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

Editor - Roland Asp, CET **#481** **02/08/2022**

Best of January 2022

The following are a dozen questions answered by the NFSA's Codes, Standards, and Public Fire Protection staff as part of the Expert of the Day (EOD) member assistance program during the month of January 2022. This information is being brought forward as the "Best of January 2022." If you have a question for the NFSA EOD submit your question online through the "My EOD" portal. It should be noted that the following are the opinions of the NFSA Engineering, Codes, and Standards staff, generated as members of the relevant NFPA and ICC 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 or ICC Council Policy #11 and should therefore not be considered, nor relied upon, as the official positions of the NFSA, NFPA, ICC, or its Committees. Unless otherwise noted the most recent published edition of the standard referenced was used.

Question #1 – 25-foot Bays and ESFR Sprinklers

A ESFR sprinkler system is being installed in accordance with the 2016 edition of NFPA 13. The building does not exceed 30 ft in height with storage heights not to exceed 20 ft. The building has bays (between structural members) that are 25 ft wide.

Is it permitted to space branch lines with ESFR sprinklers 12 ft 6 inches apart so that there are 2 branch per bay instead of 3 branch lines?

No, this concept (spacing branchlines 12 ft– 6 in apart in 25 ft bays and exceeding the maximum spacing of 12 ft) is unique to standard spray sprinklers (see asterisk to Table 8.6.2.2.1(c) and (d) and does not extend to ESFR sprinklers.

As noted in Table 8.12.2.2.1 and Section 8.12.3.1(1), the maximum spacing between ESFR sprinklers is 12 ft (for buildings with ceiling heights up to 30 ft). There is no allowance in Section 8.12 to exceed this maximum spacing.

This concept is supported by Sections 8.12.2.2.3, 8.12.2.2.4 and Section 8.12.3.1(3)(c). These sections are known as the ESFR "shift" rule and do allow deviations from the ESFR spacing rules to avoid obstructions; however, each of these sections specifically note that "in no case shall the distance between sprinklers exceed 12 ft". Although the ESFR "shift" rule may not directly apply to the situation noted, these sections do support the concept that the maximum spacing of 12 ft between ESFR sprinklers is not permitted to be exceeded.

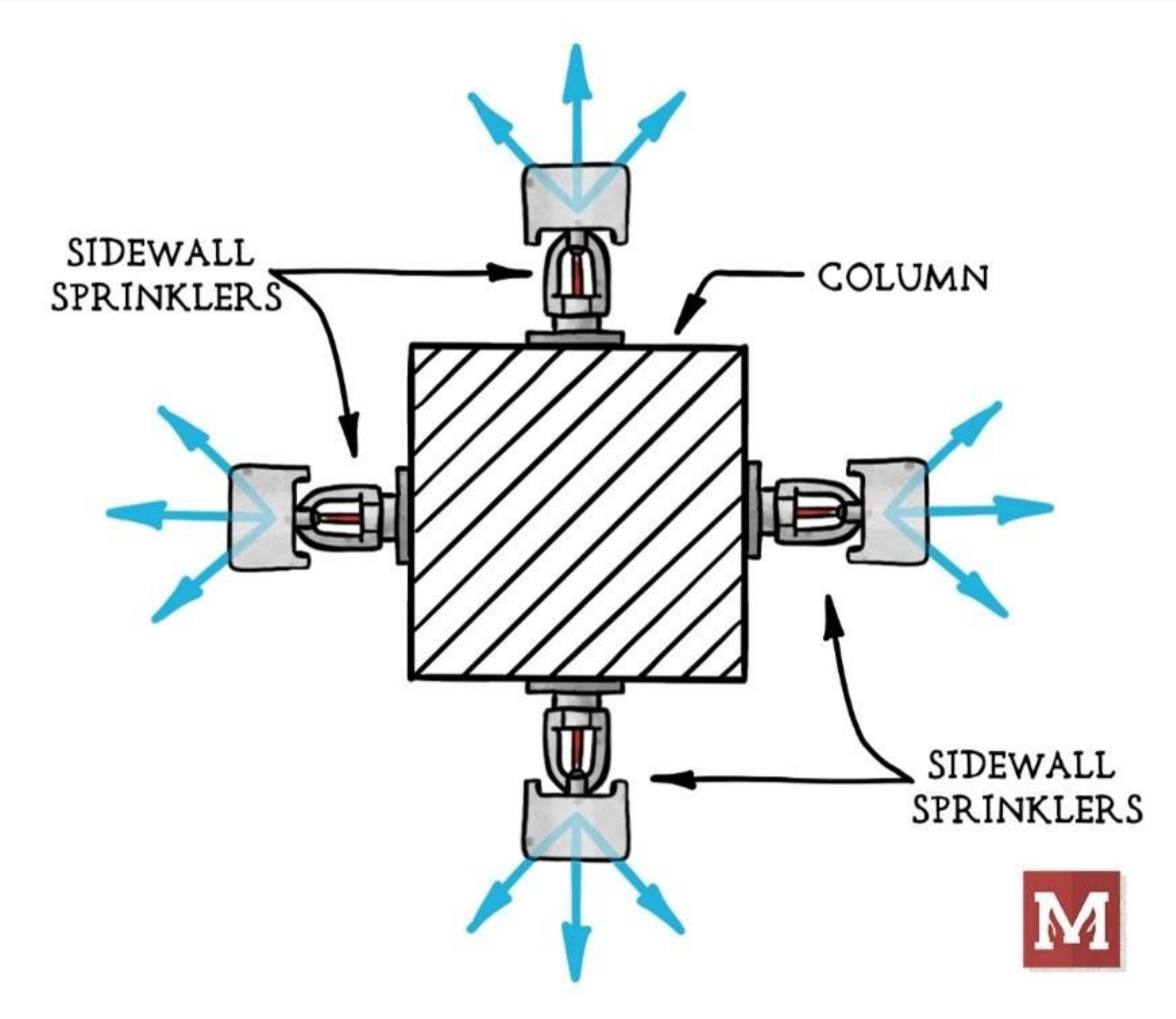
Question #2 – Sidewall Sprinklers installed on a Column

