Consumer products and installation failures are a fact of life and unfortunately they are often associated with expensive claims. The insured’s life is impacted in so many ways when a loss takes place: they may suffer substantial damage to their property, their day-to-day lives are disrupted, they may need to incur additional living expenses, and possibly lose income in the process. When these incidents take place, the first questions asked are “What happened? Why did this happen? Was it anyone’s fault? Who is going to pay for this claim?”
Regardless of what party you represent, whether you are an insurer, an independent adjuster, a manufacturer, the installer of the product, a law firm, or a risk manager – in order to determine the extent of your exposure it is a good idea to retain the services of a Forensic Engineer to assist you with the investigation. From that point you will be presented the technical facts of the loss that will help you determine your best course of action. An independent Forensic Engineer’s job is not to point fingers but to provide you with an unbiased opinion on the most probable cause of the failure in question.

- Is the failure associated with a manufacturing defect?
- Is there a design deficiency that inherently caused the component failure?
- Was the component misused or abused?
- Is there any evidence of negligence?
- Is there an installation deficiency?

When a loss takes place and a claim is first processed, often the incident seems to be straightforward and appears to require minimal investigation to answer the questions listed above. However, in most instances this is not the case and a comprehensive investigation is needed to find an answer. With accurate background information about the component and the incident, and access to the evidence, with proper investigative tools an independent Forensic Engineer will most likely find the answers.

There are several myths that are worth your consideration when dealing with consumer product failures. Here are a few examples:

**MYTH:** “Contractors don’t make mistakes often, and if they do it’s hard to prove it”

**FACT:** Installers are human too, and yes, they do make mistakes often

Historically, a major contributing factor to component failures and the conclusion of many forensic investigations is the apparent evidence of installation deficiencies. If an unqualified contractor does the job or if the job was rushed or a wrong part was used, it is very likely that a failure and resulting damages will take place. Below are two examples of common installation related failures encountered in plumbing systems:

**OVERTIGHTENING TWO COMPONENTS**

Using extreme force to tighten a connection does not ensure a better seal but, on the contrary, it can deteriorate the components and be detrimental to the quality of the connection. Often, an overtightened connection that has failed can be easily identified under a microscope, showing apparent tool marks, rounded edges, plating removal, thread deformation or orientation of smeared material, to name a few. Under such conditions, it will be only a matter of time until the connection will eventually ‘let go’, leading to water discharge, and the potential of extensive resulting damages.

**IMPROPER SOLDERING**

In plumbing, soldering is a common method used to permanently join two sections of pipe, or a pipe and a fitting. If the solder joint is improperly made, in a relatively short period of time the joint will crack or separate completely. Factors that may cause this type of failure include improper surface preparation by the installer, poor surface wetting, incorrect depth of joint, and the lack of center alignment of the joints. Such failures are relatively common, especially
with pipes associated with HVAC systems in high rise buildings. Solder defects are not always distinguishable by the naked eye, therefore the use of stereo and scanning electron microscopes are key in observing and analyzing the physical evidence. When the alloy used to solder a joint is the prime suspect in the failure of a soldered joint, a metallurgical examination of microstructures is required to identify the most probable failure mechanism. Both examinations are inexpensive yet extremely effective in assisting the forensic engineer in determining the cause of the failure, putting you in a more informed position to determine if there are any liable parties to pursue subrogation against.

**MYTH:** “A seal/stamp on a component guarantees it is flawless”

**FACT:** A product can fail even if it has been approved and/or certified by quality control

Often, parts that are certified/approved and therefore guaranteed as being defect-free are, in fact, not. This myth is the cause of millions of dollars wasted in lost subrogation opportunities and is extremely important to evaluate as a claims handler. Just because a product has been designed and produced by a well-known company doesn’t mean it was produced correctly. There are many factors that a forensic engineer evaluates when looking at a failed component; improper heat treatment during the fabrication of the component could be confirmed by metallurgical evaluation of microstructures, improper chemical composition could be determined by means of chemical analysis, mechanical testing, hardness testing, burst pressure testing, etc., are incredibly powerful tools a forensic engineer can employ to determine if the component was appropriately designed, fabricated, and manufactured to fulfill its intended purpose. Below are two typical manufacturing defects that are often major contributing factors associated with the failure of a component while under normal operating service conditions.

**IMPROPER MATERIAL COMPOSITION**

In metallic parts, if the alloy composition does not meet the manufacturer’s specifications or the applicable standards’ requirements, then the properties of the final product could be significantly altered, compromising its ability to fulfill its intended purpose. This condition would ultimately lead to a decrease in the performance of the part in service and may potentially cause catastrophic failure. There are numerous analysis methods available that can help to positively determine whether the material’s composition meets the manufacturer’s specifications or the applicable standards’ requirements. Similar tests are available for non-metallic materials, such as plastics, where numerous failures are encountered due to an improper polymer formulation.

**DESIGN DEFICIENCY**

To name a few, a design deficiency could be the use of inadequate shapes and sizes, sharp corner geometries, improper material selection, or improper coating. Such deficiencies originate at the designing stage and can impede the component’s intended use, causing it to fail prematurely while in service. When a product has a design deficiency, it is usually in the area where the failure occurs or where it originates. By using basic engineering principles a Forensic Engineer can definitively prove if a manufacturing defect was the major contributing factor to the failure.
IMPROPER PART SELECTION

In certain plumbing applications (i.e., water connections to ice maker kits on refrigerators), the manufacturer of the appliance recommends the use of copper tubing to make the connection to the water supply. Although there is nothing wrong with some plastic tubing available on the market, some installers go to the extreme and choose the cheapest version of tubing available. Some of these plastic tubes are designed for other applications and not for water pressure of at least 60 psi, as is encountered in our homes.

