First Revision No. 635-NFPA 13-2016 [ Global Input ]

See attached file for the reorganization of existing Chapter 7.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_7.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization:  [ Not Specified ]
Street Address:  
City:  
State:  
Zip:  
Submittal Date:  Fri Aug 05 17:20:50 EDT 2016

Committee Statement

Committee Statement:  Chapter 7 is a compilation of former Chapter 6 and includes requirements for system components and hardware.
Chapter 7  System Requirements [move to Chapter 8]

7.1  Wet Pipe Systems. [move to 8.1]

7.1.1  Pressure Gauges. [move to 8.1.1]

7.1.1.1  [move to 8.1.1.1]
An approved pressure gauge conforming to 8.17.3 shall be installed in each system riser.

7.1.1.2  [move to 8.1.1.2]
Pressure gauges shall be installed above and below each alarm check valve or system riser check valve where such devices are present.

7.1.1.2.1  [move to 8.1.1.2.1]
Pressure gauges below check valves required by 8.17.5.2.2(1) shall not be required.

7.1.2  Relief Valves.  [move to 8.1.2]

7.1.2.1  [move to 8.1.2.1]
Unless the requirements of 7.1.2.2 are met, a wet pipe system shall be provided with a listed relief valve not less than 1/2 in. (15 mm) in size and set to operate at 175 psi (12 bar) or 10 psi (0.7 bar) in excess of the maximum system pressure, whichever is greater.

7.1.2.2  [move to 8.1.2.2]
Where auxiliary air reservoirs are installed to absorb pressure increases, a relief valve shall not be required.

7.1.2.3  [move to 8.1.2.3]
A relief valve per 7.1.2.1 shall be required downstream of check valves required by 8.17.5.2.2(1).

7.1.3  Auxiliary Systems. [move to 8.1.3]
A wet pipe system shall be permitted to supply an auxiliary dry pipe, preaction, or deluge system, provided the water supply is adequate.

7.1.4  [move to 8.1.4]
Heat tracing shall not be used in lieu of heated valve enclosures to protect the valve and supply pipe from freezing.

7.1.5  Air Venting.  [move to 8.1.5]
A single air vent with a connection conforming to 8.16.6 shall be provided on each wet pipe system utilizing metallic pipe. (See A.8.16.6.)

7.1.5.1  [move to 8.1.5.1]
Venting from multiple points on each system shall not be required.
7.2* Dry Pipe Systems. [move to 8.2]

7.2.1 Pressure Gauges. [move to 8.2.1]
Approved pressure gauges in accordance with 8.17.3 shall be connected as follows:
(1) On the water side and air side of the dry pipe valve
(2) At the air pump supplying the air receiver where one is provided
(3) At the air receiver where one is provided
(4) In each independent pipe from air supply to dry pipe system
(5) At quick-opening devices

7.2.2 Sprinklers. [move to 8.2.2]
The following sprinkler orientations and arrangements shall be permitted for dry pipe systems:
(1) Upright sprinklers
(2) *Listed dry sprinklers
(3) Pendent sprinklers and sidewall sprinklers installed on return bends, where the sprinklers, return bend, and branch line piping are in an area maintained at or above 40°F (4°C)
(4) Horizontal sidewall sprinklers installed so that water is not trapped
(5) Pendent sprinklers and sidewall sprinklers, where the sprinklers and branch line piping are in an area maintained at or above 40°F (4°C), the water supply is potable, and the piping for the dry pipe system is copper or CPVC specifically listed for dry pipe applications

7.2.3* Size of Systems. [move to 8.2.3]

7.2.3.1* [move to 8.2.3.1]
The system capacity (volume) controlled by a dry pipe valve shall be determined by 7.2.3.2, 7.2.3.3, 7.2.3.4, 7.2.3.5, or 7.2.3.7.

7.2.3.1.1 [move to 8.2.3.1.1]
For dry pipe systems protecting dwelling unit portions of any occupancy, system size shall be such that initial water is discharged from the system test connection in not more than 15 seconds, starting at the normal air pressure on the system and at the time of fully opened inspection test connection.

7.2.3.1.1.1 [move to 8.2.3.1.1.1]
Dry pipe systems protecting dwelling unit portions of any occupancy shall not be permitted to use the options outlined in 7.2.3.2, 7.2.3.3, or 7.2.3.4.

7.2.3.2 [move to 8.2.3.2]
System size shall be such that initial water is discharged from the system test connection in not more than 60 seconds, starting at the normal air pressure on the system and at the time of fully opened inspection test connection.

7.2.3.3 [move to 8.2.3.3]
A system size of not more than 500 gal (1900 L) shall be permitted without a quick-opening device and shall not be required to meet any specific water delivery requirement to the inspection test connection.
7.2.3.4 [move to 8.2.3.4]
A system size of not more than 750 gal (2850 L) shall be permitted with a quick-opening device and shall not be required to meet any specific water delivery requirement to the inspection test connection.

7.2.3.5 [move to 8.2.3.5]
System size shall be based on dry pipe systems being calculated for water delivery in accordance with 7.2.3.6.

7.2.3.6 Dry Pipe System Water Delivery. [move to 8.2.3.6]

7.2.3.6.1 [move to 8.2.3.6.1]
Calculations for dry pipe system water delivery shall be based on the hazard shown in Table 7.2.3.6.1.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Number of Most Remote Sprinklers Initially Open</th>
<th>Maximum Time of Water Delivery (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>1</td>
<td>60</td>
</tr>
<tr>
<td>Ordinary I</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Ordinary II</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Extra I</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>Extra II</td>
<td>4</td>
<td>45</td>
</tr>
<tr>
<td>High piled</td>
<td>4</td>
<td>40</td>
</tr>
</tbody>
</table>

7.2.3.6.2 [move to 8.2.3.6.2]
The calculation program and method shall be listed by a nationally recognized testing laboratory.

7.2.3.6.3 [move to 8.2.3.6.3]
For dry pipe systems protecting dwelling unit portions of any occupancy, the sprinklers in the dwelling unit shall have a maximum water delivery time of 15 seconds to the single most remote sprinkler.

7.2.3.6.4 [move to 8.2.3.6.4]
Residential sprinklers shall be listed for dry pipe applications.

7.2.3.7* [move to 8.2.3.7]
System size shall be such that initial water discharge from the system trip test connection or manifold outlets is not more than the maximum time of water delivery specified in Table 7.2.3.6.1, starting at normal air pressure on the system and at the time of fully opened test connection.
7.2.3.7.1 [move to 8.2.3.7.1]
When flow is from four sprinklers, the test manifold shall be arranged to simulate two sprinklers on each of two sprinkler branch lines.

