NFSA NATIONAL FIRE SPRINKLER ASSOCIATION
The Voice of the Fire Sprinkler Industry

TechNotes

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Best of March 2019

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 March 2019. This information is being brought forward as the "Best of March 2019." 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 - Concrete Tee Construction

Standard spray sprinklers are to be provided on a wet system that is to be installed in an ordinary hazard occupancy with concrete tees that are approximately 60' long and 26" deep (bottom of stem to non-combustible ceiling plane) with a maximum ceiling height of 12'. Concrete tees are spaced at approximately 6' centers and sprinklers are not installed in each channel/bay. Is the quick response design area reduction permitted per NFPA 13-2016 where concrete tee construction

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is installed?

Answer: Yes. Because sprinklers are positioned in accordance with NFPA 13-2016, the channels created by the concrete tees are not considered unprotected ceiling pockets. NFPA 13-2016 allows this special requirement for the positioning of sprinklers with respect to concrete tee construction:

> ***8.6.4.1.2**** *Obstructed Construction. Under obstructed construction, the sprinkler deflector shall be located in accordance with one of the following arrangements:*
> *[...]*
> *(5)* Installed with deflectors of sprinklers under concrete tee construction with stems spaced less than 7-1/2 ft but more than 3 ft on centers, regardless of the depth of the tee, located at or above a horizontal plane 1 in. below the bottom of the stems of the tees and complying with Table 8.6.5.1.2*

Because sprinklers are installed per the section above, this is not an omission of protection of "ceiling pockets" created by the concrete tees and the QR reduction provision may be used.

Question #2 - ESFR Protection in a 54'-0 Building

Is there a scenario that NFPA 13 allows ESFR ceiling protection in a 54' tall building with horizontal barrier(s) and in-rack sprinkler protection at specified elevations?

Answer: Yes, section 25.8 in NFPA 13 provides alternate in-rack protection options that are independent of the ceiling sprinkler design. Per NFPA 13:

> ***25.8.2.11.1**** *Where the in-rack sprinkler system is designed and installed in accordance with 25.8.2, the top level of in-rack sprinklers shall be considered to be a floor for design purposes of the ceiling sprinkler system.*

By installing in-rack sprinklers per section 25.8.2, the overhead protection would essentially only need to protect the levels of storage not covered by the in-rack sprinklers and the new design criteria would be determined based off of a "building height" from the top level of in-rack sprinklers to the roof/ceiling. The overhead system would then have to meet the requirements of Chapter 23 using these parameters.

Question #3 - Fire Pump Flow Tests

If a fire pump reaches 100% of its rated gpm and psi, but not 150%, is this considered a fail?

Answer: No, this does not mean the fire pump test is considered unacceptable. Per NFPA 25-2014:

> ***8.3.7.1.1*** *The interpretation of the test results shall be the basis for determining the performance of the pump assembly.*

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8.3.3.1 *If available suction supplies do not allow flowing of 150 percent of the rated pump capacity, the fire pump shall be tested to the maximum allowable discharge.*

8.3.7.2.1 *Theoretical factors for correction to the rated speed shall be applied where determining the compliance of the pump per the test.*

8.4.2 *Test results and any documented performance issues shall be recorded and retained for comparison purposes in accordance with section 4.3*

Using the sections listed above theoretical factors can be applied to determine if the pump would meet the rated flow and pressure if ample water was available to meet the flow required. If the building owner can provide a copy of the original acceptance and any other fire pump test results, these could be used for comparison to determine if there has been any degradation of the fire pump performance.

Question #4a - Sprinklers in Spray Booths

Do the sprinkler(s) located in the duct require bags protecting them from overspray or does the filter in the booth provide adequate protection?

Answer: NFPA 13-2016 does not specifically require coverings on sprinklers in ducts, but the requirements of section 22.4.2 must be met. NFPA 13-2016 requires that sprinklers be protected from overspray when protecting spray application processes using flammable or combustible materials:

22.4.2.2 *Sprinkler systems shall be protected against overspray residue, either by location or covering, so that they will operate quickly in the event of fire.*

22.4.2.2.1 *Sprinklers shall be permitted to be covered only by cellophane bags having a thickness of 0.08 mm or less or by thin paper bags. These coverings shall be replaced frequently so that heavy deposits of residue do not accumulate.*

22.4.2.2.2 *Sprinklers that have been painted or coated by overspray or residues shall be replaced with new sprinklers.*

Sprinklers located within the ducts should be evaluated on a case by case basis on whether or not to provide bags. This is simply an economic issue. If the residue exhausted through the ducts is sufficient enough to accumulate on the sprinklers, the cellophane bags or thin paper bags could be used to eliminate the need to replace the sprinklers periodically. It should be noted that the sprinklers located within ducts need to be accessible and provided with access openings for inspection and cleaning per section 22.4.2.1.1.

