NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Tuesday e-Tech Alert
February 14, 2006

Best Questions of January 2006

A number of Association members have requested more information on the range of questions addressed by staff engineers as part of NFSA's "Engineer of the Day" program. In response, we will be using the first issue of e-Tech Alert published each month to list the most interesting questions addressed during the previous month. We have selected the following questions as the "best of January 2006":

Question 1 - Sprinkler Removal Requirements

If sprinkler systems that are not required for an occupancy are not properly maintained and have been out of service for an extended period, are they required to be removed by the owner?

Answer:

Yes. NFPA 1, the Uniform Fire Code, contains this requirement in Section 4.5.8.3 (2006 edition), and this concept is repeated in Section 10.4.3. Similar sections are found in other fire codes, including the International Fire Code.

Question 2 – Disconnected Waterflow Switch

A wet sprinkler system with a water motor gong contains a paddle type waterflow switch that is not wired to an alarm panel. Should this electric switch be removed if it is not connected and put into service?

Answer:

First, there is no problem with the redundancy of having two water flow alarms in the sprinkler system. You are correct that the water motor gong satisfies the requirement for an audible alarm required by NFPA 13. However, the waterflow switch may be needed based on a building code requirement for electrical supervision of the system. This is the case for most newly constructed buildings. If there is no requirement for electrical supervision then no action need be taken. There is no requirement that the paddle type flow switch be removed.

Question 3 - Shelf Storage of Auto Parts

We have a situation where an automotive dealership and repair facility has a parts storage mezzanine with an open metal grate walkway provided at approximately 10'-0 above finish floor. Storage in this parts area is approximately 18'-0 to top of storage. The shelves vary in configuration, at times looking like shelving units and other times appearing to be rack storage. There is solid particle board on all the shelves and in some areas the shelves exceed 64 square feet in area. The shelving system does not necessarily line up from below the walkway level to the shelving above the walkway.

Although Section 12.2.2.4 of NFPA 13 (2002 edition) appears to allow the use of sprinklers under walkways at maximum 12-ft vertical intervals, Section 12.2.2.1.1 sets a limit of 15'-0 high shelf storage. How do you determine the proper protection scenario for this situation? The situation appears further confused by the fact that Section12.3.1 refers to storage of commodities on racks and within Section 12.3.1.9 gives direction for storage on solid shelves.

Specific questions are these:

a) Where do you go to get the required ceiling density for shelf storage of automotive parts to 18'-0 if the ceiling sprinklers are to provide discharge densities for the entire height of the storage?

b) If this, because of the 18'-0 high storage height, is considered rack storage with solid shelves, does the presence of the "walkway" sprinklers present any allowance for the reduction of the ceiling sprinkler discharge density?

c) Would the addition of a solid floor on top of the walkway create a "mezzanine" type protection scenario where the sprinklers below the mezzanine would only have to protect the shelf storage to the level of the solid deck? Would the sprinklers at the roof deck then only have to provide protection of the shelf storage from the level of the solid mezzanine floor to the top of the shelf storage on top of the mezzanine?

d) If the areas of the shelves exceed the 64 square foot limit of Section 12.3.1.9.2 are sprinklers required below every shelf level?

e) Would the elimination of the solid shelves eliminate this issue altogether? Would my protection scenario then be for rack storage of automotive parts?

Answer:

The limitation of shelf storage protection to 15 ft maximum was added to the standard later than the special provisions for sprinklers under catwalks, and negates the usefulness of those criteria. Answers to the specific questions are as follows:

a) Ceiling sprinklers cannot protect the entire height of storage. So there is nowhere to go for the criteria as shelf storage.

b) To protect this as rack storage with solid shelves, the "walkway" sprinklers will not be used. In-rack sprinklers will be needed under the solid shelves in accordance with 12.3.1.9. NFPA 13 contains information on ceiling sprinkler densities when in-rack sprinklers are installed.

c) It is theoretically possible to create a solid floor to the mezzanine so that the storage areas are separated and treated as different levels of storage. However, such a separation would have to have fire resistance as required by the applicable building code to prevent fire at the lower level from getting to the upper level.

d) Yes.

e) If the solid shelves were eliminated, the storage would still need to be protected as rack storage. Obviously, the criteria would be less severe without the solid shelves.

