

How CPVC Works and Why It Fails

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A major concern related to pipes and fittings is the potential for damage when they fail and leak. Chlorinated polyvinyl chloride, commonly referred to as "CPVC," is a thermoplastic used to produce pipes and related fittings. CPVC applications include water supply pipes, water-based heat transfer systems, and sprinkler systems and drain lines, in both commercial and residential buildings.



Since introducing the thermoplastic about 40 years ago, manufacturers have marketed CPVC components as less expensive (and easier) to install when compared to metal piping products, such as black iron pipe and copper. With the growing popularity of CPVC and its adoption in building construction on an international level, the threat of damage from the failure of pipes and fittings has increased. It is therefore beneficial for claims professionals, adjusters specifically, to learn the basic properties of CPVC and how it fails so as to identify subrogation opportunities and recoveries involving these pipes and fittings.

Identifying CPVC

Whatever the specific cause, leak damage can be extremely costly, ultimately resulting in large-loss claims. Determining if CPVC pipes and fittings were either the direct cause or a contributing factor in a property loss therefore becomes critical. Identifying whether a pipe or a particular fitting is made of CPVC is usually the first step in the investigation. CPVC pipes and fittings can be found at retail home product stores, usually in a yellow or cream color, which is generally marketed for use in residential construction for domestic water applications. Because these components are sold in retail home product stores, they can be used by a do-it-yourselfer with little or no training or product experience.

Specialty plumbing and fire suppression supply companies also sell CPVC pipes and fittings; however, those versions are often orange or gray in color. When you observe yellow, cream, orange, or gray colored pipes or fittings in a residence or a commercial building, there is a strong likelihood they are made of CPVC.

PVC: A Necessary Distinction

A variety of companies manufacture CPVC piping and fittings. It is important to keep in mind that all CPVC is not identical, as the raw chemical ingredients vary between manufacturers. Although the composition may differ slightly, CPVC pipes and fittings typically do have similar properties and capabilities. Some confuse them with polyvinyl chloride (PVC) pipes and fittings. Although both are plastics, CPVC and its distant cousin PVC have different chemical properties, physical characteristics, and functional capabilities. Mixing CPVC and PVC building materials is usually not advisable, and contrary to installation instructions for many product manufacturers that make these types of plastic pipes and fittings. A piping system that combines CPVC and PVC components can be subject to failure for various reasons, including differences in compatibility to fluids used in the piping system and variations in the proper solvent cement to use for each of these products.

Property Damage Claims

From a building construction perspective, CPVC displays numerous favorable traits compared to its metal competitors. It requires only simple hand tools to cut, and basic solvent cement to make joint connections (as opposed to requiring a torch or other special tools). Given the fact that installation is less involved, CPVC is also ideal in terms of minimizing labor costs and building interruptions during the renovation process.

ENVIRONMENTAL STRESS CRACKING

A key issue with CPVC installation is environmental stress cracking (ESC) caused by chemical attack. ESC occurs when CPVC comes in contact with incompatible substances either inside or outside the pipe or fitting. Various substances have been deemed incompatible with CPVC. Many of these substances are common products used in building construction. Lists of incompatible substances are manufacturer-specific, so not all CPVC is the same from a chemical compatibility standpoint.

CPVC pipes and fittings are subject to ESC from chemical attack by certain types of the following materials: cutting oils used in the cutting process for upstream metal pipe, leak detection substances like fragrances, essential oils or dishwashing liquids, spray foam insulation, fire stop caulking, plasticizers from flexible electric wire insulation, rubber or elastomers touching the pipe, mold abatement materials, fungicides, insecticides, cooking oils and grease, oil paints, certain types and concentrations of anti-freeze, and so on.

The complexities of ESC and incompatibility issues make it crucial to have a proper analysis in chemical attack situations. Because a construction project is often done in phases, with many different contractors using various substances, protecting CPVC installations from potential chemical attack takes proper care and attention. Without due care, ESC and leaks will occur, as will claims from these failures.

Nevertheless, claims professionals must know how the thermoplastic stacks up from a property damage claims perspective. As mentioned, a person with minimal skills and experience can install these components, and no license is required to be a CPVC installer. In the absence of rigid guidelines, performance benchmarks still exist. In fact, piping and fittings will suffer failures if manufacturer instructions are not followed *precisely*. Warnings must also be heeded. The very directions and warnings that will help ensure safety and proper functioning, however, are not located on the pipes and fittings themselves.

