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Best of January 2013

This month, we have selected the following baker's dozen (13) questions as the "Best of January 2013" answered by the engineering staff as part of the NFSA's EOD member assistance program. 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. These 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 – Ceiling Sprinkler Density when In-Racks are Installed

We are protecting rack storage with solid shelves. We will be installing in-rack sprinklers under each solid shelf as required by NFPA 13. Are we allowed to take advantage of the ceiling sprinkler density reductions for these in-rack sprinklers below the solid shelves?

Answer: Yes, you can use all of the reductions allowed for in rack sprinklers. The reason for the reduction in ceiling sprinkler density is that the in-rack sprinklers will help fight a fire at a lower level in the racks, helping the ceiling sprinklers to control the fire. In the case of solid rack storage this is even more the case because the sprinklers at the ceiling level are shielded from the in-rack sprinklers.

Question 2 – Ceiling or Wall

We are being asked to protect a space where a portion of the roof slopes at a rate of 20 in 12. For the location and orientation of sprinklers, should this be protected as a ceiling with a very steep pitch or as a wall?

Answer: It should be protected as a ceiling with a very steel pitch. NFPA 5000 defines a wall as, "A component that has a slope of 60 degrees or greater with the horizontal plane used to enclose or divide space." A 20 in 12 pitch has an angle of 59 degrees, so it would be considered a roof. If the roof was slightly more pitched (21 in 12) it would have a slope greater than 60 degrees and would be considered a wall.

Question 3 – Idle Pallets Stored Above Doors

We have a situation where idle wood pallets are being stored above 12 ft high doors in a 36 ft high building. The building is a cold storage warehouse, so a dry-pipe system is going in and will need to use spray sprinklers or CMSA sprinklers. The owner is proposing single row racks above the doors to stack the pallets within 4 feet of the roof (at the 32 ft level above the floor). Since table 12.12.1.2(a)

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and Table 12.12.1.2(b) only go up to 30 ft ceiling heights for dry-pipe systems, how can we protect these idle pallets?
Answer: Due to the fact that the idle wood pallets are going to be stored above the door, you have an option under NFPA 13. Section 12.12.3.3 allows the base of the pallets above the door to be considered the "floor" for calculation of the storage and ceiling height. So, assuming the pallet storage starts 12 feet above the finished floor, your idle pallet storage becomes 20 ft of storage in a 24 ft high building. This permits the option of using standard spray sprinklers with k-11.2 or larger at 0.6 over 5850 sq ft (4500 x 1.3) with no in-rack sprinklers. Unfortunately, that is the only option in NFPA 13 due to the fact that the storage is in racks.
The owner would have more options if they stacked the pallets above the doors without putting them on racks. That would open up a number of other options for the use of CMSA sprinklers in accordance with 12.12.1.2(b).

Question 4 – Safety Margins in Water Supplies
Our local AHJ wants a safety margin of 10 psi between our sprinkler system demand from our hydraulic calculations and the water flow test information. Where does NFPA 13 say we have to provide this? We have encountered other AHJ's asking for a 10% safety margin. Is this the actual requirement rather than 10 psi?
Answer: NFPA 13 does not specifically require a 10 psi or 10% safety margin for hydraulic calculations. Instead NFPA 13 takes a two-pronged approach to safety margins:

1. The calculation methods required by NFPA 13 already have safety margins built into the calculation process. These safety factors include: the number of sprinklers expected to open during a fire, the assumption that all of these sprinklers will open at once, the amount of water that needs to flow from each sprinkler, the C-factor of the pipe and a hose stream demand. Additionally NFPA 13 includes various worst-case scenarios such as calculating the most demanding individual situation (usually the most remote from the riser) and the most demanding number of sprinklers on a branch line.

2. The 2007 and previous editions of NFPA 13 and NFPA 24 required the water flow test results to be adjusted down to account for daily and seasonal fluctuations, future expected use of the water supply, and other factors. Once the water supply had been adjusted down for these conditions, no other safety margins needed to be applied per NFPA-13. In the 2010 edition of NFPA 13, this requirement went to the annex, but stayed in NFPA 24. In the 2013 edition of both documents, this statement is now a recommendation in the annex rather than a requirement.