Is it permitted to install sidewall sprinklers on four sides of a column (for room protection) as shown in figure below?

No, NFPA 13, 2016 edition, Section 8.7.3.1.4 does not permit sidewall spray sprinklers to be installed back-to-back without being separated by a continuous lintel or soffit.

The standard does not specify guidelines for the meaning of “continuous”, but the intent is as follows. The purpose of this barrier is twofold: the barrier ensures that the sprinkler nearest the fire operates and ensures sprinklers on other sides do not operate first or simultaneously. For example, if a fire occurs on one side of the column, the sprinkler on the other sides of the column (spraying away from the fire) should not operate. The separation required is to ensure the heat from a fire is contained until the appropriate sprinkler operates. Additionally, sidewall sprinklers are designed to discharge a portion of their spray behind the sprinkler, so without a separation, one sprinkler discharging could cause cold soldering of the adjacent sprinkler. Obviously, if the sprinkler facing the fire area does not operate due to the spray of the adjacent sprinkler, the fire may not be contained.

In order to ensure that sprinklers on both sides of the barrier do not operate simultaneously; the barrier would need to be of sufficient length to contain the heat long enough for the proper sprinkler to operate. Again, there is no prescriptive dimension for the length of this barrier in the standard. Sprinklers located on all four sides of a column without a barrier (lintel or soffit) to collect the heat and ensure activation of the appropriate sprinkler would not meet the intent of the standard.



Question #3 – Fire Flow Criteria

The 2012 edition of the International Fire Code (IFC) states in Appendix B Table B105.1 that the fire flow for a 234,000 ft2 Type IIB warehouse should be 8,000 gpm for a 4-hour duration. This section permits a 75% reduction when the building is sprinklered throughout. Applying this reduction would end up with a fire flow of 2,000 gpm.

Should the flow duration be 4 hours based upon the original fire flow of 8,000 gpm or should it be 2 hours based upon the adjusted flow of 2,000 gpm?

Appendix B Table B105.1(2) allows a reduction in the duration down to 2 hours for a fully sprinklered building.

However, it is important to clarify that the IFC gives the fire code official significant authority to modify fire flow criteria for a premises as they feel appropriate. IFC Section 507.1 requires an “approved” fire flow that provides the necessary water (quantity and duration) for firefighting purposes. Appendix B, Section B105.2 also uses the word “approved” in the Exception. “Approved” is defined in the IFC as, “acceptable to the fire code official”. This is an important clarification because in the 2012 IFC to get the 75% reduction, it must be approved by the fire code official. Note: the 2015, 2018 and 2021 editions of the IFC removed the approval required and just granted the reduction in fire flow for fully sprinklered buildings.

