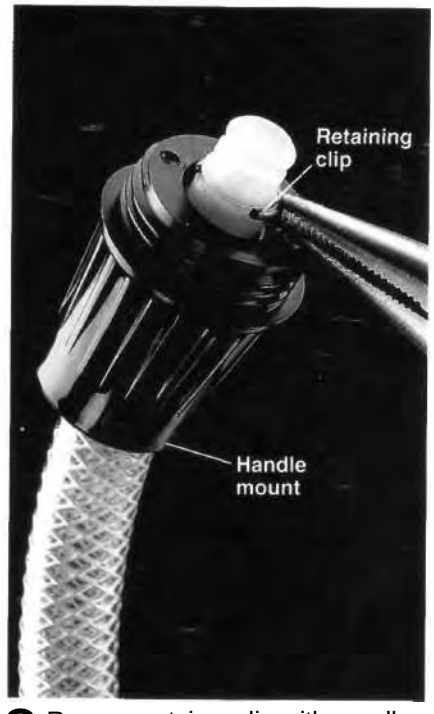
How to Replace a Sprayer Hose



1 Unscrew sprayer hose from faucet sprayer nipple, using channel-type pliers. Pull sprayer hose through sink opening.



2 Unscrew the sprayer head from the handle mount. Remove washer.



3 Remove retainer clip with needlenose pliers, and discard old hose. Attach handle mount, retainer clip, washer, and sprayer head to new hose. Attach sprayer hose to faucet sprayer nipple on faucet.

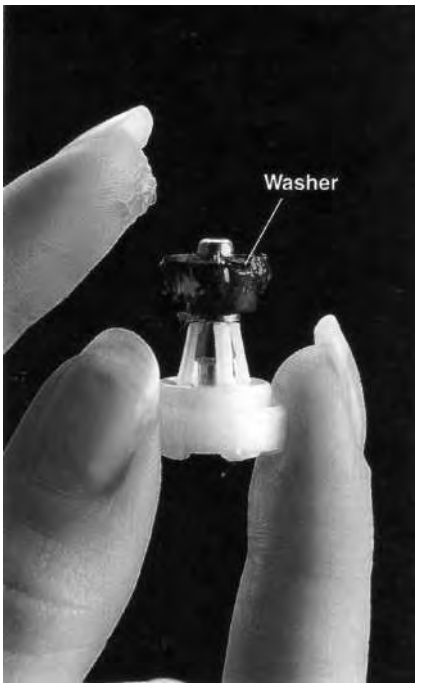
How to Fix a Diverter Valve



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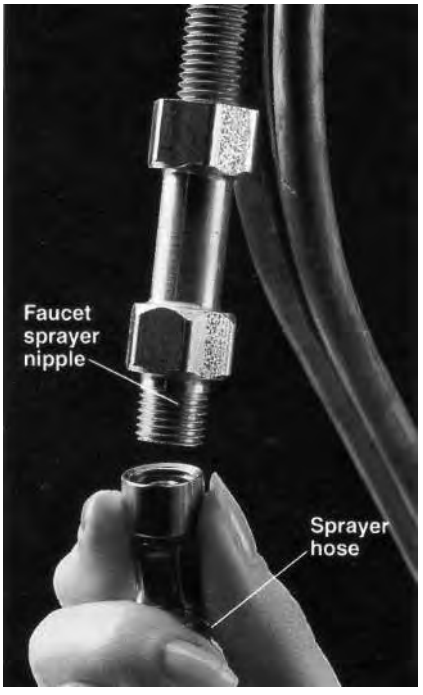


2 Pull diverter valve from faucet body with needlenose pliers. Use a small brush dipped in vinegar to clean lime buildup and debris from valve.



3 Replace any worn 0-rings or washers, if possible. Coat the new parts with heatproof grease, then reinstall the diverter valve and reassemble the faucet.

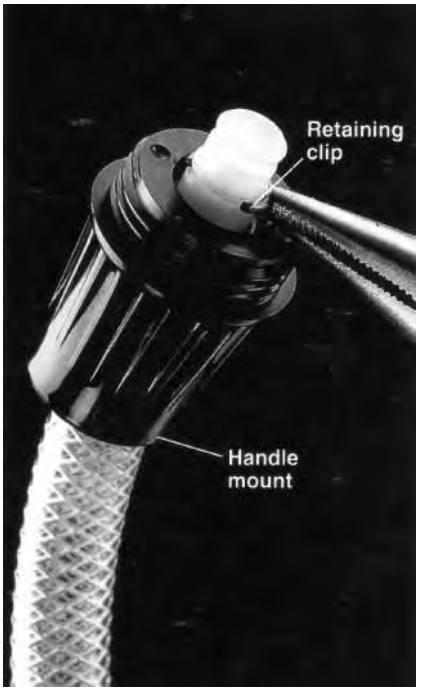
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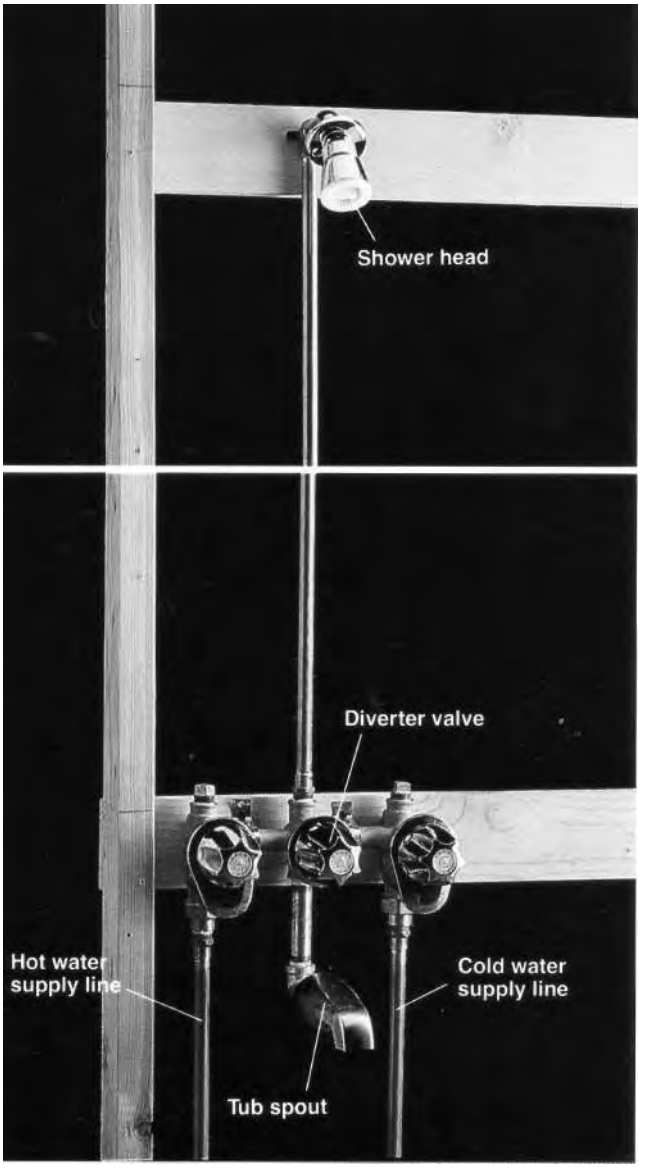


Tub & Shower Plumbing

Tub and shower faucets have the same basic designs as sink faucets, and the techniques for repairing leaks are the same as described in the faucet repair section of this book (pages 176 to 187). To identify your faucet design, you may need to take off the handle and disassemble the faucet.

When a tub and shower are combined, the shower head and the tub spout share the same hot and cold water supply lines and handles. Combination faucets are available as three-handle, two-handle.

Tub & Shower Combination Faucets



Three-handle faucet (pages 198 to 199) has valves that are either compression or cartridge design.

or single-handle types (below). The number of handles gives clues as to the design of the faucets and the kinds of repairs that may be necessary

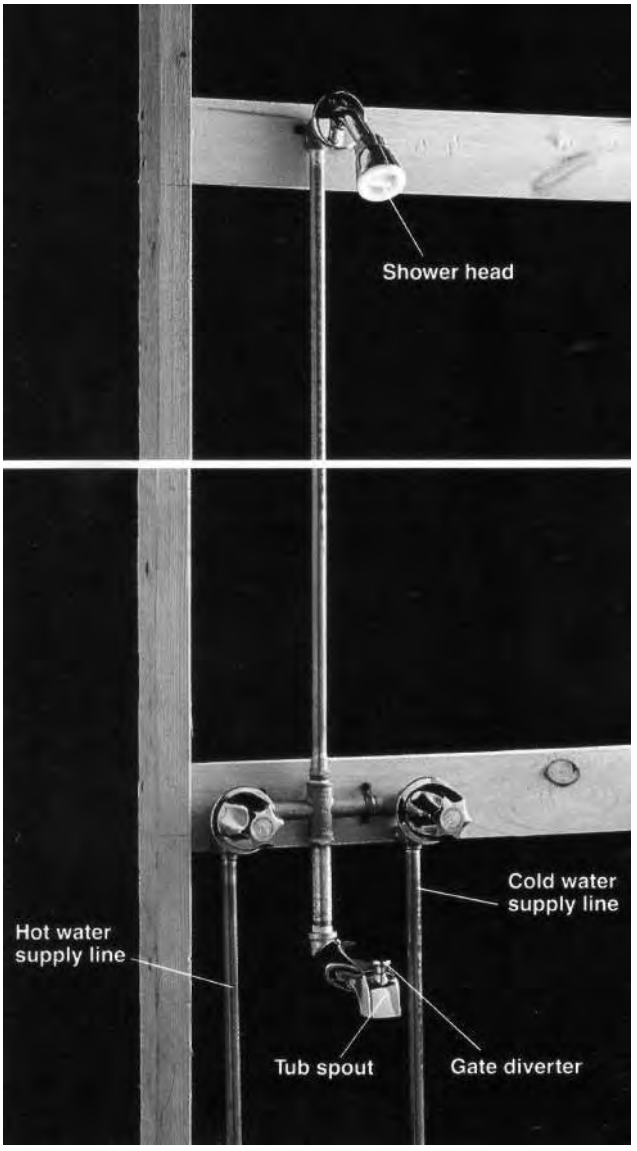
With combination faucets, a diverter valve or gate diverter is used to direct water flow to the tub spout or the shower head. On three-handle faucet types, the middle handle controls a diverter valve. If water does not shift easily from tub to spout to shower head, or if water continues to run out the spout when the shower is on, the diverter valve probably needs to be cleaned and repaired (pages 198 to 199).

Two-handle and single-handle types use a gate diverter that is operated by a pull lever or knob on the tub spout. Although gate diverters rarely need repair, the lever occasionally may break, come loose, or refuse to stay in the UP position. To repair a gate diverter set in a tub spout, replace the entire spout (page 201).

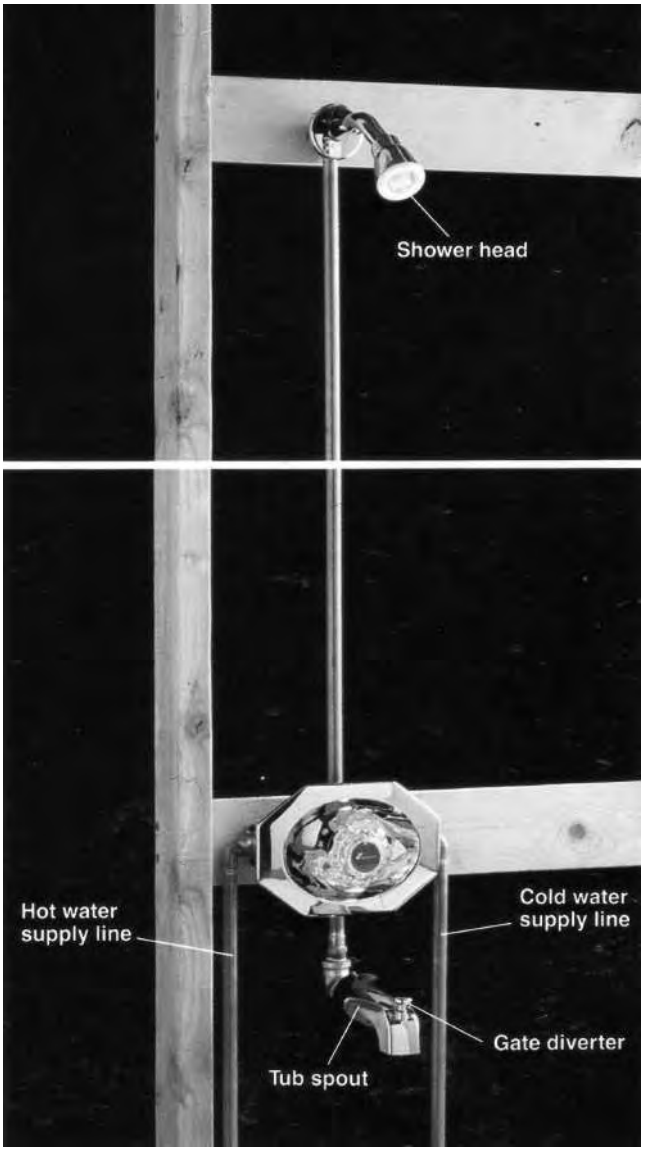
Tub and shower faucets and diverter valves may be set inside wall cavities. Removing them may require a deep-set ratchet wrench (pages 199, 201).

If spray from the shower head is uneven, clean the spray holes. If the shower head does not stay in an upright position, remove the head and replace the 0-ring (page 204).

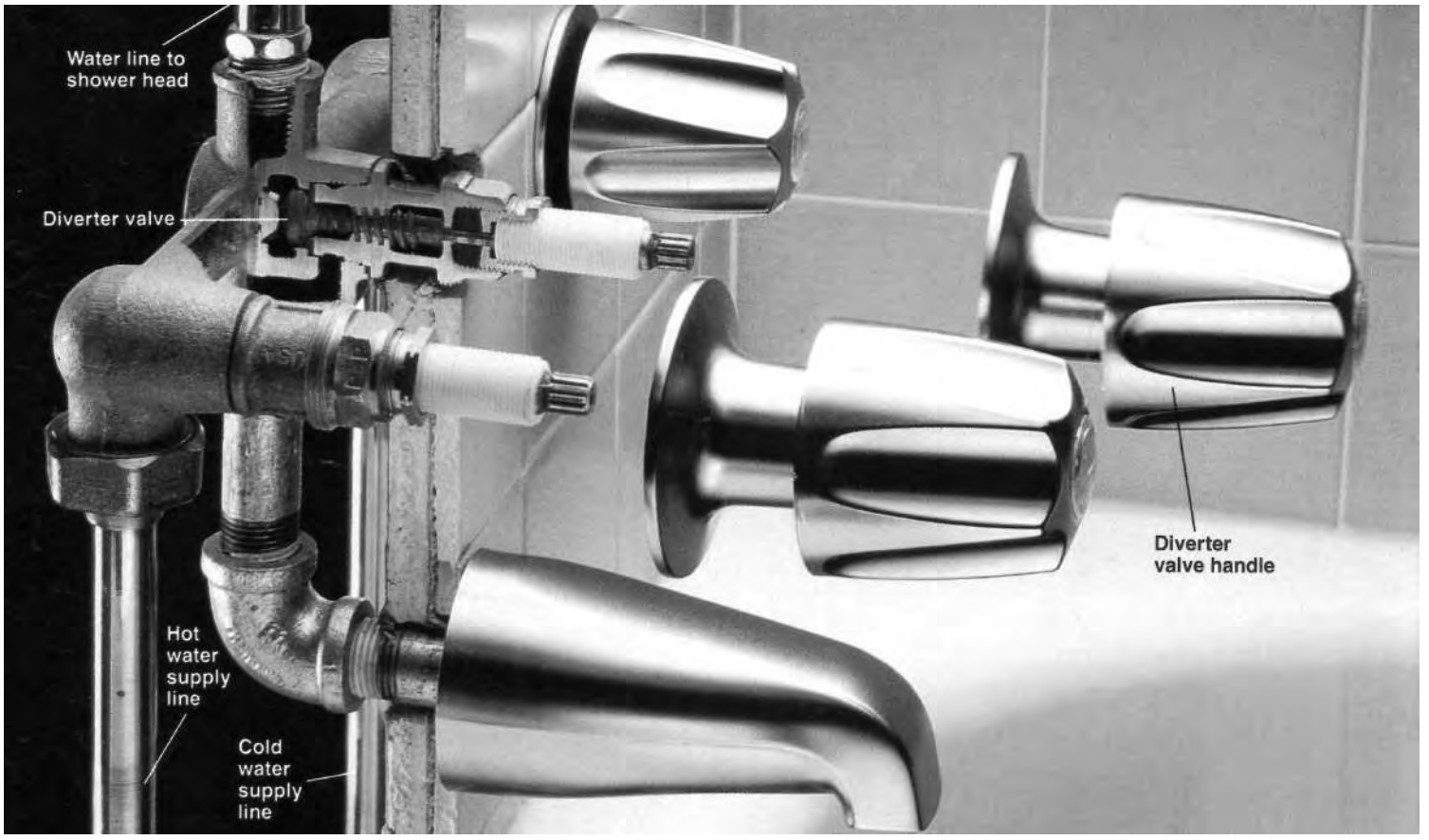
To add a shower to an existing tub, install a flexible shower adapter (page 205). Several manufacturers make complete conversion kits that allow a shower to be installed in less than one hour.



Two-handle faucet (pages 200 to 201) has valves that are either compression or cartridge design.



Single-handle faucet (pages 202 to 203) has valves that are cartridge, ball-type, or disc design.



Fixing Three-handle Tub & Shower Faucets

A three-handle faucet type has handles to control hot and cold water, and a third handle that controls the diverter valve and directs water to either a tub spout or a shower head. The separate hot and cold handles indicate cartridge or compression faucet designs. To repair them, see pages 180 to 181 for cartridge, and 182 to 185 for compression.

If a diverter valve sticks, if water flow is weak, or if water runs out of the tub spout when the flow is directed to the shower head, the diverter needs to be repaired or replaced. Most diverter valves are similar to either compression or cartridge faucet valves. Compression type diverters can be repaired, but cartridge types should be replaced.

Everything You Need:

Tools: screwdriver, adjustable wrench or channel-type pliers, deep-set ratchet wrench, small wire brush.

Materials: replacement diverter cartridge or universal washer kit, heatproof grease, vinegar.

How to Repair a Compression Diverter Valve



1 Remove the diverter valve handle with a screwdriver. Unscrew or pry off the escutcheon.



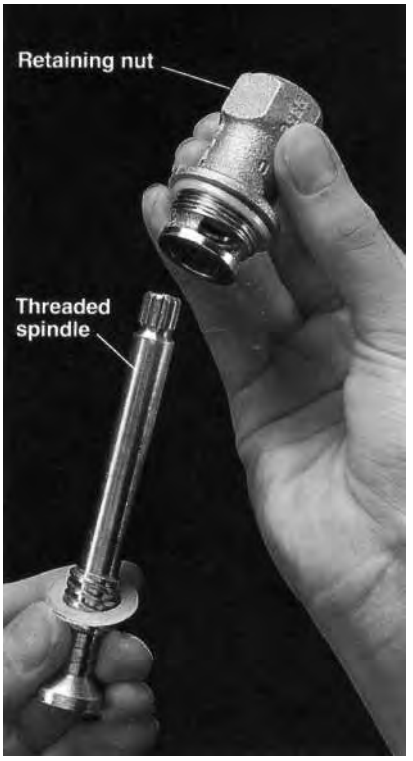
2 Remove bonnet nut with an adjustable wrench or channel-type pliers.



3 Unscrew the stem assembly, using a deep-set ratchet wrench. If necessary, chip away any mortar surrounding the bonnet nut (page 201, step 2).



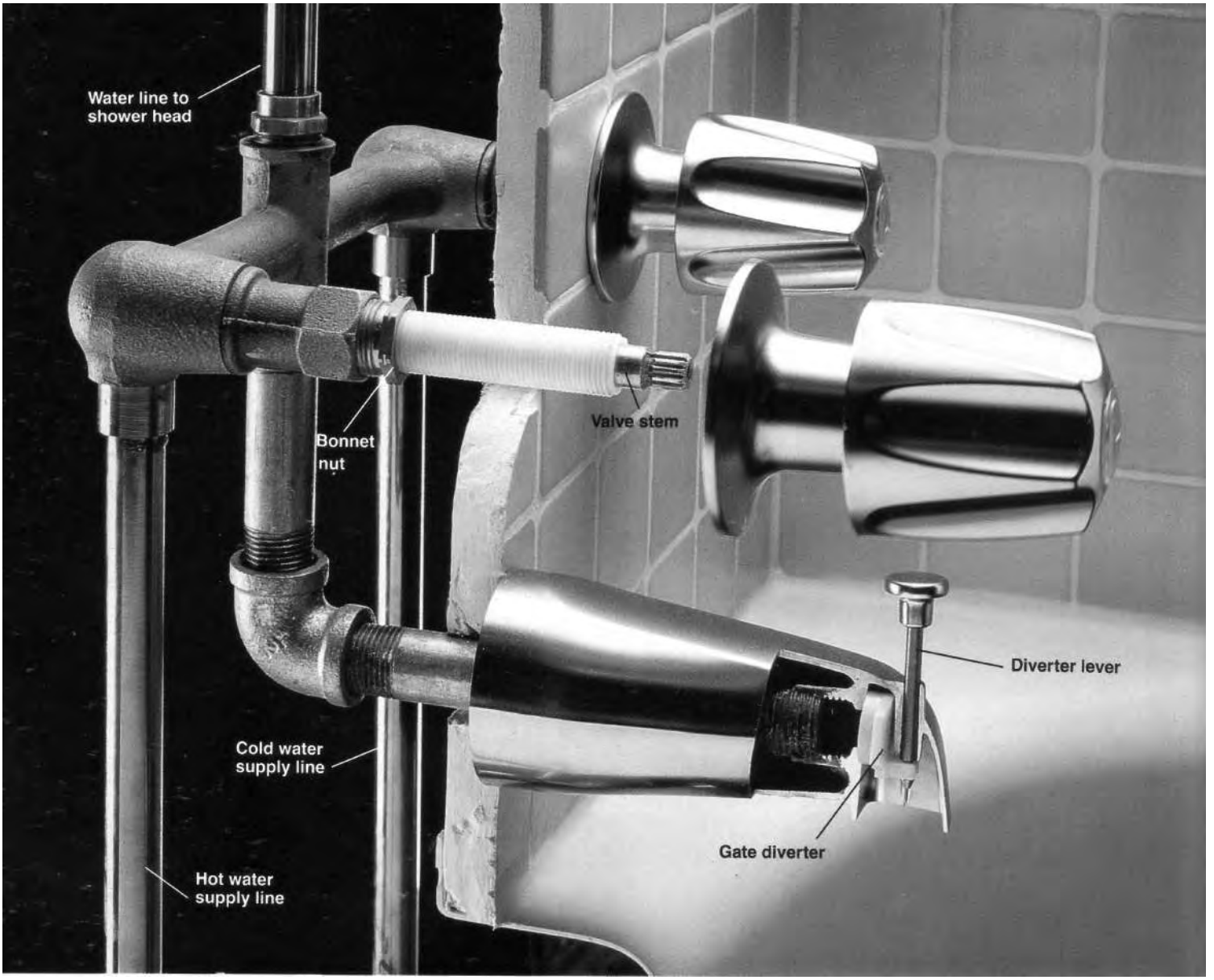
4 Remove brass stem screw. Replace stem washer with an exact duplicate. If stem screw is worn, replace it.



5 Unscrew threaded spindle from retaining nut.



6 Clean sediment and lime buildup from nut, using a small wire brush dipped in vinegar. Coat all parts with heatproof grease and reassemble diverter valve.



Fixing Two-handle Tub & Shower Faucets

Two-handle tub and shower faucets are either cartridge or compression design. They may be repaired following the directions on pages 180 to 181 for cartridge, or pages 182 to 185 for compression. Because the valves of two-handle tub and shower faucets may be set inside the wall cavity, a deep-set socket wrench may be required to remove the valve stem.

Two-handle tub and shower designs have a gate diverter. A gate diverter is a simple mechanism located in the tub spout. A gate diverter closes the supply of water to the tub spout and redirects the flow to the shower head. Gate diverters seldom need repair. Occasionally the lever may break, come loose, or refuse to stay in the UP position.

If the diverter fails to work properly, replace the tub spout. Tub spouts are inexpensive and easy to replace.

Everything You Need:

Tools: screwdriver, Allen wrench, pipe wrench, channel-type pliers, small cold chisel, ball peen hammer, deep-set ratchet wrench.

Materials: masking tape or cloth, pipe joint compound, replacement faucet parts as needed.

Tips on Replacing a Tub Spout



Check underneath tub spout for a small access slot. The slot indicates the spout is held in place with an Allen screw. Remove the screw, using an Allen wrench. Spout will slide off.



Unscrew faucet spout. Use a pipe wrench, or insert a large screwdriver or hammer handle into the spout opening and turn spout counterclockwise.



Spread pipe joint compound on threads of spout nipple before replacing spout.

How to Remove a Deep-set Faucet Valve



1 Remove handle, and unscrew the escutcheon with channel-type pliers. Pad the jaws of the pliers with masking tape to prevent scratching the escutcheon.



2 Chip away any mortar surrounding the bonnet nut, using a ball peen hammer and a small cold chisel.



3 Unscrew the bonnet nut with a deep-set ratchet wrench. Remove the bonnet nut and stem from the faucet body



Fixing Single-handle Tub & Shower Faucets

A single-handle tub and shower faucet has one valve that controls both water flow and temperature. Single-handle faucets may be ball-type, cartridge, or disc designs.

If a single-handle control valve leaks or does not function properly, disassemble the faucet, clean the valve, and replace any worn parts. Use the repair techniques described on pages 178 to 179 for ball-type, or pages 186 to 187 for ceramic disc. Repairing a single-handle cartridge faucet is shown on the opposite page.

Direction of the water flow to either the tub spout or the shower head is controlled by a gate diverter

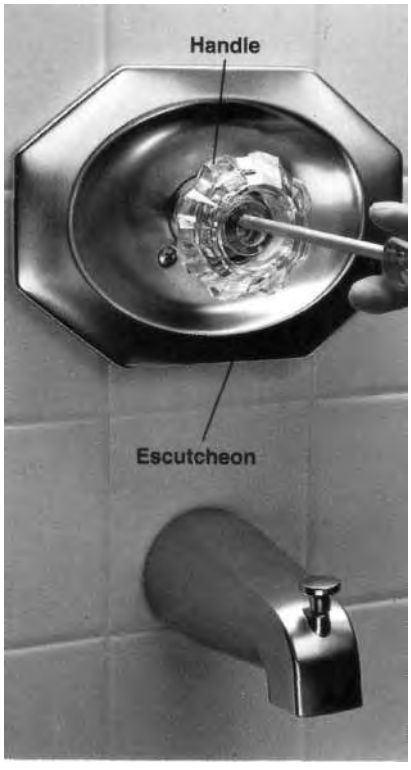
Gate diverters seldom need repair. Occasionally the lever may break, come loose, or refuse to stay in the UP position. If the diverter fails to work properly, replace the tub spout (page 201).

Everything You Need:

Tools: screwdriver, adjustable wrench, channel-type pliers.

Materials: replacement parts as needed.

How to Repair a Single-handle Cartridge Tub a Shower Faucet



1 Use a screwdriver to remove the handle and escutcheon.



2 Turn off water supply at built-in shutoff valves or main shutoff valve (page 72).



3 Unscrew and remove retaining ring or bonnet nut, using an adjustable wrench.



4 Remove cartridge assembly by grasping end of valve with channel-type pliers and pulling gently



5 Flush valve body with clean water to remove sediment. Replace any worn 0-rings. Reinstall cartridge and test valve. If faucet fails to work properly replace the cartridge.

Fixing & Replacing Shower Heads



A typical shower head can be disassembled easily for cleaning and repair. Some shower heads include a spray adjustment cam lever that is used to change the force of the spray

If spray from the shower head is uneven, clean the spray holes. The outlet or inlet holes of the shower head may get clogged with mineral deposits.

Shower heads pivot into different positions. If a shower head does not stay in position, or if it leaks, replace the 0-ring that seals against the swivel ball.

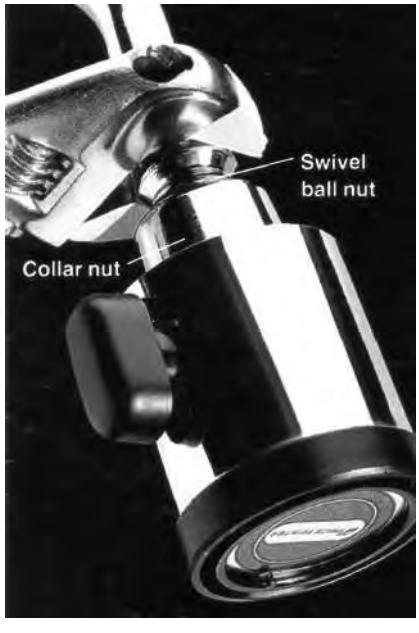
A tub can be equipped with a shower by installing a flexible shower adapter kit. Complete kits are available at hardware stores and home centers.

Everything You Need:

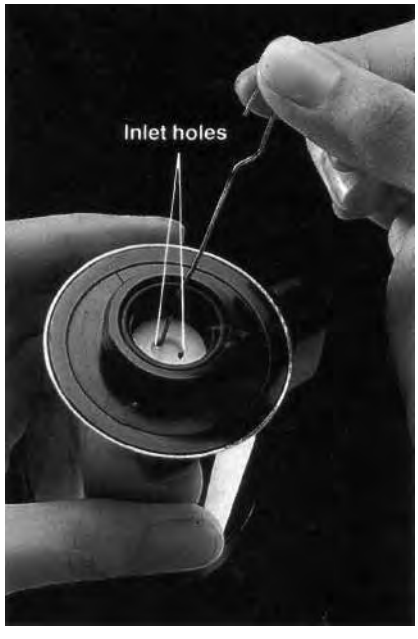
Tools: adjustable wrench or channel-type pliers, pipe wrench, drill, glass & tile bit (if needed), mallet, screwdriver

Materials: masking tape, thin wire (paper clip), heatproof grease, rag, replacement 0-rings (if needed), masonry anchors, flexible shower adapter kit (optional).

How to Clean & Repair a Shower Head



1 Unscrew swivel ball nut, using an adjustable wrench or channel-type pliers. Wrap jaws of the tool with masking tape to prevent marring the finish. Unscrew collar nut from shower head.

