

PRIVATE DRINKING WATER IN CONNECTICUT

Publication Date: November 2009

Publication No. 35: Corrosion of Copper Pipe and Fittings

The corrosion/erosion of metallic (copper, galvanized, brass, cast iron, etc.) pipes and fittings has many different causes and scenarios and is usually the result of the quality of the water in the pipe and the environment surrounding the pipe. The major emphasis of this paper will concern itself with copper piping because of its universal application and copper vessels have carried water since the time of the Egyptian dynasties.



Hard drawn domestic copper pipe is manufactured in 3 types (based on wall thickness) that is stamped on the piping itself:

- Type “K”-HPHT- (high press/high temp.) Green Stamping (thickest wall)
- Type “L”-MPMT- (med press/med temp) Blue Stamping (intermediate thickness)
- Type “M”-LPLT- (low press/low temp) Red Stamping (thinnest wall & most common)

No markings are required on the soft annealed copper coils used in private home construction, usually the ¾ inch service line from the house to the street.

It should be installed using ASTM B-813 flux and sized so that the water velocity does not exceed 4-5 feet/second. Pipe pressure should not exceed 80psig or flow (erosion or impingement) corrosion will occur at elbows and any place where there is a change in the direction of flow.

The greater part of copper pipe corrosion is the direct result of improper workmanship or poor installation such as:

- * use of acid based flux or excessive use of flux=flux corrosion
- inadequate deburring of cut tubing that results in reduced pipe internal diameter and increased water velocity=erosion corrosion
- improper flushing of the pipe system after completion=flux corrosion or corrosion cell corrosion



To lessen/eliminate the above, proper flushing of the completed plumbing after pressure testing is necessary. All piping, hot and cold, should be thoroughly flushed at “full bore”(all aerators & flow restrictors removed) for at least 10 minutes. This should remove cuttings and excessive flux runs. It is imperative that the water should not be allowed to stagnate in the pipes because the protective forming of the cuprous oxide (Cu_2O) film will not occur uniformly on the interior of the pipe wall. It is this film that protects the copper pipe from the water’s natural aggressive action. This is why copper is so popular for use in domestic plumbing. Frequent (monthly) full bore flushing should be done on all piping in new uninhabited buildings until plumbing is put into use. If “blue water” stains persist it would be a good idea to check the water’s aggressiveness for low pH and high Total Dissolved Solids, e.g. chlorides.



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Common Types of Corrosion

Keeping in mind that this fact sheet is merely a primer on metallic corrosion, only the most common types of corrosion will be mentioned. To handle difficult problems consult with a licensed Professional Engineer with corrosion control expertise.



* Galvanic or dissimilar metal corrosion - Probably the most common and best understood of the various corrosion phenomena. It occurs when 2 or more metals with different activity or 'nobility' are in direct contact with each other. The less noble metal becomes the sacrificial anode (corrodes) and the other metal becomes the acquiring cathode. The simple fix is to install a dielectric (insulating) coupling or fitting that eliminates the direct contact between the metals and there is no transference of electrons (current). This same phenomenon occurs between similar alloys but microscopically at the alloys intergranular surfaces causing the metal to fail with no obvious external reasons.



* Flux Induced (pitting) - usually cold water only, pits usually contain significant amounts of Zn and Cl, from the ZnCl salt components in the flux. Older fluxes were acid based and very aggressive to metallic plumbing. Excessive flux runs (usually found in proximity to joints, elbows and tees and sometimes as much as 10 feet away) usually give rise to tubercles containing the ZnCl residue. In horizontal pipe runs result with the pitting/tubercles forming on the bottom (6:00 position) in the pipe. They will form all around the pipe's internal surface in vertical runs of pipe. The formation of these tubercles prevents a cohesive cuprous oxide film from forming at the site and the pipe is corroded on the waterside of the pipe. It occurs in the cold water piping because the flux petrolatum is not dissolved and washed away with normal hot water piping temperatures. Even when the flux is long gone this corrosion phenomena will be found at the periphery of flux "ghost" runs.

These excessive flux runs have become a problem since the Lead Contamination Control Act of 1988 was enacted. The new approved 95-5 (tin/antimony) solder only has a fluid range of 12°F between liquid to solid phases, which results in a very short time to make a watertight seal. The older solders had a fluidus range of 60°F.

* *Stray DC Electrical Current*-this topic is discussed in article #37-*Electrical Grounds-A Controversial Necessity*.

* *Microbial Corrosion*-if an anaerobic microbe, especially sulfate reducing bacteria, is present under the tubercle then the resulting corrosion case is microbiologically induced. This may require frequent flushing/chlorination of the piping system.

As stated previously, proper initial flushing and sizing of the copper pipes and the avoidance of dead-ends and stagnant or low flowing water situations will eliminate many of these problems.

For more information please click on the following links:

EPA Office of Groundwater and Drinking Water

<http://www.epa.gov/ogwdw/>

EPA New England

<http://www.epa.gov/region01/>