If the results of the flow tests have been adjusted down for the reasonable worse-case for the water supply as discussed in number 2 above, then no additional safety margin should be applied. If the results of the flow tests have not been adjusted, then the 10 psi or 10% safety margin that the AHJ is asking for might be their response as to what they think a reasonable adjustment should be. It is possible that some AHJ's have taken the step of modifying the law in their jurisdiction to require the 10 psi or 10% margin. AHJ's certainly have the right to modify their adoption of NFPA 13 in this manner, but they need to do it in a lawful way within their community and they need to let sprinkler contractor's know if this was officially done. When encountering situations where a 10 psi or 10% safety margin is required by local law, it should be clarified that this is a 10 psi or 10% margin from the original test data and not the adjusted water supply information. To put a 10 psi or 10% margin on top of already adjusted data would be putting a triple penalty on the sprinkler system. There are already two safety margins applied to sprinkler system calculations, a third is not

needed.

Question 5 – Bathroom Size

All of the NFPA sprinkler standards (NFPA 13, NFPA 13R and NFPA 13D) have used 55 sq ft as a maximum size permitted for unsprinklered bathrooms. How did the committees arrive at the value of 55 sq ft?

Answer: The first edition of NFPA 13D was published in 1975 with the provision that sprinklers were permitted to be omitted from bathrooms up to 40 sq ft in area.

In 1980, NFPA 13D was completely rewritten and the bathroom omission was raised to 55 sq ft. There was no specific substantiation for this change. The complete rewrite was substantiated with a few paragraphs about an extensive test program and review of data. Discussions with a number of individuals responsible for the early editions of NFPA 13D have indicated that not many people paid close attention to the exact size of the bathroom.

We suspect it was an attempt to make the concept of a "small bathroom" acceptable to an AHJ. If the standard were to say "sprinklers can be omitted from small bathrooms" that would be extremely hard to enforce. By giving a number, it makes enforcement easier. My guess is that this is a number that everyone on the committee was comfortable with.

At least one member of our Engineering Department staff was involved in writing the first edition of NFPA 13R in 1989. At that same time, NFPA 13 also allowed sprinklers to be omitted from bathrooms. Both NFPA 13 and NFPA 13R used the same 55 sq ft number that had already been in NFPA 13D. Representatives of the large hotel chains were members of the NFPA Sprinkler Committee and they appeared to be happy with the 55 sq ft number because almost all of their typical hotel guest room designs had bathrooms less than 55 sq ft.

It would appear that 55 sq ft adequately provides room for a tub, a toilet and a sink without creating too much excess space to store other objects, which helps to justify the omission of sprinklers from bathrooms this small. For a bathroom larger than 55 sq ft, there is space that is not needed for a bathtub, sink, or toilet that might end up being used for storage or some other use that allows more combustibles than a typical bathroom, so such larger bathrooms should be sprinklered.

Question 6 – Firestop Material in Composite Wood Joist Channels

Section 8.15.1.2.8 of NFPA 13 requires composite wood joist channels to be firestopped to the full depth of the joist with material equivalent to the web construction in order to omit sprinklers from the concealed space. The composite wood joists in this case have 3/8 inch particle board, so the firestops are proposed to be 3/8 inch particle board. Our local AHJ is stating that since NFPA 13 uses the term "firestop" that the minimum thickness of the particle board has to be ¾ inch because the building code says that all firestops have to be at least ¾ inch thick. Who is correct?

Answer: It would depend on exactly how the building code was written. If the building code specifically had a section on firestop construction to allow sprinklers to be omitted from concealed spaces, then the building code would be correct. But for the situation where the building code has some generic reference to firestopping material, such a general reference would not override NFPA 13. If the building code is the ICC's International Building Code (IBC) without any revisions to section 717, then the requirement from NFPA 13 that the firestop material be at least 3/8 inch particle board (in your case) would be all that you would need.

