NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Tuesday e-Tech Alert
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Restraint of High Pressure Pendent Sprinklers Below Ceilings

The sections of NFPA 13 that deal with the need to restrain pendent sprinklers against upward movement through a ceiling have been the victim of several format changes through the years, producing misunderstandings as to intent.

The relevant sections were first added in the 1987 edition of the sprinkler standard, following a report of a sprinkler operation at high pressure in a high-rise building. In that incident, the reactive forces to the thrust of the sprinkler discharge pushed the sprinkler above the ceiling, distributing the water in the concealed space above the ceiling rather than on the fire within the room. The NFSA Engineering and Standards Committee set up a task group to study the problem, and the task group reviewed tests of the bending of piping that can take place using various orifice sizes of pendent sprinklers at various pressures. The NFPA Sprinkler Committee acted on an NFSA proposal to address this issue, calling for special rules when the maximum pressure at the sprinklers exceeded 100 psi. The intent was to apply only to expected operating pressures based on the water supply, not the maximum potential pressure that could be delivered through a fire department connection. The intent was also to apply these rules only to pendent sprinklers that projected down through a ceiling.

In the 1987 edition, the rules applied in two exceptions, one to the section dealing with the maximum unsupported length to end sprinklers on branch lines, and the other dealing with unsupported armovers.

For the last sprinkler on the branch line:

- - The hanger assembly closest to the end of the line was required to be arranged to prevent upward movement, and
- - The maximum distance from the last hanger to the end sprinkler could not exceed 12 inches for steel pipe or 6 inches for copper tube. If this distance was exceeded the branch line would need to be extended to pick up an additional hanger, and whichever hanger was closest to the sprinkler would need to be of a type that prevented upward movement.

For the unsupported armover:

- - The maximum length of the unsupported armover could not exceed 12 inches for steel pipe or 6 inches for copper tube. If this distance were exceeded, the hanger closest to the sprinkler would need to be of a type that prevented upward movement.

The wording of the exception dealing with armovers could have been better. Since the normal maximum unsupported length of armover was (and remains) 24 inches for steel pipe and 12 inches for copper, the wording of this rule implied to some that the reduced armover lengths could be avoided if restraint against upward movement was provided for the branch line hangers. This was never the intent. The wording should have more clearly stated that where the maximum unsupported length was exceeded, a hanger was required for the armover, and that hanger was then required to be of a type that prevented upward movement.

The rules were not changed in the 1991 edition of NFPA 13, but in the 1994 edition the exception for the unsupported length to the end sprinkler on a branch line was split into two separate exceptions. One called for the last hanger on a branch line to prevent upward movement where pressures over 100 psi supplied a pendent sprinkler through a ceiling. The other applied to situations in which the unsupported length exceeded 12 inches for steel pipe or 6 inches for copper tube. Unfortunately, while the wording of the second exception addressed pressures over 100 psi and pendent sprinklers, it didn't mention a ceiling, creating the misimpression that it applied even to pendent sprinklers under open ceilings. This confusion was carried into the 1996 edition of NFPA 13 as well.

During the reorganization of the sprinkler standard that took place with the 1999 edition, the Sprinkler Committee attempted to remedy some of these difficulties, recombining the two exceptions addressing the maximum unsupported length for an end sprinkler on a branch line. For the unsupported armovers, the Committee also made some changes. The maximum length of armovers was clarified to be "cumulative horizontal length." However, the Committee created another unfortunate situation with the unqualified statement "The hanger closest to the sprinkler shall be of a type that prevents upward movement of the piping." Again, this should have been tied to the situation in which a hanger was required on the armover due to excessive unsupported length, and was not meant to require restraint against upward movement for the branch line hangers.

By the time the 2002 edition of NFPA 13 was issued, the NFPA format had been changed to eliminate the use of exceptions. A separate Section 9.2.3.4.3 is titled "Unsupported Length with Maximum Pressure Exceeding 100 psi" and contains four subsections:

- - The first clarifies that when a pressure exceeding 100 psi is applied to a branch line supplying pendent sprinklers through a ceiling other than through the fire department connection, the last hanger must be of a type preventing upward movement.
- - The second limits the maximum unsupported length between the last hanger and the end sprinkler or drop nipple to 12 inches for steel pipe or 6 inches for copper tube
- - The third requires that when the limits of the second subsection are exceeded, the pipe is to be extended beyond the end sprinkler and supported by an additional hanger.

- - The fourth requires that the hanger closest to the sprinkler be of a type that prevents upward movement.

Similarly, a separate Section 9.2.3.5.2 is titled "Unsupported Armover Length with Maximum Pressure Exceeding 100 psi." and contains two subsections:

- - The first clarifies that when a pressure exceeding 100 psi is applied other than through the fire department connection to a branch line supplying pendent sprinklers through a ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop is limited to 12 inches for steel pipe or 6 inches for copper tube.
- - The second requires the hanger closest to the sprinkler to be of a type preventing upward movement of the piping.

A few questions and answers on the subject:

Q: Do any of these sections apply where pressures exceed 100 psi but the sprinklers are not pendent sprinklers extending downward through a ceiling?

A: No.

Q: Consider a situation in which the piping has been extended due to the length limits such that the end sprinkler is now two feet beyond one hanger with three feet to the end hanger. Do both hangers have to be arranged to prevent upward movement?

A: No, only the hanger closest to the sprinkler.

Q: How does this change in areas subject to earthquakes?

A: For systems to be protected against earthquakes, a separate section of the standard (9.3.6.3) requires that the end sprinkler on a branch line "be restrained against excessive vertical and lateral movement". Since that section does not specifically address the last hanger on a branch line, it is possible to provide both dimensions of restraint at the hanger closest to the end sprinkler.

Q: For unsupported armovers meeting the length limitation of 12 inches for steel pipe or 6 inches for copper tube, does the standard require that all branch line hangers adjacent to armovers prevent upward movement?

A: No, only for the last sprinkler on the branch line in accordance with 9.2.3.4.3. For steel pipe this would theoretically allow an unsupported branch line length of up to 12 inches plus a cumulative horizontal length of an unsupported armover of up to 12 inches.

Q: Does the standard consider the length of a drop from an armover in addressing the maximum unsupported length of an armover?

A: Not at present, although this is expected to be addressed during the preparation of the 2006 edition of NFPA 13.

Upcoming NFSA Technical Tuesday Online Seminar:

December 14, 2004
Subject: Using NFPA 13 with the Life Safety Code

Instructor: Kevin J. Kelly, P.E., NFSA Manager of Codes

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