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

TechNotes

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Best of December

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 December 2019. This information is being brought forward as the "Best of December 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 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 - Use of Concealed Sprinklers with Steeply Sloped Ceilings in a NFPA 13D System

How can concealed sprinklers (spaced at 16 ft x 16 ft) be used on a steeply peaked ceiling? It should be noted that the distance between sprinklers would be less than 8 ft. when located 3 ft. from the peak.

Answer 1:Although reference is made to the inability to comply with the 3 ft maximum distance from the peak, this rule is found in NFPA 13, but not NFPA 13D. The difference can perhaps be attributed to the additional property protection goal of NFPA 13.

Refer to Figure 8.1.1.1 of NFPA 13D (2016 or 2019 edition). Although the same figures are found in NFPA 13 depicting minimum distances between sprinklers, it is labeled here to indicate "Measuring S Dimension." Note that the maximum spacing between sprinklers can be divided between the opposing slopes. Note that Figure 8.1.1.1 and section 8.1.1.2 of NFPA 13D does state that the horizontal distance between sprinklers on either side of a peaked ceiling shall comply with the following: "shall maintain the minimum listed spacing

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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 (443) 863-4464, or you can e-mail us at eod@nfsa.org. Last year we answered more than 1400 requests for assistance.

EOD Changes

The Expert of the Day (EOD) program will undergo some internal and external changes throughout 2020. For members who utilize this valuable member service, expect to see membership prioritizations, new subject matter experts, and increased online resources. Stay tuned to future TechNotes to learn about these adjustments to maximize your membership.

but no less than 8 ft".

That being said, the sprinkler manufacturer's technical literature should also be reviewed, since compliance with the product listings and manufacturer's instructions is also required. Some manufacturers carry the 3 ft maximum dimension from the peak for their residential sprinklers, and some show it for at least the sprinkler on one side, which still might allow compliance with the minimum lateral distance between the opposing sprinklers.

If all else fails, it is recommended to contact the sprinkler manufacturer for additional guidance regarding spray patterns that might be presented to the AHJ, or consideration of some type of baffle between the sprinklers. Again, some manufacturers include information on minimum baffle depth in their literature based on the sprinkler spacing.

Question 2 - Combustible Concealed Space or Not

A concealed space consisting of a metal roof, metal trusses (spaced 10 ft apart) and a metal ceiling contains wood on the top and the bottom of the trusses as follows:

- On top of truss, there are wood 2 in. x 6 in. x 10 ft on 2 ft centers, supporting the metal roof.
- On bottom of truss are 2 in. x 4in. x 10 ft, on 4 ft centers, for holding up metal ceiling.

Would this space be considered to be a noncombustible concealed space with limited combustibles, and can sprinklers be omitted in accordance with the NFPA 13-2010?

Answer 2:The answer is "no." This space does not appear to meet the requirements of a noncombustible concealed space and sprinkler protection would be required. The wood on the top and bottom of the metal trusses (holding up the ceiling and the roof) would be considered combustible and as such the general allowance to omit sprinklers in noncombustible spaces would not apply.

The annex note to NFPA 13-2010 section 8.15.1.2.1 does suggest that a limited amount of combustibles may be acceptable in a unsprinklered noncombustible space. However, this annex note refers to "cabling, nonmetallic plumbing piping, non-structural wood". In the case described, the wood seems to be structural as it is supporting the roof and this allowance would not appear to be applicable. Additionally, as a quantity of "allowable" combustibles is not defined, it is

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difficult to state how much is too much combustibles in a unsprinklered space. This annex section reads as follows:

> ***A.8.15.1.2.1*** *Minor quantities of combustible materials such as but not limited to: cabling, nonmetallic plumbing piping, non-structural wood, etc. can be present in concealed spaces constructed of limited or noncombustible materials but should not typically be viewed as requiring sprinklers (see 8.15.1.1). For example, it is not the intent of this section to require sprinklers, which would not otherwise be required, in the interstitial space of a typical office building solely due to the presence of the usual amount of cabling within the space. The threshold value at which sprinklers become necessary in the concealed space is not defined.*

If the amount of wood is truly limited in amount and could be considered not structural, it may be prudent to talk with the specifying engineer and the AHJ. It may be possible, with permission of the AHJ, to encase the exposed wood in noncombustible material (drywall or spray-on fire proofing) and then combustible material would not be exposed. This would meet the requirements of section 8.15.1.2.1.