As an example of a poor choice of a part/component, I will mention a large loss in which the installer decided to use cheap plastic tubing to connect the ice maker kit to the water supply despite the fact that the tube he chose was clearly marked by the manufacturer as “do not use for ice maker kits”. A $500,000 insurance claim resulted just because the installer wanted to save money and decided not to use copper tubing (costing approximately $30.00 for 20 ft.) and installed a plastic tube for which he paid a mere $0.68!

COUNTERFEIT PRODUCTS

According to the Code of Plumbing, plumbing fixtures and fittings need to be certified by the Canadian Standards Association (CSA). There are examples of insurance claims in which the damage was due to the failure of a counterfeit product. Yes, it is true, it isn’t just cash and art pieces that can be counterfeit, but toilet connectors or faucets can be as well! Unfortunately some unscrupulous installers are using such non-certified products to save a buck. Usually, a counterfeit product can be identified by comparing its markings alongside a genuine product.

MYTH: “A product will last a long time without the need of maintenance”

FACT: Nothing lasts long without being maintained

With the exception of perhaps diamonds, nothing will last forever if not properly maintained or inspected at regular intervals. Almost every product/component/appliance nowadays comes with an installation or maintenance manual. A person should take the time to read the important information related to the maintenance of the item as some of the failures can be avoided by following some basic and clearly stated instructions. Below are two examples of common failures that occur either due to improper maintenance or lack of inspection.

IMPROPER MAINTENANCE

There is a large number of high quantum claims associated with washing machines and dishwashers. Although there are many instances when such claims are associated with a manufacturing defect and/or an installation deficiency,
there are cases when the damage was caused by the end user’s lack of compliance with the manufacturer’s recommendations. A typical example would be the case in which the owner’s residence was located in an area where there is hard water and therefore, susceptible to form tenacious and hard deposits anywhere in its path, including the inlet ports of a washing machine or a dishwasher. If debris collects in the inlet solenoid valve of the appliance, it is possible that the valve will not close completely thereby allowing water to continuously flow through even when the appliance is not in use; thus creating a flood in the home.

Suggesting that a single factor (i.e., manufacturing defect or installation deficiency) is the main cause of a failure is not only a myth but also one of the greatest misconceptions regarding the failure of a product. It is generally accepted by the experts involved in failure analysis that, in a large percentage of investigations it was not a single contributing factor but rather a combination effect of two or more factors that contributed to the failure. An example of this is as follows:

LACK OF INSPECTION

Many oil spill claims are associated with the internal corrosion of aboveground fuel oil storage tanks. Although the experts retained by the various parties involved in such claims generally agree that the oil spill occurred due to the degradation of the storage tank from the inside (due to microbiologically induced corrosion [MIC]), the question is often why and how this is possible. Although the issue cannot be generalized, in some claims the response is simple: internal corrosion was possible due to the presence of water at the bottom of the tank and the lack of inspection to detect its presence. A simple task required by the CSA B139 Installation Code for Fuel Burning Equipment standard is that the fuel oil storage tanks should be probed for water, and where water is detected it needs to be removed. Fuel oil is not a good electrolyte and in the absence of water at the bottom of the tank (water is heavier than oil) internal corrosion will likely not occur at such an accelerated rate.

STRESS CORROSION CRACKING OF PLUMBING COMPONENTS

Stress Corrosion Cracking (SCC) is a common failure frequently encountered in brass plumbing components such as faucets, valves, etc. In order for SCC to occur, it
requires the presence of both a stress and a corrosive environment. The combined and simultaneous interaction of mechanical and chemical forces results in crack propagation; neither factor acting alone could result in SCC. In other words, SCC in corrosive environments will not occur in the absence of stresses, and SCC will not occur when stresses are present in a non-corrosive environment. The stresses leading to SCC could be “locked” (internal), originating at the manufacturing stage, or could be external (i.e., overtightening), or both. Corrosive environments could be permanent (i.e., corrosive water) or temporary (i.e., cleaning with an aggressive chemical compound). SCC can be easily detected by conducting a complete metallurgical examination of the failed component/part.

BONUS MYTH:

**MYTH:** “Hiring a Forensic Engineer is expensive. With all their sophisticated investigative tools it would probably cost a fortune to retain them for a small claim”

**FACT:** The services of an independent Forensic Engineer can be a cost effective and integral part of investigating subrogation potential in consumer product or installation failures

The investigative work of a Forensic Materials and Metallurgical Engineer does not rely only on their eyes, knowledge and experience, but also on state-of-the-art analytical investigative methods. Although the fancy names of some of the investigative tools may suggest an expensive investigation, this too is another myth. If every unsure whether a claim would require further investigation feel free to give us a call. We frequently have free, no obligation phone calls with our clients to discuss the circumstances of the loss and within a few minutes we can advise you on the best and cost-effective course of action for your claim.

Dinu specializes in metallurgical, materials and mechanical failure analysis. During the course of his career, he has been involved in more than 700 failure investigations of various metallic and non-metallic components, and in 23 projects leading to the development of new materials and processes.

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