NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
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TechNotes

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Best of January 2018

Following are a dozen questions answered by the engineering staff as part of the NFSA's Expert of the Day (EOD) member assistance program during the month of January 2018. This information is being brought forward as the "Best of January 2018." If you have a question for the NFSA EOD (and you are an NFSA member), send your question to eod@nfsa.org and the EOD will get back to you.

It should be noted that the following are the opinions of the NFSA Engineering Department staff, generated as members of the relevant NFPA technical committees and through our general experience in writing and interpreting codes and standards. They have not been processed as formal interpretations in accordance with the NFPA Regulations Governing Committee Projects and should therefore not be considered, nor relied upon, as the official positions of the NFPA or its Committees. Unless otherwise noted the most recent published edition of the standard referenced was used.

Question 1 - Velocity Limitations

You note that FM Global insured projects limit flow velocities in sprinkler systems.

Does NFPA 13 limit the velocity of water flow through a pipe?

Answer: The answer to your question is "no." NFPA 13 does not set a limit on flow velocities in sprinkler systems. When Hazen-Williams or Darcy-Weisbach calculations are performed, NFPA 13-2016 section 23.4.1.4* explicitly states that flow velocity is not to be limited unless required by another NFPA standard.

23.4.1.4* *Unless required by other NFPA standards, the velocity of water flow shall not be limited when hydraulic calculations are performed using the Hazen-Williams or Darcy Weisbach formulas.*

A.23.4.1.4 *NFPA 13 does not provide a specific velocity limitation for the use of the Hazen-Williams formula. This is, in part, due to an expectation that excessive friction loss values will result in increasing pipe sizes, thereby serving as an inherent limit on velocity. However, the fact that NFPA 13 does not provide a specific limit should not be taken as an endorsement that the formula can be used for any velocity of water flow. The formula was empirically determined using "normal" conditions. When the velocity in the pipe exceeds that which was used to determine the formula, the formula might no longer be valid. There has been some research performed (Huggins 1996) in which results using the Hazen-Williams formula and the Darcy-Weisbach formula were compared, and the conclusion was that a specific velocity limit applied to all pipe sizes is not appropriate.*

This topic was discussed in NFSA's SQ magazine, #162, September/October 2010.

Question 2 - Water Meter Requirements

You have indicated that there is a large medical office building being designed in your jurisdiction with a 6 in. combined domestic and fire protection water service. The water authority is requiring a 6 in. water meter in the combined water service line upstream of the sprinkler riser and 2 in. domestic line. You have commented that the 6 in. water meter is undesirable because of friction loss and cost concerns.

Is the 6 in. water meter required?

Answer: The answer to your question is "a listed 6 in. water meter is required." NFPA 13 neither requires nor prohibits the installation of water meters; it is silent as to the requirement. The water authority has jurisdiction over the location, type and size of water meter to use. Some jurisdictions will only require the domestic water to be metered and others require both fire protection and domestic usage to be metered. Many jurisdictions require a detector check valve with metered by-pass or double detector check valve with metered by-pass. This allows for domestic water usage to be metered without imposing significant friction loss on the fire protection system. NFPA 13-2016 section 24.1.7 states "Where meters are required by other authorities, they shall be listed." NFPA 13 section 23.1.3 (28) identifies that working drawings shall include water meters when one is provided. NFPA 13 section 23.4.4.8.1 (1) requires the friction loss for water meters to be accounted for in the hydraulic calculations when one is provided. Although large diameter water meters might be considered undesirable due to friction loss and cost concerns, the water authority determines if and where meters are required to be installed.

Upcoming In-Class Seminars

Question 3 - Underground Piping to an FDC

You have described underground piping to a remote fire department connection (FDC). You have noted that this piping is generally "dry" except when charged by the fire department. You have stated that underground pipe in your jurisdiction is usually required to have a bury depth of 6 ft.-6 in.

Does the underground piping (normally dry) feeding a remote FDC require a certain bury depth?

