

Developments in Fire Sprinkler Technology

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Technology in fire sprinklers has exploded. There is more private fire sprinkler research now than ever before. New technology in fire sprinklers has tested the existing standard and found that it was wrong in some cases, it has provided new sprinklers that control fire better while reducing the cost of the overall system. This expansion of the types and applications of fire sprinklers has created a great need for education for the Authorities Having Jurisdiction and the Engineer as they must be able to make informed decisions regarding this new technology.

Significant research has been done at Factory Mutual Research Corporation and Underwriters Laboratory in the United States. Full scale fire testing is done to prove any new technology did not lower the level of protection of existing fire sprinkler system installations. In each and every case, the existing level of fire protection was the baseline against which the new sprinklers were tested. This level can not be lowered for the test to be considered a success.

This is intended to be an overview of the developments in fire sprinklers. Although extensive detail is not included, the overall aspects of these developments can be discussed. The research that will be covered will include the following general subjects: high piled and rack storage sprinkler protection without in-rack sprinklers, extended coverage and quick response sprinklers for ordinary and light hazard occupancies, as well as special sprinklers and their applications.

High piled and rack storage sprinkler protection without in-rack sprinklers

In high piled storage, including rack storage, the goal has been for some time to eliminate in-rack sprinklers and provide ceiling sprinklers only while controlling fires that can be as hazardous as Group A plastics. This has been successfully done with ESFR and Large Drop Sprinklers. More recently ELO sprinklers were tested to provide a high level of protection while not requiring in-rack sprinklers. The key to the success of all of these sprinklers is the droplet size and their ability to penetrate the fire plume while providing some ceiling cooling.

The ESFR is the highest level of protection that can be installed into a building. The ESFR sprinkler is the only suppression sprinkler available and it uses a unique combination of a fast response element, water velocity, droplet size and spray pattern to achieve fire suppression. The important factors regarding ESFR sprinklers is to recognize their maximum and minimum spacing and the correct distance from the ceiling to the deflector of the sprinkler, confirm there are no obstructions to the spray pattern, and verify that their

is enough water and pressure available. ESFR's can protect buildings that are 12.2m high with 10.7m of storage without in-rack sprinklers.

Recently ESFR sprinklers have been tested with Flammable Liquids. The testing was done with heptane in small metal containers. These tests showed that ESFR sprinklers can control these types of fires. The testing was done with both in-racks at lower pressures and without in-racks sprinklers at higher pressures. The key is to have a relieving style container to avoid an explosion by pressurization of the container. This is usually accomplished by a plastic cap on the top of the container. This concept of a pressure relieving container is also critical in larger containers of flammable liquids.

Large Drop Sprinklers can eliminate in-racks in buildings also. Their advantage is they are upright sprinklers making the required distance from the ceiling to the deflector easier to meet. The Large Drop can be used in wet and dry systems while the ESFR is for wet systems only. The ability to be used in dry systems proved to be significant in one test program that was specifically designed for freezers. This showed that with class 2 commodity and a 30 second delay in the dry system, the large drop sprinkler can protect up to 12.2m buildings with 10.7m of storage. This allows ceiling only large drop sprinklers to be installed in freezers thereby avoiding the potential for a in-rack sprinkler to be damaged and possible flood the freezer. The key is the 30 second delay. A longer delay will result in too many sprinklers opening before the water arrives at the sprinklers.

ELO sprinklers have been successfully tested for storage occupancies. Their advantage is in the k-factor of the sprinkler. Unlike the large drop and the ESFR, they do not require high pressures. In fact, they require very low pressures when compared to standard 10mm and 15mm sprinklers. They were tested against the performance of standard sprinklers and did extremely well. For example, in one test standard with 4.6m of storage in a 7.6m building containing rack storage of Group A Plastics, the 15mm sprinkler operated 29 sprinklers flowing almost 7000 liters per minute and allowed almost 1000 degrees C at the ceiling for 10 minutes. The same test with ELO sprinklers operated 4 sprinklers flowing 900 liters per minute and allowed the maximum ceiling temperature of only 450 degrees C. This lead to more testing with ELO's in higher buildings and with more demanding commodities such as flammable liquids and to an overall reduction in the area that needs to be calculated when compared to standard large orifice sprinklers.

