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

TechNotes

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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 August 2019. This information is being brought forward as the "Best of August 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

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Question #1 - 5 Year PRV Flow Test

A sprinkler system was installed utilizing a 1500 gpm fire pump with an 8 in. pressure reducing valve (PRV) on the discharge side of the pump. What is the appropriate flow rate in order to meet requirements for a 5-year flow test?

Answer: NFPA 25 has no guidance on the volume of flow or pressure downstream of the PRV, it only states

that normal pressures shall be compared to previous tests. To determine flow rates, the manufacturer, make, and model as well as inlet and outlet pressures would need to be known to determine how much if any loss of flow there would be.

Per UL 1468 Standard for Direct Acting Pressure Reducing and Pressure Restricting Valves, the following operational test is required when certifying a valve:

> ***24.3 Pressure reducing valves***
>
> ***24.3.1*** *The inlet of a sample valve is to be connected to a piezometer to which a pressure gauge is attached and to a water supply that provides the rated pressure and maximum flow required. The downstream side of the sample is to be fitted with a piezometer equipped with a pressure gauge, piping, and a valve to control the water flow through the sample.*

Disregarding the language above that involves the laboratory testing equipment, the installed PRV assembly should be flown with the maximum flow required by the system.

Question #2 - Sprinkler in Hospital Patient Rooms

Can sprinklers be omitted from closets and shower located in a patient room in a hospital?

Answer: A sprinkler may be omitted from the closet if coverage in the room meets the requirements of NFPA 13-2019 section 9.2.5. Sprinklers must protect the entire footprint of the bathroom.

Per NFPA 13-2019:

> ***9.2.5* Hospital Clothes Closets****. Sprinklers shall not be required in clothes closets of patient sleeping rooms in hospitals where the area of the closet does not exceed 6 ft2, provided the distance from the sprinkler in the patient sleeping room to the back wall of the closet does not exceed the maximum distance permitted by 9.5.3.2.*

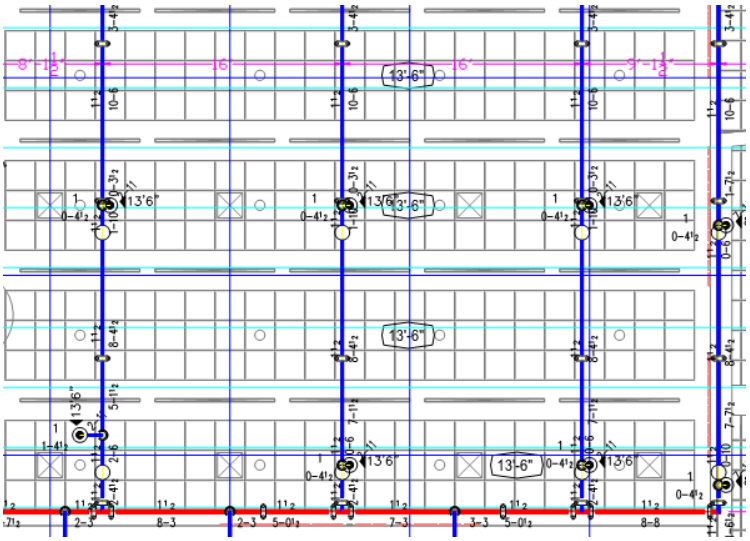
If the sprinklers are spaced in the room such that they do not violate the maximum permitted spacing or area of coverage, and the distance from the sprinkler to the back of the closet is no more than half the allowable sprinkler spacing, then a sprinkler may be omitted from the closet.

Only dwelling units are allowed to have sprinklers omitted from bathrooms meeting certain requirements. Because this is a hospital, sprinklers must be spaced in the bathroom to cover the entire floor area, including the

shower's floor area.

Question #3 - Cloud Ceilings

Extended coverage pendent sprinklers are being used in a light hazard application to protect beneath a suspended ceiling. The ceiling does not meet the cloud ceiling requirements per NFPA 13-2016 section 8.15.24. Is there any way to not have sprinklers installed in each cloud ceiling?