Part of the confusion here is in the role of the firestopping material and part of the confusion is coming from the terminology being used by different codes and standards. As far as the role of firestopping material is concerned, the intent of NFPA 13 is NOT to try and stop a fire from ever getting through the material. In this

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respect, “firestopping” is a poorly chosen word in NFPA 13. But since section 8.15.1.2.8 is very clear as to what constitutes acceptable material for the firestopping, the poor choice of words should be forgiven. NFPA 13 is very clear that any material that is as least as fire resistant as the web material of the composite wood joist is acceptable for the firestopping in the joist channel.

As far as NFPA 13 is concerned, the purpose of the firestopping is to stop the flow of hot gasses early in a fire from going down the joist channel and staying near the deck. The goal is to force the hot gasses from a fire to come down and activate sprinklers below the joists early in a fire, not to prevent the eventual spread of fire down the joist channel. The use of very thick firestops would not make sense as a requirement. A fire might be stopped from heading down the joist channel by very thick firestops, but the fire would then burn through the joist web into the next channel, so the firestop would really not be stopping the spread of fire.

The reason that we say that there is no conflict with the IBC is that this code does not use the term “firestop” to describe an object in a joist channel in a concealed space. Instead, this code uses the term “fireblock” to describe the construction material that needs to have a certain thickness in a certain space (having nothing to do with sprinklers). Since the IBC uses a different term than NFPA 13, it is clear that they mean something completely different and there is no reason to use the requirements of the IBC to imply any additional criteria to what is specified by NFPA 13.

In summary, as far as the sprinkler system is concerned, sprinklers are permitted to be omitted from concealed spaces formed by composite wood joists as long as the joist channels have vertical barriers installed to the full depth of the joist that are at least the same material (in composition and thickness) as the web material of the joist.

We should point out however that such a sprinkler system would probably be required to have a minimum design area of 3,000 sq ft in accordance with section 11.2.3.1.4(3) unless the firestops had higher fire resistance. In order to avoid the 3,000 sq ft design area, the firestops would need to be at least ½ gypsum board in accordance with 11.2.3.1.4(4)(j). Other rules also apply, so please read NFPA 13 carefully.

Question 7 – Sprinklers in Mechanical Equipment Spaces

In a building with large mechanical equipment that has access doors for maintenance (large plenum and duct spaces for example), does the interior of the mechanical equipment need to be protected with fire sprinklers?

Answer: No. In general, it is not industry practice to install fire sprinklers inside of equipment. The space where the equipment is located must be able to handle the hazard of that space including any equipment. An access door for the equipment does not automatically require that sprinklers be installed inside. This long-standing practice has been formalized in the 2013 edition of NFPA 13 by the addition of a new section 8.1.1(8), which says, “Sprinklers shall not be required to be installed within electric equipment, mechanical equipment, or air handling units not intended for occupancy.”

Question 8 – External Projections from a Building

In an area outside of a building that is covered by a projection from the building and blocked from the wind by some partial walls, are sprinklers required in the space? Does it make a difference if the projection is there for cars to pull up (such as a porte-cochere) or if the projection is there for some other reason?

Answer: Exterior projections from the building are handled in accordance with section 8.15.7 of NFPA 13. It does not matter whether you call the projection a porte-cochere, a balcony or an exterior roof. The fact that there are some walls around it does not matter either. The space is an exterior projection from the building; that is all that matters. Section 8.15.7 says that sprinklers may or may not be required based on the construction of the projection, the

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width of the projection, and the use of the space (allowing storage or not). The following is a summary table of the rules:

Construction of Projection	Width of Projection from Outside Wall	Use of Projection	Sprinklers Required?
Combustible	2 ft or less	No storage	No
Combustible	2 ft or less	Storage	No
Combustible	Greater than 2 ft up to 4 ft	No storage	No
Combustible	Greater than 2 ft up to 4 ft	Storage	Yes
Combustible	Over 4 ft	No storage	Yes
Combustible	Over 4 ft	Storage	Yes
Non-combustible, limited-combustible or FRT Wood	2 ft or less	No storage	No
Non-combustible, limited-combustible or FRT Wood	2 ft or less	Storage	No
Non-combustible, limited-combustible or FRT Wood	Greater than 2 ft	No storage	No
Non-combustible, limited-combustible or FRT Wood	Greater than 2 ft	Storage	Yes

Hopefully, you can find which situation matches your building and determine whether or not you need sprinklers.