Question 4 – Replacing an Electric Fire Pump Motor

Are electric motors listed for use with a specific fire pump? If an electric driven fire pump motor fails, can it simply be replaced using a new motor with the same horsepower rating? What if there is a small increase in the RPM rating, i.e. 3565 vs. 3550?

Answer:

Electric motors that drive fire pumps have not always been required to be listed for fire pump service. In fact, the requirement for the motor to be listed first appeared in the 1990's. After that, it took several years for the motor manufacturers to address the market and to get their motors UL listed for fire pump service. As such, it is entirely possible that an older motor was not listed for fire pump service. Still, as you put in a new device, it should meet the requirements of the new standard (if possible) so a motor listed for fire pump service should be used.

One of the reasons for the requirement for a listed motor is that people were not selecting motors with appropriate duty cycles for fire pump service. The duty cycle relates to the number of times that a motor can be started or stopped in a short period of time. Many motors burn out when they are started and stopped frequently during a short period, and no one wants a fire pump motor to short out. During the acceptance test, we start and stop the pump 6 times in about 30 minutes in an attempt to recreate some possible worst-case conditions during a fire. The fact that your pump passed this test at least leads me to believe that it might have a correct duty cycle even if it is not listed for fire pump service.

To answer the questions specifically:

(a) No, motors are not listed for a specific pump. They are listed for service to drive a fire pump and can be interchanged with different pumps. The issue is the same as fire sprinklers being listed for use in a sprinkler system. Sprinklers are not listed for use with specific types of pipe; they are just listed for use in a sprinkler system. The motor listings are similar and generic for the system.

(b) Horsepower and speed are the two determining factors for the flow that can move through a pump and the pressure produced by the pump. A motor can be replaced with another motor that has the same exact horsepower and speed conditions without much concern. A motor with different horsepower and speed conditions can also be used as a replacement, but calculations have to be performed to make sure that the motor can supply the demand of the fire protection system.

(c) An increase of 15 RPM will not affect the rated capacity of the pump, but it will affect the actual flow that will occur through the pump and the net pressure that the pump will produce. An increase from 3550 to 3565 is an increase in speed of 0.4%, almost negligible. The relationship between speed and the flow through the pump is proportional and linear, meaning that an increase 0.4% in speed will create an increase of 0.4% in flow under the same condition. This means that the conditions that would cause a flow of 1000 gpm through the old pump would cause a flow of 1004 gpm with the replacement pump. The situation with net pressure is not linear. Instead, the situation with net pressure is proportional to the second power, meaning that an increase in speed of 0.4% will cause an increase in net pressure of 0.8% (1.004 x 1.004 = 1.008). This means that the conditions that would have created a net pressure of 100 psi through the old pump will create a net pressure of 100.8 psi through the replacement pump.

Whether or not an unlisted motor is accepted is a matter of judgment. Many AHJs will allow an unlisted device to replace a device that was not initially listed. The discharge curve should be reviewed to ensure that it satisfies the demand of the fire protection system(s) with a comfortable safety margin to account for any reasonable fluctuations from the suction supply.

Question 5 – Blown-in Insulation for a Residential Installation

The annex of NFPA 13D shows insulation for a residential sprinkler installation is applied with the facing placed down in a tenting arrangement to prevent freezing in areas where the unheated space is above. Cellulosic blown-in insulation has a higher "R" factor but completely covers the pipe when blown in and cannot be applied until after the sheetrock is installed. If such blown-in insulation is used, should the pipe first be tented with plastic?

Answer:

Yes. The kraft or foil facing on insulation is placed toward the heated side in order to form a vapor barrier. In cold climates this prevents the moisture from the heated area from entering and condensing, compromising the insulation as well as leading to deterioration of the structure. The unheated side is expected to be vented to atmosphere either directly or through a permeable barrier to permit the passage of vapor to the exterior. Where insulation is blown in there is still a need for a vapor barrier, which can be directly above the sheetrock. If sheet plastic is spread above the joists, damaging moisture can be trapped in the joist space. The tenting of plastic above the sprinkler piping is a good idea but should be done in a way that does not trap joists in the moisture zone. The tenting of plastic above the sprinkler pipes should be used only to prevent the insulation from getting between the sprinkler pipe and the ceiling, since insulation in that area will reduce the freeze protection. The sprinkler pipe can also be tented with fiberglass insulation (facing down) prior to blowing in additional insulation.

