NFSA TechNotes
The Voice of the Fire Sprinkler Industry

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Best of October 2013

This month, we have selected the following baker's dozen questions as the "Best of October 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 – Protecting Group Homes with NFPA 13D

We have been asked to protect a group home (a small number of unrelated people in need of care, support, or supervision living together, such as those who are elderly or mentally ill) with a fire sprinkler system. Are we permitted to use NFPA 13D?

Answer: The answer to your question depends on exactly which code is being enforced in your jurisdiction. It is possible that multiple codes are being enforced, in which case you will need to select the most stringent of those.

As far as the NFPA Committee on Residential Fire Sprinkler Systems (the committee that writes NFPA 13D) is concerned, NFPA 13D is for buildings where a family lives together. NFPA 13D assumes that there is some sort of rescue available early in the fire scenario. Members of a family generally care about one another and will attempt to rescue each other during a fire. Unrelated people, no matter how nice, do not have the same sense of connection to the people they live with and may not attempt rescue during a fire. If the people in the building need care or are mentally ill, then the subject of rescue becomes a more significant concern. As far as the people who wrote NFPA 13D are concerned, it should not be used for these group home facilities.

But everyone within the NFPA system does not share the same opinion of NFPA 13D. The members of the Committee on Residential Occupancies, who are responsible for writing the residential chapters of NFPA 101 (the Life Safety Code), have reviewed the protection provided by NFPA 13D and declared it acceptable to use in certain small residential occupancies where there is no family. Since this document is a "Code", it is permitted to reference standards outside their scope. So, legally, NFPA 13D systems can be used in locations permitted by the Life Safety Code in jurisdictions that enforce the Life Safety Code, even if this violates the scope of NFPA 13D itself.

The Life Safety Code defines two different types of residential occupancies (that are not one- or two-family homes) where NFPA 13D is permitted to be used. The first is a Lodging and Rooming House. These houses are for up to 16 people who are unrelated. In order to qualify as a Lodging and Rooming House, no care is allowed to be provided. This is generally the type of occupancy that small army barracks, camp cabins, and bed-and-breakfast buildings tend to fall in. Lodging and Rooming Houses are also where the residential portion of mixed use occupancies are classified such as the bunk room of a fire house. The Life Safety Code allows NFPA 13D systems to be installed in Lodging and Rooming Houses that are not a part of a mixed use occupancy (see section 26.3.6.3.3 of NFPA 101). If the Lodging and Rooming House is for more than 8 occupants (up to 16), then the water supply needs to be treated as a two-family home per NFPA 13D (5 gpm added for potential simultaneous domestic demand).

The second type of residential occupancy that the Life Safety Code allows to use NFPA 13D is a small Board and Care Home (16 or fewer residents). Board and Care Homes are those facilities that provide some level of personal care, but the level of care is less than a nursing home or hospital. Board and Care Homes include housing for the physically or mentally handicapped who have the ability to attend school, worship in the community and use community services, a place that provides services for the elderly (but not nursing care), and facilities for social rehabilitation including alcohol and drug rehab. The Life Safety Code allows Board and Care facilities housing 16 or fewer residents to use NFPA 13D, however, the following modifications need to be made to the system (see sections 32.2.3.5.3.2 and 32.2.3.5.5 of NFPA 101):

1. The water supply duration needs to be increased to 30 minutes

2. All habitable areas, closets, porches, decks and balconies need to be sprinklered

3. Facilities with more than 8 residents (up to 16) need to be treated as a two-family dwelling per NFPA 13D (5 gpm added for potential simultaneous domestic demand)

4. The control valve needs to be supervised in one of the following manners:

    a. An arrangement that shuts off the domestic supply when the sprinkler system is turned off
    b. Electrical supervision with a tamper switch wired to a central station service or other permitted receiving facility
    c. A valve that will sound an alarm if closed

The International Building Code (IBC) also has something to say on this subject. Again, since this is a Code, it is allowed to reference NFPA 13D as appropriate for buildings that are outside the scope of NFPA 13D. The IBC defines R-3 occupancies as meeting any one of the following categories (section 310.5):

- Boarding houses for non-transient occupants with 16 or fewer residents
- Boarding houses for transient occupants with 10 or fewer residents
- Care facilities with accommodations for 5 or fewer occupants

The IBC also defines an R-4 occupancy in much the same way as a Board and Care facility described above (section 310.6) for 16 or fewer persons.

Section 903.3.1.3 of the IBC then says that NFPA 13D systems are permitted to be used in R-3 and R-4 occupancies. There are no additional restrictions in the IBC.

