First Revision No. 31-NFPA 13D-2013 [ Section No. 2.4 ]

2.4  References for Extracts in Mandatory Sections.


Submitter Information Verification

Submitter Full Name: Matthew Klaus
Organization: National Fire Protection Assoc
Street Address:
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Submittal Date: Mon Oct 21 14:12:38 EDT 2013

Committee Statement

Committee Statement: Editorial change to update the reference to the latest edition.
Response Message:
First Revision No. 2-NFPA 13D-2013 [New Section after 5.1.1]

5.1.1.1*
Where a sprinkler is removed from a fitting or welded outlet, it shall not be reinstalled except as permitted by 5.1.1.1.1.

5.1.1.1.1*
Dry sprinklers shall be permitted to be reinstalled, where they are not removed by applying torque at the point where the sprinkler is attached to the barrel.

Supplemental Information

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Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address: 
City: 
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Submittal Date: Thu Aug 29 09:14:38 EDT 2013

Committee Statement

Committee Statement: This section is being added to correlate with NFPA 13 and NFPA 13R.
Response Message:
Public Input No. 7-NFPA 13D-2012 [New Section after 5.1.1]
A.5.1.1.1

Where the sprinkler being removed from the system remains attached to the original fitting or welded outlet, the sprinkler should be permitted to be reinstalled when the sprinkler being removed from the system remains attached to the original fitting or welded outlet, provided care has been taken to ensure the sprinkler has not been damaged. Flexible hose connections are considered a fitting.

In new installations, where sprinklers are installed on pendent drop nipples or sidewall sprinklers prior to final cut-back, protective caps and/or straps should remain in place until after the drop nipple has been cut to fit to the final ceiling elevation.

A.5.1.1.1

Provided dry sprinklers are removed by utilizing a pipe wrench on the barrel, where permitted by the manufacturer, they can be reinstalled. If a dry sprinkler is removed by utilizing the sprinkler wrench on the boss of the sprinkler, the dry sprinkler should not be reinstalled.
5.1.2 Devices

Except as permitted by 5.1.2.1, devices and materials used in sprinkler systems shall be listed unless permitted not to be listed by 5.1.3.

5.1.2.1 Tanks, expansion tanks, pumps, hangers, waterflow detection devices, and valves shall not be required to be listed.

Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 29 09:17:09 EDT 2013

Committee Statement

Committee Statement: There is no technical change to this section, simply a rewording for clarity.
Response Message:

Public Input No. 8-NFPA 13D-2012 [Section No. 5.1.2]
5.1.3
Tanks, expansion tanks, pumps, hangers, waterflow detection devices, and waterflow valves shall not be required to be listed.

Submitter Information Verification
Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 29 09:22:14 EDT 2013

Committee Statement
Committee Statement: Deleted the term waterflow. This term is not defined. All valves in a sprinkler system will have waterflow through them.
Response Message: Public Input No. 9-NFPA 13D-2012 [Section No. 5.1.3]
First Revision No. 5-NFPA 13D-2013 [Section No. 6.2.1]

6.2.1
Where a pump is the source of pressure for the water supply for a fire sprinkler system but is not a portion of the domestic water system, the following shall be met:

1. A test connection shall be provided downstream of the pump that creates a flow of water equal to the smallest sprinkler K-factor on the system.

2. Pump motors using ac power shall be connected to a 240 V normal circuit rated for 240 V and wired in accordance with the NEC (NFPA 70).

3. Any disconnecting means for the pump shall be approved.

4. The pump shall not be permitted to sit directly on the floor. It shall be located not less than 1 1/2 in. off the floor.

Submitter Information Verification

Submitter Full Name: [Not Specified]
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Street Address:
City:
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Submittal Date: Thu Aug 29 10:08:36 EDT 2013

Committee Statement

Committee Statement: Modifications were made to clarify the language on the wiring of the pump, to confirm that it must be in accordance with the NEC. The use of a 240 V pump has been shown to reduce the potential for failure in the pump as these pump draw less amperage and have shown not to cause circuit breakers to trip. Historically there has been no specified dimension off of the floor that the pump needs to sit. This has lead installers to put a thin (1/16") mat under the pump. The intent of having the pump off the floor is to keep it out of water if the area flooded. The new dimension achieves this intent without being too restrictive.

Response Message:
Public Input No. 10-NFPA 13D-2012 [Section No. 6.2.1]
Public Input No. 11-NFPA 13D-2012 [Section No. 6.2.1]
### 6.3.4

A warning sign, with minimum ¼ in. (6 mm) letters, shall be affixed adjacent to the main shutoff valve and shall state the following:

**WARNING:** The water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems, and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

### Supplemental Information

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### Submitter Information Verification

- **Submitter Full Name:** [Not Specified]
- **Organization:** [Not Specified]
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Thu Aug 29 10:30:36 EDT 2013

### Committee Statement

**Committee Statement:** Note: This Proposal originates from Tentative Interim Amendment 13D-13-2 (TIA 1041) issued by the Standards Council on August 9, 2012. This proposed language is currently located within the “Common Supply Pipes” section of Chapter 6. This sign is not appropriate for this section and is only needed for multipurpose piping systems. This section should be moved to 6.3.4 so that it falls under the “Multipurpose Piping” heading. Emergency Nature: This was a mistake that the committee made between the ROP and ROC. Originally wording was in 6.3(5), 2007 Edition. Originally proposed as 6.3.4 during ROP and then moved for some reason to 6.5.3. This sign is not necessary on stand-alone systems. Because of construction practices in California the sign must be places at the meter by the street or on the outside of the home sometimes by the front door. This is a major problem for the builders, their marketing departments and their sales personnel.

**Response Message:**

Public Input No. 21-NFPA 13D-2013 [Section No. 6.3.4]
A warning sign, with minimum 1/4 in. letters, shall be affixed adjacent to the main shutoff valve and shall state the following:

**WARNING:** The water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems, and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

**Substantiation:** This proposed language is currently located within the “Common Supply Pipes” section of Chapter 6. This sign is not appropriate for this section and is only needed for multipurpose piping systems. This section should be moved to 6.3.4 so that it falls under the “Multipurpose Piping” heading.

**Emergency Nature:** This was a mistake that the committee made between the ROP and ROC. Originally wording was in 6.3(5), 2007 Edition. Originally proposed as 6.3.4 during ROP and then moved for some reason to 6.5.3. This sign is not necessary on stand-alone systems. Because of construction practices in California the sign must be places at the meter by the street or on the outside of the home sometimes by the front door. This is a major problem for the builders, their marketing departments and their sales personnel.
6.4 Manufactured Home Water Supply.
For sprinklered buildings manufactured off-site, the minimum flow and pressure needed to satisfy the system design criteria on the system side of the meter shall be specified on a data plate by the manufacturer.

Committee Statement
Committee Statement: Pressure alone is not adequate information to establish whether the available supply is acceptable. A corresponding flow at design pressure needs to be stipulated. While it is understood that a 2-sprinkler calculation results in a relatively low flow relative to available flow in typical city supplies, some of these supply curves are very "steep" and drop of pressure very quickly during flowign conditions. The system hydraulic calculation report identifies required flow and should be included to assure adequacy.

Response Message:
Public Input No. 48-NFPA 13D-2013 [Section No. 6.4]
7.1.2
The sprinkler system piping shall not have a separate control valve installed unless supervised by one of the following methods:

(1) Central station, proprietary, or remote station alarm service
(2) Local alarm service that causes the sounding of an audible signal at a constantly attended location
(3) Valves that are locked open

Submitter Information Verification
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Submittal Date: Thu Aug 29 12:27:34 EDT 2013

Committee Statement
Committee Statement: The previous language did not require additional control valves that may be installed downstream to be supervised. The revised language clarifies that this is the intent of the section.
Response Message: [ Not Specified ]
First Revision No. 8-NFPA 13D-2013 [Section No. 7.2.5]

7.2.5
The test connections, where provided, shall contain an orifice a K-factor equal to or smaller than the smallest sprinkler K-factor installed in the system.

Submitter Information Verification

Submitter Full Name: [Not Specified]
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Street Address:
City:
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Submittal Date: Thu Aug 29 10:38:58 EDT 2013

Committee Statement

Committee Statement: Correlates with NFPA 13 by using the term K Factor.
Response Message:
Public Input No. 12-NFPA 13D-2012 [Section No. 7.2.5]
7.2.6* Where a pressure-reducing or pressure-regulating valve is installed on a stand alone system, a pressure gauge and a test connection with an orifice a K-factor at least as large as the smallest orifice sprinkler on K-factor on the system shall be installed downstream of the device.

Submitter Information Verification

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Submittal Date: Thu Aug 29 10:40:32 EDT 2013

Committee Statement

Committee Statement: There has been a shift in NFPA 13 to use the term K Factor in place of orifice.
Response Message:
Public Input No. 1-NFPA 13D-2012 [Section No. 7.2.6]
### First Revision No. 25-NFPA 13D-2013 [Section No. 8.2.1.3]

<table>
<thead>
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<th>8.2.1.3</th>
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<tr>
<td>Pendent and upright sprinklers in closets shall be permitted to be installed within 12 in. (305 mm) of the ceiling in order to avoid obstructions near the ceiling.</td>
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</table>

### Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>Matthew Klaus</th>
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<tr>
<td>Organization:</td>
<td>National Fire Protection Assoc</td>
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<tr>
<td>Street Address:</td>
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<td>City:</td>
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<td>State:</td>
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<td>Submittal Date:</td>
<td>Tue Oct 01 11:17:15 EDT 2013</td>
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### Committee Statement

| Committee Statement: | This section has been deleted in favor of the revised language added to section 8.2.7.1 and 8.2.7.2. |

### Response Message:

Public Input No. 13-NFPA 13D-2012 [Section No. 8.2.1.3]
8.2.5.1 Closets.
In all closets and compartments, including those housing mechanical equipment, that are not larger than 400 ft$^3$ (11.3 m$^3$) in size, a single sprinkler at the highest ceiling space shall be sufficient without regard to obstructions or minimum distances to wall.
Sprinklers shall be positioned with respect to an obstruction against a wall in accordance with Figure 8.2.5.3.3(a) or Figure 8.2.5.3.3(b).

**Figure 8.2.5.3.3(a) Positioning of Sprinkler to Avoid Obstruction Against Walls (Residential Upright and Pendent Spray Sprinklers):**

**Figure 8.2.5.3.3(b) Positioning of Sprinkler to Avoid Obstruction Against Walls (Residential Upright and Pendent Spray Sprinklers):**

**Supplemental Information**
Committee Statement:

This common situation was not addressed in previous editions. This concept is included in NFPA 13R as well, so this will correlate with that standard.

Response Message:

Public Input No. 27-NFPA 13D-2013 [Section No. 8.2.5.4.3]
FIGURE 8.2.5.4.3(b) Positioning of Sprinkler to Avoid Obstruction Against Wall (Residential Upright and Pendent Spray Sprinklers)

\[ A \geq (D - 8 \text{ in.}) + B \]
\[ [A \geq (D - 0.2 \text{ m}) + B] \]
where \( D \leq 30 \text{ in.} (0.8 \text{ m}) \)
8.2.7  Closets.

8.2.7.1  In all closets and compartments, including those housing mechanical equipment that are larger than 400 ft\(^3\) (11.3 m\(^3\)) in size, pendent, upright, and sidewall sprinklers shall be permitted to be installed within 12 in. (305 mm) of the ceiling in order to avoid obstructions near the ceiling.

8.2.7.2  In all closets and compartments, including those housing mechanical equipment smaller than 400 ft\(^3\) (11.3 m\(^3\)) in size, pendent, upright, and sidewall sprinklers shall be permitted to be installed within 18 in. (450 mm) of the ceiling to avoid obstructions near the ceiling. A single sprinkler at the highest ceiling space shall be sufficient without regard to obstructions or minimum distances to wall.

Submitter Information Verification

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Submittal Date: Tue Oct 01 11:19:47 EDT 2013

Committee Statement

Committee Statement: This section was added to consolidate the requirements for closets in a single section. Section 8.2.1.3 and 8.2.5.1 have been deleted in favor of this section.
8.3.3 Sprinklers shall not be required in clothes closets, linen closets, and pantries that meet all of the following conditions:

1. The area of the space does not exceed 24 ft$^2$ (2.2 m$^2$).
2. The shortest dimension does not exceed 3 ft (0.9 m). Walls and ceilings are surfaced with noncombustible or limited-combustible materials as defined in NFPA 220.
3. Walls and ceilings are surfaced with noncombustible or limited-combustible materials as defined in NFPA 220.

Submitter Information Verification

Submitter Full Name: [Not Specified]
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Submittal Date: Wed Aug 28 14:42:02 EDT 2013

Committee Statement

Committee Statement: The three foot dimension is not necessary since it does not change the size of the closet where sprinklers can be omitted. The fire doesn't know whether the closet 2x12 or 4x6. This action correlates with the action taken on NFPA 13R.

