

TechNotes Issue # 412
January 15, 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 December 2018. This information is being brought forward as the "Best of December 2018." If you have a question for the NFSA EOD (and you are an NFSA member), send your question to eod@nfsa.org and the EOD will get back to you.

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

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Question #1 - Listed Antifreeze Solutions

A question was submitted in response to the release of Tech Notes #411 regarding a new antifreeze product and a recent call for participation in a UL Standards Technical Panel (STP). The outreach for the development and maintenance of UL 2901 as a new standard for Antifreeze Solutions for Use in Fire Sprinkler Systems, prompted the following question: How is it that there is a UL listed antifreeze product on the market

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without having a developed STP?

Answer: In order to answer this question, NFSA contacted UL and received the following statement from Jeff Hebenstreit, Principal Engineer of Fire Suppression Products:

"At this point there is no STP for UL 2901 and UL 2901 is an Outline of Investigation, not an ANSI standard. UL first published the Outline of Investigation for UL 2901 in December 2013, in which the requirements were developed by UL based upon the information and knowledge available at that time. The ability for UL to develop Outlines of Investigation provides the opportunity for UL to develop requirements in a timely manner for innovative products and for new areas in which there may not be a standard. UL may or may not seek input from outside parties in developing requirements for Outlines of Investigation, but in all cases, UL makes the final decision as to the requirements that are published in an Outline of Investigation. Requirements in UL's Outlines of Investigation are not consensus requirements, such as those that are published in ANSI standards.

Over the course of the last 5 years UL has been working with the test methods in UL 2901 as we have been evaluating antifreeze products. As is often the case with testing in standards and especially new standards and new test methods, modifications to the methods and requirements may be needed as information and data is gathered while evaluating products to the new methods. We anticipated that would be the case with UL 2901 while we were working with several new test methods. Information and data can be gathered from testing or dialogue and collaboration with other stakeholders as well, such as AHJs, clients, previous research reports on the topic such as the FPRF testing, etc. Prior to making any revisions to the requirements in an Outline of Investigation, UL 2901 in this case, UL thoroughly vets the information and data internally with several UL staff who have relevant expertise. In November 2018, UL published Issue 2 of UL 2901, which was modified based upon information we gathered from extensive research and work with all of the test methods over the course of the last 5 years.

Now that we have been able to work through all the methods, we believe that the current version of UL 2901 is suitable for consideration as an ANSI standard, so steps are being taken to form an STP which will provide the opportunity for consensus requirements to be published in an ANSI version of UL 2901. If that occurs, the UL 2901 Outline of Investigation will be withdrawn at the appropriate time."

Question #2 - Clean Agent

Is there any language in NFPA 13 or NFPA 2001 to permit a clean agent system in lieu of a sprinkler system in a room containing information technology equipment?

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Answer: No, there is no language in NFPA 13 or NFPA 2001 that would permit the use a clean agent system in lieu of a sprinkler system. This is a building code issue and the adopted building codes in your jurisdiction should be followed. One example is the 2018 IBC Section 904.2.1:

904.2.1 Restriction of using automatic sprinkler system exceptions or reductions.

Automatic fire-extinguishing systems shall not be considered alternatives for the purposes of exceptions or reductions allowed for automatic sprinkler systems or by other requirements of this code.

While the IBC does permit substitution of alternate systems. If sprinklers are omitted in the room, the building is no longer "fully sprinklered" and none of the sprinkler exemptions or reductions can be applied in the building. The building code official in your jurisdiction, or a responsible design professional, should be consulted to determine if the arrangement described is permissible.

The use of a clean agent system is not typically considered as an equivalency or substitution for a sprinkler system. The use of a clean agent system can be compromised by having a door propped open, too many penetrations through partitions which were not accounted for in the design, an insufficient soak time or application rate used. In general terms, a clean agent system is used as a supplemental system. These systems are intended to provide protection of the equipment in the server room while the sprinkler system is intended to provide protection of the structure/building. These systems have different purposes, so the sprinkler system should not be replaced by the clean agent system but rather supplemented by the addition of the clean agent system.