7.2.3.7.2 [move to 8.2.3.7.2]
When flow is from three sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line and one sprinkler on the next adjacent branch line.

7.2.3.7.3 [move to 8.2.3.7.3]
When flow is from two sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line.

7.2.3.7.4 [move to 8.2.3.7.4]
When flow is from one sprinkler, the test manifold shall be installed as per the requirements for a trip test connection in accordance with 8.17.4.2.

7.2.3.7.5 [move to 8.2.3.7.5]
A system meeting the requirements of this section shall not be required to also meet the requirements of 7.2.3.2 or 7.2.3.5.

7.2.3.8 [move to 8.2.3.8]
Dry pipe systems with water delivery times other than 7.2.3.2, 7.2.3.5, and 7.2.3.7 shall be acceptable where listed by a nationally recognized testing laboratory.

7.2.3.9 [move to 8.2.3.9]
Unless installed in a heated enclosure, check valves shall not be used to subdivide the dry pipe systems.

7.2.3.9.1 [move to 8.2.3.9.1]
When check valves are used to subdivide dry pipe systems in accordance with 7.2.3.9, a hole 1/8 in. (3.2 mm) in diameter shall be drilled in the clapper of each check valve to permit equalization of air pressure among the various parts of the system.

7.2.3.9.2 [move to 8.2.3.9.2]
Where auxiliary drains are not provided for each subdivided section, an approved indicating drain valve supervised in the closed position in accordance with 8.16.1.1.2, connected to a bypass around each check valve, shall be provided as a means for draining the system.

7.2.3.10 [move to 8.2.3.10]
Gridded dry pipe systems shall not be installed.

7.2.4 Quick-Opening Devices. [move to 8.2.4]

7.2.4.1 [move to 8.2.4.1]
A listed quick-opening device shall be permitted to help meet the requirements of 7.2.3.2, 7.2.3.5, 7.2.3.7, or 7.2.3.8.
7.2.4.2 The quick-opening device shall be located as close as practical to the dry pipe valve.

7.2.4.3 To protect the restriction orifice and other operating parts of the quick-opening device against submergence, the connection to the riser shall be above the point at which water (priming water and back drainage) is expected when the dry pipe valve and quick-opening device are set, except where design features of the particular quick-opening device make these requirements unnecessary.

7.2.4.4 Where a valve is installed in the connection between a dry pipe sprinkler riser and a quick-opening device, it shall be an indicating-type valve that is sealed, locked, or electrically supervised in the open position.

7.2.4.5 A check valve shall be installed between the quick-opening device and the intermediate chamber of the dry pipe valve, where the quick-opening device requires protection against submergence after system operation.

7.2.4.6 If the quick-opening device requires pressure feedback from the intermediate chamber, a valve type that will clearly indicate whether it is opened or closed shall be permitted in place of that check valve.

7.2.4.7 Where a valve is utilized in accordance with 7.2.4.6, the valve shall be constructed so that it can be locked or sealed in the open position.

7.2.4.8 Antiflooding Device.

7.2.4.8.1 Unless the requirements of 7.2.4.8.2 are met, a listed antiflooding device shall be installed in the connection between the dry pipe sprinkler riser and the quick-opening device.

7.2.4.8.2 A listed antiflooding device shall not be required where the quick-opening device has built-in antiflooding design features or the quick-opening device is listed or approved without the use of an antiflooding device.

7.2.5* Location and Protection of Dry Pipe Valve.

7.2.5.1* General. The dry pipe valve and supply pipe shall be protected against freezing and mechanical injury.
7.2.5.2 Valve Rooms. [move to 8.2.5.2]

7.2.5.2.1 [move to 8.2.5.2.1]
Valve rooms shall be lighted and heated.

7.2.5.2.2 [move to 8.2.5.2.2]
The source of heat shall be of a permanently installed type.

7.2.5.2.3 [move to 8.2.5.2.3]
Heat tape shall not be used in lieu of heated valve enclosures to protect the dry pipe valve and supply pipe against freezing.

7.2.5.3 Supply. [move to 8.2.5.3]
The supply for the sprinkler in the dry pipe valve enclosure shall be either from the dry side of the system or from a wet pipe sprinkler system that protects the area where the dry pipe valve is located.

7.2.5.4 High Water Level Protection. [move to 8.2.5.4]

7.2.5.4.1 [move to 8.2.5.4.1]
Where it is possible to reseat the dry valve after actuation without first draining the system, protection against occurrence of water above the clapper shall be permitted in accordance with 7.2.5.4.3.

7.2.5.4.2 Low Differential Dry Pipe Valve. [move to 8.2.5.4.2]
Protection against accumulation of water above the clapper shall be provided for low differential dry pipe valves in accordance with 7.2.5.4.3.

7.2.5.4.3 High Water Level Device. [move to 8.2.5.4.3]
An automatic high water level signaling device or an automatic drain shall be permitted.

7.2.6 Air Pressure and Supply. [move to 8.2.6]

7.2.6.1 [move to 8.2.6.1]
Where the term air is used throughout this standard, it shall also include the use of nitrogen or other approved gas.

7.2.6.2 Maintenance of Air Pressure. [move to 8.2.6.2]
Air or nitrogen or other approved gas pressure shall be maintained on dry pipe systems throughout the year.

7.2.6.3* Air Supply. [move to 8.2.6.3]

7.2.6.3.1 [move to 8.2.6.3.1]
The compressed air supply shall be from a source available at all times.
7.2.6.3.2* [move to 8.2.6.3.2]
The air supply shall have a capacity capable of restoring normal air pressure in the system within 30 minutes.

7.2.6.3.3 [move to 8.2.6.3.3]
The requirements of 7.2.6.3.2 shall not apply in refrigerated spaces maintained below 5°F (–15°C), where normal system air pressure shall be permitted to be restored within 60 minutes.

7.2.6.4 Air Supply Connections.  [move to 8.2.6.4]

7.2.6.4.1 [move to 8.2.6.4.1]
Connection pipe from the air supply to the dry pipe valve shall not be less than 1⁄2 in. (15 mm) in diameter and shall enter the system above the priming water level of the dry pipe valve.

7.2.6.4.2 [move to 8.2.6.4.2]
A check valve shall be installed in the air filling connection, and a listed or approved shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of this check valve and shall remain closed unless filling the system.

7.2.6.5 Relief Valve.  [move to 8.2.6.5]
An approved relief valve shall be provided between the air supply and the shutoff valve and shall be set to relieve pressure no less than 10 psi (0.7 bar) in excess of system air pressure provided in 7.2.6.7.1 and shall not exceed the manufacturer's limitations.