Question 3 - Standpipe System Drains

For a situation with a manual wet standpipe system supplied by city water, standpipes are located in multiple stairways. There is a main control valve located where the city water supply enters the building. Each of the standpipes in the stairways are provided with an isolation valve. The main control valve has a drain and gauge connection in accordance with NFPA 14-2013 Figure 7.11.2.1 and Table 7.11.2.3.

Are the drains downstream of the individual standpipe isolation control valves to be sized in accordance with Table 7.11.2.3?

Answer 3:The answer is "no." You state the system meets NFPA 14-2013 Section 7.11.2.1. That means the main drain was sized appropriately on the system side of the control valve. NFPA 14 would allow the auxiliary drains from the isolation valves to be sized accordingly but not according to Table 7.11.2.3.

Question 4 - Fan Obstructions to ESFR Sprinklers

What are the sprinkler installation requirements for 76-inch diameter fans that appear to be installed at an angle to the floor and not HVLS fans?

Answer 4:There is no official criteria in NFPA 13 to

handle this type of fan. A design professional needs to evaluate each situation on a case-by-case basis. There are two concerns regarding ceiling fans:

1) The obstruction to the sprinkler spray caused by the fan housing and the blades.
2) The movement of air caused by the fan that might change the location of the sprinklers that open and might prevent the sprinklers directly over the fire from opening.

During the fire testing that went into the HVLS fan research, it was determined that the fan blades themselves were not significant obstructions to the sprinklers. However, it might not be appropriate to extrapolate that data to the fans in your situation since your fans are not HVLS fans. The design of the HVLS fan allows the blade itself to be fairly small and the low speed of the fan allowed water spray to penetrate the area within the sweep of the blades. Whether or not the same can be said of your fan is a question that I can't answer and might take some significant investigation including possibly water distribution or fire tests.

With respect to the activation of sprinklers, a fire protection engineer should be able to perform an analysis of the relative velocity of the hot gasses from the fire as they travel through the air being moved by the fan. The fan manufacturer should be able to assist with some indication of the velocity of air normally being moved by the fans. Given the relative velocity of the hot gasses, it may be possible to determine the effect on possible delays to sprinklers opening over the fire or sprinklers remote from the fire opening when they should not. Based on this analysis, the sprinklers may need to be spaced closer together, the pressure at the sprinklers may need to be increased and/or the design area may need to be increased beyond 12 sprinklers.

Question 5 - Exterior Vestibule

Are there any allowances in NFPA 13 which would permit the omission of sprinklers from an exterior vestibule? The vestibule is 5 ft x 25 ft with non-combustible construction and has occupied space above it.

Answer 5: The answer is that there is no current allowance for sprinkler omission. NFPA 13 essentially requires sprinklers to be installed in all parts of a building unless there is a specific section that allows sprinklers to be omitted. In the case of exterior vestibules, there was a proposal to create an allowable omission under some circumstances as the 2019 edition of NFPA 13 was being prepared, but it was ultimately rejected.

Question 6 - Birdcage Sprinkler Systems

Two questions were asked about "bird cage" systems which are systems without individual floor control valves. A "bird cage system" is where the sprinkler system piping is run on a single floor and then rises up in the walls to feed sprinklers on the floors above.

Question 6.1: Is it permitted to use one floor control assembly for five floors of a residential high-rise having a floor area of 10,000 sq ft per floor? It is realized that this would a maintenance nightmare, but in theory could it be allowed?

