

TechNotes Issue # 375 June 13, 2017

Best of May 2017

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 May 2017. This information is being brought forward as the "Best of May 2017." 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 - Requirement for Tank Refill in 8 Hours

A 125,000-gallon water storage tank is to be filled from a well that does not the flow capacity to fill the tank within 8 hours as required by NFPA 22. The required capacity for this installation is 117, 000 gallons and the well is only able to supply 80 gpm. In order to fill the tank to 117,000 gallons in 8 hours, a flow rate of 260 gpm would be required.

Question 1a: If the tank was oversized, can that alleviate the 8 hour fill requirement? If so, how large would the tank have to be?

Answer: No. While you certainly can oversize the tank, this will not help to meet the requirement of NFPA 22 to fill the tank within 8 hours. The purpose of the 8-hour fill time



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requirement is to minimize the time that the fire protection system will be out of service due to insufficient water supply after a system activation or during maintenance. It must be noted that anytime that the tank does not have sufficient capacity to meet the demand of the fire protection system, the impairment procedures of NFPA 25 must be followed. See the answer to question 1c for a possible solution to this issue.

Question 1b: Is there any way to have a "reserve" amount in the tank to supplement the lack of water supply?

Answer: As stated in Answer 1a above, you may oversize the tank to include a reserve but this will not help you meet the fill time requirement. If the tank is drained for maintenance, a reserve capacity will not be available to the fire protection system. The 8-hour fill time is to limit the down time in these cases and with an 80 gpm flow-rate for the fill, you would not be able to fill the 117,000 gallons needed in this time frame.

Question 1c: Can the tank be filled by alternate methods and still meet the intent of the standard? (e.g. tanker trucks)

Answer: Yes, an alternate means to fill the tank would be acceptable if approved by the AHJ. This allowance is found in NFPA 22 (2013) in section 14.4.1.1 which reads as follows:

14.4.1.1 Where a permanent water supply is not available to refill the tank, an approved plan shall be permitted for manually refilling the tank.

It is suggested that you approach the AHJ with a plan to refill the tank as you cannot meet the 8-hour fill time requirement. As part of the plan, it would be important to spell out the impairment procedures for the time when the tank does not have sufficient capacity to meet the fire protection system demand. See also section 14.4.1.2 which reads:

14.4.1.2 During the time that the tank does not have sufficient capacity to meet the demand of the fire protection system(s), the impairment procedures of NFPA 25 shall be followed.

Question 2 - Horizontal Sidewalls and Sloping Ceilings

A gym to be provided with sprinkler protection has a smooth ceiling with a slope of 3:12. The owner would like to protect this sloped ceiling with horizontal sidewalls spraying across the slope. (i.e. piping to be run up the slope

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alongside the beams)

NFPA 13 states that the horizontal sidewall sprinklers must be located at the high point of the slope and discharging down the slope and not across the slope. Is this interpretation correct?

Answer: Yes. Sidewall sprinklers are permitted to be installed under sloped ceilings but they must be installed at the high point of the slope and positioned to discharge down the slope. NFPA 13 does not permit sidewall sprinklers to spray across the slope. This requirement is found in section 8.7.4.2.2 of the 2016 edition of NFPA 13 and reads as follows:

8.7.4.2.2 Sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located at the high point of the slope and positioned to discharge downward along the slope.

Question 3 - Minimum Clearances Around Pump Controller

What is the minimum distance of piping from a fire pump controller? The consensus is 3 feet minimum, is this correct and where is the code reference found?

Answer: The minimum distance of piping from a fire pump controller is based upon the type of controller, the voltage of the controller, and configuration of the controller. In many cases the 3-foot minimum clearance stated above is correct, however there are situations where this clearance is required to be greater (e.g. 3 ½ feet or 4 feet). The base requirement for clearances is found in in NFPA 20 (2016) in section 4.13.1.1.7 which reads as follows:

4.13.1.1.7 The pump room or pump house shall be sized to fit all of the components necessary for the operation of the fire pump and to accommodate the following:

- (1) Clearance between components for installation and maintenance
- (2) Clearance between a component and the wall for installation and maintenance
- (3) Clearance between energized electrical equipment and other equipment in accordance with NFPA 70
- (4) Orientation of the pump to the suction piping to allow compliance with 4.15.6.3

Subsection (3) deals with the required clearance from electrical equipment such as fire pump controllers. As you can be seen, the requirements of NFPA 70 must be followed in addition to those of NFPA 20.

