Fixing Leaky Copper

How to remove and replace a failing valve or fitting

BY GEORG EFIRD

New construction has dominated my plumbing business in Asheville, N.C., for the past two years. My crew and I spent our days installing PEX tubing. The work was clean and quick. Before housing starts picked up, though, and since they've declined, I spent the majority of my time working with copper. These jobs often involved repairing or tapping into copper water lines in old houses.

Whether you're cutting out a leaky joint or tapping into an existing line, there's a methodical, easy-to-learn process to working with copper. Like any trade-based skill, however, practice is the path to mastery. The steps outlined here and some hard-earned tips that I've acquired over the years can save you some time and money on most repairs involving solder.

Turbulent flow weakens joints

Leaks happen, and they happen for many reasons. More often than not, leaks develop

2 WAYS TO REMOVE A LEAKY JOINT

To solder copper properly, all joints need to be free of water. After locating the leak, turn off the water main, then open all fixtures. Removing a joint allows trapped water to purge from the system. Use a 5-gal. bucket to catch the water.

SWEAT IT OFF

The least invasive way to remove a leaky fitting is to sweat it off. Heat the pipe and fitting together at the same time, lightly tapping the section with a wrench until the joint can be pulled apart. Wipe away the excess solder while it's hot. Wear eye protection, and watch out for splattering solder. A wet cloth and Channellock pliers are a safe way to handle hot pipe.

CUT IT OUT

If the joint won't sweat off, it needs to be cut out. Place a pipe-cutter wheel far enough back from the joint to clear any hardened solder. Be sure the pipe sits squarely on both wheels. Then spin the cutter around the pipe, tightening the wheel slightly with each full revolution until it breaks free. In tight quarters, use a mini-cutter.

Photos facing page: top right, Justin Fink; bottom right, Rodney Diaz.

over time, especially in tees, 45° elbows, and 90° elbows, which are subject to significant force as water flows. Water slowly eats and erodes copper in these areas. Improper soldering techniques are also a common source of leaks.

The erosive power of water at these diversion points is why fittings are made of a harder copper than piping. Well water or water that contains sediment or sand can be especially hard on fittings. Sand is particularly bad for copper water systems because of its abrasive quality. Sand can cause pinholes to develop around connections, creating small leaks that can be difficult to spot. Wiping each joint with a dry rag is a good way to test for leaks.

The fittings at the water heater are common trouble spots, too. If the fittings are overheated during the installation process, the Teflon tape around threaded connections can melt, causing the joint to leak. Teflon can break down over time due to heat as well.

To prevent leaks, be sure to protect threaded joints from excessive heat during soldering. I use a tubing cutter and a wet rag to isolate these and any other joints I want to protect ("Tip" p. 41).

First, flush the system

To be soldered, a joint needs to be free of water. Water won't allow the joint to heat properly, impeding the solder's bond to the pipe. The best way to ensure that water doesn't creep into the area I'm working on is to drain the system. I do this by turning off the water heater, turning off the water, then opening all the valves in the house.

I turn off electric water heaters at the breaker. To ensure that no one turns on the breaker before I'm finished, I clip a safety lock-out tag on the switch. (Tape works, too.) If it's a gas water heater, I turn it to its lowest setting. Next, I turn off the main water valve and the cold-water valve on top of the water heater. Then I open all faucets in the house, hot and cold, to relieve pressure. This includes hose bibs and toilets, which will drain the rest of the system.

Because I do this work regularly, I have a small supply house in my truck. Piled high in various bins are tees, elbows, and shutoff valves of all sizes, as well as various lengths of pipe from old jobs. I'm able to determine by eye the size of the copper pipe that needs replacing. If you can't size by eye, the most foolproof way to make sure you get the right size is to take a piece of the existing pipe to the hardware store.

Once I've gathered the materials I need, I place a bucket under the section of pipe I plan to remove. Then I sweat or cut out the section and allow any trapped water to drain into a bucket.