Answer: The answer is "yes" but this answer requires further clarification. There are two reasons that underground pipe requires a certain bury depth. The first is to prevent mechanical damage and the second is to prevent freezing. NFPA 24 states that the underground pipe subject to mechanical damage pipe must have a depth of coverage of at least 30 in. (see NFPA 24-2016) section 10.4.2.2.3

10.4.2.2.2 *In locations where freezing is not a factor, the depth of cover shall not be less than 30 in. (0.8 m) below grade to prevent mechanical damage.*

This section continues to require certain bury distances based upon the conditions. For example, pipe under driveways would be required to have a minimum depth of cover of 36 in., and pipe under railroad tracks would be required to have a minimum depth of cover of 48 in.

It must be noted that if the remote FDC is fed from the sprinkler system and not the private fire main it may not officially be within the scope of NFPA 24; however, adhering to the guidelines prudent.

The next question is if this underground piping is subject to freezing. Although this piping is not normally filled with water, it may be during testing and/or fire department operations. Unless the water in the FDC is immediately drained after use, it would be subject to freezing and the required burial depth for your jurisdiction would be prudent.

NFSA's June 9th, 2009 Tuesday e-Tech Alert answered a similar question as follows:

Question 11 *- Freeze Protection for Underground FDC Piping Does an underground FDC line have to be buried per the requirements of NFPA 13 Section 10.5 or can the cover be simply per the mechanical protection requirements of 10.4.3, 10.4.4, and 10.4.5? In other words, can the protection against freezing be ignored?*

Answer: *Common sense would dictate that unless there is a specific mechanism by which the underground pipe is automatically drained after it has been charged during use, then freeze protection must be provided.*

The required automatic drain (ball drip) for the fire department piping will drain the piping however as this drain is sometimes slow to drain, freeze protection of this line should not be ignored without consulting with the AHJ.

Question 4 - Sprinklers Used for Symmetry

You describe a situation where a room is protected with concealed sprinklers installed in accordance with NFPA 13. The architect wants to add additional concealed sprinkler cover plates (with no sprinklers) to create visual "symmetry" with the real sprinklers in order to produce a more aesthetic appearance.

Is this practice permissible.?

Answer: The answer to your question is "no." Although this issue is not addressed in NFPA 13, the Life Safety Code (NFPA 101), the Fire Code (NFPA 1) and the International Fire Code (IFC) prohibit the installation of devices that appear to provide fire protection but do not. NFPA 1 - 2015 section 4.5.8.3 references NFPA 101 section 4.6.12.3, which states that inoperable life safety devices shall be removed. The annex section provides additional context.

4.5.8.3* *Existing life safety features obvious to the public, if not required by the Code, shall be either maintained or removed. [101: 4.6.12.3]*

A.4.5.8.3 *Examples of such features include automatic sprinklers, fire alarm systems, standpipes, and portable fire extinguishers. The presence of a life safety feature, such as sprinklers or fire alarm devices, creates a reasonable expectation by the public that these safety features are functional. When systems are inoperable or taken out of service but the devices remain, they present a false sense of safety. Also, before taking any life safety features out of service, extreme care needs to be exercised to ensure that the feature is not required, was not originally provided as an alternative or equivalent, or is no longer required due to other new requirements in the current Code. It is not intended that the entire system or protection feature be removed. Instead, components such as sprinklers, initiating devices, notification appliances, standpipe hose, and exit systems should be removed to reduce the likelihood of relying on inoperable systems or features. Conversely, equipment, such as fire or smoke dampers, that is not obvious to the public should be able to be taken out of service if no longer required by this Code. Where a door that is not required to be fire protection-rated is equipped with a fire protection listing label, it is not the intent of 4.5.8.3 to require such door to be self- or automatic-closing due merely to the presence of the label [101: A.4.6.12.3]*

IFC-2015 section 901.4.5 specifically prohibits the use of inoperable equipment having the appearance of providing a

life safety or fire protection function. Even in jurisdictions where the model codes or similar state or local language has not been adopted, it would be considered bad practice.

901.4.5 *Appearance of equipment. Any device that has the physical appearance of life safety or fire protection equipment but that does not perform that life safety or fire protection function shall be prohibited. [IFC]*

Note that this is the same basis for prohibiting the installation of hidden cameras that mimic sprinklers or smoke detectors. Some states have additional statutory prohibitions on this type of activity in addition to any restrictions in their adopted fire codes.