7.2.6.6 Automatic Air Maintenance.  [move to 8.2.6.6]

7.2.6.6.1* [move to 8.2.6.6.1]
Unless the requirements of 7.2.6.6.2 are met, where the air supply to a dry pipe system is maintained automatically, the air supply shall be from a dependable plant system or an air compressor with an air receiver, and shall utilize an air maintenance device specifically listed for such service and capable of controlling the required air pressure on, and maximum airflow to, the dry pipe system.

7.2.6.6.2 [move to 8.2.6.6.2]
Where the air compressor supplying the dry pipe system has a capacity less than 5.5 ft³/min (160 L/min) at 10 psi (0.7 bar), an air receiver or air maintenance device shall not be required.

7.2.6.6.3 [move to 8.2.6.6.3]
The automatic air supply to more than one dry pipe system shall be connected to enable individual maintenance of air pressure in each system.

7.2.6.6.3.1 [move to 8.2.6.6.3.1]
Each dry pipe system shall have a dedicated air maintenance device.

7.2.6.6.4 [move to 8.2.6.6.4]
A check valve or other positive backflow prevention device shall be installed in the air supply to each system to prevent airflow or waterflow from one system to another.

7.2.6.7 System Air Pressure. [move to 8.2.6.7]

7.2.6.7.1 [move to 8.2.6.7.1]
The system air pressure shall be maintained in accordance with the instruction sheet furnished with the dry pipe valve, or shall be 20 psi (1.4 bar) in excess of the calculated trip pressure of the dry pipe valve, based on the highest normal water pressure of the system supply.

7.2.6.7.2 [move to 8.2.6.7.2]
The permitted rate of air leakage shall be as specified in 25.2.2.

7.2.6.8 Nitrogen or Other Approved Gas. [move to 8.2.6.8]

7.2.6.8.1* [move to 8.2.6.8.1]
Where nitrogen or other approved gas is used, the supply shall be from a reliable source.

7.2.6.8.2 [move to 8.2.6.8.2]
Where stored nitrogen or other approved gas is used, the gas shall be introduced through a pressure regulator and shall be in accordance with 7.2.6.6.

7.2.6.8.3 [move to 8.2.6.8.3]
A low pressure alarm shall be provided on gas storage containers to notify the need for refilling.

7.3 Preaction Systems and Deluge Systems. [move to 8.3]

7.3.1* General. [move to 8.3.1]

7.3.1.1* [move to 8.3.1.1]
All components of pneumatic, hydraulic, or electrical systems shall be compatible.

7.3.1.2 [move to 8.3.1.2]
The automatic water control valve shall be provided with hydraulic, pneumatic, or mechanical manual means for operation that is independent of detection devices and of the sprinklers.

7.3.1.3 Pressure Gauges. [move to 8.3.1.3]
Approved pressure gauges conforming with 8.17.3 shall be installed as follows:
(1) Above and below preaction valve and below deluge valve
(2) On air supply to preaction and deluge valves

7.3.1.4 [move to 8.3.1.4]
A supply of spare fusible elements for heat-responsive devices, not less than two of each temperature rating, shall be maintained on the premises for replacement purposes.

7.3.1.5 [move to 8.3.1.5]
Hydraulic release systems shall be designed and installed in accordance with manufacturer's requirements and listing for height limitations above deluge valves or deluge valve actuators to prevent water column.

7.3.1.6 Location and Spacing of Releasing Devices. [move to 8.3.1.6]

7.3.1.6.1 [move to 8.3.1.6.1]
Spacing of releasing devices, including automatic sprinklers used as releasing devices, shall be in accordance with their listing and manufacturer's specifications.

7.3.1.6.2 [move to 8.3.1.6.2]
The release system shall serve all areas that the preaction system protects.

7.3.1.6.3 [move to 8.3.1.6.3]
Where thermal activation is utilized, the activation temperature of the release system shall be lower than the activation temperature of the sprinkler.

7.3.1.7 Devices for Test Purposes and Testing Apparatus. [move to 8.3.1.7]

7.3.1.7.1 [move to 8.3.1.7.1]
Where detection devices installed in circuits are located where not accessible for testing, an additional detection device shall be provided on each circuit for test purposes at an accessible location and shall be connected to the circuit at a point that will ensure a proper test of the circuit.

7.3.1.7.2 [move to 8.3.1.7.2]
Testing apparatus capable of producing the heat or impulse necessary to operate any normal detection device shall be furnished to the owner of the property with each installation.

7.3.1.7.3 [move to 8.3.1.7.3]
Where explosive vapors or materials are present, hot water, steam, or other methods of testing not involving an ignition source shall be used.

7.3.1.7.4* [move to 8.3.1.7.4]
A separate additional indicating control valve, supervised in accordance with 8.16.1.1.2, shall be permitted to be installed in the riser assembly above a preaction or deluge valve to permit full function trip testing as required by NFPA 25, without flooding the system.

7.3.1.8 Location and Protection of System Water Control Valves. [move to 8.3.1.8]

7.3.1.8.1 [move to 8.3.1.8.1]
System water control valves and supply pipes shall be protected against freezing and mechanical injury.

7.3.1.8.2 Valve Rooms. [move to 8.3.1.8.2]
7.3.1.8.2.1 [move to 8.3.1.8.2.1]
Valve rooms shall be lighted and heated.

7.3.1.8.2.2 [move to 8.3.1.8.2.2]
The source of heat shall be of a permanently installed type.

7.3.1.8.2.3 [move to 8.3.1.8.2.3]
Heat tracing shall not be used in lieu of heated valve enclosure rooms to protect preaction and
deluge valves and supply pipe against freezing.

7.3.2 Preaction Systems. [move to 8.3.2]

7.3.2.1 [move to 8.3.2.1]
Preaction systems shall be one of the following types:
(1) A single interlock system, which admits water to sprinkler piping upon operation of
detection devices
(2) A non-interlock system, which admits water to sprinkler piping upon operation of detection
devices or automatic sprinklers
(3) A double interlock system, which admits water to sprinkler piping upon operation of both
detection devices and automatic sprinklers

7.3.2.2 Size of Systems — Single and Non-Interlock Preaction Systems. [move to 8.3.2.2]
Not more than 1000 automatic sprinklers shall be controlled by any one preaction valve.

7.3.2.3 Size of Systems — Double Interlock Preaction Systems. [move to 8.3.2.3]

7.3.2.3.1 [move to 8.3.2.3.1]
The system size controlled by a double interlock preaction valve shall be determined by either
7.3.2.3.1.1, 7.3.2.3.1.2, 7.3.2.3.1.3, and 7.3.2.3.1.4.