In summary, if you are in a jurisdiction that only adopts the IBC, then you can use NFPA 13D to protect an R-3 or R-4 occupancy. What you have described probably meets the R-4 occupancy definition if it is limited to 16 or fewer residents.

If you are in a jurisdiction that only adopts the Life Safety Code (NFPA 101), then you can use NFPA 13D (assuming 16 or fewer occupants) under the Board and Care rules, but you would need to add the four items listed above in the Life Safety Code discussion.

If you are in a jurisdiction that has adopted both the Life Safety Code and the IBC, then you will need to meet the most stringent of the rules. This is probably going to be the Life Safety Code rules since this requires a level of protection higher than what is in NFPA 13D alone.

Question 2 – Pumps in NFPA 13D Systems

What are the electrical requirements for a pump in an NFPA 13D system? Is the pump required to meet NFPA 20 and Article 695 of NFPA 70?

Answer: The pump is not required to meet NFPA 20 or Article 695 of NFPA 70. NFPA 13D has basic requirements for pumps in section 6.2.1 as follows:

1) Pump motors using AC power shall be connected to a 240 V normal circuit. Unfortunately, this requirement is not written very well. What the committee really wants here is the use of a 240V motor. This cuts down on the amperage draw during start-up and significantly reduces the chance that the motor will cause the circuit breaker to trip.

2) Any disconnecting means for the pump shall be approved. Disconnecting means (off switches) are too tempting for people to switch "off" and leave that way. AHJ's want the ability to limit the number and location of disconnecting means.

3) The pump cannot sit directly on the floor. While this is not technically an electrical requirement, it is important for the function of electrical equipment. Pumps are frequently installed in basements where water can collect on the floor. We don't want water getting into the pump and damaging the motor. While the standard does not currently have a minimum requirement, the committee hopes that common sense will prevail. There is some thought to clarifying this requirement in the 2016 edition to say that the motor needs to be at least 1.5 inches off of the floor, which would allow for the motor to be placed on a 2 x 4 on its side.

In addition, section 11.2.2 outlines the test requirements for the acceptance of systems with pumps as follows:

1) The pump shall be tested by opening the drain/test connection.
2) The pump shall sense the above flow, turn on and flow for the required duration without interruption.

Question 3 – Sprinklers for Attics in NFPA 13R Systems

We have a three story multiple family residential buildings being protected in accordance with NFPA 13R that has an attic space. Per the building code, the attic must have access via a locked door or hatch. The access hatch will not be accessible from any dwelling units and the owner has agreed that no equipment or storage will be allowed. The owner has agreed to post signs stating that no storage is to be permitted at the access hatch. The AHJ has stated that since there is access, there is the potential for storage and thus sprinklers are required in this attic space. Do you agree with the AHJ or are we permitted to omit fire sprinklers from the attic space under these circumstances?

Answer: Section 6.6.6 of NFPA 13R does not require sprinklers in attics or other concealed spaces that are not used or intended to be used for living purposes or storage and does not contain fuel fire equipment. NFPA 13R does not mention access or limited access for these spaces as being a deciding factor for whether storage may or may not be present. The key to this sentence is "not used or intended to be used for storage". Based upon your description, the owner does not intend this space to be used for storage and the signs will help enforce this. The sprinklers should be permitted to be omitted.

Question 4 – Fuel-Fired Equipment in Attics with NFPA 13R Systems

We are protecting a multiple family residential building with an NFPA 13R system. The attic will have a fuel-fired heater (nothing else and no provisions for storage). Do we need to sprinkler the entire attic?

Answer: No. Section 6.6.6.1 of NFPA 13R is specific to fuel-fired appliances (gas furnaces, gas hot water heaters, etc.) and when installed in an attic space, a single sprinkler can be installed above the equipment, regardless of the size of the attic. It is not the intent of this section to:

- Require sprinklers throughout the attic.
- Require a fire rated enclosure around the fuel-fired appliance.
- Require the sprinkler for air handling equipment that is not fuel-fired

Question 5 – Sprinklers in Stairwells and the Quick Response Reduction

We are putting sprinklers in a light hazard occupancy in accordance with NFPA 13. On each floor, the ceiling height does not exceed 10 ft, but we are wondering if the sprinklers at the top of a stairwell negate the possibility of using the quick response decrease in design area because they are more than 20 ft from the floor?

Answer: No, the sprinklers in the stairwell do not negate the quick response reduction. You are free to use the quick response reduction in calculating the sprinkler systems on each floor.

