



## Chemical Compatibility Assessment of CPVC Fire Suppression Sprinkler Pipe

ESi investigated CPVC fire sprinkler pipe compatibility with common plasticizers chemicals found in communication wires and cables.

### The Situation

CPVC fire suppression sprinkler pipes were found to be contacting electrical wires and communication cables in a building. Industry guidelines and manufacturer warnings prohibit such contact due to concerns about Environmental Stress Cracking (ESC) caused by migration of the plasticizers in wire jacketing materials into the CPVC pipes. When wire-to-pipe contact was discovered in existing installations, the building owner faced potentially massive financial obligations to remove and replace entire CPVC sprinkler systems based on the assumption that any contact with “incompatible” chemicals would inevitably lead to system failure. ESi devised and investigated to determine if common plasticizers in modern wires and cables pose a risk of ESC failure in CPVC pipes under real-world service conditions.

### Our Approach

ESi developed a chemical compatibility test methodology based on ASTM F442 standards and actual service conditions. Our team prepared six CPVC pipe assemblies using BlazeMaster® resin pipes with ¼-inch diameter and 2-foot lengths that were hydrostatically pressurized to either 175 psi or

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#### Services Utilized:

- Fire & Explosion Investigations
- Risk Assessment and Mitigation

## Our Approach *cont.*

670 psi. The CPVC pipes were exposed to various chemicals while the pipes were maintained under pressure. We tested multiple exposure scenarios: direct application of pure plasticizers (DOP and TOTM at  $\geq 99\%$  purity), contact with Cat 5e cables, and contact with fire alarm cables under various pressure conditions.

The testing protocol included long-term sustained pressure testing at both service pressure (175 psi) and elevated test pressure (670 psi) for durations exceeding 1,000 hours, with one assembly tested for 5,472 hours (228 days). Following sustained pressure exposure, we conducted hydrostatic burst strength testing per ASTM D1599 to evaluate any degradation in pipe integrity. We used digital stereomicroscopy to examine pipe surfaces for stress cracking and analyzed fracture surfaces to understand failure modes. Our approach incorporated stress-rupture curve analysis to determine critical stress levels required for chemical incompatibility to manifest.

ESi's testing demonstrated that CPVC pipes exposed to pure plasticizers at service pressure (175 psi) for over 5,400 hours showed no reduction in burst strength compared to control samples, with failure occurring away from chemical application areas. While pipes tested at elevated pressures (670 psi) with wire contact did show some strength reduc-



tion, they still exceeded ASTM requirements by significant margins. All tested pipe assemblies demonstrated burst strengths significantly exceeding ASTM D1599 requirements. Notably, ongoing sustained pressure testing at 175 psi with Cat5e and fire alarm cables reached 7,800 hours as of August 2025 and continued without signs of cracking or pressure loss. Our findings revealed that chemical incompatibility is both time and stress dependent - at normal service pressures, the stress levels are below the critical threshold required for ESC to occur.

## The Outcome

This research provided the fire protection industry with scientific evidence that inadvertent wire contact does not automatically require costly system replacement. The study emphasizes that CPVC systems have significant built-in safety factors, and proper risk assessment considering actual service conditions can prevent unnecessary expenditures while maintaining system integrity and safety. Building owners can now make informed, risk-based decisions using ESi's compatibility testing methodology instead of costly blanket replacement approaches.



Photo (above) taken from Lubrizol white paper by Liotta, L (2019) "Not all wiring systems are the same – Learn what is compatible with BlazeMaster® CPVC"; Photo (left) taken from video: BlazeMaster® CPVC vs. Spears FlameGuard®, [www.blazemaster.com](http://www.blazemaster.com)



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