Answer: No, sprinklers need to be installed in each suspended cloud ceiling section over 4 ft in width.

Per NFPA 13-2016 section 8.8.5.3.4 sprinklers are required to be placed under obstructions greater than 4 ft wide for installations using extended coverage uprights and pendents. The protection above the suspended ceilings is spaced to protect the floor area, and the sprinklers installed in the suspended ceiling sections protect the area where the discharge from above is not able to reach the hazard. If a fire were to originate at a location under a cloud ceiling where sprinklers were not installed, heat and smoke from the fire would potentially pass through the gaps between the suspended ceiling sections, slowing or preventing activation of the pendent sprinklers installed in the suspended cloud ceiling sections. Upright sprinklers would activate, and spray would be severely obstructed or shielded from reaching the fire by the suspended ceiling beneath the sprinklers.

Question #4 - Seismic Separation Assemblies

A project having a seismic separation with a 6 ft. vertical offset; the structure on one side of the separation being more than 6 ft. higher than the other side. The rise up after the seismic assembly is needed to attach the four-way brace, which will be approximately 4 ft. horizontally from the separation assembly. Will this meet the

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requirement of NFPA 13-2016 section 9.3.3.3 to have a four-way within 6 ft. of the seismic assembly? And does the vertical pipe need to be included in this measurement?

Answer: No. The requirement of NFPA 13-2016 section 9.3.3.3 is to have a four-way brace within 6 ft. upstream and downstream of the seismic separation assembly to allow for differential movement at the seismic joint but also to allow the portion of the sprinkler system on either side of the joint to move independently with those portions of the building. Bracing should be added on the lower main within 6 ft. of the seismic separation assembly.

Since the seismic separation assembly is being installed at the lower elevation, the length of the riser would be included in the measurements but could be implicitly accounted for in the design. Given that the riser is greater than 3 ft in length, a four-way brace would be required based on NFPA 13-2016 section 9.3.5.8.1. This brace would also fulfill the requirement to have a four-way brace on the opposite side of the seismic separation assembly as long as it is within 6 ft. An additional brace at the higher pipe would not be required in accordance with section 9.3.5.5.5 since the four-way brace on the riser would be considered to comply with this requirement as stated in section A. 9.3.5.8.1.

> ***9.3.3* Seismic Separation Assembly.***
>
> ***9.3.3.1*** *An approved seismic separation assembly shall be in-stalled where sprinkler piping, regardless of size, crosses building seismic separation joints at ground level and above.*
> ***9.3.3.2*** *Seismic separation assemblies shall consist of flexible fittings or flexible piping so as to allow movement sufficient to accommodate closing of the separation, opening of the separation to twice its normal size, and movement relative to the separation in the other two dimensions in an amount equal to the separation distance.*
> ***9.3.3.3**** *The seismic separation assembly shall include a four-way brace upstream and downstream within 6 ft (1.8 m) of the seismic separation assembly.*
> ***9.3.3.4*** *Bracing shall not be attached to the seismic separation assembly.*
> ***9.3.5.5.5*** *The distance between the last brace and the end of the pipe shall not exceed 6 ft (1.8 m).*
> ***9.3.5.8.1**** *Tops of risers exceeding 3 ft (900 mm) in length shall be provided with a four-way brace.*
> ***A.9.3.5.8.1*** *The four-way brace provided at the riser can also provide longitudinal and lateral bracing for adjacent mains. This section is not intended to require four-way bracing on a sprig or*

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on a drop to a single sprinkler.

The above answer assumes that the separation is at the bottom and the seismic separation assembly is appropriate at the lower elevation. If the joint is at the top, the seismic separation assembly would more appropriately be located at the top. In that case, the additional brace would be located on the upper pipe within 6 ft. of the seismic separation assembly and the four-way brace on riser would be considered to be part of the lower level piping.