NFPA 75-2017 provides the following requirements for buildings or rooms having information technology equipment (ITE):

9.1 Automatic Fire Protection Systems.

9.1.1 *ITE rooms and ITE areas located in a sprinklered building shall be provided with an automatic sprinkler system.*

...

9.1.2* *Automatic sprinkler systems protecting ITE rooms or ITE areas shall be installed in accordance with NFPA 13.*

9.1.3 *Sprinkler systems protecting ITE areas shall be valved separately from other sprinkler systems.*

9.1.3.1 *Valves shall be in an approved location that is exterior to the room, readily accessible, and labeled as to what they control.*

Question #3 - Combustible Construction and Concealed Mechanical Equipment

Combustible construction is being used to house a fan coil unit (non-fuel fired) which has created a combustible concealed space. NFPA 13-2016 section 8.1.1(8) states, "Sprinklers shall



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(2016 Edition)

not be required to be installed within electrical equipment, mechanical equipment, or air handling units not intended for occupancy." Is this an appropriate exception?

Answer: No, this is not the most appropriate provision to omit sprinklers. The referenced citation applies to the installation of sprinklers within mechanical equipment not the enclosure housing the equipment. Clarification is provided in annex section A.8.1.1(8).

A.8.1.1(8) Equipment having access for routine maintenance should not be considered as intended for occupancy.

The area described is a combustibile concealed space and should follow the requirements of section 8.15.1. Specifically:

8.15.1.1 *Concealed Spaces Not Requiring Sprinkler Protection. Concealed spaces of exposed combustibile construction shall be protected by sprinklers except in concealed spaces where sprinklers are not required to be installed by 8.15.1.2.1 through 8.15.1.2.18 and 8.15.6*

There are two applicable conditions which would permit the omission of sprinklers from the combustibile mechanical equipment enclosure. The first would be the condition identified in section 8.15.1.2.7. The other is the condition identified in section 8.15.1.2.10.

8.15.1.2.7 *Concealed spaces filled with noncombustibile insulation shall not require sprinkler protection.*

Filling the space with a noncombustibile insulation is acceptable, however the units must be able to be fully serviced without disturbing the insulation if the cavities are entirely filled.

8.15.1.2.10 *Concealed spaces where ridged materials are used and the exposed surfaces have a flame spread index of 25 or less, and the materials have been demonstrated not to propagate fire more than 10.5 ft when tested in accordance with ASTM E84, "Standard Test Method of Surface Burning Characteristics of Building Materials" or ANSI/UL 723, "Standard for Test for Surface Building Characteristics of Building Materials," extended for an additional 20 minutes in the form in which they are installed, shall not require sprinkler protection.*

The entire space can be faced with one layer of gypsum board; however, the constructability seems to be an issue.

There is an additional requirement that comes into play if sprinklers are omitted per the provisions above:

11.2.3.1.5.1* *When using the density/area or room design method, unless the requirements of 11.2.3.1.5.2 are met for buildings having unsprinklered combustibile concealed spaces, as described in 8.15.1.2 and 8.15.6, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft².*

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The design area of 3000 ft² shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed space, where the term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying combustible concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

In the event that sprinklers are omitted in this scenario, the design area would have to be increased unless the omission meets one of the requirements of 11.2.3.1.5.2. While similar to the provisions in 8.15.1.2, they are not exactly the same since two separate NFPA 13 technical committees are responsible for the provisions of Chapter 8 and Chapter 11.

Question #4 - Minimum Pipe Size in Gridded Systems

Can 1 in. pipe be used in gridded systems?

Answer: Yes, per NFPA 13-2016 section 23.4.1.2, "Pipe sizes shall be no less than 1 in. nominal for black or galvanized steel piping and ¾ in. nominal for copper tubing or brass, stainless steel, or nonmetallic piping listed for fire sprinkler service unless permitted by 8.15.20.4 and 8.15.20.5."