Question #4b - Sprinklers in Spray Booths

What is the recommended method of securing the bag around

the sprinkler/reducing fitting?

Answer: There are no prescriptive requirements in NFPA 13-2016 for securing coverings to sprinklers in this application. Coverings should be secured so that they are not displaced by air movement caused by normal operations, but not secured to the point where activation of a sprinkler would not dislodge the covering. Additionally, any means of securing the covering to the sprinkler should not inhibit the heat element of the sprinkler to activate normally in the event of a fire.

Question #5 - Draft Curtains

In a commercial NFPA 13-2016 3-Story Building, the Architect wants to install an open stair with 20-feet of draft curtain. The stairs only access the Residential units from a dedicated first floor lobby and will require a water curtain. Since we are proposing using residential sprinklers in the lobby and corridors, do they still need to meet the 6-foot on center criteria for a water curtain at the stair location?

Answer: Yes, sprinklers protecting vertical openings must meet the requirements of NFPA 13-2016 section 8.15.4.3. Per NFPA 13-2016:

> ***8.15.4.3.1*** *Sprinklers shall be spaced not more than 6 ft apart and placed 6 in. to 12 in. from the draft stop on the side away from the opening.*
>
> ***8.15.4.3.2*** *Where sprinklers are closer than 6 ft, cross baffles shall be provided in accordance with 8.6.3.4.2.*

Closely spaced sprinklers must meet the two provisions above and there is no deviation in the standard to provide separate requirements for the different spray types of sprinklers. All sprinklers should be installed per their listing, and if a residential sprinkler is chosen, the minimum spacing should be followed. If that minimum allowable spacing per its listing is greater than 6 ft, then the closely spaced sprinklers should still be installed 6 ft on center; however, baffles shall be installed per section 8.10.3.3.

It should be noted that residential sprinklers can only be used if the following circumstances:

> ***8.4.5.1**** *Residential sprinklers shall be permitted in dwelling units and their adjoining corridors, provided they are installed in conformance with their listing.*
>
> ***8.5.4.2*** *Residential sprinklers shall be used only in wet systems unless specifically listed for use in dry systems or preaction systems.*
>
> ***8.4.5.3*** *Where residential sprinklers are installed in a compartment as defined in 3.3.6, all sprinklers within the compartment shall be residential sprinklers.*
> *Verify these requirements are met before using residential sprinklers to protect the vertical opening.*

Question #6 - FDC Signage

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Do FDC's require an additional sign to be mounted above if the connection is identified on the plate or fitting per NFPA 13-2016 section 8.17.2.4.7.1?

Answer: No, according to NFPA 13-2016 and the 2018 IBC as long as the connection is visible from the approaching fire apparatus; however, verify that local amendments to the code do not add additional requirements. NFPA 13-2016 requires the following signage:

> ***8.17.2.4.7.1*** *Each fire department connection to sprinkler systems shall be designated by a sign having raised or engraved letters at least 1 in. in height on plate or fitting reading service design - for example, AUTOSPKR., OPEN SPKR., AND STANDPIPE.*

The plate installed around the FDC satisfies this requirement and no other signage is necessary per NFPA 13. This is consistent with the model building codes. Per the 2018 IBC:

> ***[F]912.5 Signs****.*
> *A metal sign with raised letters not less than 1 inch in size shall be mounted on all fire department connections serving automatic sprinklers, standpipes or fire pump connections. Such signs shall read: AUTOMATIC SPRINKLERS or STANDPIPES or TEST CONNECTION or a combination thereof as applicable. Where the fire department connection does not serve the entire building, a sign shall be provided indicating the portions of the building served.*

Section 912.2.1 requires the FDC itself to be in a visible location, otherwise the additional sign described in the question would be required.

Question #7 - Alternate Power Sources for Fire Pumps

An addition for a one-story school building requires a fire pump to be installed. Per NFPA 20 at least one alternate source of power is required if the height of the structure is beyond the pumping capacity of the local fire department. Would that be required for this project?

Answer: The requirement to provide alternate power for an electric fire pump is usually dependent on the reliability of the normal power source. The height of the building is not likely to be an issue on this situation. The usual reason for needing alternate power is that the 'normal power', as covered in NFPA 20 section 9.2, is not deemed 'reliable' by the AHJ. The requirements and specific exemptions for 'alternate power' are covered in section 9.3. The annex commentary in A.9.3.2 discusses the characteristics of a reliable power source and should be consulted as a basis for evaluating 'normal power'.

