

Fire Protection Engineering Forensics

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Fire protection systems are around us all the time. Most people go through their daily lives without recognizing their presence. There are the obvious systems - like the sprinkler system in the hotel or the fire exit in the night club - even the smoke detectors in your own home, but there are also fire protection systems that are harder to see like fire-rated walls and doors and fire suppression systems in commercial kitchens.

These systems and products are all designed to protect lives and property. What happens when they fail? What happens when the products that are designed to save us cannot be relied upon? A failure of a fire protection system can be catastrophic. Buildings burn. Businesses are lost. People die.

Failures can be less devastating, but still have a significant impact on the individuals they affect and the insurance companies that cover them. Sprinklers can discharge when there is no fire, or worse, not discharge when there is a fire. Commercial kitchen chemical extinguishing systems can fail to suppress a growing fire.

Design

The design of fire protection systems is integral to their effectiveness. The design of an effective system should include what kind of sprinkler heads and smoke detectors are placed in certain areas. For example, a common design or installation error occurs when a sprinkler head with an "ordinary" temperature rating (between 135 and 170 degrees F) is installed in an unventilated attic space. According to NFPA 13, the proper sprinkler head for such an installation would be rated between 175 and 225 degrees F, which would prevent an unexpected activation on a hot summer's day.

The opposite occurs when sprinklers get too cold and freeze. NFPA 13 requires that freeze protection be provided in any system in which the temperature can reach 40° F or less. The two most common methods to protect a sprinkler system from freezing are installing an antifreeze system or installing a dry-pipe sprinkler system.

An antifreeze system, like a wet-pipe (or traditional) sprinkler system always has water in the pipes right up to the sprinkler heads. The difference, though, is that the water is mixed with antifreeze (often glycol or glycerin). The concentration of antifreeze required in the system is mandated by NFPA 13.

A dry-pipe sprinkler system is one in which the pipes that require the freeze protection are filled with compressed air. When the sprinkler head activates, the air escapes and the water is allowed to enter the pipes.

Common problems with freeze-protection devices are found when sprinkler systems with CPVC (plastic) pipes are protected from freezing with glycol. Glycol is for use in metal pipes only and will break down CPVC pipes and cause them to fail.

Recently, following research and specific case studies, the NFPA released an update to their requirements for residential sprinkler systems. They have banned the use of antifreeze

in new construction residences because of the potential hazard created when a sprinkler activates with excess glycerin (glycol) above a fire. Both glycerin and glycol are flammable and, in the right concentration, can actually worsen a fire.

Dry-pipe systems are susceptible to condensation buildup from the compressed air in the dry portions of the pipes. The pipes are required to be sloped toward drains (NFPA 13) and drained at set intervals, including before freezing weather arrives (NFPA 25).

There are two main problems with ice in sprinkler pipes. The first, and most common, problem is the buildup of ice and the inherent buildup of pressure in the sprinkler pipes. This can cause the heads to fail or the pipes to fail unexpectedly creating a significant water loss, especially in unoccupied buildings (such as business at night or on the weekends).

The other problem, which is not as common, but is arguably more significant, is a threat to life safety. If the sprinkler system is freezing, but has not yet failed, the ice can create a plug or ice block in the pipes leaving the sprinkler system inoperable.

Maintenance

Just as important as proper installation, the proper maintenance of fire protection systems is vital to their effective operation. NFPA 25 has a table of all of the maintenance required on a sprinkler system. The 2008 edition of NFPA 25 lists the requirements in Table 5.1. For example, control valves and gauges are required to be inspected every week or month. Sprinkler heads are required to be inspected annually. Every 5 years the sprinkler system is required to be tested for obstructions. Antifreeze solutions are required to be tested every year.

The owner of the sprinkler system is responsible for the maintenance of the system. If there is a problem concerning the maintenance, they are often the responsible party. They can, however, hire a company to perform the regular maintenance on the system. Depending on the contract and what work is performed, the system's owner may or may not be responsible for a certain loss.

About the Author

Jay Kramarczyk is a licensed Fire Protection Engineer in multiple states. His bachelor's degree is in mechanical engineering, and his master's degree is in fire protection engineering, both from Worcester Polytechnic Institute (WPI) in Worcester, Massachusetts. Jay is active on the national committee responsible for writing the fire protection engineering professional engineering examination for potential applicants. Additionally, Jay is a Certified Fire and Explosion Investigator through the National Association of Fire Investigators. He can be reached at Phoenix at (303) 762-8487 or at jkramarczyk@phoenix-investigations.com.