NFSA The Voice of the Fire Sprinkler Industry

TechNotes

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Best of March 2014

This month, we have selected the following dozen questions as the "Best of March 2014" answered by the engineering staff as part of the NFSA's EOD member assistance program. If you have a question (and you're a member of the NFSA), you can send your question to eod@nfsa.org and we'll answer it as soon as we can.

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 a formal interpretation in accordance with the NFPA Regulations Governing Committee Projects and should therefore not be considered, nor relied upon, as the official position of the NFPA or its Committees.

Question 1 – Concealed Space Sprinklers

We are providing sprinkler protection for two different buildings in accordance with NFPA 13. In both buildings, there will be structural members in horizontal concealed spaces supporting combustible construction above. In one building, there are 30-inch deep concealed spaces with wood bar joists very similar to Figure A.3.7.2(a) in NFPA 13. In the other building, there will be 24-inch deep concealed spaces containing composite wood joists similar to Figure A.3.7.1(b). Neither of these spaces qualify for any of the sections in 8.15.1.2 that would allow us to omit sprinklers from the space, so we will be providing fire sprinklers in both types of concealed spaces. Are the sprinklers required to be specifically listed for concealed spaces?

Answer: In the building with the wood bar joists, the sprinklers are required to be those specifically listed for concealed spaces. Section 8.15.1.6 of NFPA 13 specifically requires these sprinklers for this type of construction which is a hybrid of wood truss and bar joist construction.

For the second building, with the composite wood joists, you are not required to use the concealed space sprinklers. You are permitted to use standard spray sprinklers, or you are permitted to use concealed space sprinklers in accordance with section 8.15.1.7 of NFPA 13.

Question 2 – Measuring the Size of Bathrooms

All three of the sprinkler standards allow sprinklers to be omitted from bathrooms that are less than or equal to 55 sq ft in area. If we have a bathroom that is 55.3 sq ft in area, can we omit sprinklers?

Answer: Ultimately, any issue of tolerance such as this is left up to the authority having jurisdiction (AHJ). While the room area might be simple to

calculate on a set of building plans, when it comes to actual installation, the room may (or may not) end up being exactly 55.3 sq ft in area. To pretend that such precision exists in the construction industry would be a difficult position to defend.

It is worthy of note that the rule in the NFPA standards is 55 sq ft and not 55.0 sq ft. Technically, there is a difference between the two. When a limit of measurement is expressed as only an integer (as it is in this case), any measurement compared to that limit would be rounded to the nearest integer. So, from a scientific standpoint, there is no difference between 55 sq ft and 55.3 sq ft, they should both be rounded to 55 for the sake of comparison to a limit of 55.

Question 3 – ESFR Sprinklers Closer than 8 ft

Are we allowed to install ESFR sprinklers closer than 8 ft apart when solid structural members are in between the sprinklers? Don't the solid structural members act as baffles to prevent on sprinklers from getting wet from the adjacent sprinkler discharge?

Answer: No. The minimum acceptable distance between ESFR sprinklers is 8 ft, regardless of the existence of solid structural members or baffles between the sprinklers. There is no section in 8.12 of NFPA 13 that permits the installation of ESFR sprinklers closer than 8 ft apart when baffles are present. In fact, section 8.4.6.3 of NFPA 13 states that where ESFR sprinklers are being used with obstructed types of construction more than 12 inches deep, the sprinklers need to be in every channel formed by the structural members and the sprinklers need to be at least 8 ft apart.

The concern is not just one sprinkler spraying on the adjacent sprinkler. Instead, in occupancies where high challenge fires are possible, the concern is that the water droplets that leave the sprinkler and head down to the floor might be picked up by the vertical momentum of the fire plume and deposited on a nearby sprinkler. Tests have shown that this effect can be minimized by putting the sprinklers at least 8 ft apart.

Question 4 – Remote Area and Fire Rated Wall

We have a situation where we have a fire rated wall going through the remote area. Can we just stop the remote area at the fire rated wall and not calculate the sprinklers on the other side of the wall?