Question 6 - Column Sprinklers

When specifically are column sprinklers required? NFPA 13 Section 12.3.1.7.1 (2002 edition) makes a reference to 'where sprinkler protection of building columns within the rack structure or vertical rack members supporting the building are required in lieu of fireproofing' but does clarify where this applies.

Answer:

The determination of whether column sprinklers are necessary within rack storage can come from the building code or design choices that the architect/engineer has made. For most storage situations NFPA 13 only provides the options when the decision is made to use sprinklers instead of fireproofing where deemed acceptable by the building code.

Question 7 - Orifice Sizes and SIN Numbers

When analyzing the capability of an existing sprinkler system in the field, how do you determine the orifice size of the sprinkler? Older sprinklers were not subject to the same marking requirements as today's sprinklers, and many times manufacturers had more than one orifice size for some model numbers.

Answer:

This type of problem is what led to the development of the Sprinkler Identification Number. A unique SIN is now required for every change in orifice size and shape (they are not all perfectly round), so this can now be tracked back through the product literature. For older sprinklers it can be an estimate. In the absence of a pintle you can approximate the orifice based on thread size using tables from older standards. With a pintle you may be forced to try to use some type of calipers on a sprinkler of the same type from the spare sprinkler cabinet.

Question 8 – Leakage Testing of Underground Piping

It has been suggested that the "allowance" for pressure drop during the hydrostatic test of underground piping is assessed by virtue of the quantity of leakage measured, i.e. if the leakage is less than 2 quarts per hour then the piping passes both the hydrostatic and the leakage test. It appears from a search on the internet that the norm is to perform a hydrostatic test that must pass within certain parameters (arbitrarily +/- 5psi). If leakage occurs (within the parameters of the hydrostatic test), then the quantity of water leaked must pass the leakage test parameters given in NFPA 13 or 24. For example, a hydrostatic test is performed with the initial pressure being 200 psi. After 2 hours the pressure is 198 psi with notable leakage. Must a

separate leak test then be performed to determine if the rate of leakage is more than 2 quarts per hour with the pressure maintained at 200 psi?

Answer:

Section 10.10.2.2.4 of NFPA 13 (and NFPA 24) states that a specific amount of leakage is permitted during the hydrostatic test. The permitted leakage rate is expressed in terms of a quantity of liquid over a time period. The easiest way to meet this test would be to use a pump with a churn pressure of 200 psi taking suction from a calibrated bucket to pressurize the system to 200 psi (leaving the pump in the churn condition during the test). Watching the water level in the bucket during the test will determine the pass/fail situation. If more water leaks out during the test than is permitted by section 10.10.2.2.4, then the system fails the test. If less water leaks out, then the system passes the test. A full description and picture of this procedure is included in the book *Pumps for Fire Protection Systems* (available from the NFPA) due to the fact that the suction pipe from the water supply to the pump has to be tested in accordance with NFPA 24 (see page 321 in Chapter 11 of that book). However, most sprinkler contractors do not like this procedure. So they run the hydrostatic test by pumping up the pressure to 200 psi and shutting off a valve, trapping the pressure in the system and turning off the pump. If the pressure does not drop in the system, they pass the test. If the pressure drops in the system, they then run a second leakage test to determine if the leakage was in accordance with section 10.10.2.2.4. If the leakage was in accordance with 10.10.2.2.4, most AHJs let them pass the test, although they technically did not hold the pipe at 200 psi for 2 hours. In this circumstance, the AHJ is accepting the leakage test as an alternate method of proving that the pipe is joined properly in accordance with sections 1.5 and 1.6 of NFPA 13.

Question 9 – Rack Sprinklers in Freezers

Half of the storage in an existing freezer is being converted to rack storage. The installation of the racks and in-rack sprinklers would be done in the ambient freezer temperature of -25 °F. The area not being converted at this time has high pile storage, and the temperature cannot be reduced during installation. NFPA 13 indicates the use of sprinklers in racks for the height of storage, but is mute on the subject of dry systems with in-rack applications. Some questions:

(a) Are in-rack sprinklers really needed in a freezer?