Current CPVC installation instructions and warnings require significant interpretation and research, all of which hinges upon the specific brand used. CPVC is also prone to freeze-

ups, so in addition to specific failure modes, it suffers from a commonly occurring failure present in metal piping systems. CPVC is a product that is located above ceilings, behind walls, and below floors. Therefore, failures can result in extremely costly repairs. These failures are sometimes indicative of systemic problems throughout the entire CPVC system, requiring greater replacement beyond the area of failure. CPVC pipes and fittings may be well-received in the building materials market. From a property claims perspective, however, there are many concerns to evaluate when it comes to pipe and fitting usage.

Ways to Fail

Among the many causes of CPVC failures, and the ensuing water damage claims, are raw material flaws, manufacturing defects, inadequate warnings, improper shipping and handling practices, system design issues, poor installation practices, incorrect maintenance, and chemical attack.

Certain failure modes for CPVC are manufacturer-based. Because CPVC is a combination of raw materials, there is always the chance of faulty ingredients, which would consequently create faulty CPVC. The absence of great care during the manufacturing process can also result in defects in the extrusion or injection-mold processes. Inadequate warnings and imperfect product installation instructions are other concerns, as are improper shipping and handling practices that may cause CPVC pipes and fittings to be crushed, bent, or severely abraded.

Speaking of CPVC failures storage and handling by the installer, including exposure to sunlight, can result in malfunctions. When a CPVC piping system is designed, special attention must be paid so that booster pump pressure is not too high, and so pressure regulators are present when needed. Additionally, CPVC is not appropriate for use in pressurized-air applications, and that so thermal expansion must be considered and accounted for. Once the CPVC makes it to the job site, a myriad of problems can occur, including shoddy assembly techniques, an incorrect adhesive being applied, mixing CPVC with PVC components, too much adhesive, too little adhesive, too much dry time, support claim issues, and improper alignment of pipes and fittings.

Pinpointing the Cause of Loss

Should you encounter a water loss because of a failed CPVC pipe or fitting, proper preservation of the failed part(s) is crucial. An analysis of the entire CPVC system at issue may also be necessary. Proper forensic techniques should be employed to determine the root cause. The CPVC, and the chemicals on it and/or in it, are a treasure trove of information to be discovered, literally at a molecular level. Do not tape labels on the failed part, and do not handle the failed part extensively if it can be avoided. The tape's adhesive may hamper discovery of the true cause of failure. Skin oils may cover up other

more important aggressive materials that may be on the surface. If you cannot leave the failed parts in their installed position, then wrap them in sheets of aluminum foil before placing them in any plastic evidence storage bag. Materials in plastic bags can leach out and contaminate oils, or aggressive agents on the surfaces of the failed CPVC parts. Also, do not break open cracked CPVC pipes and fittings to see what is inside. A skilled forensic scientist should do that, and only under controlled conditions after notifying all interested parties to avoid allegations of spoliation of evidence.

With respect to a CPVC failure, forensics is not a mechanical/metals evaluation (black iron, copper, and so on) but rather it is a chemical/materials evaluation, which requires unique skills and specialized examination methods. Looking at CPVC at the microscopic and molecular level, using various chemical examination techniques (gas chromatography-mass spectrometry, fourier transform infrared spectroscopy, and so on) may be needed to determine the cause of a failure.

CPVC and Subrogation

Determining the cause of a CPVC failure is complicated, and determining which party is responsible is even more difficult. However, a properly manufactured, designed, installed, and maintained CPVC piping system should not fail. So, when a failure does occur, there is likely some party that made a mistake along the way. Navigating the course between cause analysis and recovery dollars can be filled with pitfalls, from product liability defenses, contractual defenses and spoliation of evidence issues.

With a multitude of causes comes a myriad of potential subrogation targets. Developing the relevant list of interested parties, and placing targets on notice, is crucial before finalizing your subrogation evaluation. The critical point, however is recognizing that when CPVC fails, there are numerous potential avenues for subrogation to be explored.

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