Answer: No. The assumption here is that you are using the density/area method of calculations and not the room design method.> Once you decide to use the density/area method of calculation, you must ignore walls, even if they are fire rated walls, and calculate the correct number of sprinklers and the correct number of sprinklers along a branch line. The reason for this is that the density/area method of NFPA 13 does not necessarily force you to calculate the most likely combination of sprinklers that might open in a fire; instead if forces you to calculate a reasonably demanding combination of sprinklers that might open in a fire, knowing that more likely combinations will need less water. While the exact sprinklers in the design area might never really open during a fire (because they are on the other side of a firewall in your case), it is still necessary to calculate them for no other reason than the rules in NFPA 13 are simplified and standardized so that we all can decide on the same sprinklers in the design area without fighting over them with an AHJ. Without these simplified rules, it would not be as clear which sprinklers to calculate and arguments would break out in terms of what assumptions are reasonable to make.

Question 5 – Small Dry-Pipe System

We have a dry-pipe system in an ordinary hazard area that is adjacent to a wet pipe system. The area protected by the dry-pipe system is only 1400 sq ft. If we use the density/area method of design, we would have to calculate 1950 sq ft (1500 sq ft increased by 30%). Since we don't have 1950 sq ft of sprinklers on the dry system, do we need to pick up sprinklers from the wet system to get 1950 sq ft in our design area?

Answer: With the dry-pipe system that you have described, you have three options for the design area. The first option is to use the room design method. This would require that the dry-pipe system was in a room with walls having a sufficient fire resistance rating and automatic or self closers on the doors. The doors would also have to be appropriately fire resistance rated.

The second option would be to use the density/area method and calculate the 1400 sq ft from the dry-pipe system and then add at least 550 sq ft of sprinklers from the wet system to create a design area of 1950 sq ft.

The third option is new to the 2013 edition of NFPA 13 and is referred to internally by NFSA staff as the Phantom Flow option. Sections 23.4.4.1.1.4 and 23.4.4.1.1.5 allow you to calculate just the 1400 sq ft of the dry-pipe system and then add some additional flow to the cross main to bump up the water supply without attributing that flow to any specific sprinklers (which is why we call it Phantom Flow). The extra flow that you add is the difference between what you calculated and the minimum flow required to achieve the density in the design area. For example, to achieve protection of OH-2 in a dry-pipe system (0.2 gpm per sq ft over 1950 sq ft), the minimum amount of water flow you would need is 390 gpm (0.2 x 1950 = 390). If you calculated the 1400 sq ft of the dry-pipe system and found that your waterflow demand was 310 gpm, then you would need an additional 80 gpm (390 – 310 = 80) added to the cross main at the location where the most remote branch line for the dry-pipe system connects to the cross main.

NFPA 13 does not express a preference for any of these three options. The person performing the hydraulic calculations is permitted to pick whichever option suits them best. Of course, if you are not yet in a community using the 2013 edition, you'll have to talk to the AHJ about using the new provisions of the 2013 edition under the equivalency clauses of sections 1.5 and 1.6. For more information on Phantom Flow, see the article of that name in the May/June issue of SQ magazine, which should be available in the next few weeks.

Question 6 – Alarm Throughout the Building

If a building has a sprinkler system, but no alarm system installed (and no alarm system required) is the sprinkler system waterflow alarm required to be annunciated throughout the building?

Answer: No. A fire sprinkler system is not a fire alarm system. The two systems serve different functions. If the building code has determined that the building needs a fire alarm system, then Code turns the waterflow switch on the sprinkler system into an initiating device on the alarm system (see section 907.6(2) of the International Building Code). But if there is no fire alarm system in the building, there is no requirement for an initiating device. In other words, there is no signaling system in place for the waterflow switch to initiate.

If the people that write the building code thought that a certain type of building needed to have people warned throughout the building that a fire was happening, then they would require a fire alarm system throughout the building. The fact that they have not required a fire alarm system to be installed throughout the building indicates that they do not believe such a system to be necessary. The decision to put a sprinkler system in the building is separate.> Once the sprinkler system is installed, there is no need to annunciate the waterflow signal throughout the building because the code has already declared that a fire alarm system is not required in the building.

Question 7 – Laying Pipe on a Trapeze Member

Can a branch line or cross main just sit on top of a trapeze member without being secured to the trapeze hanger?

Answer: No. While there is no specific section in NFPA 13 that specifically says that pipe needs to be secured to the structure, there are certain laws of physics that can't be denied. The piping needs to stay in place so that the sprinklers don't move. When a sprinkler discharges, there are reactionary forces at the sprinkler, and there are also forces on elbows and tees as water flows through the pipe. The pipe needs to stay in place and resist all of these forces. In addition, if the sprinkler system needs to be restrained and braced to the structure in accordance with section 9.3. The following specific sections apply:

- Section A.9.1.1 – "As an alternative to the conventional method of hanging pipe from the structure using attachments and rod, the piping can be simply laid on the structural member, provided the structure can adequately support the added load in accordance with 9.2.1.3.1 and the maximum distance between supports as required by Chapter 9 is not exceeded. Listed pipe should still be installed and supported in accordance with its listing limitations. To prevent pipe movement, it should be secured with an approved device to the structure and located to ensure that the system piping remains in its original location and position."