To address your question, many code officials will accept the 75% reduction AND approve lowering the duration (4 hours down to 2, in this case) for a fully sprinklered building. The reason is, assuming the fire sprinkler system is adequately designed for the hazard and commodity, there shouldn’t be a need for the fire department to flow 2,000 gpm for 4 hours. That being said, since your question specifically references the 2012 IFC, both the fire flow AND the duration need to be approved by the fire code official. Some code officials may be comfortable granting the 75% reduction, but not approve lowering the duration, which is within their authority. Therefore, the quantity and the duration (4 hours vs. 2 hours) is ultimately up to the fire code official to approve.

Question #4 – FDC Testing

NFPA 25 requires the piping to the fire department connection be hydrostatically tested every 5 years. How is this testing performed on remote FDCs where the check valve and automatic drain are buried?

NFPA 25 does not specifically address how to conduct the hydrostatic test of the FDC piping when the check valve and ball drip is buried and has no access. NFPA 25 Section 13.8.5 only states to conduct a hydrostatic test every five years.

If the ball drip does not hold pressure or there is no way to relieve pressure it may have to be excavated to conduct this test.

Another way to perform this test is to install a blank in the pipe to isolate the pipe between the FDC connection and the pipe where it enters the building and install a drain valve. The drain valve would have to be installed between the blank and where the pipe exits through the exterior wall to the FDC. This will only work if the drain valve would be between the FDC check valve and the automatic drain valve, essentially the FDC check valve would have to be installed inside the building and not buried with the automatic drain valve. Once a new drain valve is installed you can hydrostatically test the fire department connection as you normally would, the automatic drain valve should close once enough pressure is built. After the test you can drain the water using the installed valve to relieve the pressure and drain most of the water from the FDC piping. At this point the automatic drain valve should open to drain the remaining water in the pipe.

It is for these reasons that NFPA 13 requires the FDC check valve and ball drip to be installed in a manner that allows for testing in accordance with NFPA 25.

Question #5 - Open Sprinklers and Deflector Distance

A deluge system with open sprinklers and pilot line detection is to be installed in a parking garage in accordance with the 2016 edition of NFPA 13. The garage is steel beam construction, and the steel beams are 24 in deep and are more the 7 ft-6in apart. This makes it unobstructed construction.

As the pilot line will be used for detection and activation of the deluge system, can the open sprinklers be installed below the bottom of the beams?

No, open sprinklers cannot be placed below the bottom of the beam if this exceeds the maximum permitted deflector distance below the ceiling. NFPA 13, 2016 edition, Section 8.4.4.2 requires open sprinklers to be installed in accordance with all applicable requirements of the standard for their automatic counterpart. There is no exception in the prescriptive requirements of the standard to permit open sprinklers on a deluge system to be located in excess of the permitted deflector distance from the ceiling of their automatic counterpart.

While the pilot sprinklers are used for detection and activation of the deluge system, the open sprinklers are used to control the fire and protect the structure, therefore the requirement for maximum deflector distance from the ceiling is still applicable as noted in Section 8.4.4.2. In this case, the ceiling of a garage with 24 in. deep beams are greater than 7.5 ft. on center. Based on the Section 3.7.1 and 3.7.2 construction definitions, this appears to be defined as unobstructed construction as noted in Section 3.7.2. Assuming you are using standard spray sprinklers (without operating element), Section 8.6.4.1.1.1 requires the sprinkler deflector to be located 1-12 in. below the ceiling. This would require the sprinkler deflector to be located above the bottom of the 24 in. deep beams.

Question #6 - Aisle Widths and Density

In accordance with NFPA 13 in regard to rack storage and aisle width, the required density is lower when the aisle is wider. It would appear that more water would be needed as there is more oxygen in the aisle and this concept seems to be contradictory to the logic applied to open and closed storage arrays.

Why are density requirements always lower when there is a wider aisle?

The answer to your question is based on fire science and fire dynamics. Transfer of flames and heat occur in three ways: conduction, convection, and radiation. Conduction is the transfer of heat by direct contact (flame touching the other object). Convection is the transfer of heat through a liquid or gas. Radiation is the transfer of heat through rays, waves, or particles. Fire/flame will spread using all three of these methods.