7.3.2.3.1.1 [move to 8.3.2.3.1.1]
A system size for double interlock preaction systems of not more than 500 gal (1900 L) shall be
permitted and shall not be required to meet any specific water delivery requirement to the trip
test connection.

7.3.2.3.1.2 [move to 8.3.2.3.1.2]
The system size for double interlock preaction systems shall be designed to deliver water to the
system test connection in no more than 60 seconds, starting at the normal air pressure on the
system, with the detection system activated and the inspection test connection fully opened
simultaneously.

7.3.2.3.1.3 [move to 8.3.2.3.1.3]
The system size for double interlock preaction systems shall be based on calculating water
delivery in accordance with 7.2.3.6, anticipating that the detection system activation and
sprinkler operation will be simultaneous.
7.3.2.3.1.4* [move to 8.3.2.3.1.4]
The system size for double interlock preaction systems shall be designed to deliver water to the system trip test connection or manifold outlets in not more than the maximum time of water delivery specified in Table 7.2.3.6.1, starting at the normal air pressure on the system, with the detection system activated and the inspection trip test connection or manifold opened simultaneously.

7.3.2.3.2 [move to 8.3.2.3.2]
A listed quick-opening device shall be permitted to be used to help meet the requirements of 7.3.2.3.1.2, 7.3.2.3.1.3, and 7.3.2.3.1.4.

7.3.2.4* Supervision. [move to 8.3.2.4]

7.3.2.4.1 [move to 8.3.2.4.1]
Sprinkler piping and fire detection devices shall be automatically supervised where more than 20 sprinklers are on the system.

7.3.2.4.2 [move to 8.3.2.4.2]
Except as permitted by 7.3.2.4.3, air or nitrogen supervising pressure for preaction systems shall be installed in conformance with the dry pipe system air pressure and supply rules of 7.2.6.

7.3.2.4.3 [move to 8.3.2.4.3]
The relief valves required by 7.2.6 shall be permitted to be omitted for the type of preaction system described in 7.3.2.1(1) when the air pressure is supplied from a source that is not capable of developing pressures in excess of 15 psi (1.0 bar).

7.3.2.4.4 [move to 8.3.2.4.4]
All preaction system types described in 7.3.2.1(2) and 7.3.2.1(3) shall maintain a minimum supervising air or nitrogen pressure of 7 psi (0.5 bar).

7.3.2.5 Sprinklers. [move to 8.3.2.5]
The following sprinkler orientations and arrangements shall be permitted for preaction systems:
(1) Upright sprinklers
(2) *Listed dry sprinklers
(3) Pendent sprinklers and sidewall sprinklers installed on return bends, where the sprinklers, return bend, and branch line piping are in an area maintained at or above 40°F (4°C)
(4) Horizontal sidewall sprinklers, installed so that water is not trapped
(5) Pendent sprinklers and sidewall sprinklers, where the sprinklers and branch line piping are in an area maintained at or above 40°F (4°C), the water supply is potable, and the piping for the preaction system is copper or CPVC specifically listed for dry pipe applications

7.3.2.6 System Configuration. [move to 8.3.2.6]
Preaction systems of the type described in 7.3.2.1(3) and all preaction systems protecting storage occupancies, excluding miscellaneous storage, shall not be gridded.

7.3.* Deluge Systems. [move to 8.3.3]
7.3.3.1  The detection devices or systems shall be automatically supervised.

7.3.3.2  Deluge systems shall be hydraulically calculated.

7.4  Combined Dry Pipe and Preaction Systems for Piers, Terminals, and Wharves. 

7.4.1  In addition to the requirements of Section 7.4, design and installation requirements for piers, terminals, and wharves shall be in accordance with Section 22.22.

7.4.2*  General.

7.4.2.1*  Combined automatic dry pipe and preaction systems shall be so constructed that failure of the detection system shall not prevent the system from functioning as a conventional automatic dry pipe system.

7.4.2.2  Combined automatic dry pipe and preaction systems shall be so constructed that failure of the dry pipe system of automatic sprinklers shall not prevent the detection system from properly functioning as an automatic fire alarm system.

7.4.2.3  Provisions shall be made for the manual operation of the detection system at locations requiring not more than 200 ft (61 m) of travel.

7.4.2.4  Sprinklers.

The following types of sprinklers and arrangements shall be permitted for combined dry pipe and preaction systems:
(1) Upright sprinklers
(2) *Listed dry sprinklers
(3) Pendent sprinklers and sidewall sprinklers installed on return bends, where both the sprinklers and the return bends are located in a heated area
(4) Horizontal sidewall sprinklers, installed so that water is not trapped

7.4.3  Dry Pipe Valves in Combined Systems.

7.4.3.1  Where the system consists of more than 600 sprinklers or has more than 275 sprinklers in any fire area, the entire system shall be controlled through two 6 in. (150 mm) dry pipe valves connected in parallel and shall feed into a common feed main.
7.4.3.2* [move to 8.4.3.2]
Where parallel dry pipe valves are required by 7.4.3.1, these valves shall be checked against each other.

7.4.3.3 [move to 8.4.3.3]
Each dry pipe valve shall be provided with a listed tripping device actuated by the detection system.

7.4.3.4 [move to 8.4.3.4]
Dry pipe valves shall be cross-connected through a 1 in. (25 mm) pipe connection to permit simultaneous tripping of both dry pipe valves.

7.4.3.5 [move to 8.4.3.5]
The 1 in. (25 mm) cross-connection pipe shall be equipped with an indicating valve so that either dry pipe valve can be shut off and worked on while the other remains in service.

7.4.3.6 [move to 8.4.3.6]
The check valves between the dry pipe valves and the common feed main shall be equipped with 1/2 in. (15 mm) bypasses so that a loss of air from leakage in the trimmings of a dry pipe valve will not cause the valve to trip until the pressure in the feed main is reduced to the tripping point.

7.4.3.7 [move to 8.4.3.7]
An indicating valve shall be installed in each of these bypasses so that either dry pipe valve can be completely isolated from the main riser or feed main and from the other dry pipe valve.

7.4.3.8 [move to 8.4.3.8]
Each combined dry pipe and preaction system shall be provided with listed quick-opening devices at the dry pipe valves.

7.4.4 Subdivision of System Using Check Valves. [move to 8.4.4]

7.4.4.1 [move to 8.4.4.1]
Where more than 275 sprinklers are required in a single fire area, the system shall be divided into sections of 275 sprinklers or fewer by means of check valves.

7.4.4.2 [move to 8.4.4.2]
Where the system is installed in more than one fire area or story, not more than 600 sprinklers shall be supplied through any one check valve.

7.4.4.3 [move to 8.4.4.3]
Each section shall have a 1 1/4 in. (32 mm) drain on the system side of each check valve supplemented by a dry pipe system auxiliary drain.

