

*Case Study*  
**Copper Pipe Corrosion**

*December 17, 2004*

**Background**

During the housing boom of the early 2000's numerous condominiums were erected in South Florida to meet a burgeoning demand. Unfortunately, over production coupled with a changing economy left many of these new units vacant for considerable time. In this example a condominium was purchased and left vacant for 18 months. Upon occupation significant water damage was discovered behind several walls, resulting in \$30k worth of damage. The culprit was a water pipe that was inadvertently penetrated by a wood screw when the contractor hung the kitchen cabinetry.

**Results**

A 3/4 inch copper pipe was submitted for examination. The pipe had two holes representing the entry and exit point of a galvanized wood screw (Figure 1). The soft copper formed a seal around the screw preventing water from leaking initially. The deformation can be observed in Figure 2 and illustrates how the screw was able to penetrate and seal the pipe. No escaped water was detected or heard during the final inspection.



Figure 1. As-received copper pipe. Red arrows represent entry and exit point of wood screw.

The wood screw gradually corroded away as the contact between copper and steel created a galvanic cell and the steel was exposed to oxygenated water. As the screw corroded away the seal it created lost integrity allowing water to escape at an increasing rate. Eventually the water was “spraying” out and could be heard behind the wall during a visit by the owners. The area damaged was behind the wall and inaccessible. To repair the pipe the cabinetry needed to be removed as well as significant water damaged material. Figure 3 illustrates the condition of the screw upon removal from the pipe. Its condition represents 14 months from installation to removal. The corrosion products consist of iron oxide (red) and zinc oxide (white).



Figure 2. Copper pipe illustrating hole created by wood screw. Note shape of hole reflects deformation created by wood screw penetrating wall of pipe.

Some accelerated tests were done to attempt to re-create the corrosion rate and determine if the pipe was damaged by work done after the homeowner took possession of the residence. The tests were terminated early at the request of the insurance company. However, the initial results correlated with the timeline of the contractors work. Our experimentation also illustrated how a good seal was created when the screw entered and exited the pipe. Only drops of water escaped the freshly breached copper pipe.

### Discussion

The significance of the time required for the screw to begin leaking was the subject of a subrogation investigation. The homeowner left the residence vacant over a year. The owner was moving in and doing some work in the unit when the water damage was discovered. A claim was submitted to the carrier, who determined the original builder was responsible for the escaped water. The builder responded by stating the type of screw discovered was not the type they used and the homeowner must

of damaged the pipe while installing cabinet lights. After reviewing the details it became very clear that the cabinet installer was responsible for breaching the water pipe with a wood screw due to its location and the degree to which the corrosion had advanced. (The owner discovered the leak only weeks after installing cabinet lights).



Figure 3. Cabinet screw as-received. Note the base still retains the zinc coating while most of the material was corroded away due to exposure to water and a more noble copper.

### **Conclusion**

A confidential settlement was reached between the insurance carrier and general contractor to cover the water damage. During repair it was discovered several *near-miss* wood screws that were in contact with the water pipes or within  $\frac{1}{4}$  inch. There is a bit of irony in that the characteristics of the copper and steel delayed the discovery of the breach by forming a seal. (The soft copper conformed to the shape of the screw) Yet, the two dissimilar metals created a galvanic cell that doomed the screw to eventually fail by corrosion and begin to leak water.