Section 10.2.4 and section 12.2.4 of NFPA 20 further specifies that working clearances around controllers shall comply with NFPA 70 (National Electric Code®), Article 110. Specifically, section 110.26 of the NEC outlines the clearance requirements needed around electrical equipment for inspection and maintenance purposes.

It is important to note that there are two distinct categories for required open space around electrical equipment such as fire pump controllers. These categories are:

Dedicated Equipment Space: NFPA 70 (2017) Section 110.26(E)(1)(a) defines a dedicated electrical space as the space equal to the width and the depth of the equipment extending from the floor to a height of 6 feet above the equipment or the structural ceiling, whichever is lower. This section further states that no foreign systems shall be allowed in this zone. So, as long as the sprinkler piping does not run through this dedicated electrical space, it can go in and out of the electric room without issue. NFPA 70, Section 110.26(E)(1)(b) further goes on to say that foreign systems can be in the area above the dedicated electrical space so long as the electrical equipment is properly protected against leaks or breaks in the foreign system. So the sprinkler piping may run above the dedicated electrical space (6 ft above equip), as long as the equipment below is protected from leaks. This is accomplished with the use of shields. The annex section only aimed to emphasize that this is permitted.

Working Space: NFPA 70 (2017) Section 110.26 outlines the minimum clear distance needed for maintenance purposes.

Depth of working space is found in section 110.26(A)(1) which outlines the minimum clear distance (depth) required in front of the electrical equipment such as fire pump controllers. For example, for electrical equipment that operates at 151 to 600 volts, the minimum clear distance is based upon the type and configuration of electrical equipment. The required depth of the working space would be:

- 1) Working space of 3 feet is required if the controller meets Condition 1 which is defined as:
"Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials." This is a common situation for fire pump controllers.

2) Working space of 3 ½ feet is required if the controller meets Condition 2 which is defined as:
"Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded."

3) Working space of 4 feet is required if the controller meets Condition 3 which is defined as:
"Exposed live parts on both sides of the working space."

Width of the working space in front would be in accordance with section 110.26(2) which requires the width of the working space in front of the electrical equipment to be the width of the equipment or 30 in., whichever is greater.

Height of the working space is found in section 110.26(3) and must extend from the grade, floor, or platform to a height of 2.0 m (6½ feet) or the height of the equipment, whichever is greater.

In order to make sure that your piping meets the required clearance from the fire pump controller, the installing contractor should review NFPA 70 and also review the controller manufacturer's instructions.

Question 4 - Sidewall Sprinklers Directly Below a Skylight

A sidewall sprinkler will be located on a wall directly under a skylight. The deflector distance from the sidewall sprinkler to the top of the skylight exceeds the maximum deflector distance permitted by NFPA 13 (2013) 8.7.4.1.1.

Can this sprinkler remain or must it be repositioned to a location with a ceiling directly above it?

Answer: Based on new language added to the 2016 edition of NFPA 13, this sprinkler would not need to be repositioned. Sprinklers are not required to be located within any skylight that does not exceed 32 square feet in area. However, the floor area below is required to be covered by sprinklers at the lower ceiling level. As the skylight in question is approximately 14 square feet, the skylight itself would not be required to have a sprinkler inside.

This requirement is found in section 8.5 which applies to all sprinkler types including sidewall sprinklers. This section reads as follows:

8.5.7.1 Sprinklers shall be permitted to be omitted from skylights not exceeding 32 ft² (3.0 m²) in area, regardless

of hazard classification, that are separated by at least 10 ft (3.0 m) horizontally from any other unprotected skylight or unprotected ceiling pocket.

Prior to the 2016 edition, it would typically have been interpreted to mean that the sprinkler at the lower level must be positioned directly below the ceiling within the required deflector distance (i.e. 4 to 6 inches for sidewall sprinklers). It would have been recommended that the sprinkler be repositioned directly under the lower ceiling. However, in the 2016 edition of NFPA 13, a section was added stating that the position of this sprinkler directly under the skylight is acceptable. This new section reads as follows:

8.5.7.1.1 When a sprinkler is installed directly beneath a skylight not exceeding 32 ft² (3.0 m²), the distance to the ceiling shall be measured to the plane of the ceiling as if the skylight was not present.