While friction loss substantially increases when gridded branch lines are reduced to 1 in., as long as the system works hydraulically, 1 in. pipe may be used on gridded systems. The only other special requirements for calculating gridded systems are found in section 23.4.4.5 which requires the layout technician to verify that the most hydraulically demanding area is being used and that two additional sets of calculations are provided to demonstrate peaking or have peaking be shown on a computer-generated calculation.

Question #5 - Sprinklers in Grease Ducts

Two separate questions have been asked which have been responded to separately.

Question 5.1: Does NFPA 13 or NFPA 96 detail an approved opening/penetration for protection of exhaust ducts?

Answer 5.1: Neither NFPA 13 nor NFPA 96 detail penetrations into the duct. The only requirement is that the opening should be protected. Per NFPA 96-2017:

7.4.4 Protection of Openings.

7.4.4.1 *Openings for installation, servicing, and inspection of listed fire protection system devices and for duct cleaning shall be provided in ducts and enclosures and shall conform to the requirements of Section 7.3 and 7.7.4.*

The duct manufacturer should be contacted to determine the proper way to penetrate and seal their product as to not violate their listing.



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Question 5.2: Rather than penetrate the duct work would a dedicated wet pipe sprinkler system above or pointed at the duct (at the prescribed spacing/location) meet the intent for duct protection?

Answer 5.2: No, NFPA 13-2019 section 8.9 covers the protection of commercial-type cooking equipment and ventilation. The section states the following:

8.9 Commercial-Type Cooking Equipment and Ventilation.

8.9.1 General. *In cooking areas protected by automatic sprinklers, additional sprinklers or automatic spray nozzles shall be provided to protect commercial-type cooking equipment and ventilation systems that are designed to carry away grease-laden vapors unless otherwise protected.*

This charging language in section 8.9.1 requires the ducts described to be protected with sprinklers as they are not protected by another means, and section 9.2 provides for the scope of the cooking equipment protection to include those items as stated in 8.9.2.1:

8.9.2* Sprinklers and Automatic Spray Nozzles.

8.9.2.1 *Standard spray sprinklers or automatic spray nozzles shall be so located as to provide for the protection of exhaust ducts, hood exhaust duct collars, and hood exhaust plenum chambers.*

As sprinklers are required in this application, their location is determined by section 8.9.3:

8.9.3 Sprinkler and Automatic Spray Nozzle Location - Ducts.

8.9.3.1 *Unless the requirements of 8.9.3.2 or 8.9.3.4 are met, exhaust ducts shall have one sprinkler or automatic spray nozzle located at the top of each vertical riser and at the midpoint of each offset.*

8.9.3.2 *Sprinklers or automatic spray nozzles shall not be required in a vertical riser located outside of a building, provided the riser does not expose combustible material or provided the interior of the building and the horizontal distance between the hood outlet and the vertical riser is at least 25 ft (7.6 m).*

8.9.3.3 *Unless the requirements of 8.9.3.4 are met, horizontal exhaust ducts shall have sprinklers or automatic spray nozzle devices located on 10 ft (3.0 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.*

8.9.3.4 *Sprinklers or automatic spray nozzles shall be required in ducts.*

8.9.3.4.1 *Where ducts do not exceed 75 ft (23 m) in length and the entire exhaust duct is protected in accordance with NFPA 96, sprinkler(s) or automatic spray nozzle(s) shall not be required.*

8.9.3.5 *A sprinkler(s) or an automatic spray nozzle(s) in exhaust ducts subject to freezing shall be properly protected against freezing by approved means. (See*

Please note the requirements of section 8.9.3.4 where it specifically states that the sprinklers are required in the ducts. Per this language, the suggestion to simply install a line overtop of the ducts that is dedicated to the duct's protection is not allowed. This is the same language that was referenced in the question to NFPA 13-2016 section 7.9.3.4. It was not technically changed during the 2019 revision cycle.