Question 5 - Fire Pump Room Access

You describe a fire pump room only accessible by traversing a receiving area, main corridor, and maintenance/storage area within a building. You note that NFPA 20-2010 section 4.12.2.2.1 requires access to the fire pump room to be either directly from the building exterior or via an enclosed passageway of 2-hour fire resistance-rated construction.

Does this arrangement comply with the intent of NFPA 20?

Answer: The answer to your question is "no." The described arrangement does not provide adequate protection for personnel assigned to directly supervise the fire pump during an emergency. The intent of this section is to assure that personnel can access the fire pump room without being exposed to dangerous conditions in the event of a fire. This can be accomplished either by arranging access directly from the exterior, or by providing a protected path from the exterior to the fire pump room. Traversing a variety of occupied spaces which might themselves be the location of the fire event does not meet this requirement.

Note that the 2016 edition does provide an exception in 4.13.2.1.1.1 for cases where the fire pump only supplies local application systems as long as the fire pump can be accessed from a path not exposed to the local hazard so protected.

4.13.2 Equipment Access.

4.13.2.1 *The location of and access to the fire pump room(s) shall be pre-planned with the fire department.*

4.13.2.1.1 *Except as provided in 4.13.2.1.1.1, fire pump rooms not directly accessible from the outside shall be accessible through an enclosed passageway from an enclosed stairway or exterior exit.*

4.13.2.1.1.1 *Fire pump units supplying only local application fire protection systems shall be accessible by a path that is*

not subject to exposure from a fire in any hazard protected by the fire pump.

4.13.2.1.2 *The enclosed passageway shall have a fire-resistance rating not less than the fire-resistance rating of the fire pump room.*

Question 6 - Glu-Lam Beams

Would Glu-Lam (glue laminated) beams be considered limited combustible?

Answer: The answer to this question is "no." To be considered limited combustible, the product would have to meet the definition of a limited-combustible material as stated in NFPA 13-2016 section 3.3.16 which would include that the structural base is a noncombustible material or that the composition of the surface that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion. It is unknown if Glu-Lam products are commercially available which would meet these two requirements. As such, the Glu-Lam beams should be considered combustible, unless documentation can be provided by the manufacturer demonstrating compliance with these requirements.

Question 7 - Retrofit Backflow Preventer for a Pipe Schedule System

You have described a project for an existing pipe schedule system that needs to be hydraulically calculated for replacement of a backflow preventer. You have noted that the existing system was designed for an extra hazard occupancy (Table A.22.5.4). You have also referenced NFPA 13-2013 Table 11.2.2.1 which specifies residual pressures for light and ordinary hazards but not for extra hazard.

What is the calculation criteria for an existing extra hazard pipe schedule system?

Answer: The answer to this question is "a complete hydraulic calculation would not be required simply for the replacement of a backflow preventer with similar hydraulic loss characteristics as the one being replaced, however, if the existing system is being retrofitted with a backflow preventer, the requirements of section 8.17.4 would require a fire flow test and a thorough hydraulic analysis. Following the pipe schedule calculations of Chapter 23 for light hazard and ordinary hazard is acceptable. However, when handling extra hazard pipe schedule system calculations, NFPA 13-2013 requires it to be hydraulically calculated in accordance with section 11.3, which would then require either a density/area or room design approach for an extra hazard calculation.

An argument could be made to follow the standard at which the original extra hazard pipe schedule was installed to, though this may prove difficult to accurately determine as records from the days of pipe schedule systems are often misplaced.

Question 8 - Open Grid Wall

You have referenced NFPA 13-2010 section 8.15.13 regarding open grid ceilings.

Can the definition for open grid ceilings be utilized to omit obstruction issues created by a wire cage storage area (wire vertical partitions) if all criteria are met for ordinary hazard and vertical clearance to ceiling is assumed to be horizontal clearance from cage partition?

Answer: The answer to your question is "no." The open grid ceiling criteria is specific to obstructions in the horizontal plane. A wire cage in the vertical configuration would need to meet the obstruction to sprinkler discharge pattern development of NFPA 13-2010 section 8.6.5.2 if it extends floor to ceiling for security purposes. This type of obstruction would fall within the requirements of the three times rule, which would be easily met. Positioning sprinklers away from the wire cage (fencing) support components would require the largest offset distance. However, NFPA 13-2010 section 8.5.2.1.4 indicates that for "light and ordinary hazard occupancies, structural members only shall be considered when applying the requirements of section 8.6.5.2.1.3."