The stairwell can be calculated using the room design method separately from the sprinklers in the rest of the building. Since the stairwell will have a 1-hr or 2-hr rating with self-closing doors, this limits the demand for the sprinklers in the stairwell to the two or three sprinklers in the stairwell. The sprinklers in the rest of the building can then be calculated using the density/area method, which permits the reduction in design area for the use of quick response sprinklers (assuming that you meet the requirements of 11.2.3.2.3.1).

Question 6 – Shortcut for Hydraulic Calculations

We are renovating a building with a sprinkler system designed for 0.14 gpm per sq ft over 2500 sq ft. Can we automatically assume that we meet the demand of 0.2 gpm per sq ft over 1500 sq ft due to the fact that the older design requires more flow than the new one (0.14 over 2500 would require a minimum flow of 350 gpm while the 0.2 over 1500 requires a minimum of only 300 gpm)?

Answer: No. While your quick analysis handles the flow information, it does not do anything to guarantee the pressure. Let's say that the sprinklers are k-5.6 and that they cover 120 sq ft each. With a density demand of 0.14, the sprinkler would need to discharge 16.8 gpm (0.14 x 120 = 16.8). In order to get a flow of 16.8 gpm from the sprinkler, you need to have a pressure at the sprinkler of 9 psi $[(16.8/5.6)^2 = 9]$.

For a system with a density demand of 0.2 gpm per sq ft, each sprinkler would need to flow at least 24 gpm. A pressure of 18.4 psi would be needed to push that amount of water out of the sprinkler.

As you can see, you can't assume that a water supply that can get 9 psi to the most remote sprinkler can also get 18.4 psi to the most remote sprinkler.

You will need to recalculate the system. Since the old demand has a greater flow requirement, my guess is that you will find that the mains are sized well and do not need to be changed, but you may need to upsize the pipes on the branch lines, especially near the ends, in order to minimize the friction loss and make sure that you get enough pressure to the end sprinklers.

Question 7 – Use of EC Sidewall Sprinklers in Each Bay of Obstructed Construction

What is the definition of a "bay" as used in NFPA 13 Section 8.4.3(6)?

Answer: NFPA 13 does not have an official definition, but a bay is the space created by solid structural members. This section specifically states "obstructed construction". Beam and girder, concrete tee, wood joists, etc., as described in A.3.7.1 would create bays.

This section was added because NFPA 13 is not clear on whether extended coverage sprinklers can be used in small bays created by solid structural members. This use of sprinklers appears to violate the rules for minimum distances between sprinklers and the rules for extended coverage sprinklers did not have the same baffle exceptions as standard spray sprinklers.

Question 8 – Calculations for a Wet Pipe System with Dry Upright Sprinklers

We have a wet pipe sprinkler system that includes dry upright sprinklers. Is this system required to have a 30% increase applied to the design area as you would do for a dry pipe system?

Answer: No. The system described is still a wet system even with dry upright sprinklers installed and section 11.2.3.2.5 applies only to dry pipe and double interlock preaction systems. The purpose of the 30% increase in the design area for dry systems is to compensate for the time delay in delivering water to the fire. It takes time for the air in the dry system piping to escape and allow the water to get to the fire. This delay can lead to a larger fire that would need additional sprinklers to control. NFPA 13 compensates for this by increasing the design area for dry systems.

A wet pipe system, even with dry sprinklers installed, would not experience this water delivery delay and an increase in the design area is not required.

Question 9 – Calculating Flow from a Main Drain Test

Is there a way to determine a flow rate in gpm based upon the results of a 2-inch main drain test?

Answer: No. There is no accepted way to use the main drain test results to determine an accurate flow rate of the system. There are too many variables, including assumptions needed relative to the roughness of the discharge line and how much of the diameter of the drain is used for discharging the water.

Some people have theorized that they could stick a pitot gage in the drain outlet and convert the velocity pressure reading to a flow. But the use of a pitot gauge in this manner would not result in an accurate calculation of flow. The formula that is used to convert velocity pressure to flow assumes the full use of the diameter of the outlet, which just does not happen consistently with drain pipes. Therefore it would not provide an accurate conversion from velocity pressure to flow.

The 2-inch drain test is intended to simply confirm that the water supply has not degraded since the previous test and that the valves to the system are open.

Question 10 – Hose Outlets at High Pressure on Standpipe Systems

Why does Section 7.2.2.1 of NFPA 14 state that no hose outlets are allowed, "on any portion of the system where the pressure exceeds 350 psi"? If we have components that are rated for high pressures, in our case up to 400 psi, why are we limited to the 350 psi requirement?

Answer: We need to be concerned with firefighter safety. If a pressure in excess of 175 psi exists at a hose outlet, we put a pressure reducing valve prior to the outlet to take the pressure down to 175 psi or less. But if this valve fails, it will typically fail in the fully open position, exposing a firefighter to all of that water pressure. If the pressure reducing valve fails, there is a chance that firefighters might be able to hang onto hose discharging around 350 psi. But if the pressure is above 350 psi, serious harm could occur to a firefighter.