If the jurisdiction has adopted the earlier edition of NFPA 13, it would be up to the AHJ whether or not to allow the sprinkler to remain as installed based on the new language in the latest edition. The 2016 edition of NFPA 13 is the current thinking of the technical committee and they have deemed that the installation as described is acceptable.

Question 5 - Sprinklers Below a Round Duct Obstruction

There is a situation where sprinklers are required beneath a round duct in excess of 4 feet wide as per NFPA 13 (2016) 8.5.5.3.1.1 regarding sprinklers below wide obstructions.

8.5.5.3.1.1 Sprinklers shall be located below the obstruction and not more than 3 in. (75 mm) from the outside edge of the obstruction.

Where are sprinklers required to be installed in relation to the large round duct?

Answer: Sprinklers must be installed within 12 inches below the lowest point of the obstruction either directly below any part of the obstruction as it appears in plan view or within 3 inches horizontally outside the edge of the obstruction". The requirements in 8.5.5.3.1 do not differentiate based on the cross sectional profile of the obstruction; a round duct is treated the same as a rectangular duct. Research has shown that, as long as the sprinkler is placed under or close to the edge of an obstruction, sufficient heat from a fire directly below the obstruction will be channeled to the sprinkler to cause it to

operate. Sprinklers may be located up to 3 inches outside the perimeter of the obstruction or provided with an armovert to any point below it. In either case, the deflector height must be within 12 inches vertically below the level of the lowest part of the obstruction.

8.5.5.3.1* Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) in width.

8.5.5.3.1.1 Sprinklers shall be located below the obstruction and not more than 3 in. (75 mm) from the outside edge of the obstruction.

8.5.5.3.1.2 Where sprinklers are located adjacent to the obstruction, they shall be of the intermediate level rack type.

8.5.5.3.1.3 The deflector of automatic sprinklers installed under fixed obstructions shall be positioned no more than 12 in. (300 mm) below the bottom of the obstruction.

Note that intermediate level/rack type sprinklers are always required under round ducts as per 8.6.5.3.7. This section applies to standard upright/pendent sprinklers but should be carefully considered for other types as well.

8.6.5.3.7 Sprinklers installed under round ducts shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

A similar question was addressed in NFSA's TechNotes, #310, January 13, 2015.

Question 4 - Large Round Ductwork

A round duct is being installed. It is over 4 feet in diameter. The ceiling sprinklers are standard spray sprinklers with more than 18 inches between the deflector and the ductwork. When locating sprinklers below the obstruction, do they have to be in the center-line of the duct or is it permitted to be anywhere below the duct?

Answer: NFPA 13 has no requirement for the sprinkler below an obstruction to be located in the center-line of the obstruction when using standard spray sprinklers, even if it is a round duct. Yet, it is important to remember that the sprinklers below an obstruction are to handle a situation that starts directly under that obstruction. This was discussed in the first draft meeting for the 2016 edition of NFPA 13. There were concerns presented that the heat would not bank below round ducts and the activation of the sprinkler could be delayed. However, no modifications were made to the rules of NFPA 13. The rule remains that a sprinkler must be located under obstructions more than 4 ft wide, but no further guidance on placement under round obstructions is given. There was a first draft revision that

stated "sprinklers shall be located below the obstruction and not more than 3 inches from the outside edge of the obstruction. It goes on to say that if the sprinkler is in that 3-inch range beyond the obstruction then it is considered adjacent to the obstruction and will need to be intermediate level rack type.

Question 6 - NFPA 30 Section 12.8.1 Option 1

There is a project where the owner is proposing the storage of class IIIB liquids stored up to 14 feet in single and double row racks. NFPA 30 (2015) 12.8.1 regarding general purpose warehouses has been referenced. It has been stated that the intention is to utilize option 1 and to eliminate in-rack sprinklers.

12.8.1* Class IB and IC liquids in containers of 1.3 gal (5 L) or less capacity, Class II liquids in containers of 5.3 gal (20 L) or less capacity, Class IIIA liquids in containers of 60 gal (230 L) or less capacity, and Class IIIB liquids in containers, intermediate bulk containers, or portable tanks of 275 gal (1040 L) or less capacity shall be permitted to be stored in warehouses that handle combustible commodities, as defined in NFPA13, Standard for the Installation of Sprinkler Systems, provided that the storage area for liquids is protected with automatic sprinklers in accordance with either of the following:

- (1) The applicable provisions of NFPA 13 for 20 ft (6 m) high storage of Class IV commodities based on the storage configuration of the liquids
- (2) The provisions of Chapter 16

It has been proposed to utilize NFPA 13 (2013) Table 16.2.1.3.2 which directs the user to Figure 16.2.1.3.2(d) and curve E which indicates a density of 0.495 gpm/ft² over 2000 ft². Applying Figure 16.2.1.3.4.1 reduces the density to 0.297 gpm/ft².