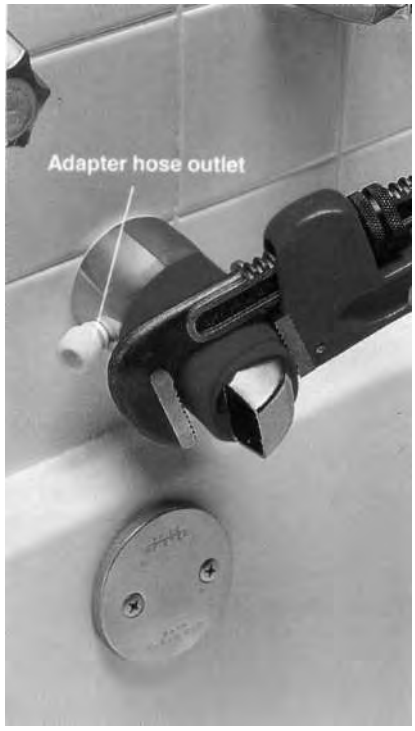


2 Clean outlet and inlet holes of shower head with a thin wire. Flush the head with clean water

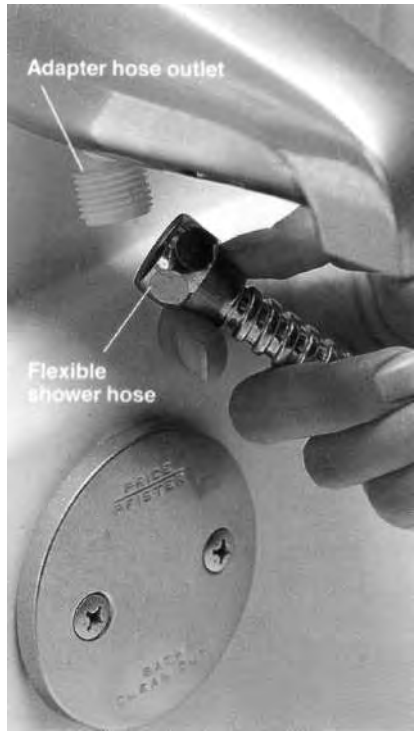


3 Replace the 0-ring, if necessary Lubricate the 0-ring with heatproof grease before installing.

How to Install a Flexible Shower Adapter



1 Remove old tub spout (page 103). Install new tub spout from kit, using a pipe wrench. New spout will have an adapter hose outlet. Wrap the tub spout with a rag to prevent damage to the chrome finish.



2 Attach flexible shower hose to the adaptor hose outlet. Tighten with an adjustable wrench or •channel-type pliers.



3 Determine location of shower head hanger. Use hose length as a guide, and make sure shower head can be easily lifted off hanger.



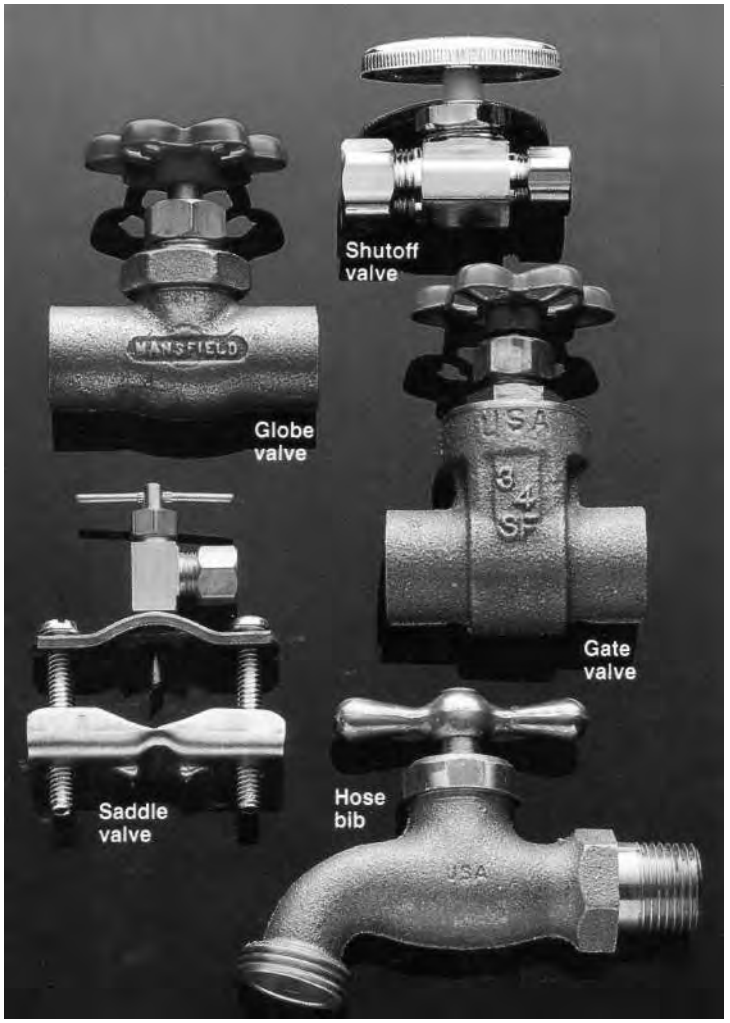
4 Mark hole locations. Use a glass and tile bit to drill holes in ceramic tile for masonry anchors.



5 Insert anchors into holes, and tap into place with a wooden or rubber mallet.



6 Fasten shower head holder to the wall, and hang shower head.



Repairing Valves & Hose Bibs

Valves make it possible to shut off water at any point in the supply system. If a pipe breaks or a plumbing fixture begins to leak, you can shut off water to the damaged area so that it can be repaired. A hose bib is a faucet with a threaded spout, often used to connect rubber utility or appliance hoses.

Valves and hose bibs leak when washers or seals wear out. Replacement parts can be found in the same universal washer kits used to repair compression faucets (page 182). Coat replacement washers with heatproof grease to keep them soft and prevent cracking.

Everything You Need:

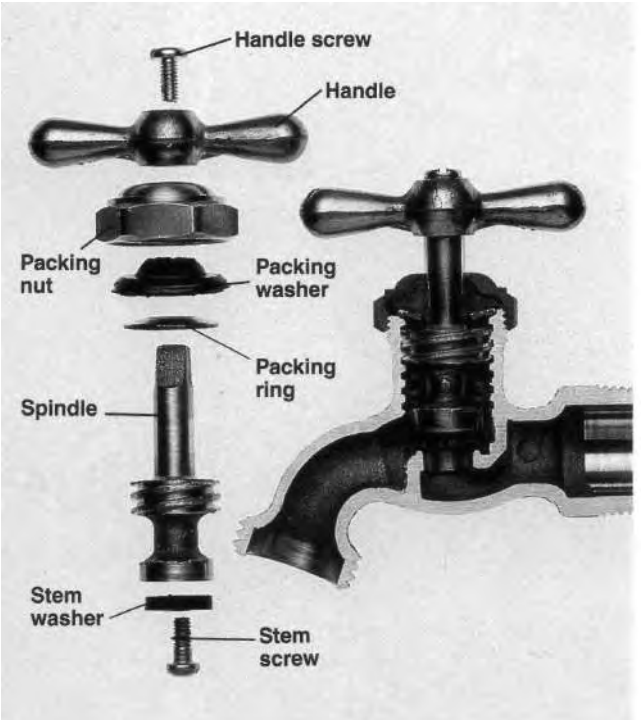
Tools: screwdriver, adjustable wrench.

Materials: universal washer kit, heatproof grease.

How to Fix a Leaky Hose Bib

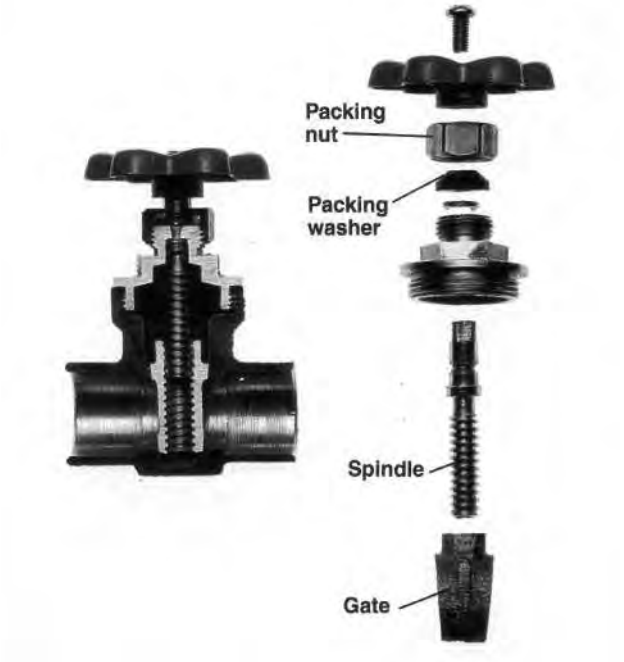


1 Remove the handle screw, and lift off the handle. Unscrew the packing nut with an adjustable wrench.

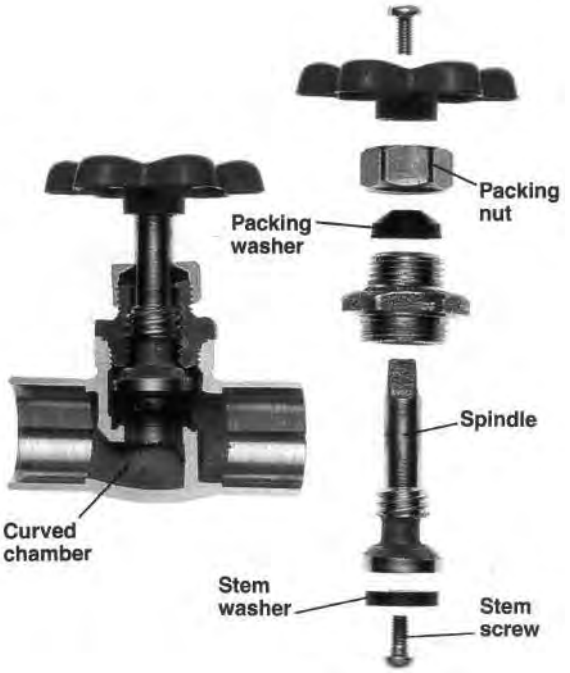


2 Unscrew the spindle from the valve body Remove the stem screw and replace the stem washer. Replace the packing washer, and reassemble the valve.

Common Types of Valves



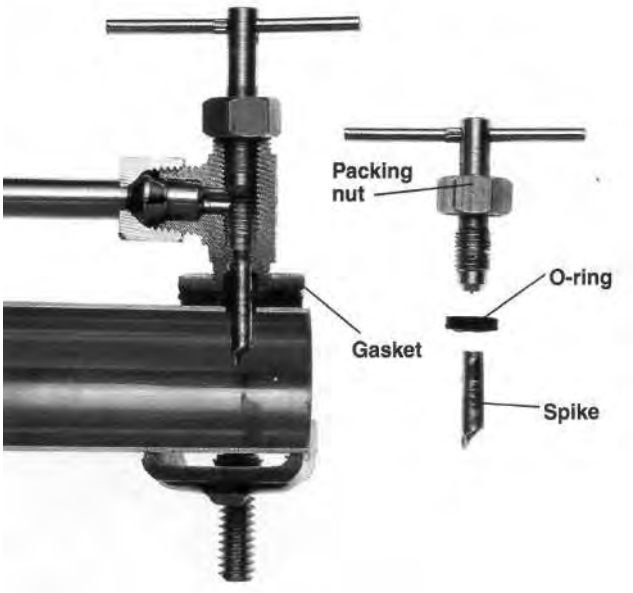
Gate valve has a movable brass wedge, or "gate," that screws up and down to control water flow. Gate valves may develop leaks around the handle. Repair leaks by replacing the packing washer or packing string found underneath the packing nut.



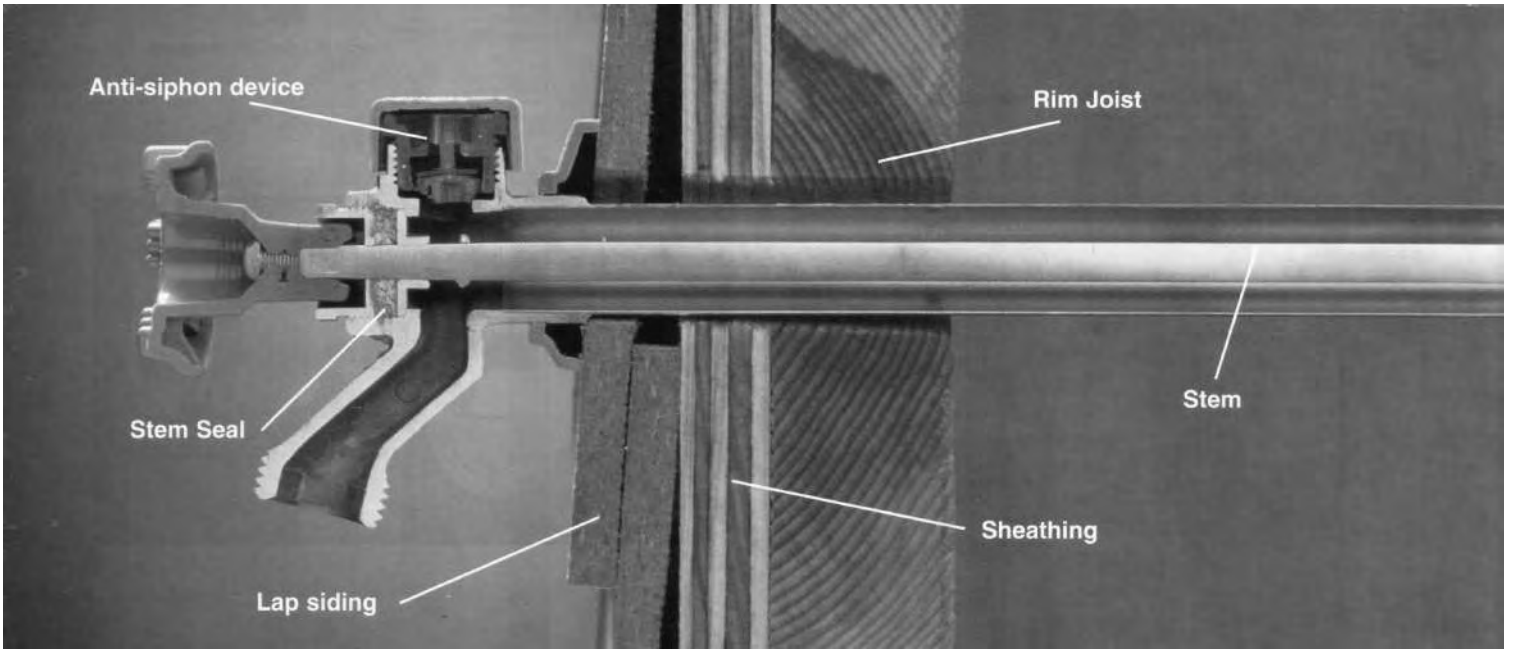
Globe valve has a curved chamber. Repair leaks around the handle by replacing the packing washer. If valve does not fully stop water flow when closed, replace the stem washer.



Shutoff valve controls water supply to a single fixture (pages 192 to 193). Shutoff valve has a plastic spindle with a packing washer and a snap-on stem washer. Repair leaks around the handle by replacing the packing washer. If valve does not fully stop water flow when closed, replace the stem washer.



Saddle valve is a small fitting often used to connect a refrigerator icemaker or sink-mounted water filter to a copper water pipe. Saddle valve contains a hollow metal spike that punctures water pipe when valve is first closed. Fitting is sealed with a rubber gasket. Repair leaks around the handle by replacing the O-ring under the packing nut.



Frost-proof sillcock is mounted against the header joist (sill), and has a long stem that reaches 6" to 30" inside the house to protect the valve from cold. A sillcock should angle downward slightly to provide drainage. The stem washer and O-ring (or packing string) can be replaced if the sillcock begins to leak. In a copper plumbing system,

Installing & Repairing Sillcocks

A sillcock is a compression faucet attached to the outside of the house. Repair a leaky sillcock by replacing the stem washer and the O-ring.

Sillcocks can be damaged by frost. To repair a ruptured pipe, see pages 250 to 251. To prevent pipes from rupturing, close the indoor shutoff valves at the start of the cold weather season, disconnect all garden hoses, and open the sillcock to let trapped water drain out.

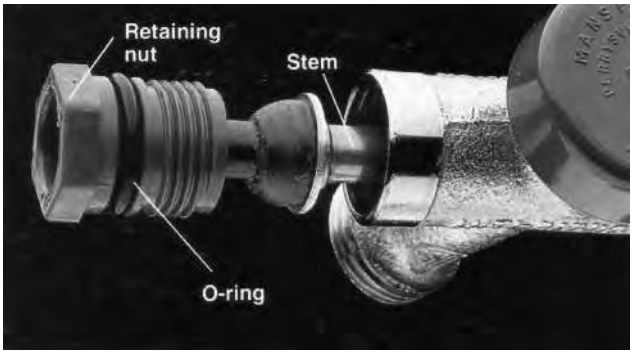
A special frost-proof sillcock has a long stem that reaches at least 6" inside the house to protect it from cold. Install a sillcock so the pipe angles downward from the shutoff valve. This allows water to drain away each time the faucet is turned off.

Everything You Need:

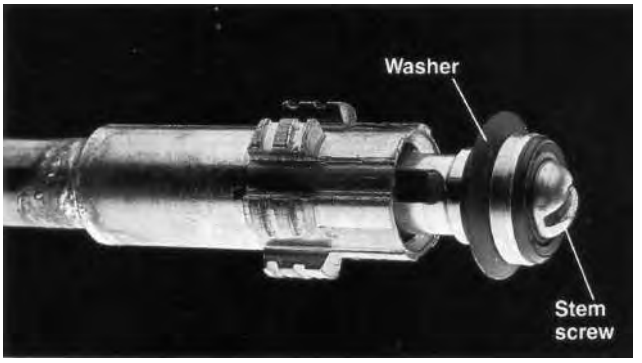
Tools: screwdriver, channel-type pliers, pencil, right-angle drill or standard drill, 1" spade bit, caulk gun, hacksaw or tubing cutter, propane torch.

Materials: universal washer kit, sillcock, silicone caulk, 2" corrosion-resistant screws, copper pipe, T-fitting, Teflon tape, threaded adapter, shutoff valve, emery cloth, soldering paste (flux), solder.

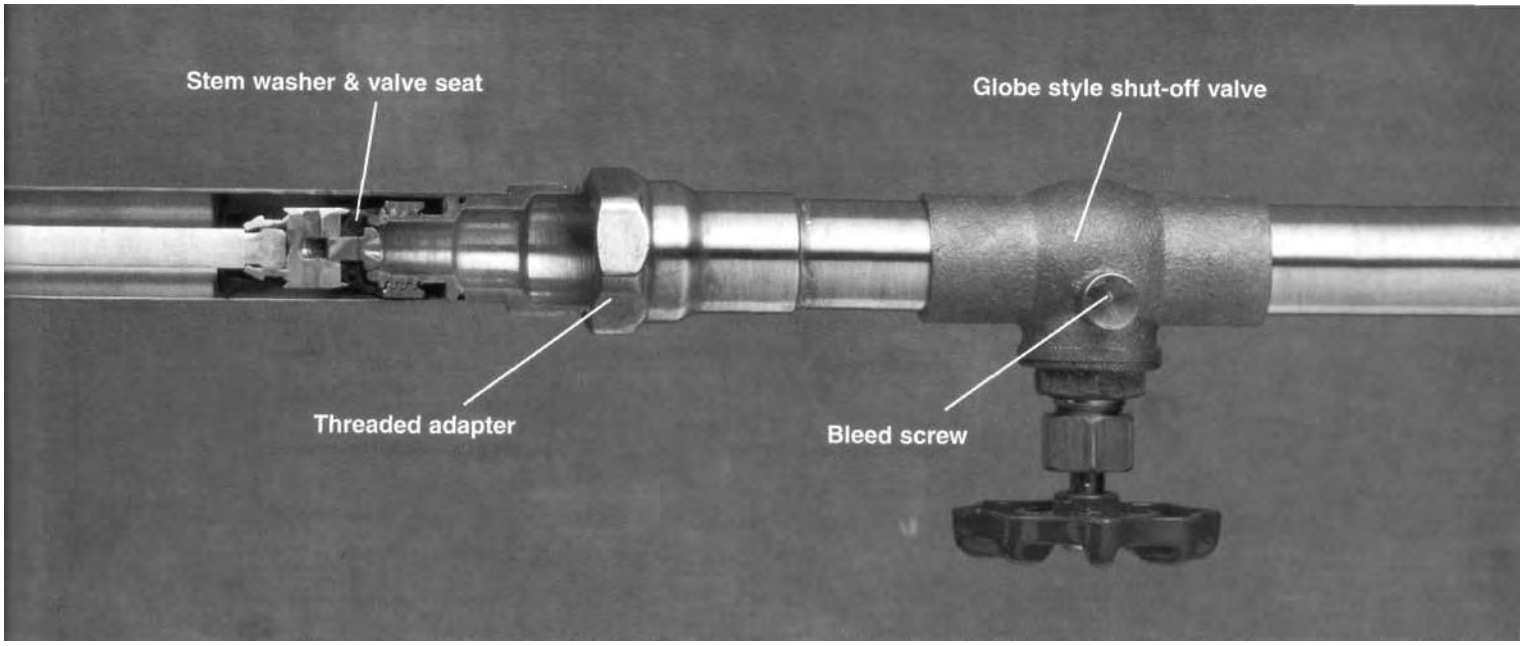
How to Repair a Sillcock



1 Remove sillcock handle, and loosen retaining nut with channel-type pliers. Remove stem. Replace O-ring found on retaining nut or stem.

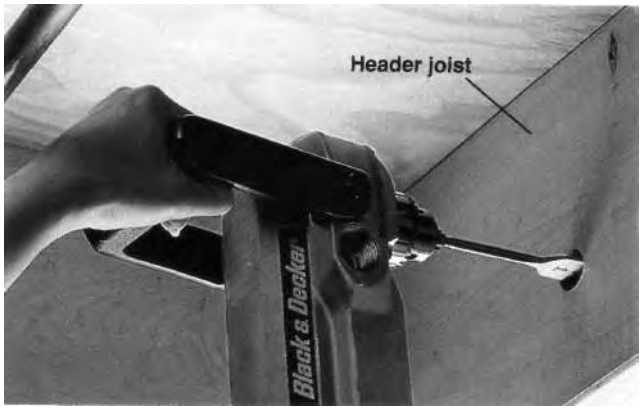


2 Remove the brass stem screw at the end of the stem, and replace the washer. Reassemble the sillcock.

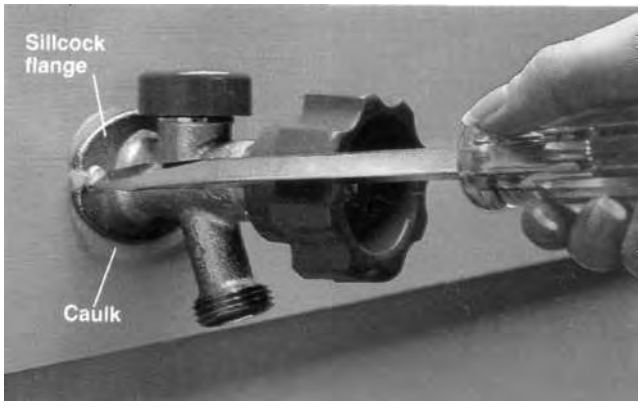


the sillcock is connected to a nearby cold water supply pipe with a threaded adapter, two lengths of soldered copper pipe, and a shutoff valve. A T-fitting (not shown) is used to tap into an existing cold water pipe.

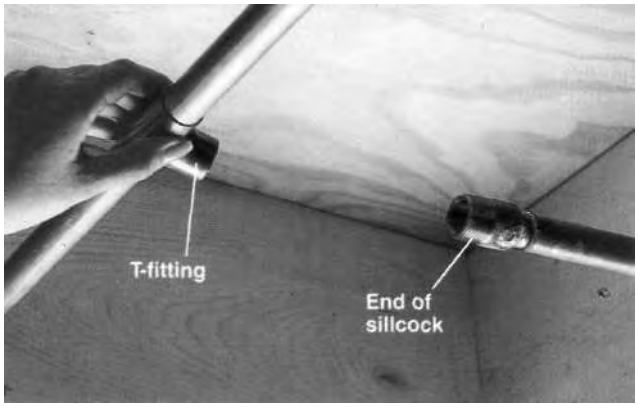
How to Install a Frost-proof Sillcock



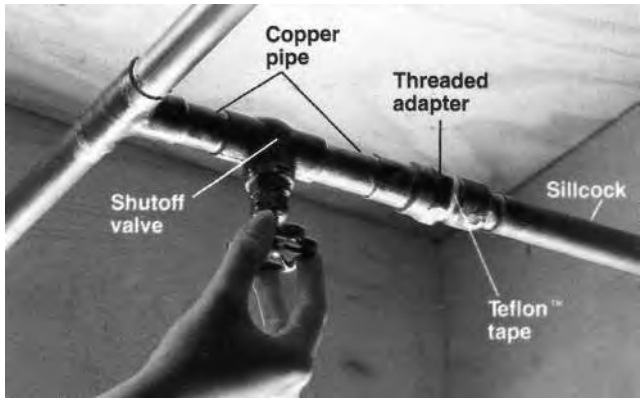
1 Locate position of hole for sillcock. From nearest cold water pipe, mark a point on header joist that is slightly lower than water pipe. Drill a hole through header, sheathing, and siding, using a 1" spade bit.



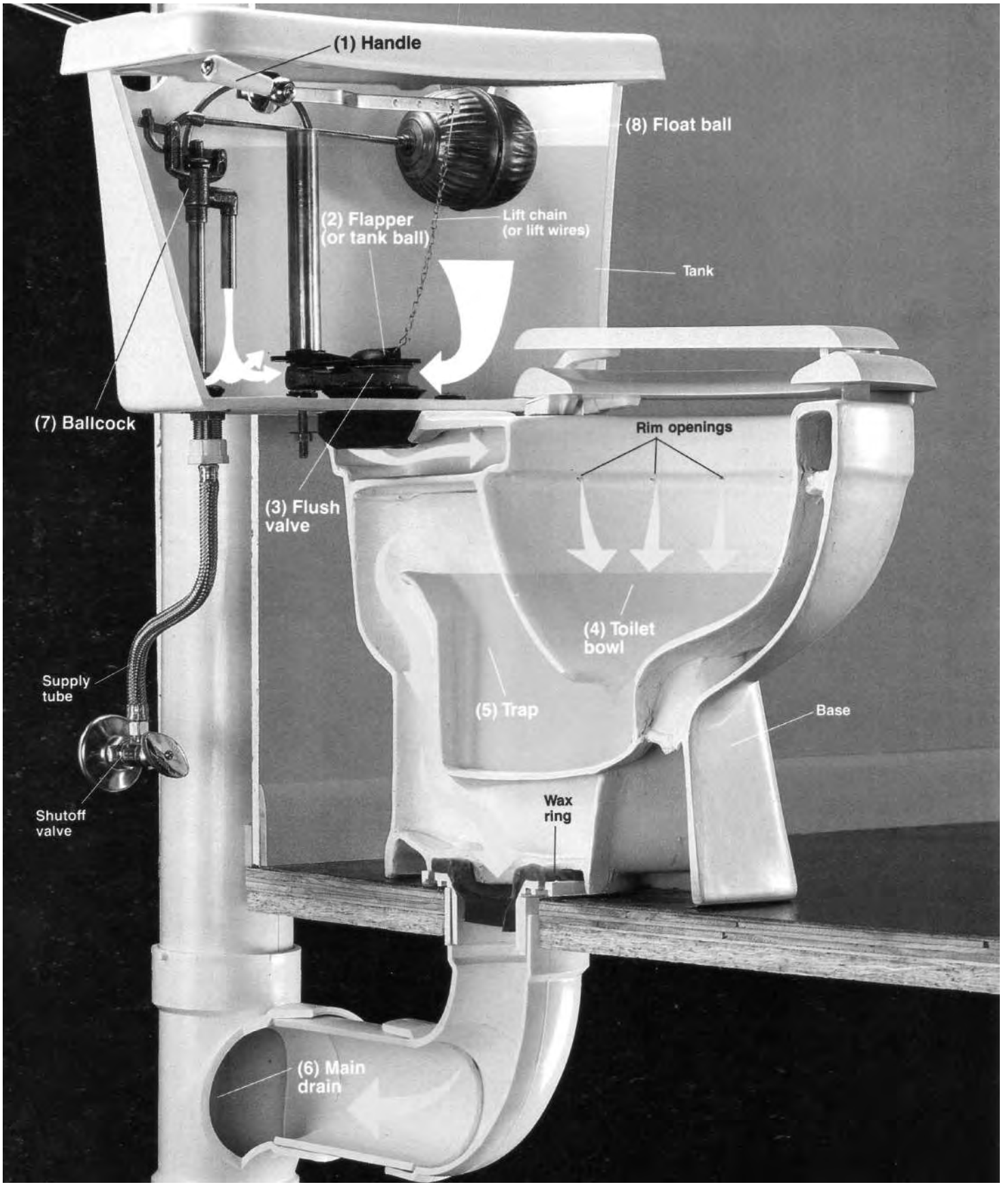
2 Apply a thick bead of silicone caulk to bottom of sillcock flange, then insert sillcock into hole, and attach to siding with 2" corrosion-resistant screws. Turn handle to ON position. Wipe away excess caulk.



3 Mark cold water pipe, then cut pipe and install a T-fitting (pages 48 to 51). Wrap Teflon tape around threads of sillcock.



4 Join T-fitting to sillcock with threaded adapter (page 43), a shutoff valve, and two lengths of copper pipe. Prepare pipes and solder the joints. Turn on water, and close sillcock when water runs steadily.



How a toilet works: When the handle (1) is pushed, the lift chain raises a rubber seal, called a flapper or tank ball (2). Water in the tank rushes down through the flush valve opening (3) in the bottom of the tank, into the toilet bowl (4). Waste water in the bowl is forced through the trap (5) into the main drain (6). When the toilet tank is empty, the flapper seals the tank, and a water supply valve, called a ballcock (7), refills the toilet tank. The ballcock is controlled by a float ball (8) that rides on the surface of the water. When the tank is full, the float ball automatically shuts off the ballcock.