Response Message:
9.2* Antifreeze Systems.
9.2.1* Conformity with Health Regulations.
The use of antifreeze solutions shall be in conformity with any state or local health regulations.
9.2.2* Antifreeze Solutions.
9.2.2.1
Except as permitted in 9.2.2.3, antifreeze solutions shall be listed for use in new sprinkler systems.
9.2.2.1.1
For existing systems, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5 percent) at a maximum concentration of 50 percent by volume, propylene glycol at a maximum concentration of 40 percent by volume, or other solutions listed specifically for use in fire protection systems.
9.2.2.2*
Premixed solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5 percent at a maximum concentration of 48 percent by volume or propylene glycol at a maximum concentration of 38 percent by volume shall be permitted to protect piping that is supplying sprinklers in a specific area of the dwelling unit, where acceptable to the authority having jurisdiction.
9.2.2.2.1*
Documentation shall be presented to the AHJ to substantiate the use of the antifreeze solution.
9.2.2.3
The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature.
9.2.2.4*
The specific gravity of the antifreeze solution shall be checked by a hydrometer with a scale having 0.002 subdivisions.
9.2.3* Arrangement of Supply Piping and Valves.
9.2.3.1 Connections Between Antifreeze System and Wet Pipe System with No Backflow Prevention Device.
9.2.3.1.1
A 5 ft (1.5 m) drop pipe, or U-loop, shall be installed in the connection between the antifreeze system and the wet pipe system as illustrated in Figure 9.2.3.1.1.

Figure 9.2.3.1.1 Arrangement of Supply Piping and Valves.

Notes:
1. Check valve shall be permitted to be omitted where sprinklers are below the level of valve A.
2. The ½ in. (0.8 mm) hole in the check valve clapper is needed to allow for expansion of the solution during a temperature rise, thus preventing damage to sprinklers.
9.2.3.1.2
If sprinklers are above the level of the water supply to the antifreeze system, a check valve with a \( \frac{1}{32} \) in. (0.8 mm) hole in the clapper shall be provided in the U-loop.

9.2.3.1.3
Valves shall be provided as illustrated in Figure 9.2.3.1.1.

9.2.3.1.4
Arrangement of supply piping when the water supply comes from a storage tank or the water supply feeds through a check valve that does not have a \( \frac{1}{32} \) in. (0.8 mm) hole drilled in the clapper shall meet the requirements of 9.2.3.2.

9.2.3.2* Connections Between Antifreeze System and Wet Pipe System with Backflow Prevention Device Installed.

9.2.3.2.1
Valves shall be provided as illustrated in Figure 9.2.3.2.1.

Figure 9.2.3.2.1 Arrangement of Supply Piping with Backflow Device.

9.2.3.2.2
An expansion chamber shall be provided as illustrated in Figure 9.2.3.2.1.

9.2.3.2.3
The expansion chamber shall be sized based on the minimum and maximum volume of the antifreeze solution over the life of the system.

9.2.4 Hydrostatic Test.
Where pendent sprinklers are utilized, and where a hydrostatic test shall be performed, the hydrostatic test shall be performed with water and then the water shall be completely drained before antifreeze solution is placed in the system, or the hydrostatic test shall be performed with antifreeze solution at the proper concentration for the system.

9.2.5 Placard Information.
A placard shall be placed on the antifreeze system main valve that indicates the manufacturer type and brand of antifreeze solution, the concentration of antifreeze solution used, and the volume of the antifreeze solution used in the system.

Supplemental Information

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Submitter Information Verification

Submitter Full Name: [ Not Specified ]
Organization: [ Not Specified ]
Street Address:  
City:  
State:  
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Submittal Date: Thu Aug 29 11:05:52 EDT 2013
Committee Statement

Note: This Proposal originates from Tentative Interim Amendment 13D-13-1 (TIA 1067) issued by the Standards Council on August 9, 2012. The Technical Committee on Residential Sprinkler Systems is taking a different path in dealing with antifreeze in NFPA 13D than it has in NFPA 13R or the Sprinkler System Installation Criteria Committee is taking with NFPA 13. This different path is fundamentally based on the fact that one- and two-family dwellings are treated differently in building codes and fire codes than other types of occupancies and in recognition of the fact that NFPA 13D has a different objective than NFPA 13R and NFPA 13. From its inception in 1975, NFPA 13D has been less stringent than NFPA 13 in order to present a document that balances the issues of reasonable fire protection with the realistic concerns of cost and redundancy. NFPA 13D has always recognized that if fire sprinkler systems are too much like NFPA 13, they will not be installed in one-and two-family dwellings and they will not be able to help change the fact that thousands of people continue to die each year due to fires in unsprinklered one-and two-family dwellings. As such, the Technical Committee on Residential Sprinkler Systems, concerned with the overall effort to get sprinkler systems into more one- and two-family dwellings is consciously choosing to be less restrictive than NFPA 13, while still maintaining a reasonable level of fire safety for the occupants of sprinklered one- and two-family dwellings.

The information provided in the report, Antifreeze Systems in Home Fire Sprinkler Systems – Phase II Report (Fire Protection Research Foundation, December 2010) was the basis for TIA 10-2 to NFPA 13D that was issued by the NFPA on March 1, 2011. That research report is still valid and demonstrates how residential sprinklers perform in typical dwelling units of typical one- and two-family dwellings with a variety of antifreeze solutions tested through a variety of pendant and sidewall residential sprinklers. Subsequent testing has been performed as a part of a project sponsored by the Fire Protection Research Foundation (FPRF), who released an interim report in February of 2012 titled, Antifreeze Solutions Supplied through Spray Sprinklers. This report followed up on the Phase II tests and looked at antifreeze solutions and their performance with a variety of standard spray sprinklers. Given that NFPA 13D calls for the use of residential sprinklers in all locations except mechanical closets and unheated areas not intended for living purposes (see section 7.5.3 and 7.5.4 of NFPA 13D), the results of this latest FPRF research is less important to NFPA 13D.

Still, in reviewing the results of the tests, the committee has chosen to tighten up the rules with respect to new installations by proposing this TIA so that designers can make better decisions regarding the potential use of antifreeze systems. For existing systems, the committee is not recommending any changes from the TIA processed and issued in March of 2011. Based on input from Authorities Having Jurisdiction, a total ban on antifreeze systems is not realistic and would be detrimental to the effort to pass legislation for mandatory sprinkler requirements in one- and two-family dwellings. Since there are currently no listed antifreeze solutions, a requirement to only use listed antifreeze would be tantamount to a ban on the use of antifreeze. While the use of listed antifreeze systems is probably the best long-term solution, some recognition of glycerine or propylene glycol is necessary in the short term, even for new systems. NFPA 13D systems are intended to be cost effective. Completely eliminating the use of antifreeze in specific, isolated areas, may significantly drive up the cost of residential sprinkler systems. This TIA starts out expressing a preference for the use of listed antifreeze systems in section 9.2.2.1, but then goes on to allow the use of unlisted 48% glycerine or 38% propylene glycol where two conditions are met. The first condition is that the system has to be acceptable to the Authority Having Jurisdiction (AHJ). It is anticipated that the AHJ will understand the gravity of the decision and only approve situations where other options have been explored and rejected as impossible or impractical. The second condition is that the antifreeze has to be limited to a “specific area”. The committees intent is to limit the antifreeze as much as possible to the portion of the system that will experience the cold temperatures. This language is the best that the committee could agree on that allowed the flexibility necessary to handle the wide range of design situations that currently exist. It is anticipated that the AHJ would be able to consider each situation on a case-by-case basis and determine if the system was sufficiently isolated. The use of 48% glycerine and 38% propylene glycol is supported by the Phase II test report discussed above when limited to residential sprinklers in typical dwelling units. This position is strengthened by the existing requirement in section 9.2.2.2 which becomes 9.2.2.3 in this TIA, which requires the antifreeze to be limited to what is needed for the environment. If the pipe is only going to be subjected to temperatures of 20°F, then a solution of 48% glycerine would not be permitted and a premixed solution of 25% glycerine should be used instead since this is all that is needed to protect down to 20°F. In order to provide the designer with as much information as possible, so that informed decisions can be made, this TIA proposes an expanded annex section that discusses the findings of the various tests that have been performed, including the latest tests just released. This should help designers understand the risks involved and...
the consequences of their decisions and help guide them to keep antifreeze solutions to the lowest possible concentrations if they decide they want to use antifreeze at all. This TIA does not propose changes to the rules for existing systems (allowing them to stay as they were in TIA 10-2 with up to 50% glycerine and 40% propylene glycol). This decision was made after a review of the testing programs to date and a first order risk analysis that looked at the potential problems that would arise if we forced people to retroactively change out their existing systems. This risk analysis shows that the risk of changing the antifreeze requirements for existing building and forcing building owners to make a change is higher (6 to 6.3 deaths per year) than leaving the 50% glycerine or 40% propylene glycol in systems (3.0 to 3.6 deaths/year). The following is a summary of this analysis: Risk Analysis for Antifreeze Systems Assumptions · There are approximately 100 million homes (1 and 2 family) in America · There are approximately 300,000 fires in the homes each year (0.003 fires/home/year) · There are approximately 3000 fire deaths per year in homes (0.01 deaths/fire) o Of these fire deaths, 10% occur in fires that started in spaces that NFPA 13D does not require to be sprinklered, so these deaths will be assumed in this analysis to occur, even in sprinklered homes, even though actual fire experience has shown that sprinklers in adjacent rooms sometimes activate to control these fires and significant losses are not being experienced. o In an effort to be conservative, this analysis will also assume that sprinklers are only 90% effective, even though significant work has shown them to be much more effective · There are approximately 2 million sprinklered homes in America (2% of all homes) o There are approximately 500,000 systems (25% of all sprinklered homes) with antifreeze that is required right now by NFPA 13D to be a maximum of 50% glycerin or 40% propylene glycol. o There are approximately 1500 fires/yr in the homes with these antifreeze systems o There have been no deaths associated with fires in homes having antifreeze systems with 50% or less glycerine or 40% or less propylene glycol o There have been two incidents of flash fires in the last 5 years causing 1 death and 2 serious injuries in apartments. In both cases, the system concentration is believed to have been greater than 50% with one of these being believed to be 70% glycerine and the other 60% glycerine. For the purposes of this conservative analysis, the 2 serious injuries will be considered as deaths. o Using these last two bullet points, the risk of death due to flash fire caused by the antifreeze is between 0 and 0.0004 deaths per year depending on what mix of concentrations is assumed for the population of sprinklered homes with antifreeze in the systems. If the Situation is Left “As Is” with 50% Glycerine or 40% Propylene Glycol Allowed to Remain · There will be 1500 fires each year in the systems with antifreeze (500,000 sprinklered homes with antifreeze and 0.003 fires/home/year) · There will be 3 deaths per year assuming that sprinklers are 90% effective and in 90% of the locations where deadly fires start (1500 fires times 0.01 deaths per fire is a potential for 15 deaths, 1.5 might occur from fires starting in unsprinklered spaces, 1.5 might occur due to some failure of the system, the other 12 will be saved) · There will be 0 and 0.6 deaths due to flash fires depending on the population of antifreeze solutions in homes (1500 fires times 0.0004 is 0.6, which is extremely conservative considering this statistic is gathered from high concentration systems that were not in homes) · Total of between 3.0 and 3.6 possible deaths per year from this decision If We Call for Replacement/Reduction of Solutions · Assumption that 125,000 systems (25% of existing antifreeze systems) will get turned off · Assumption that 125,000 people (25% of existing antifreeze systems) will comply and spend the money to do something else (lower system concentration, heat tracing or conversion to dry-pipe or preaction system) · Assumption that 250,000 systems (50% of existing systems) will be left “as is” with whatever antifreeze they have · The homeowners who shut off their systems will experience 375 fires and 3.75 fire deaths that can’t be prevented by a sprinkler system shut off · The homeowners who complied will experience 375 fires and 0.75 fire deaths assuming the sprinkler systems are 90% effective and that sprinklers are installed in 90% of locations where deadly fires start · The homeowners that left their systems “as is” will experience 750 fires and between 1.5 and 1.8 fire deaths (1.5 of the fire deaths are from the system being 90% effective and 90% of the fires starting in sprinklered spaces and up to 0.3 of the fire deaths are from the potential for a flash fire depending on the antifreeze concentrations that are assumed) · Total of between 6.0 and 6.3 potential deaths per year from this decision Of course, any risk analysis like this is dependent on the assumptions used to formulate the conclusions. A sensitivity analysis was performed on the assumption above that if some change was required by NFPA 13D that 25% of the systems would be shut off and only 25% of the systems would be changed to comply. If the assumption was changed to 10% of the systems being shut off and 80% of the systems being changed to comply (with the remaining 10% of the systems left “as is”) then the decision to force the change still comes out worse (with a risk between 4.2 and 4.26) than the decision to leave all of the systems alone (with a risk between 3 and 3.6).
research. It meets the definition of part 5.2(c) in the Regulations Governing Committee Projects as an emergency since the issues raised by the research were not known at the time the standard was being developed. The use of propylene glycol and glycerin antifreeze solutions should only be considered when other sprinkler system design alternatives are not available or practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in design and installation of the sprinkler system.

Response
Message:
Public Input No. 22-NFPA 13D-2013 [Section No. 9.2]
The use of antifreeze solutions shall be in conformity with any state or local health regulations. 