Is this solution permissible under NFPA 13?

Answer: Yes, if option 1 of NFPA 30 (2015) 12.8.1 is selected, the proposed solution appears to be permissible.

Please note that we cannot endorse the selection of option 1 in this application. As indicated in A.12.8.1, this option should not be construed to provide adequate protection. There is no data supporting this option as an effective protection strategy. In response to a Public Input submitted by NFSA, this option will not appear in the 2018 edition of NFPA 30 unless it is reinstated by the Standards Council prior to that edition's anticipated publication later

this year.

A.12.8.1 The provision of automatic sprinklers designed to protect Class IV commodities to a height of 20 ft (6 m) for the liquid storage quantities and arrangements allowed in a general-purpose warehouse should not be construed as providing adequate protection. Fire tests utilizing such design criteria on the allowed storage arrangements have never been conducted, and other test results imply that control of a liquid pool fire might not be obtained. Examples of fire protection can be found in Chapter 16.

Question 7 - Determining Floor Levels

A building has 3 floors of residential occupancy, a basement level, and a sundeck on the roof. The overall height above grade is 33 feet 2 inches. It is proposed to protect this building with a NFPA 13R system.

Is an NFPA 13R system appropriate for this building?

Answer: Yes, based on NFPA 13R (2010) 1.1 Scope, that standard would be appropriate. The installation standard does not explicitly define a "story" but the building code typically counts building heights based on the number of stories above grade. Under the International Building Code, this building would be either a 2 or 3 story building depending on whether the first floor above the basement is above the grade plane. The basement level would not be counted as a story as its floor would be below the grade plane. The sundeck on the roof does not count as a story unless it is provided with a roof or roof structure of its own. Otherwise it does not meet the definition of a story; it is simply an occupiable roof. Based on the building height provided, it is assumed that the sundeck has no roof structure.

1.1* Scope. This standard shall cover the design and installation of automatic sprinkler systems for protection against fire hazards in residential occupancies up to and including four stories in height.

STORY. That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above (see "Basement," "Building height," "Grade plane" and "Mezzanine"). A story is measured as the vertical distance from top to top of two successive tiers of beams or finished floor surfaces and, for the topmost story, from the top of the

floor finish to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters.

Note that the 2016 edition carries an updated scope for NFPA 13R:

1.1* Scope. This standard shall cover the design and installation of automatic sprinkler systems for protection against fire hazards in residential occupancies up to and including four stories in height in buildings not exceeding 60 ft (18 m) in height above grade plane.

Question 8 - Omitting Sprinklers Under Exterior Projections

A high-rise building protected with a NFPA 13 (2013) system. There is an exterior projection 9 feet 2 inches wide at the main entrance as part of the egress path. An interpretation of 8.15.7 Exterior Projections would permit sprinklers to be omitted under this exterior projection. However, the commentary in A.8.15.7.2 suggests that sprinklers should be provided where there are occupied areas above*.

A.8.15.7.2 Vehicles that are temporarily parked are not considered storage. Areas located at drive-in bank windows or porte-cocheres at hotels and motels normally do not require sprinklers where there is no occupancy above, where the area is entirely constructed of noncombustible or limited-combustible materials or fire retardant-treated lumber, and where the area is not the only means of egress. However, areas under exterior ceilings where the building is sprinklered should be protected due to the occupancy above.

Are sprinklers permitted to be omitted under exterior projections with occupied spaces above?

Answer: Yes, as long as the construction of the exterior projection meets the requirement of 8.15.7.2, sprinklers may be omitted. The commentary in Annex A does not reflect the full consensus of the technical committee and is not an enforceable part of the standard. It serves only as a suggestion.

8.15.7.2* Sprinklers shall be permitted to be omitted where the exterior projections are constructed with materials that are noncombustible, limited-combustible, or fire retardant-treated wood as defined in NFPA 703.

*Note that the annex comment recommending sprinklers in

exterior ceilings when there is occupied space above has been removed from the First Revision of the 2019 edition of NFPA 13.