7.4.4.4 [move to 8.4.4.4]
Section drain lines and dry pipe system auxiliary drains shall be located in heated areas or inside heated cabinets to enclose drain valves and auxiliary drains for each section.
7.4.5 Time Limitation. [move to 8.4.5]

7.4.5.1 [move to 8.4.5.1]
The sprinkler system shall be so constructed and the number of sprinklers controlled shall be so limited that water shall reach the farthest sprinkler within a period of time not exceeding 1 minute for each 400 ft (120 m) of common feed main from the time the heat-responsive system operates.

7.4.5.2 [move to 8.4.5.2]
The maximum time permitted shall not exceed 3 minutes.

7.4.6 System Test Connection. [move to 8.4.6]
The end section shall have a system test connection as required for dry pipe systems.

7.5 Multi-Cycle Systems. [move to 8.5]

7.5.1 [move to 8.5.1]
All multi-cycle systems shall be specifically tested and listed as systems.

7.5.2 [move to 8.5.2]
All multi-cycle systems shall be installed in compliance with the manufacturer’s installation instructions.

7.6* Antifreeze Systems. [move to 8.6]

7.6.1* General. [move to 8.6.1]

7.6.1.1 [move to 8.6.1.1]
The use of antifreeze solutions shall be in conformity with state and local health regulations.

7.6.1.2 [move to 8.6.1.2]
Antifreeze shall not be used in ESFR systems unless the ESFR sprinkler is listed for use with the antifreeze solution.

7.6.1.3 [move to 8.6.1.3]
Where pendent sprinklers are utilized, the water shall be drained from the entire system after hydrostatic testing with water.

7.6.1.3.1 [move to 8.6.1.3.1]
The requirements of 7.6.1.3 shall not apply where the system is hydrostatically tested with properly mixed antifreeze solution.

7.6.1.4 [move to 8.6.1.4]
Where antifreeze systems are remote from the system riser, a placard shall be mounted on the system riser that indicates the number and location of all remote antifreeze systems supplied by that riser.

7.6.1.5 [move to 8.6.1.5]
A placard shall be placed on the antifreeze system main valve that indicates the manufacture type and brand of the antifreeze solution, the concentration by volume of the antifreeze solution used, and the volume of the antifreeze solution used in the system.

7.6.2* Antifreeze Solutions. [move to 8.6.2]

7.6.2.1* [move to 8.6.2.1]
Except as permitted in 7.6.2.2, antifreeze solutions shall be listed for use in sprinkler systems.

7.6.2.2 [move to 8.6.2.2]
Premixed antifreeze solutions of propylene glycol shall be permitted to be used with ESFR sprinklers where the ESFR sprinklers are listed for such use in a specific application.

7.6.3 Arrangement of Supply Piping and Valves. [move to 8.6.3]

7.6.3.1 [move to 8.6.3.1]
Where the connection between the antifreeze system and the wet pipe system does not incorporate a backflow prevention device, and the conditions of 7.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 7.6.3.1.

Figure 7.6.3.1 Arrangement of Supply Piping and Valves.
7.6.3.2* [move to 8.6.3.2]
Where the connection between the antifreeze system and the wet pipe system incorporates a backflow prevention device, and the conditions of 7.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 7.6.3.3 or Figure 7.6.3.4.

7.6.3.2.1 [move to 8.6.3.2.1]
A means shall be provided to perform a full forward flow test in accordance with 8.17.4.5.

7.6.3.3* [move to 8.6.3.3]
Where the connection between the antifreeze system and the wet pipe system incorporates a backflow prevention device, and the conditions of 7.6.3.5 are not met, a listed expansion chamber shall be provided to compensate for thermal expansion of the antifreeze solution as illustrated in Figure 7.6.3.3.

Figure 7.6.3.3 Arrangement of Supply Piping with Backflow Device.

Notes:
1. Check valves are permitted to be omitted where sprinklers are below the level of valve A.
2. The \( \frac{3}{8} \) 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.
7.6.3.3.1 [move to 8.6.3.3.1]
When determining the size of the expansion chamber, the precharge air temperature and precharge air pressure shall be included.

7.6.3.3.2 [move to 8.6.3.3.2]
The size of the expansion chamber shall be such that the maximum system pressure does not exceed the rated pressure for any components of the antifreeze system.

7.6.3.4 [move to 8.6.3.4]
A listed 1⁄2 in. (13 mm) relief valve shall be permitted in lieu of the expansion chamber required in 7.6.3.3, and as illustrated in Figure 7.6.3.4, provided the antifreeze system volume does not exceed 40 gal (150 L).

Figure 7.6.3.4 Arrangement of Supply Piping with Relief Valve and Backflow Device.
The requirements of paragraphs 7.6.3.1, 7.6.3.2, and 7.6.3.3 shall not apply where the following three conditions are met:

1. The antifreeze system is provided with an automatic pressure pump or other device or apparatus to automatically maintain a higher pressure on the system side than on the supply side of the water supply check valve separating the antifreeze system from the water supply.
2. Provision is made to automatically release solution to prevent overpressurization due to thermal expansion of the solution.
3. Provision is made to automatically supply premixed solution as needed to restore system pressure due to thermal contraction.

Notes:
1. Check valve can be omitted where sprinklers are below the level of valve A.
2. The \( \frac{3}{8} \) 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.

7.6.3.5 [move to 8.6.3.5]
The requirements of paragraphs 7.6.3.1, 7.6.3.2, and 7.6.3.3 shall not apply where the following three conditions are met:

1. The antifreeze system is provided with an automatic pressure pump or other device or apparatus to automatically maintain a higher pressure on the system side than on the supply side of the water supply check valve separating the antifreeze system from the water supply.
2. Provision is made to automatically release solution to prevent overpressurization due to thermal expansion of the solution.
3. Provision is made to automatically supply premixed solution as needed to restore system pressure due to thermal contraction.

7.6.3.6* [move to 8.6.3.6]
A drain/test connection shall be installed at the most remote portion of the system.

7.6.3.7 [move to 8.6.3.7]
For systems with a capacity larger than 150 gal (570 L), an additional test connection shall be provided for every 100 gal (380 L).

**7.7 Outside Sprinklers for Protection Against Exposure Fires (Exposure Protection Sprinkler Systems).** [move to 8.7]

**7.7.1 Applications.** [move to 8.7.1]

**7.7.1.1** [move to 8.7.1.1]
Exposure protection sprinkler systems shall be permitted on buildings and structures regardless of whether the building's interior is protected by a sprinkler system.

