NFSA TechNotes
The Voice of the Fire Sprinkler Industry

Editor-Kenneth E. Isman, P.E. Issue# 273 August 13, 2013

Best of July 2013

This month, we have selected the following dozen questions as the "Best of July 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 – Sprinklers in Exhaust Duct for Paint Spray Application

We are protecting a paint spray booth and its exhaust duct in accordance with NFPA 33 (the sprinkler rules are also extracted into the 2013 edition of NFPA 13 in section 22.4 (similar sections in previous editions). The exhaust duct will have a very long vertical section (more than 12 ft long). Can we place a single sprinkler at the top of the vertical section of duct or do we need to space sprinklers at a maximum interval of 12 ft vertically? Also, how many sprinklers should be in the design area from the duct?

Answer: The distance between sprinklers in the duct is measured vertically and horizontally. The standard makes no distinction regarding direction; it just requires sprinklers at maximum 12 ft intervals in the duct. As far as the hydraulic calculations are concerned, all sprinklers of the sprinklers in the duct need to be included in the hydraulic calculation. The NFPA standards state that the design area needs to include, "all of the sprinklers likely to open in any one fire incident." An annex note goes on to clarify that this means all of the sprinklers in the spray area. NFPA 33 goes on to define the spray area in section 3.3.2.3 as including:

(1) Any area in the direct path of the spray application process
(2) The interior of a spray booth
(3) Interior of exhaust plenum
(4) Interior of exhaust duct
(5) Interior of air re circulation filter
(6) Solvent recovery or concentration unit

Since the interior of the exhaust duct is considered part of the spray area, and the standard requires the whole spray area to be considered part of the design area, then you need to include all of the sprinklers in the duct in the design area. We recognize that this is clarified through an annex note, which is not legally enforceable. However, the annex note simply provides information on how to interpret the phrase, “all sprinklers likely to open in any one fire incident,” which is in the enforceable portion of the standard. Without the annex note, the user would need to come up with some other legitimate method to assess the “likelihood” of fewer sprinklers opening, which is a difficult assessment to make.

Question 2 – Hydrostatic Test of Standpipe System Under Construction

Is a hydrostatic test is required for a standpipe system that is not finished in a building that is under construction?

Answer: No. NFPA 14 only requires the hydrostatic test during the acceptance testing at the end of the standpipe installation, not at any point during construction. This answer assumes that the standpipe system in question is the permanent standpipe system that is required for the building. It should be noted that many building and fire codes require temporary standpipe systems during building construction. The requirements for these temporary standpipe systems depend on the local building or fire code. As far as the International Building Code (IBC) is concerned, temporary standpipe systems installed for use during building construction do not need to be hydrostatically tested. Section 3311.3 of the IBC only requires that standpipes conform to the “capacity, outlet and materials” requirements for standpipe systems. Note that this does not include hydrostatic testing. The temporary nature of standpipes being used during construction does not warrant a full 200 psi hydrostatic test.

Question 3 – Hydraulic Calculations for Standpipe Systems

We have a standpipe system going into a 23 story building with three standpipes. Two of the standpipes go all the way up to the 23rd floor while the other one only goes up to the 3rd floor. Does the third standpipe get included in the calculation? It makes a difference because a two-standpipe calculation would only be 750 gpm while a three-standpipe calculation would be 1000 gpm.

Answer: Two separate calculations need to be performed. The first calculation needs to be done for the two standpipes at the top of the building. This calculation would include discharge of 250 gpm from standpipe 1 at the 23rd floor, 250 gpm from standpipe 1 at the 22nd floor, and 250 gpm from standpipe 2 at the 23rd floor. The total flow demand for this calculation would be 750 gpm.

The second calculations would be done with 250 from standpipe 1 at the 3rd floor, 250 gpm from standpipe 1 on the second floor, 250 gpm from standpipe 2 at the 3rd floor and 250 gpm from standpipe 3 at the 3rd floor. The total flow demand for this calculation would be 1000 gpm.

The water supply would have to meet both demands individually, not added together. The pressure demand for the first calculation at 750 gpm would likely be much higher than the pressure demand for the second calculation at 1000 gpm.

NFPA 14 was clarified to specifically handle this situation in the 2010 edition. See Section 7.10.1.2.1.1 and its accompanying figure in the annex. For people using earlier editions of NFPA 14, the same answer applies, but rather than stating a specific section, you have to use logic and the principle that the standpipe system is only trying to help firefighters deal with one fire at a time. It would not be logical for a fire department to put a hose in service from the third standpipe on the 3rd floor when fighting a fire on the 23rd floor.