Unless permitted in 9.2.2.2, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 48% by volume, propylene glycol at a maximum concentration of 38% by volume, or other solutions listed specifically for use in fire protection systems. [ROP-12]

For existing systems, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 50% by volume, propylene glycol at a maximum concentration of 40% by volume, or other solutions listed specifically for use in fire protection systems. [ROP-12]

Premixed solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 48% by volume or propylene glycol at a maximum concentration of 38% by volume shall be permitted to protect piping that is supplying sprinklers in a specific area of the dwelling unit, where acceptable to the Authority Having Jurisdiction.

Documentation shall be presented to the AHJ to substantiate the use of the antifreeze solution.

The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature. [ROP-12]

An antifreeze solution with a freezing point below the expected minimum temperature for the locality shall be installed. [ROP-12]

The specific gravity of the antifreeze solution shall be checked by a hydrometer with a scale having 0.002 subdivisions. [ROP-12] [ROC-53]

Listed CPVC nonmetallic sprinkler pipe and fittings should be protected from freezing with an antifreeze solution that is compatible with the nonmetallic material glycerine only. The use of diethylene glycol, ethylene glycol, or propylene glycol is specifically prohibited. Laboratory testing shows that glycol-based antifreeze solutions present a chemical environment detrimental to nonmetallic pipe CPVC. [ROP-108]
The documentation should substantiate that the proposed use of premixed glycerine and propylene glycol antifreeze solutions is consistent with the FPRF testing for the specific installation parameters.

Examples of specific areas might include piping installed in an exterior wall or an unheated concealed space above a cathedral ceiling that cannot be protected with insulation or heat tracing. Premixed solutions of glycerine and propylene glycol should be used only where other freeze protections options are not practical. The specific areas protected by premixed glycerine and propylene glycol shall be limited to the greatest extent possible.

Propylene glycol and glycerin antifreeze solutions discharged from sprinklers have the potential to ignite under certain conditions. Research testing has indicated that several variables may influence the potential for large-scale ignition of the antifreeze solution discharged from a sprinkler. These variables include, but are not limited to, the concentration of antifreeze solution, sprinkler discharge characteristics, inlet pressure at the sprinkler, location of fire relative to the sprinkler, and size of fire at the time of sprinkler discharge. Research testing also indicates that propylene glycol or glycerin solutions can be used successfully with certain other combinations of these same variables. Given the need for additional testing to further define acceptable versus unacceptable scenarios, the use of propylene glycol and glycerin antifreeze solutions should only be considered when other sprinkler system design alternatives are not practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in the sprinkler system. The following is a list of research reports that have been issued by the Fire Protection Research Foundation related to the use of antifreeze in sprinkler systems:

3. Antifreeze Solutions Supplied through Spray Sprinklers – Interim Report. Fire Protection Research Foundation, February 2012. (UPDATE REFERENCE TO "FINAL REPORT" if available prior to issuance of TIA)

Many all permitted antifreeze solutions are heavier than water. At the point of contact (interface), provisions are required by 9.2.3 to prevent the diffusion of water into unheated areas. To avoid leakage, the quality of materials and workmanship should be superior, the threads should be clean and sharp, and the joints should be tight. Only metal-faced valves should be used.

Substantiation: The Technical Committee on Residential Sprinkler Systems is taking a different path in dealing with antifreeze in NFPA 13D than it has in NFPA 13R or than the Sprinkler System Installation Criteria Committee is taking with NFPA 13. This different path is fundamentally based on the fact that one- and two-family dwellings are treated differently in building codes and fire codes than other types of occupancies and in recognition of the fact that NFPA 13D has a different objective than NFPA 13R and NFPA 13.

From its inception in 1975, NFPA 13D has been less stringent than NFPA 13 in order to present a document that balances the issues of reasonable fire protection with the realistic concerns of cost and redundancy. NFPA 13D has always recognized that if fire sprinkler systems are too much like NFPA 13, they will not be installed in one-and two-family dwellings and they will not be able to help change the fact that thousands of people continue to die each year due to fires in unsprinklered one-and two-family dwellings. As such, the Technical Committee on Residential Sprinkler Systems, concerned with the overall effort to get sprinkler systems into more one- and two-family dwellings is consciously choosing to be less restrictive than NFPA 13, while still maintaining a reasonable level of fire safety for the occupants of sprinklered one- and two-family dwellings.

The information provided in the report, Antifreeze Systems in Home Fire Sprinkler Systems – Phase II Report (Fire Protection Research Foundation, December 2010) was the basis for TIA 10-2 to NFPA 13D that was issued by the NFPA on March 1, 2011. That research report is still valid and demonstrates how residential sprinklers perform in
typical dwelling units of typical one- and two-family dwellings with a variety of antifreeze solutions tested through a variety of pendent and sidewall residential sprinklers.

Subsequent testing has been performed as a part of a project sponsored by the Fire Protection Research Foundation (FPRF), who released an interim report in February of 2012 titled, Antifreeze Solutions Supplied through Spray Sprinklers. This report followed up on the Phase II tests and looked at antifreeze solutions and their performance with a variety of standard spray sprinklers. Given that NFPA 13D calls for the use of residential sprinklers in all locations except mechanical closets and unheated areas not intended for living purposes (see section 7.5.3 and 7.5.4 of NFPA 13D), the results of this latest FPRF research is less important to NFPA 13D. Still, in reviewing the results of the tests, the committee has chosen to tighten up the rules with respect to new installations by proposing this TIA so that designers can make better decisions regarding the potential use of antifreeze systems. For existing systems, the committee is not recommending any changes from the TIA processed and issued in March of 2011.

Based on input from Authorities Having Jurisdiction, a total ban on antifreeze systems is not realistic and would be detrimental to the effort to pass legislation for mandatory sprinkler requirements in one- and two-family dwellings. Since there are currently no listed antifreeze solutions, a requirement to only use listed antifreeze would be tantamount to a ban on the use of antifreeze. While the use of listed antifreeze systems is probably the best long-term solution, some recognition of glycerine or propylene glycol is necessary in the short term, even for new systems. NFPA 13D systems are intended to be cost effective. Completely eliminating the use of antifreeze in specific, isolated areas, may significantly drive up the cost of residential sprinkler systems.

This TIA starts out expressing a preference for the use of listed antifreeze systems in section 9.2.2.1, but then goes on to allow the use of unlisted 48% glycerine or 38% propylene glycol where two conditions are met. The first condition is that the system has to be acceptable to the Authority Having Jurisdiction (AHJ). It is anticipated that the AHJ will understand the gravity of the decision and only approve situations where other options have been explored and rejected as impossible or impractical. The second condition is that the antifreeze has to be limited to a "specific area". The committees intent is to limit the antifreeze as much as possible to the portion of the system that will experience the cold temperatures. This language is the best that the committee could agree on that allowed the flexibility necessary to handle the wide range of design situations that currently exist. It is anticipated that the AHJ would be able to consider each situation on a case-by-case basis and determine if the system was sufficiently isolated.

The use of 48% glycerine and 38% propylene glycol is supported by the Phase II test report discussed above when limited to residential sprinklers in typical dwelling units. This position is strengthened by the existing requirement in section 9.2.2.2 (which becomes 9.2.2.3 in this TIA), which requires the antifreeze to be limited to what is needed for the environment. If the pipe is only going to be subjected to temperatures of 20°F, then a solution of 48% glycerine would not be permitted and a premixed solution of 25% glycerine should be used instead since this is all that is needed to protect down to 20°F.

In order to provide the designer with as much information as possible, so that informed decisions can be made, this TIA proposes an expanded annex section that discusses the findings of the various tests that have been performed, including the latest tests just released. This should help designers understand the risks involved and the consequences of their decisions and help guide them to keep antifreeze solutions to the lowest possible concentrations if they decide they want to use antifreeze at all.

This TIA does not propose changes to the rules for existing systems (allowing them to stay as they were in TIA 10-2 with up to 50% glycerine and 40% propylene glycol). This decision was made after a review of the testing programs to date and a first order risk analysis that looked at the potential problems that would arise if we forced people to retroactively change out their existing systems. This risk analysis shows that the risk of changing the antifreeze requirements for existing building and forcing building owners to make a change is higher (6 to 6.3 deaths per year) than leaving the 50% glycerine or 40% propylene glycol in systems (3.0 to 3.6 deaths/year). The following is a summary of this analysis:

Risk Analysis for Antifreeze Systems
Assumptions

- There are approximately 100 million homes (1 and 2 family) in America
- There are approximately 300,000 fires in the homes each year (0.003 fires/home/year)
- There are approximately 3000 fire deaths per year in homes (0.01 deaths/fire)
Of these fire deaths, 10% occur in fires that started in spaces that NFPA 13D does not require to be sprinklered, so these deaths will be assumed in this analysis to occur, even in sprinklered homes, even though actual fire experience has shown that sprinklers in adjacent rooms sometimes activate to control these fires and significant losses are not being experienced.

In an effort to be conservative, this analysis will also assume that sprinklers are only 90% effective, even though significant work has shown them to be much more effective.

There are approximately 2 million sprinklered homes in America (2% of all homes)

There are approximately 500,000 systems (25% of all sprinklered homes) with antifreeze that is required right now by NFPA 13D to be a maximum of 50% glycerin or 40% propylene glycol

There are approximately 1500 fires/yr in the homes with these antifreeze systems

There have been no deaths associated with fires in homes having antifreeze systems with 50% or less glycerine or 40% or less propylene glycol

There have been two incidents of flash fires in the last 5 years causing 1 death and 2 serious injuries in apartments. In both cases, the system concentration is believed to have been greater than 50% with one of these being believed to be 70% glycerine and the other 60% glycerine. For the purposes of this conservative analysis, the 2 serious injuries will be considered as deaths.

Using these last two bullet points, the risk of death due to flash fire caused by the antifreeze is between 0 and 0.0004 deaths per year depending on what mix of concentrations is assumed for the population of sprinklered homes with antifreeze in the systems.

There will be 1500 fires each year in the systems with antifreeze (500,000 sprinklered homes with antifreeze and 0.003 fires/home/year)

There will be 3 deaths per year assuming that sprinklers are 90% effective and in 90% of the locations where deadly fires start (1500 fires times 0.01 deaths per fire is a potential for 15 deaths, 1.5 might occur from fires starting in unsprinklered spaces, 1.5 might occur due to some failure of the system, the other 12 will be saved)

There will be between 0 and 0.6 deaths due to flash fires depending on the population of antifreeze solutions in homes (1500 fires times 0.0004 is 0.6, which is extremely conservative considering this statistic is gathered from high concentrations systems that were not in homes)

Total of between 3.0 and 3.6 possible deaths per year from this decision

If the Situation is Left “As Is” with 50% Glycerine or 40% Propylene Glycol Allowed to Remain

There will be 1500 fires each year in the systems with antifreeze (500,000 sprinklered homes with antifreeze and 0.003 fires/home/year)

There will be 3 deaths per year assuming that sprinklers are 90% effective and in 90% of the locations where deadly fires start (1500 fires times 0.01 deaths per fire is a potential for 15 deaths, 1.5 might occur from fires starting in unsprinklered spaces, 1.5 might occur due to some failure of the system, the other 12 will be saved)

There will be between 0 and 0.6 deaths due to flash fires depending on the population of antifreeze solutions in homes (1500 fires times 0.0004 is 0.6, which is extremely conservative considering this statistic is gathered from high concentrations systems that were not in homes)

Total of between 3.0 and 3.6 possible deaths per year from this decision

If We Call for Replacement/Reduction of Solutions

Assumption that 125,000 systems (25% of existing antifreeze systems) will get turned off

Assumption that 125,000 people (25% of existing antifreeze systems ) will comply and spend the money to do something else (lower system concentration, heat tracing or conversion to dry-pipe or preaction system)

Assumption that 250,000 systems (50% of existing systems) will be left “as is” with whatever antifreeze they have

The homeowners who shut off their systems will experience 375 fires and 3.75 fire deaths that can't be prevented by a sprinkler system shut off

The homeowners that complied will experience 375 fires and 0.75 fire deaths assuming the sprinkler systems are 90% effective and that sprinklers are installed in 90% of locations where deadly fires start

The homeowners that left their systems “as is” will experience 750 fires and between 1.5 and 1.8 fire deaths (1.5 of the fire deaths are from the system being 90% effective and 90% of the fires starting in sprinklered spaces and up to 0.3 of the fire deaths are from the potential for a flash fire depending on the antifreeze concentrations that are assumed)

Total of between 6.0 and 6.3 potential deaths per year from this decision

Of course, any risk analysis like this is dependent on the assumptions used to formulate the conclusions. A sensitivity analysis was performed on the assumption above that if some change was required by NFPA 13D that 25% of the systems would be shut off and only 25% of the systems would be changed to comply. If the assumption was changed to 10% of the systems being shut off and 80% of the systems being changed to comply (with the remaining 10% of the systems left “as is”) then the decision to force the change still comes out worse (with a risk between 4.2 and 4.26) than the decision to leave all of the systems alone (with a risk between 3 and 3.6).
Emergency Nature: This TIA has been prompted by the recently released interim research report, *Antifreeze Solutions Supplied through Spray Sprinklers*, issued by the Fire Protection Research Foundation in February of 2012. It is part of a package of TIA’s being submitted by each of the fire sprinkler installation and maintenance documents in order to address the issues raised by that research. It meets the definition of part 5.2(c) in the Regulations Governing Committee Projects as an emergency since the issues raised by the research where not known at the time the standard was being developed.