Additional requirements for the location of sprinklers in the duct collar and exhaust plenum chambers are below:

8.9.4 Sprinkler and Automatic Spray Nozzle Location - Duct Collar.

8.9.4.1 *Each hood exhaust duct collar shall have one sprinkler or automatic spray nozzle located 1 in. minimum to 12 in. maximum (25 mm minimum to 300 mm maximum) above the point of duct collar connection in the hood plenum.*

8.9.4.2 *Hoods that have listed fire dampers located in the duct collar shall be protected with a sprinkler or automatic spray nozzle located on the discharge side of the damper and shall be so positioned as not to interfere with damper operation.*

8.9.5 Sprinkler and Automatic Spray Nozzle Location - Exhaust Plenum Chambers.

8.9.5.1 *Hood exhaust plenum chambers shall have one sprinkler or automatic spray nozzle centered in each chamber not exceeding 10 ft (3.0 m) in length.*

8.9.5.2 *Plenum chambers greater than 10 ft (3.0 m) in length shall have two sprinklers or automatic spray nozzles evenly spaced, with the maximum distance between the two sprinklers not to exceed 10 ft (3.0 m).*

Question #6 - Inactive/Nonfunctioning Equipment

Does either NFPA 13 or NFPA 25 permit nonfunctioning equipment to be abandoned in place?

Answer: Yes, but only to a very limited extent. NFPA 13-2016 section 27.2 allows that some abandoned components may be left in place under certain conditions. The more important consideration is usually the AHJ's approval. Both model fire codes have restrictions against inoperable equipment, such as NFPA 1-2018 section 13.1.7 and the 2018 IFC section 901.4.5. Although generally applied to whole fire protection systems, some AHJs apply these sections broadly to require the complete removal of any nonfunctioning components of otherwise functioning systems rather than allowing them to be abandoned in place.

NFPA 13-2016

27.2* Inactive Sprinkler Systems Abandoned in Place.

A.27.2 *The presence of a sprinkler system and components creates a reasonable expectation by the public that these safety features are functional. When systems are inoperable or taken out of service but the*

devices remain, they present a false sense of safety. Also, before taking any part of a sprinkler system out of service, extreme care needs to be exercised to ensure that the system is not required, was not originally provided as an alternative or equivalent, or is no longer required due to other new requirements in the current codes and standards. It is not intended that the entire system or all components be removed. Instead, components such as sprinklers, initiating devices, notification appliances, and standpipe hose should be removed to reduce the likelihood of relying on inoperable systems or features. Control valves and other components that are allowed to be abandoned in place should have operating mechanisms removed and be painted a unique color to indicate that they are no longer in service.

27.2.1 Where all or part of an inactive sprinkler system is abandoned in place, components including sprinklers, hose valves and hoses, and alarm devices shall be removed.

27.2.2 Control valves abandoned in place shall have the operating mechanisms removed.

27.2.3 Sprinkler system piping and/or valves abandoned in place shall be uniquely identified to differentiate them from active system piping and valves.

NFPA 1-2018

13.1.7 All fire protection systems and devices shall be maintained in a reliable operating condition and shall be replaced or repaired where defective or recalled.

2018 IFC

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

Question #7 - Solid Shelving Rack Storage

Would in-rack sprinkler protection be required for Class I-IV commodities stored in racks not exceeding 12-feet in height which have solid shelving?

Answer: It depends on whether the storage is considered miscellaneous storage or not. Miscellaneous storage of Class I through Class IV commodities up to 12 ft in height is covered in Chapter 13 "Protection of Miscellaneous and Low-Piled Storage." Per section 13.1.3.1:

13.1.3.1 For storage of Class I through Class IV 12 ft or less in height that does not meet the definition of Miscellaneous Storage that is on solid shelf racks, in-rack sprinklers shall be provided in accordance with 16.1.6, and ceiling sprinkler protection shall be provided in accordance with Chapter 13.

Miscellaneous Storage is defined as follows:

3.9.1.18* Miscellaneous Storage. Storage that does not exceed 12 ft in height, is incidental to another occupancy use group, does not constitute more than 10 percent of

the building area or 4000 ft² of the sprinklered area, whichever is greater, does not exceed 1000 ft² in one pile or area, and is separated from other storage areas by at least 25 ft.