The key to all this testing was that ELO sprinklers need approximately half the pressure of standard 15mm sprinklers. This is because the k-factor is larger with the ELO 163 vs. 116. This allows more water to flow at the same pressure or the same amount of water to flow but at lower pressure. This can allow sprinkler systems to be installed with smaller pipe size and larger spacing resulting in both an increase in the level of protection and a reduction in cost of the overall system.

Extended Coverage and Quick Response Sprinklers for Ordinary and Light Hazard Occupancies.

Sprinklers that cover larger area or sprinklers that respond faster than standard sprinklers are the latest developments in ordinary and light hazard. The extended coverage sprinklers were developed with the same premise as the ELO for storage. They use a larger orifice size to reduce the required pressure to a reasonable amount while providing

larger droplets for better penetration and control of the fire. Some of the extended coverage sprinkler use fast response elements and some are even listed as quick response. The maximum spacing allowed and tested for is 37.2m². This makes the spacing between upright and pendent sprinklers 6m x 6m. There are different flows and pressures for each type of spacing and the information contained in the manufacturer's literature will provide guidance for the correct installation procedures. The things to look for are the correct type of construction, number of sprinklers in the remote area, and flow and pressure.

Quick response sprinklers have proven to be very successful in controlling fires earlier adding to the life safety aspect of the buildings. They have done so well that the next edition of NFPA 13 will mandate quick response sprinklers for all light hazard occupancies and encourage them in ordinary hazard with an area reduction for the calculations. This change is the result of the move toward quick response in all of fire testing including non-life safety occupancies. There are now quick response in-rack sprinklers, quick response storage sprinklers, quick response extended coverage sprinklers and of course quick response residential sprinklers. This movement toward quick response will continue with other advances likely in the future.

Special sprinklers and their applications.

Two of the more specialized sprinklers are window and attic sprinklers. These two typify the future of fire sprinkler protection. They are unique in their applications and very specific in their installation criteria. The window sprinkler was specially tested and listed to protect glass windows in rated walls. The Attic Sprinkler protects sloped roofs in attic with either combustible or noncombustible framing. Because these sprinklers have been full scale fire tested against the baseline of existing code requirements and successfully proved that another, possibly better, way of doing things was acceptable, they truly represent the future of fire sprinkler development.

The window sprinklers were tested with the same method as a rated wall except when the temperature exceeded the operating temperature of the sprinkler, water flowed from the sprinkler providing a very specific pattern on the face of the glass. This film of water on the glass protects it from the exposure in the room which is approximately 1000 degrees C. When the duration of two hours is complete, a hose stream is applied to the window and the glass still remained intact. This allowed the window sprinkler to bridge the gap between passive and active fire protection and become listed for protection of glazing in rated walls of up to two hours while maintaining the rating of the wall.

The Attic Sprinklers resulted from the poor performance of standard sprinklers on sloped ceilings. The full scale tests showed that if a fire was started between sprinklers it would burn up the slope and down the ridge without providing significant heat to the perimeter where the sprinklers are located. The Attic sprinkler offsets the travel of the heat by being located at the ridge of the roof and throwing a very extended coverage pattern down both sides of the slope. This means the attic sprinkler can protect an area that is 18.3m wide. This was taken several steps further and resulted in a family of Attic sprinklers that were all full scale fire tested.

Unique sprinklers like the attic and window sprinklers are truly the future of the fire sprinkler industry. Certainly ESFR and ELO sprinklers, Quick Response sprinklers and

Extended coverage sprinklers have made their mark in fire sprinkler protection already. The more fire testing that is done the more is learned about the interaction of fire sprinkler discharge and fire control. There are many new types of sprinklers that are available and each one has its own advantages and its own unique set of installation rules. Carefully review the literature from the manufacturer and the pertinent code sections. Correct installation of these new sprinklers will result in an increased level of fire protection and safety.