The use of propylene glycol and glycerin antifreeze solutions should only be considered when other sprinkler system design alternatives are not available or practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in design and installation of the sprinkler system.
9.3.3.2 Water delivery shall be based on one of the following:

1. **Calculation** A calculation program and method that shall be listed by a nationally recognized laboratory.

2. An inspector's test connection providing a flow equivalent to the smallest orifice sprinkler utilized K-factor utilized, wherein the test orifice test connection is located on the end of the most distant sprinkler pipe most remote branchline.

Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address: [Not Specified]
City: [Not Specified]
State: [Not Specified]
Zip: [Not Specified]
Submittal Date: Thu Aug 29 11:06:24 EDT 2013

Committee Statement

Committee Statement: Modified language to correlate with NFPA 13 with the term K Factor. Additional editorial modifications were made for clarity.
Response Message: Public Input No. 14-NFPA 13D-2012 [Section No. 9.3.3.2]
10.1.2 Water Supply.

10.1.2.1 Where the water supply is a public or private water main 4 in. (nominal) in size or larger, the static pressure shall be permitted to be used for comparison to the sprinkler system demand regardless of the method used to determine the adequacy of the piping.

Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 29 12:31:46 EDT 2013

Committee Statement

Committee Statement: While this has always been implied by NFPA 13D, the standard has never come right out and stated this. While section 10.4.3 never comes right out and says, “use the static pressure”, the worksheet in Figure A.10.4.3(a) implies that the static pressure is used by asking in the first line for the water pressure in the street without referring to a flow. Section 10.4.9.2(1) specifically says to use the static pressure for comparison, but that only applies to the simplified process in that section. It does not apply to the method of estimating demand in section 10.4.3 and it does not apply to systems calculated in accordance with NFPA 13. We need a definitive statement that applies to all NFPA 13D systems, including those calculated under NFPA 13, the simplified method of 10.4.3 and the simplified method of 10.4.9.

Response Message:
Unless the pipe size is in accordance with the prescriptive pipe sizing method of 10.4.9, pipe shall be sized by hydraulic calculations in accordance with the methods described in NFPA 13, in accordance with the manufacturer's listed installation instructions, with 10.4.4, or in accordance with the following general method for straight-run systems connected to a city water main of at least 4 in. (102 mm) in diameter:

1. The system flow rate shall be established in accordance with Sections 10.1 and 10.2, and it shall be determined that the flow allowed by the water meter meets or exceeds the system demand and that the total demand flow does not exceed the maximum flow allowed by the piping system components.

2. The water pressure in the street shall be determined.

3. Pipe sizes shall be selected.

4. Pressure loss for a water meter, if any, shall be determined and deducted using one of the following:
   
   (a) Table 10.4.3(a) shall be permitted to be used, even where the sprinkler demand flow exceeds the meter's rated continuous flow.
   
   (b) Higher pressure losses specified by the manufacturer shall be used in place of those specified in Table 10.4.3(a).
   
   (c) Lower pressure losses shall be permitted to be used where supporting data are provided by the meter manufacturer.

5. Pressure loss for elevation shall be deducted as follows:
   
   (a) Building height above street (ft) × 0.433 = pressure loss (psi)
   
   (b) Building height above street (m) × 0.098 = pressure loss (bar)

6. Pressure losses from the city main to the inside control valve shall be deducted by multiplying the pressure loss associated with the pipe material by the total length(s) of pipe in feet (meters).

7. Pressure loss for piping within the building shall be deducted by multiplying the pressure loss associated with the pipe material by the total length(s) of pipe in feet (meters).

8. Pressure loss for valves and fittings shall be deducted as follows:
   
   (a) The valves and fittings from the control valve to the farthest sprinkler shall be counted.
   
   (b) The equivalent length for each valve and fitting as shown in Table 10.4.3(b), Table 10.4.3(c), or Table 10.4.3(d) or Table 10.4.3(e) shall be determined and the values added to obtain the total equivalent length for each pipe size.
   
   (c) The equivalent length for each size shall be multiplied by the pressure loss associated with the pipe material and the values totaled.

9. In multilevel buildings, the steps in 10.4.3(1) through 10.4.3(8) shall be repeated to size piping for each floor.

10. If the remaining pressure is less than the operating pressure established by the testing laboratory for the sprinkler being used, the sprinkler system shall be redesigned.

11. If the remaining pressure is higher than required, smaller piping shall be permitted to be used where justified by calculations.

12. The remaining piping shall be sized the same as the piping up to and including the farthest sprinkler unless smaller pipe sizes are justified by calculations.

Table 10.4.3(a) Pressure Losses in psi in Water Meters

<table>
<thead>
<tr>
<th>Meter Size (in.)</th>
<th>Flow (gpm)</th>
<th>18 or less</th>
<th>23</th>
<th>26</th>
<th>31</th>
<th>39</th>
<th>52</th>
</tr>
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<tbody>
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<td>9</td>
<td>14</td>
<td>18</td>
<td>26</td>
<td>38</td>
<td></td>
<td>*</td>
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<td>3/4</td>
<td>7</td>
<td>11</td>
<td>14</td>
<td>22</td>
<td>35</td>
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<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1 1/2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Diameter (in.)</td>
<td>45° Elbow</td>
<td>90° Elbow</td>
<td>Long-Radius Elbow</td>
<td>Tee or Cross (flow turned 90 degrees)</td>
<td>Tee or Cross (flow straight through)</td>
<td>Gate Valve</td>
<td>Angle Valve</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>-----------</td>
<td>------------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
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<td>3</td>
<td>10</td>
<td>3</td>
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<td>24</td>
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</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 10.4.3(c) Equivalent Length in Feet of Fittings and Valves for Type K Copper Tube

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>45° Elbow</th>
<th>90° Elbow</th>
<th>Long-Radius Elbow</th>
<th>Tee or Cross (flow turned 90 degrees)</th>
<th>Tee or Cross (flow straight through)</th>
<th>Gate Valve</th>
<th>Angle Valve</th>
<th>Globe Valve</th>
<th>Globe &quot;Y&quot; Pattern Valve</th>
<th>Cock Valve</th>
<th>Check Valve</th>
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<tbody>
<tr>
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<td>0</td>
<td>7</td>
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<td>28</td>
<td>66</td>
<td>33</td>
<td>8</td>
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</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 10.4.3(d) Equivalent Length in Feet of Fittings and Valves for Type L Copper Tube

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>45° Elbow</th>
<th>90° Elbow</th>
<th>Long-Radius Elbow</th>
<th>Tee or Cross (flow turned 90 degrees)</th>
<th>Tee or Cross (flow straight through)</th>
<th>Gate Valve</th>
<th>Angle Valve</th>
<th>Globe Valve</th>
<th>Globe &quot;Y&quot; Pattern Valve</th>
<th>Cock Valve</th>
<th>Check Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>8</td>
<td>18</td>
<td>10</td>
<td>3</td>
<td>0</td>
</tr>
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<td>1</td>
<td>3</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>0</td>
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<td>38</td>
<td>20</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>1¼</td>
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<td>3</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>15</td>
<td>35</td>
<td>18</td>
<td>5</td>
<td>7</td>
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<td>1½</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>20</td>
<td>47</td>
<td>24</td>
<td>7</td>
<td>10</td>
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<td>2</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>12</td>
<td>4</td>
<td>1</td>
<td>30</td>
<td>71</td>
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<td>14</td>
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</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 10.4.3(e) Equivalent Length in Feet of Fittings and Valves for Type M Copper Tube
<table>
<thead>
<tr>
<th>diameter</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<th>12</th>
<th>13</th>
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<td>21</td>
<td>11</td>
<td>3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>19</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1 1/4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>16</td>
<td>38</td>
<td>20</td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>21</td>
<td>50</td>
<td>26</td>
<td>7</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>7</td>
<td>4</td>
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<td>1</td>
<td>3</td>
<td>75</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address: [Not Specified]
City: [Not Specified]
State: [Not Specified]
Zip: [Not Specified]
Submittal Date: Thu Aug 29 11:08:01 EDT 2013

Committee Statement

Committee Statement: Adding this language would allow sizing fire sprinkler piping based on published prescriptive pipe sizing by pipe manufacturers. This would allow prescriptive pipe sizing for systems utilizing specially listed piping products when the tables supporting the calculation procedure of 10.4.9.2 do not cover the available sizes or are otherwise not appropriate.

Response Message:
Public Input No. 43-NFPA 13D-2013 [Section No. 10.4.3]
10.4.9.2 Calculation Procedure.
Determination of the required size for water distribution piping shall be in accordance with the following procedure:

1. **Step 1 — Determine \( P_{sup} \)**: Obtain the static supply pressure that will be available from the water main from the water purveyor or from a private source, such as a tank system, a private well system, or a combination of these. For a private source, the available water supply pressure shall be based on the minimum pressure control setting for the pump.

2. **Step 2 — Determine \( P_{svc} \)**: Use Table 10.4.9.2(a) to determine the pressure loss in the water service pipe based on the selected size of the water service.

3. **Step 3 — Determine \( P_{m} \)**: Use Table 10.4.3(a) to determine the pressure loss from the water meter based on the selected water meter size. Where the actual water meter pressure loss is known, \( P_{m} \) shall be the actual loss.

4. **Step 4 — Determine \( P_{d} \)**: Determine the pressure loss from devices, other than the water meter, installed in the piping system supplying sprinklers, such as pressure-reducing valves, backflow preventers, water softeners, or water filters, taking into account the following:
   - (a) Device pressure losses shall be based on the device manufacturer’s specifications.
   - (b) The flow rate used to determine pressure loss shall be the rate from Section 10.1, except that 5 gpm (19 L/min) shall be added where the device is installed in a water service pipe that supplies more than one dwelling.
   - (c) As an alternative to deducting pressure loss for a device, an automatic bypass valve shall be installed to divert flow around the device when a sprinkler activates.

5. **Step 5 — Determine \( P_{e} \)**: Use Table 10.4.9.2(b) to determine the pressure loss associated with changes in elevation. The elevation used in applying the table shall be the difference between the elevation where the water source pressure was measured and the elevation of the highest sprinkler.

6. **Step 6 — Determine \( P_{sp} \)**: Determine the maximum pressure required by any individual sprinkler based on the following:
   - (a) The area of coverage
   - (b) The ceiling configuration
   - (c) The temperature rating
   - (d) Any additional conditions specified by the sprinkler manufacturer

The required pressure is provided in the sprinkler manufacturer’s published data for the specific sprinkler model based on the selected flow rate.

7. **Step 7 — Calculate \( P_{t} \)**: Using the equation in 10.4.9.1, calculate the pressure available to offset friction loss in water distribution piping between the service valve and the sprinklers.

8. **Step 8 — Determine the maximum allowable pipe length.** Use Table 10.4.9.2(c) through Table 10.4.9.2(h) to select a material and size for water distribution piping. The piping material and size shall be acceptable if the developed length of pipe between the service valve and the most remote sprinkler does not exceed the maximum allowable length specified by the applicable table. Interpolation of \( P_{t} \) between the tabular values shall be permitted.

---

Table 10.4.9.2(a) Water Service Pressure Loss (\( P_{svc} \))

<table>
<thead>
<tr>
<th>Flow Rate* (gpm)</th>
<th>⅛ in. Water Service Pressure Loss (psi)</th>
<th>1 in. Water Service Pressure Loss (psi)</th>
<th>1¼ in. Water Service Pressure Loss (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 ft or less</td>
<td>41 ft to 75 ft</td>
<td>76 ft to 100 ft</td>
</tr>
<tr>
<td>8</td>
<td>5.1</td>
<td>8.7</td>
<td>11.8</td>
</tr>
</tbody>
</table>
### Flow Rate*

**Flow Rate** *(gpm)*

<table>
<thead>
<tr>
<th>3/4 in. Water Service Pressure Loss (psi)</th>
<th>1 in. Water Service Pressure Loss (psi)</th>
<th>1 1/4 in. Water Service Pressure Loss (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>40 ft or less</strong></td>
<td><strong>41 ft to 75 ft</strong></td>
<td><strong>76 ft to 100 ft</strong></td>
</tr>
<tr>
<td>10</td>
<td>7.7</td>
<td>13.1</td>
</tr>
<tr>
<td>12</td>
<td>10.8</td>
<td>18.4</td>
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<tr>
<td>14</td>
<td>14.4</td>
<td>24.5</td>
</tr>
<tr>
<td>16</td>
<td>18.4</td>
<td>NP</td>
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<tr>
<td>18</td>
<td>22.9</td>
<td>NP</td>
</tr>
<tr>
<td>20</td>
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<td>NP</td>
<td>NP</td>
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<tr>
<td>34</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>36</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

NP: Not permitted. Pressure loss exceeds reasonable limits.

Notes:

1. Values are applicable for underground piping materials permitted by the local plumbing code and are based on an SDR of 11 and a Hazen-Williams C factor of 150.

2. Values include the following length allowances for fittings: 25 percent length increase for actual lengths up to 100 ft and 15 percent length increase for actual lengths over 100 ft.

*Flow rate from Sections 10.1 and 10.2. Add 5 gpm to the flow rate required by 10.4.9.2, Step 4, where the water service pipe supplies more than one dwelling.

