Concrete and Masonry Industry Firesafety Committee

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Position Paper And Information Sheet On NFPA 13D: Standard For Installation of Sprinkler Systems In One- And Two-Family Dwellings And Mobile Homes

Position: The concrete and masonry industry *endorses* the use of all means and measures intended to improve the firesafe performance of buildings. This includes support for voluntary or code-mandated installation of the National Fire Protection Association (NFPA) 13D automatic sprinkler systems for use as they are intended in one- and two-family dwellings and mobile homes. However, the concrete and masonry industry strongly *opposes* building code provisions that trade off proven methods of fire protection, such as compartmentation and fire-resistive construction, as an incentive to encourage installation of an NFPA 13D sprinkler system. Reliable protection can best be accomplished by requiring a combination of detection, suppression, and compartmentation systems without tradeoffs. Protection of property from fire should not be compromised if one of these systems fails.

General

The NFPA 13D Sprinkler System Code was developed in 1975 and amended in 1980 in response to the continuing high incidence of death in residential fires. Systems designed under NFPA 13D are intended for use in one- and two-family dwellings and mobile homes. The Code does not anticipate or allow for application in any other structure.

An NFPA 13D system differs from a conventional NFPA 13 system in several ways; for example: the engineering design and review process may be less stringent, a reduced-duration water supply is required, the required area of operation is reduced, no maintenance is explicitly required, and a combined domestic and fire protection water supply is allowed.

Purpose of System

The NFPA 13D system is a lifesafety protection system intended to perform two functions: (1) prevent flashover, a rapid involvement of the entire room of fire origin due to ignition of collecting gases; and (2) provide an improved chance for egress of occupants located in the room of fire origin. Other fire protection measures such as compartmentation are required to control the spread of fire once flashover has occurred. The system is not intended to control fire should flashover occur.

As a lifesafety protection system the NFPA 13D standard suggests but does not require sprinklering of all areas within a structure. The standard specifies installation of protection in statistically frequent areas of fire origin (NFPA statistics).

Design

Proper design of a sprinkler system requires thorough knowledge of sprinkler hydraulics, available water supply, and fire department water supply requirements for hose streams. Sprinkler hydraulics differ significantly from domestic water system design due to demand for larger flows and higher pressure. Small, seemingly inconsequential, changes to a properly designed system at a jobsite may cause a significant drop in available water flow and pressure at any given point in the system.

A conventional NFPA 13 system is normally designed by a person with specific expertise in sprinkler hydraulics. The NFPA 13D system by comparison can be designed by individuals inexperienced with sprinkler system hydraulics or even a do-it-yourselfer. Unlike NFPA 13 systems, the 13D standard does not call for review of system design plans by a second party. Conventional NFPA 13 system design plans must be reviewed by building officials, fire department personnel, and frequently insurance company engineers in order to make certain that all engineering requirements of the system are satisfied.

Operation

The NFPA 13D system is designed on the basis of the two most hydraulically remote sprinkler heads flowing at 13 gpm per head, or one head flowing at 18 gpm for a total duration of 10 minutes. Maximum allowable area per head is 144 sq ft. Some heads are listed for larger areas based on a specific individual design pressure requirement. The code also stipulates that the design area be limited to a single compartment.

This differs markedly from NFPA 13. The NFPA 13 standard generally requires strict analysis of the most hydraulically remote area of the system, regardless of compartmentation. NFPA 13 systems are required to have a minimum water supply duration of 30 minutes with 60-, 90-, and 120-minute periods specified for higher hazard occupancies. NFPA 13D requires the

BIA Brick Institute of America
CRSI Concrete Reinforcing Steel Institute
ESCSI Expanded Shale Clay and Slate Institute
NCMA National Concrete Masonry Association
NRMCA National Ready Mixed Concrete Association
PCA Portland Cement Association
PCI Prestressed Concrete Institute