Common Toilet Problems

A clogged toilet is one of the most common plumbing problems. If a toilet overflows or flushes sluggishly, clear the clog with a plunger or closet auger (page 228). If the problem persists, the clog may be in the main waste and vent stack (page 235).

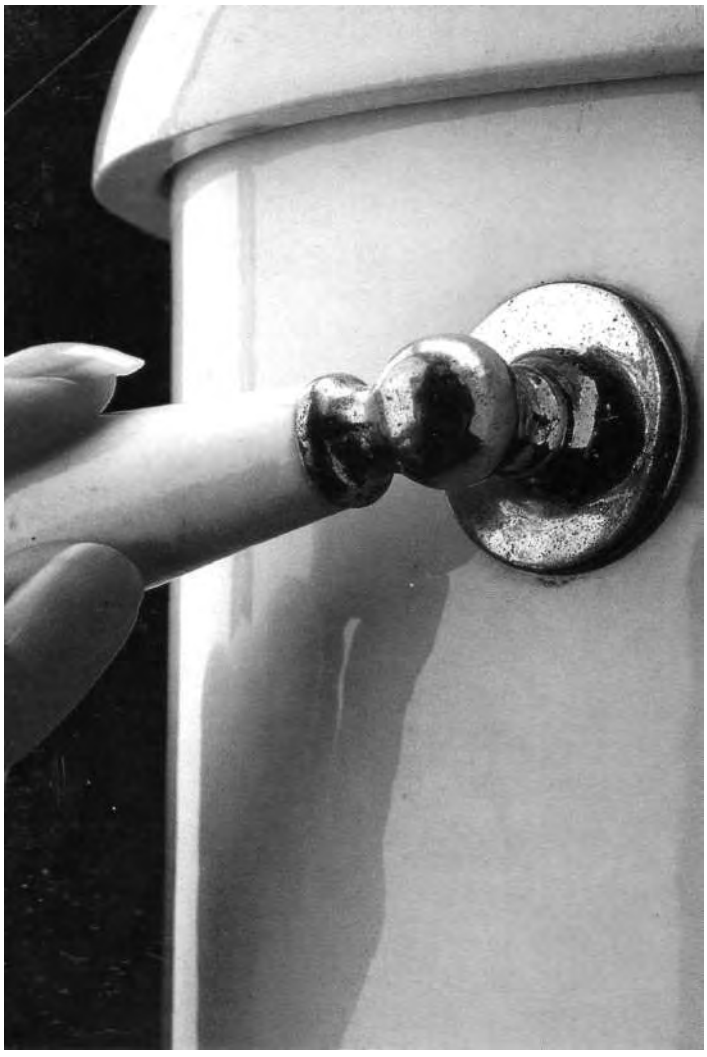
Most other toilet problems are fixed easily with minor adjustments that require no disassembly or replacement parts. You can make these adjustments in a few minutes, using simple tools (page 212).

If minor adjustments do not fix the problem, further repairs will be needed. The parts of a standard toilet are not difficult to take apart, and most repair projects can be completed in less than an hour.

A recurring puddle of water on the floor around a toilet may be caused by a crack in the toilet base or in the tank. A damaged toilet should be replaced. Installing a new toilet is an easy project that can be finished in three or four hours.

A standard two-piece toilet has an upper tank that is bolted to a base. This type of toilet uses a simple gravity-operated flush system, and can be repaired easily using the directions on the following pages. Some one-piece toilets use a complicated, high-pressure flush valve. Repairing these toilets can be difficult, so this work should be left to a professional.

Problems		Repairs
	Toilet handle sticks, or is hard to push.	1. Adjust lift wires (page 212). 2. Clean & adjust handle (page 212).
	Handle is loose.	1. Adjust handle (page 212). 2. Reattach lift chain or lift wires to lever (page 212).
	Toilet will not flush at all.	1. Make sure water is turned on. 2. Adjust lift chain or lift wires (page 212).
	Toilet does not flush completely.	1. Adjust lift chain (page 212). 2. Adjust water level in tank (page 214).
	Toilet overflows, or flushes sluggishly.	1. Clear clogged toilet (page 228). 2. Clear clogged main waste and vent stack (page 235).
	Toilet runs continuously.	1. Adjust lift wires or lift chain (page 212). 2. Replace leaky float ball (page 213). 3. Adjust water level in tank (page 214). 4. Adjust & clean flush valve (page 217). 5. Replace flush valve (page 217). 6. Repair or replace ballcock (pages 215 to 216).
	Water on floor around toilet.	1. Tighten tank bolts and water connections (page 218). 2. Insulate tank to prevent condensation (page 218). 3. Replace wax ring (pages 219 to 220). 4. Replace cracked tank or bowl (pages 218 to 221).



Making Minor Adjustments

Many common toilet problems can be fixed by making minor adjustments to the handle and the attached lift chain (or lift wires).

If the handle sticks or is hard to push, remove the tank cover and clean the handle mounting nut. Make sure the lift wires are straight.

If the toilet will not flush completely unless the handle is held down, you may need to remove excess slack in the lift chain.

If the toilet will not flush at all, the lift chain may be broken or may need to be reattached to the handle lever.

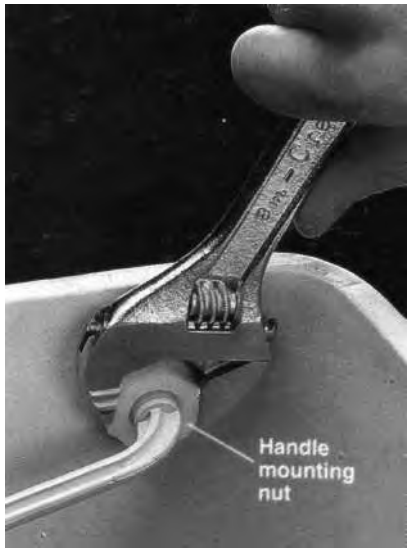
A continuously running toilet (page opposite) can be caused by bent lift wires, kinks in a lift chain, or lime buildup on the handle mounting nut. Clean and adjust the handle and the lift wires or chain to fix the problem.

Everything You Need:

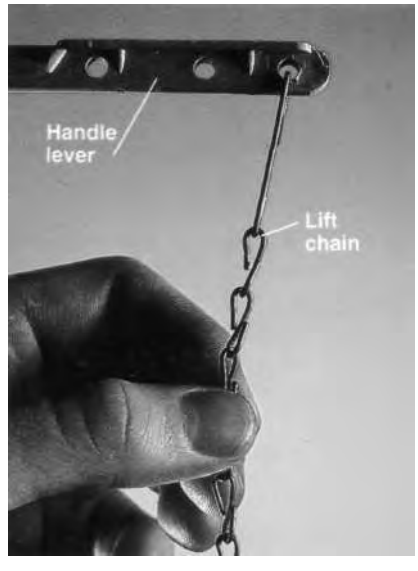
Tools: adjustable wrench, needlenose pliers, screwdriver, small wire brush.

Materials: vinegar.

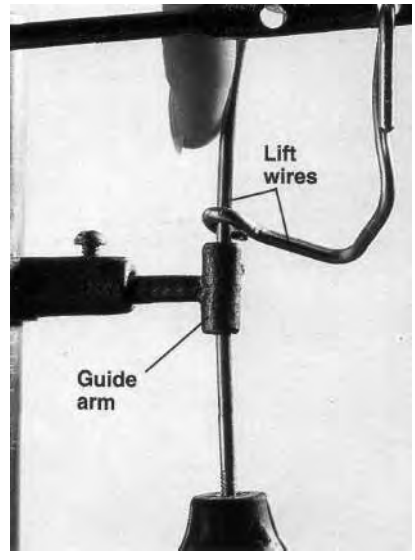
How to Adjust a Toilet Handle & Lift Chain (or Lift Wires)



Clean and adjust handle mounting nut so handle operates smoothly Mounting nut has reversed threads. Loosen nut by turning clockwise; tighten by turning counterclockwise. Remove lime buildup by scrubbing handle parts with a brush dipped in vinegar.



Adjust lift chain so it hangs straight from handle lever, with about 1/2"of slack. Remove excess slack in chain by hooking the chain in a different hole in the handle lever, or by removing links with needlenose pliers. A broken lift chain must be replaced.



Adjust lift wires (found on toilets without lift chains) so that wires are straight and operate smoothly when handle is pushed. A sticky handle often can be fixed by straightening bent lift wires.

Fixing a Running Toilet

The sound of continuously running water occurs if fresh water continues to enter the toilet tank after the flush cycle is complete. A running toilet can waste 20 or more gallons of fresh water each day

To fix a running toilet, first jiggle the toilet handle. If the sound of running water stops, then either the handle or the lift wires (or lift chain) need to be adjusted (page opposite).

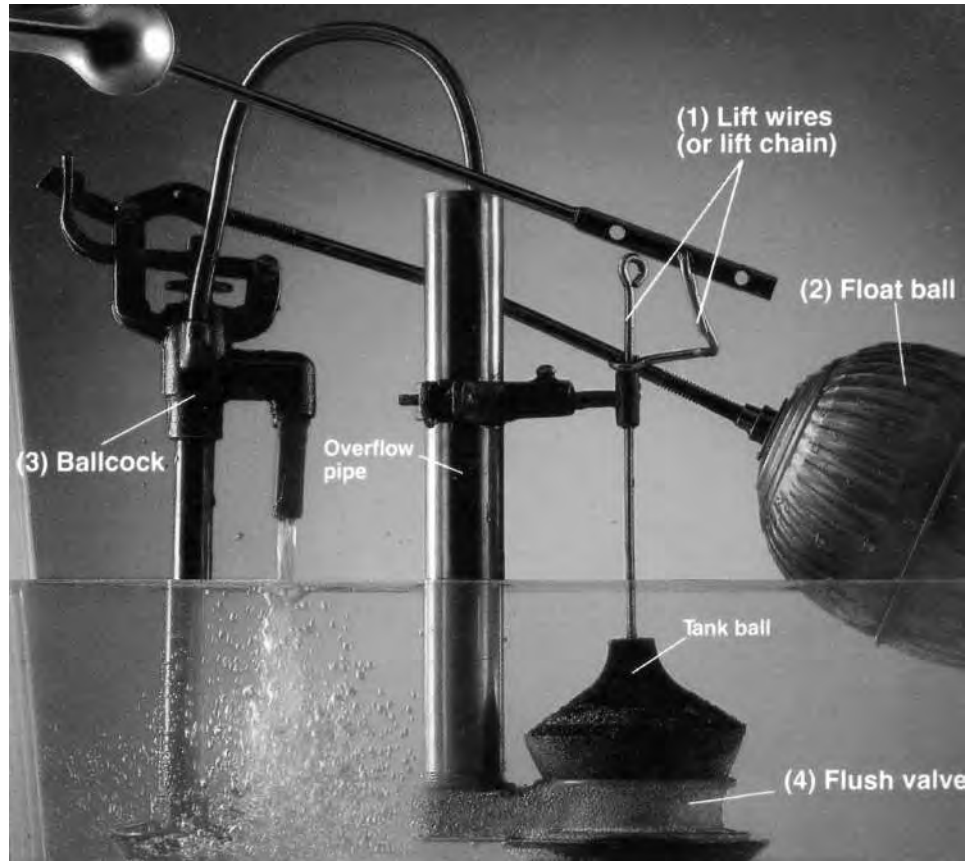
If the sound of running water does not stop when the handle is jiggled, then remove the tank cover and check to see if the float ball is touching the side of the tank. If necessary bend the float arm to reposition the float ball away from the side of the tank. Make sure the float ball is not leaking. To check for leaks, unscrew the float ball and shake it gently If there is water inside the ball, replace it.

If these minor adjustments do not fix the problem, then you will need to adjust or repair the ballcock or the flush valve (photo, right). Follow the directions on the following pages.

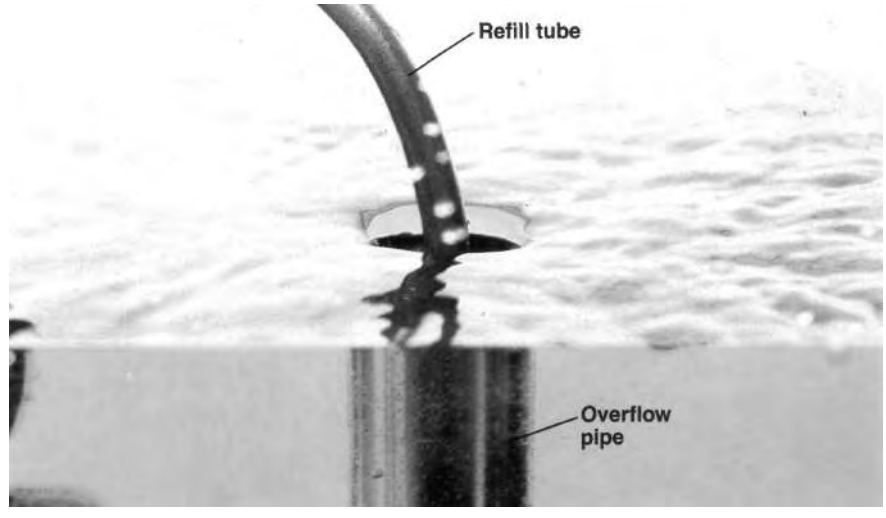
Everything You Need:

Tools; screwdriver, small wire brush, sponge, adjustable wrenches, spud wrench or channel-type pliers.

Materials: universal washer kit, ballcock (if needed), ballcock seals, emery cloth, Scotch Brite pad, flapper or tank ball, flush valve (if needed).

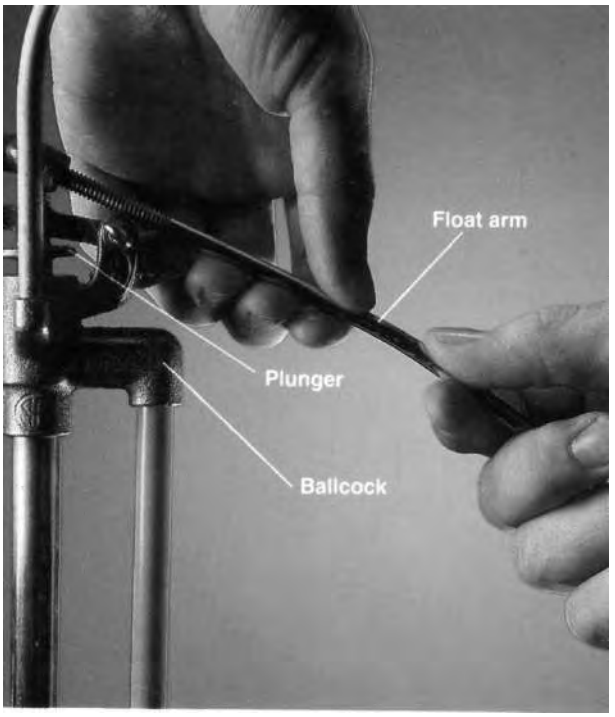


The sound of continuously running water can be caused by several different problems: if the lift wire (1) (or lift chain) is bent or kinked; if the float ball (2) leaks or rubs against the side of the tank; if a faulty ballcock (3) does not shut off the fresh water supply; or if the flush valve (4) allows water to leak down into the toilet bowl. First, check the lift wires and float ball. If making simple adjustments and repairs to these parts does not fix the problem, then you will need to repair the ballcock or flush valve (photo, below).

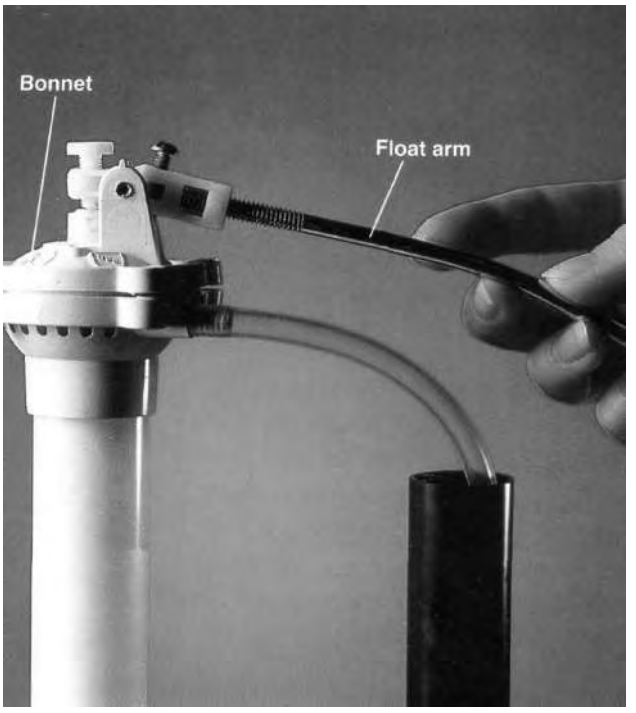


Check the overflow pipe if the sound of running water continues after the float ball and lift wires are adjusted. If you see water flowing into the overflow pipe, the ballcock needs to be repaired. First adjust ballcock to lower the water level in the tank (page 214). If problem continues, repair or replace the ballcock (pages 215 to 216). If water is not flowing into the overflow pipe, then the flush valve needs to be repaired (page 217). First check the tank ball (or flapper) for wear, and replace if necessary. If problem continues, replace the flush valve.

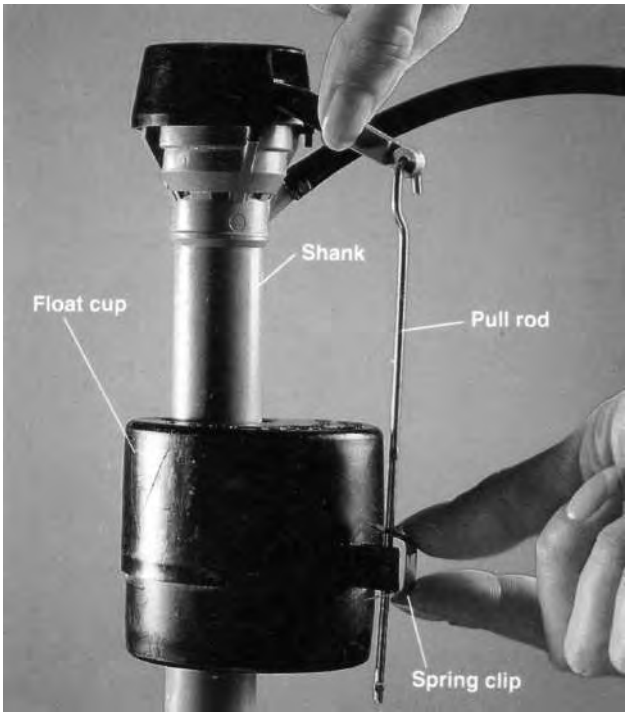
How to Adjust a Ballcock to Set Water Level



Traditional plunger-valve ballcock is made of brass. Water flow is controlled by a plunger attached to the float arm and ball. Lower the water level by bending the float arm downward slightly Raise the water level by bending float arm upward..-



Diaphragm ballcock usually is made of plastic, and has a wide bonnet that contains a rubber diaphragm. Lower the water level by bending the float arm downward slightly Raise the water level by bending float arm upward.

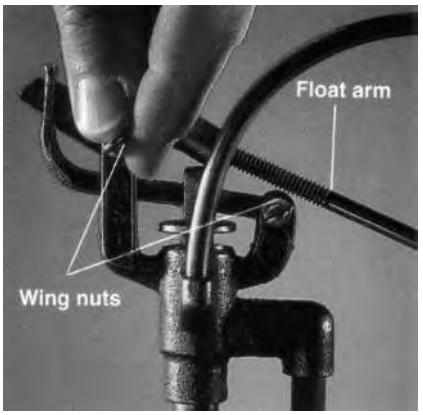


Float cup ballcock is made of plastic, and is easy to adjust. Lower the water level by pinching spring clip on pull rod, and moving float cup downward on the ballcock shank. Raise the water level by moving the cup upward.

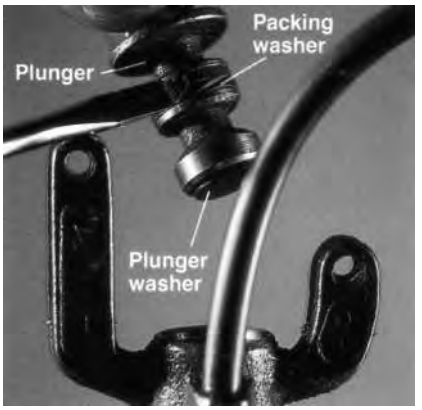


Floatless ballcock controls water level with a pressure-sensing device. Turn the adjustment screw clockwise, 1/2 turn at a time, to raise the water level; counterclockwise to lower it. Note: floatless ballcocks are no longer allowed by Code, and should be replaced.

How to Repair a Plunger-valve Ballcock



1 Shut off the water, and flush to empty the tank. Remove the wing nuts on the ballcock. Slip out the float arm.

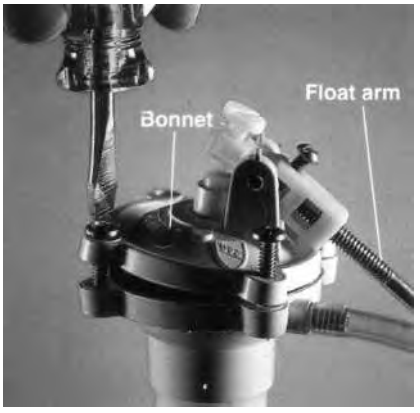


2 Pull up on plunger to remove it. Pry out packing washer or 0-ring. Pry out plunger washer. (Remove stem screw, if necessary)

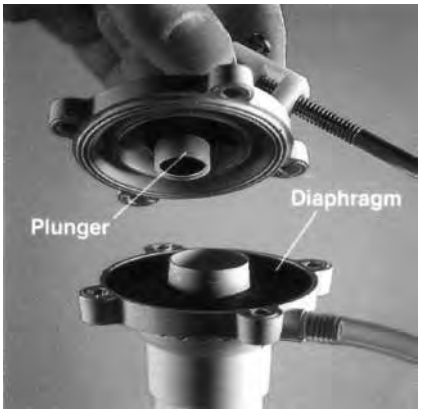


3 Install replacement washers. Clean sediment from inside of ballcock with a wire brush. Reassemble ballcock.

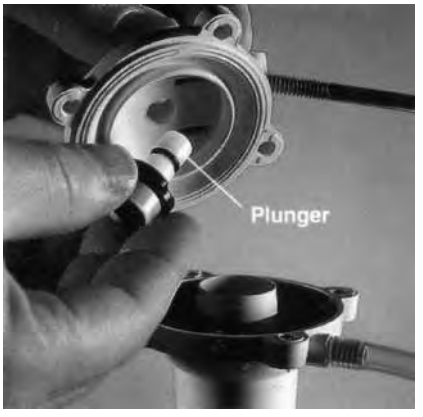
How to Repair a Diaphragm Ballcock



1 Shut off the water, and flush to empty the tank. Remove the screws from the bonnet.



2 Lift off float arm with bonnet attached. Check diaphragm and plunger for wear.

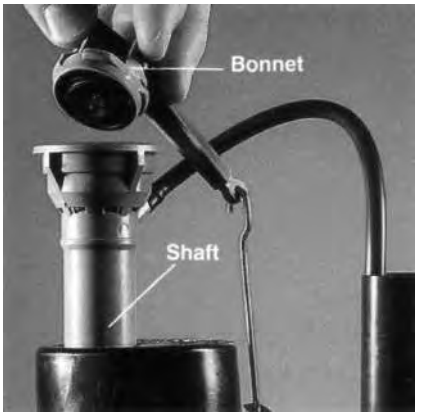


3 Replace any stiff or cracked parts. If assembly is badly worn, replace the entire ballcock (page 216).

How to Repair a Float Cup Ballcock



1 Shut off the water, and flush to empty the tank. Remove the ballcock cap.

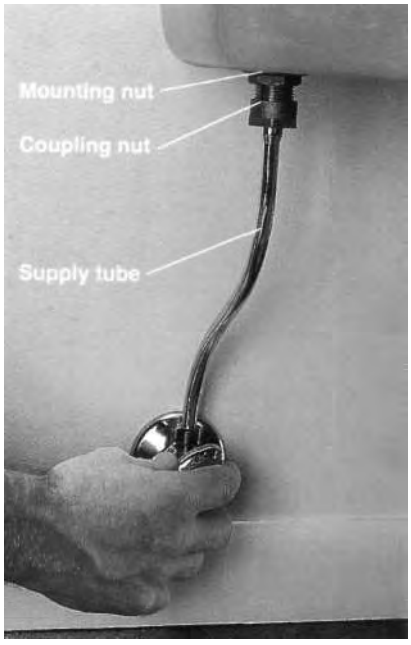


2 Remove bonnet by pushing down on shaft and turning counterclockwise. Clean out sediment inside ballcock with wire brush.



3 Replace the seal. If assembly is badly worn, replace the entire ballcock (page 216).

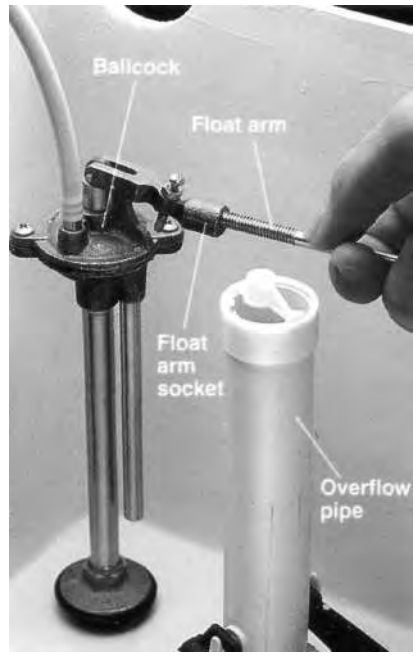
How to Install a New Ballcock



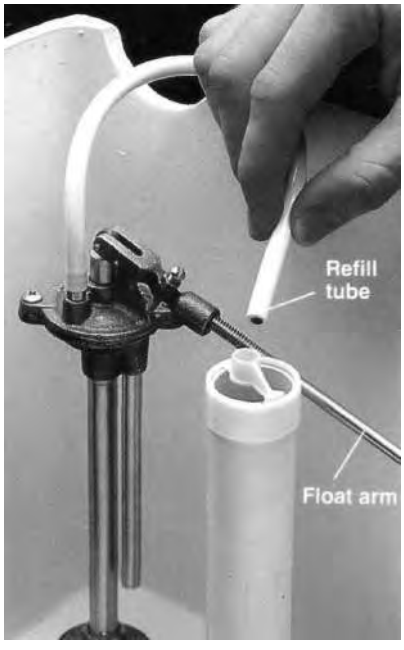
1 Shut off water, and flush toilet to empty tank. Use a sponge to remove remaining water. Disconnect supply tube coupling nut and ballcock mounting nut with adjustable wrench. Remove old ballcock.



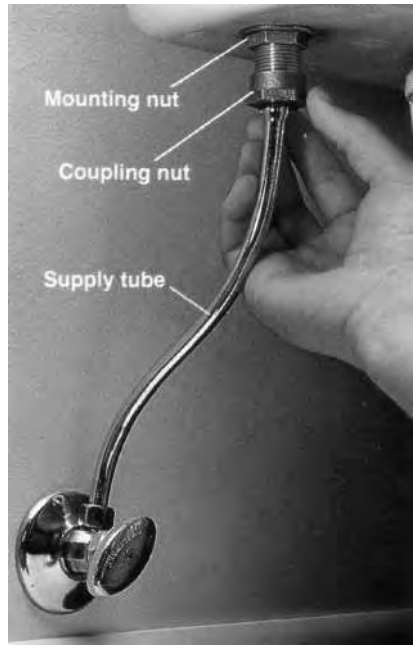
2 Attach cone washer to new ballcock tailpiece and insert tailpiece into tank opening.



3 Align the float arm socket so that float arm will pass behind overflow pipe. Screw float arm onto ballcock. Screw float ball onto float arm.



4 Bend or clip refill tube so tip is inside overflow pipe.

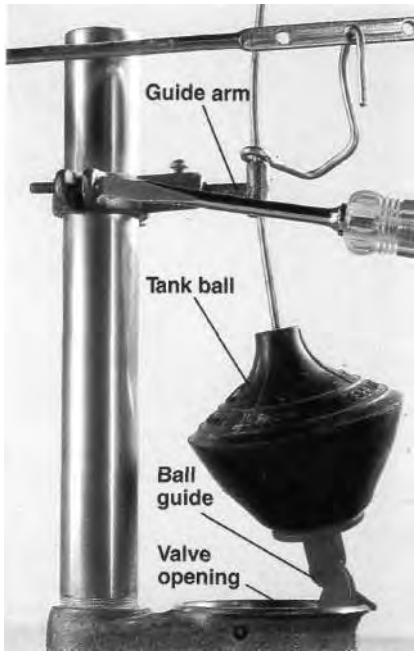


5 Screw mounting nut and supply tube coupling nut onto ballcock tailpiece, and tighten with an adjustable wrench. Turn on the water, and check for leaks.

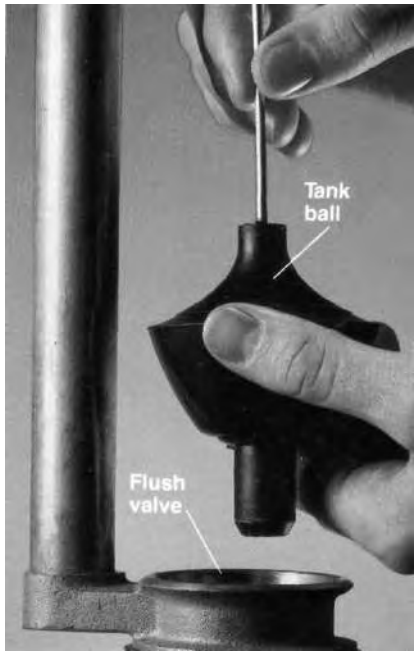


6 Adjust the water level in the tank so it is about V2" below top of the overflow pipe (page 214).

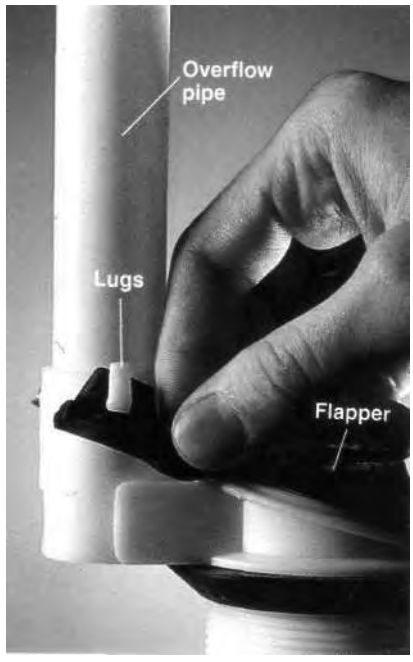
How to Adjust & Clean a Flush Valve



Adjust tank ball (or flapper) so it is directly over flush valve. Tank ball has a guide arm that can be loosened so that tank ball can be repositioned. (Some tank balls have a ball guide that helps seat the tank ball into the flush valve.)