### Table 10.4.9.2(b) Elevation Loss (PLe)

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Pressure Loss (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2.2</td>
</tr>
<tr>
<td>10</td>
<td>4.4</td>
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<tr>
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</tr>
<tr>
<td>35</td>
<td>15.2</td>
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<tr>
<td>40</td>
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</tr>
</tbody>
</table>

### Table 10.4.9.2(c) Allowable Pipe Length for in. Type M Copper Water Tubing

<table>
<thead>
<tr>
<th>Sprinkler Flow Rate* (gpm)</th>
<th>Water Distribution Size (in.)</th>
<th>Available Pressure, $P_t$ (psi)</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>3/4</td>
<td>Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)</td>
<td>217</td>
<td>289</td>
<td>361</td>
<td>434</td>
<td>506</td>
<td>578</td>
<td>650</td>
<td>723</td>
<td>795</td>
<td>867</td>
</tr>
</tbody>
</table>
### Sprinkler Flow Rate and Water Distribution Size

<table>
<thead>
<tr>
<th>Sprinkler Flow Rate* (gpm)</th>
<th>Water Distribution Size (in.)</th>
<th>Available Pressure, ( P_f ) (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>( \frac{3}{4} )</td>
<td>143 191 239 287 335 383 430 478 526 574</td>
</tr>
<tr>
<td>11</td>
<td>( \frac{3}{4} )</td>
<td>120 160 200 241 281 321 361 401 441 481</td>
</tr>
<tr>
<td>12</td>
<td>( \frac{3}{4} )</td>
<td>102 137 171 205 239 273 307 341 375 410</td>
</tr>
<tr>
<td>13</td>
<td>( \frac{3}{4} )</td>
<td>88  118 147 177 206 235 265 294 324 353</td>
</tr>
<tr>
<td>14</td>
<td>( \frac{3}{4} )</td>
<td>77  103 128 154 180 205 231 257 282 308</td>
</tr>
<tr>
<td>15</td>
<td>( \frac{3}{4} )</td>
<td>68  90 113 136 158 181 203 226 248 271</td>
</tr>
<tr>
<td>16</td>
<td>( \frac{3}{4} )</td>
<td>60  80 100 120 140 160 180 200 220 241</td>
</tr>
<tr>
<td>17</td>
<td>( \frac{3}{4} )</td>
<td>54  72  90 108 125 143 161 179 197 215</td>
</tr>
<tr>
<td>18</td>
<td>( \frac{3}{4} )</td>
<td>48  64  81  97 113 129 145 161 177 193</td>
</tr>
<tr>
<td>19</td>
<td>( \frac{3}{4} )</td>
<td>44  58  73  88 102 117 131 146 160 175</td>
</tr>
<tr>
<td>20</td>
<td>( \frac{3}{4} )</td>
<td>40  53  66  80  93 106 119 133 146 159</td>
</tr>
<tr>
<td>21</td>
<td>( \frac{3}{4} )</td>
<td>36  48  61  73  85  97 109 121 133 145</td>
</tr>
<tr>
<td>22</td>
<td>( \frac{3}{4} )</td>
<td>33  44  56  67  78  89 100 111 122 133</td>
</tr>
<tr>
<td>23</td>
<td>( \frac{3}{4} )</td>
<td>31  41  51  61  72  82  92 102 113 123</td>
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<tr>
<td>24</td>
<td>( \frac{3}{4} )</td>
<td>28  38  47  57  66  76  85  95 104 114</td>
</tr>
<tr>
<td>25</td>
<td>( \frac{3}{4} )</td>
<td>26  35  44  53  61  70  79  88  97 105</td>
</tr>
<tr>
<td>26</td>
<td>( \frac{3}{4} )</td>
<td>24  33  41  49  57  65  73  82  90  98</td>
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<tr>
<td>27</td>
<td>( \frac{3}{4} )</td>
<td>23  30  38  46  53  61  69  76  84  91</td>
</tr>
<tr>
<td>28</td>
<td>( \frac{3}{4} )</td>
<td>21  28  36  43  50  57  64  71  78  85</td>
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<td>29</td>
<td>( \frac{3}{4} )</td>
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</tr>
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<td>( \frac{3}{4} )</td>
<td>NP  NP 22  26  29  33  37  40  44  44</td>
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</tbody>
</table>

NP: Not permitted.

*Flow rate from Sections 10.1 and 10.2.

Table 10.4.9.2(d) Allowable Pipe Length for 1 in. Type M Copper Water Tubing
<table>
<thead>
<tr>
<th>Sprinkler Flow Rate* (gpm)</th>
<th>Water Distribution Size (in.)</th>
<th>Available Pressure, $P_t$ (psi)</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
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<td>447</td>
<td>596</td>
<td>745</td>
<td>894</td>
<td>1043</td>
<td>1192</td>
<td>1341</td>
<td>1491</td>
<td>1640</td>
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<td>888</td>
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<td>588</td>
<td>672</td>
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*Flow rate from Sections 10.1 and 10.2.

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*Flow rate from Sections 10.1 and 10.2.

Table 10.4.9.2(f) Allowable Pipe Length for 1 in. CPVC (IPS) Pipe
### Table 10.4.9.2(g) Allowable Pipe Length for in. PEX Tubing

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NP: Not permitted.

*Flow rate from Sections 10.1 and 10.2.

Table 10.4.9.2(h) Allowable Pipe Length for 1 in. PEX Tubing
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*Flow rate from Sections 10.1 and 10.2.

Submitter Information Verification

Submitter Full Name: [ Not Specified ]
Organization: [ Not Specified ]
Street Address: [ Not Specified ]
City:
State:
Zip:
Submittal Date: Thu Aug 29 11:11:52 EDT 2013

Committee Statement

Committee Statement: There is a substantial difference in internal diameters from IPS (Iron Pipe Size) CPVC and CTS (Copper Tubing Size) CPVC. The title of this table should delineate which type of CPVC it refers to.

Response Message:
Public Input No. 15-NFPA 13D-2012 [Section No. 10.4.9.2]
12.3.2
Any sprinkler that is operated, damaged, corroded, covered with foreign materials, or showing signs of leakage shall be replaced with a new listed sprinkler having the same performance characteristics as the original equipment.

12.3.2.1 *
Where replacing residential sprinklers manufactured prior to 2003 and installed using a design density less than 0.05 gpm/ft² (204 mm/min), a residential sprinkler with an equivalent K-factor (± 5%) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

Supplemental Information

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Submitter Information Verification

Submitter Full Name: [ Not Specified ]
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 29 12:41:40 EDT 2013

Committee Statement

Committee Statement: NFPA 13D is not covered by NFPA 25, therefore guidance is needed in this standard for replacing sprinklers that no longer exist. It is important that the coverage areas of the replacement sprinkler are consistent with the original sprinkler.

Response Message:
A.12.3.2.1
It is recognized that the flow and pressure available to the replacement sprinkler *may/might* be less than its current flow and pressure requirement.
First Revision No. 19-NFPA 13D-2013 [Section No. A.6.2]

A.6.2

The connection to city mains for fire protection is often subject to local regulation of metering and backflow prevention requirements. Preferred and acceptable water supply arrangements are shown in Figure A.6.2(a)–Figure A.6.2(b) and Figure A.6.2(c) through Figure A.6.2(d). Where it is necessary to use a meter between the city water main and the sprinkler system supply, an acceptable arrangement as shown in Figure A.6.2(c) and Figure A.6.2(d) can be used. Under these circumstances, the flow characteristics of the meter are to be included in the hydraulic calculation of the system [see Table 10.4.3(a)]. Where a tank is used for both domestic and fire protection purposes, a low water alarm that actuates when the water level falls below 110 percent of the minimum quantity specified in 6.1.2 should be provided.

The effect of pressure-reducing valves on the system should be considered in the hydraulic calculation procedures.

Figure A.6.2(a), Figure A.6.2(c), or Figure A.6.2(d) is the preferred method for getting the water supply into the unit for a stand-alone sprinkler system (one that does not also provide direct connections to the cold water fixtures) because the common supply pipe for the domestic system and the sprinkler system between the water supply and the dwelling unit has a single control valve that shuts the sprinkler system, which helps to ensure that people who have running water to their domestic fixtures also have fire protection. This serves as a form of supervision for the control valve and can be used to make sure that the valve stays open in place of other, more expensive options such as tamper switches with a monitoring service.

Some water utilities insist on separate taps and supply pipes from the water supply to the dwelling unit for fire sprinkler systems as shown in Figure A.6.2(b) and Figure A.6.2(d), due to concerns about shutting off the water supply for nonpayment of bills and the desire not to shut off fire protection if this ever occurs. While this type of arrangement is acceptable, it is not these types of arrangements acceptable, they might not be cost efficient and should be discouraged due to the extra cost burden this places on the building owner. The concern over shutting off the water for nonpayment of bills is a nonissue for a number of reasons. First, the water utilities rarely actually shut off water for nonpayment. Second, if they do shut off water for nonpayment, they are creating violations of all sorts of health and safety codes, allowing people to live in a home without running water. Concern over the fire protection for those individuals when they are violating all kinds of other health codes is disingenuous. More likely, the water utility will not shut off the water and will follow other legal avenues to collect on unpaid bills, such as liens on property. Millions of people should not have to pay hundreds of millions of dollars to install separate water taps and lines for the few services that might get shut off.

Figure A.6.2(a) Preferable Arrangement Minimum Requirements for a Stand-Alone Piping System.
Figure A.6.2(b) Acceptable Arrangement for Stand-Alone Piping Systems with Valve Supervision — Option 1.
**Figure A.6.2(c) Acceptable Arrangement for Stand-Alone Piping Systems with Valve Supervision — Option 2.**

**Figure A.6.2(d) Acceptable Arrangement for Stand-alone Piping Systems — Option 3.**
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Submitter Information Verification

Submitter Full Name: [Not Specified]
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 29 12:12:55 EDT 2013

Committee Statement and Meeting Notes

Committee: The existing water supply sketches are dated, do not use contemporary and standard plumbing industry references for water service piping, and include components of the sprinkler service that are either optional or not required. The proposed changes to this section are intended to broaden the range of acceptable arrangements and to better reflect current practices.

Response
Message:
Committee Notes:

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<th>Submitted By</th>
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Oct 20,  M. Beady Please provide captions for figures 2013
Public Input No. 35-NFPA 13D-2013 [Section No. A.6.2]
City water main

CITY WATER MAIN

CORPORATION STOP (IF REQUIRED)

LOCKABLE METER STOP (PUBLIC)

WATERFLOW DETECTOR (IF REQUIRED)

PRESSURE GAUGE (IF REQUIRED)

To automatic sprinkler system

Drain and test connection

Check valve or IF REQUIRED CROSS CONNECTION CONTROL DEVICE

WATER METER

MAIN SHUTOFF VALVE (PRIVATE)

To domestic system

DOMESTIC SYSTEM SHUTOFF VALVE

Optional valve: See 7.1.4
City water main

CORPORATION STOP (IF REQUIRED)

FIRE SPRINKLER SHUTOFF VALVE (SUPERVISED OR LOCKABLE) *

Check valve or Backflow Prevention Device (IF REQUIRED)

PUSH TO RELEASE SHUTOFF VALVE (IF REQUIRED)

PRESSURE GAUGE (IF REQUIRED)

Drain and test connection

WATERFLOW DETECTOR (IF REQUIRED)

PUSH TO RELEASE SHUTOFF VALVE (IF REQUIRED)

PUSH TO RELEASE SHUTOFF VALVE (IF REQUIRED)

WATER METER

METER STOP (PUBLIC)

DOMESTIC SYSTEM SHUTOFF VALVE

To domestic system

To automatic sprinkler system

*Optional valve: See 7.1.4
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 \text{10.2.1} and \text{10.2.3}.

For the ceiling constructions and room configurations that are beyond the scope of the two-sprinkler discharge criterion referenced in \text{10.2.1} and \text{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.

### Supplemental Information

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### Submitter Information Verification

- **Submitter Full Name:** Matthew Klaus
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Tue Oct 01 11:21:21 EDT 2013

### Committee Statement

**Committee Statement:** This proposed language is based upon the findings of the Fire Protection Research Foundation’s project on residential sprinklers and sloped and beamed ceilings into NFPA 13D. The limitations of the test facility have been translated into limitations on the generic use of residential sprinklers. The maximum ceiling height of 24 ft. and limitation on communicating spaces considers the data generated under the FPRF project as well as other fire tests conducted at other times. This same language was accepted by the Technical Committee as proposal 13D-67 Log #CP9 at the A2012 ROP meeting. Please see the attached FPRF Report for the technical substantiation supporting this language. Emergency Nature: The information provided in the FPRF report was not available to the technical committees during the development of the 2010 edition. The absence of information of this type contributed to the lack of direction on this subject within the document. Lack of clear guidance from the committee on these issues significantly drives up the installed cost of residential sprinkler systems. These cost increases have been referenced by certain jurisdictions as reasons they have chosen not to adopt or have repealed existing residential sprinkler ordinances within their communities.
and is the reason this amendment is emergency in nature.