**7.7.1.2** [move to 8.7.1.2]
Where exposure protection systems are required, they shall be installed to provide protection of windows and other openings within masonry walls, complete protection of walls, protection of roofs, or any combination thereof.

**7.7.2 Water Supply and Control.** [move to 8.7.2]

**7.7.2.1** [move to 8.7.2.1]
Unless the requirements of 7.7.2.2 are met, sprinklers installed for protection against exposure fires shall be supplied from a standard water supply as outlined in Chapter 24.

**7.7.2.2** [move to 8.7.2.2]
Where approved, other supplies, such as manual valves or pumps or fire department connections, shall be permitted to supply water to sprinklers for exposure protection.

**7.7.2.3** [move to 8.7.2.3]
Where fire department connections are used for water supply, they shall be so located that they will not be affected by the exposing fire.

**7.7.3 Control.** [move to 8.7.3]

**7.7.3.1** [move to 8.7.3.1]
Each system of outside sprinklers shall have an independent control valve.

**7.7.3.2** [move to 8.7.3.2]
Manually controlled open sprinklers shall be used only where constant supervision is present.

**7.7.3.3** [move to 8.7.3.3]
Sprinklers shall be of the open or automatic type.

**7.7.3.4** [move to 8.7.3.4]
Automatic sprinklers in areas subject to freezing shall be on dry pipe systems conforming to Section 7.2 or antifreeze systems conforming to Section 7.6, or be dry sprinklers of an adequate length connected to wet pipe systems located in heated areas.
7.7.3.5 [move to 8.7.3.5]
Automatic systems of open sprinklers shall be controlled by the operation of fire detection 
devices designed for the specific application.

7.7.4 System Components. [move to 8.7.4]

7.7.4.1 Drain Valves. [move to 8.7.4.1]
Each system of outside sprinklers shall have a separate drain valve installed on the system side of 
each control valve, except where an open sprinkler, top-fed system is arranged to facilitate 
drainage.

7.7.4.2 Check Valves. [move to 8.7.4.2]

7.7.4.2.1* [move to 8.7.4.2.1]
Where sprinklers are installed on two adjacent sides of a building, protecting against two 
separate and distinct exposures, with separate control valves for each side, the end lines shall be 
connected with check valves located so that one sprinkler around the corner will operate.

7.7.4.2.2 [move to 8.7.4.2.2]
The intermediate pipe between the two check valves shall be arranged to drain.

7.7.4.2.3* [move to 8.7.4.2.3]
As an alternate solution, an additional sprinkler shall be installed on each system located around 
the corner from the system involved.

7.7.4.3 System Arrangement. [move to 8.7.4.3]
Where one exposure affects two sides of the protected structure, the system shall not be 
subdivided between the two sides but rather shall be arranged to operate as a single system.

7.7.5 Pipe and Fittings. [move to 8.7.5]
Pipe and fittings installed on the exterior of the building or structure shall be corrosion resistant.

7.7.6 Strainers. [move to 8.7.6]
A listed strainer shall be provided in the riser or feed main that supplies sprinklers having 
nominal K-factors smaller than K-2.8 (40).

7.7.7 Gauge Connections. [move to 8.7.7]
A listed pressure gauge conforming with 8.17.3 shall be installed immediately below the control 
valve of each system.

7.7.8 Sprinklers. [move to 8.7.8]

7.7.8.1 [move to 8.7.8.1]
A single line of sprinklers is permitted to protect a maximum of two stories of wall area or two levels of vertically aligned windows where architectural features are sufficiently flush to allow rundown.

7.7.8.2 [move to 8.7.8.2]
Where window sills or similar features result in recesses or projections exceeding 1 in. (25 mm) in depth, separate sprinklers shall be provided for each window on each level, regardless of whether protection is being provided for windows or complete walls.

7.7.8.3 [move to 8.7.8.3]
For wall protection systems, sprinklers shall be located 6 in. to 12 in. (150 mm to 300 mm) from the wall surface and within 6 in. (150 mm) of the top of the wall, with maximum spacing of 8 ft (2.4 m) or as indicated in the sprinkler listing for exposure protection use.

7.7.8.4 [move to 8.7.8.4]
For protection of window and similar openings, listed window sprinklers shall be positioned within 2 in. (50 mm) of the top of the window sash in accordance with Table 7.7.8.4.

### Table 7.7.8.4 Position of Window Sprinklers

<table>
<thead>
<tr>
<th>Width of Window (ft)</th>
<th>Nominal K-Factor</th>
<th>Nominal Distance from Window [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S.</td>
<td>Metric</td>
</tr>
<tr>
<td>Up to 3</td>
<td>2.8</td>
<td>40</td>
</tr>
<tr>
<td>&gt;3 to 4</td>
<td>2.8</td>
<td>40</td>
</tr>
<tr>
<td>&gt;4 to 5</td>
<td>2.8</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>5.6</td>
<td>80</td>
</tr>
<tr>
<td>&gt;5 to 7</td>
<td>11.2</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Two 2.8</td>
<td></td>
</tr>
<tr>
<td>&gt;7 to 9.5</td>
<td>14.0</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Two 2.8</td>
<td></td>
</tr>
<tr>
<td>&gt;9.5 to 12</td>
<td>Two 5.6</td>
<td>80</td>
</tr>
</tbody>
</table>

For SI units, 1 ft = 0.3048 m.

7.7.8.5 [move to 8.7.8.5]
Where exposure protection sprinkler systems are installed, listed cornice sprinklers shall be used to protect combustible cornices exceeding 12 in. (300 mm) in depth.

7.7.8.5.1 [move to 8.7.8.5.1]
Cornice sprinklers shall be installed in each bay formed by cornice features and shall be spaced up to a maximum distance of 10 ft (3.0 m) apart, with deflectors 8 in. (200 mm) below the underside of the roof sheathing.

7.7.8.6 [move to 8.7.8.6]
Open spray sprinklers (upright, pendent, or sidewall) shall be permitted for application in roof protection when installed in accordance with ordinary hazard Group 1 protection areas and
discharge criteria, with defectors aligned parallel to the slope and positioned a minimum 18 in. (450 mm) above the roof surface.

7.7.8.6.1 [move to 8.7.8.6.1] Upright sprinklers positioned as ridge pole sprinklers shall be permitted with their defectors horizontal and minimum 6 in. (150 mm) above the ridge, with their maximum spacing and protection areas determined in the plan view rather than along the slope.

7.8* Refrigerated Spaces. [move to 8.8]

7.8.1 Spaces Maintained at Temperatures Above 32°F (0°C). [move to 8.8.1] Where temperatures are maintained above 32°F (0°C) in refrigerated spaces, the requirements in this section shall not apply.