Question 9 - Upright ESFR Sprinklers Under Beam and Z-Purlin Roof

A building has a roof structure that is comprised of large beams at the columns and small z-purlins (10" tall) that span across the beams. Upright ESFR sprinklers will be used. Is it permissible for the ESFR sprinklers to be installed with deflectors at 12 inches below the ceiling and spaced within the large beam pockets or must sprinklers be spaced within each z-purlin pocket?

Answer: NFPA 13 (2016) 8.4.6.3.1 identifies that, where depths of solid structural members exceed 12 inches, ESFR sprinklers shall be installed in each channel formed by the solid structural members. Since the z-purlins are 10 inches, this rule does not apply and the ESFR sprinklers can be spaced within the larger beam pockets. Sections 8.12.4.1.4 and 8.12.4.1.5 identify that the sprinkler deflectors must be within 12 inches of the roof/ceiling when upright ESFR sprinklers are used, which has been properly accounted for in the proposed configuration.

Question 10 - Grated Mezzanines Less than 4 Feet in Width

Open grate mezzanines less than 4 feet wide are scattered throughout a mezzanine level. Beneath the open grating is a space roughly 9 feet tall with noncombustible construction and mechanical equipment. Are sprinklers required under these grated mezzanine areas?

Answer: NFPA 13 (2013) requires sprinklers to be installed beneath obstructions that are over 4 feet in width, per section 8.5.5.3.1. Subsequent sections of chapter 8 calls out for the same requirements for each individual sprinkler type (Sections 8.6, 8.7, 8.8, etc.). This requirement also applies to open grate walkways. The rationale behind this is, where you have open grate walkways regardless how open the grates are, there is a constant concern of leaving objects above to open grate and creating an obstruction below. We see in section 8.6.5.3.5 that "Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers" and there is similar language for other sprinkler types.

Therefore, if these walkways are less than 4 feet in width it

would not be required to install additional sprinklers below them.

Question 11 - Inspectors Test Connection for Dry Pipe System

A diagram of an inspector's test connection (trip test) for a dry pipe system indicates that the connection comes off of an auxiliary drain (drum drip) and includes a 1 inch by ½ inch sight glass and discharges to the exterior. The arrangement shown does not include a line break with a plug.

Is this test arrangement, without a plug, acceptable?

Answer: No, a plug or nipple & cap is required in the trip test connection to a dry pipe system. The dry pipe inspectors test connection must be located at the end of the most remote sprinkler pipe and must include an accessible valve and a plug or nipple & cap. The purpose of this plug is to avoid leakage of air past the valve which may lead to accidental tripping of the dry pipe valve.

This requirement is found in NFPA 13 (2016) in section 8.17.4.2.2 and 8.17.4.2.3. Earlier edition of NFPA 13 have similar requirements.

8.17.4.2.2 The trip test connection or manifold shall be located on the end of the most distant sprinkler pipe in the upper story and shall be equipped with an accessible shutoff valve and a plug not less than 1 in. (25 mm), of which at least one shall be brass.

8.17.4.2.3 In lieu of a plug, a nipple and cap shall be acceptable.

As the requirement for a plug in the inspector's test connection is in the body of the standard, it is a requirement and cannot be omitted.

Question 12 - Residential Sprinklers Under High, Sloped, and Beamed Ceilings

The 2007 edition of NFPA 13 in regards to the use of residential sprinklers under sloped roofs has been referenced. Section 8.10.2.2. states, "Where residential sprinklers are installed on a slope greater than 2 in 12, they shall be listed for this application." Specifically, it is asked if the 2010 or 2013 edition of NFPA 13 has eliminated the requirement for residential sprinklers to be installed for use under sloped ceilings.

Answer: The 2013 edition of NFPA 13 changed the verbiage of section 8.10.2.2 to require listing where "slopes greater than 8:12 or ceilings with heights greater than 24 feet". These criteria came from the 2012 Fire Protection Research Foundation report on their testing of residential sprinklers under sloped, and beamed & sloped ceilings. The results of this testing introduced new criteria into NFPA 13, NFPA 13R and NFPA 13D for sloped ceilings up to 8:12 and with beams up to 14 inches in depth. Upon the inclusion of the new language in NFPA 13, NFPA 13R and NFPA 13D, listing agencies have terminated special listings as the standards now permit residential sprinklers to be installed in such situations without special listings.

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