If any exterior hose bibs are easily accessible, I like to use my shop vacuum to help blow water through the pipes and out the bib. Opening the relief valve on the water heater helps to break the vacuum if

TIP

DAM THE DRIP

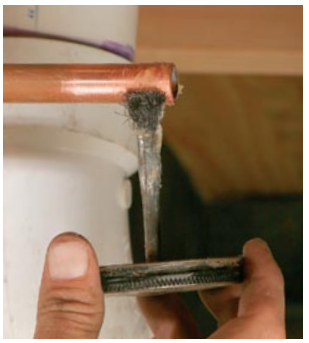
A ball of white bread (photo above) stuffed inside piping will absorb trickling water. Once the water is turned back on, the bread should be purged from the plumbing via an exterior hose bib or a washing-machine-hose line. Plumber's bread (photo below) works the same way and won't become moldy in your plumbing kit.

CLEAN THE PIPE AND THE FITTINGS

Cleaning the copper removes oxidation, which prevents solder from bonding properly. Fitting brushes fit perfectly around the pipe or in the fitting, so they're easy to use. Don't touch cleaned areas; oil from your hands could impede the solder's bond. Once all pipe and fittings are clean, apply flux, and assemble the pieces.

REAM
Use the flare tool attached to the tubing cutter to remove the lip remaining from the cutter wheel. Hold a reamer firmly inside the pipe, and turn it, cutting away the inner lip.

CLEAN
Sand the last 1 in. to 2 in. of pipe, then run the sanding cloth over the edge of the pipe as well to remove any burrs left from the reaming tool. Next, scrub the fitting with a piece of sanding cloth. Both surfaces should shine like a new penny.

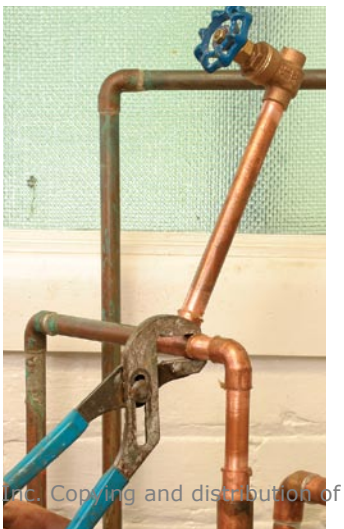


FLUX
Apply a thin coat of flux around the pipe and inside the fitting. Don't gob it on. Flux liquefies when heated, so it can bubble and get in the way of solder.

TIP

CRIMP THE JOINT

Flux acts like a lubricant, so an assembly of pipe and fittings can become unruly. To keep work from falling apart, turn the pipe out of alignment, then crimp the joint slightly with Channellock pliers. This snugs up the fitting, allowing it to hold in any direction. Don't bear down too hard on the pliers, though, which could deform the pipe or the fitting.



water is still draining. I typically open the relief valve regardless.

Ream, clean, and flux

Whether I'm working with piping that's 60 years old or brand new, creating a leak-free joint still requires the same basic steps. The process starts with reaming the ends of the pipe that I just cut. Tubing cutters leave a lip around the inside of the piping. Although it looks insignificant, it decreases the inside diameter enough to affect water flow.

Next, I clean the ends of the pipe and the fittings to remove oxidation, which prevents solder from bonding properly to copper. Although I consider fitting brushes to be well worth the money for this task, I prefer sanding mesh. It's inexpensive and durable, and it works just as well wet as it does dry.

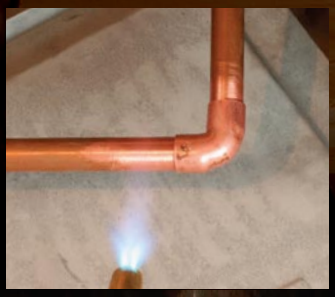
Once I've cleaned the pipe and fittings until they're as shiny as a new copper penny, I apply flux and assemble the pieces. I like flux that comes with a brush under the lid because it helps the flux to stay clean. If the brush is already in the container, it is less likely to pick up dirt that could end up on a pipe or fitting. On that note, I'm also careful that I don't touch cleaned areas; oil from my hands could interfere with the solder bond.

Before lighting the torch, I make sure to protect plastic piping and framing in the area I'm about to solder. If wood is the only fire hazard around, I spray it with water for about a minute to protect it from the torch flame. More often than not, though, I use sheet metal or fire-retardant cloth to protect plastic piping and framing. In tight areas, I often solder a section before I install it.