7.8.2* Spaces Maintained at Temperatures Below 32°F (0°C). [move to 8.8.2]

7.8.2.1 General. [move to 8.8.2.1]

7.8.2.1.1 [move to 8.8.2.1.1] Where sprinkler pipe passes through a wall or floor into the refrigerated space, a section of pipe arranged for removal shall be provided immediately inside the space.

7.8.2.1.2 [move to 8.8.2.1.2] The removable length of pipe required in 7.8.2.1.1 shall be a minimum of 30 in. (750 mm).

7.8.2.2 Low Air Pressure Alarm. [move to 8.8.2.2]

7.8.2.2.1 [move to 8.8.2.2.1] Unless the requirements of 7.8.2.2 are met, a low air pressure alarm to a constantly attended location shall be installed.

7.8.2.2.2 [move to 8.8.2.2.2] Systems equipped with local low pressure alarms and an automatic air maintenance device shall not be required to alarm to a constantly attended location.

7.8.2.3 Piping Pitch. [move to 8.8.2.3] Piping in refrigerated spaces shall be installed with pitch as outlined in 8.16.2.3.3.

7.8.2.4* Air or Nitrogen Supply. [move to 8.8.2.4] Air or nitrogen supply for systems shall be one of the following:
(1) Air from the room of lowest temperature to reduce the moisture content
(2) Air compressor/dryer package listed for the application utilizing ambient air
(3) Compressed nitrogen gas from cylinders used in lieu of compressed air

7.8.2.5* Control Valve. [move to 8.8.2.5]
An indicating-type control valve for operational testing of the system shall be provided on each sprinkler riser outside of the refrigerated space.

7.8.2.6*  Check Valve. [move to 8.8.2.6]

7.8.2.6.1 [move to 8.8.2.6.1]
Unless the requirements of 7.8.2.6.2 are met, a check valve with a 3/32 in. (2.4 mm) diameter hole in the clapper shall be installed in the system riser below the test valve required in 7.8.2.5.

7.8.2.6.2 [move to 8.8.2.6.2]
Check valves shall not be required where dry pipe or preaction valves are used and designed to completely drain all water above the seat and that are listed for installation without priming water remaining and where priming water is not used in the system riser.

7.8.2.7*  Air or Nitrogen Supply Piping. [move to 8.8.2.7]

7.8.2.7.1 [move to 8.8.2.7.1]
The air or nitrogen supply piping entering the freezer area shall be as stated in 7.8.2.7.1.1 and 7.8.2.7.1.2.

7.8.2.7.1.1 Air Supply. [move to 8.8.2.7.1.1]
The supply piping shall be equipped with two easily removable supply lines at least 6 ft (1.8 m) long and at least 1 in. (25 mm) in diameter as shown in Figure 7.8.2.7.1.1(a) or Figure 7.8.2.7.1.1(b).

Figure 7.8.2.7.1.1(a) Refrigerator Area Sprinkler System Used to Minimize the Chances of Developing Ice Plugs.
Notes:
1. Check valve with 3/8 in. (2.4 mm) hole in clapper not required if prime water not used.
2. Supply air to be connected to top or side of system pipe.
3. Each removable air line to be a minimum of 1 in. (25 mm) diameter and a minimum of 6 ft (1.8 m) long.
7.8.2.7.1.2 Nitrogen Supply. [move to 8.8.2.7.1.2]
The supply piping shall be equipped with a single easily removable supply line at least 6 ft (1.8 m) long and at least 1 in. (25 mm) in diameter.

7.8.2.7.2 [move to 8.8.2.7.2]
Each supply line shall be equipped with control valves located in the warm area.

7.8.2.7.3 [move to 8.8.2.7.3]
Only one air supply line shall be open to supply the system air at any one time.

7.8.2.8  Fire Detection for Preaction Release.  [move to 8.8.2.8]

7.8.2.8.1  Detectors for Preaction Systems.  [move to 8.8.2.8.1]

7.8.2.8.1.1*  [move to 8.8.2.8.1.1]  
The release system shall be designed to operate prior to sprinkler operation, unless detectors meet the requirements of 7.8.2.8.1.2.

(A) Detectors shall be electric or pneumatic fixed temperature type with temperature ratings less than that of the sprinklers.

(B) Detection devices shall not be rate-of-rise type.

7.8.2.8.1.2  [move to 8.8.2.8.1.2]  
Where the system is a double interlock preaction system or single interlock preaction antifreeze system, detection devices shall be permitted to be any type specifically approved for use in a refrigerated area if installed in accordance with their listing requirements and NFPA 72.

7.8.2.8.2  Detector Location at Ceiling.  [move to 8.8.2.8.2]

7.8.2.8.2.1  [move to 8.8.2.8.2.1]  
Under smooth ceilings, detectors shall be spaced not exceeding their listed spacing.

7.8.2.8.2.2  [move to 8.8.2.8.2.2]  
For other than smooth ceilings, detectors shall not exceed one-half of the listed linear detector spacing or full allowable sprinkler spacing, whichever is greater.

7.8.2.8.3  Detector Location in Racks.  [move to 8.8.2.8.3]

7.8.2.8.3.1  [move to 8.8.2.8.3.1]  
Unless conditions in 7.8.2.8.4 are met, one level of detectors shall be installed for each level of sprinklers.

7.8.2.8.3.2  [move to 8.8.2.8.3.2]  
Detectors shall be installed vertically within one storage level of the rack sprinklers and as follows:
(1) Detectors shall be located in the transverse flue in single-row racks and in the longitudinal flue in double-row racks.
(2) For multiple-row racks, detectors shall be located in either longitudinal or transverse flue space and shall be within 5 ft (1.5 m) horizontally of each sprinkler.
(3) Separate detection systems shall be installed for ceiling sprinkler systems and in-rack sprinkler systems.
(4) Where system is double interlock preaction type, ceiling detection system shall operate solenoid valves on both ceiling and in-rack preaction systems.

7.8.2.8.4 Single Detection System for Ceiling and In-Rack Sprinklers.  [move to 8.8.2.8.4]
Ceiling detection only shall be permitted where all of the following conditions are met:
(1) Maximum storage height is 35 ft (10.5 m).
(2) Maximum ceiling height is 40 ft (12.0 m).
(3) Maximum hazard of storage is Class III.
(4) No solid shelves are present.
(5) One preaction valve is used for both ceiling and in-rack sprinklers protecting the same area, with separate indicating control valves and check valves provided downstream as shown in Figure 7.8.2.8.4.
(6) Detectors at the ceiling are spaced at a maximum of one-half the listed detector spacing but not less than the sprinkler spacing.

Figure 7.8.2.8.4 Valve Arrangement.