Answer 6.1:As long as this building is not considered a high-rise building, the answer is yes, NFPA 13 does not prohibit a "bird cage" system that does not exceed 52,000 sq. ft in total (not per floor). This answer, however, needs some clarification:

You used the term high-rise which is typically considered to be a "building with an occupied floor located more than 75 feet above the lowest level of fire department vehicle access".If this building meets this definition, then section 903.4.3 of the 2018 IBC states that supervised control valves would need to be provided on each floor and would thus prohibit "bird cage systems. This section reads:

> ***[F] 903.4.3*** *Floor control valves. Approved supervised indicating control valves shall be provided at the point of connection to the riser on each floor in high-rise buildings.*

If the building does not meet the definition of a high-rise, then NFPA 13-2019 section 16.9.11 (NFPA 13-2016 section 8.2.4) must be followed. In general, this section requires that all floors of a multistory building exceeding two stories must include a floor control assembly serving each floor. However, section 16.9.11.3 (section 8.2.4.3 in 2016) states that this floor control valve is not required where "the total area of all floors combined does not exceed the system protection area limitations" which in this case would be 52,000 sq. ft.

As the total area of your building appears to be 50,000 sq. ft. (5 floors of 10,000 sq ft each), floor control valves would not be required per section 16.9.11.3. As such a "bird cage" system would not be specifically prohibited by NFPA 13.

Question 6.2: Were "birdcage" systems ever prohibited? Was the term birdcage used in a Tech Notes?

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Answer 6.2: A specific prohibition of "bird-cage" systems in past editions of NFPA 13 is unknown but unlikely. The topic of bird-cage systems was not included in any previous Tech Notes. However, review of our archives revealed that bird-cage systems were discussed in the Spring 1976 issue of SQ magazine.

Question 7 - Pressure Reducing Valves on Standpipes

A number of questions were asked regarding the arrangement of pressure control equipment on an addition to an existing standpipe system that currently creates 220 psi. NFPA 13-2016 and NFPA 14-2016 were identified as being applicable. It should be noted that the answers will be basically the same for all recent editions of both documents.

Question 7.1: Can a single pressure reducing valve be installed to control the pressure of multiple standpipe outlets downstream?

Answer 7.1:The answer is "no." NFPA 14 section 7.2.4 prohibits a single pressure reducing device from serving more than two hose outlets.

Question 7.2: Can two pressure reducing valves be installed in parallel to control the pressure of multiple standpipe outlets downstream?

Answer 7.2: The answer is "no." According to section 7.2.4 of NFPPA 14, the two valves need to be installed in series to meet part 3 of the list of nine items that need to be considered when using two pressure reducing valves. In order to make this arrangement work, the second pressure reducing valve needs to be a pilot operated valve that can adjust to the condition of the first valve. If the first valve is working properly, the second valve stays open and does not reduce the pressure (other than the normal friction loss through the device). But if the first valve fails, the second valve can adjust and create the necessary reduction in pressure to keep the firefighters safe. Figure A.7.2.4 in the annex of NFPA 14 provides a picture of one arrangement that complies with this section.

Question 7.3: Are there other alternatives that would comply with both NFPA 13 and NFPA 14 without any pressure reducing valves?

Answer 7.3:There is at least one. From the existing standpipe system that creates a pressure of 220 psi, you can install an atmospheric tank high up in the building. Depending on how tall the building is and whether the provisions of Chapter 5 of NFPA 14 kick in, this could be a 30,000 gallon tank, or it could be smaller if you are allowed to rely on the refill ability of

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the existing system to get water back into the tank quickly. The tank can be served by a new pump that can be sized to handle the addition on its own. Since the pump is taking suction from the tank at atmospheric pressure, the 220 psi from the existing system is no longer an issue. Depending on the height of the addition, the addition may need to be broken into multiple vertical zones with multiple tanks and pumps in order to control the pressure with no pressure reducing valves.

A variation on this design would be to put the new tank as high as possible in the new addition and size the fire pump to only provide the pressure for the upper floors of the addition. The lower floors might be capable of being supplied by the tank with just the elevation head creating the necessary pressure.

Question 7.4: What does NFPA 13 have to say about pressure reducing valves?