> ***9.2* Normal Power.***
>
> ***9.2.1*** *An electric motor-driven fire pump shall be provided with a normal source of power as a continually available source.*

[....]

9.3 Alternate Power.

9.3.1 *Unless there is an installed power arrangement as described in 9.3.3, at least one alternative source of power shall be provided for high-rise buildings.*

9.3.2* *Other Sources. Except for an arrangement described in 9.3.3, at least one alternate source of power shall be provided where the normal source is not reliable.*

9.3.3 *An alternate source of power for the primary fire pump shall not be required where a backup engine-driven fire pump, backup steam turbine-driven fire pump, or backup electric motor-driven fire pump with independent power source meeting 9.2.2 is installed in accordance with this standard.*

Question #8 - NFPA 13R Garages

A 3-story residential building to be protected with an NFPA 13R-2016 sprinkler system where some individual garages are accessed via a common corridor. Would this meet the intent of NFPA 13R-2016 section 7.3.3?

Answer: Yes. Per NFPA 13R-2016:

7.3.3* *Garages that are accessible only from a single dwelling unit shall be considered as part of that dwelling unit.*

7.3.3.1 *Garages that meet the criteria of 7.3.3 shall be protected in accordance with one of the following:*

(1) Use of a residential sprinkler in accordance with Section 7.1
(2) Use of an extended coverage sprinkler discharging water not less than its listed flow rate for light hazard
(3) Quick-response spray sprinkler at light hazard spacing in accordance with NFPA 13 designed to discharge at 0.05 gpm/ft2 (2.04 mm/min) density

This issue was further clarified in the 2019 edition with the addition of a new 7.3.3. The issue at stake here is whether or not the garage itself serves a single dwelling unit or multiple dwelling units:

7.3.3 *Garages that serve only a single dwelling unit shall be considered as part of that dwelling unit.*

7.3.4* *Garages that are accessible only from a single dwelling unit shall be considered as part of that dwelling unit.*

It is not necessary that the garage is accessed directly from the dwelling unit.

Question #9 - Monitoring Valves for Water Spray Systems

A manual fixed spray water system is installed per NFPA 15. The butterfly valve currently controlling the system are monitored in the normally open condition. Is this correct?

Answer: No, there is no requirement to monitor the system actuation valve in a manual fixed water spray system. The reference to NFPA 15 section 6.3.1.2 refers to the valve controlling the water supply to the water spray system, not the valve controlling the water spray system itself:

> ***6.3.1.2 Valve Supervision.*** *Valves controlling the water supply to water spray systems shall be supervised in the normally open position by one of the following methods:*
>
> *(1) Central station, proprietary, or remote station alarm service*
> *(2) Local alarm service that will cause the sounding of an audible signal at a constantly attended point*
> *(3) Locking valves open*
> *(4) Sealing of valves and approved weekly recorded inspection where the valves are located within fenced enclosures under the control of the owner.*

The valve in question is a "system actuation valve" and is covered under section 6.3.1.4:

> ***6.3.1.4.1*** *System actuation valves shall be as close to the hazard as accessibility during the emergency will permit.*
>
> ***6.3.1.4.2*** *The location of system actuation valves shall include an elevation of all the following factors:*
>
> *(1) Radiant heat from the exposing fire*
> *(2) Potential for explosions*
> *(3) The location and arrangement of drainage facilities including dikes, trenches, and impounding basins*
> *(4) Potential for freezing and mechanical damage*
> *(5) Accessibility*
> *(6) System discharge time*

There are no specific requirements for supervision in this section so the requirements of 6.5.3 Arrangement and Supervision of Systems should be followed:

> ***6.5.3.1.1*** *Water spray systems that depend on electric thermostats, relay circuits, flammable gas detectors, or other similar equipment shall be so arranges that such equipment is normally energized or completely supervised in a manner that will result in positive notification of an abnormal condition in accordance with NFPA 72 unless failure of the detection system results in the operation of the water spray system.*
>
> ***6.5.3.1.2*** *Supervision shall include, but not be limited to, the tripping devices, solenoid valve, and any connecting wiring.*
>
> ***6.5.3.2*** *Pneumatic and Hydraulic Systems. Pneumatically and hydraulically operated systems shall be supervised in a manner such that failure will result in positive*

notification of the abnormal condition, unless the failure resulted in operation of the water spray system.

As the system installed is manual, none of the requirements above apply and no additional supervision would be required on the system actuation valve.

Question #10 - Double Open Joist Construction

A concealed space created by solid wood studs with 4½" between the top of one stud and the bottom of the other stud. Per NFPA 13-2016 section 8.15.1.2.3 is it acceptable to omit fire sprinklers from the concealed space as the space between the stud edges are less than 6", even though 8.15.1.2.3 references Figure 8.6.4.1.5.1 which does not show a concealed space and shows a sloping ceiling or roof with no sheathing on the lower joists?

Answer: Yes, sprinklers may be omitted from this combustible concealed space as the distance between the two sets of joists is less than 6 in. NFPA 13-2016 allows sprinklers to be omitted in concealed spaces as long as the construction meets one of the scenarios in section 8.15.1.2:

> ***8.15.1.2.3*** *Concealed spaced formed by studs or joists with less than 6 in. between the inside or near edges of the studs or joists shall not require sprinkler protection. (See Figure 8.6.4.1.5.1)*

While the figure above references open joists, the note in section 8.15.1.2.3 points to this figure only to reference the joist construction and spacing. The space may still be concealed with a ceiling/floor to make the space concealed. With the joists in the attached detail spaced 4-1/2 in. apart with no slope, sprinklers would not be required to be installed in this space.

It should be noted that because sprinklers are omitted in this space, one of the provisions in section 11.2.3.1.5.2 needs to be met in order to waive the requirement to increase the design area to 3,000 sq. ft for adjacent areas.

Question #11 - End of Branch Line Restraint

Is there any NFPA13-2016 section that mandates the minimum distance a branch line restraint must be located from end of branch line?

Answer: Yes, the branch line must be restrained at the end sprinkler. Unlike hangers, there is no minimum distance that restraint has to be installed from the end of a line; however, NFPA 13-2016 section 9.6.3.6 states the following:

> ***9.3.6.3*** *The end sprinkler on a branch line shall be restrained*.

Restraint should be installed at the last sprinkler on a branch line and at additional intervals per Table 9.3.6.4(a) or Table 9.3.6.4(b) depending on the sprinkler pipe installed.

Question #12 - Test Certificates

Can a single test certificate (Contractor's Material and Test Certificate for Aboveground Piping) be used for a building having multiple sprinkler system zones separated by zone control assemblies or does an individual test certificate must be submitted for each sprinkler system zone?

Answer: NFPA 13 section 28.1 does not specifically state the requirement one way or the other. Section 28.1(3) states that "appropriate" contractor's material test certificate(s) shall be completed and signed. NFPA 25 also requires that these certificates be retained throughout the life of the system.

> ***28.1 Approval of Sprinkler Systems and Private Fire Service Mains.*** *The installing contractor shall do the following:*
>
> *(1) Notify the authority having jurisdiction and the property owner or the property owner's authorized representative of the time and date testing will be performed*
> *(2) Perform all required acceptance tests (see Section 28.2)*
> *(3) Complete and sign the appropriate contractor's material and test certificate(s) (see Figure 28.1)*
> *(4) Remove all caps and straps prior to placing the sprinkler system in service*

Since NFPA 13 does not provide a definition for "appropriate," the definition provided in Merriam-Webster Collegiate Dictionary, 11th Edition must be used to determine the ordinarily accepted meaning.

> ***3.1 General****. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. Merriam-Webster's Collegiate Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning.*

The following definition is provided for appropriate:

> ***Definition of appropriate***
> *especially suitable or compatible: fitting*

Use of the terms especially suitable allows for interpretation regarding the application. The requirements provided in NFPA 13 do not align with the way things are actually done in practice. The determination of when the test certificates are required to be submitted is critical in defining the outcome. NFPA 13 defines each "zone" as a separate sprinkler system, so technically it would make sense to have a test certificate per zone. However, if construction is done in a manner in which all zones are completed and tested at the same time a single test certificate would also make sense.

> ***3.3.206* Sprinkler System****. A system, commonly*

activated by heat from a fire and discharges water over the fire area, that consists of an integrated network of piping designed in accordance with fire protection engineering standards that includes a water supply source, a water control valve, a waterflow alarm, and a drain. The portion of the sprinkler system above ground is a network of specifically sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern.

In some instances, multiple test certificates might be required for a single sprinkler system installation. As an example, once the hydrostatic test is conducted a test certificate is required to document the procedure. In order to be submitted to the AHJ or design professional prior to completion of the project, a partially completed test certificate is needed. Separate test certificates might also be required after each subsequent test or material submission for documentation purposes. Currently, NFPA 13 does not provide specific requirements which coincide with the actual process that is being applied in the industry. Determination of appropriate is often left to the AHJ based on how jurisdictional requirements for submission of test certificates are required to be implemented. Additional requirements are often included as part of contracts or technical specifications.

A test certificate should be submitted for each sprinkler system zone. While this is not a requirement of NFPA 13, it is a case where additional clarification would be appropriate in the standard.