(b) Is a 30 percent increase needed for the number of in-rack sprinklers included in the sprinkler demand because they are part of a dry pipe system?

(c) How are hydrostatic and flow tests conducted in a refrigerated space?

(d) Would antifreeze work in this situation?

Answer:

To address the questions individually:

(a) Yes, in-rack sprinklers are required even though the space is cold. While it is somewhat counter-intuitive that a fire could start in such a cold space, fires have started in freezers and have proven quite challenging. Therefore, NFPA 13 makes no exceptions for storage protection within freezer spaces.

(b) The 30 percent increase in hydraulic design area is only applicable to ceiling sprinklers.

(c) NFPA 13 does not offer guidance on testing in freezers. Typically, when the system is installed the space is not yet at the refrigerated temperatures and the testing can be conducted in the standard fashion. If the space cannot be brought up to non-freezing temperatures, then the piping would have to be tested in

another manner, such as the air test at one possibility might be air pressure. This really becomes the judgment of the AHJ. Flow tests simply cannot be conducted at –25°F.

(d). It is possible that antifreeze would work in this situation. However, it is merely a design option. The contractor can choose to use antifreeze or a dry system. The other point to note about antifreeze is that in large systems there are concerns of the amount of antifreeze required. High antifreeze concentrations are flammable, so if there are large amounts of it in a system, it is possible that this would add fuel to the fire.

Question 10 - Sprinklers Within HVAC Units

A duct exceeding four feet in width runs virtually on top of a floor-mounted air-handling unit, such that there is less than 12 inches of vertical space between the two. Sprinklers are provided at the ceiling above the duct. Is a level of sprinklers also required in the space directly below the duct and above the air-handling unit?

Answer:

No. With the approval of the AHJ, the duct can be considered part of the overall HVAC unit, allowing the gap to be considered part of the equipment. However, when the duct continues past the HVAC unit it may require sprinklers below it if it still exceeds four feet in width at that point.

Prior to the merger of NFPA 231C into the 1999 edition of NFPA 13, that standard required that columns in rack storage exceeding 15 ft in height and without in-rack sprinklers be protected with either fireproofing, column sprinklers, upgraded ceiling densities or large drop or ESFR sprinklers. For rubber tire storage, Section 12.4.1.1 of NFPA 13 continues to specifically require sprinkler protection of columns if fireproofing or in-rack sprinklers are not provided.

Upcoming NFSA Technical Tuesday Online Seminar

Topic: Extended Coverage and Quick Response Sprinklers
Instructor: Kenneth E. Isman, P.E., NFSA Assistant Vice President of Engineering
Date: February 21, 2006

This program will cover the specific tests necessary to achieve a listing for these two types of sprinklers in order to help the listener understand the differences between the sprinklers. The program will continue with a comparison of the installation requirements of the two types of sprinklers to each other and to standard spray sprinklers.

Information and registration for this seminar is available at www.nfsa.org.

Are You Aware of CPFST?

There are more than a hundred students currently enrolled in the NFSA's Certificate Program for Fire Sprinkler Technicians (CPFST). This 2-year program, initiated in 2004, has become the industry standard for technician training. It starts with the NFSA's two-week basic technician training seminar, and continues with a planned sequence of proctored on-the-job training, online training, chat rooms, and advanced training. The program includes periodic testing to monitor progress, and a certificate is awarded to recognize successful completion of the program. There are two "entry points" to the program each year, with the next entry point aligning with the March 6-17, 2006, 2-week technician training seminar in

Chicago, IL. More information is available at the NFSA website or by contacting Ken Isman at isman@nfsa.org.

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In the promotion of the fire sprinkler concept, the National Fire Sprinkler Association represents all fire sprinkler industry interests including fire sprinkler contractors, manufacturers and suppliers of fire sprinklers and related equipment and fire protection professionals. Established in 1905, the National Fire Sprinkler Association provides publications, nationally accredited seminars, representation in codes and standards-making, market development, labor relations and other services to its membership. Headquartered in Patterson, New York, the National Fire Sprinkler Association has regional operations offices throughout the country.