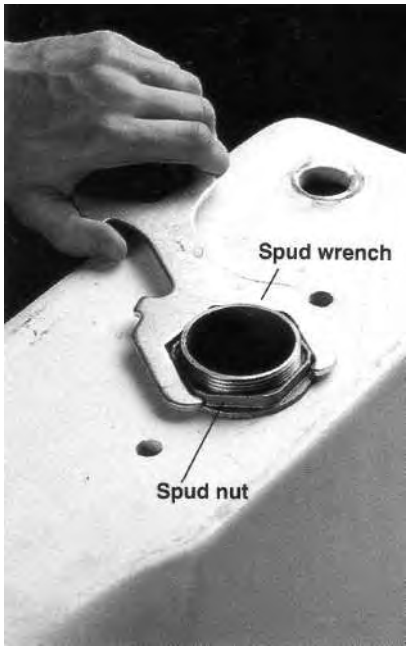


Replace the tank ball if it is cracked or worn. Tank balls have a threaded fitting that screws onto the lift wire. Clean opening of the flush valve, using emery cloth (for brass valves) or a Scotch Brite pad (for plastic valves).

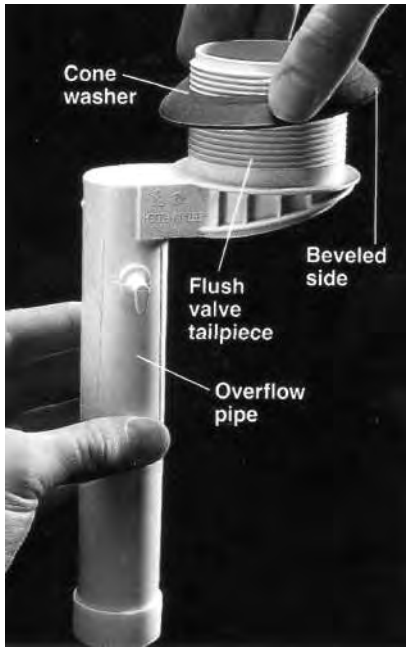


Replace flapper if it is worn. Flappers are attached to small lugs on the sides of overflow pipe.

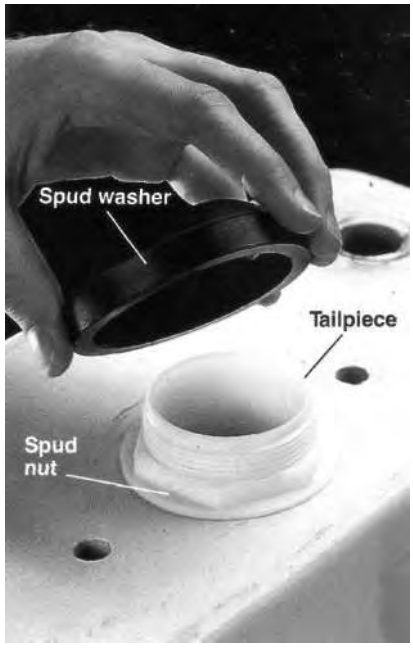
How to Install a New Flush Valve



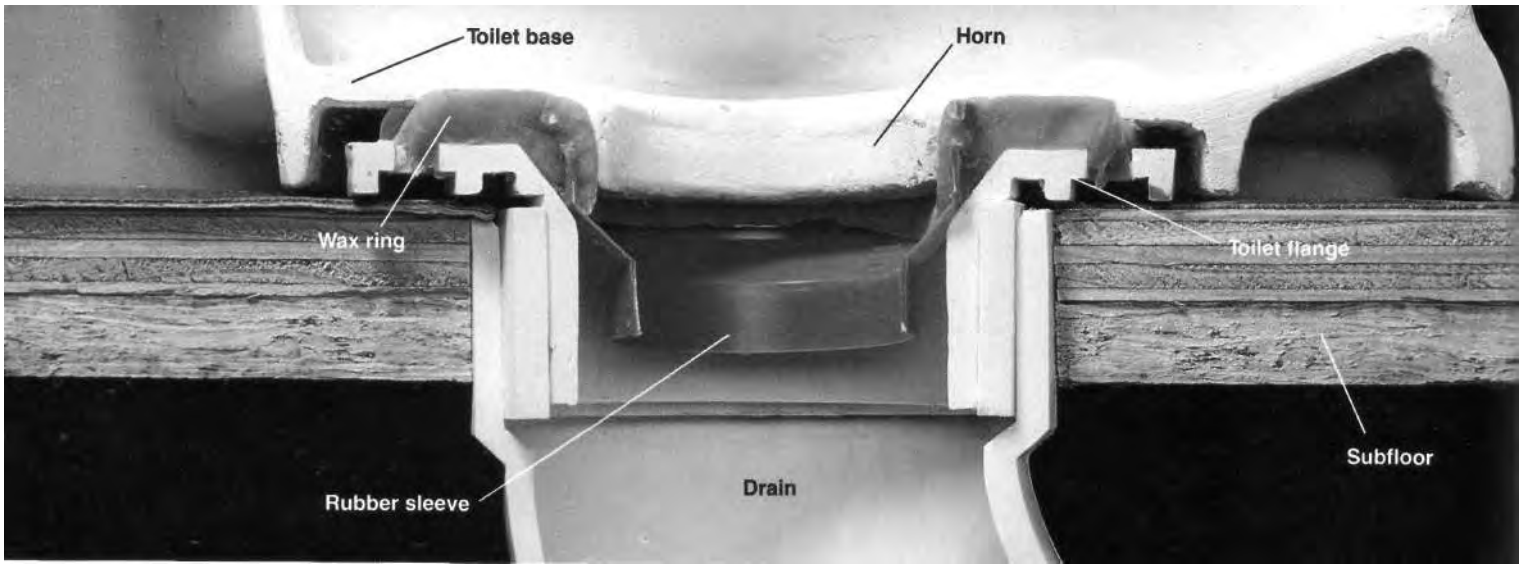
1 Shut off water, disconnect ballcock (page opposite, step 1), and remove toilet tank (page 219, steps 1 and 2). Remove old flush valve by unscrewing spud nut with spud wrench or channel-type pliers.



2 Slide cone washer onto tailpiece of new flush valve. Beveled side of cone washer should face end of tailpiece. Insert flush valve into tank opening so that overflow pipe faces ballcock.



3 Screw spud nut onto tailpiece of flush valve, and tighten with a spud wrench or channel-type pliers. Place soft spud washer over tailpiece, and reinstall toilet tank (pages 220 to 221).



Fixing a Leaking Toilet

Water leaking onto the floor around a toilet may be caused by several different problems. The leaking must be fixed as soon as possible to prevent moisture from damaging the subfloor. •

First, make sure all connections are tight. If moisture drips from the tank during humid weather, it is probably condensation. Fix this "sweating" problem by insulating the inside of the tank with foam panels. A crack in a toilet tank also can cause leaks. A cracked tank must be replaced.

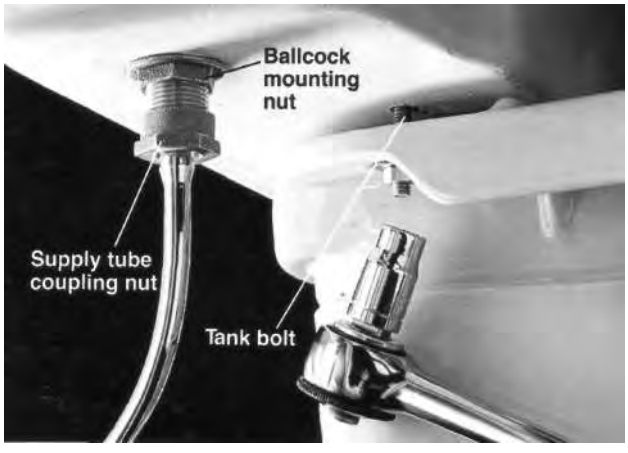
Water seeping around the base of a toilet can be caused by an old wax ring that no longer seals against the drain (photo, above), or by a cracked toilet base. If leaking occurs during or just after a flush, replace the wax ring. If leaking is constant, the toilet base is cracked and must be replaced.

New toilets sometimes are sold with flush valves and ballcocks already installed. If these parts are not included, you will need to purchase them. When buying a new toilet, consider a water-saver design. Water-saver toilets use less than half the water needed by a standard toilet.

Everything You Need:

Tools: sponge, adjustable wrench, putty knife, ratchet wrench, screwdriver.

Materials: tank liner kit, abrasive cleanser, rag, wax ring, plumber's putty *For new installation:* new toilet, toilet handle, ballcock, flush valve, tank bolts, toilet seat.



Tighten all connections slightly Tighten nuts on tank bolts with a ratchet wrench. Tighten ballcock mounting nut and supply tube coupling nut with an adjustable wrench. **Caution: overtightening tank bolts may crack the toilet tank.**



Insulate toilet tank to prevent "sweating," using a toilet liner kit. First, shut off water, drain tank, and clean inside of tank with abrasive cleanser. Cut plastic foam panels to fit bottom, sides, front, and back of tank. Attach panels to tank with adhesive (included in kit). Let adhesive cure as directed.

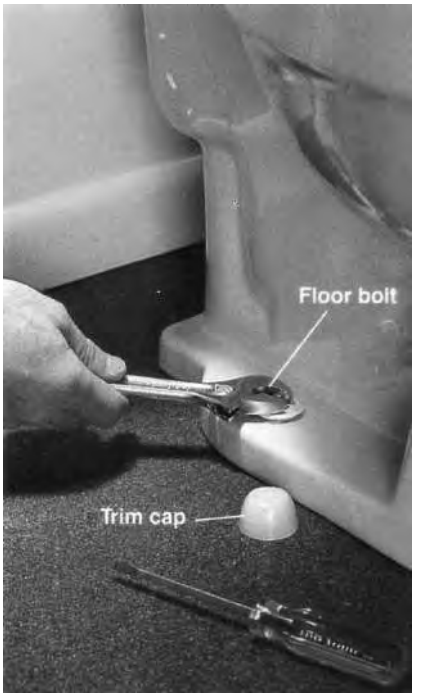
How to Remove & Replace a Wax Ring & Toilet



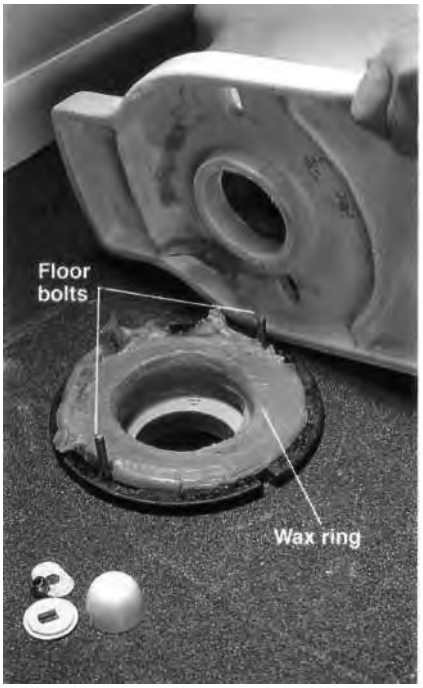
1 Turn off water, and flush to empty toilet tank. Use a sponge to remove remaining water in tank and bowl. Disconnect supply tube with an adjustable wrench.



2 Remove the nuts from the tank bolts with a ratchet wrench. Carefully remove the tank and set it aside.



3 Pry off the floor bolt trim caps at the base of the toilet. Remove the floor nuts with an adjustable wrench.



4 Straddle the toilet and rock the bowl from side to side until the seal breaks. Carefully lift the toilet off the floor bolts and set it on its side. Small amount of water may spill from the toilet trap.



5 Remove old wax from the toilet flange in the floor. Plug the drain opening with a damp rag to prevent sewer gases from rising into the house.

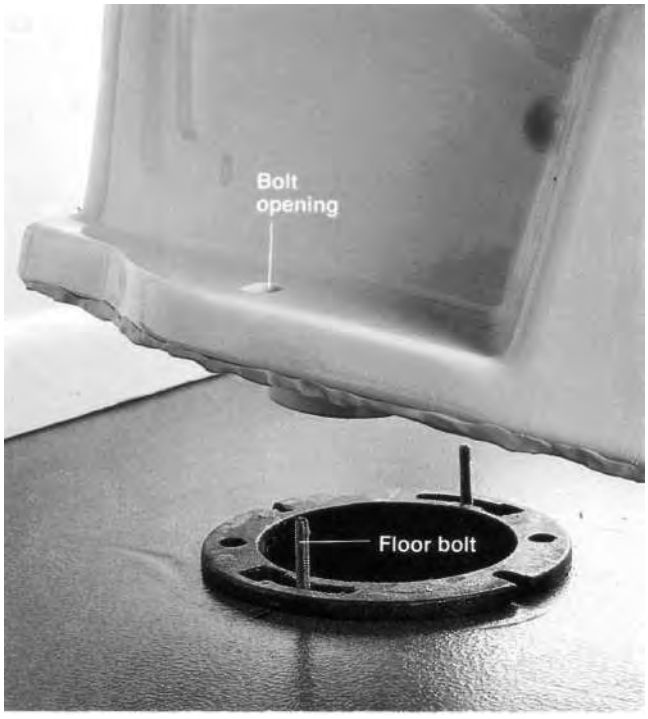


6 If old toilet will be reused, clean old wax and putty from the horn and the base of the toilet.

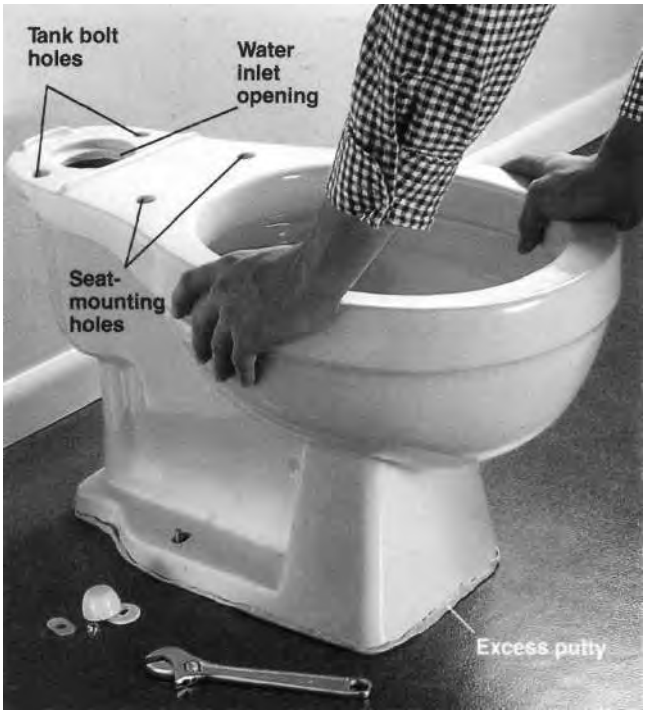
How to Remove & Replace a Wax Ring & Toilet



7 Turn stool upside down. Place new wax ring over drain horn. If ring has a rubber or plastic sleeve, sleeve should face away from toilet. Apply a bead of plumber's putty to bottom edge of toilet base.



8 Position the toilet over drain so that the floor bolts fit through the openings in the base of the toilet.



9 Press down on toilet base to compress wax and putty. Thread washers and nuts onto floor bolts, and tighten with adjustable wrench until snug. **Caution: overtightening nuts may crack the base.** Wipe away excess plumber's putty Cover nuts with trim caps.



Prepare tank for installation. If necessary, install **10** a handle (page 212), ballcock (page 216), and flush valve (page 217). Carefully turn tank upside down, and place soft spud washer over the flush valve tailpiece.



11 Turn tank right side up and position it on rear of toilet base so that spud washer is centered in water inlet opening.



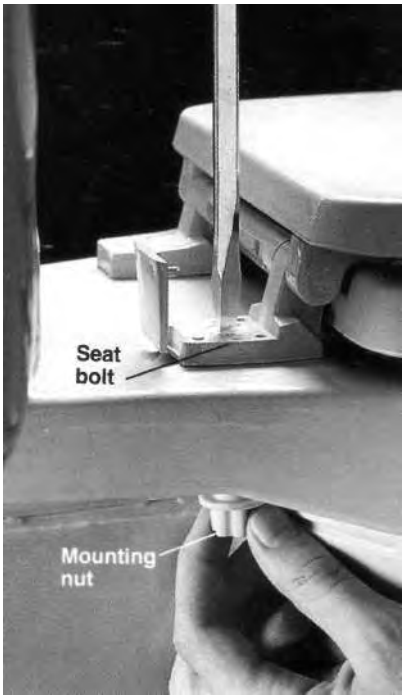
12 Line up the tank bolt holes with holes in base of toilet. Slide rubber washers onto the tank bolts and place the bolts through holes. From underneath the tank, thread washers and nuts onto the bolts.



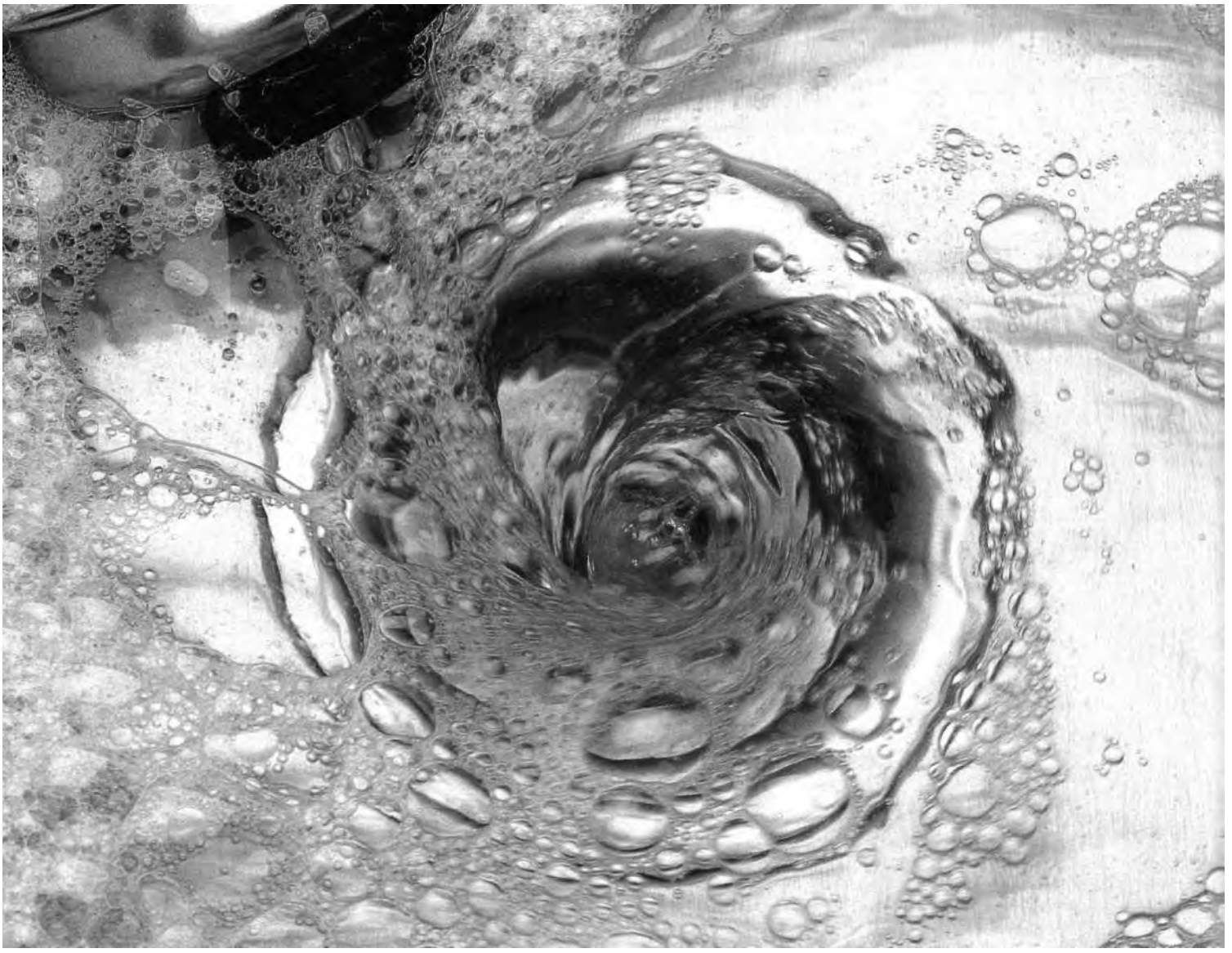
13 Tighten nuts with ratchet wrench until tank is snug. Use caution when tightening nuts: most toilet tanks rest on the spud washer, not directly on the toilet base.



14 Attach the water supply tube to the ballcock tailpiece with an adjustable wrench (page 216). Turn on the water and test toilet. Tighten tank bolts and water connections, if necessary.



15 Position the new toilet seat, if needed, inserting seat bolts into mounting holes in toilet. Screw mounting nuts onto the seat bolts, and tighten.



Clearing Clogs & Fixing Drains

Clear a clogged drain with a plunger, hand auger, or blow bag. A plunger breaks up clogs by forcing air pressure into the drain line. Because a plunger is effective and simple to use, it should be the first choice for clearing a clog.

A hand auger has a flexible steel cable that is pushed into the drain line to break up or remove obstructions. An auger is easy to use, but for bast results the user must know the "feel" of the cable in the drain line. A little experience often is necessary to tell the difference between a soap clog and a bend in the drain line (pages 226 to 227).

A blow bag hooks to a garden hose and uses water pressure to clear clogs. Blow bags are most effective on clogs in floor drains (page 233).

Use caustic, acid-based chemical drain cleaners only as a last resort. These drain cleaners, usually available at hardware stores and supermarkets, will dissolve clogs, but they also may damage pipes and must be handled with caution. Always read the manufacturer's directions completely

Regular maintenance helps keep drains working properly. Flush drains once each week with hot tap water to keep them free of soap, grease, and debris. Or, treat drains once every six months with a non-caustic (copper sulfide- or sodium hydroxide-based) drain cleaner. A non-caustic cleaner will not harm pipes.

Occasionally, leaks may occur in the drain lines or around the drain opening. Most leaks in drain lines are fixed easily by gently tightening all pipe connections. If the leak is at the sink drain opening, fix or replace the strainer body assembly

Clearing Clogged Sinks

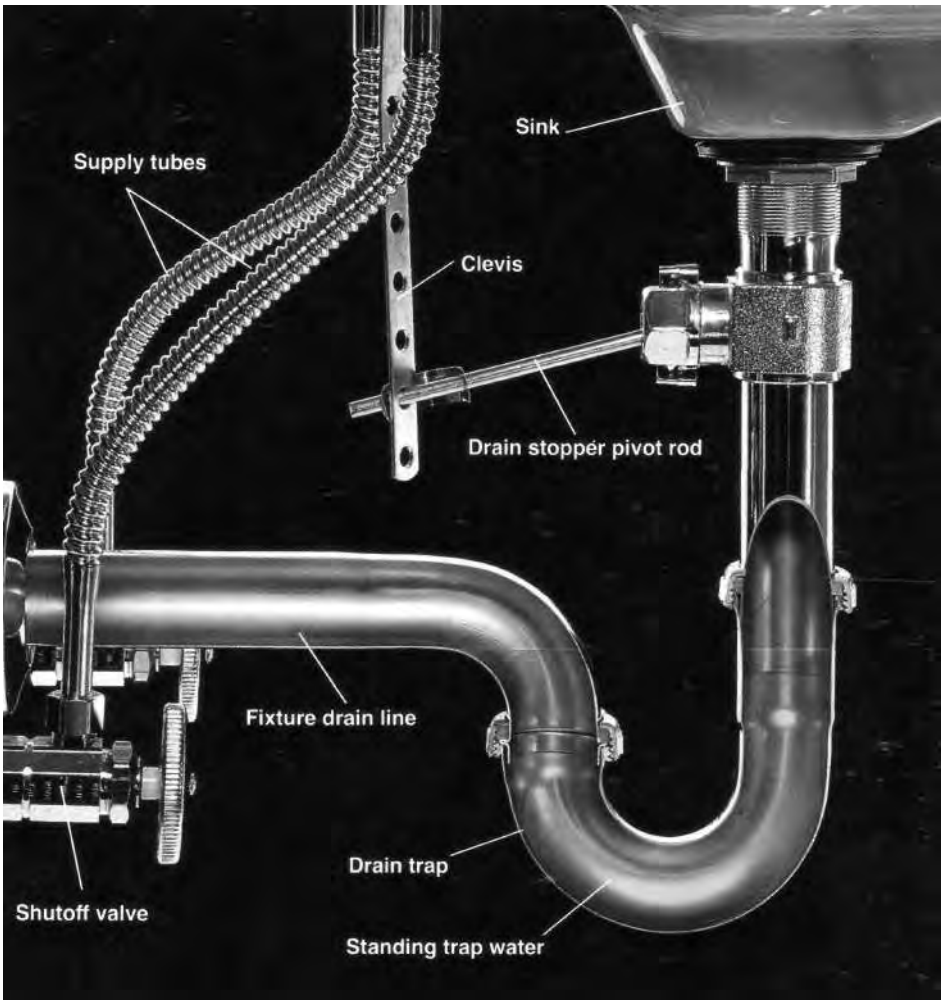
Every sink has a drain trap and a fixture drain line. Sink clogs usually are caused by a buildup of soap and hair in the trap or fixture drain line. Remove clogs by using a plunger, disconnecting and cleaning the trap (page 224), or using a hand auger (pages 226 to 227).

Many sinks hold water with a mechanical plug called a *pop-up stopper.* If the sink will not hold standing water, or if water in the sink drains too slowly, the pop-up stopper must be cleaned and adjusted (page 224).

Everything You Need:

Tools: plunger, channel-type pliers, small wire brush, screwdriver

Materials: rag, bucket, replacement gaskets.



Drain trap holds water that seals the drain line and prevents sewer gases from entering the home. Each time a drain is used, the standing trap water is flushed away and replaced by new water The shape of the trap and fixture drain line may resemble the letter "P" and sink traps sometimes are called P-traps.

How to Clear Sink Drains with a Plunger

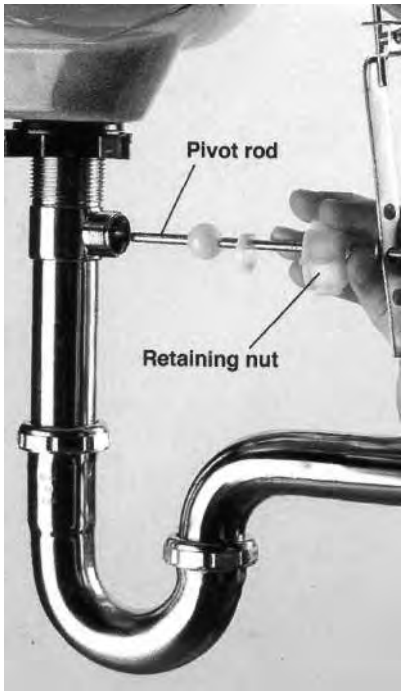


1 Remove drain stopper Some pop-up stoppers lift out directly; others turn counterclockwise. On some older types of stoppers, the pivot rod must be removed to free the stopper

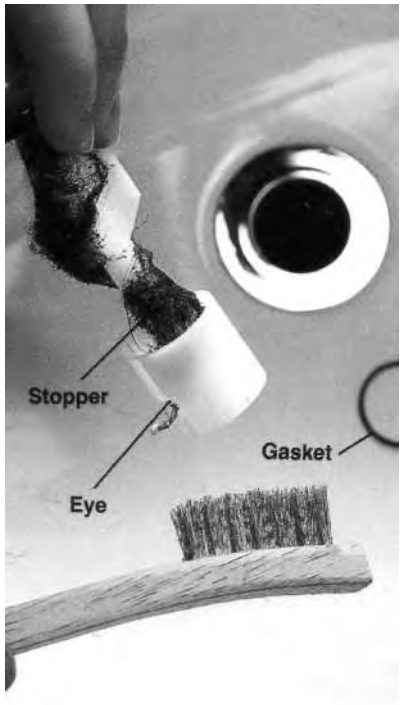


2 Stuff a wet rag in sink overflow opening. Rag prevents air from breaking the suction of the plunger Place plunger cup over drain and run enough water to cover the rubber cup. Move plunger handle up and down rapidly to break up the clog.

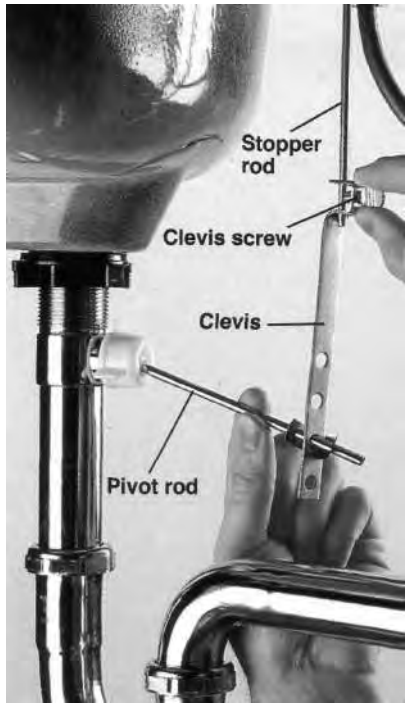
How to Clean & Adjust a Pop-up Sink Drain Stopper



1 Raise stopper lever to full upright (closed) position. Unscrew the retaining nut that holds pivot rod in position. Pull pivot rod out of drain pipe to release stopper.



2 Remove stopper. Clean debris from stopper, using a small wire brush. Inspect gasket for wear or damage, and replace if necessary. Reinstall stopper.



3 If sink does not drain properly, adjust clevis. Loosen clevis screw. Slide clevis up or down on stopper rod to adjust position of stopper. Tighten clevis screw.