Question 9 – Hydrostatic Test after Renovations

We just conducted a renovation of a sprinkler system where we replaced 21 sprinklers. Are we required to perform a hydrostatic test? Is the minimum pressure required to run the test 200 psi?

Answer: Yes, you are required to perform a hydrostatic test; however, you are not required to run the test at 200 psi. The test can be run at the normal water supply pressure, whatever that might be.

There are three different conditions that might occur with a sprinkler system and the installer doing the renovating work needs to decide which condition applies before determining what the pressure demand is for the hydrostatic test. If the work affects 20 or fewer sprinklers, the test is performed at the system working pressure. If the work affects more than 20 sprinklers and the work can be isolated, the test is done at 200 psi. If the work affects more than 20 sprinklers and the work cannot be isolated, then the test is done at system working pressure.

The intent of NFPA 13 is to be very careful and only expose new piping and components to the 200 psi test. Remember that most piping and components are only rated for 175 psi maximum pressure. We should not be exposing existing components to any pressure more than 175 psi. Any AHJ that forces a test to be conducted on existing system piping at 200 psi is exposing the system to unnecessary excess pressure and is risking severe damage to the system.

When you relocated 21 sprinklers, you probably did not use all new pipe between all of the sprinklers. The branch line piping is probably still the old piping that was there before you started your work. If you were to conduct a 200 psi test of the whole portion of

the system where the 21 sprinklers were relocated, this existing piping would be exposed to that 200 psi pressure and might not be able to withstand the situation. Since the new work that you did cannot be isolated from the existing pipe, section 24.2.1.6 of NFPA 13 allows you to run the test at the system working pressure so that you do not expose existing pipe (which you may not have installed and have no liability for) to excess pressure. It is important to note that section 24.2.1.6 does not have a count as to the number of sprinklers that it applies to.

The only time that the 200 psi test is required for modifications to systems is when the new work can be isolated. In this way, it is only new pipe that is subjected to the 200 psi test. Even though this new pipe is usually only rated for 175 psi, the safety factors involved with the new product allow this test to be run safely at 200 psi for a very short period of time (2 hrs).

It is also worth noting that some recent revisions to NFPA 13 have made it clear that the piping up near the ceiling should never be exposed to 200 psi during an acceptance test, even when the test is being done on new pipe. Section 24.2.1.8 in the 2007 and 2010 editions of NFPA 13 clarify that the 200 psi is measured at the bottom of the system, not at the top. So, during the acceptance test on a system with a typical riser, the 200 psi is measured at the bottom of the riser and the branch line piping will see a lower pressure based on the elevation head loss that occurs over the distance between the bottom of the system where the pressure was measured and the sprinkler piping near the top. A system with a 10 ft height would only experience a 4.3 psi drop, so the branch line piping would be acceptance tested at 195.7 psi, but a system with a 30 ft height (which would be common in a warehouse or manufacturing building) would have a 13 psi difference and would only have the branch lines exposed to 187 psi during the test.

Question 10 – Concrete Anchors

We have two related questions on concrete anchors:

Question A - Are concrete screw fasteners acceptable for hanger installations in accordance with Section 9.3.7.8 of NFPA 13, 2013 Edition since they have been tested under AC193 and reported by the ICC ES for prequalification in cracked concrete for seismic applications?