Question 4 – Spray Patterns for NFPA 15 System Nozzles

Section 7.4.2.3 of NFPA 15 states that nozzles shall be spaced such that their spray patterns meet or overlap at the protected surface. If I am protecting a horizontal vessel and if I have a nozzle that produces an 8ft diameter "circular" spray pattern and I space the nozzles at 8ft on center horizontally along the vessel then have I adequately complied with this section, or do I need to be worried that there is a dry spot because the spray patterns are only meeting at one spot.

Answer: You need to check with the nozzle manufacturer, but the odds are that you do meet the standard. Typically, when the nozzle manufacturers list the spacing rules for their nozzles, they take the circular spray pattern into account and only provide the spacing rules for the square within the circle. Consider the figure below, which was developed from a spray pattern for a listed water spray nozzle that is designed to be installed on an 8 ft spacing.

In the case of the figure above, this manufacturer knows that their nozzle produces a spray greater than 8 ft in diameter. By listing the nozzle for use with the 8 ft spacing (the square within the circle), they guarantee that the spray patterns will overlap (as shown by the shaded area).

As long as you are using the maximum spacing provided by the manufacturer in the listing of the spray nozzle, it should be taking into account the geometry of the situation and you should be in compliance with the rule in NFPA 15 to have the spray patterns meet or overlap.

Question 5 – Using Hose on Main Drain Test

We have a situation where the building owner does not want us to run a main drain test and allow the water to discharge straight from the main drain (they are worried about damage to landscaping and getting rust stains on their new pavement). They want us to attach 300 ft of hose to the end of the main drain to carry the water well away from the building. Will this affect the results of the main drain test due to the friction loss in the hose?

Answer: Yes and no. The basic procedure of the main drain test will be the same. However, since the water will discharge at the end of the hose at a lower pressure than out of the main drain, you will not be able to produce the same flow as you would from the main drain without the hose. Since the flow will be lower, your drop in pressure will be lower and the pressure in the riser during the main drain test will be higher. If you are doing this test with hose, it would not be legitimate to compare the results of the test back to times when the test was done without hose.

If you are doing the test for the first time, it would be legitimate to do it with the hose as long as every other time in the future that the test is done, it is done with the same length and the same kind of hose. If any changes are made to the type or length of hose, the comparisons to previous tests would not be legitimate. If you are doing the test for the first time with hose, it might be advantageous to run the water for a while until it is clear, then disconnect the hose and do the test again with just the bare main drain connection. This would help establish a baseline result both with and without hose that would help determine the pass/fail criteria of future tests.

Question 6 – Free Flowing Plastics

We are trying to protect 10 ft high rack storage of free flowing Group A plastics that does not meet the definition of miscellaneous storage. Can we use Ordinary Hazard Group 2 protection in accordance with Table 13.2.1 and the rules for Class IV commodity in NFPA 13? Our local AHJ is saying that section 17.2.1.1 only allows Table 13.2.1 to be used with Group A plastics up to 5 ft in height since we do not meet the definition of miscellaneous storage.

Answer: You are permitted to use the Ordinary Hazard Group 2 provisions of Table 13.2.1. Section 17.2.1.1 does not apply to free flowing Group A plastics. Section 5.6.3.4.1(2) of NFPA 13 defines a free flowing Group A plastic as a Class IV commodity. Therefore, you should never end up in Chapter 17 for protection of a free flowing Group A plastics. The whole point of section 5.6.3.4.1(2) is to tell the user of NFPA 13 to treat the free flowing Group A plastics exactly the same as you would treat a Class IV commodity. This means that you go to Chapter 16 for the protection criteria when they are stored on racks. Section 16.2.1.2.1 sends the user to Table 13.2.1 for protection of Class IV commodity under 12 ft in height. Table 13.2.1 says that Ordinary Hazard Group 2 protection is sufficient for Class IV commodities stored on racks up to 10 ft in height.

Question 7 – Single FDC for Multiple Systems

We have a dedicated fire loop that supplies multiple systems in a complex. Is it acceptable to have a single fire department connection on the fire loop that feeds these multiple systems?

Answer: Yes. There is no requirement in NFPA 13 for a separate FDC on each system or for the building as long as the FDC meets the requirements as outlined in 8.17.2 of NFPA 13 (2013 Edition or earlier editions). The thinking here is that the sprinkler system is protecting for a single fire at a time. The standard does not anticipate protecting for multiple fires at the same time.

Question 8 – Converting Seismic Forces

We are working with seismic forces that have been calculated under ASCE 7 and we wonder if we need to convert them in order to use them in NFPA 13. Specifically, are we required to apply a 140% conversion factor on the ASCE 7 load?

Answer: No. First, the previous concept in the building codes was to divide the load by 1.4 in order to convert from an ultimate strength design to an allowable stress design (as used in NFPA 13). In more recent codes, the concept is the same for reference standards, but the value used is now 0.7. This is the inverse of 1.4, so the 0.7 is multiplied by the ultimate strength design value in order to use it in NFPA 13. This is a statement found in Section 13.1.7 of ASCE/SEI 7-10.