Building codes dedicate entire chapters to this topic by requiring fire rated walls, doors, dampers, sprinklers, fire caulking, etc. The goal from an NFPA 13 perspective is to contain and prevent the transfer of heat through the application of water as quickly and efficiently as possible.

To specifically answer this question, when aisle widths are closer together, a higher density is necessary to prevent flames from jumping the aisle to an adjoining rack through conduction, convection, and/or radiation. For aisle widths greater than 8 ft., aisle jump is no longer a controlling factor in the design. If the fire has spread from one rack to another and jumped an 8-ft. aisle in the process, the fire has likely outgrown the capacity of the sprinkler system to control it.

To describe it another way, when the adjacent rack(s) are further away, the likelihood of fire spreading through conduction, convection and/or radiation is reduced. This should allow the sprinkler system to hold the fire in check until the fire department arrives.

Question #7 – Dry System in Heated Areas

Is it acceptable by NFPA 13 to protect heated area by a dry pipe system that also protects cold area?

Yes, it is acceptable for the dry pipe sprinkler system to protect both areas subject to freezing and heated spaces.

NFPA 13, 2022 edition, Section 16.4.1 for protection of piping against freezing indicates where any portion of a system is subject to freezing and the temperatures cannot be reliably maintained at or above 40°F (4°C), the system shall be installed as a dry pipe or preaction system.

The standard requires the use of dry pipe sprinkler systems to protect areas subject to freezing and allows adjacent heated areas to be protected with the same dry pipe system.

Question #8 – Freeze Protection

NFPA 13 states that a sprinkler system must be protected from freezing when "the temperature cannot be reliably maintained at or above 40° F."

The following three questions were asked:

Why is 40° F utilized when freezing is 32° F?

By what standard is the is the 40° F determined? If data indicates that the mean average temperature of a site is 40°-95° does that suffice, or do you look at the one-time 25 year or 50-year low temperature?

Section 8.16.4.1.5 in the 2016 edition of NFPA 13 allows heat loss calculation to be used to prove the pipe will not freeze - At what temperature and duration would heat loss calculations be performed when the ambient temperature was recorded at 40° F?

Answer to #1: The 40° Fahrenheit has been the threshold for providing freeze protection of fire sprinkler systems since the 1972 edition of NFPA 13. This temperature serves at least two purposes; 1) fire sprinkler water is stagnant and because water is not consistently flowing it 2) provides a safety factor for fluctuating temperatures. Another less commonly known reason is as water gets closer to 32° F, it starts the freezing process, becoming denser, and thus altering the flow characteristics of water.

Answer to #2: The 40° F is determined by the pipe exposure. Where the piping is in a space or area that cannot be maintained at 40° or higher, NFPA 13 requires a dry or preaction system, or other alternatives, such as heat trace, antifreeze, etc.

The lowest one-day mean temperature map in NFPA 13, such as in A.10.4.2(b), comes from the underground requirements of NFPA 24. It is not specifically applicable to aboveground piping…until the 2022 edition of NFPA 13. In the 2022 NFPA 13, a new Section 16.4.1.1.1 states, "The weather temperature used to determine if an unheated portion of a system is subject to freezing and required to be protected in accordance with 16.4.1.1 shall be the lowest mean temperature for one day, obtained from an approved source."

It is also important to note, in editions other than the 2022, regarding the lowest-one day map in A.10.4.2 (b), it is in the Annex, which only contains explanatory and unenforceable text. Section 10.4.2 does not drive the user to this map to make enforceable determinations.

Answer to #3: Based on the answer to #2 above, at 40°F, the exposed portion of the system complies with Section 8.16.4.1.1. There is not a pointer or reference to a specific method or map that determines this, until the 2022 edition.

The heat loss calculation is not required until 39° F. When the area is at 40° F, it complies, so when the heat loss calculation is performed, it should at least aim for 40° F.

The NFSA published a whitepaper titled, INSULATION FOR FIRE SPRINKLERS GUIDE, located at https://nfsa.org/wp-content/uploads/2021/02/Insulation-White-Paper-final-2.pdf It digs a little more into this topic.

The heat calculation was new to the 2013 edition. The reason for this new section was substantiated by the following: *"NFPA already allows an engineer to step in and verify that a hanger will meet certain requirements. Heat loss calculations proving that a space will not encounter freezing temperatures should be allowed. There are reliable programs available to scientifically calculate low temperatures. There are many locations that encounter sub-40-degree temperatures but never approach freezing. If the user/building owner wishes to incur this expense to eliminate a dry system or antifreeze system, they should be allowed."*

Question #9 – Whiskey Rickhouse

A rickhouse being constructed for the storage of wooden barrels laying down containing distilled spirits.