Question #5 - ESFR Sprinklers in Obstructed Construction

ESFR sprinklers are installed in a building where the structure consists of 2 ft deep beams. Is it the intent of NFPA 13-2016 section 8.12.4.1.6 to allow for sprigs and return bends or can the sprinklers be positioned with deflectors at a lower elevation than their listing?

Answer: Per NFPA 13-2016 section 8.4.6.3.1 sprinklers must be installed in channels formed by beams exceeding 1 ft in depth and if installed in section 8.12.4.1.6 allows for branch lines to be installed below beams, but the sprinklers must be installed above the lower plane of the beam.

In addition to the above requirements that the sprinklers be located above the beams, ESFR sprinklers must be positioned per one of the following or their listing:

- Pendent K-14 and pendent K-16.8 ESFR sprinklers need to be positioned so that the deflectors are between 6 and 14 inches from the ceiling deck.
- Pendent K-22.4 and pendent K-25.2 ESFR sprinklers need to be positioned so that the deflectors are between 6 and 18 inches from the ceiling deck.
- Upright ESFR sprinklers (K-14 and K-16.8) need to be positioned so that the deflectors are between 3 and 12 inches from the ceiling deck.

It also is important to note that the ESFR sprinklers must still meet the minimum spacing and area of coverage requirements as stated in section 8.4.6.3.2.

> ***8.4.6.3.2*** *Minimum sprinkler spacing and area of coverage shall comply with the requirements of 8.12.2 and 8.12.3.*

Sprinklers may not violate their listing. Sprigs may be used to achieve the appropriate positioning; however, if return bends are used and the deflectors are installed above the branch lines, the ESFR obstruction rules

must be followed.

Question #6 - Fabric Ductwork

A project is utilizing a 54 in. round fabric duct which inflates upon use. The duct is being installed in an open area where the duct will be exposed. When not in use, the duct will "flatten" out in a vertical fashion and droop from the hanger attachments. Is sprinkler protection beneath the duct required?

Answer: Yes, sprinklers must be installed to protect the obstruction to sprinkler discharge.

Per NFPA 13-2019 for standard spray uprights and pendents:

> ***10.2.7.3.2**** *Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide.*
>
> ***10.2.7.3.5*** *Sprinklers installed under round ducts shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.*

Sprinklers can be located up to 3 in. from the edge of the obstruction, so a pendent sprinkler on a straight drop can be installed 3 in. from the outer edge of the round duct at an elevation 1 in. to 12 in. below the bottom edge per section 9.5.5.3.1.2 (See the associated annex figure for the section above for additional clarification.):

> ***9.5.5.3.1.2**** *Sprinklers located under obstructions shall comply with one of the following:*
> *(1) Installed below the obstruction*
> *(2) Installed adjacent to the obstruction not more than 3 in. (75 mm) from the outside edge of the obstruction*

If the sprinkler is installed adjacent to the duct (and will be subject to the discharge from the ceiling sprinklers) the sprinkler must be an intermediate level rack type sprinkler in accordance with section 9.5.5.3.1.3.

While no prescriptive requirement exists, you may be able to enlist the services of a professional engineer to provide a performance-based design where the operation of the sprinkler system would shunt the HVAC and deflate the duct, eliminating the obstruction and a need for additional sprinklers.

Question #7 - FDC Piping

A 4 in. riser supplies a sprinkler system. The main reduces to 3 in. diameter above the riser and reduces further to 2 ½ in. diameter. The designer's intention is to

install 4 in. pipe from the fire department connection and tie into the 2 ½ in. main. The AHJ has requested 4 in. pipe between the riser and the fire department connection. Is this a correct interpretation?

Answer: No. The pipe between the fire department connection and the system main must be 4 in. This does not mean that all pipe between the riser and the fire department connection must be 4 in. If the sprinkler system piping has been sized based on hydraulic calculations, the main only needs to be sized to deliver the necessary flow and pressure to the sprinklers as required by NFPA 13-2019 Chapter 27. The provision of section 16.12.4 does not apply to the sprinkler system main.

NFPA 13-2019 section 16.2.4 (3) permits the pipe for the fire department connection to be less than 4 in. but not less than the size of the largest riser served by the fire department connection. The annex section describes that the purpose of the fire department connection is to supplement pressure and not flow.

> ***16.12.4* Size.*** *The size of the pipe for the fire department connection shall be in accordance with one of the following:*
>
> *(1) Pipe size shall be a minimum of 4 in. (100 mm) for fire engine connections.*
> *(2) Pipe size shall be a minimum of 6 in. (150 mm) for fire boat connections.*
> *(3) For hydraulically calculated systems, the pipe size shall be permitted to be less than 4 in. (100 mm), but not less than the largest riser being served by that connection.*
>
> ***A.16.12.4*** *The purpose of a fire department connection is to supplement the pressure to an automatic fire sprinkler system. It is not the intent to size the fire department connection piping based on system demand. For multiple system risers supplied by a manifold, the fire department connection need not be larger than that for an individual system.*

The pipe supplying the fire department connection is permitted to be the same size as the largest riser served. In this case the pipe between the fire department connection and the point of connection to the 2 ½ in. cross main must be 4 in. based on section 16.12.4 (1) and (3) since a 4 in. riser has been installed. However, a 4 in. main from the riser to the fire department connection is not required by NFPA 13-2019 or prior editions.

Question #8 - Drain Sizes

A sprinkler system was installed in a new sports

complex. The riser and main piping are 3 in. diameter, so a 1¼ in. drain line was installed per NFPA 13-2016 Table 8.16.2.4.2. The fire marshal requested a 2 in. drain because the underground lead into the building is 4 in. Does the size of the underground determine the size of the main drain, or is it only the system riser and mains that considered when making the determination?

Answer: Sprinkler drains should be sized to drain the sprinkler system and not the underground. The 1-1/4 in. drain is adequate for a 3 in. riser.

In NFPA 13-2016:

> ***8.16.2.4.1**** *Provisions shall be made to properly drain all parts of the system.*
> ***8.16.2.4.2**** *Drain connections for systems supply risers and mains shall be sized as shown in Table 8.16.2.4.2*

The intent of the drain is to remove water from the sprinkler system and not to flow water from the underground. The use of "mains" in this case is being misinterpreted by the AHJ. NFPA 13-2019 provides these definitions for risers and mains:

> ***3.3.181 Risers.*** *The vertical supply pipes in a sprinkler system.*
> ***3.3.53 Cross Mains.*** *The pipes supplying the branch lines, either directly or through riser nipples.*
> ***3.3.72 Feed Mains.*** *The pipes supplying cross mains, either directly or through risers.*

As none of the definitions apply to underground supply pipe, the provisions for drain sizing would not apply either. Additionally, the intent of the main drain test required by NFPA 25 is incorrectly applied. The intent of the test is to compare residual pressures when the main drain is fully open, there is no requirement to flow a certain volume of water.

Question #9 - Storage Racking Arrangements

In a building having a single compartment with (3) sets of multiple row racks, the storage method for two of the racks will be changed causing the addition of in-rack sprinkler protection. Is there anything in NFPA 13 that specifies that in-rack sprinklers would not be required in the third rack if it is not changed?

Answer: Yes, if the rack is separated by at least 15 feet from the adjacent hazard. This would allow the third rack to be considered as having an adjacent hazard utilizing a different design method in accordance with NFPA 13-2019 section 10.10.1 (1).