Solder follows heat

A properly heated fitting should accept solder in a liquid state. The position of the joint—horizontal or vertical—doesn't matter. Liquid solder overcomes gravity to flow toward heat. The amount of solder needed per joint should match the diameter of the fitting. For example, a ½-in.-dia. pipe joint requires only ½ in. of solder. Sometimes I extend only what I plan to use to make sure I don't overfill the joint, which would likely drip. Excess cured solder in the joint could affect water flow. Keep a wet cloth and a bucket handy to catch solder drippings.

With solder and torch in hand, I heat the pipe, then the fitting. Next, I add the solder, working from the lowest fitting up. If it's necessary to reach past fittings that need to be



APPLY HEAT, THEN FILL THE JOINT

Spray nearby combustibles with water for about a minute to protect them from the torch flame. Sheet metal or fire-retardant cloth can also be used to protect plastic piping and framing. If it's necessary to reach past fittings that need to be soldered, solder the farthest ones first to avoid scalding yourself. Wipe down the joint with a damp rag once it has cooled. Don't reheat already-soldered fittings unless absolutely necessary. See "What's the Difference?" on p. 80 to learn about torches and gases that are available.

HEAT

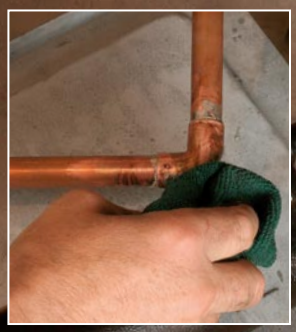
Apply heat from the bottom of the pipe about ½ in. back from where the pipe enters the fitting. Keep the tip of the blue flame no closer than a quarter-inch from the pipe. After 3 to 7 seconds, slowly move the heat closer to the fitting. When soldering shutoff valves, open the valve to prevent damaging the washer.

SOLDER

After 10 seconds, apply solder from above (the 12 o'clock position) where the pipe meets the fitting. Move the solder back and forth over the joint. Hold the flame between the 4 o'clock and 8 o'clock position to keep flux and solder from dripping into the torch head. A properly heated fitting should draw liquefied solder into the joint. If the solder doesn't melt immediately, remove the torch tip and continue to heat both the pipe and the joint. A properly soldered joint should have a thin, even band around it.

WIPE

After the pipe has cooled but is still warm, use a wet towel to wipe down all pipe to remove flux, which is corrosive. Inspect each fitting connection before turning the water system back on.



TIP

DIVERT AND ABSORB THE HEAT

Copper is a great heat conductor, so it's important to keep areas like nearby shutoff valves and threaded fittings from overheating. Use a tubing cutter to absorb the heat. The cutter's wheels create an alternate path, but they need only to touch the pipe. Wrapping a vulnerable area with wet cloth provides good protection, too.

soldered, I try to solder the farthest ones first to avoid scalding myself. I also make sure to open all shutoffs that will be heated to avoid damaging washers.

If solder starts to melt on a joint, then hardens immediately without flowing into the joint, it means there is still water in the line. I turn off the torch, then remove the fitting after it has cooled. I try to drain the pipe again or dam the water using white bread or plumber's bread ("Tip" p. 39).

If soldering isn't an option, it's possible to use a different method. Compression fittings were the solder-free choice for a while, but thanks to new technology, SharkBite fittings (www.sharkbite.com) are a better option. These fittings slip onto copper, PEX, or CPVC tubing, making them incredibly handy for transitioning between different materials. These fittings are pricey, though. At about $6 for a ½-in. elbow compared to less than 50¢ for copper, copper is clearly the most economical choice when multiple joints are involved.

Once I'm done soldering, I wait until every joint is cool to the touch. Then I turn on the water system. I like to keep all faucets open for several minutes to let air and flux drain from the system. Then, one by one, I turn off each fixture beginning with the lowest in the house and working up to the highest. Finally, I look around each joint for leaks. If they exist, I repeat the process. If not, I pack up my things and trust the solder. □

Georg Efird owns A2Z Plumbing (www.eatsleepplumb.com), a green plumbing company in Asheville, N.C. Photos by Chris Ermides, except where noted.