If the storage configuration meets all of the requirements of the definition above, then in-rack protection is not required per section 16.1.6. Ceiling protection is required per Chapter 13. Additionally, Chapter 16 points you in the same direction:

16.2.1.2.1 *The protection criteria for storage up to and including 12 ft shall be the same as miscellaneous storage from Chapter 13.*

16.2.1.2.2 *The protection criteria in Chapter 13 shall be acceptable for storage of Class I through Class IV commodities up to and including 12 ft in height. (See Table 13.2.1 for specific Class I through Class IV storage height protection criteria.)*

16.2.1.2.3 *For storage 12 ft or less in height that does not meet the definition of Miscellaneous Storage that is on solid shelf racks, in-rack sprinklers shall be provided in accordance with 16.1.6, and ceiling sprinkler protection shall be provided in accordance with Chapter 13.*

Question #8 - Underground Flushing

How would you determine the maximum flow rate needed to properly flush an underground main for acceptance testing per NFPA 13-2013 section 10.10.2.1.3(3)?

Answer: Chapter 10 of NFPA 13 is extracted from Chapter 10 of NFPA 24, so either standard can be used to determine the required flow rate.

Before answering this specific question, it must be noted that the flushing criteria was changed in the 2016 edition of NFPA 24. As you have correctly noted, the 2013 edition (section 10.10.2.1.3) included three options for determining an acceptable flow rate:

- (1) Hydraulically calculated water demand flow rate of the system, including any hose requirements
- (2) Flow in accordance with Table 10.10.2.1.3
- (3) Maximum Flow rate available to the system under fire conditions

For the 2016 edition of NFPA 24, the first option (calculated flow rate) was removed by the committee. Based upon this change I suggest you use the flushing rates of the 2016 edition of NFPA 24.

Starting in 2016 edition the underground must be flushed at a minimum flowrate listed in table 10.10.2.1.2:

10.10.2.1.3* *The minimum rate of flow shall be in accordance with Table 10.10.2.1.3.*

Table 10.10.2.1.3 Flow Required to Produce Velocity of 10 ft/sec in Pipes

Nominal Pipe Size (in.)	Flow Rate (gpm)
2	100
2-1/2	150
3	220
4	390
5	610
6	880
8	1560
10	2440
12	3520

The flow rates within this table are based upon a velocity of 10 ft/sec. This velocity has been shown to be sufficient to clean the pipe and removing foreign materials from the underground pipe. In the case of a 6-in. underground, the minimum flow rate should be 880 gpm.

If the water supply is not capable of producing the required flow rate identified in Table 10.10.2.1.3, section 10.10.2.1.3.1 in the 2016 edition (option 3 of section 10.10.2.1.3 in the 2013 edition) allows you to flush the system at the maximum flow rate available:

10.10.2.1.3.1 *Where the flow rates established in Table 10.10.2.1.3 are not attainable, the maximum flow rate available to the system shall be acceptable.*

It must be noted that if the system in question included a fire pump, NFPA 20 requires a greater flow rate than does NFPA 24. The 2019 edition of NFPA 20 requires that the suction pipe be flushed at a flow rate in accordance with "Table 14.1.1.1 or at the hydraulically calculated water demand rate of the system, whichever is greater." Table 14.1.1.1 reads as follows:

Table 14.1.1.1 Minimum Flow Rates for Flushing Suction Piping

Nominal Pipe Size (in.)	Flow Rate (gpm)
1	37
1-1/2	85
2	150
2-1/2	229
3	330
3-1/2	450
4	590
5	920
6	1,360
8	2,350
10	3,670
12	5,290
14	7,200
16	9,400

Question #9 - Wall Hydrants

Are wall hydrants treated as an outside hose allowance?

