



## **Sprinkler Heads in Beams**

Senju Sprinkler's UL Approved products comply with the NFPA 13D, NFPA 13R, and Automatic Sprinkler Systems for Residential Occupancies Handbook Set, 2013 Edition. This letter specifically focuses on updated rules for sprinkler heads in beams. Below is quoted from the most updated NFPA 13D Handbook.

If you have any additional questions please feel free to contact your local Senju Sprinkler representative or your local regional NFPA office.

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### **NFPA 13D 2013**

#### **10.2.1**

For each of the following situations, the number of sprinklers in the design area shall be all of the sprinklers within a compartment, up to a maximum of two sprinklers, that require the greatest hydraulic demand:

1. A flat, smooth, horizontal ceiling with no beams up to a maximum of 24 ft (7.3 m) above the floor.
2. A flat, horizontal beamed ceiling, with a maximum ceiling height of 24 ft (7.3 m), with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the beamed ceiling shall be a maximum of 600 ft<sup>2</sup> (55 m<sup>2</sup>) in area. The highest sprinkler in the compartment shall be above all openings from the compartment into any communicating spaces.
3. A smooth, flat, sloped ceiling with no beams up to a maximum slope of 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.

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4. A sloped ceiling with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft<sup>2</sup> (55 m<sup>2</sup>) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
5. A sloped ceiling with beams of any depth with sidewall or pendent sprinklers in each pocket formed by the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft<sup>2</sup> (55 m<sup>2</sup>) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor.

Paragraph 10.2.1 sets up the central goal of NFPA 13D, which is to provide protection with only two sprinklers as a design area. Full-scale fire tests have demonstrated that two sprinklers is sufficient to control a fire in an NFPA 13D dwelling. Limiting the design area to two sprinklers controls the cost of the sprinkler system and keeps demand on the water supply low, which helps keep residential sprinkler systems affordable. While a single sprinkler has been shown to extinguish residential fires, the system design was based on two sprinklers flowing, and the water discharge from the first sprinkler typically exceeds the design flow due to the concept of “hydraulic increase.” See the second paragraph in Section A.10.2 for more discussion on the concept of “hydraulic increase.”

Limiting system design to a single flowing sprinkler raises questions about overall risk. However, in paragraphs 10.2.1(1) through (5), limitations are placed on the compartment features concerning ceiling height, ceiling slope, beam dimensions, and compartment size. Note that, as indicated in the first paragraph of A.10.2, some residential sprinklers are listed for use in situations beyond those described in 10.2.1(1) through (5), and 10.2.2 specifically allows for the use of such sprinklers.

## **FAQ**

Where a compartment has more than two sprinklers within it, how many sprinklers are required to be calculated?

Even if more than two sprinklers are required to cover the floor area in a compartment, the maximum number of sprinklers that must be included in the design calculations for water supply



is two. This requirement is frequently misinterpreted to mean that the room size must be limited to ensure that only two sprinklers cover the floor area.

In the Los Angeles and Charlotte fire tests [Cote 1980; Cote 1982; Kung 1982; Moore 1980], all of the test fires were in typical residential room configurations. These fires were controlled or extinguished with one or two sprinklers under the specific sprinkler waterflow rates, spacing, and discharge (spray pattern) characteristics established by the test. When one of these factors (such as spacing) was not met, the test failed, because an acceptance criterion (such as temperature — see commentary following [A.1.2](#)) was exceeded, or because the water supply was overtaxed when more than two sprinklers operated. Accordingly, residential system design should be based on two sprinklers operating, unless each compartment is protected with only one sprinkler.

In the hopes of making sprinkler protection even more affordable, the implementation of a single sprinkler design area has been suggested. While this single sprinkler design would decrease costs and make residential sprinkler systems for one- and two-family dwellings more appealing, the concern is that these design criteria would create an unacceptable level of protection with a smaller safety factor. In the 2010 edition of NFPA 13, text was added to A.8.1.2 (now A.10.2) to provide a technical counterpoint to the concept of a single sprinkler design.

## 10.2.2

Listed flows associated with testing under a smooth, flat, horizontal 8 ft (2.44 m) high ceiling shall be permitted to be used for the ceiling configurations referenced in 10.2.1.

Some residential sprinklers are listed to specifically protect spaces with compartment features beyond those indicated in 10.2.1(1) through (5) and are permitted for use in accordance with 10.2.2. Some of these sprinklers are listed for a two-sprinkler design. Others are listed for more sprinklers in the design area. In any case, sprinklers used to protect spaces not specifically addressed in 10.2.1(1) through (5) are to be used in specific configurations in accordance with their listing.

## 10.2.3

For situations not meeting one of the conditions in 10.2.1, residential sprinklers listed for use in specific ceiling configurations shall be permitted to be used in accordance with their listing.

There are some situations where no listed sprinklers exist for the compartment features under consideration. For example, there may be a single-family residence in which the ceiling height in the family room exceeds 24 ft (7.3 m). For this situation, compliance with 10.2.2 is not possible.

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Furthermore, if no sprinklers are listed for the ceiling height in question, compliance with 10.2.2 is also not possible. In this case, no standardized guidance on determining the appropriate number of sprinklers exists. However, local laws still require sprinklers to be installed in the residence in accordance with NFPA 13D. For this situation, the appropriate number of sprinklers for the design area is to be determined through an analysis by qualified individuals in consultation with the authority having jurisdiction.

## **10.2.4\***

For situations not meeting one of the conditions in 10.2.1 and 10.2.3, the number of sprinklers in the design area shall be determined in consultation with the authority having jurisdiction as appropriate for the conditions.

### **A.10.2.4**

A number of variables exist that would influence the number of sprinklers that might open during a fire. In many of the fire tests that led to the development of the residential sprinkler, and in many of the subsequent tests, including the testing conducted as a part of the previously referenced FPRF sloped ceiling research project, more than two sprinklers have opened during certain fire tests, but the water supply, sized for only two sprinklers, was still capable of controlling the fire for 10 minutes and meeting the goals of NFPA 13D. While there is no guarantee that more than two sprinklers would always open, it is believed that the two-sprinkler design criterion is appropriate for ceiling constructions and room configurations that are within the limitations referenced 10.2.1 and 10.2.3.

For the ceiling constructions and room configurations that are beyond the scope of the two-sprinkler discharge criterion referenced in 10.2.1 and 10.2.3, a greater number of design sprinklers and/or higher discharge flows should be considered in the system design. As of this date, there is limited fire test data available to include specific design criteria in this standard. In these situations, sprinklers can be installed in



a manner acceptable to the authority having jurisdiction to achieve the results specified in this standard. In making these determinations, consideration should be given to factors influencing sprinkler system performance, such as sprinkler response characteristics, impact of obstructions on sprinkler discharge, and number of sprinklers anticipated to operate in the event of a fire.

For the situation of flat, smooth, horizontal ceilings with beams at the ceiling, there are a number of variables that could cause many sprinklers to open during a fire. Residential sprinklers used in accordance with all of the restrictions of their listing can be used to protect this circumstance.

*End Quote*