The wire cage would also be treated like a suspended or floor mounted vertical obstruction as cited in section 8.6.5.2.2. However, these criteria only applies to light hazard occupancies with the objective of achieving water discharge throw over the obstruction. The criteria was specifically added to address patient dividing curtains in hospitals which extend to the ceiling. The other obstruction rules do not apply to a wire cage (chain link fence).

Demonstration of compliance with the three times rule would be sufficient and there would be no need to draw a comparison to the open grid ceiling for this application.

Question 9 - Room Design Method on Dry Systems

Is it acceptable to use the room design method to hydraulically calculate a dry system?

Answer: The answer to your question is "yes." The room design method can be used with dry pipe and preaction systems. In such case, there is no requirement for an increase in the design area. The assumption is that all sprinklers within the room will operate and that the walls will

have enough fire resistance to keep the fire within the room until the sprinklers have suppressed or controlled the fire until the fire department has arrived to handle final suppression efforts.

Question 10 - Mixing Orifices in Mercantile Occupancies

You have described a renovation project in an existing mercantile occupancy having K-14 extended coverage upright sprinklers. The building will remain as a mercantile occupancy. However, when the sprinkler system was originally installed, areas outside the mercantile occupancy (offices, restrooms, deli, deli storage) were protected with K-5.6 standard spray sprinklers. Now, during the renovation project, these areas protected by standard spray K-5.6 sprinklers are identified as being part of the mercantile occupancy.

Can the existing K-5.6 standard spray sprinklers be used to protect the same mercantile area as the K-14 extended coverage upright sprinklers?

Answer: The answer to the question is "yes." However, there are two scenarios to consider when mixing K-factors and sprinkler types. The first is where the sprinklers are in different compartments. In this situation, it would be acceptable to use K-5.6 standard spray sprinklers as long as the hydraulic calculations demonstrate that the sprinkler discharge is sufficient to supply the appropriate density for the mercantile area.

The second scenario is where these sprinklers are in the same compartments. In this situation, there are several things to consider, such as thermal sensitivity, coverage areas, and maintenance issues. You could still maintain existing K-5.6 sprinklers in a compartment with K-14 Extended coverage sprinklers while meeting the spacing requirements for each sprinkler. While you have not mentioned the response characteristic of these sprinklers, it is required to maintain the same thermal sensitivity for sprinklers in the same compartment. Therefore, all sprinklers in a compartment must either be quick response or standard response, with no intermixing. Lastly are the considerations during maintenance which would require clarification that sprinkler types are intermixed in the same compartment to avoid issues during inspection, testing, and replacement of sprinklers.

Question 11 - Check Valves and Standpipes

You describe a building with multiple standpipes. Some serve only hose valves while others serve only sprinkler floor control valves. You state that they will all have isolation valves at the manifold that ties into the water supply from the fire pump. You have referenced NFPA 14-2013 section 6.3.5

referencing check valves in combined standpipe and sprinkler systems. You note that you are unclear about "part of a combined system".

6.3.5* *Control Valves and Check Valves on Combined (Standpipe/Sprinkler) Systems.*

6.3.5.1 *Each connection from a standpipe that is part of a combined system to a sprinkler system shall have an individual control valve and check valve of the same size as the connection.*

6.3.5.2 *A listed pressure-regulating device that prevents backflow shall be considered a check valve, and an additional check valve shall not be required.*

Would check valves be required for floor control valve assemblies strictly serving sprinklers?

Answer: The answer to your question is "no, not with respect to NFPA 14 and standpipe systems but yes, with respect to NFPA 13 and sprinkler systems". The phrase, "part of a combined system" in this context refers to installations where a standpipe is also used as the supply riser for individual sprinkler systems, such as is shown in section A.6.3.5 and its associated Figures A.6.3.5(a) and (b). Only those parts of the standpipe system that supply both hose valves and sprinkler systems are "combined." A "standpipe" that has no hose valves and serves only sprinkler systems is really not a standpipe at all and not subject to NFPA 14 but rather to NFPA 13 where it serves as a vertical water supply riser manifold serving multiple sprinkler systems.