Response
Message:
Public Input No. 51-NFPA 13D-2013 [New Section after A.7.6]
8.1.2* Number of Design Sprinklers. The number of design sprinklers under flat, smooth, horizontal ceilings shall include all sprinklers within a compartment, up to a maximum of two sprinklers, that require the greatest hydraulic demand.

A.8.1.2 All residential sprinklers have been investigated under a flat, smooth, 8 ft (2.4 m) high horizontal ceiling. Some residential sprinklers have been investigated and listed for use under specific ceiling configurations such as a horizontal beamed ceiling. The performance of residential sprinklers under flat, smooth, horizontal ceilings has been well documented throughout the life of NFPA 13D. Prior to 2010, several manufacturers of residential sprinklers had performed testing and received listings for residential sprinklers under certain slopes and in certain beam conditions. In 2010, the Fire Protection Research Foundation (FPRF) conducted a research project consisting of 76 FDS simulations and 12 full-scale fire tests. The results have been used to develop system design criteria in a generic manner in order to simplify the use of residential sprinklers. Some residential sprinkler listings still exist for situations beyond the scope of the generic design. See the FPRF report, Analysis of the Performance of Residential Sprinkler Systems with Sloped or Sloped and Beamed Ceilings, dated July 2010, for more information. Questions are frequently asked regarding the minimum two-sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be accurate, the water supplies for the fire sprinkler systems under which these statistics were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system’s water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called “hydraulic increase.” Hydraulic increase can also occur when a water supply’s capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined. But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts. The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two-sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two-sprinkler water supply from the start. In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft (4.3 m × 4.3 m) with an adjoining hallway, each with flat, smooth, 8-ft (2.4-m) high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control. For examples of selecting a compartment for consideration, see Figure A.8.1.2(a) and Figure A.8.1.2(b), which show examples of design configurations for compartments based on the presence of lintels to stop the flow of heat.
been investigated and are currently listed for use under flat, smooth, horizontal ceilings. Some residential sprinklers have been investigated and listed for use under specific smooth sloped or horizontal beamed ceilings. Where ceilings have configurations outside the scope of current listings, special sprinkler system design features such as larger flows, a design of three or more sprinklers to operate in a compartment, or both can be required. Figure A.8.1.2(a) and Figure A.8.1.2(b) show examples of design configurations. Questions are frequently asked regarding the minimum two sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be correct, the water were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system’s water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called “hydraulic increase.” Hydraulic increase can also occur when a water supply’s capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined. But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts. The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two sprinkler water supply from the start. In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft with an adjoining hallway, each with flat, smooth, 8 ft high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control.

2. Add 8.1.2.1, 8.1.2.2, 8.1.2.3, and A.8.1.2.3 to read as follows:

8.1.2.1 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 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.
(3) A sloped ceiling with beams up to 14 in. (4.3 m) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (56 m²) 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.
(4) 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 ft² (56 m²) 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.
8.1.2.2 For situations not meeting one of the conditions in 8.1.2.1, residential sprinklers listed for use in specific ceiling configurations shall be permitted to be used in accordance with their listing.

8.1.2.3* For situations not meeting one of the conditions in 8.1.2.1 and 8.1.2.2, the number of sprinklers in the design area shall be determined in consultation with the authority having jurisdiction as appropriate for the conditions. Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing.

A.8.1.2.3 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 ten minutes and meeting the goals of NFPA 13D. While there is no guarantee that this would always happen, it is believed that the two sprinkler design criteria is appropriate for ceiling constructions and room configurations that are within the limitations referenced 8.1.2.1 and 8.1.2.2. For the ceiling constructions and room configurations that are beyond the scope of the two-sprinkler discharge criteria referenced in 8.1.2.1 and 8.1.2.2, 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.

3. Revise 8.1.3 to read as follows:

8.1.3 Sprinkler Coverage.

8.1.3.1 Residential Sprinklers.

8.1.3.1.1 Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing.

8.1.3.1.2* Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations.

A.8.1.3.1.2 See A.8.1.2 and A.8.1.2.3. Construction features such as large horizontal beamed ceilings, sloped ceilings having beams, and steeply sloped ceilings are outside of the current listings. 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.

8.1.3.1.3 Sloped Ceilings.

8.1.3.1.3.1 Where the ceiling is sloped, the maximum \( S \) dimension shall be measured along the slope of the ceiling to the next sprinkler, as shown in Figure 8.1.3.1.3.1.

8.1.3.1.3.2 The sprinklers shall maintain the minimum listed spacing, but no less than 8 ft (2.44 m), measured in the plan view from one sprinkler to another, as shown in Figure 8.1.3.1.3.1.

Submitter’s Substantiation: This proposed language is based upon the findings of the Fire Protection Research Foundation’s project on residential sprinklers and sloped and beamed ceilings into NFPA 13D. The limitations of the test facility have been translated into limitations on the generic use of residential sprinklers. The maximum ceiling height of 24 ft. and limitation on communicating spaces considers the data generated under the FPRF project as well as other fire
tests conducted at other times. This same language was accepted by the Technical Committee as proposal 13D-67 Log #CP9 at the A2012 ROP meeting. Please see the attached FPRF Report for the technical substantiation supporting this language.

**Emergency Nature:** The information provided in the FPRF report was not available to the technical committees during the development of the 2010 edition. The absence of information of this type contributed to the lack of direction on this subject within the document. Lack of clear guidance from the committee on these issues significantly drives up the installed cost of residential sprinkler systems. These cost increases have been referenced by certain jurisdictions as reasons they have chosen not to adopt or have repealed existing residential sprinkler ordinances within their communities and is the reason this amendment is emergency in nature.
A.8.1.3.1.2
See A.10.2.4.

Supplemental Information

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Submitter Information Verification

Submitter Full Name: Matthew Klaus
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Oct 01 11:21:46 EDT 2013

Committee Statement

Note: This Proposal originates from Tentative Interim Amendment 13D-10-3 (TIA 1028R) issued by the Standards Council on August 11, 2011. This proposed language is based upon the findings of the Fire Protection Research Foundation’s project on residential sprinklers and sloped and beamed ceilings into NFPA 13D. The limitations of the test facility have been translated into limitations on the generic use of residential sprinklers. The maximum ceiling height of 24 ft. and limitation on communicating spaces considers the data generated under the FPRF project as well as other fire tests conducted at other times. This same language was accepted by the Technical Committee as proposal 13D-67 Log #CP9 at the A2012 ROP meeting. Please see the attached FPRF Report for the technical substantiation supporting this language. Emergency Nature: The information provided in the FPRF report was not available to the technical committees during the development of the 2010 edition. The absence of information of this type contributed to the lack of direction on this subject within the document. Lack of clear guidance from the committee on these issues significantly drives up the installed cost of residential sprinkler systems. These cost increases have been referenced by certain jurisdictions as reasons they have chosen not to adopt or have repealed existing residential sprinkler ordinances within their communities and is the reason this amendment is emergency in nature.

Response Message:

Public Input No. 50-NFPA 13D-2013 [Section No. A.8.1.3.1.2]
8.1.2* Number of Design Sprinklers. The number of design sprinklers under flat, smooth, horizontal ceilings shall include all sprinklers within a compartment, up to a maximum of two sprinklers, that require the greatest hydraulic demand.

A.8.1.2 All residential sprinklers have been investigated under a flat, smooth, 8 ft (2.4 m) high horizontal ceiling. Some residential sprinklers have been investigated and listed for use under specific ceiling configurations such as a horizontal beamed ceiling. The performance of residential sprinklers under flat, smooth, horizontal ceilings has been well documented throughout the life of NFPA 13D. Prior to 2010, several manufacturers of residential sprinklers had performed testing and received listings for residential sprinklers under certain slopes and in certain beam conditions. In 2010, the Fire Protection Research Foundation (FPRF) conducted a research project consisting of 76 FDS simulations and 12 full-scale fire tests. The results have been used to develop system design criteria in a generic manner in order to simplify the use of residential sprinklers. Some residential sprinkler listings still exist for situations beyond the scope of the generic design. See the FPRF report, Analysis of the Performance of Residential Sprinkler Systems with Sloped or Beamed Ceilings, dated July 2010, for more information.

Questions are frequently asked regarding the minimum two-sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be accurate, the water supplies for the fire sprinkler systems under which these statistics were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system’s water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called “hydraulic increase.” Hydraulic increase can also occur when a water supply’s capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined. But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts. The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two-sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two-sprinkler water supply from the start. In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft (4.3 m × 4.3 m) with an adjoining hallway, each with flat, smooth, 8-ft (24-m) high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control. For examples of selecting a compartment for consideration, see Figure A.8.1.2(a) and Figure A.8.1.2(b), which show examples of design configurations for compartments based on the presence of lintels to stop the flow of heat. All residential sprinklers have
been investigated and are currently listed for use under flat, smooth, horizontal ceilings. Some residential sprinklers have been investigated and listed for use under specific smooth sloped or horizontal-beamed ceilings. Where ceilings have configurations outside the scope of current listings, special sprinkler system design features such as larger flows, a design of three or more sprinklers to operate in a compartment, or both can be required. Figure A.8.1.2(a) and Figure A.8.1.2(b) show examples of design configurations. Questions are frequently asked regarding the minimum two sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be correct, the water were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system’s water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called “hydraulic increase.” Hydraulic increase can also occur when a water supply’s capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined. But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts. The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two sprinkler water supply from the start. In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft with an adjoining hallway, each with flat, smooth, 8 ft high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control.

2. Add 8.1.2.1, 8.1.2.2, 8.1.2.3, and A.8.1.2.3 to read as follows:

8.1.2.1 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 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.
(3) A sloped ceiling with beams up to 14 in. (4.3 m) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (56 m²) 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.
(4) 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 ft² (56 m²) 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.
8.1.2.2 For situations not meeting one of the conditions in 8.1.2.1, residential sprinklers listed for use in specific ceiling configurations shall be permitted to be used in accordance with their listing.

8.1.2.3* For situations not meeting one of the conditions in 8.1.2.1 and 8.1.2.2, the number of sprinklers in the design area shall be determined in consultation with the authority having jurisdiction as appropriate for the conditions. Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing.

A.8.1.2.3 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 ten minutes and meeting the goals of NFPA 13D. While there is no guarantee that this would always happen, it is believed that the two sprinkler design criteria is appropriate for ceiling constructions and room configurations that are within the limitations referenced 8.1.2.1 and 8.1.2.2. For the ceiling constructions and room configurations that are beyond the scope of the two-sprinkler discharge criteria referenced in 8.1.2.1 and 8.1.2.2, 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.

3. Revise 8.1.3 to read as follows:

8.1.3 Sprinkler Coverage.

8.1.3.1 Residential Sprinklers.

8.1.3.1.1 Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing. Sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the listing.

8.1.3.1.2* Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations.

A.8.1.3.1.2 See A.8.1.2 and A.8.1.2.3. Construction features such as large horizontal beamed ceilings, sloped ceilings having beams, and steeply sloped ceilings are outside of the current listings. 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.

8.1.3.1.3 Sloped Ceilings.

8.1.3.1.3.1 Where the ceiling is sloped, the maximum $S$ dimension shall be measured along the slope of the ceiling to the next sprinkler, as shown in Figure 8.1.3.1.3.1.

8.1.3.1.3.2 The sprinklers shall maintain the minimum listed spacing, but no less than 8 ft (2.44 m), measured in the plan view from one sprinkler to another, as shown in Figure 8.1.3.1.3.1.

Submitter’s Substantiation: This proposed language is based upon the findings of the Fire Protection Research Foundation’s project on residential sprinklers and sloped and beamed ceilings into NFPA 13D. The limitations of the test facility have been translated into limitations on the generic use of residential sprinklers. The maximum ceiling height of 24 ft. and limitation on communicating spaces considers the data generated under the FPRF project as well as other fire
tests conducted at other times. This same language was accepted by the Technical Committee as proposal 13D-67 Log #CP9 at the A2012 ROP meeting. Please see the attached FPRF Report for the technical substantiation supporting this language.

**Emergency Nature:** The information provided in the FPRF report was not available to the technical committees during the development of the 2010 edition. The absence of information of this type contributed to the lack of direction on this subject within the document. Lack of clear guidance from the committee on these issues significantly drives up the installed cost of residential sprinkler systems. These cost increases have been referenced by certain jurisdictions as reasons they have chosen not to adopt or have repealed existing residential sprinkler ordnances within their communities and is the reason this amendment is emergency in nature.
The objective is to position sprinklers so that the response time and discharge are not unduly affected by obstructions such as ceiling slope, beams, light fixtures, or ceiling fans. The rules in this section, while different from the obstruction rules of NFPA 13, provide a reasonable level of life safety while maintaining the philosophy of keeping NFPA 13D relatively simple to apply and enforce.

Fire testing has indicated the need to wet walls in the area protected by residential sprinklers at a level closer to the ceiling than that accomplished by standard sprinkler distribution. Where beams, light fixtures, sloped ceilings, and other obstructions occur, additional residential sprinklers are necessary to achieve proper response and distribution. In addition, for sloped ceilings, higher flow rates could be needed. Guidance should be obtained from the manufacturer.