Where can fire protection requirements for this use be found?

As of now, only FM Data Sheet 7-29 and the Distilled Spirits Council of the United States (DISCUS) Recommended Fire Protection Practices for Distilled Spirits Beverage Facilities has published criteria.

The 2024 International Fire Code did use parts from each document for design densities of palletized and rack storage of wooden barrels through proposal F186-21 Part I. It also established design criteria for small facilities. The ICC membership approved the above proposal in 2021, but the 2024 IFC is not yet published. The 2024 edition cycle of NFPA 30 has established a task group during the first draft meeting to establish similar criteria as the IFC. The document is open for public comment until May.

Question #10 – 5 Year Internal Inspection per NFPA 25

There is a combined system with a standpipe riser feeding a CPVC sprinkler system on each floor of a multi-story building. In accordance with NFPA 25 Chapter 14, "Nonmetallic pipe" shall not require a 5th year internal inspection.

If the system is constructed of CPVC and only the system riser is steel, does the riser need to be internally inspected?

Yes, the standpipe riser does require an internal assessment. Section 14.2.1 states that all systems shall require an internal assessment of the system. Annex Section A.14.2.1 subsection 2 of NFPA 25 provides an explanation of how to conduct an internal assessment of the standpipe system. Also note that the floor check valve for each floor will require a five-year internal inspection.

Question #11 – Thermal Expansion of CPVC

When installing a CPVC sprinkler system during the winter, it is common that the building will be temporally heated to facilitate the installation.

How is thermal expansion of the CPVC pipe accounted for and should CPVC only be installed at normal temperatures?

CPVC (like all piping materials) is subject to the effects of thermal expansion. In some cases, this can put stress on the pipe and fittings and must be accounted for. For CPVC piping that is subject to temperature changes possible expansion and contraction of the pipe needs to be calculated and accounted for.

In many cases, this becomes a non-issue as normal change in direction is one way to compensate for thermal expansion.

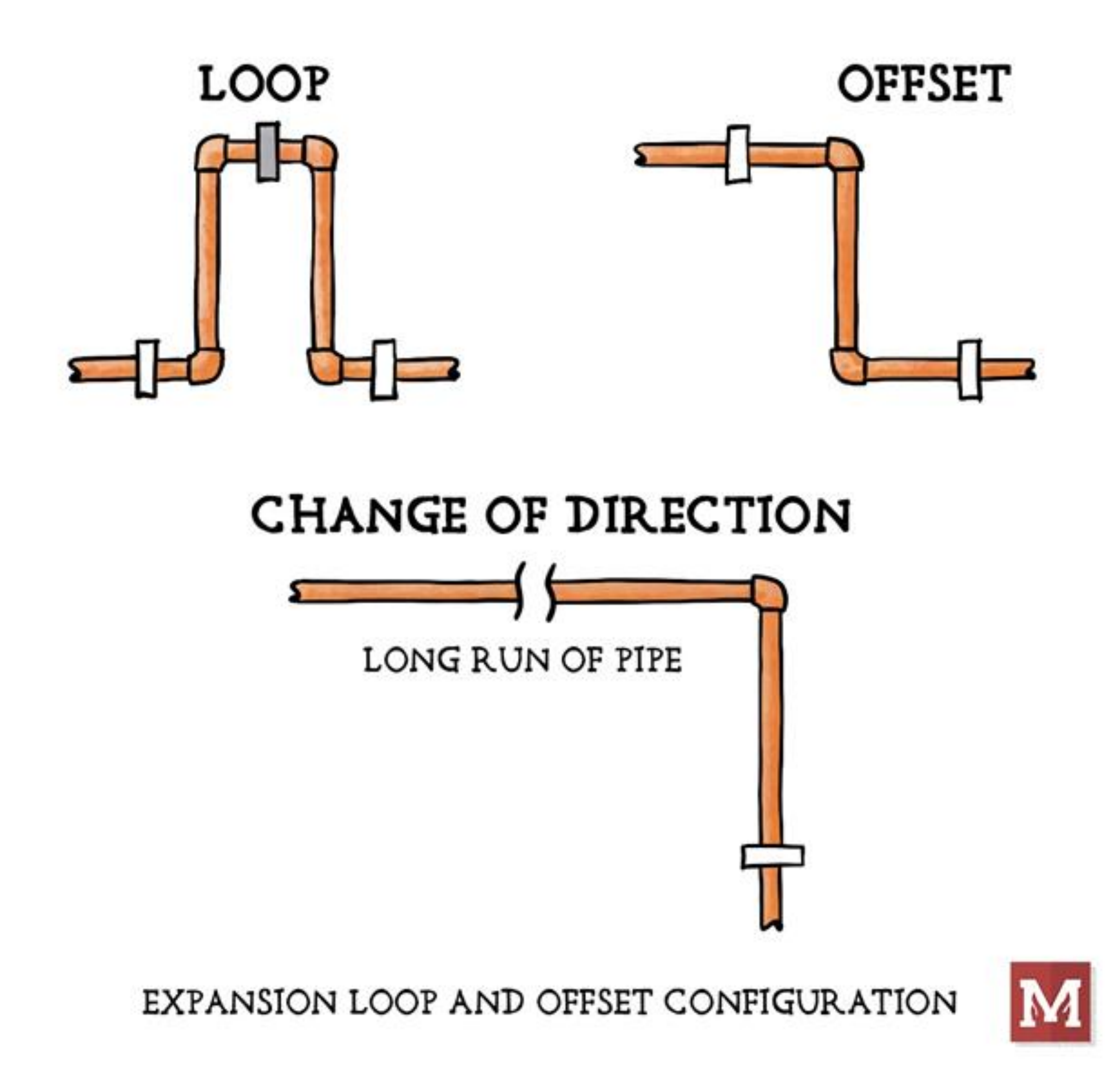
All the manufacturers of CPVC piping used for fire sprinklers have within their installation manuals the method of calculating thermal expansion and also will outline acceptable means of compensating for expansion when needed. These methods include expansion loops, offsets, and changes of direction.