Answer: In regard to the calculations of a fire sprinkler system, a wall hydrant (with hydrant outlets on exterior of building) would be treated as an outside hose allowance. Although not specific to wall hydrants, this requirement would be found in NFPA 13 (2016) in section 11.1.6.2 which reads as follows:

11.1.6.2 Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a private fire hydrant, whichever is closer to the system riser.*

NFPA 13 and NFPA 14 do not have specific references to wall hydrants. Limited references to wall hydrants are found in NFPA 24. Standard for the Installation of Private Fire Service Mains and Their Appurtenances. References from the 2019 edition of NFPA 24 include:

7.2.4 Where hydrants cannot be located in accordance with 7.2.3, hydrants located closer than 40 ft (12 m) from the building or wall hydrants shall be permitted to be used where approved by the AHJ.

A.7.2.3 Where wall hydrants are used, the AHJ should be consulted regarding the necessary water supply and arrangement of control valves at the point of supply in each individual case. (See Figure A.7.2.3.)

Note that Figure A.7.2.3 is a diagram of a typical wall hydrant installation.

Question #10 - Field Welding Leaks

Several leaks were found at welds during the hydrostatic test and the fabrication company came on site and repaired the welds on site. The system was retested and held the required pressure of the hydrostatic test. The AHJ rejected the field welding and indicated that the entire system should be replaced. Is this required?

Answer: Replacing the entire system seems like overkill and would not be required. NFPA 13 generally discourages on-site welding of sprinkler pipe and fittings due the risk of Hot Work, however, as you have stated this hot work has already been performed in accordance with the requirements of NFPA 51B and of NFPA 13 section 6.5.2 and the repaired fittings have successfully passed the hydrostatic test, it would appear that the final project would meet the requirements of NFPA 13.

NFPA 13 is not particularly clear on the requirements of on-site welding repair, and I would suggest that the fabrication company that performed the repairs have a discussion with the AHJ in regard to the repaired welds. As stated in section 6.5.2.5.6 of the 2013 edition of NFPA 13, the fabricator should provide to the AHJ a written quality assurance procedure ensuring compliance with the welding requirements of

Question #11 - Air Diffusers

An ordinary temperature rated sprinkler is located adjacent to an HVAC diffuser that discharges air at a temperature less than 100°F. The AHJ believes that the sprinkler needs to be an intermediate rated sprinkler based upon section 8.3.2.5(a)(1)(c) of NFPA 13-2016; however, wouldn't ordinary temperature sprinklers be acceptable based upon section 8.3.2.5 (9) which allows ordinary temperature sprinklers to be installed adjacent to heat ducts that discharge air less than 100°F?

Answer: It depends. If the air duct discharges air at a temperature less than 100°F, then ordinary temperature sprinklers are not required to be separated in accordance with table 8.3.2.5(a). In this case the diffuser would not be considered a "hot air diffuser" and ordinary temperature sprinklers could be used.

It must be noted, however, that even if this diffuser normally discharges at a temperature below 100°F, it may have the potential to release heated air above 100°F. If so, this could be a potential problem for an ordinary temperature sprinkler that is too close, and the requirements of Table 8.3.2.5(a)(1)(c) may be warranted.

Question #12 - Four-Way Bracing

Is a four-way brace required at the top of a standpipe above the top landing?

Answer: NFPA 13-2013 section 9.3.5.8.1 identifies that a four-way brace is required at the top of risers exceeding 3 ft in length. The requirement of NFPA 13-2016 is the same; however, clarification has been added in a new subsection of NFPA 13-2019 which applies specifically to this situation. NFPA 13-2019 section 18.5.8.1.1 permits the omission of four-way bracing for risers extending up to 7 ft above the top landing.

From NFPA 13-2013:

9.3.5.8.1* *Tops of risers exceeding 3 ft (1 m) 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 on a drop to a single sprinkler.*

From NFPA 13-2019:

18.5.8.1.1* The four-way brace shall not be required for risers up to 7 ft (2.1 m) in length that terminate above the roof assembly or top landing.

for which no NFSA Technical Tuesday Online Seminar is scheduled. Statements and conclusions are based on the best judgment of the NFSA Engineering staff, and are not the official position of the NFPA or its technical committees or those of other organizations except as noted. Opinions expressed herein are not intended, and should not be relied upon, to provide professional consultation or services. Please send comments to Mark Hopkins, P.E. at Hopkins@nfsa.org.