A series of 33 full-scale tests were conducted in a test room with a floor area of 12 ft × 24 ft (3.6 m × 7.2 m) to determine the effect of cathedral (sloped) and beamed ceiling construction, and combinations of both, on fast-response residential sprinkler performance. The testing was performed using one pendent-type residential sprinkler model, two ceiling slopes (0 degrees and 14 degrees), and two beam configurations on a single enclosure size. In order to judge the effectiveness of sprinklers in controlling fires, two baseline tests, in which the ceiling was smooth and horizontal, were conducted with the pendent sprinklers installed and with a total water supply of 26 gpm (98 L/min) as required by this standard. The results of the baseline tests were compared with tests in which the ceiling was beamed or sloped, or both, and two pendent sprinklers were installed with the same water supply. Under the limited conditions used for testing, the comparison indicates that sloped or beamed ceilings, or a combination of both, represent a serious challenge to the fire protection afforded by fast-response residential sprinklers. However, further tests with beamed ceilings indicated that fire control equivalent to that obtained in the baseline tests can be obtained where one sprinkler is centered in each bay formed by the beams and a total water supply of 36 gpm (136 L/min) is available. Fire control equivalent to that obtained in the baseline tests was obtained for the smooth, sloped ceiling tests where three sprinklers were installed with a total water supply of 54 gpm (200 L/min). In a single smoldering-started fire test, the fire was suppressed.

Small areas created by architectural features such as planter box windows, bay windows, and similar features can be evaluated as follows:

1. Where no additional floor area is created by the architectural feature, no additional sprinkler protection is required.
2. Where additional floor area is created by an architectural feature, no additional sprinkler protection is required, provided all of the following conditions are met:
   a. The floor area does not exceed 18 ft² (1.7 m²).
   b. The floor area is not greater than 2 ft (0.65 m) in depth at the deepest point of the architectural feature to the plane of the primary wall where measured along the finished floor.
   c. The floor area is not greater than 9 ft (2.9 m) in length where measured along the plane of the primary wall.

Measurement from the deepest point of the architectural feature to the sprinkler should not exceed the maximum listed spacing of the sprinkler. The hydraulic design is not required to consider the area created by the architectural feature.

Where the obstruction criteria established by this standard are followed, sprinkler spray patterns will not necessarily get water to every square foot of space within a room. As such, a sprinkler in a room with acceptable obstructions as outlined in this standard might not be capable of passing the fire test (specified by ANSI/UL 1626, Residential Sprinklers for Fire-Protection Service, and other similar laboratory standards) if the fire is started in one of these dry areas. This occurrence is not to be interpreted as a failure of the sprinkler. The laboratory fire tests are sufficiently challenging to the sprinkler without additional obstructions as a safety factor to account for the variables that actually occur in dwellings, including acceptable obstructions to spray patterns.

The rules on 8.2.5.1 and 8.2.5.2 were developed from a testing series conducted by the National Fire Sprinkler Association and The Viking Corporation that included fire modeling, sprinkler response tests, sprinkler distribution tests, and full-scale fire tests (Valentine and Isman, Interaction of Residential Sprinklers, Ceiling Fans and Similar Obstructions, National Fire Sprinkler Association, November 2005). This test series, along with additional industry experience, shows that a difference exists between obstructions that are tight to the ceiling and obstructions that hang down from the ceiling, allowing spray over the top. Residential sprinklers require high wall wetting, which means that they tend to spray over obstructions that hang down from the ceiling. The test series showed that the fan blades were not...
significant obstructions and that as long as the sprinkler was far enough from the fan motor housing (measured from the center of the housing), the sprinkler could control a fire on the other side of the fan in a small room. In larger rooms, the sprinkler will need to be augmented by additional sprinklers on the other side of the fan. The test series showed that the fan on low or medium speed did not make a significant difference in sprinkler performance. On high speed (pushing air down), the fan did impact sprinkler performance, but fire control was still achieved in small rooms. In larger rooms, it is expected that additional sprinklers would be installed. The test series also showed that the fan blowing down was more significant than the fan pulling air up.

The rules in 8.2.5.6 were developed from years of experience with obstruction rules and an additional test series conducted by the National Fire Sprinkler Association with the help of Tyco International (Valentine and Isman, *Kitchen Cabinets and Residential Sprinklers*, National Fire Sprinkler Association, November 2005), which included fire modeling, distribution tests, and full-scale fire tests. The test series showed that pendent sprinklers definitely provide protection for kitchens, even for fires that start under the cabinets. The information in the series was less than definitive for sidewall sprinklers, but distribution data show that sprinklers in the positions in this standard provide adequate water distribution in front of the cabinets and that sidewall sprinklers should be able to control a fire that starts under the cabinets. When protecting kitchens or similar rooms with cabinets, the pendent sprinkler should be the first option. If pendent sprinklers cannot be installed, the next best option is a sidewall sprinkler on the opposite wall from the cabinets, spraying in the direction of the cabinets. The third best option is the sidewall sprinkler on the same wall as the cabinets on a soffit flush with the face of the cabinet. The last option should be putting sprinklers on the wall back behind the face of the cabinet because this location is subject to being blocked by items placed on top of the cabinets. It is not the intent of the committee to require sprinklers to be installed under kitchen cabinets.

**Submitter Information Verification**

**Submitter Full Name:** [Not Specified]

**Organization:** [Not Specified]

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Thu Aug 29 11:23:19 EDT 2013

**Committee Statement**

**Committee Statement:** This annex material was removed by the "Accept in Principle" committee action during the last revision cycle. Unfortunately, the committee action also significantly revised the original proposal that would have placed this language in the standard. This has created a situation where these types of architectural features are no longer referenced in the standard or the annex material, thereby causing local interpretations and confusion. In essence, this FR reverses part 3 of the committee action on Proposal 13D-70 Log #93 for the 2010 Edition.

**Response Message:**

Public Input No. 44-NFPA 13D-2013 [Section No. A.8.2.5]
A.8.2.5.6
Corridors being protected with sidewall sprinklers will frequently have small areas behind the sprinklers called shadow areas, that are inset for a doorway. Even though these shadow areas are slightly behind the sprinklers, it is not the intent of NFPA 13D to require additional sprinkler protection in these doorways.

Examples of shadow areas are provided in Figure A.8.2.5.6(a) and Figure A.8.2.5.6(b). The obstruction shown in Figure A.8.2.5.6(a) is a vertical obstruction in a room similar to a column. Sprinkler response and water distribution tests have been conducted on such obstructions and the data shows that the size of the obstruction as well as the size of the compartment are critical variables to sprinkler response. A larger shadow area can be acceptable in a smaller compartment. The obstruction shown in Figure A.8.2.5.6(b) is a bump out of a wall. Sprinkler response and water distribution tests have shown that this type of obstruction is not a problem.

Figure A.8.2.5.6(a) Example of Shadow Areas (SSU/SSP).

Figure A.8.2.5.6(b) Example of Shadow Areas (HSW).
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<td>Sprinkler response and water distribution tests have been done on a variety of shadow area situations. The column issue is the most difficult to deal with. Various size columns and compartments produce differing results. With a large (24 inch) column and a large compartment, the sprinkler may not open in time to control a fire behind the column. With the bump out situation, there was good sprinkler response and coverage.</td>
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<tr>
<td>Public Input No. 42-NFPA 13D-2013 [Section No. A.8.2.5.7]</td>
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In areas subject to freezing, care should be taken in unheated attic spaces to cover sprinkler piping completely with insulation. Installation should follow the guidelines of the insulation manufacturer. Figure A.9.1.1(a) through Figure A.9.1.1(e) show several methods that can be considered. These are for illustrative purposes only. Consultation with the general contractor and/or owner is recommended to ensure proper methods and materials are used to make sure 40°F (4°C) will be maintained.

The Fire Protection Research Foundation completed a research project ("Sprinkler Insulation: A Literature Review," July 2011) on the use of insulation to protect sprinkler pipe from freezing that can be downloaded for free from their website.

**Figure A.9.1.1(a) Insulation Recommendations — Arrangement 1.**

**Figure A.9.1.1(b) Insulation Recommendations — Arrangement 2.**

**Figure A.9.1.1(c) Insulation Recommendations — Arrangement 3.**

**Figure A.9.1.1(d) Insulation Recommendations — Arrangement 4.**
Figure A.9.1.1(e) Insulation Recommendations — Arrangement 5.

Caution: Care should be taken to avoid compressing the insulation. This reduces its R value. To prevent potential freeze-ups of the sprinkler piping, the insulation should be installed tight against the joists.

Figure A.9.1.1(f) Insulation Recommendations — Arrangement 6.

Caution: Care should be taken to avoid compressing the insulation. This reduces its R value. To prevent potential freeze-ups of the sprinkler piping, the insulation should be installed tight against the joists.

Supplemental Information

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Submitter Information Verification

Submitter Full Name: [ Not Specified ]
Organization: [ Not Specified ]
Street Address:
Committee Statement

Committee Statement: This common method of addressing insulation in attics should be included as an advisory figure. This was added to correlate to the revision with NFPA 13R.

Response Message:
FIGURE A.5.4.2 (f) Insulation Recommendations - Arrangement 6
A.9.2.1
Antifreeze solutions can be used for maintaining automatic sprinkler protection in small, unheated areas. Antifreeze solutions are recommended only for systems not exceeding 40 gal (151 L). Because of the cost of refilling the system or replenishing small leaks, small, dry valves should be used where more than 40 gal (151 L) are to be supplied.
Propylene glycol or other suitable material can be used as a substitute for priming water to prevent evaporation of the priming fluid and thus reduce ice formation within the system.

A.9.2.2
Listed nonmetallic sprinkler pipe and fittings should be protected from freezing with an antifreeze solution that is compatible with the nonmetallic material. Laboratory testing shows that glycol-based antifreeze solutions present a chemical environment detrimental to nonmetallic pipe.
Examples of specific areas might include piping installed in an exterior wall or an unheated concealed space above a cathedral ceiling that cannot be protected with insulation or heat tracing. Premixed solutions of glycerine and propylene glycol should be used only where other freeze protection options are not practical. The specific areas protected by premixed glycerine and propylene glycol shall be limited to the greatest extent possible.

Propylene glycol and glycerine antifreeze solutions discharged from sprinklers have the potential to ignite under certain conditions. Research testing has indicated that several variables can influence the potential for large-scale ignition of the antifreeze solution discharged from a sprinkler. These variables include, but are not limited to, the concentration of antifreeze solution, sprinkler discharge characteristics, the inlet pressure at the sprinkler, the location of the fire relative to the sprinkler, and the size of the fire at the time of sprinkler discharge. Research testing also indicates that propylene glycol or glycerine solutions can be used successfully with certain other combinations of these same variables. Given the need for additional testing to further define acceptable versus unacceptable scenarios, the use of propylene glycol and glycerine antifreeze solutions should be considered only when other sprinkler system design alternatives are not practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in the sprinkler system. The following is a list of research reports that have been issued by the Fire Protection Research Foundation related to the use of antifreeze in sprinkler systems:

1. Antifreeze Systems in Home Fire Sprinkler Systems — Literature Review and Research Plan
3. Antifreeze Solutions Supplied through Spray Sprinklers — Interim Report

Table A.9.2.2.2 provides an overview of the testing.

Table A.9.2.2.2 FPRF Antifreeze Testing Summary

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<td>Scope of sprinklers tested</td>
<td>The following sprinklers were used during the residential sprinkler research program described in Antifreeze Systems in Home Fire Sprinkler Systems — Phase II Final Report:</td>
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<td>(1) Residential pendent style having nominal K-factors of 3.1, 4.9, and 7.4 gpm/psi(^{1/2})</td>
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<td>(2) Residential concealed pendent style having a nominal K-factor of 4.9 gpm/psi(^{1/2})</td>
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<tr>
<td></td>
<td>(3) Residential sidewall style having nominal K-factors of 4.2 and 5.5 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td></td>
<td>The following sprinklers were used during the spray sprinkler research program described in Antifreeze Solutions Supplied through Spray Sprinklers — Interim Report:</td>
</tr>
<tr>
<td></td>
<td>(1) Residential pendent style having a nominal K-factor of 3.1 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td></td>
<td>(2) Standard spray pendent style having nominal K-factors of 2.8, 4.2, 5.6, and 8.0 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td></td>
<td>(3) Standard spray concealed pendent style having a nominal K-factor of 5.6 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td></td>
<td>(4) Standard spray upright style having a nominal K-factor of 5.6 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td></td>
<td>(5) Standard spray extended coverage pendent style having a nominal K-factor of 5.6 gpm/psi(^{1/2})</td>
</tr>
<tr>
<td>Antifreeze solution concentration</td>
<td>&lt;50% glycerine and &lt;40% propylene glycol antifreeze solutions: Solutions were not tested.</td>
</tr>
<tr>
<td></td>
<td>50% glycerine and 40% propylene glycol antifreeze solutions: Large-scale ignition of the sprinkler spray did not occur in tests with sprinkler discharge onto a fire having a nominal heat release rate (HRR) of 1.4 MW. Large-scale ignition of the sprinkler spray occurred in multiple tests with sprinkler discharge onto a fire having a nominal HRR of 3.0 MW.</td>
</tr>
<tr>
<td></td>
<td>55% glycerine and 45% propylene glycol antifreeze solutions: Large-scale ignition of the sprinkler spray occurred in tests with sprinkler discharge onto a fire having a nominal HRR of 1.4 MW.</td>
</tr>
</tbody>
</table>
The documentation should substantiate that the proposed use of premixed glycerine and propylene glycol antifreeze solutions is consistent with the FPRF testing for the specific installation parameters.