Question 9 – Alarm Test Connection on Riser

Does NFPA 13 permit the installation of an alarm test connection directly in the vertical riser, downstream of the waterflow alarm (flow switch)?

Answer: For a wet pipe system, the answer is "Yes". The purpose of the alarm test connection on a wet pipe system is to create a flow equal to a single sprinkler to see if the waterflow alarm senses the flow and sends a signal. This test connection can be anywhere downstream of the waterflow alarm to perform this task. For a dry-pipe system, the alarm test connection cannot be on the riser because this would trip the dry-pipe valve whenever the alarm is being tested. Instead, on a dry-pipe system, there is an alarm test bypass that is part of the trim piping for the dry-pipe valve. This bypass takes water from underneath the dry-pipe valve and passes it through the waterflow alarm (typically a pressure switch, but it could be a mechanical water motor gong) to see if it sends a signal.

Question 10 – Remoteness of Alarm Test Connection

Is the alarm test connection required to be at the end of a remote branch

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line?

Answer: For a wet pipe system, the answer is “no”. See the discussion in Question 9 above regarding the purpose and location of the valve. Since there is no need with a wet pipe system to time how long it takes to get water to the most remote portion of the system, there is no need to have any type of connection at the most remote portion of the wet pipe system. There is also some evidence that suggests that putting the alarm test connection at the end of the system could be encouraging extra corrosion in the system. Each time that the test is run, fresh water, with fresh submerged oxygen is being pulling into the system. The oxygen is combining with the steel to cause additional corrosion. The deeper into the system that the alarm test connection is installed, the farther the corrosion is occurring. From a corrosion standpoint, it is better to keep the alarm test connection as close to the waterflow alarm as possible.

For a dry-pipe system, the answer is “no” regarding the alarm test connection, which is on the trim for the dry-pipe valve as discussed in Question 9 above. But the dry-pipe system is required to have another device at the most remote branch line called a “trip test connection”. Many people call the “trip test connection” an “inspector’s test connection”. The purpose of the trip test connection is to see how long it takes water to get to the most remote portion of the system. Due to this purpose, the trip test connection needs to be at the most remote portion of the system.

Question 11 – Location of Alarm Test Connection and Time for Alarm to Sound

Does the location of the alarm test connection affect the ability of the waterflow alarm to react within 90 seconds?

Answer: It might, depending on the amount of trapped air in the sprinkler system. If a wet pipe system is a tree system with lots of trapped air in the branch lines and this system has the test connection at the most remote portion of the system, the trapped air will expand when water starts to flow and will push water out of the branch lines first, before allowing water to flow from the riser, which will delay the operation of a waterflow switch on the riser. This is one of the reasons that we limit systems to 52,000 sq ft per floor. It tends to limit the affect of this delay in waterflow alarms. For a gridded system, it would not be much of an issue because there should not be much trapped air in a gridded system.

Question 12 – Conflict in Waterflow Times

NFPA 72 requires that waterflow occur within 90 seconds (section 5.11) and NFPA 13 requires waterflow within 5 minutes (section 24.2.3.1). Why the difference?

Answer: There is a fundamental difference between NFPA 13 and NFPA 72 regarding the purpose of a fire sprinkler system. As far as NFPA 13 is concerned, the purpose of the sprinkler system is to control or suppress a fire. As far as NFPA 13 is concerned, the waterflow alarm is just to let people know that there is water flowing in the building. People need to pay attention to the water flow so that they don’t have too much water damage in their building. The 5 minute delay is considered acceptable because the flow of water from one or two sprinklers is not that large for 5 minutes and the total water damage will be limited just fine if people know that water is flowing in the building within that time period. The 5 minute delay was important in the early years of sprinkler protection because we needed to limit false alarms with mechanical devices like retard chambers. Sprinkler systems work independently of electricity and the people in the sprinkler business have worked hard to invent devices like water motor gongs that are mechanical and completely independent of electrical devices.

As far as NFPA 72 is concerned, the fire sprinkler system should also be used as a means to sound the fire alarm that might also be in a building. This use of a sprinkler systems as a means to create an emergency signal to evacuate the building is not in NFPA 13, but is in NFPA 72. When you change the purpose of the alarm, you create a need to speed up the sounding of the alarm.

So, if the sprinkler system is going into a building with no fire alarm, then the 5 minute rule of NFPA 13 applies. If the sprinkler system is going into a building that also has a fire alarm, then the sprinkler waterflow alarm has to be tied into the fire alarm and the 90 second rule of NFPA 72 applies.