NFSA The Voice of the Fire Sprinkler Industry TechNotes

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Best of March 2016

Following are a dozen questions answered by the engineering staff as part of the NFSA's Expert of the Day (EOD) member assistance program being brought forward as the "Best of March 2016." If you have a question for the NFSA EOD (and you are an NFSA member), send your question to eod@nfsa.org and the EOD will get back to you.

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

Question 1 – Manufacturer's Rated Pump Curve Versus Certified Shop Test Curves
There is a project that includes a fire pump. The hydraulic calculations were performed using the results of the certified shop test curve as opposed to the manufacturer's rated pump curve. It has been stated that the pump is rated for 80 psi but that the pump actually produced 85 psi during the test. The 85 psi was used for the calculations. Is it acceptable to use the certified pump test results from the manufacturer to perform the hydraulic calculations?

Answer: Yes. Although it is standard industry practice to use the rated pump curve from the datasheets to perform the calculations, this is primarily because the calculations are usually performed prior to purchasing the fire pump. The certified pump test will indicate the actual performance of the fire pump and is perhaps a more accurate starting point for the calculations, when available. In fact, the NFPA publication, Pumps for Fire Protection by Kenneth E. Isman and Milosh Puchovsky, states the following: "The manufacturer provides the actual performance of each fire pump through the use of certified shop test curves for use in hydraulic calculations."

A likely possibility for the difference between the rated pump curve and the certified shop test curve is that the manufacturer may have run the pump faster when they generated the performance curve at the factory. It is possible and likely that the shop curve actually meets the rated curve if the results are adjusted for the different speed. The formulas (known as the Affinity Laws) for adjusting the data from a pump test are as follows:

$$Q_2 = Q_1(N_2/N_1)$$

$$P_2 = P_1(N_2/N_1)^2$$

Where:
Q_1 = Flow at speed 1
Q_2 = Flow at speed 2
N_1 = Speed 1 (number of RPMs)
N_2 = Speed 2 (number of RPMs)
P_1 = Pressure (net) at speed 1
P_2 = Pressure (net) at speed 2

As shown, the relationship between the pressure created by the pump and the speed of the pump is exponential. So, a small change in speed can make a significant difference in the net pressure created by the pump.

As the certified shop test will likely indicate the actual performance of the fire pump it may be a better starting point for the hydraulic calculations. There may be concern if the system works with the new certified pump test curve and not the rated curve. Care would then be needed to confirm the acceptance test curve meets the shop performance curve and will serve the demand of the system. Subsequent flow tests of the fire pump will be compared back to the acceptance test.

Question 2 – Type and Size of Sprinklers for In-Rack Protection
It has been noted that NFPA 13 Figure 17.3.1.5(b) does not include information on the type and size of the sprinklers required for in-rack fire sprinkler protection. This figure references a storage arrangement for Group A plastics stored over 25 ft high. The ceiling is being protected with control mode density area (CMDA) sprinklers. What sprinklers are permitted to be used within the rack structure?

Answer: NFPA 13 would permit any spray sprinkler that complies with the minimum K-factor requirements found in Section 12.6 Storage Applications (specifically 12.6.1, 12.6.2, or 12.6.3) and is capable of delivering the required minimum flow as per Section 17.3.1.16. Note that the in-rack sprinklers are permitted to be quick response if listed for storage as per Section 12.6.6. However, this may be applied only when the ceiling sprinklers are also quick response.

Question 3 – Expected Lifespan of Wet Pipe Sprinkler System
NFPA 13 (2016) now requires the installation of an air vent in wet pipe sprinkler systems. Are there any studies providing data on the expected life span of a wet fire sprinkler system?

Answer: An exact lifespan of a fire sprinkler system cannot specifically be determined. However, it is common to hear 50 years quoted as a reasonable service life for a sprinkler system. The effective lifetime can vary significantly depending on the piping materials used and the conditions under which it is installed. For instance, a 1977 study by Batelle Columbus Laboratories examined 56 specimens of Schedule 40 pipe taken from 41 locations around the country. They predicted service lives for the specimens ranging from as little as 15 years to well over a thousand years with the most critical differentiating factor being the availability of oxygen within the pipe. The addition of venting to reduce the amount of oxygen from air trapped in the

pipe provides a theoretical advantage but there are no empirical studies that are public on this issue at this time.

Question 4 – Bowstring Truss Creating a Curved Ceiling
A building has a bowstring truss roof noting that the center is almost flat, but the ends are sloped (curved). Is it required to calculate the hydraulically remote area adding an additional 30 percent as required for ceilings with a slope in excess of 2 in 12 as per NFPA 13 Section 11.2.3.2.4 even though only a portion of the space has a sloped ceiling exceeding the 2 in 12 limit?

Answer: Yes, given a typical bowstring truss, when the remote area is under a sloped ceiling, even if only part of the area is below a sloped ceiling, the increase in calculation area would apply. A curved ceiling is just a ceiling where the slope changes constantly as a tangent to the curve. Given the geometry of a typical bowstring truss, the slope near the sides will generally be well in excess of 2 in 12 but decreasing to 0 in 12 at the highest point. The point at which the slope equals 2 in 12 can be determined mathematically, but it may be more practical to simply evaluate the rise and run from any given point along the ceiling to another to determine the slope at the halfway point along the curve of the ceiling between them.

In most cases the hydraulically remote area is near an edge of the building, which is where the curved portion of the truss is generally located. However, if a calculation area were required with the entire area fit below a portion of the ceiling/truss arrangement where the slope does not exceed 2 in 12, then the increase would not be necessary. Yet, if even a portion of the remote area has a sloped ceiling (more than 2 in 12), then the 30 percent area adjustment is needed.

Question 5 – Residential Sprinklers and Quick Response Sprinklers
Is it permissible according to NFPA 13R to mix residential sprinklers protecting a compartment and quick response sprinklers protecting the windows in the same residential dwelling unit?

Answer: No. Section 6.2, Use of Sprinklers, indicates that using residential sprinklers and quick response sprinklers in a single space is outside the scope of the standard. The challenge is that this occurs inside a dwelling unit and sprinklers, other than residential sprinklers, are extremely limited in their use inside a dwelling unit. The authority having jurisdiction (AHJ) should be involved as the protection of windows with sprinklers is not required from the fire sprinkler installation standards. The origin of the requirement, along with the AHJ, will lead to appropriate protection of the space.

Question 6 – Internal Inspection of Limited System
With regards to the 5-year internal pipe inspections in NFPA 25, what would be required to be done on a 1-inch limited system that does not have a "system" check valve per se? This system also does not have a drain, Inspectors Test Valve, or gauge.

Answer: Assuming NFPA 25 applies to the limited system**,** regarding an internal inspection (titled "Assessment of Internal Condition" in the 2014 edition) of a small pipe, NFPA 25 does not differentiate the need for internal inspection based on pipe diameter. The intent of the internal inspection is to look for "foreign organic and inorganic material". Prior to the 2014

edition, the standard had specific locations where this inspection needed to be conducted. Here is the language from the 2011 edition:

> The internal inspection shall be conducted by "opening a flushing connection at the end of one main and by removing a sprinkler toward the end of one branch line".

Beginning with the 2014 edition, that prescriptive requirement was moved to annex guidance and the purpose of the inspection was clarified to just involve assessing the internal condition of the pipe.

How is this performed for small pipe (approximately 1-inch)? This would not be treated differently than any other diameter piping in a system. The pipe would be opened in a few places that could give a good indication of whether or not there might be corrosion developing or foreign materials present. Of course, the alternative methods (ultrasound, x-ray, etc.) are always permitted as well.

Question 7 – Glass Protection
A pedestrian walkway has been installed with a fire sprinkler system according to the IBC (2012) Section 3104.5 Ex.1. This section requires that the interior side of the glazing and wall be "...completely wet...when [fire sprinklers are] actuated." It has been noted that the windows have horizontal mullions. Is there is any guidance on this application?

Answer: The requirements in the IBC are fairly straightforward – To wet the entire surface of the glass to create an active barrier when there is a fire event. However, the horizontal mullion is most likely going to be an obstruction to this objective. To avoid this, additional sprinklers under the horizontal mullion will be necessary. Many architects do not realize that these performance requirements do have some limitations, such as horizontal mullions. Depending on the height of the wall and the number of levels of mullions, there may be an alternative glazing option that would work better than many levels of fire sprinklers to wet the glass.

Question 8 –Obstructions Far Below ESFR Sprinklers
A situation exists where there is a 1 foot wide obstruction located 3 feet below an ESFR sprinkler and 6 inches horizontally (plan view) away. Section 8.12.5.2 allows obstructions up to 2 feet wide when located greater than 1 foot away horizontally from the ESFR sprinkler. Non-storage sprinklers can have obstructions up to 4 feet in width when they are positioned more than 18 inches below the sprinkler deflector. At what point below the sprinkler does the obstruction no longer impact the spacing for an ESFR sprinkler?

Answer: There is no limit to the distance below a sprinkler at which point the obstruction does not impact the spray pattern of the ESFR sprinklers. This is because ESFR sprinklers are suppression mode sprinkler which are more sensitive to disruptions in water delivery. Standard spray sprinklers, which are control mode sprinklers, have an allotment for obstructions more than 18 inches below the standard spray upright/pendent sprinklers to be up to 4 feet wide. This takes into consideration the purpose of standard spray sprinklers to simply control a fire rather than suppress a fire. As ESFR sprinklers are intended to suppress the fire, there is not an equivalent exception to obstructions below the sprinklers.

Question 9 – Small Combustible Concealed Spaces
There is a 7-inch wide concealed combustible space that exists between a wall and a 30-inch tall plywood beam. Is a sprinkler in this space permitted to be omitted as Section 8.6.3.3 requires sprinklers to be located a minimum of 4 inches from a wall?

Answer: No. Unless this situation fits one of the sections which permits the omission of sprinklers from a space, the sprinkler(s) would need to be installed. The 4-inch requirement is a practical requirement to allow maintenance/installation of the sprinklers. Other concealed space requirements should be reviewed to see if any minor modifications can be made to be able to omit the sprinkler from this small space. One example may be to fill the space with insulation as noted in Section 8.15.1.2.7.

Question 10 – NFPA 13 vs NFPA 20
Is there a conflict between NFPA 13 (2013) and NFPA 20 (2013) as section 6.5.2.2.5 of NFPA 13 does not permit welding of sprinkler system piping and section 4.13.6 of NFPA 20 does allow torch-cutting or welding of pump house piping? Can the suction piping of the fire pump be welded to fix a pinhole leak?

Answer: Yes. You are permitted to perform torch-cutting or welding as means of modifying or repairing the suction piping of the fire pump for pump house piping when performed in accordance with NFPA 51B. NFPA 20 governs fire pump piping, which is defined as the suction piping and the discharge piping. The suction piping is defined as all pipe, valves and fittings from the pump suction flange to the connection to the water supply (4.15.1.1 of NFPA 20) The discharge piping is defined as the pipe, valves and fittings extending from the pump discharge flange to the system side of the discharge valve (section 4.16.1 of NFPA 20). Piping from the system side of the fire pump discharge valve would then be governed by NFPA 13.

Question 11 – ESFR Sprinklers - Light Fixture above and below deflector.
A sprinkler system using ESFR sprinklers has been installed where a sprinkler is located 1 foot horizontally away from a light fixture. The light fixture extends down from the ceiling passing the elevation of the ESFR sprinkler by 2 feet. Is this considered an "obstruction at or near the ceiling" (8.12.5.1) or an "isolated obstruction below the elevation of the sprinklers" (8.12.5.2)?

Answer: This would fall under Section 8.12.5.1 for obstructions near or at the ceiling. The light fixture interrupts the development of the water spray pattern. To fall under the requirements of Section 8.12.5.2 the isolated obstruction would have to be completely below the sprinkler deflector elevation. Since this light fixture is at and above the sprinkler deflector level, you would follow Section 8.12.5.1.

Question 12 – Seismic Restraint
A main in a corridor feeds the neighboring sprinklers in the adjacent rooms. Most of the rooms are protected with a single sprinkler. Are these runs to individual sprinklers still considered an armover such that branch line restraint would not be required?

Answer: Yes. An armover is defined as the piping that feeds an individual sprinkler in Section 3.5.3 of NFPA 13, 2016 Edition (with similar language in earlier editions). The Committee has said that pipe feeding only one sprinkler is not required to have restraint. Of course, the intent of the restraint is to limit the amount a pipe can move due to earthquake forces. If there is something nearby where movement should be limited, then it would be prudent to put restraint on the line even if it is feeding a single sprinkler.