The specific gravity for any liquid can be found by taking the density of the liquid at a specific temperature and dividing it by the density of water at that same temperature. The densities of propylene glycol and glycerine can be found for a wide range of temperatures in Figure A.9.2.3.2(a) and Figure A.9.2.3.2(b).

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Committee Statement

Note: This Proposal originates from Tentative Interim Amendment 13D-13-1 (TIA 1067) issued by the Standards Council on August 9, 2012. The Technical Committee on Residential Sprinkler Systems is taking a different path in dealing with antifreeze in NFPA 13D than it has in NFPA 13R or than the Sprinkler System Installation Criteria Committee is taking with NFPA 13. This different path is fundamentally based on the fact that one- and two-family dwellings are treated differently in building codes and fire codes than other types of occupancies and in recognition of the fact that NFPA 13D has a different objective than NFPA 13R and NFPA 13. From its inception in 1975, NFPA 13D has been less stringent than NFPA 13 in order to present a document that balances the issues of reasonable fire protection with the realistic concerns of cost and redundancy. NFPA 13D has always recognized that if fire sprinkler systems are too much like NFPA 13, they will not be installed in one-and two-family dwellings and they will not be able to help change the fact that thousands of people continue to die each year due to fires in unsprinklered one-and two-family dwellings. As such, the Technical Committee on Residential Sprinkler Systems, concerned with the overall effort to get sprinkler systems into more one- and two-family dwellings is consciously choosing to be less restrictive than NFPA 13, while still maintaining a reasonable level of fire safety for the occupants of sprinklered one- and two-family dwellings. The information provided in the report, Antifreeze Systems in Home Fire Sprinkler Systems – Phase II Report (Fire Protection Research Foundation, December 2010) was the basis for TIA 10-2 to NFPA 13D that was issued by the NFPA on March 1, 2011. That research report is still valid and demonstrates how residential sprinklers perform in typical dwelling units of typical one- and two-family dwellings with a variety of antifreeze solutions tested through a variety of pendent and sidewall residential sprinklers. Subsequent testing has been performed as a part of a project sponsored by the Fire Protection Research Foundation (FPRF), who released an interim report in February of 2012 titled, Antifreeze Solutions Supplied through Spray Sprinklers. This report followed up on the Phase II tests and looked at antifreeze solutions and their performance with a variety of standard spray sprinklers. Given that NFPA 13D calls for the use of residential sprinklers in all locations except mechanical closets and unheated areas not intended for living purposes (see section 7.5.3 and 7.5.4 of NFPA 13D), the results of this latest FPRF research is less important to NFPA 13D. Still, in reviewing the results of the tests, the committee has chosen to tighten up the rules with respect to new installations by proposing this TIA so that designers can make better decisions regarding the potential use of antifreeze systems. For existing systems, the committee is not recommending any changes from the TIA processed and issued in March of 2011. Based on input from Authorities Having Jurisdiction, a total ban on antifreeze systems is not realistic and would be detrimental to the effort to pass legislation for mandatory sprinkler requirements in one- and two-family dwellings. Since there are currently no listed antifreeze solutions, a requirement to only use listed antifreeze would be tantamount to a ban on the use of antifreeze. While the use of listed antifreeze systems is probably the best long-term solution, some recognition of glycerine or propylene glycol is necessary in the short term,
even for new systems. NFPA 13D systems are intended to be cost effective. Completely eliminating
the use of antifreeze in specific, isolated areas, may significantly drive up the cost of residential
sprinkler systems. This TIA starts out expressing a preference for the use of listed antifreeze systems
in section 9.2.2.1, but then goes on to allow the use of unlisted 48% glycerine or 38% propylene glycol
where two conditions are met. The first condition is that the system has to be acceptable to the
Authority Having Jurisdiction (AHJ). It is anticipated that the AHJ will understand the gravity of the
decision and only approve situations where other options have been explored and rejected as
impossible or impractical. The second condition is that the antifreeze has to be limited to a “specific
area”. The committees intent is to limit the antifreeze as much as possible to the portion of the system
that will experience the cold temperatures. This language is the best that the committee could agree
on that allowed the flexibility necessary to handle the wide range of design situations that currently
exist. It is anticipated that the AHJ would be able to consider each situation on a case-by-case basis
and determine if the system was sufficiently isolated. The use of 48% glycerine and 38% propylene
glycol is supported by the Phase II test report discussed above when limited to residential sprinklers in
typical dwelling units. This position is strengthened by the existing requirement in section 9.2.2.2
(which becomes 9.2.2.3 in this TIA), which requires the antifreeze to be limited to what is needed for
the environment. If the pipe is only going to be subjected to temperatures of 20°F, then a solution of
48% glycerine would not be permitted and a premixed solution of 25% glycerine should be used
instead since this is all that is needed to protect down to 20°F. In order to provide the designer with as
much information as possible, so that informed decisions can be made, this TIA proposes an
expanded annex section that discusses the findings of the various tests that have been performed,
including the latest tests just released. This should help designers understand the risks involved and
the consequences of their decisions and help guide them to keep antifreeze solutions to the lowest
possible concentrations if they decide they want to use antifreeze at all. This TIA does not propose
changes to the rules for existing systems (allowing them to stay as they were in TIA 10-2 with up to
50% glycerine and 40% propylene glycol). This decision was made after a review of the testing
programs to date and a first order risk analysis that looked at the potential problems that would arise if
we forced people to retroactively change out their existing systems. This risk analysis shows that the
risk of changing the antifreeze requirements for existing building and forcing building owners to make a
change is higher (6 to 6.3 deaths per year) than leaving the 50% glycerine or 40% propylene glycol in
systems (3.0 to 3.6 deaths/year). The following is a summary of this analysis: Risk Analysis for
Antifreeze Systems Assumptions · There are approximately 100 million homes (1 and 2 family) in
America · There are approximately 300,000 fires in the homes each year (0.003 fires/home/year) ·
There are approximately 3000 fire deaths per year in homes (0.01 deaths/fire) o Of these fire deaths,
10% occur in fires that started in spaces that NFPA 13D does not require to be sprinklered, so these
deaths will be assumed in this analysis to occur, even in sprinklered homes, even though actual fire
experience has shown that sprinklers in adjacent rooms sometimes activate to control these fires and
significant losses are not being experienced. o In an effort to be conservative, this analysis will also
assume that sprinklers are only 90% effective, even though significant work has shown them to be
much more effective o There are approximately 2 million sprinklered homes in America (2% of all
homes) o There are approximately 500,000 systems (25% of all sprinklered homes) with antifreeze
that is required right now by NFPA 13D to be a maximum of 50% glycerin or 40% propylene glycol o
There are approximately 1500 fires/yr in the homes with these antifreeze systems o There have been
no deaths associated with fires in homes having antifreeze systems with 50% or less glycerine or 40%
or less propylene glycol o There have been two incidents of flash fires in the last 5 years causing 1
death and 2 serious injuries in apartments. In both cases, the system concentration is believed to have
been greater than 50% with one of these being believed to be 70% glycerine and the other 60%
glycerine. For the purposes of this conservative analysis, the 2 serious injuries will be considered as
deaths. o Using these last two bullet points, the risk of death due to flash fire caused by the antifreeze
is between 0 and 0.0004 deaths per year depending on what mix of concentrations is assumed for the
population of sprinklered homes with antifreeze in the systems. If the Situation is Left “As Is” with 50%
Glycerine or 40% Propylene Glycol Allowed to Remain · There will be 1500 fires each year in the
systems with antifreeze (500,000 sprinklered homes with antifreeze and 0.003 fires/home/year) ·
There will be 3 deaths per year assuming that sprinklers are 90% effective and in 90% of the locations
where deadly fires start (1500 fires times 0.01 deaths per fire is a potential for 15 deaths, 1.5 might
occur from fires starting in unsprinklered spaces, 1.5 might occur due to some failure of the system,
the other 12 will be saved) · There will be between 0 and 0.6 deaths due to flash fires depending on the
population of antifreeze solutions in homes (1500 fires times 0.0004 is 0.6, which is extremely
conservative considering this statistic is gathered from high concentrations systems that were not in
homes) · Total of between 3.0 and 3.6 possible deaths per year from this decision If We Call for
Replacement/Reduction of Solutions · Assumption that 125,000 systems (25% of existing antifreeze
systems) will get turned off · Assumption that 125,000 people (25% of existing antifreeze systems) will comply and spend the money to do something else (lower system concentration, heat tracing or conversion to dry-pipe or preaction system) · Assumption that 250,000 systems (50% of existing systems) will be left “as is” with whatever antifreeze they have · The homeowners who shut off their systems will experience 375 fires and 3.75 fire deaths that can’t be prevented by a sprinkler system shut off · The homeowners that complied will experience 375 fires and 0.75 fire deaths assuming the sprinkler systems are 90% effective and that sprinklers are installed in 90% of locations where deadly fires start · The homeowners that left their systems “as is” will experience 750 fires and between 1.5 and 1.8 fire deaths (1.5 of the fire deaths are from the system being 90% effective and 90% of the fires starting in sprinklered spaces and up to 0.3 of the fire deaths are from the potential for a flash fire depending on the antifreeze concentrations that are assumed) · Total of between 6.0 and 6.3 potential deaths per year from this decision Of course, any risk analysis like this is dependent on the assumptions used to formulate the conclusions. A sensitivity analysis was performed on the assumption above that if some change was required by NFPA 13D that 25% of the systems would be shut off and only 25% of the systems would be changed to comply. If the assumption was changed to 10% of the systems being shut off and 80% of the systems being changed to comply (with the remaining 10% of the systems left “as is”) then the decision to force the change still comes out worse (with a risk between 4.2 and 4.26) than the decision to leave all of the systems alone (with a risk between 3 and 3.6). Emergency Nature: This TIA has been prompted by the recently released interim research report, Antifreeze Solutions Supplied through Spray Sprinklers, issued by the Fire Protection Research Foundation in February of 2012. It is part of a package of TIA’s being submitted by each of the fire sprinkler installation and maintenance documents in order to address the issues raised by that research. It meets the definition of part 5.2(c) in the Regulations Governing Committee Projects as an emergency since the issues raised by the research were not known at the time the standard was being developed. The use of propylene glycol and glycerin antifreeze solutions should only be considered when other sprinkler system design alternatives are not available or practical. If these solutions are used, all relevant data and information should be carefully reviewed and considered in design and installation of the sprinkler system.

Response Message:

Public Input No. 23-NFPA 13D-2013 [Sections A.9.2.1, A.9.2.2, A.9.2.2.2, A.9.2.2.2.1, A.9.2.2.4]
A.10.2
All residential sprinklers have been investigated under a flat, smooth, 8 ft (2.4 m) high horizontal ceiling. Some residential sprinklers have been investigated and listed for use under specific ceiling configurations such as a horizontal beamed ceiling. The performance of residential sprinklers under flat, smooth, horizontal ceilings has been well documented throughout the life of NFPA 13D. Prior to 2010, several manufacturers of residential sprinklers had performed testing and received listings for residential sprinklers under certain slopes and in certain beam conditions. In 2010, the Fire Protection Research Foundation (FPRF) conducted a research project consisting of 76 FDS simulations and 12 full-scale fire tests. The results have been used to develop system design criteria in a generic manner in order to simplify the use of residential sprinklers. Some residential sprinkler listings still exist for situations beyond the scope of the generic design. See the FPRF report, “Analysis of the Performance of Residential Sprinkler Systems with Sloped or Sloped and Beamed Ceilings” dated July 2010 for more information.

Questions are frequently asked regarding the minimum two sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics might or might not be accurate, the water supplies for the fire sprinkler systems under which these statistics were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system’s water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called “hydraulic increase.” Hydraulic increase can also occur when a water supply’s capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined.

But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire, given any obstructions and the layout of the space where the fire starts.

The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single-sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two-sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two-sprinkler water supply from the start.

In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft (4.3 m × 4.3 m) with an adjoining hallway, each with flat, smooth, 8 ft (2.4 m) high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never might not have been able to provide fire control.

For examples of selecting a compartment for consideration, see Figure A.10.2(a) and Figure A.10.2(b), which show examples of design configurations for compartments based on the presence of lintels to stop the flow of heat.

**Figure A.10.2(a) Sprinkler Design Areas for Typical Residential Occupancy — Without Lintel.**
Figure A.10.2(b) Sprinkler Design Areas for Typical Residential Occupancy — With Lintel.

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Committee Statement

Committee Statement: The words "would never" are being changed to "might not" in the last line. This has to do with a judgement regarding the results of fire tests we conducted and the way our phase is being interpreted. Rather than making the definitive statement that something "never" would happen, we are more comfortable saying that it "might" not happen.

Response Message:
Public Input No. 41-NFPA 13D-2013 [Section No. A.10.2]
Public Input No. 52-NFPA 13D-2013 [New Section after A.7.6]
B.3 References for Extracts in Informational Sections.

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Committee Statement

Committee Statement: Editorial change to update to the most recent edition.
Response Message: