

DO I HEAR RUNNING WATER?

By Douglas E. Jones, PE



I recently awoke in the middle of the night to the sound that sends shivers up the spine of central Florida homeowners – running water. I walked out to the garage hoping to see the comforting sight of the irrigation timer counting down the operation of one of the zones. Unfortunately, I spent the next half hour with my ear to floors and walls trying to locate the source of the noise. I finally located the source...water spewing out a pinhole leak in the copper tubing leading to the shower. I was well acquainted with this sound as a similar leak several years ago resulted in the plumber jack hammering the slab in the master closet. The plumber's comments from that first leak popped in my brain – *“Fix the first leak. When (not if) the second leak occurs, re-pipe the house.”* So began a three-day effort to rid the house of copper plumbing.

Copper is easy to install, widely used in residential plumbing, and has a history of resistance to corrosion. However, in some areas of the country, corrosion of copper pipe and tubing is a significant cause of plumbing failure. Its prevalence is probably underestimated as the majority of failures are not likely reported to the local water utility. Often small leaks initially go undetected and the resulting wet conditions can provide a favorable environment for termites and mold. Consequently, repair of the plumbing and associated damage is often costly for the owner.

Regulation and Health Effects

The Environmental Protection Agency (EPA) has set the action level for copper at 1.3 parts per million for 90% of the first-draw samples collected at the tap. This action level is the lowest level to which utilities can reasonably be required to control copper levels at customers' taps. Exceeding this level is not a violation but may trigger other requirements such as additional monitoring or treatment. EPA believes that short-term exposure to copper above the action limit may lead to such health effects as gastroenteritis, nausea, and vomiting. Long-term exposure to elevated copper levels has been implicated in kidney and liver damage.

Types of Copper Corrosion

Copper corrosion is typically classified as either uniform or localized (pitting) based on visual inspection of the pipe. Uniform corrosion will demonstrate an even thinning of the pipe wall and is typically associated with elevated copper levels at the tap. Often the surface will be tarnished or covered with a powdery blue-green scale (Figure 1). Localized corrosion, as the name implies, describes specific areas of corrosion. Localized corrosion usually does not result in a significant increase in copper levels at the tap, as the amount of corrosion is often very low.

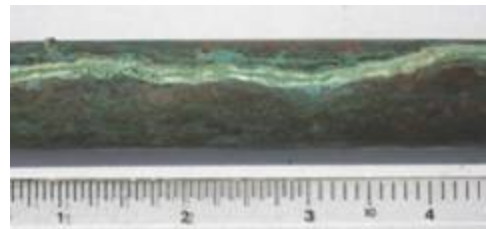


Figure 1: Corrosion resulting in blue-green scale

The mechanisms of copper corrosion are not well understood. Numerous causes of corrosion have been suggested, including water quality, microbial activity, material imperfections, workmanship, soldering flux, and stray currents. Corrosion is also accelerated by high velocity and turbulence. Uniform corrosion is most commonly associated with low pH, high alkalinity water.

Localized or pitting corrosion is by far the most common type observed in central Florida. It is characterized by small areas of increased corrosion that can eventually lead to perforation of the pipe resulting in pinhole leaks. Pinhole leaks often occur at fittings and bends (Figure 2). This form of corrosion is often the most damaging as the leaks may go unnoticed for months.

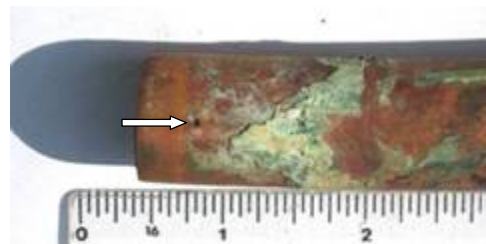


Figure 2: Localized (pitting) corrosion resulting in pinhole leak near a soldered joint

This type of corrosion may appear to occur randomly, striking some houses while neighboring homes are unaffected. This has led to speculation that localized corrosion is the result of multiple factors such as water quality, use patterns, and construction quality.

Localized corrosion is further divided into three subtypes:

1. Type I (Cold Water Pitting) – This is typically seen in horizontal runs of cold water pipes with hard well water, pH 7.0-7.8, high sulfide, and high alkalinity. This type appears to be the most common.
2. Type II (Hot Water Pitting) – Occurs with hot water often with pH below 7.2 and/or high chlorine residuals.
3. Type III (Soft Water Pitting) – Occurs with soft water often with pH above 8.0 and low alkalinity.

What's a Homeowner to Do - Treatment or Replacement?

Successful case studies have been reported in literature where copper corrosion was mitigated by the water utility through treatment of the water supply. In cases where the water supply is the definite cause, corrosion can sometimes be reduced or prevented by adding corrosion inhibitors to the water or adjusting the pH. However, utilities are sometimes reluctant to take action for fear of liability.

When the cause of copper corrosion is unclear, it is the homeowner who must decide what to do. An Internet search shows a number of companies and technologies that advertise solutions. Many of these “solutions” are questionable at best. I have had neighbors tell me that they were not concerned because they were sold water softeners to prevent copper corrosion. The Water Quality Association states that ion exchange water softening neither causes nor controls corrosion. Calcium carbonate scale on the inside of piping often forms a protective layer against corrosion. Water softeners can dissolve this layer and subject the pipe to corrosion.

Localized corrosion is usually discovered only after the first leak. By this time there are likely multiple points of corrosion within the plumbing. It is uncertain whether any form of mitigation or treatment will prevent continued propagation of these pits. This leaves the homeowner with two choices – fix the leak or replace the copper plumbing. Based on discussions with plumbers and experience with my house, I believe it is only a matter of time before the second, third, or fourth leak occurs.

The decision to replace the copper plumbing is an individual choice. I chose to take the advice of my plumber - *“Fix the first leak. When (not if) the second leak occurs, re-pipe the house.”*

Bite the Bullet and Re-pipe

While the Florida Plumbing Code allows several pipe materials to be installed (including copper), the overwhelming choice of local plumbers is Copper Tube Size (CTS) Chlorinated Polyvinyl Chloride (CPVC). The pipe should meet NSF61 standards and conform to ASTM D2846 rated for continuous service to at least 100 psi and 180°F. CPVC has a long history of dependable and safe service for drinking water uses.

For a typical single-story, two-bath house, the re-plumbing work should require 2½ to 3 days to complete. The first two days involve installing the distribution and service lines. This can be performed while the water service to house remains active. On the third day, the individual fixtures (toilet, shower, etc.) are disconnected from the copper lines and connected to the new service lines.

The hot and cold distribution lines are routed into the attic rather than under the slab. Individual service lines are dropped vertically through inside walls to the fixtures. The horizontal lines in the attic should be attached to the roof trusses at a height sufficient to be readily visible above the insulation and not create a trip hazard. The lines should be routed to minimize conflicts with future maintenance such as air conditioning repairs.

It is important to consider expansion when installing the pipe, as attics in Florida can easily reach 140°F in the summer. For example, a 50-foot straight length of CPVC pipe will expand by approximately 2 inches when the attic and water temperature increases from 50°F to 140°F. In addition, the pipe needs to be well supported as CPVC becomes more flexible at higher temperatures and will sag. To reduce pipe expansion and prevent excessive heating of the cold water line, the homeowner should install foam insulation around the pipes (Figure 3).



Figure 3: Insulated CPVC lines

It is important that the new distribution and service lines be pressurized to check for leaks prior to turning the water on. Most plumbing contractors will perform the pressure test with air.

Selecting the right plumber is critical to making the process as painless as possible. Time is not on your side once there is a leak. Fortunately your house is probably not the first in your neighborhood to be re-plumbed. Neighbors can be good sources of information for selecting your plumber. Some tips to consider are:

- Contact at least two or three plumbing contractors for estimates as prices can vary significantly.
- Do not select a plumbing contractor solely on price. Ask about their experience with re-plumbing houses and contact references. Experience is important in minimizing damage to drywall and bathroom tile. An experienced contractor should be able to install the service lines with minimal to no damage.
- Do not accept a price quote without a contract. The contract should include a detailed description of the work, materials, testing, schedule, and warranty.

Insist on having the new lines pressure tested for leaks.

The Results

- Most homeowners will notice improved pressure over copper due to slightly larger inside pipe diameter and less friction.
- Some people report a slight change in taste (I did not notice any difference).
- Exercise caution when using the water during the summer. The water (both the cold and hot water lines) may be very hot when first turning on a faucet. The heat buildup can be reduced by insulating the lines in the attic.

Depending on the quality of installation, the service lines in the walls may creak slightly when water is flowing through them.

While prices can vary significantly, the typical cost for re-plumbing a typical single-story, two-bath house in central Florida is \$4,500 - \$5,000. This price is actually favorable when compared to the costs incurred with repairing leaks and subsequent damage. Imagine a leak under your hardwood flooring!

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