The Benefits of UL Listed LFP® Antifreeze in Fire Sprinkler Systems

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Introduction

Antifreeze has long been a cost-effective freeze protection method for fire sprinkler systems; however, antifreeze is not without challenges, creating issues such as leaking and corrosion. After a fatal fire event in 2009 attributed to highly concentrated antifreeze in a system, the National Fire Protection Association (NFPA) announced restrictions and new requirements for antifreeze use, which included a mandate that antifreeze solutions be agency listed. The UL 2901 test protocol for antifreeze was introduced and its rigorous requirements created significant barriers to obtaining a listing. In a collaborative effort between the Johnson Controls fire sprinkler research and development team and special hazards foam products chemists, Johnson Controls developed TYCO® LFP® antifreeze—the first and currently only solution specifically listed for fire sprinkler systems.

Freeze Protection and Antifreeze Requirements

Freeze protection is required for fire sprinkler systems that cannot be maintained at or above 40°F (4°C) by NFPA Standard 13:19, 16.4.1 (as well as by NFPA 13D and 13R). NFPA 13, 13D, and 13R require that all new antifreeze systems use an agency listed solution. NFPA 25 mandates that by 2022, all existing antifreeze systems be drained and a listed antifreeze installed (if a system needs to be drained prior to 2022, it must be refilled with a listed solution). The guidelines also state that antifreeze solutions follow specific concentration requirements.

The UL Listing (obtained through UL under UL 2901 Outline of Investigation) is currently the only third-party listing for antifreeze. UL 2901 tests antifreeze solutions to evaluate, among other properties: solution stability, corrosion rate, resistance to leakage, material compatibility, toxicity, fire-fighting effectiveness, and combustibility when exposed to fire.

Benefits of Listed Antifreeze

Balancing Freeze Protection with Safety

While unlisted antifreeze products might provide adequate freeze protection, their freeze protection ingredients—either glycerin or propylene glycol—are combustible at certain levels. NFPA Research Foundation testing showed danger with antifreeze solutions containing higher than 50% glycerin or higher 40% propylene glycol, leading the NFPA to place limits on the percentage of these ingredients with an additional reduction of two percentage points as an added safety factor. The final NFPA guidelines require limits of 48% glycerin and 38% propylene glycol for antifreeze used in fire sprinkler systems. Johnson Controls formulated its glycerin-based LFP® Antifreeze with a design that meets percentage safety restrictions while also providing a dependable minimum use temperature of -10°F (23,3°C). The solution was further tested for fire-fighting effectiveness and exposure to fire limitations by UL to meet its safety requirements for the UL Listing.

Mitigating Leaks and Corrosion

A common issue with unlisted antifreeze is solution leaking through threads on system piping and fittings. The properties of glycerin and propylene glycol make them more likely than water to seep through threaded connections on pipe and fittings, causing antifreeze systems to be more prone to leaking. Over time, as the system leaks antifreeze, water from the supply source may enter the piping through a backflow device, diluting the antifreeze and raising the freeze point of the combined solution in sections of the system piping, as water freezes at a higher temperature than antifreeze solutions. If any sections do not have the proper freeze protection, the risk of damage increases. A burst pipe will cause property damage and insufficient fire protection. During rigorous high-pressure testing for the UL Listing, LFP® Antifreeze demonstrated equivalent leak resistance compared to water in both thermoplastic and metal piping materials.

Corrosion is another common issue in antifreeze sprinkler systems. As glycerin and propylene glycol antifreeze solutions degrade over time they produce acidic byproducts which corrode fire sprinkler system piping materials. This can lead to weakened pipes, pin-hole leaks, or plastic softening in Chlorinated Poly Vinyl Chloride (CPVC) piping materials. NFPA restricts the type of antifreeze used in CPVC sprinkler systems to solutions with United States Pharmacopeia (USP)-grade glycerin (USP-grade means a chemical meets a sufficient purity level to be acceptable for use in food or drugs). When low-quality glycerin is used in antifreeze, it breaks down CPVC, causing it to droop and eventually crack over time. LFP® Antifreeze uses USP-grade ingredients to ensure compatibility with thermoplastic piping to reduce the risk of plastic softening, cracking, or other failures. In addition, testing shows that LFP® Antifreeze has a lower corrosion rate than many types of municipal water.

Formula Stability

The ingredients in glycerin- and propylene glycol-based water solutions have a tendency to separate over time, with gravity causing the denser glycerin and propylene glycol to settle out into the lower parts of the sprinkler system and drops. This creates a potentially dangerous situation where a sprinkler activation discharges mostly glycerin or propylene glycol onto a fire. LFP® Antifreeze has a stable formula, made with high quality ingredients, that is not prone to separation or drift in solution properties. Annual system inspections are recommended per NFPA 25 guidelines to verify the solution meets test requirements. In addition to formula separation over time, other antifreeze solutions currently available on the market which are not specifically designed and tested for fire sprinkler systems, will also have a drop in pH (a measure of acidity or alkalinity in a substance), making the solution acidic. UL accelerated life testing has ensured that the pH level of LFP® Antifreeze (as well as other properties, such as specific gravity, viscosity, and freeze point), maintains a similar level after high temperature exposure and temperature cycling. This type of stability is intended to make LFP® Antifreeze less likely to be detrimental to sprinkler system materials, including CPVC and PEX, than other antifreeze solutions.

Conclusion

The use of a UL Listed antifreeze, such as LFP® Antifreeze, helps to meet the intent of NFPA freeze protection requirements and the requirement of utilizing an agency listed antifreeze in both new (effective as of 2012) and existing (effective in 2022) systems. The market gap in this product offering meant that since 2012 installers have resorted to either more costly freeze protection methods, or used unlisted alternatives when installing new systems. LFP® Antifreeze fills this gap with an antifreeze that has passed rigorous UL testing and been proven to both meet freeze protection needs, while also exceeding the properties of unlisted alternatives.

References:

1. Andrew Loeffelman, 2015, "White Paper: Acid Based Corrosion in Antifreeze Fire Protection Systems"
2. Paul J. Gramann, 2013, "Effects of Glycerin Antifreeze on CPVC"
3. "Antifreeze Solutions Supplied through Spray Sprinklers – Final Report" Code Consultants, Inc. November 2012