As a forensic engineering firm, we investigate thousands of insurance claims every year; everything from appliance fires to structural collapses. But some of the most devastating losses we investigate aren’t the result of fire or structural damage, they’re caused by water supply line failures. That such a simple and commonplace component can cause so much damage is incredible, and not a little bit disconcerting. We’re talking something that’s found in every house, commercial and industrial building — anywhere there’s a sink or toilet. To make matters worse, these parts are unpredictable and have very high failure rate in comparison to other plumbing components. 

Eduaro Mari, M.Sc., P.Eng., Forensic Engineer
While homeowners often cite fire their top concern, water damage accounts for over 40 percent of all home insurance claims. Every year, the Canadian insurance industry pays out over one billion dollars in claims related to water damage, and the average cost per claim has been increasing. One of the most common causes of water related losses is failed indoor plumbing, which can result in hundreds of thousands of dollars in repairs and property damage.

Twenty-five years ago, flexible supply lines were made of an inner tube made of PVC, surrounded by a woven mesh and a translucent outer polymer cover for added protection. Early designs also utilized metal coupling nuts. These supply lines were heavy duty, and failures were extremely uncommon. With the advent of cheaper, easier to produce materials, most manufacturers switched to a braided stainless steel sheath over a flexible supply line hose, and coupling nuts made of plastic.

What manufacturers failed to realize is that stainless steel tends to corrode when exposed to some household cleaning products, especially when the stainless steel wires used in manufacturing have not been specifically designed to withstand such conditions.

After prolonged exposure, the steel braids corrode, crack, and eventually weaken to the point of failure, in a process called stress corrosion cracking. Water pressure then causes the interior tube to bulge and expand through the hole until it ruptures.

The plastic coupling nuts used these days suffer from similar design and material selection issues: On paper, it’s a great material; it’s hard and strong; it allows for easy manufacturing and injection moulding; and it’s easy and inexpensive to produce. However, when the component is installed, it’s exposed to conditions that ultimately change its properties and can cause the material to degrade rapidly.

The plastic is susceptible to “creep”, which is the deformation of the material when subjected to stress. In metals, creep occurs at elevated temperatures; however, in polymers such as plastic, it can occur at room temperature. Over-tightening of the plastic coupling during installation can increase the amount of stresses and contribute to an early failure.
The plastic is also prone to creep rupture and cracking wherever there are sharp angles and notches in the geometry of the part. Now initially, the plastic nuts were designed much like the original metal hex nuts, that is, with wrench flats, which creates two problems. The first issue is that it suggests to consumers that you should use a wrench to tighten it, when in fact they were only meant to be hand-tightened. The other issue is that once screwed on, it experiences a stress concentration effect at the sharp internal angles, which can result in a creep crack that grows until the coupling fractures, causing the failure and allowing water to escape.

As you’ll see, the most common failures we see in flexible water supply lines can be connected to manufacturing deficiencies – a result of inadequate material selection and improper design. And this is something we see in our investigations all the time – a slight oversight on the part of the manufacturer that leads to big problems later on.

**COMMON CAUSES OF FAILURE**

1. Acetal Plastic Coupling Nut Fracture
2. Corrosion of the Braided Metal Hose
3. Stress Corrosion Cracking of the Brass Barbed Fitting
4. Separation of the Barbed Fitting (improper crimping)

**WHERE WE COME IN**

We see these failures all the time. We know what to look for and how to equip our clients with the information they need to establish their liability opinion and pursue subrogation confidently.

Our experts can tell whether the failure was due to improper installation or due to a manufacturing defect. Once we have the component, we go through an assessment and determine if it was improperly installed (whether it was over-tightened or tightened using a tool). If the installer isn’t at fault, we perform a chemical analysis of the material. We check the geometry and look at the fracture under a microscope to determine if it was creep or other mechanisms of failure caused by a manufacturing defect.
With regards to the future of flexible supply line manufacturing innovations and associated insurance claims, unfortunately we don’t see these problems going away any time soon. As manufacturers have moved to reduce the cost of materials and manufacturing processes, the cost and occurrence of failures has increased. And while newer flexible supply lines made with better materials and improved designs have emerged, the vast majority of those currently installed remain those made from plastic, which are known to cause catastrophic failures and water losses.

These incidents can be extremely complex: You need to manage emergency services; mitigate damages; arranging accommodations for your insureds; sort through all the ALE; deal with business interruption; and on and on. Because there’s so much to deal with, a lot of our clients tend to put subrogation considerations on the back burner.

But the faster you can secure the component, the more efficiently you can document installation conditions and chain of custody, and the sooner you can secure the evidence in a proper facility, the higher the potential of recovering the cost of your claim. We keep things as simple as possible. We tell our clients, next time you have a water loss, regardless of how straightforward it seems, give us a call. One of our forensic experts can walk you through exactly what to do to determine if there’s any subrogation potential, and whether you need a forensic expert on site.

Eduardo Mari, Forensic Engineer
M.Sc., P.Eng.

Eduardo is a professional materials and metallurgical engineer with a Masters Degree in Materials Science and Engineering from the State University of New York. With 15 years of experience, he has led over 500 forensic and failure investigations. He is currently a member of the National Association of Corrosion Engineers (NACE) and the Professional Engineers of Ontario (PEO).