Per NFPA 13-2019:

20.10* Adjacent Hazards or Design Methods.
20.10.1 *For buildings with two or more adjacent hazards or design methods, the following shall apply:*

(1) Where areas are not physically separated by a barrier or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding design basis shall extend 15 ft (4.6 m) beyond its perimeter.
(2) The requirements of 20.10.1(1) shall not apply where the areas are separated by a draft curtain or barrier located above an aisle, horizontally a minimum of 24 in. (600 mm) from the adjacent hazard on each side, or a partition that is capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area.
(3) The requirements of 20.10.1(1) shall not apply to the extension of more demanding criteria from an upper ceiling level to beneath a lower ceiling level where the difference in height between the ceiling levels is at least 24 in. (600 mm), located above an aisle, horizontally a minimum 24 in. (600 mm) from the adjacent hazard on each side.

Question #10 - Paint Booths

For a paint spray booth protected with sprinkler system(s), both NFPA 13 and NFPA 33 require that "the sprinkler system shall be controlled by a separate, listed indicating valve(s), operable from floor level." Are the sprinklers in the exhaust ducts required to be controlled by this indicating valve, no matter how long the exhaust ducts are?

Answer: Yes; however, it should be pointed out that the rules cited for protection of paint spray booths are developed solely by the NFPA 33 committee and are extracted into NFPA 13. In the 2019 edition of NFPA 13, additional annex material has also been included from a newer edition of NFPA 33 that provides some additional insight. One such point is found in A.26.4.2.1: "Loss experience has shown that fires starting in the exhaust duct can spread to the spray booth and that fires starting in the spray booth can spread to the exhaust duct." A.26.4.2.1(6) clarifies that it is not expected that the building ceiling and spray area systems will operate simultaneously, eliminating the need to add the water supply demands.

As such, when considering why the accessible control valve for the spray booth is needed, it is because a fire within the spray booth and/or the ducts is more likely than a fire involving the overhead sprinkler system. The separate control valve allows for the possibility of taking

the spray booth system out of service without eliminating the overhead sprinkler protection. Since the booth and its exhaust ductwork are linked in the probability of involvement, it makes sense that the accessible control valve also controls the sprinklers in the ductwork. Should a fire occur in a duct that is served by sprinklers from multiple floor systems, it is possible that the sprinkler systems protecting all of those floors would need to be taken out of service simultaneously during system restoration efforts.

Question #11 - Change in Water Supply

A facility with multiple ordinary hazard pipe schedule sprinkler systems installed is changing the supply from a fire pump and reservoir to a city water main. Would this change require a hydraulic calculation of the system?

Answer: Since the only modification to the existing pipe schedule system is disconnecting the fire pump and connecting to the city supply, the existing pipe schedule is kept intact as the water supply is considered a part of the sprinkler system per NFPA 13-2019 section 3.3.206. Per NFPA 13-2019:

> ***19.3.2.3*** *The pipe schedule method shall be permitted as follows:*
> *(1) Additions or modifications to existing pipe schedule systems sized according to the pipe schedules of Section 27.5*
> *(2) Additions or modifications to existing extra hazard pipe schedule systems*
> *(3) New systems of 5000 ft2 (465 m2) or less*

As this meets the requirements of section 19.3.2.3 (1), the change in water supply would require verification that the supply meets or exceeds the requirements of Table 19.3.2.1 and a full hydraulic calculation would not be required.

Question #12 - Fire Pump Test with Hoses

Is there any guidance on using more than 100 ft of hose during a fire pump flow test? The current arrangement requires 150 ft of hose to perform the flow test. Should the friction loss through the hose or any other factors be accounted for during the test?

Answer: NFPA 25 provides additional guidance when hoses are used but does not provide a minimum or maximum length.

As for the adjusted test results, there will be additional friction loss through a longer hose. It may be a good idea to use 3 in. hose instead of 2.5 in. as well as applying theoretical factors to adjust for speed (rpm) per

NFPA 25-2014:

> ***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.*

Did You Know??

The NFSA assigns a member of the Engineering Department staff every business day to answer your technical questions. We call this the Expert of the Day (EOD) program and it is available to our members by phone, or e-mail. Call us at (845) 878-4200 and press 2, or you can e-mail us at eod@nfsa.org. Last year we answered more than 1400 requests for assistance.