Answer 7.4:NFPA 13 is much more flexible than NFPA 14 because firefighter safety is not an issue. If the excess pressure in the standpipe system causes equipment to be damaged in a sprinkler system, that does not endanger people or firefighters. So, section 8.16.1.2 of NFPA 13 has requirements for the equipment that needs to be installed along with a pressure reducing valve, it does not prohibit the use of a single valve from serving multiple sprinklers or even multiple systems.

All of these options and more are covered in the book, *Standpipe Systems for Fire Protection*, written by Ken Isman, P.E.

Question 8 - Replacement of Standard Response Sprinklers with Quick Response Sprinklers

When replacing a large number of 50-year-old standard response sprinklers in a hospital, are quick response sprinklers required to be used as the replacements?

Answer 8:The answer is it depends. However, quick response sprinklers would be the best option. Standard response sprinklers might be permitted but might create problems for the hospital down the road.

The requirement for quick response (or residential) sprinklers in NFPA 13 only applies to light hazard areas. As far as NFPA 13 is concerned, any ordinary hazard areas in the hospital (like janitor's closets, kitchens, stockroom, etc.) are permitted to use standard response sprinklers, even in new applications. However, NFPA 101 (which all hospitals must meet in order to be eligible for reimbursement

under Medicare and Medicaid) goes a bit further to require quick response (or residential) sprinklers in all spaces of smoke compartments that contain patient rooms (see NFPA 101 section 18.3.5.6). In this context, the term "smoke compartment" refers to a wing of the hospital that is significantly separated from the rest of the hospital by tight construction that resists the passage of smoke from one area to the next. Smoke compartments are groups of rooms that usually go up to about 20,000 sq. ft.

When considering the rules of NFPA 13 and NFPA 101 together, all of the sprinklers in a smoke compartment that contains patient rooms must be quick response, even if they are ordinary hazard rooms. Outside of these smoke compartments with patient rooms (operating rooms, treatment rooms, offices, storerooms, kitchens, janitor's closets, etc.) sprinklers in ordinary hazard rooms can be standard response.

NFPA 13 does allow standard response sprinklers to be replaced with standard response sprinklers (see section 8.3.3.1(6), however this section specifically says "individual standard response sprinklers", meaning that if one sprinkler needed to be replaced (possibly because there was paint on it or it was damaged), then you would be permitted to replace it with a new standard response sprinkler. The implication of the phrase "individual standard response sprinklers" in this section is that when many sprinklers are being replaced, they must be quick response.

It could be argued that the building does not need to meet the recent editions of NFPA 13. However, it is general practice in most jurisdictions that buildings only need to meet the edition of the code for when they were originally constructed (in this case at least 50 years ago). While this argument might have some merit within the code structure, it would put the hospital at a distinct disadvantage because they need to meet the more recent editions of the *Life Safety Code* in order to be eligible for Medicare and Medicaid, which is critical to the bottom line for most hospitals. There are some clauses in the *Life Safety Code* for existing buildings that might allow continued use of standard response sprinklers, but the Life Safety Code as a whole, makes the hospital easier to use and more flexible in design if quick response sprinklers are used.

In summary, while a path might be found through the grandfather clauses that allow a building to meet the code under which it was originally constructed and through the existing building requirements of the *Life Safety Code*, it would be much better for the client to have the quick response sprinklers in their facility.

Question 9 - Sprinkler Protection Above a Ceiling

with I-Joists

In a one-story building with 24 in. deep I-Joists spaced 24 in. on center, plywood roof sheathing and a lay in ceiling below, what options are available to provide sprinkler protection above the lay-in ceiling in accordance with NFPA 13-2016?

Answer 9: NFPA 13-2016 section 8.6.4.1.2(2) sets a maximum deflector distance below the deck of 22 inches. Centered between the I-joists, you would be less than 1 ft from either side, meaning that Table 8.6.5.1.2 would not allow the deflector to be located above the lower edge of the I-joists.