> **Answer to Question A:** Yes. The handbook for NFPA 13 explains that ACI 355.2 is the testing methodology for the prequalification of concrete anchors. The ACI reference is also the basis for AC193. The commentary notes that the Committee intended the same requirements for prequalified anchors used with hangers as those required for sway braces in Section 9.3.5.12.7. This would include the allowance of AC193.
>
> Question B - Is the performance requirement found in ACI 355.2 an acceptable route to allow for concrete anchors not covered in other sections?
>
> **Answer to Question B**: There are performance options in many standards. The end result is the same. A professional engineer will be required to analyze the scenario and the product being used to support the sprinkler piping. Then information will have to be conveyed to the AHJ to agree that adequate information was used in the evaluation. Then a product or arrangement can be used.

Question 11 – Hose Connection Requirements in NFPA 1

NFPA 1 appears to require 2-1/2 inch outlets that are really standpipe systems that are connected to sprinkler systems. This appears to violate section 8.17.5.2.2 of NFPA 13 that requires separation between sprinkler and standpipe systems. How can one standard require something that violates another? In addition, the hose outlets on our system have been connected to the sprinkler mains. Is that okay? Do the outlets require separate control valves?

Answer: NFPA 1 is not calling for a standpipe system. Instead, it is calling for a 2-1/2 inch outlet to be connected to the sprinkler

system. The word “standpipe” is not used in NFPA 1, so we should not consider this any type of standpipe system. Instead, it should be considered a hose connection on a sprinkler system, which is permitted by NFPA 13 under section 8.17.5.2.1.

Section 8.17.5.2.1 requires the connection for the hose system to be at the sprinkler system riser, probably to insure that the friction loss will not be too significant since a connection to smaller piping might be a problem. In your case, you say that the hose outlet has been piped to the sprinkler system main. Since the issue is mainly hydraulics, it would be up to the AHJ to decide if the situation is acceptable, assuming that the hydraulic calculations show that the system will work.

There is nowhere in the standard that requires separate control valves for 2-1/2 inch hose outlets on sprinkler systems. Interestingly, section 8.17.5.1.3 requires separate valves for 1-1/2 inch hose connection on sprinkler systems, but there is no similar section for 2-1/2 inch hose. This is certainly something the committee needs to address for the future.

Question 12 – Symmetrical Arrangements for Multiple Pumps

Are the suction pipe arrangements required to be symmetrical for two pumps in the same pump room when one pump is going to be used as a back-up to the other pump?

Answer: No. The suction pipe would have to be hydraulically calculated so that each pump worked individually. If the pipes were not symmetrical, then the more demanding situation would still need to comply with the requirement to have a positive pressure at the suction flange during maximum flow.

Section 4.14.7 of NFPA 20 requires a symmetrical design when multiple pumps are going to be running at the same time, assuming that the pumps will equally share in the load. But this is not a requirement that is to be applied to multiple pumps that are installed for redundancy and are not expected to run at the same time.

Question 13 – Column Sprinklers and NFPA 409

NFPA 409 requires additional sprinklers (supplied from the ceiling system) to spray directly on columns when the columns do not have a certain fire resistance rating. Are these sprinklers required to be included in the hydraulics with the ceiling sprinklers? Note that we are using the 2004 edition of NFPA 409.

Answer: Yes. NFPA 409 has design area requirements that are different for each hangar group. For Group 1 hangars, the design area requirement is 15,000 sq ft (section 6.2.4.5). For Group II hangars, the design area requirement is 5,000 sq ft (section 7.2.5). In either case, the requirement is to calculate ALL of the sprinklers that fall within the design area. There is no exception that allows the user to drop any of the sprinklers. The column sprinklers are connected to the ceiling sprinkler system and are likely to open if there is a fire, so they need to be included in the hydraulic calculations. The only way that you would be allowed to omit them would be if there was a specific section telling you that you were allowed to omit them. Since there is no such section in the 2004 edition, you need to include them as a part of the design area.

In the 2011 edition of the standard, section 5.6.3.5 was added to clarify that the flow for column protection needs to be included in the calculations. Evidently enough people were questioning the issue that the committee found a need to clarify their intent.

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