How to Remove & Clean a Sink Drain Trap



1 Place bucket under trap to catch water and debris. Loosen slip nuts on trap bend with channel-type pliers. Unscrew nuts by hand and slide away from connections. Pull off trap bend.



2 Dump out debris. Clean trap bend with a small wire brush. Inspect slip nut washers for wear, and replace if necessary Reinstall trap bend, and tighten slip nuts.

Fixing Leaky Sink Strainers

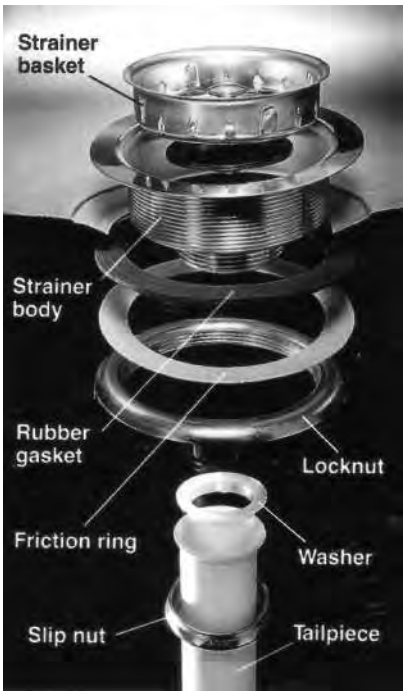
A leak under a sink may be caused by a strainer body that is not properly sealed to the sink drain opening. To check for leaks, close the drain stopper and fill sink with water From underneath sink, inspect the strainer assembly for leaks.

Remove the strainer body clean it, and replace the gaskets and plumber's putty Or, replace the strainer with a new one, available at home centers.

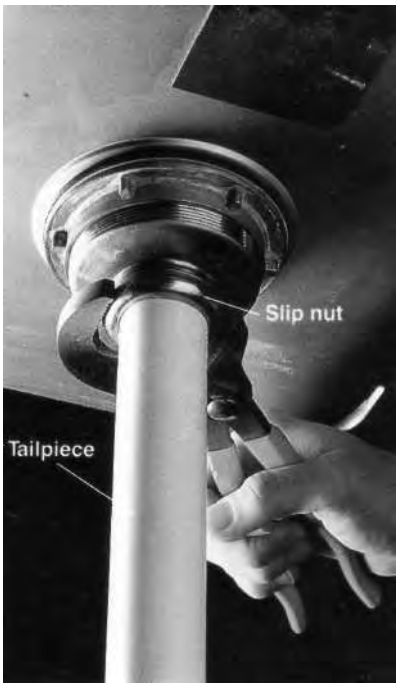
Everything You Need:

Tools: channel-type pliers, spud wrench, hammer, putty knife.

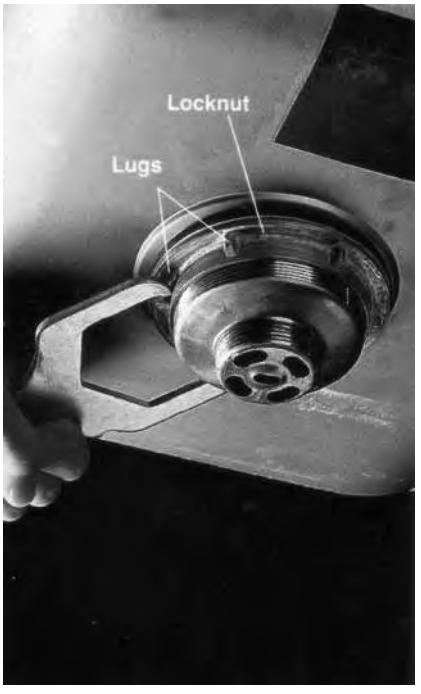
Materials: plumber's putty replacement parts (if needed).



Sink strainer assembly connects the sink to the drain line. Leaks may occur where the strainer body seals against the lip of the drain opening.



1 Unscrew slip nuts from both ends of tailpiece, using channel-type pliers. Disconnect tailpiece from strainer body and trap bend. Remove tailpiece.



2 Remove the locknut, using a spud wrench. Stubborn locknuts may be removed by tapping on the lugs with a hammer. Unscrew the locknut completely, and remove the strainer assembly. If necessary, cut the locknut.

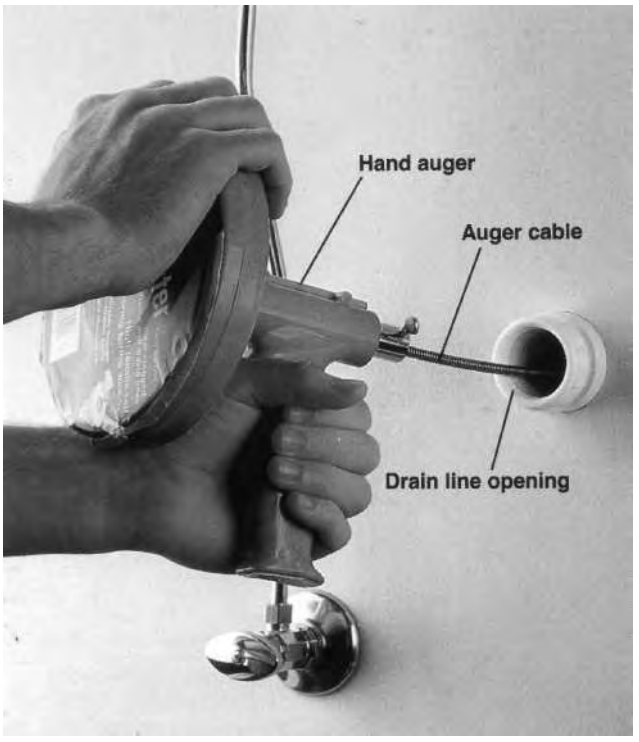


3 Remove old putty from the drain opening, using a putty knife. If reusing the old strainer body clean off old putty from under the flange. Old gaskets and washers should be replaced.

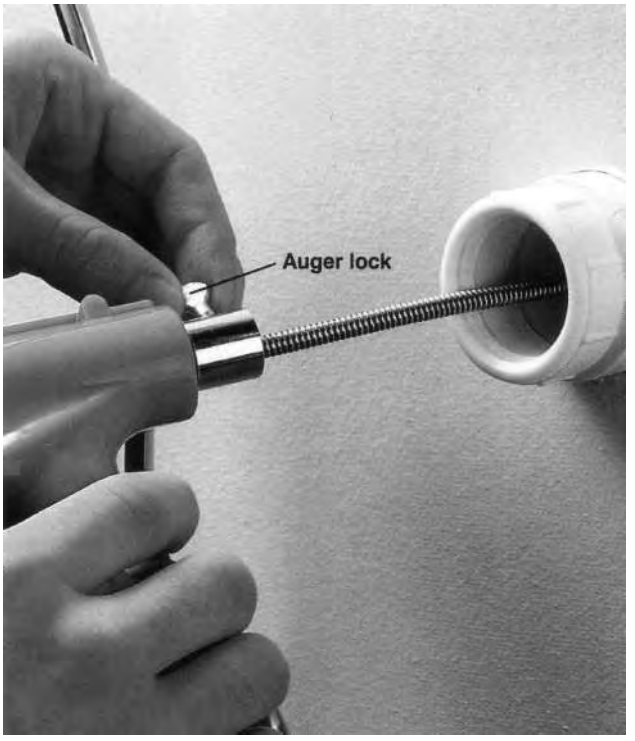


4 Apply a bead of plumber's putty to the lip of the drain opening. Press strainer body into drain opening. From under the sink, place rubber gasket, then metal or fiber friction ring, over strainer Reinstall locknut and tighten. Reinstall tailpiece.

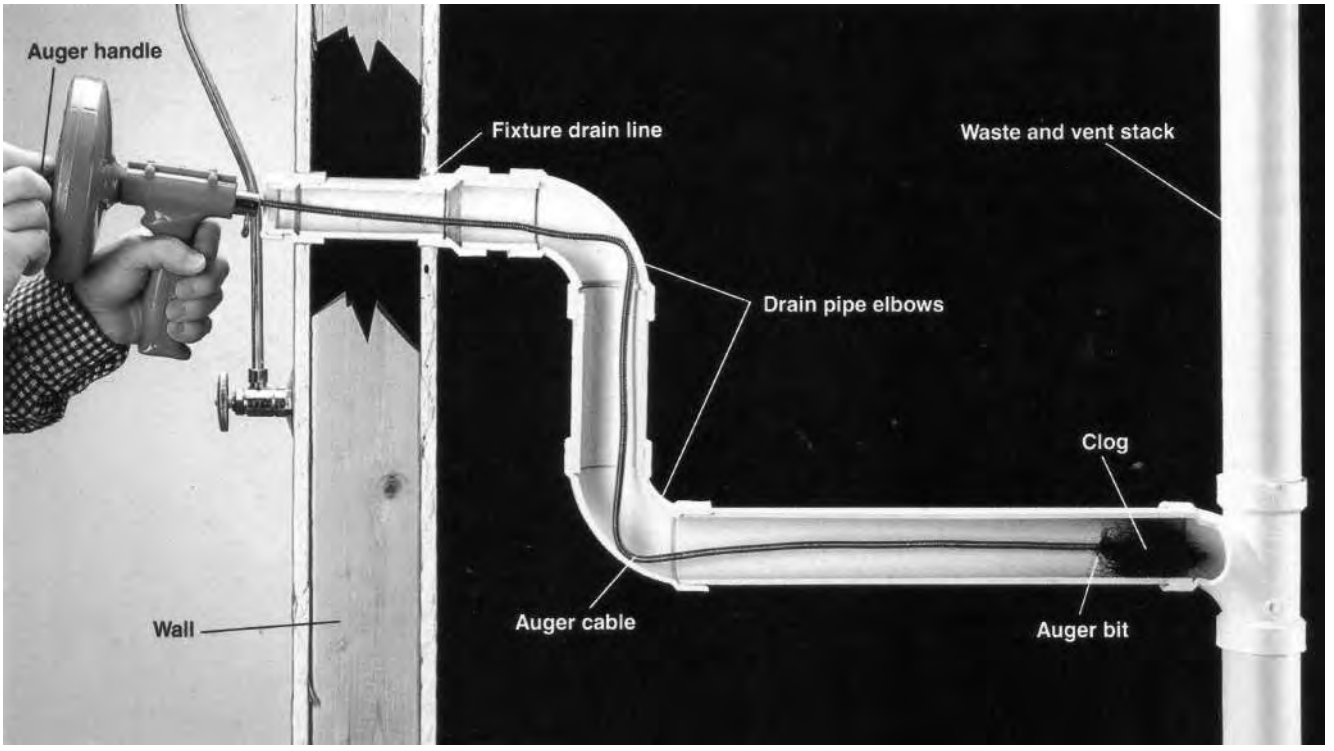
How to Clear a Fixture Drain Line with a Hand Auger



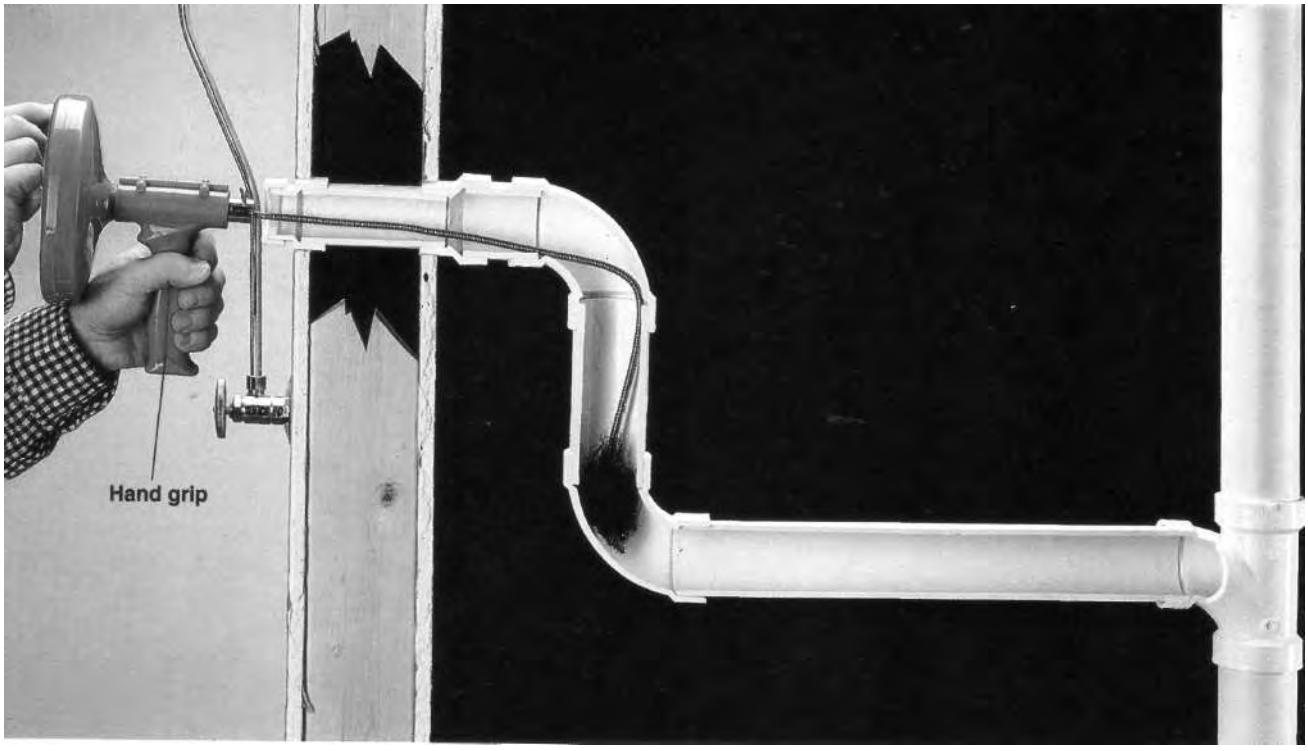
1 Remove trap bend (page 224). Push the end of the auger cable into the drain line opening until resistance is met. This resistance usually indicates end of cable has reached a bend in the drain pipe.



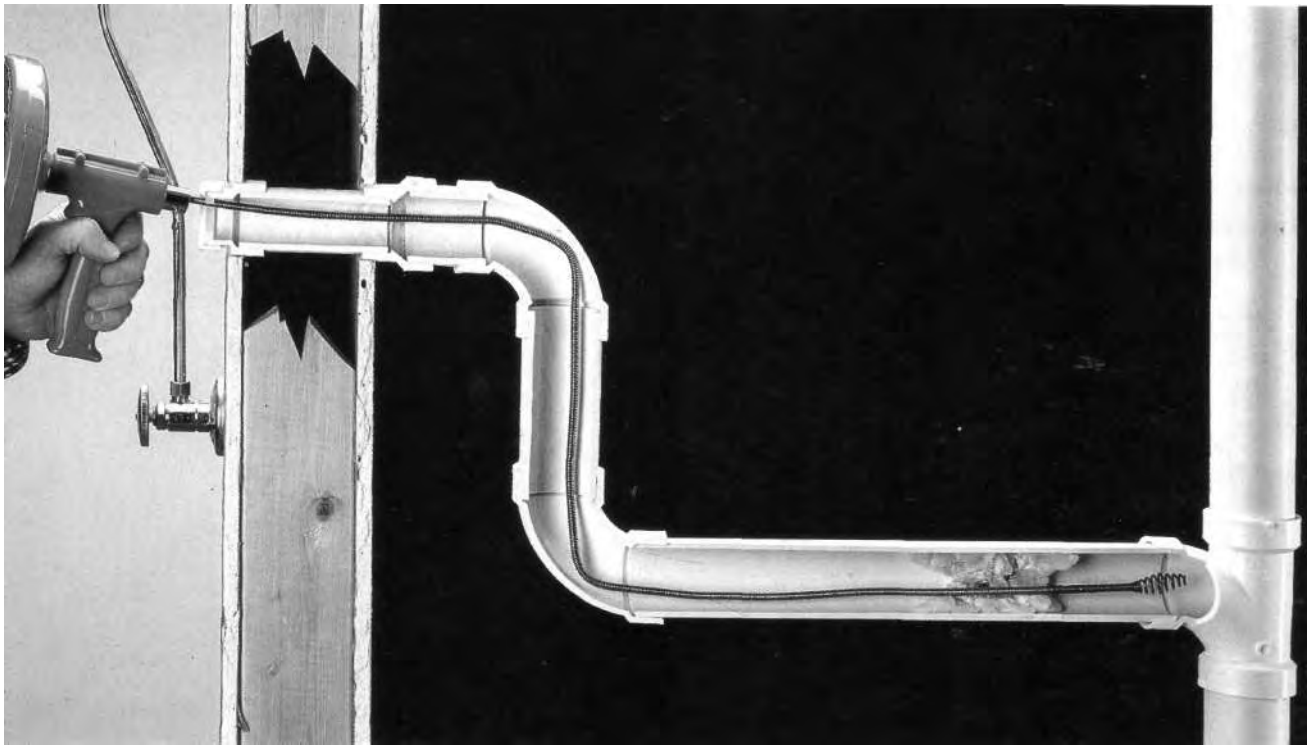
2 Set the auger lock so that at least 6" of cable extends out of the opening. Crank the auger handle in a clockwise direction to move the end of the cable past bend in drain line.



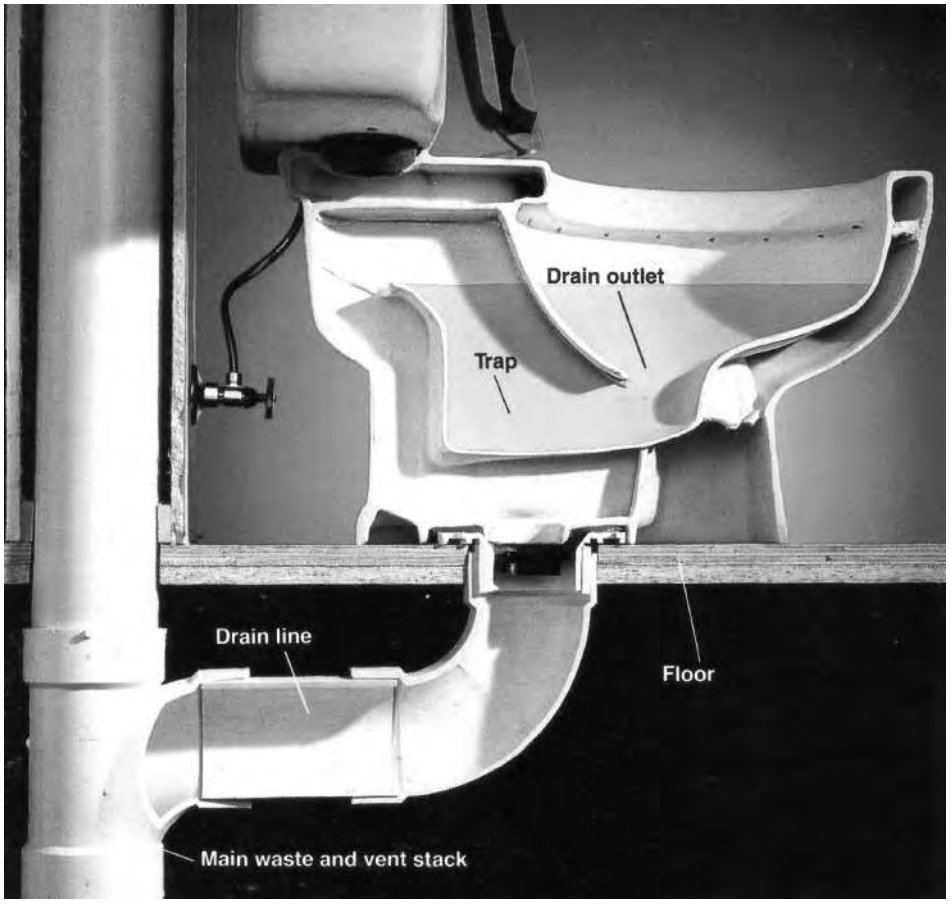
3 Release the lock and continue pushing the cable into the opening until firm resistance is felt. Set the auger lock and crank the handle in a clockwise direction. Solid resistance that prevents the cable from advancing indicates a clog. Some clogs, such as a sponge or an accumulation of hair, can be snagged and retrieved (step 4). Continuous resistance that allows the cable to advance slowly is probably a soap clog (step 5).



4 Pull an obstruction out of the line by releasing the auger lock and cranking the handle clockwise. If no object can be retrieved, reconnect the trap bend and use the auger to clear the nearest branch drain line or main waste and vent stack (pages 234 to 235).



5 Continuous resistance indicates a soap clog. Bore through the clog by cranking the auger handle clockwise while applying steady pressure on the hand grip of the auger. Repeat the procedure two or three times then retrieve the cable. Reconnect the trap bend and flush the system with hot tap water to remove debris



Toilet drain system has a drain outlet at the bottom of the bowl and a built-in trap. The toilet drain is connected to a drain line and a main waste and vent stack.

Clearing Clogged Toilets

Most toilet clogs occur because an object is stuck inside the toilet trap. Use a flanged plunger or a closet auger to remove the clog

A toilet that is sluggish during the flush cycle may be partially blocked. Clear the blockage with a plunger or closet auger. Occasionally, a sluggish toilet flush indicates a blocked wast and vent stack. Clear the stack as shown on page 235.

Everything You Need:

Tools: flanged plunger, closet auger.

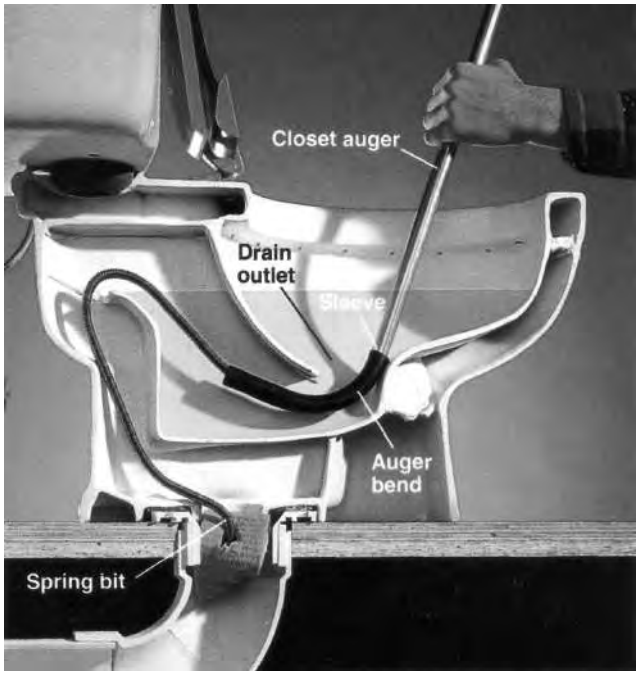
Materials: bucket.

How to Clear a Toilet with a Plunger



Place cup of flanged plunger over drain outlet opening. Plunge up and down rapidly Slowly pour a bucket of water into bowl to flush debris through drain. If toilet does not drain, repeat plunging, or clear clog with a closet auger.

How to Clear a Toilet with a Closet Auger



Place the auger bend in the bottom of the drain opening, and push the auger cable into the trap. Crank the auger handle in a clockwise direction to snag obstruction. Continue cranking while retrieving the cable to pull the obstruction out of the trap.

Clearing Clogged Shower Drains

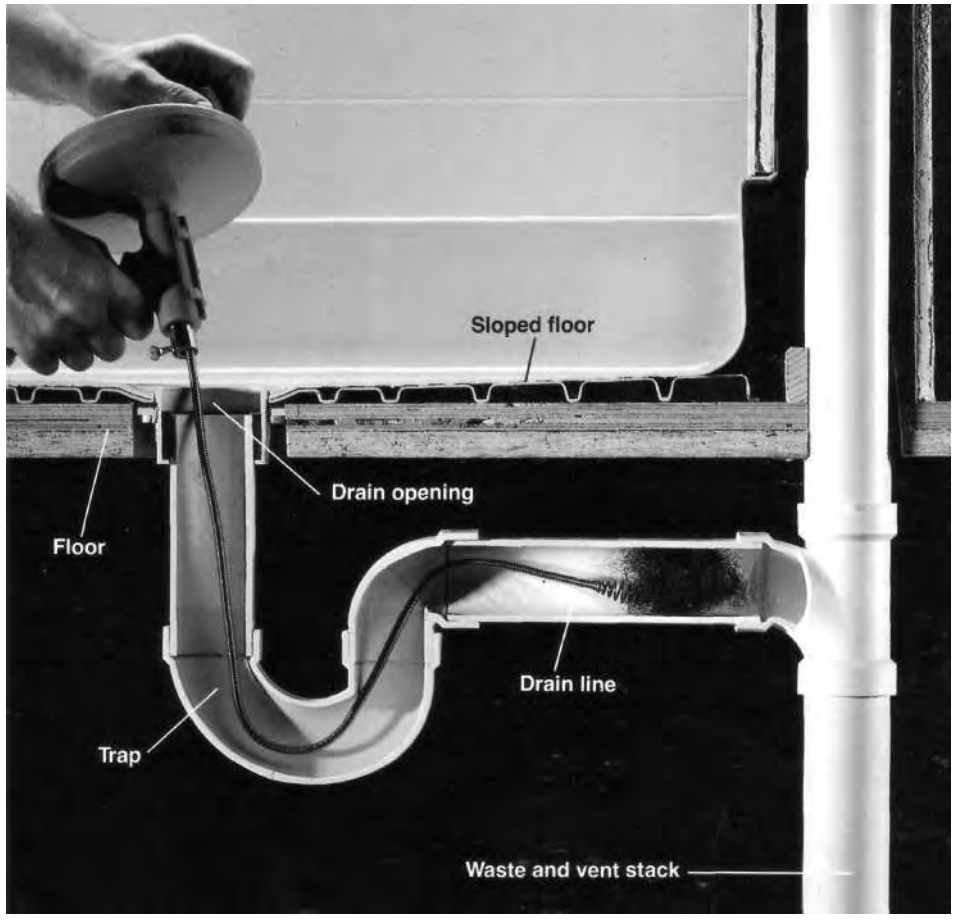
Shower drain clogs usually are caused by an accumulation of hair in the drain line. Remove the strainer cover and look for clogs in the drain opening (below). Some clogs are removed easily with a piece of stiff wire.

Stubborn clogs should be removed with a plunger or hand auger.

Everything You Need:

Tools: screwdriver, flashlight, plunger, hand auger.

Materials: stiff wire.



Shower drain system has a sloped floor, a drain opening, a trap, and a drain line that connects to a branch drain line or waste and vent stack.

How to Clear a Shower Drain



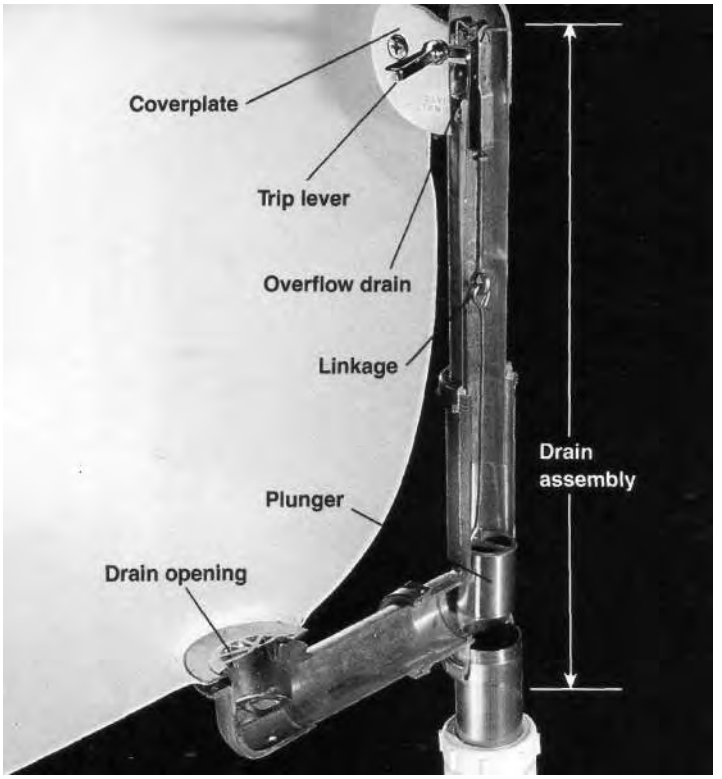
Check for clogs. Remove strainer cover, using a screwdriver. Use a flashlight to look for hair clogs in the drain opening. Use a stiff wire to clear shower drain of hair or to snag any obstructions.



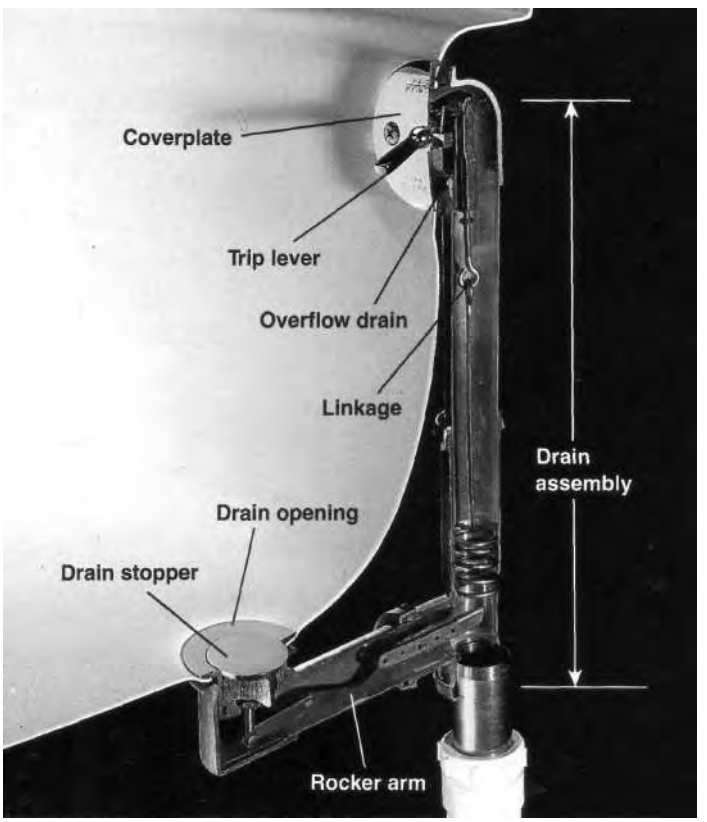
Use a plunger to clear most shower drain clogs. Place the rubber cup over the drain opening. Pour enough water into the shower stall to cover the lip of the cup. Move plunger handle up and down rapidly



Clear stubborn clogs in the shower drain with a hand auger. Use the auger as shown on pages 226 to 227.