There are a number of options:

1. Locate sprinklers within every joist channel
2. Attach a ceiling to the underside of the wood joists such that the joist channels are allowed as nonsprinklered combustible concealed spaces in accordance with section 8.15.1.2.6 (note additional restrictions). Depending on the combustibility of the ceiling, the space above the suspended ceiling might still require sprinklers.
3. Provide some noncombustible insulation in the joist channels to reduce their effective depth such that sprinklers can be located below the composite wood joists or, depending on the height of the space above the suspended ceiling, special listed combustible concealed space sprinklers can be used in the space below the joists.
4. If the I-joists have a maximum nominal chord width of 2 inches, completely fill the joist spaces with noncombustible insulation and with a noncombustible or limited combustible suspended ceiling below so as to allow omission of sprinklers above the ceiling in accordance with section 8.15.1.2.17.

There may be other options as well - we encourage a thorough review of the applicable edition of the standard.

Question 10 - Sprinklers Below Obstructions

If a large piece of HVAC equipment is installed about 4 inches above the floor above a pan that sits on the floor, would sprinklers be required under the HVAC equipment (above the pan on the floor)?

Answer 10:The answer is "no." The pan on the floor and the isolators that keep the HVAC unit above the pan are important parts of the operation of the HVAC unit. The pan is there to collect small amounts of condensate that might drop from the unit and the

isolators hold the rest of the unit above the pan so that air can circulate and evaporate the small amount of water that might collect. Since the pan is part of the HVAC unit, sprinklers are not required per NFPA 13 - 2019, section 9.2.10 (NFPA 13-2016 section 8.1.1(8)), which states that sprinklers are not required in mechanical equipment. The space between the pan and the rest of the unit above is all part of the unit and therefore does not require sprinkler protection.

In NFPA 13-2016, the concept was expanded to allow sprinklers to be omitted from under any noncombustible object that is 24 inches or less above the floor. So, the intent of the committee is clearly not to require sprinklers under such a low object.

Question 11 - Concealed Space Sprinklers

Due to the installation of a new noncombustible suspended ceiling, a noncombustible concealed space has been created from which most of the existing upright sprinklers have been removed. Is there basis for requiring removal of the remaining sprinklers?

Answer 11: There is no known mandate to remove the additional sprinklers if they are part of a functioning sprinkler system. Although NFPA 13 allows omission of sprinklers from a noncombustible concealed space, there is no prohibition against sprinkler protection of such spaces. And while the removal of many of the sprinklers has left incomplete protection, the spot protection provided may nevertheless be useful at some point in the future. The NFPA sprinkler standards contain some rules specifically allowing spot protection for localized combustibles. However, generally speaking, sprinklers installed in spaces where protection is permitted to be omitted should still meet the location, spacing, and positioning requirements of the standard, or meet the localized protection per section NFPA 13-2016 section 8.15.1.5.

Fire codes do generally require the removal of fire sprinkler equipment that is not functional on the basis that it could give responding firefighters and others a false sense of protection. It would be prudent to discuss the situation with both the owner and the authority having jurisdiction to determine if the sprinklers should be removed or remain in place.

Question 12 - Additional Sway Bracing

Does NFPA 13-2016 section 9.3.5.5.9 require additional sway bracing requirements where additional flexible couplings have been on installed on 4 in. and 6 in. on mains passing through a rated lathe and plaster wall? The firestop detail indicates a maximum annular clearance of 2.25 in. which does not meet the NFPA 13

requirements. Use of NFPA 13-2016 section 9.3.4.5 requires the installation of a flexible coupling within 1 ft of each side of the wall, and sizing of the holes in accordance with the listing of the firestop assembly. Would additional lateral bracing be required at these flexible couplings?

Answer 12:The answer is "no." The use of flexible couplings as described is essentially within the requirements of NFPA 13-2016 section 9.3.2, which is exempt from the extra bracing requirements of section 9.3.5.5.9.

Section 9.3.2.3.1(3) specifically discusses flexible couplings on both sides of a wall. While this is slightly different from the described situation, the fact still remains that the system is arranged exactly like section 9.3.2.3.1(3) and would have the same rigidity, so it would be allowed as an "alternate arrangement that meets the same level of protection as described by the standard" in accordance with section 1.7.

The purpose of section 9.3.5.5.9 is to discourage the use of flexible couplings where they are unnecessary. In this case, the flexible couplings are necessary and there is no reason to require additional lateral bracing.