We never want the failure of a single pressure reducing valve to expose a firefighter to more than 350 psi. NFPA 14 allows a pressure in excess of 350 psi to exist in the system (assuming that the components can handle it) in any location where there is not a hose connection. This would pretty much limit the use of pressure in excess of 350 psi to express risers that only have hose connections above the elevation where the pressure has dropped below 350 psi due to elevation loss.

Question 11 – Test Header and Flow Meter on Fire Pump Installation

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.

We have a fire pump with a closed-loop flow meter arrangement (water comes out of the pump, through a meter and then goes right back into the pump). Is a test header also required to be installed?

Answer: Yes. While NFPA-20 does allow closed loop flow meters to be used, the standard does require that an alternate means of measuring flow be provided. This requirement may be found in NFPA 20 (2013) in section 4.20.2.10 (similar sections in previous editions). There are two reasons for this alternate testing means:

1. The water supply must be able to be tested at the range of flows necessary to conduct a full flow test. This would not be possible with a flow meter in a loop arrangement since the water during a closed-loop test does not come from the water supply.

2. The second reason for this alternate test means is simply to be able to verify the accuracy of the flow meter (calibrate the meter).

Question 12 – Testing Hose Valves on Standpipe Systems

With respect to the individual 2-1/2" fire department hose valves located at each floor level within a Class I or Class III standpipe system, do individual hose valves need to be exercised annually? Do individual hose valves need to be flow tested, other than flowing the hose valve at the highest level every 5 years? We have been under the impression that pressure reducing hose valves needed testing annually, but NFPA 25 appears to require that only every five years. Please confirm which is correct. Do the answers differ for pressure reducing hose valves?

Answer: Yes, individual (2-1/2 inch) hose valves on Class 1 and Class III standpipe systems need to be opened and closed annually. The requirement is in the Valve chapter of NFPA 25 in section 13.5.6.2.1. Why they put the standpipe test requirements in the valve chapter is a mystery that I'm not sure that we can answer.

There is no requirement to do any flow testing from the individual outlets (other than the small amount of flow that will discharge during the opening and closing test discussed above). The only flow testing that is required is the 5-year test and that is only from the remote connections.

There are two different test requirements for pressure reducing hose valves:

1) Once every 5 years, you need to do a full-flow test. This is where you put 250 gpm through the PRV and make sure that it works from a pressure drop perspective.

2) In the years when you do not do a full flow test, you need to do a "partial flow test". There is a procedure in NFPA 25 for doing a partial flow test. One way to perform this test is to replace the regular cap on the outlet with one that has a pressure gage attached. Tighten down the cap and then open the hose valve. Water will fill the discharge part of the connection and press against the cap giving you a pressure reading. You then shut the valve and loosen the cap, dropping the small amount of water into a bucket.

The requirements for the pressure reducing valve hose connections are in NFPA 25 in section 13.5.2 with the full flow test in 13.5.2.2 and the partial in 13.5.2.3.

Question 13 – Water Delivery Times for Dry-Pipe Trip Tests

NFPA 25 just states that a dry-pipe system needs to be trip tested annually and to record the trip time. NFPA 25 does not list any requirements for water delivery time to the inspectors test. The current edition of NFPA 13 lists specific water delivery times for various building occupancy classifications but this standard is for new installations. How do we determine a pass/fail situation on dry-pipe systems that are 20-30 years old? Are they required to meet any certain water delivery time or trip time?

Answer: No. NFPA 25 does not require the dry system to meet the 60 second rule (or other rules) found in NFPA 13. Section 13.4.4.2.2.2 of NFPA 25 asks the user to measure the current trip test and compare it to the previous or original trip test to determine if there is a problem with the system. If there are no records of previous trip tests, then you'll need to simply perform a trip test to establish a baseline time for the dry system riser.

NFPA 25 goes on to say that if the water delivery time is 50% more than the original, an obstruction investigation has to be done. If there are no records to compare back to and the first trip time takes a very long time then it should be reported to the owner. But NFPA 25 can't have a single set of rules for all systems because the rules have changed so dramatically during the years. For example, NFPA 13 in 1961 stated that water delivery time could not exceed 3 minutes (for new systems during acceptance testing). If a system was designed to trip in 3 minutes under this standard, then 50 years later, a water delivery time of 4 minutes would still be under the threshold as a trigger for an obstruction investigation, if the occupancy, use, process and/or materials are the same.