It must be noted that thermal expansion must be accounted for not just based upon temperature at installation but also for the normal range of temperature difference that the pipe will be subject to. Based upon this concept, refer to the installation manual of the specific CPVC product to determine which configurations are needed to compensate for expansion/contraction of the pipe based upon the temperature differences that the pipe will be subject to.

As stated above, the suggested configuration to account for thermal expansion may be expansion loops, offsets, or even a simple change in direction. The specific answer would be dependent on the expected change in temperature, the pipe sizing, and the length of the pipe run.

It must also be noted that based upon the installation manuals. It appears that is acceptable to use solvent cement at temperatures as low as 4° C (40° F) although curing times may be longer for colder temperature installations.

To minimize the temperature changes that affect thermal expansion, it may be beneficial to install at temperatures more in line with what the system would be normally exposed to.



Question #12 – Rated Stairwell and Exterior Openings

A question was raised by a general contractor in regard to stairways having a 2-hr fire rating but has windows on the exterior wall of the stairways that have no fire rating.

Shall a fire protection contractor provide sprinkler protection at the windows having no fire rating, and if so, what would the installation standard be?

An interior exit stair is allowed to have unprotected exterior openings per IBC Section 1022.5 of the 2012 edition. However, the code official or the architect may have other reasons for rating the exterior glazing, i.e., distance to property line or another building. If a rating is required, listed window fire sprinklers can provide the equivalency of the 2-hr rating, per IBC Section 703.4, but it will have to be pitched to the code official as an alternative means (101.8). The only fire sprinklers able to provide the equivalency are listed window sprinklers, such as the Tyco WS, Viking VK960/962, or Reliable WP56.

Window sprinklers are installed per NFPA 13 and specifically per the listing requirements, which go into greater installation and design details. The product listing/manufacturers data sheet and the ICC-ES report (if applicable), along with the details on the shop drawings and calculations should be sufficient for review and acceptance by the code official and architect.

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Tech Tuesday Webinars

Remote inspections have increased dramatically over the past couple of years. NFPA, ICC, and local codes are expanding their rules and recommendations on this developing practice. Other remote verifications, such as remote monitoring to meet the requirements of NFPA 25 inspection and testing frequencies are also being developed and installed every day. These technologies are making an impact on local code officials, fire sprinkler contractors, inspectors and building owners. This program covers the latest technology, equipment, rules, and best practices for the fire sprinkler industry.

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