With a few exceptions in multistory buildings, check valves are required as part of each required floor control assembly in accordance with NFPA 13-2013 section 8.16.1.5. The net result of the two standards is that a check valve will generally be required at each floor control assembly either because of the requirement of NFPA 14-2013 section 6.3.5.1 in any combined system or because of the requirement in NFPA 13-2013 section 8.16.1.5 in most multistory buildings where the floor control valve assembly is supplied by a dedicated vertical manifold serving multiple floors.

8.16.1.5 Floor Control Valve Assemblies.

8.16.1.5.1* *Multistory buildings exceeding two stories in height shall be provided with a floor control valve, check valve, main drain valve, and flow switch for isolation, control, and annunciation of water flow on each floor level.*

8.16.1.5.2 *The floor control valve, check valve, main drain valve, and flow switch required by 8.16.1.6.3 shall not be required where sprinklers on the top level of a multistory building are supplied by piping on the floor below.*

8.16.1.5.3 *The floor control valve, check valve, main drain*

valve, and flow switch required by 8.16.1.6.3 shall not be required where the total area of all floors combined does not exceed the system protection area limitations of 8.2.1.

Question 12 - Sprinklers and Open Grid Ceiling Clouds

You describe an office project where there are numerous round ceiling clouds that vary in diameter from 4 feet to 9 feet. You note they are not solid but an open grid style. There are sprinklers installed at the ceiling throughout the area above the clouds. You have referenced NFPA 13-2007 section 8.15.13 (1) regarding open-grid ceilings.

8.15.13 Open-Grid Ceilings. Open-grid ceilings shall only be installed beneath sprinklers where one of the following is met:*

(1) Open-grid ceilings in which the openings are 1/4 in. (6.4 mm) or larger in the least dimension, where the thickness or depth of the material does not exceed the least dimension of the opening, and where such openings constitute 70 percent of the area of the ceiling material. The spacing of the sprinklers over the open-grid ceiling shall then comply with the following:

(a) In light hazard occupancies where sprinkler spacing (either spray or old-style sprinklers) is less than 10 ft × 10 ft (3 m × 3 m), a minimum clearance of at least 18 in. (457 mm) shall be provided between the sprinkler deflectors and the upper surface of the open-grid ceiling. Where spacing is greater than 10 ft × 10 ft (3 m × 3 m) but less than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 24 in. (610 mm) shall be provided from spray sprinklers and at least 36 in. (914 mm) from old-style sprinklers. Where spacing is greater than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 48 in. (1219 mm) shall be provided.

(b) In ordinary hazard occupancies, ...

You ask three questions which will be addressed separately.

Question1: Is it appropriate to apply the open-grid ceiling rules in this case?

Answer 1: The answer to this question is "no." Although those rules do provide a benchmark for comparison when evaluating the clouds as individual obstructions. The gridded clouds only cover a portion of the ceiling area or even the operating area of any given sprinkler. Applying the open-grid ceiling rules in this scenario would be overly conservative. Based on the information provided, a minimum of 48 inches of clearance would be required between the top of the clouds and the ceiling sprinkler deflectors to achieve compliance and there would still be an issue of strict applicability raised in question 2 below.

Question 2: If the openings in the clouds are at least 70% open but the thickness of the material exceeds the least

dimension of the openings, are sprinklers required below these cloud obstructions?

Answer 2: The answer to this question is "yes, if the open-grid ceiling rules are strictly applied."
The thickness of the material would prevent prescriptive treatment as an open grid ceiling. It would be a better fit, in this scenario, to apply the wide obstruction rule (8.5.5.3.1) individually to each distinct cloud than to apply the open-grid ceiling rule overall.

8.5.5.3.1 *Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as ducts, decks, open grate flooring, cutting tables, and overhead doors.*

Question 3: If sprinklers are required below the cloud obstructions, are shields required to protect them from water discharged from the ceiling level sprinklers?

Answer 3: The answer to this question is "yes, if sprinklers are installed below the ceiling clouds, intermediate level/rack storage type sprinklers must be used as per 8.5.5.3.3*".

8.5.5.3.3 Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.*