Plunger-type tub drain has a hollow brass plug, called *a plunger,* that slides up and down inside the overflow drain to seal off the water flow. The plunger is moved by a trip lever and linkage that runs through the overflow drain.



Pop-up tub drain has a rocker arm that pivots to open or close a metal drain stopper. The rocker arm is moved by a trip lever and linkage that runs through the overflow drain.

When water in the tub drains slowly or not at all, remove and inspect the drain assembly Both plunger and pop-up type drain mechanisms catch hair and other debris that cause clogs.

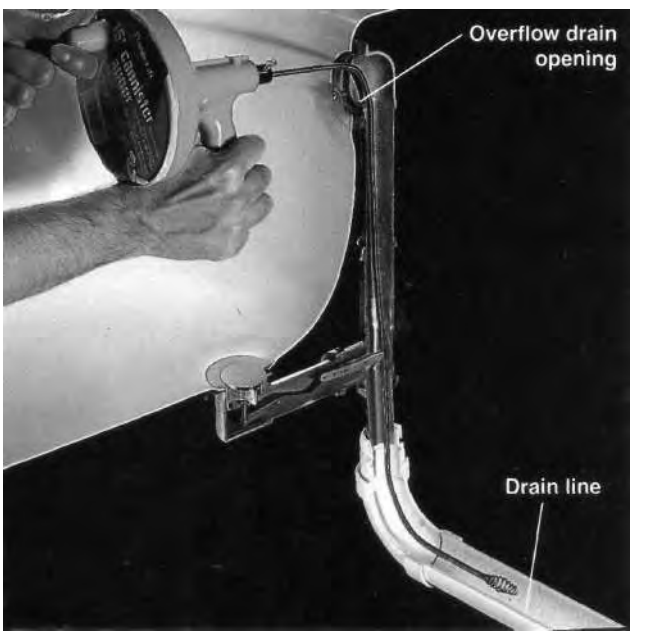
If cleaning the drain assembly does not fix the problem, the tub drain line is clogged. Clear the line with a plunger or a hand auger. Always stuff a wet rag in the overflow drain opening before plunging the tub drain. The rag prevents air from breaking the suction of the plunger. When using an auger, always insert the cable down through the overflow drain opening.

If the tub will not hold water with the drain closed, or if the tub continues to drain slowly after the assembly has been cleaned, then the drain assembly needs adjustment. Remove the assembly, and follow the instructions on the opposite page.

Everything You Need:

Tools: plunger, screwdriver, small wire brush, needlenose pliers, hand auger.

Materials: vinegar, heatproof grease, rag.

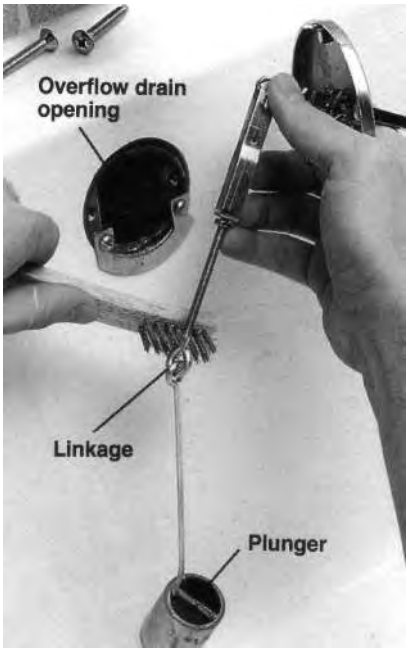


Clear a tub drain by running the auger cable through the overflow opening. First, remove the coverplate and carefully lift out the drain linkage (page opposite). Push auger cable into the opening until resistance is felt (pages 226 to 227). After using the auger, replace drain linkage. Open drain and run hot water through drain to flush out any debris.

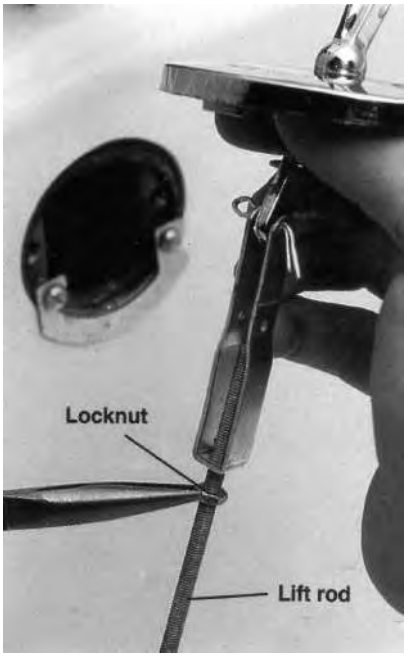
How to Clean & Adjust a Plunger-type Tub Drain



1 Remove screws on coverplate. Carefully pull coverplate, linkage, and plunger from the overflow drain opening.

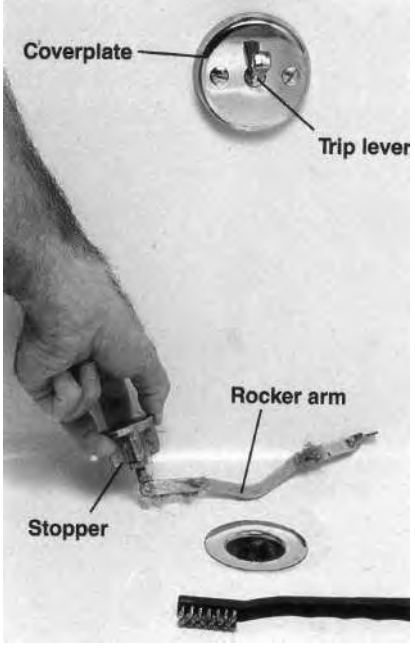


2 Clean linkage and plunger with a small wire brush dipped in vinegar. Lubricate assembly with heat-proof grease.

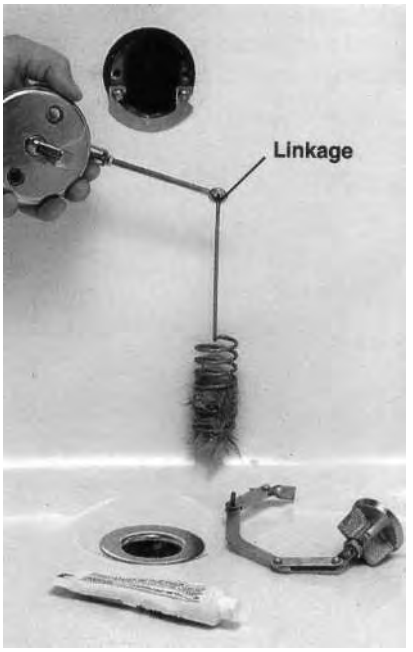


3 Adjust drain flow and fix leaks by adjusting linkage. Unscrew locknut on threaded lift rod, using needlenose pliers. Screw rod down about 1/8". Tighten locknut and re-install entire assembly

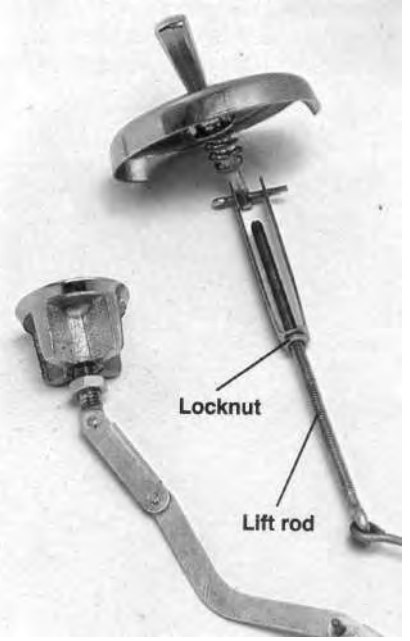
How to Clean & Adjust a Pop-up Tub Drain



1 Raise trip lever to the full open position. Carefully pull stopper and rocker arm assembly from drain opening. Clean hair or debrris from rocker arm with a small wire brush.

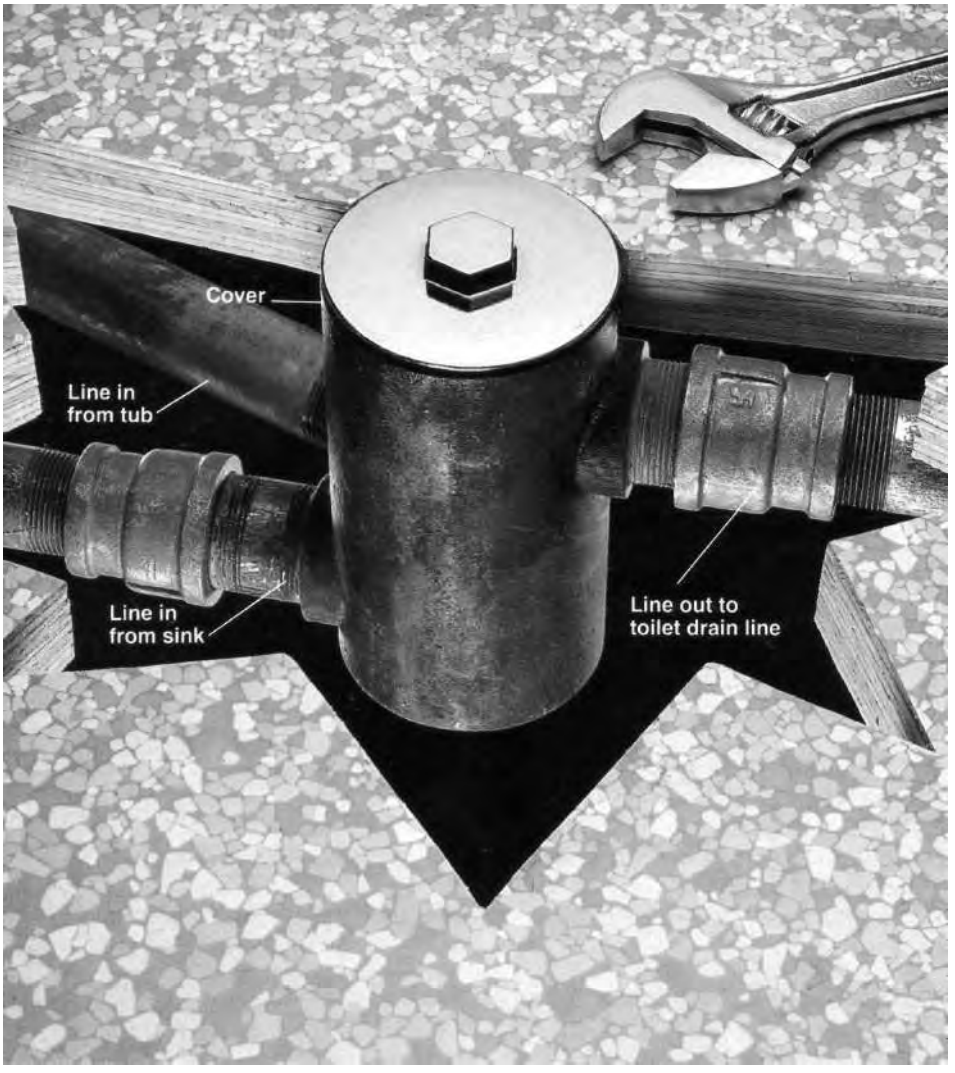


2 Remove screws from coverplate. Pull coverplate, trip lever, and linkage from overflow drain. Remove hair and debris. Remove corrosion with a small wire brush dipped in vinegar Lubricate linkage with heat-proof grease.



3 Adjust drain flow and fix leaks by adjusting the linkage. Loosen locknut on threaded lift rod and screw lift rod up about 1/8". Tighten locknut and reinstall entire assembly

Clearing Clogged Drum Traps



A drum trap is a canister made of lead or cast iron. Usually more than one fixture drain line is connected to the drum. Drum traps are not vented, and they are no longer approved for new plumbing installations.

In older homes, clogs in bathroom sinks or bathtubs may be caused by blockage in the drain lines connected to a drum trap. Remove the drum trap cover and use a hand auger to clear each drain line.

Drum traps usually are located in the floor next to the bathtub. They are identified by a flat, screw-in type cover or plug that is flush with the floor Occasionally a drum trap may be located under the floor This type of drum trap will be positioned upside down so that the plug is accessible from below.

Everything You Need:

Tools: adjustable wrench, hand auger.

Materials: rags or towels, penetrating oil. Teflon tape.

How to Clear a Clogged Drum Trap



1 Place rags or towels around the opening of the drum trap to absorb water that may be backed up in the lines.



2 Remove the trap cover, using an adjustable wrench. Work carefully: older drum traps may be made of lead, which gets brittle with age. If cover does not unscrew easily apply penetrating oil to lubricate the threads.



3 Use a hand auger (pages 226 to 227) to clear each drain line. Then wrap the threads of the cover with Teflon tape and install. Flush all drains with hot water for five minutes.

Clearing Clogged Floor Drains

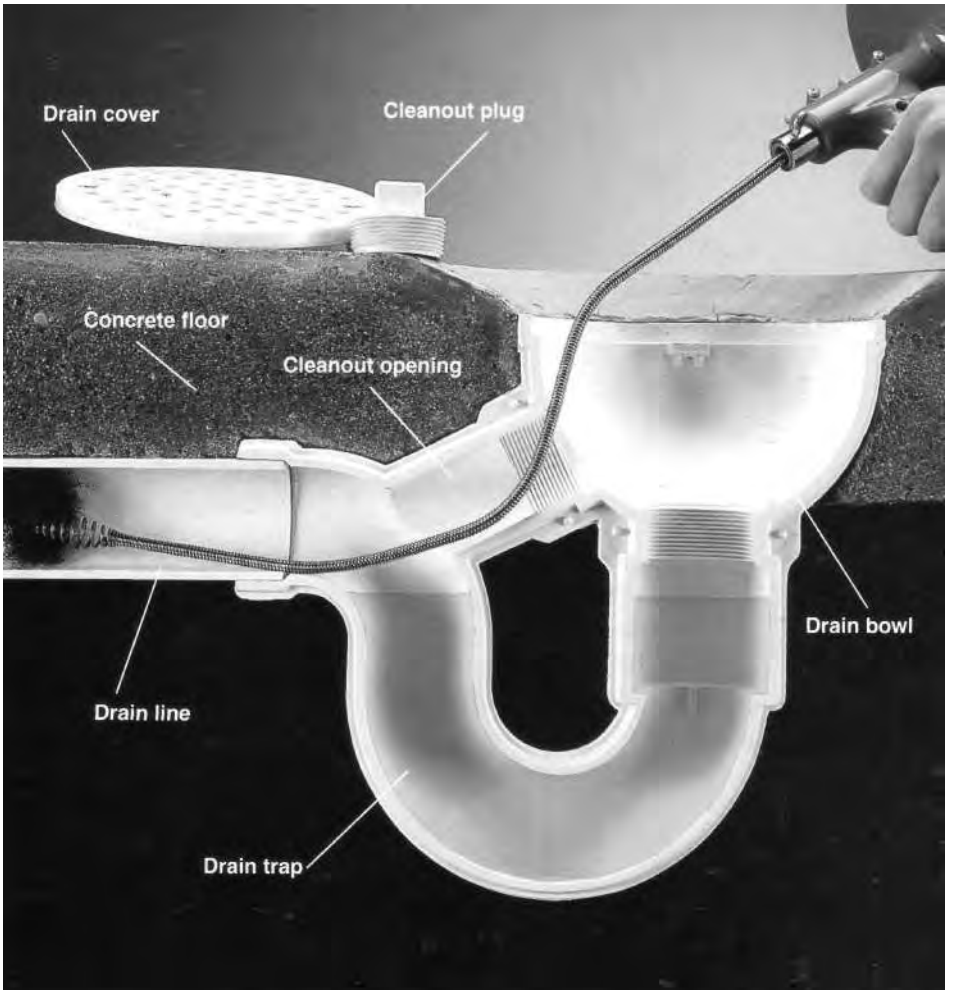
When water backs up onto a basement floor, there is a clog in either the floor drain line, drain trap, or the sewer service line. Clogs in the drain line or trap may be cleared with a hand auger or a blow bag. To clear a sewer service line, see page 234.

Blow bags are especially useful for clearing clogs in floor drain lines. A blow bag attaches to a garden hose and is inserted directly into the floor drain line. The bag fills with water and then releases a powerful spurt that dislodges clogs.

Everything You Need:

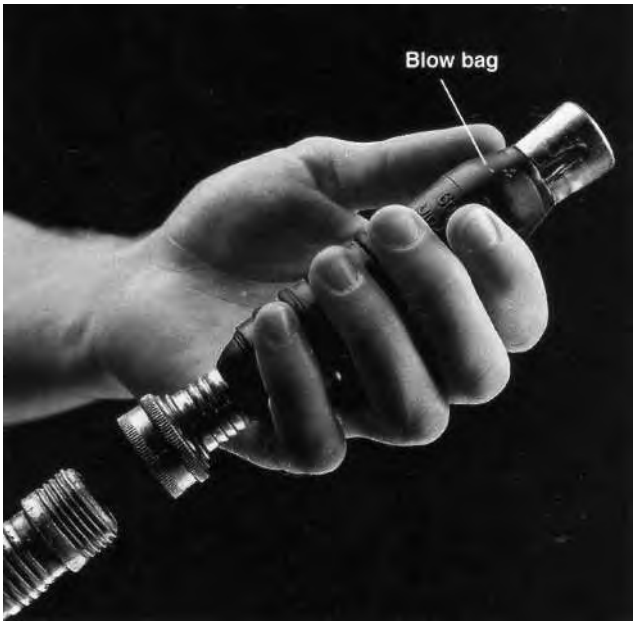
Tools: adjustable wrench, screwdriver, hand auger, blow bag.

Materials: garden hose.

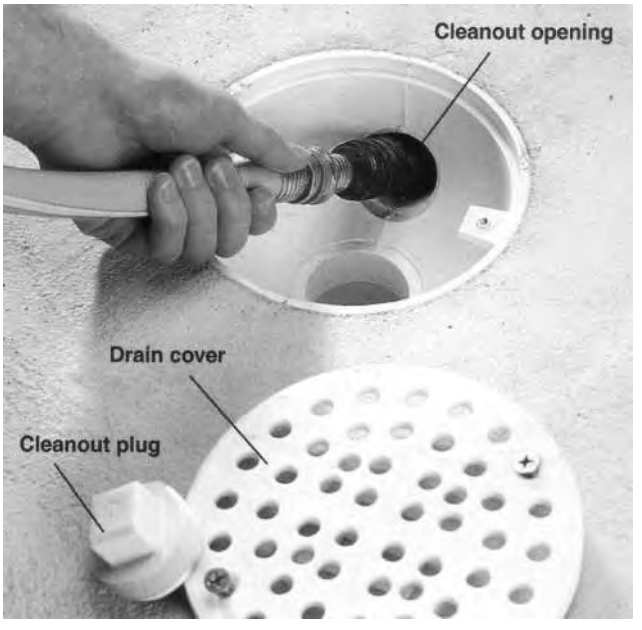


Clear clogged floor drains using a hand auger. Remove the drain cover, then use a wrench to unscrew the cleanout plug in the drain bowl. Push the auger cable through the cleanout opening directly into the drain line.

How to Use a Blow Bag to Clear a Floor Drain



1 Attach blow bag to garden hose, then attach hose to a hose bib or utility faucet.



2 Remove drain cover and cleanout plug. Insert the blow bag completely into the cleanout opening and turn on water. Allow several minutes for the blow bag to work properly

Clearing Clogs in Branch & Main Drain Lines

If using a plunger or a hand auger does not clear a clog in a fixture drain line, it means that the blockage may be in a branch drain line, the main waste and vent stack, or the sewer service line (see the photo on page 13).

First, use an auger to clear the branch drain line closest to any stopped-up fixtures. Branch drain lines may be serviced through the cleanout fittings located at the end of the branch. Because waste water may be backed up in the drain lines, always open a cleanout with caution. Place a bucket and rags under the opening to catch waste water Never position yourself directly under a cleanout opening while unscrewing the plug or cover.

If using an auger on the branch line does not solve the problem, then the clog may be located in a main waste and vent stack. To clear the stack, run an auger cable down through the roof vent. Make sure that the cable of your auger is long enough to reach down the entire length of the stack. If it is not, you may want to rent or borrow another auger Always use extreme caution when working on a ladder or on a roof.

If no clog is present in the main stack, the problem may be located in the sewer service line. Locate the main cleanout, usually a Y-shaped fitting at the bottom of the main waste and vent stack. Remove the plug and push the cable of a hand auger into the opening.

Some sewer service lines in older homes have a house trap. The house trap is a U-shaped fitting located at the point where the sewer line exits the house. Most of the fitting will be beneath the floor surface, but it can be identified by its two openings. Use a hand auger to clean a house trap.

If the auger meets solid resistance in the sewer line, retrieve the cable and inspect the bit. Fine, hair-like roots on the bit indicate the line is clogged with tree roots. Dirt on the bit indicates a collapsed line.

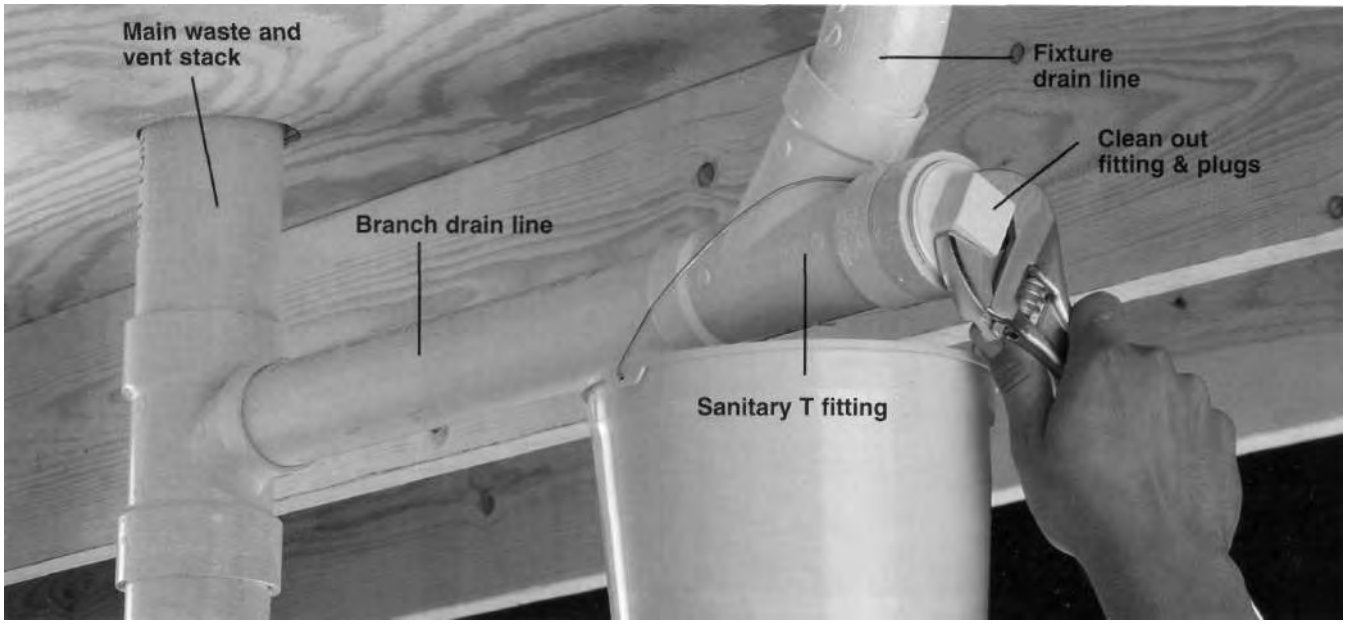
Use a power auger to clear sewer service lines that are clogged with tree roots. Power augers (page 37) are available at rental centers. However, a power auger is a large, heavy piece of equipment. Before renting, consider the cost of rental and the level of your do-it-yourself skills versus the price of a professional sewer cleaning service. If you rent a power auger, ask the rental dealer for complete instructions on how to operate the equipment.

Always consult a professional sewer cleaning service if you suspect a collapsed line.

Everything You Need:

Tools: adjustable wrench or pipe wrench, hand - auger, cold chisel, ball peen hammer

Materials: bucket, rags, penetrating oil, cleanout plug (if needed), pipe joint compound.



Clear a branch drain line by locating the cleanout fitting at the end of the line. Place a bucket underneath the opening to catch waste water, then slowly unscrew the cleanout plug with an adjustable wrench. Clear clogs in the branch drain line with a hand auger (pages 226 to 227).

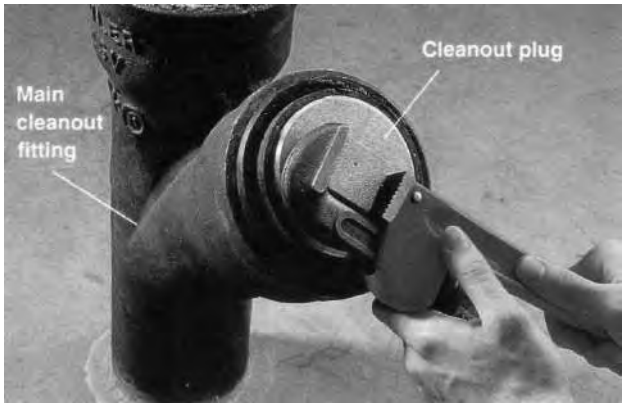


Clear the main waste and vent stack by running the cable of a hand auger down through the roof vent. Always use extreme caution while working on a ladder or roof.



Clear the house trap in a sewer service line using a hand auger Slowly remove only the plug on the "street side" of the trap. If water seeps out the opening as the plug is removed, the clog is in the sewer line beyond the trap. If no water seeps out, auger the trap. If no clog is present in the trap, replace the street-side plug and remove the house-side plug. Use the auger to clear clogs located between the house trap and main stack.

How to Remove & Replace a Main Drain Cleanout Plug



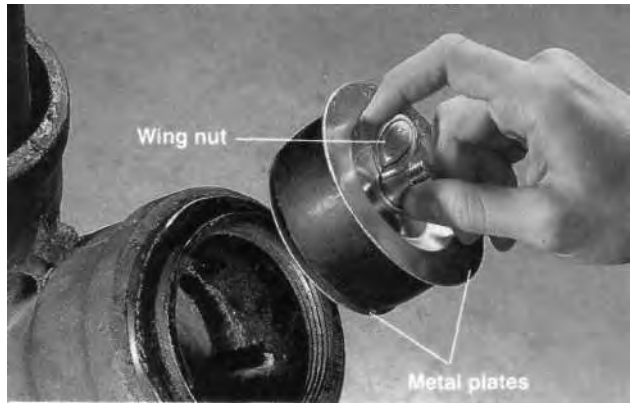
1 Remove the cleanout plug, using a large wrench. If plug does not turn out, apply penetrating oil around edge of plug, wait 10 minutes, and try again. Place rags and a bucket under fitting opening to catch any water that may be backed up in the line.



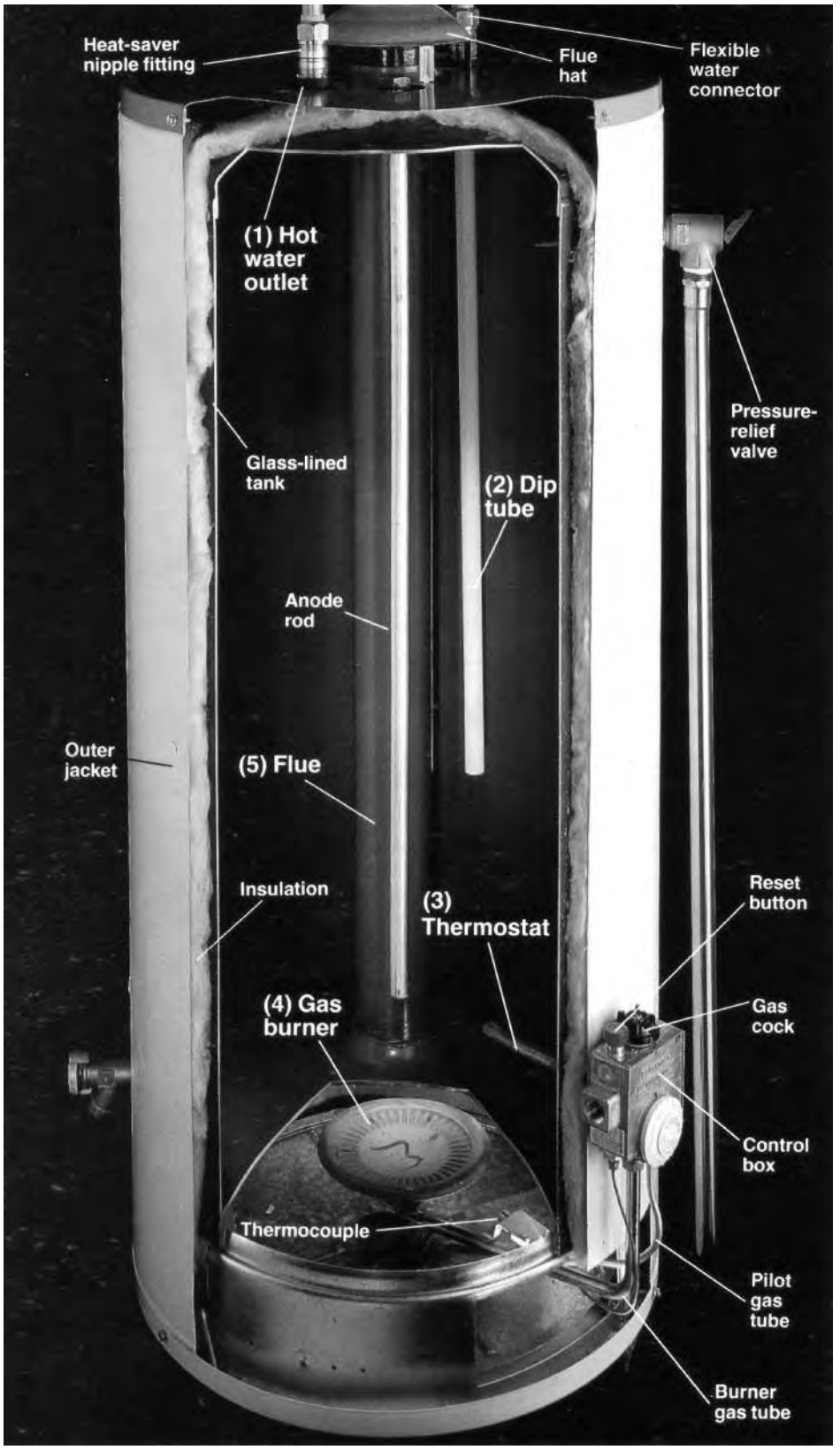
2 Remove stubborn plugs by placing the cutting edge of chisel on edge of plug. Strike chisel with a ball peen hammer to move plug counterclockwise. If plug does not turn out, break it into pieces with the chisel and hammer Remove all broken pieces.