- Section A.9.2.3.4 – "Sprinkler piping should be adequately secured to restrict the movement of piping upon sprinkler operation. The reaction forces caused by the flow of water through the sprinkler could result in displacement of the sprinkler, thereby adversely affecting sprinkler discharge."

Question 8 – Protecting Storage of Fertilizer

We have been asked to protect storage of fertilizer that contains some ammonium nitrate with a sprinkler system. What should we do? What would be the hazard classification?

Answer: Unfortunately, we are not going to be able to design a system for you. To start a project like this, a responsible design professional needs to determine some basic performance goals and objectives. Is the goal going to be to assure life safety in the room that the fertilizer is being stored in if combustion occurs? Is the goal going to be to prevent an explosion of the product? Is the goal going to be to allow combustion of the product as long as it does not get beyond the building of origin? Once a design professional answers these questions, and understands the combustion properties of the compound, they can begin answering the questions as to which type of

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Residential Sprinklers: Homes to High-Rise

system to install and what the discharge criteria might be to achieve the stated goals and objectives.

Regarding the hazard classification, these questions are difficult to answer except in those circumstances where some NFPA occupancy committee has specifically addressed the issue. This is especially true because hazard classification is considered in many states to be the most important aspect of fire protection system design, and an obligation of the responsible design professional. One reason many states require involvement of a responsible design professional is to ensure that the site-specific attributes of the project are recognized and properly addressed, which cannot be accomplished in a generic manner.

In this case, since we are not aware of any relevant decisions by other NFPA technical committees specifically regarding these fertilizer compounds, the responsible design professional is encouraged to investigate how similar this fertilizer is to ammonium nitrate. We note from the question that the fertilizer contains some ammonium nitrate, but it is unclear how the other compounds involved affect the combustion aspects of the material. NFPA 400, Hazardous Materials Code, contains some sprinkler discharge criteria for solid ammonium nitrate. In section 11.2.6.1.3, NFPA 400 tells the user that, depending on the type of container that the product is stored in, it can be considered like a Class I, Class II or Class III storage commodity.

Whether that discharge criteria would apply to your fertilizer situation would depend on how close your particular fertilizers are to ammonium nitrate in the combustion properties.

Question 9 - Manual Standpipes, Sprinklers and High Pressure

We have a manual wet standpipe system that shares the riser with the sprinkler system. The automatic water supply only has a static pressure of 60 psi, but the pressure that the fire department needs to pump into the fire department connection is 200 psi. Do the sprinkler system components need to be rated for 200 psi or do we need to put pressure reducing valves on the sprinkler connection to the standpipe system?

Answer: No. The pressure rating limitations of components in NFPA 13 are based upon System Working Pressure, which is defined in NFPA 13 as, “The maximum anticipated static (nonflowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures and exclusive of pressure from the fire department connection.”

As stated in this definition, the working pressure does not include the pressure added from the fire department connection. Section 6.1.3 further states that system components shall be rated for the maximum system working pressure to which they are exposed.

As the elevated pressure pumped into the FDC is not part of the system working pressure, and the pressure ratings of components in the sprinkler system is based upon working pressure, there is no requirement to base the sprinkler system components pressure rating on the 200 psi which is pumped into the FDC. As long as the city water does not have a maximum static pressure in excess of 175 psi, the sprinkler system components only need to be rated at 175 psi.

Question 10 – Solid Shelves and Aerosol Storage

We have a situation where we are protecting storage of aerosols on solid shelves. Section 6.3.2.12.2 of NFPA 30B takes a different position than

NFPA 13 regarding solid shelves. NFPA 30B requires face sprinklers under the shelves in addition to the flue in-rack sprinklers required for open racks of the same commodity. If the particular arrangement of aerosol storage on open racks does not require in-rack sprinklers (for example, a situation with ESFR sprinklers at the ceiling), does that mean we don't need any face sprinklers if we have solid shelves?