Standard	Scope	Minimum required design area	Minimum design flow	Minimum duration for design flow
NFPA 13 Standard for Installation of Sprinkler Systems	Any occupancy, entire structure required to be protected.	750 sq ft to 1500 sq ft	75 to 150 gpm—sprinklers; minimum of 100 gpm for inside and outside hoses.	30 minutes for light hazard; 60, 90, 120 minutes for higher hazards.
NFPA 13D Standard for Installation of Sprinkler Systems in one- and two-family dwellings and mobile homes	One- and two-family dwellings and mobile homes. Numerous omissions allowed. Can omit protection from areas that are statistically low with regard to area of origin.	144 sq ft except for heads that have been tested and listed for larger areas based on a nozzle design pressure.	26 gpm (two heads)—sprinklers plus 5 gpm coincident domestic flow. No allowance for hose streams is required, domestic coincident flow requirement required when two dwelling units are protected.	10 minutes.

water supply to provide only a 10-minute duration of sprinkler system demand plus an additional 5 gpm coincident domestic flow (dishwasher, and so on) if the system protects a two-family dwelling.

A comparison of the NFPA 13 and NFPA 13D systems is shown in the accompanying table.

Duration of flow is one reason that 13D systems should not be applied to multifamily dwellings. *Duration* refers to the length of time a given water supply can provide the sprinkler system design flow plus manual firefighting water requirements. The 13D system hydraulics may be compromised due to a decreased available pressure if more than two sprinkler heads operate at the same time. The appendix to NFPA 13D states that the performance of the system may be unreliable if combustible loading exceeds 10 lb per square foot, an uncontrollable factor. The reason for this unreliability is that when higher than normal (that is, higher than 10 lb per square foot) combustible loading exists, the rate of heat release increases. Since residential sprinkler heads used in the 13D system are five to ten times faster than traditional heads in response to temperature rise, this could lead to operation of more than two (standard design area) sprinkler heads and a decreased available pressure. This can occur because frequently more than two heads are located within a compartment.

The proper application of NFPA 13D limits the number of dwellings protected by a single system to two. Should the 13D system be installed in a multifamily dwelling, it is possible that a single system may protect four, five, or more dwelling units. Under these conditions, the probability of exceeding the capacity of the system increases significantly. Also, this will increase the probability of exceeding the coincident domestic water demand of 5 gpm specified in the 13D standard.

Indeed, the NFPA itself has stated that the NFPA 13D system is not suitable for protection of multifamily dwellings (dwellings with three or more units). At a minimum, fire-resistance ratings should not be compromised if 13D systems are installed in multifamily dwellings.

Maintenance

Like all mechanical systems, sprinkler systems require periodic maintenance to ensure their performance. Unlike other mechanical systems, malfunction of a sprinkler system cannot be observed and repaired on the basis of overall ongoing performance. The sprinkler system must perform properly every time it is needed.

The NFPA 13D code suggests monthly maintenance procedures but does not require implementation or proof thereof. Proper maintenance of a 13D system would require instruction for the building owner and his maintenance staff when the building is constructed and at periodic intervals thereafter. Without enforcement, this is not likely to happen. Also at issue is where the maintenance responsibility rests. Standard 13D is explicit in calling for maintenance by the building owner, usually the residential homeowner cannot be expected to have this kind of knowledge. Should an NFPA 13D system be installed in multifamily dwellings such as condominiums, it is likely that the unit owners will have no control of their system because they do not control common areas where water supply connections are usually located.

Experience

NFPA 13D systems are untested in the field. While full-scale tests were conducted during development of the 13D standard, these tests took place under controlled conditions. In order to evaluate the effectiveness and reliability of 13D systems, a reliable statistical base of actual system operations is needed. Until these statistics are available, 13D systems should not be assumed capable of performance beyond the stated scope of either the 13D standard or developmental testing—that being for one- and two-family dwellings and mobile homes.

Conclusion

Residential fire death, injury, and property-loss statistics in the United States remain the highest per capita in the world despite our level of technology. The concrete and masonry industry believes that only a combination of fire-resistive construction in conjunction with properly designed, installed, and maintained automatic sprinkler systems, smoke detectors, and increased public awareness will significantly reduce residential fire loss statistics. Success in reducing residential fire losses cannot be achieved by trading off one fire-protection measure for another.