3 Replace old plug with new plastic plug. Apply pipe joint compound to the threads of the replacement plug and screw into cleanout fitting.



Alternate: Replace old plug with an expandable rubber plug. A wing nut squeezes the rubber core between two metal plates. The rubber bulges slightly to create a watertight seal.



How a gas water heater works: Hot water leaves tank through the hot water outlet (1) as fresh, cold water enters the water heater through the dip tube (2). As the water temperature drops, the thermostat (3) opens the gas valve, and the gas burner (4) is lighted by pilot flame. Exhaust gases are vented through flue (5). When water temperature reaches preset temperature, the thermostat closes gas valve, extinguishing burner The thermocouple protects against gas leaks by automatically shutting off gas if pilot flame goes out. Anode rod protects tank lining from rust by attracting corrosive elements in the water Pressure-relief valve guards against ruptures caused by steam buildup in tank.

Fixing a Water Heater

Standard tank water heaters are designed so that repairs are simple. All water heaters have convenient access panels that make it easy to replace worn-out parts. When buying new water heater parts, make sure the replacements match the specifications of your water heater. Most water heaters have a nameplate (page 242) that lists the information needed, including the pressure rating of the tank, and the voltage and wattage ratings of the electric heating elements.

Many water heater problems can be avoided with routine yearly maintenance. Flush the water heater once a year, and test the pressure-relief valve. Set the thermostat at a lower water temperature to prevent heat damage to the tank. (Note: water temperature may affect the efficiency of automatic dishwashers. Check manufacturer's directions for recommended water temperature.) Water heaters last about 10 years on average, but with regular maintenance, a water heater can last 20 years or more.

Do not install an insulating jacket around a gas water heater. Insulation can block air supply and prevent the water heater from ventilating properly Many water heater manufacturers prohibit the use of insulating jackets. To save energy insulate the hot water pipes instead, using the materials described on page 250.

The pressure-relief valve is an important safety device that should be checked at least once each year and replaced, if needed. When replacing the pressure-relief valve, shut off the water and drain several gallons of water from the tank.

Problems	Repairs
 No hot water, or not enough hot water.	1. **Gas heater**: Make sure gas is on, then relight pilot flame (page 247). **Electric heater**: Make sure power is on, then reset thermostat (page 249). 2. Flush water heater to remove sediment in tank (photo, below). 3. Insulate hot water pipes to reduce heat loss (page 250). 4. **Gas heater**: Clean gas burner & replace thermocouple (pages 238 to 239). **Electric heater**: Replace heating element or thermostat (pages 250 to 257). 5. Raise temperature setting of thermostat.
 Pressure-relief valve leaks.	1. Lower the temperature setting (photo, below). 2. Install a new pressure-relief valve (pages 244 to 245, steps 10 to 11).
 Pilot flame will not stay lighted.	Clean gas burner & replace the thermocouple (pages 238 to 239).
 Water heater leaks around base of tank.	Replace the water heater immediately (pages 242 to 249).

Tips for Maintaining a Water Heater



Flush the water heater once a year by draining several gallons of water from the tank. Flushing removes sediment buildup that causes corrosion and reduces heating efficiency



Lower the temperature setting on thermostat to 120°F. Lower temperature setting reduces damage to tank caused by overheating and also reduces energy use.

Fixing a Gas Water Heater

If a gas water heater does not heat water, first remove the outer and inner access panels and make sure the pilot is lighted. To relight a pilot, see steps 20 to 23, page 247. During operation, the outer and inner access panels must be in place. Operating the water heater without the access panels may allow air drafts to blow out the pilot flame.

If the pilot will not light, it is probably because the thermocouple is worn out. The thermocouple is a safety device designed to shut off the gas automatically if the pilot flame goes out. The thermocouple is a thin copper wire that runs from the control box to the gas burner. New thermocouples are inexpensive, and can be installed in a few minutes.

If the gas burner does not light even though the pilot flame is working, or if the gas burns with a yellow, smoky flame, the burner and the pilot gas tube should be cleaned. Clean the burner and gas tube annually to improve energy efficiency and extend the life of the water heater.

A gas water heater must be well ventilated. If you smell smoke or fumes coming from a water heater, shut off the water heater and make sure the exhaust duct is not clogged with soot. A rusted duct must be replaced.

Remember to shut off the gas before beginning work.

Everything You Need:

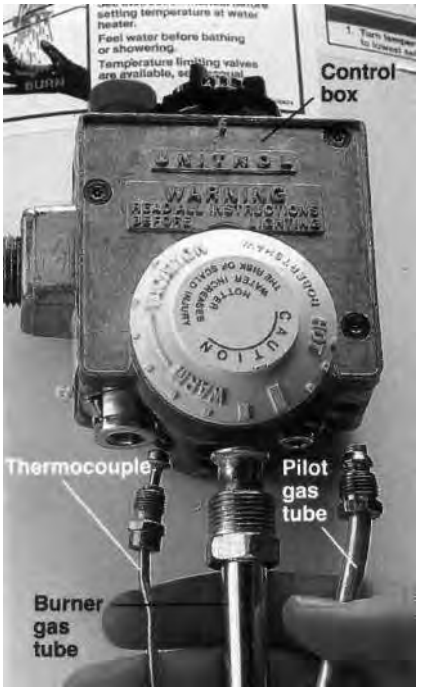
Tools: adjustable wrench, vacuum cleaner, needlenose pliers.

Materials: thin wire, replacement thermocouple.

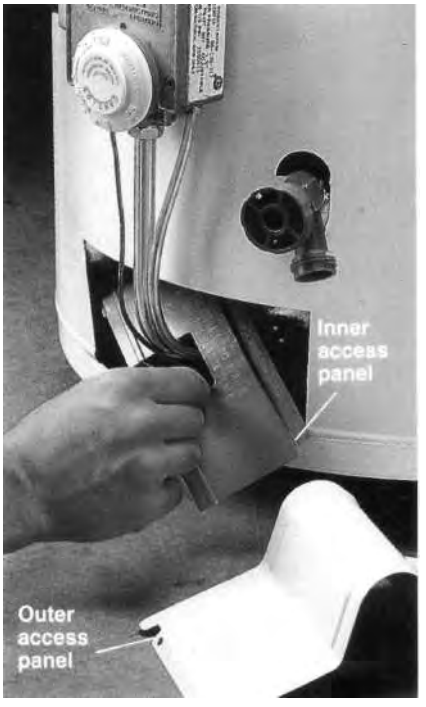
How to Clean a Gas Burner & Replace a Thermocouple



1 Shut off gas by turning the gas cock on top of the control box to the OFF position. Wait 10 minutes for gas to dissipate.



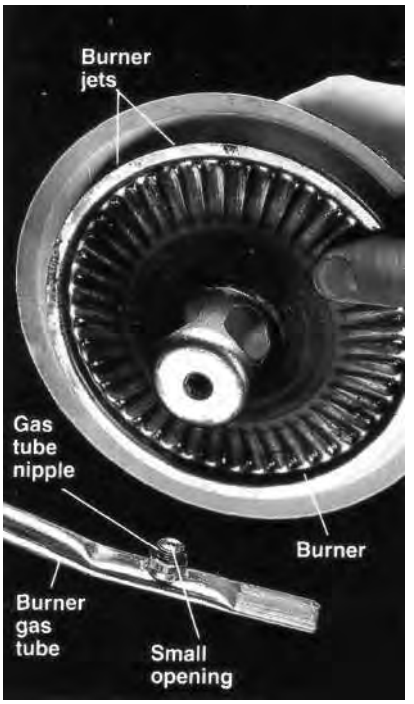
2 Disconnect the pilot gas tube, the burner gas tube, and the thermocouple from the bottom of the control box, using an adjustable wrench.



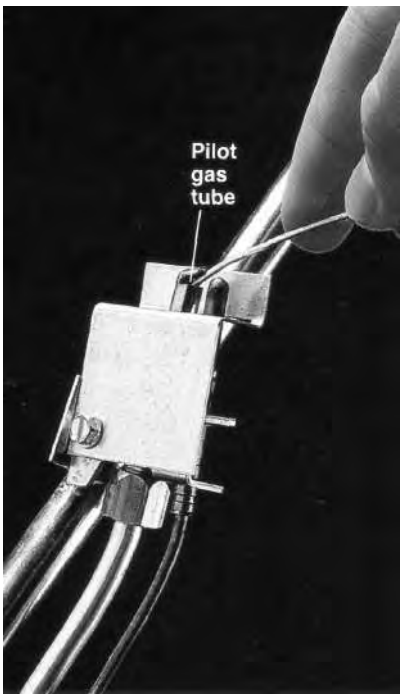
3 Remove the outer and inner access panels covering the burner chamber.



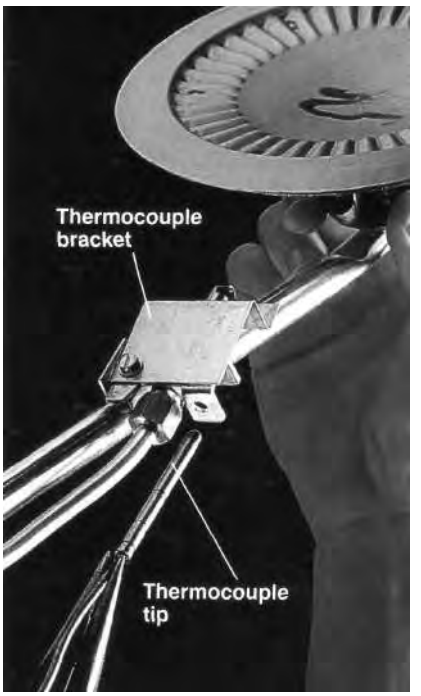
4 Pull down slightly on the pilot gas tube, the burner gas tube, and thermocouple wire to free them from the control box. Tilt the burner unit slightly and remove it from the burner chamber.



5 Unscrew burner from burner gas tube nipple. Clean small opening in nipple, using a piece of thin wire. Vacuum out burner jets and the burner chamber.



6 Clean the pilot gas tube with a piece of wire. Vacuum out any loose particles. Screw burner onto gas tube nipple.



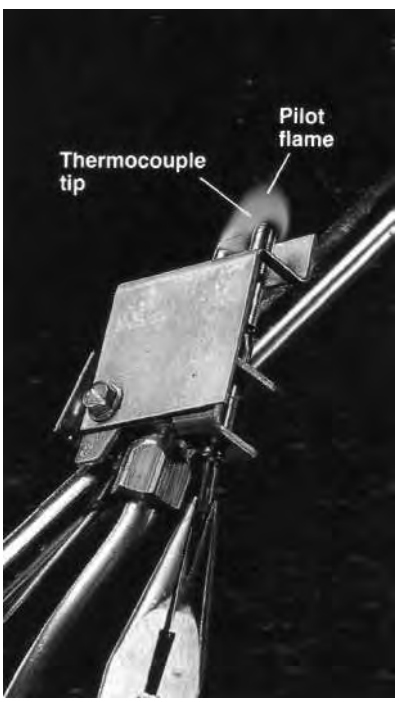
7 Pull the old thermocouple from bracket. Install new thermocouple by pushing the tip into the bracket until it snaps into place.



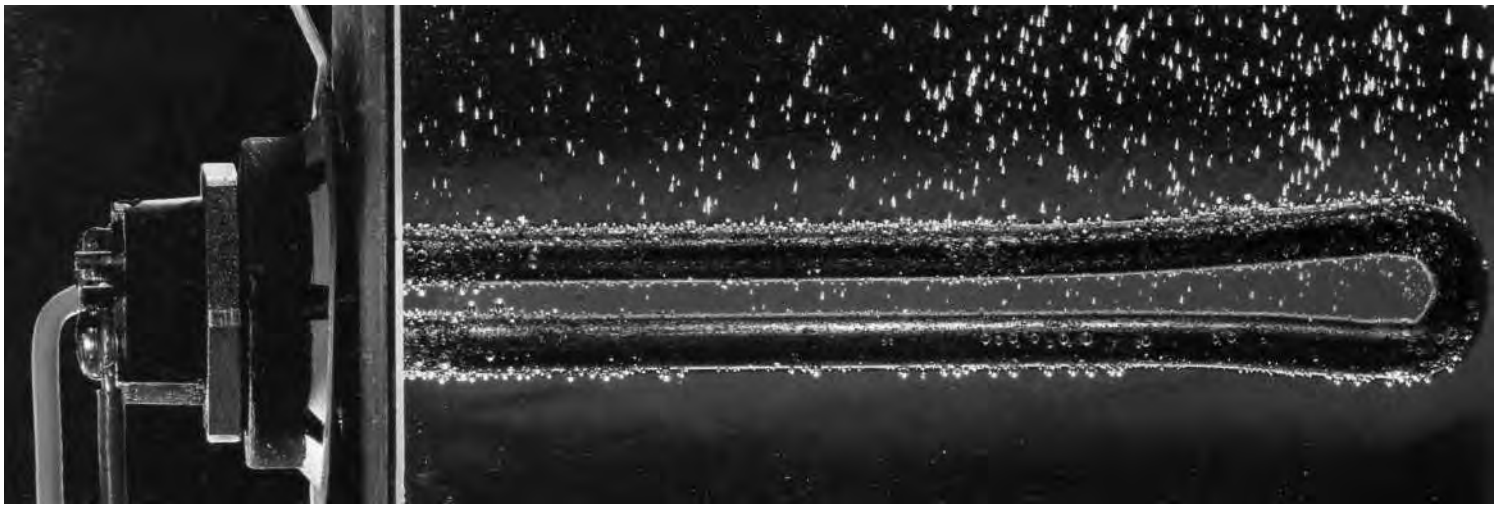
8 Insert the burner unit into the chamber. Flat tab at end of burner should fit into slotted opening in mounting bracket at the bottom of the chamber



9 Reconnect the gas tubes and the thermocouple to the control box. Turn on the gas and test for leaks (page 246, step 19). Light the pilot (page 247, steps 20 to 23).



10 Make sure pilot flame wraps around tip of thermocouple. If needed, adjust thermocouple with needlenose pliers until tip is in flame. Replace the inner and outer access panels.



Electric water heater has one or two heating elements mounted in the side wall of the heater. Each element is connected to its own thermostat. When buying a replacement heating element or thermostat, make sure the replacement has same voltage and wattage rating as old part. This information is found on the nameplate (page 242).

Fixing an Electric Water Heater

The most common problem with an electric water heater is a burned-out heating element. Many electric water heaters have two heating elements. To determine which element has failed, turn on a hot water faucet and test the temperature. If the water heater produces water that is warm, but not hot, replace the top heating element. If the heater produces a small amount of very hot water, followed by cold water, replace the bottom heating element.

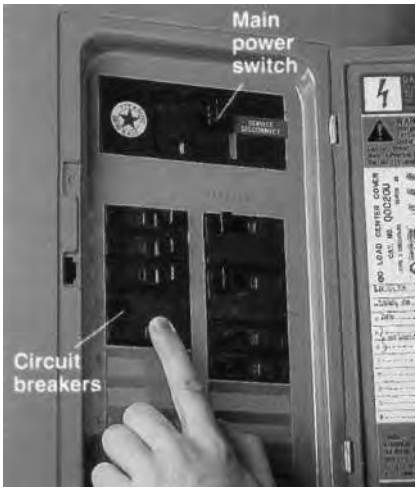
If replacing the heating element does not solve the problem, then the thermostat may need to be replaced. These parts are found under convenient access panels on the side of the heater.

Everything You Need:

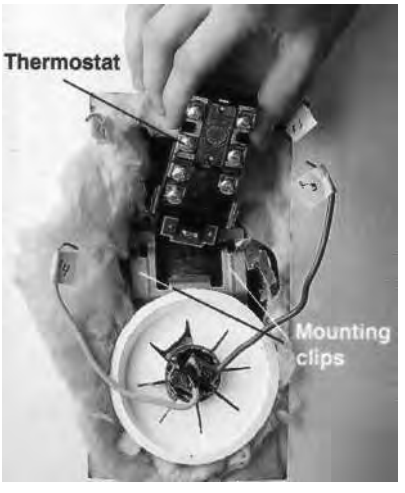
Tools: screwdriver, gloves, neon circuit tester, channel-type pliers.

Materials: masking tape, replacement heating element or thermostat, replacement gasket, pipe joint compound.

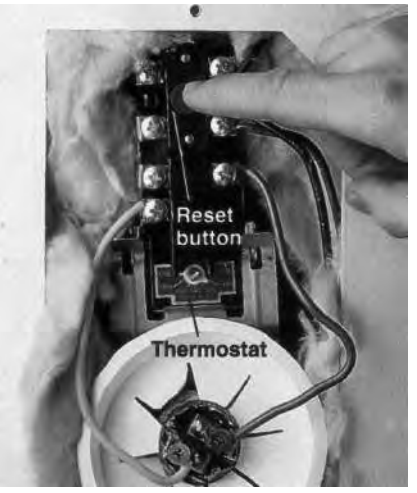
How to Replace an Electric Thermostat



1 Turn off power at main service panel. Remove access panel on side of heater, and **test for current (page 248, step 4).**

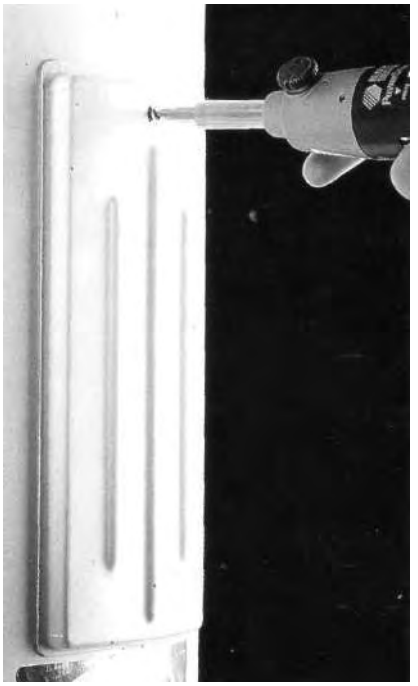


2 Disconnect thermostat wires, and label connections with masking tape. Pull old thermostat out of mounting clips. Snap new thermostat into place, and reconnect wires.

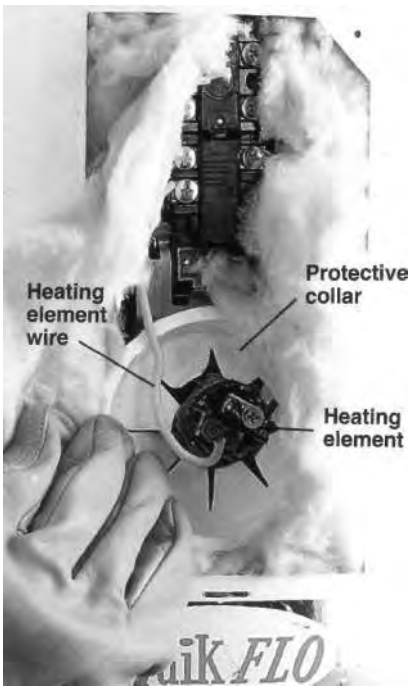


3 Press thermostat reset button, then use a screwdriver to set thermostat to desired temperature. Replace insulation and access panel. Turn on power.

How to Replace an Electric Heating Element



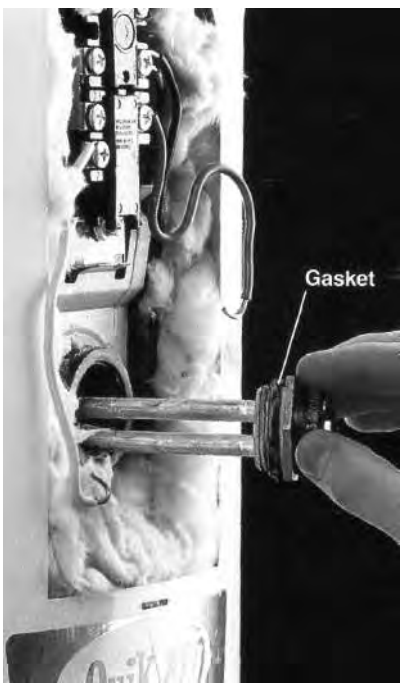
1 Remove access panel on side of water heater. Shut off power to water heater (page 248, step 1). Close the shutoff valves, then drain tank (page 243, step 3).



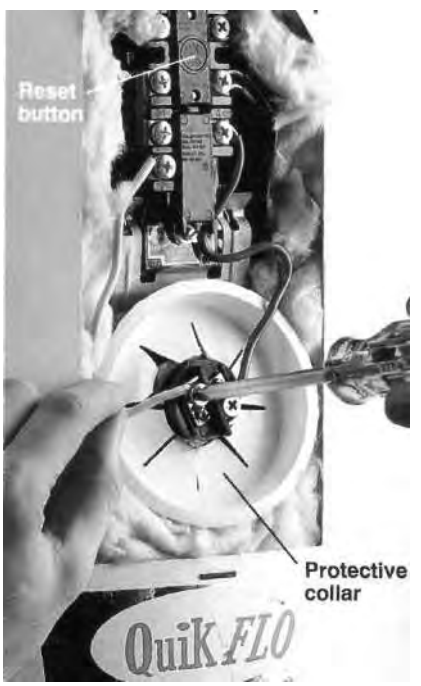
2 Wearing protective gloves, carefully move insulation aside. **Caution: test for current (page 248, step 4),** then disconnect wires on heating element. Remove protective collar.



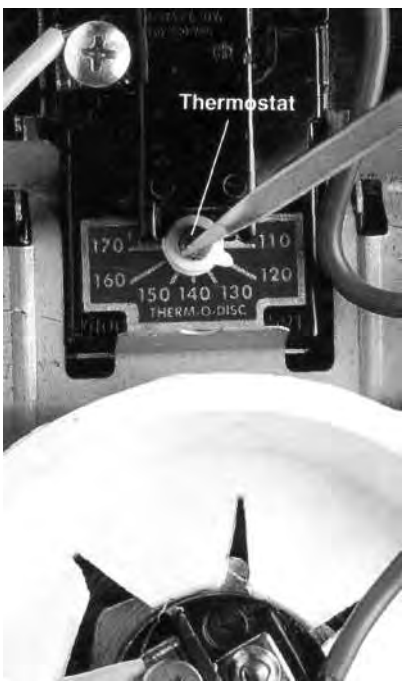
3 Unscrew the heating element with channel-type pliers. Remove old gasket from around water heater opening. Coat both sides of new gasket with pipe joint compound.



4 Slide new gasket over heating element, and screw element into the tank. Tighten element with channel-type pliers.



5 Replace protective collar, and reconnect all wires. Turn on hot water faucets throughout house, then turn on water heater shutoff valves. When tap water runs steadily close faucets.



6 Use a screwdriver to set thermostat to desired temperature. Press thermostat reset buttons. Fold insulation over thermostat, and replace the access panel. Turn on power.



Replacing a Water Heater

A water heater that leaks should be replaced immediately to prevent expensive water damage. Leaks occur because the inner tank has rusted through.

When replacing an electric water heater, make sure the voltage of the new model is the same as the old heater. When replacing a gas water heater, maintain a clearance of 6" or more around the unit for ventilation. Water heaters are available with tank sizes ranging from 30 to 65 gallons. A 40-gallon heater is large enough for a family of four.

Energy-efficient water heaters have Polyurethane foam insulation, and usually carry an extended warranty. These models are more expensive, but over the life of the water heater they cost less to own and operate. Some top-quality water heaters have two anode rods for extra corrosion protection.

The pressure-relief valve usually must be purchased separately. Make sure the new valve matches the *working pressure* rating of the tank (photo, left).



Nameplate on side of water heater lists tank capacity, insulation R-value, and working pressure (pounds-per-square-inch). More efficient water heaters have an insulation R-value of 7 or higher. Nameplate for an electric water heater includes the voltage and the wattage capacity of the heating elements and thermostats. Water heaters also have a yellow energy guide label (photo, top) that lists typical yearly operating costs. Estimates are based on national averages. Energy costs in your area may differ.

Everything You Need:

Tools: pipe wrenches, hacksaw or tubing cutter, screwdriver, hammer, appliance dolly level, small wire brush, propane torch, adjustable wrench, circuit tester (electric heaters).

Materials: bucket, wood shims, #4 gauge 3/8" sheet-metal screws, pressure-relief valve, threaded male pipe adapters; solder, two heat-saver nipples, Teflon tape, flexible water connectors, 3/4" copper pipe, pipe joint compound, sponge, masking tape.

How to Replace a Gas Water Heater



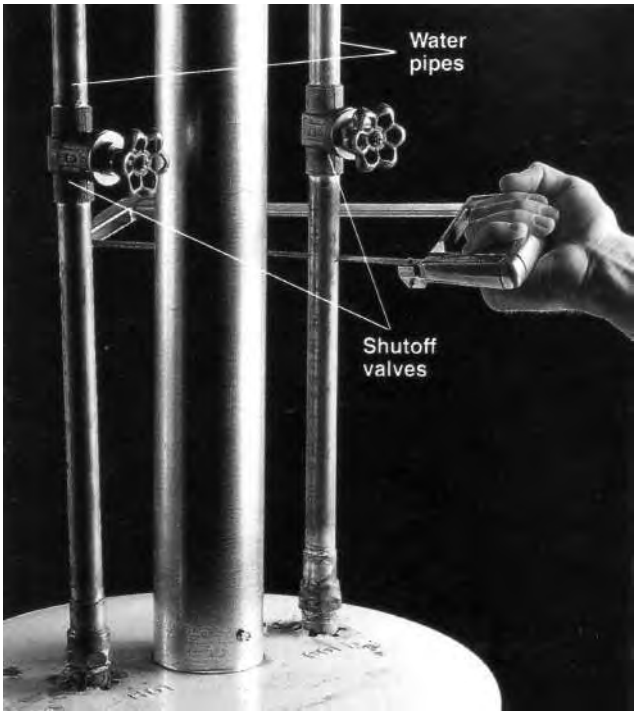
1 Shut off the gas by turning the handle of the in-line valve so it is perpendicular to gas line. Wait 10 minutes for gas to dissipate. Shut off the water supply at the shutoff valves (photo, below).



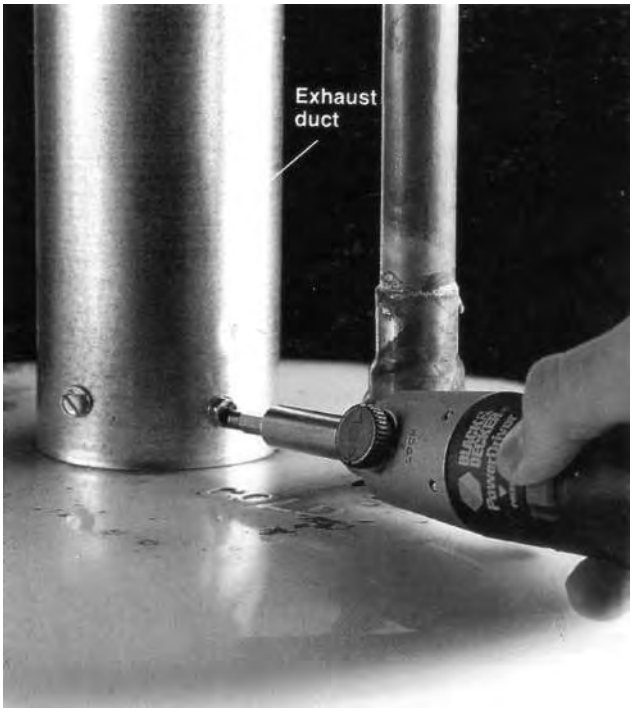
2 Disconnect gas line at the union fitting or at the flare fitting below shutoff valve, using pipe wrenches. Disassemble and save the gas pipes and fittings.



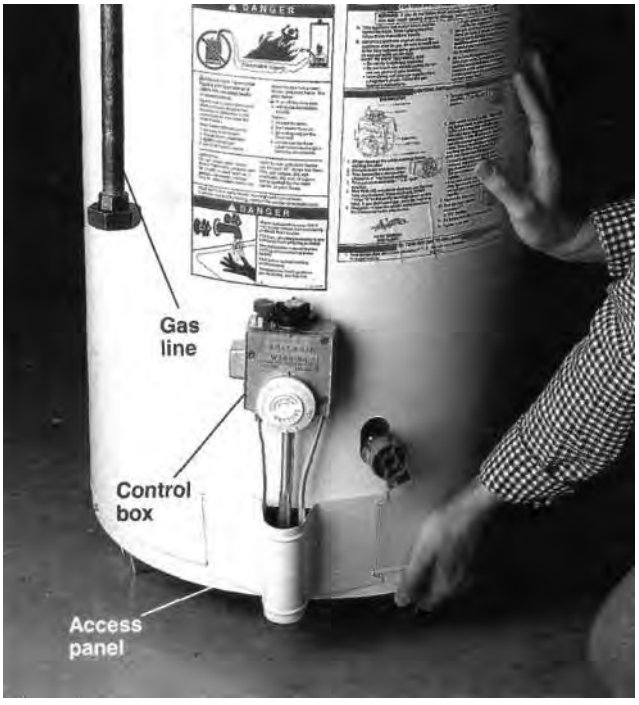
3 Drain water from the water heater tank by opening the hose bib on the side of the tank. Drain the water into buckets, or attach a hose and empty the tank into a floor drain.



4 Disconnect the hot and cold water pipes above the water heater. If pipes are soldered copper, use a hacksaw or tubing cutter to cut through water pipes just below shutoff valves. Cuts must be straight.