Answer: No. You are correct that NFPA 30B takes a different approach than NFPA 13 for sprinklers and solid shelves. Consider the situation with solid shelves and with ESFR sprinklers being used at the ceiling where Tables 6.3.2.7(e) through (l) allow the use of ESFR sprinklers with no in-rack sprinklers. Section 6.3.2.12.2 still requires face sprinklers directly below each solid shelf. Section 6.3.2.12.3 has these face sprinklers located at maximum 8 ft spacing. These face sprinklers will need to circle the rack structure, which should provide pretty good fire protection in most circumstances. It is just a very deep multiple-row rack that I would be worried about where there could be a great deal of burning commodity between face sprinklers.

Contrast this protection with what NFPA 13 would require, which is in-rack sprinklers under each solid shelf at longitudinal and transverse flue space intersections. The maximum distance allowed between sprinklers varies by the commodity, but would be 5 ft for group A plastics. For a single or double-row rack, this would not be too different from what NFPA 30B has required for aerosols.

In the long run, the NFPA has given the NFPA 30B committee the responsibility to write their own rules regarding ESFR sprinkler use and discharge. Since they are very specific about the subject, the criteria in NFPA 30B can be used for situations where ESFR sprinklers are at the ceiling and the racks have solid shelves.

Question 11 – Fireworks

With the NFPA withdrawing their standard on fireworks (NFPA 1124), how do we protect mercantile buildings that sell fireworks? Since small arms ammunition can be protected as Class IV commodities, can we protect fireworks that way?

Answer: The answer is that while small arms ammunition may be considered a Class IV commodity in the annex of NFPA 13, you cannot extend this to include fireworks. They are totally different commodities that behave differently in a fire.

One suggestion that we can offer you is to have the owner retain a fire protection engineer to come up with a protection scheme that would be appropriate for this situation.

An article appeared in Sprinkler Quarterly magazine many years ago (Winter 2004) that Ken Isman wrote after reviewing some fire tests performed on fireworks. The article summarizes how ordinary hazard group 2, extra hazard group 2, and ESFR sprinklers did not work to protect fireworks in a situation similar to what you might find in a mercantile occupancy (although the k-25.2 ESFR sprinklers did control the fire, all of the sprinklers in the test facility opened, so there is no way to determine what a reasonable design area would be). The article was widely criticized by the fireworks industry because they said that the product that was tested was not really consumer fireworks. Representatives of the state of Ohio, who sponsored the tests, thought that it was a fair test, so we don't know who to believe.

Since then, the fireworks industry ran some fire tests at South West

Did You Know??

The NFSA keeps a member of the Engineering Department staff on duty every business day to answer your technical questions live. We call this the Expert of the Day (EOD) program and it is available to our members by phone, fax, or e-mail. Call us at (845) 878-4200 and press 5, or you can send a fax to (845) 878-4215, or you can e-mail us at eod@nfsa.org. Last year we answered more than 2600 requests for assistance.

Research Labs. The tests (which had sprinkler systems designed for Ordinary Hazard Group 2) were failures because the fire burned to the end of the array and jumped the aisle, so we know that does not work for any significant amount of fireworks. But we don't know what will work.

There is an FPRF research project on the subject, but it is stalled due to a lack of funding. Nobody, including the fireworks industry, has been willing to pay for the tests.

An engineer might be able to study the specific situation and conclude that one of the following might work:

- Room design method using k-25.2 ESFR sprinklers and having all of the sprinklers in the room in the design area.

- Use Ordinary Hazard Group 2 and severely limit the length of the shelves and make the aisles at least 15 ft wide to prevent the fire from jumping the aisle

Question 12 – Chapter 12 in NFPA 409

In the "Best of February" issue of TechNotes, you mentioned that when protecting unfueled aircraft in a Group II hangar (using the 2011 edition of NFPA 409), you can ignore the rules of Chapter 7 and you only have to use Chapter 12. But we don't read Chapter 7 that way. Can you explain to us where NFPA 409 says this?

Answer: There is an errata issued by the NFPA that helps to explain this subject. You can go to the document information page on NFPA 409 at www.nfpa.org/409 and download the errata. It reads (in part) that section 7.1.2 needs to be modified as follows:

7.1.2 Group II aircraft hangar storage and service areas housing unfueled aircraft shall be provided with automatic sprinkler protection as specified in Chapter 12 ~~Sections 7.2 and 7.8.~~

As you can see, the errata should clear up the use of Chapter 12 for unfueled aircraft.