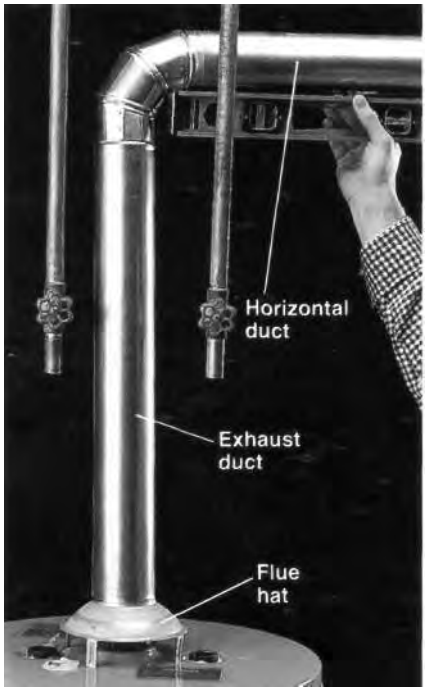
5 Disconnect the exhaust duct by removing the sheetmetal screws. Remove the old water heater with a rented appliance dolly



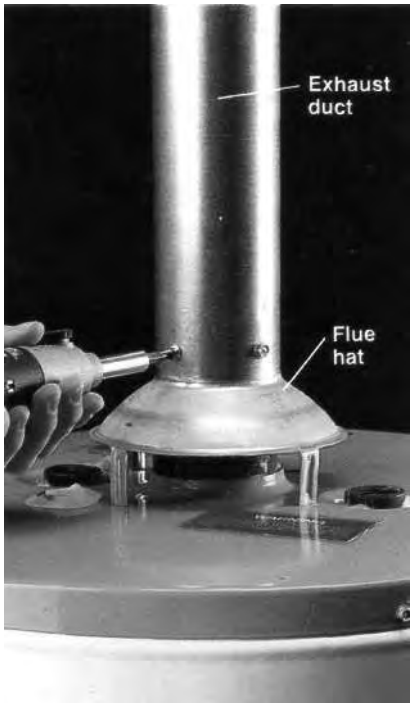
6 Position new heater so that control box is close to gas line, and access panel for burner chamber is not obstructed.



7 Level the water heater by placing wood shims under the legs.



8 Position flue hat so legs fit into slots on water heater, then slip exhaust duct over flue hat. Make sure horizontal duct slopes upward 1/4″ per foot so fumes cannot back up into house.



9 Attach the flue hat to the exhaust duct with #4 gauge 3/8" sheet-metal screws driven every 4".



10 Wrap threads of new pressure-relief valve with Teflon tape, and a screw valve into tank opening with a pipe wrench.



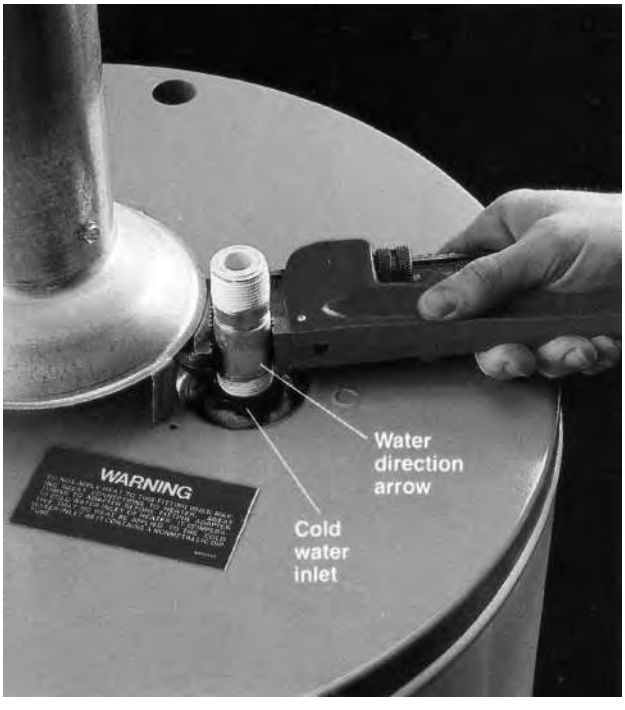
11 Attach a copper or CPVC drain pipe to the pressure-relief valve, using threaded male adapter (page 43). Pipe should reach to within 3" of floor.



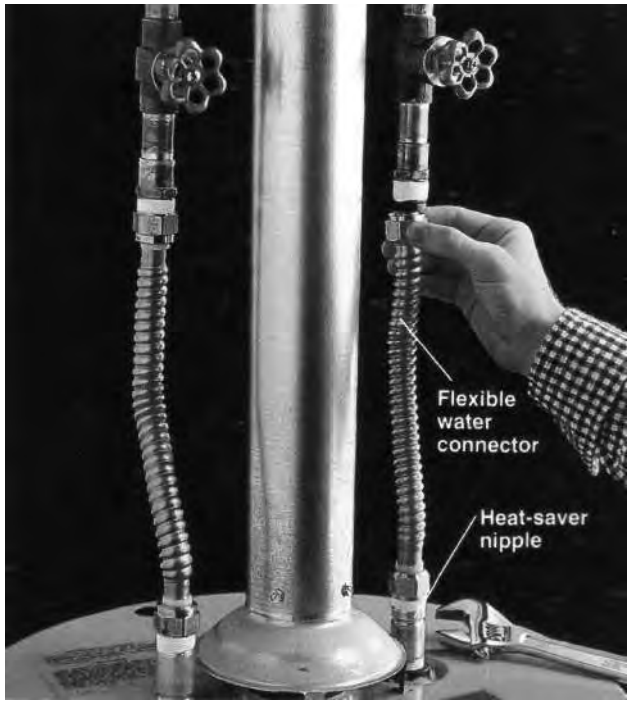
12 Solder threaded male adapters to the water pipes (pages 46 to 51). Let pipes cool, then wrap Teflon tape around threads of adapters.



13 Wrap Teflon tape around the threads of two heat-saver nipples. The nipples are color-coded, and have water-direction arrows to ensure proper installation.

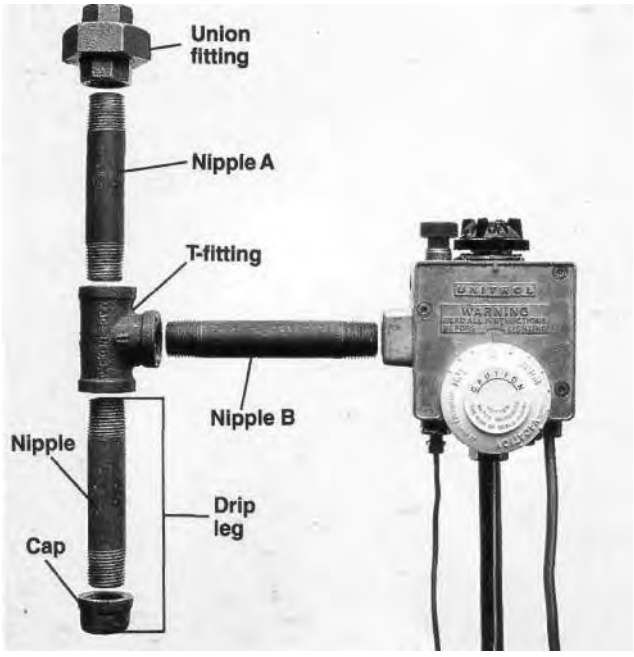


14 Attach blue-coded nipple fitting to cold water inlet and red-coded fitting to hot water outlet, using a pipe wrench. On cold water nipple, water direction arrow should face down; on hot water nipple, arrow should face up.



15 Connect the water lines to the heat-saver nipples with flexible water connectors. Tighten fittings with an adjustable wrench.

How to Replace a Gas Water Heater



16 Test fit gas pipes and fittings from old water heater (step 2). One or two new black-iron nipples (A, B) may be necessary if new water heater is taller or shorter than old heater. Use black iron, not galvanized iron, for gas lines. Capped nipple is called a drip leg. The drip leg protects the gas burner by catching dirt particles.



17 Clean pipe threads with a small wire brush, and coat the threads with pipe joint compound. Assemble gas line in the following order: control box nipple (1), T-fitting (2), vertical nipple (3), union fitting (4), vertical nipple (5), cap (6). (Black iron is fitted using same methods as for galvanized iron. See pages 64 to 67 for more information.)



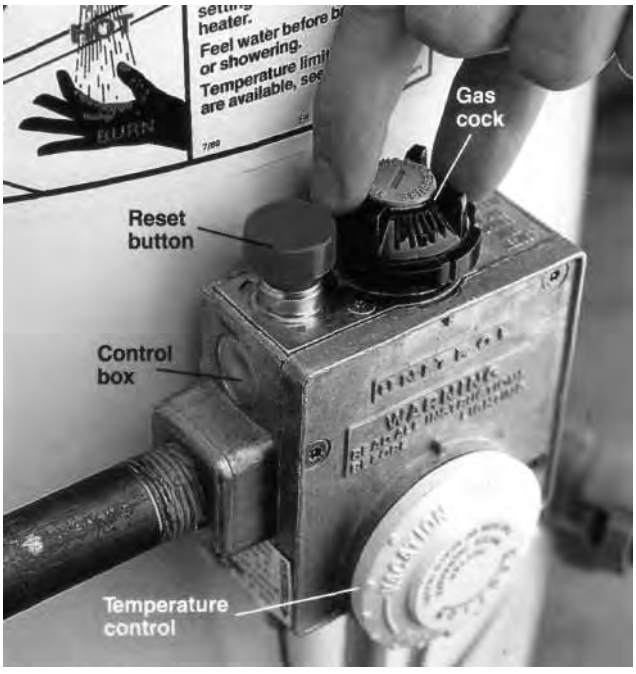
Alternate: if gas line is made of flexible copper, use a flare fitting to connect the gas line to the water heater. (For more information on flare fittings, see pages 54 to 55.)



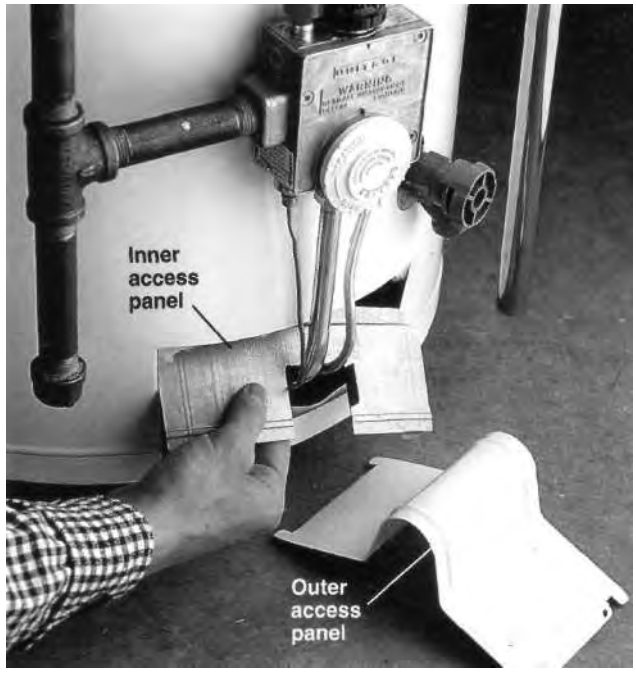
18 Open the hot water faucets throughout house, then open the water heater inlet and outlet shutoff valves. When water runs steadily from faucets, close faucets.



19 Open the in-line valve on the gas line (step 1). Test for leaks by dabbing soapy water on each joint. Leaking gas will cause water to bubble. Tighten leaking joints with a pipe wrench.



20 Turn the gas cock on top of control box to the PILOT position. Set the temperature control on front of box to desired temperature.



21 Remove the outer and inner access panels covering the burner chamber.



22 Light a match, and hold flame next to the end of the pilot gas tube inside the burner chamber. Be sure to keep your face away from the opening.



23 While holding match next to end of pilot gas tube, press the reset button on top of control box. When pilot flame lights, continue to hold reset button for one minute. Turn gas cock to ON position, and replace the inner and outer access panels.

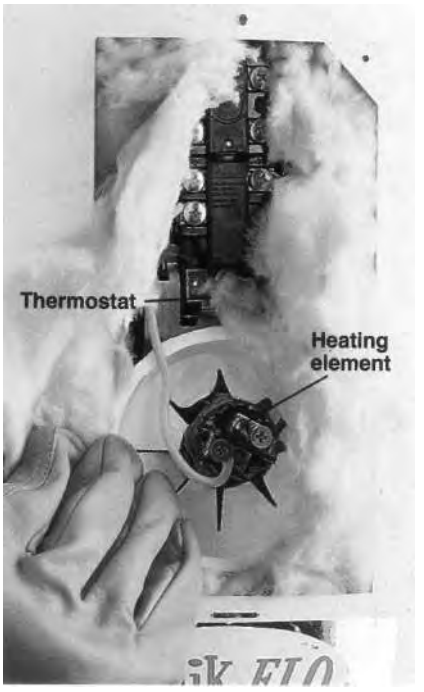
How to Replace a 220/240-volt Electric Water Heater



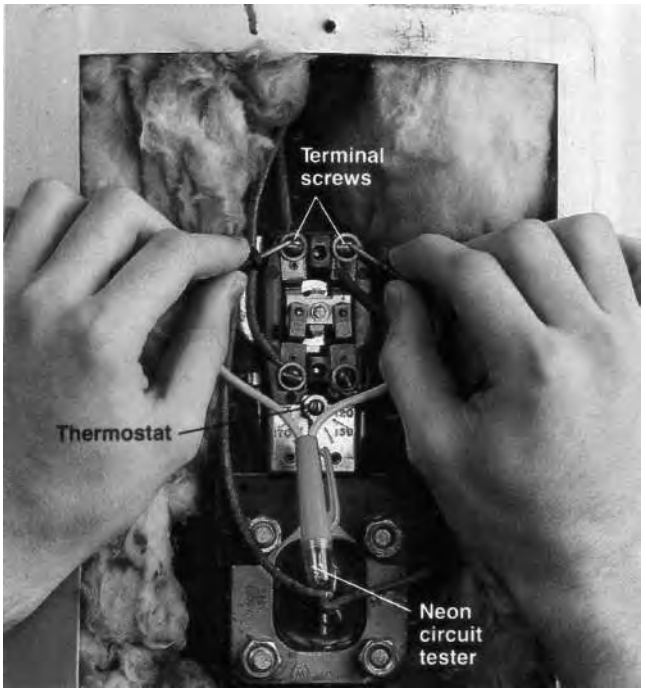
1 Turn off power to water heater by switching off circuit breaker (or removing fuse) at main service panel. Drain water heater and disconnect water pipes (page 243, steps 3 and 4).



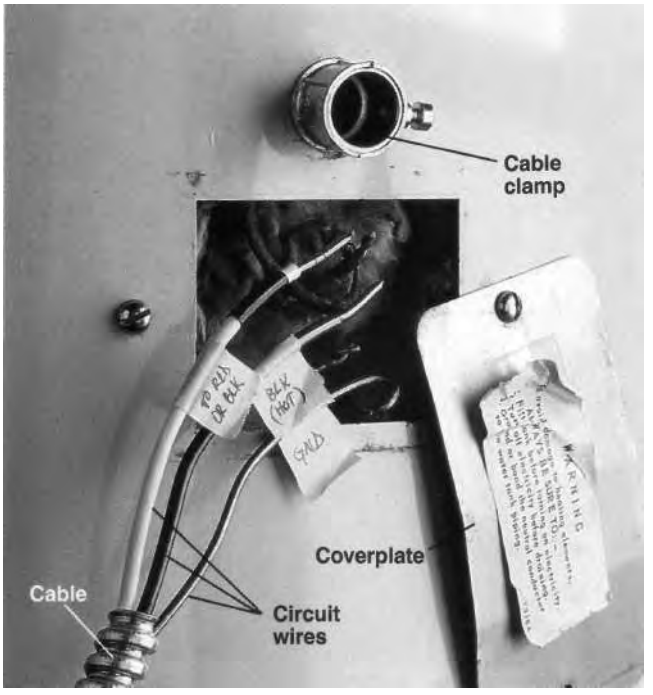
2 Remove one of the heating element access panels on the side of the water heater.



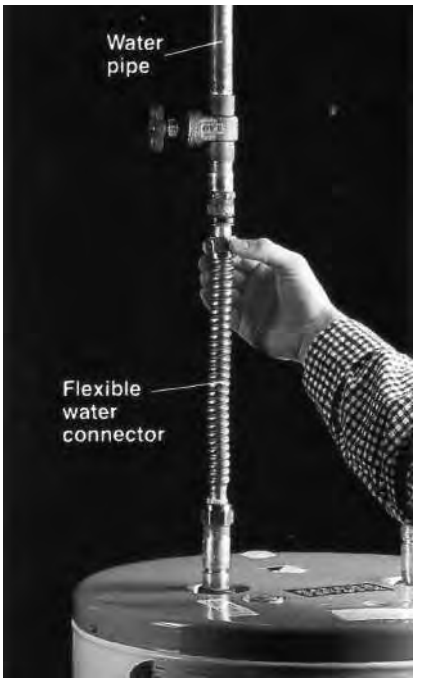
3 wearing protective gloves, fold back the insulation to expose the thermostat. **Caution: do not touch bare wires until they have been tested for current.**



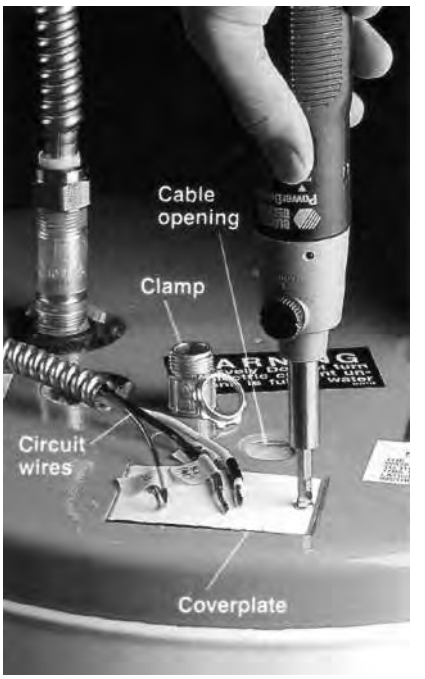
4 Test for current by touching probes of neon circuit tester to top pair of terminal screws on the thermostat. If tester lights, wires are not safe to work on; turn off main power switch and retest for current.



5 Remove coverplate on electrical box, found at side or top of water heater. Disconnect all wires, and label with masking tape for reference. Loosen cable clamp. Remove wires by pulling them through clamp. Remove old heater, then position new heater.



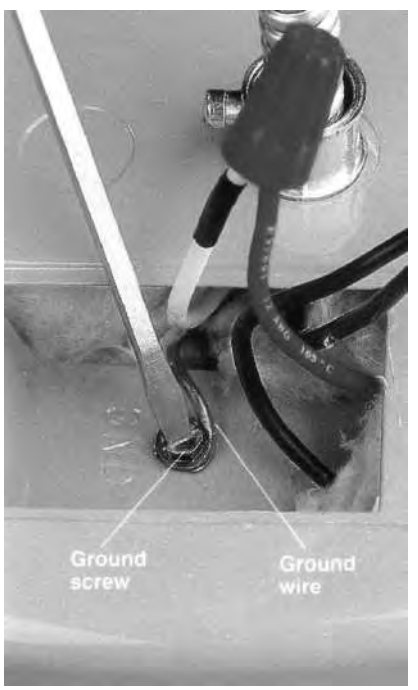
6 Connect water pipes and pressure-relief valve, following directions for gas water heaters (pages 244 to 245, steps 10 to 15). Open hot water faucets throughout house, and turn on water. When water runs steadily, turn off faucets.



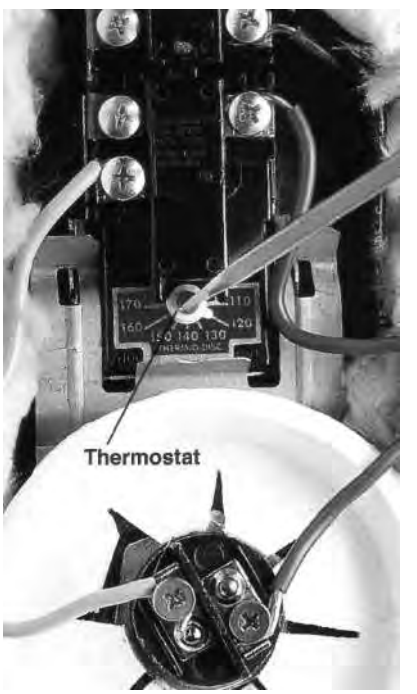
7 Remove the electrical box coverplate on new water heater Thread the circuit wires through the clamp. Thread circuit wires through the cable opening on the water heater, and attach clamp to water heater.



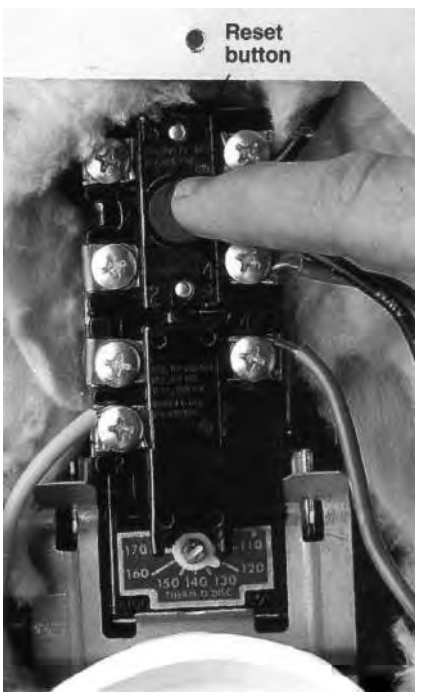
8 Connect the circuit wires to the water heater wires, using wire nuts.



9 Attach bare copper or green ground wire to ground screw. Replace coverplate.



10 Remove access panels on side of water heater (steps 2 to 3), and use a screwdriver to set thermostats to desired water temperature.



11 Press reset button on thermostats. Replace the insulation and access panels. Turn on power

Fixing Burst or Frozen Pipes



Begin any emergency repair by turning off water supply at main shutoff valve. The main shutoff valve is usually located near water meter.

When a pipe bursts, immediately turn off tine water at the main shutoff valve. Make temporary repairs with a sleeve clamp repair kit (page opposite).

A burst pipe is usually caused by freezing water. Prevent freezes by insulating pipes that run in crawl spaces or other unheated areas.

Pipes that freeze, but do not burst, will block water flow to faucets or appliances. Frozen pipes are easily thawed, but determining the exact location of the blockage may be difficult. Leave blocked faucets or valves turned on. Trace supply pipes that lead to blocked faucet or valve, and look for places where the line runs close to exterior walls or unheated areas. Thaw pipes with a heat gun or hair dryer (below).

Old fittings or corroded pipe also may leak or rupture. Fix old pipes according to the guidelines described on pages 44 to 71.

Everything You Need:

Tools: heat gun or hair dryer, gloves, metal file, screwdriver.

Materials: pipe insulation, sleeve clamp repair kit.

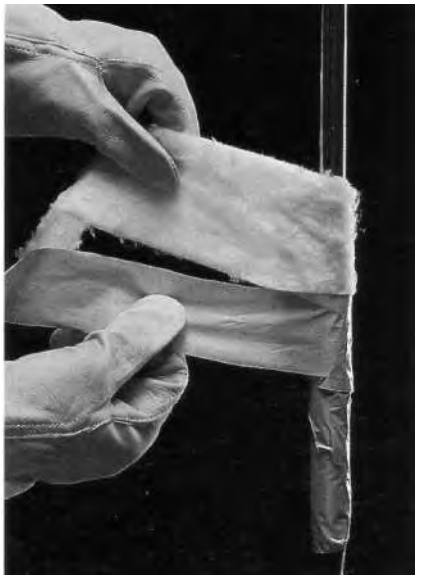
How to Repair Pipes Blocked with Ice



1 Thaw pipes with a heat gun or hair dryer. Use heat gun on low setting, and keep nozzle moving to prevent overheating pipes.

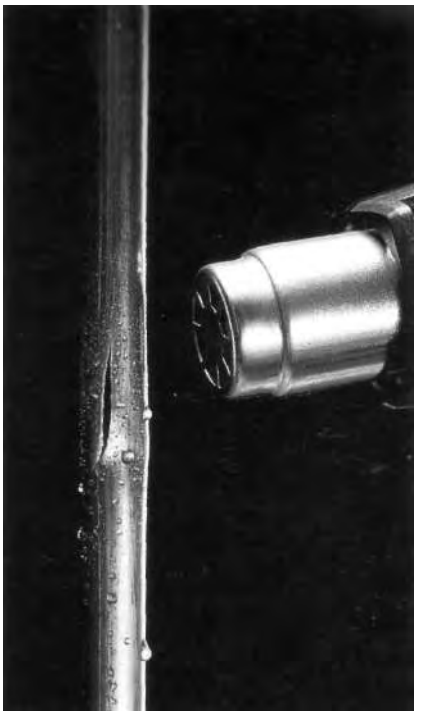


2 Let pipes cool, then insulate with sleeve-type foam insulation to prevent freezing. Use pipe insulation in crawl spaces or other unheated areas.

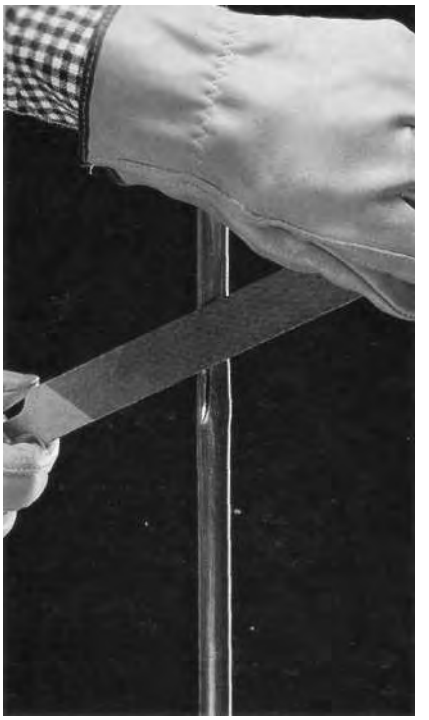


Alternate: Insulate pipes with fiberglass strip insulation and waterproof wrap. Wrap insulating strips loosely for best protection.

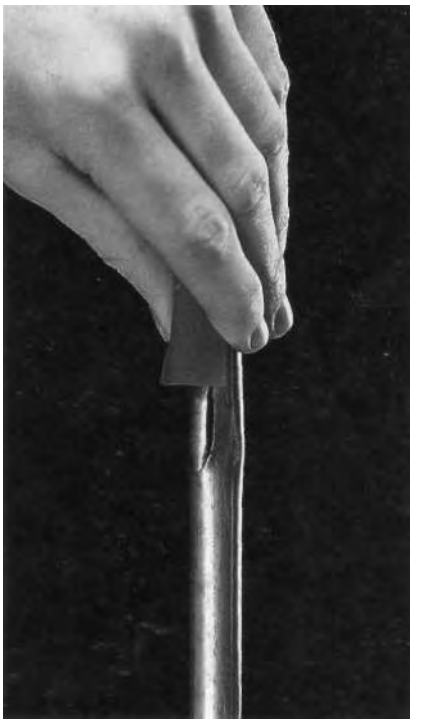
How to temporarily fix a burst pipe



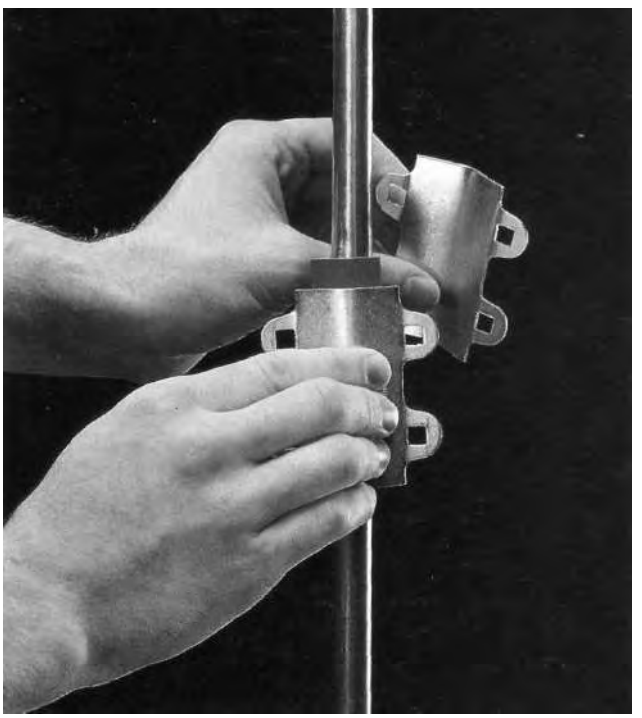
1 Turn off water at main shutoff valve. Heat pipe gently with heat gun or hair dryer. Keep nozzle moving. Once frozen area is thawed, allow pipe to drain.



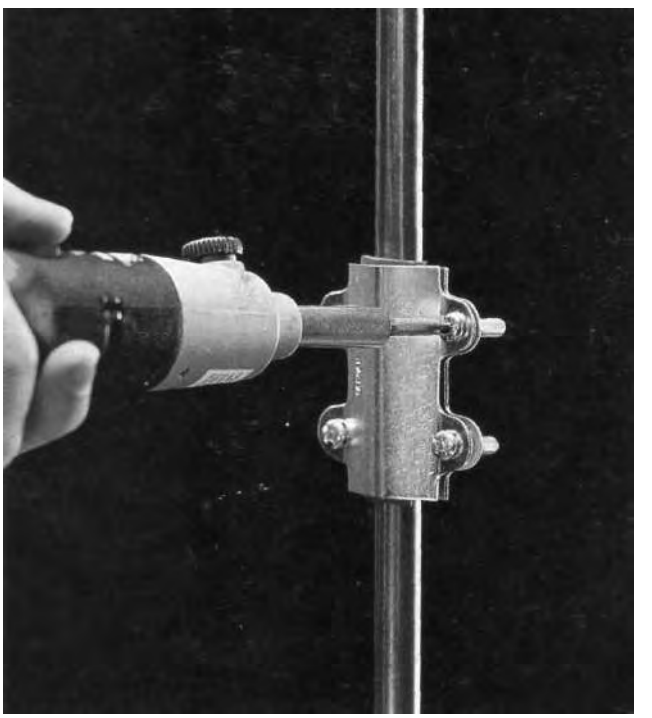
2 Smooth rough edges of rupture with metal file.



3 Place rubber sleeve of repair clamp around rupture. Make sure seam of sleeve is on opposite side of pipe from rupture.



4 Place the two metal repair clamps around rubber sleeve.



5 Tighten screws with screwdriver Open water supply and watch for leaks. If repair clamp leaks, retighten screws. **Caution: repairs made with a repair clamp kit are temporary.** Replace ruptured section of pipe as soon as possible.