7.9 Commercial-Type Cooking Equipment and Ventilation.  [move to 8.9]

7.9.1 General.  [move to 8.9.1]
In cooking areas protected by automatic sprinklers, additional sprinklers or automatic spray nozzles shall be provided to protect commercial-type cooking equipment and ventilation systems that are designed to carry away grease-laden vapors unless otherwise protected.

7.9.2* Sprinklers and Automatic Spray Nozzles.  [move to 8.9.2]

7.9.2.1  [move to 8.9.2.1]
Unless the requirements of 7.9.2.2 are met, standard sprinklers or automatic spray nozzles shall be so located as to provide for the protection of exhaust ducts, hood exhaust duct collars, and hood exhaust plenum chambers.

7.9.2.2  [move to 8.9.2.2]
Sprinklers or automatic spray nozzles in ducts, duct collars, and plenum chambers shall not be required where all cooking equipment is served by listed grease extractors.

7.9.2.3  [move to 8.9.2.3]
Unless the requirements of 7.9.2.5 are met, standard sprinklers or automatic spray nozzles shall be so located as to provide for the protection of cooking equipment and cooking surfaces.

7.9.2.4  [move to 8.9.2.4]
Hoods containing automatic fire-extinguishing systems are protected areas; therefore, these hoods are not considered obstructions to overhead sprinkler systems and shall not require floor coverage underneath.

7.9.2.5  [move to 8.9.2.5]
Cooking equipment below hoods that contain automatic fire-extinguishing equipment is protected and shall not require protection from the overhead sprinkler system.

7.9.3  Sprinkler and Automatic Spray Nozzle Location — Ducts.  [move to 8.9.3]

7.9.3.1  [move to 8.9.3.1]
Unless the requirements of 7.9.3.2 or 7.9.3.4 are met, exhaust ducts shall have one sprinkler or automatic spray nozzle located at the top of each vertical riser and at the midpoint of each offset.

7.9.3.2  [move to 8.9.3.2]
Sprinklers or automatic spray nozzles shall not be required in a vertical riser located outside of a building, provided the riser does not expose combustible material or provided the interior of the building and the horizontal distance between the hood outlet and the vertical riser is at least 25 ft (7.6 m).

7.9.3.3  [move to 8.9.3.3]
Unless the requirements of 7.9.3.4 are met, horizontal exhaust ducts shall have sprinklers or automatic spray nozzle devices located on 10 ft (3.0 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.

7.9.3.4  [move to 8.9.3.4]
Sprinklers or automatic spray nozzles shall be required in ducts.

7.9.3.4.1  [move to 8.9.3.4.1]
Where ducts do not exceed 75 ft (23 m) in length and the entire exhaust duct is protected in accordance with NFPA 96, sprinkler(s) or automatic spray nozzle(s) shall not be required.

7.9.3.5  [move to 8.9.3.5]
A sprinkler(s) or an automatic spray nozzle(s) in exhaust ducts subject to freezing shall be properly protected against freezing by approved means. *(See 8.16.4.1.)*

**7.9.4 Sprinkler and Automatic Spray Nozzle Location — Duct Collar.** *(move to 8.9.4)*

**7.9.4.1** *(move to 8.9.4.1)*
Each hood exhaust duct collar shall have one sprinkler or automatic spray nozzle located 1 in. minimum to 12 in. maximum (25 mm minimum to 300 mm maximum) above the point of duct collar connection in the hood plenum.

**7.9.4.2** *(move to 8.9.4.2)*
Hoods that have listed fire dampers located in the duct collar shall be protected with a sprinkler or automatic spray nozzle located on the discharge side of the damper and shall be so positioned as not to interfere with damper operation.

**7.9.5 Sprinkler and Automatic Spray Nozzle Location — Exhaust Plenum Chambers.** *(move to 8.9.5)*

**7.9.5.1** *(move to 8.9.5.1)*
Hood exhaust plenum chambers shall have one sprinkler or automatic spray nozzle centered in each chamber not exceeding 10 ft (3.0 m) in length.

**7.9.5.2** *(move to 8.9.5.2)*
Plenum chambers greater than 10 ft (3.0 m) in length shall have two sprinklers or automatic spray nozzles evenly spaced, with the maximum distance between the two sprinklers not to exceed 10 ft (3.0 m).

**7.9.6 Sprinkler and Automatic Spray Nozzle Temperature Ratings and K-Factors.** *(move to 8.9.6)*

**7.9.6.1** *(move to 8.9.6.1)*
Where the exposed temperature is expected to be 300°F (149°C) or less, sprinklers or automatic spray nozzles being used in duct, duct collar, and plenum areas shall be of the extra high-temperature classification [325°F to 375°F (163°C to 191°C)].

**7.9.6.2** *(move to 8.9.6.2)*
When use of a temperature-measuring device indicates temperatures above 300°F (149°C), a sprinkler or automatic spray nozzle of higher classification shall be used.

**7.9.6.3** *(move to 8.9.6.3)*
Sprinklers or automatic spray nozzles being used in duct, duct collar, and plenum areas shall have orifices with K-factors not less than K-1.4 (20) and not more than K-5.6 (80).

**7.9.7 Sprinkler and Automatic Spray Nozzle.** *(move to 8.9.7)*
Access shall be provided to all sprinklers or automatic spray nozzles for examination and replacement.
7.9.8 Cooking Equipment. [move to 8.9.8]

7.9.8.1 General. [move to 8.9.8.1]
Cooking equipment (such as deep fat fryers, ranges, griddles, and broilers) that is considered to be a source of ignition shall be protected in accordance with the provisions of 7.9.1.

7.9.8.2 Deep Fat Fryers. [move to 8.9.8.2]

7.9.8.2.1 [move to 8.9.8.2.1]
A sprinkler or automatic spray nozzle used for protection of deep fat fryers shall be listed for that application.

7.9.8.2.2 [move to 8.9.8.2.2]
The position, arrangement, location, and water supply for each sprinkler or automatic spray nozzle shall be in accordance with its listing.

7.9.8.3 Fuel and Heat Shutoff. [move to 8.9.8.3]

7.9.8.3.1 [move to 8.9.8.3.1]
The operation of any cooking equipment sprinkler or automatic spray nozzle shall automatically shut off all sources of fuel and heat to all equipment requiring protection.

7.9.8.3.2 [move to 8.9.8.3.2]
Any gas appliance not requiring protection but located under ventilating equipment shall also be shut off.

7.9.8.3.3 [move to 8.9.8.3.3]
All shutdown devices shall be of the type that requires manual resetting prior to fuel or power being restored.

7.9.9 Indicating Valves. [move to 8.9.9]
A listed indicating valve shall be installed in the water supply line to the sprinklers and spray nozzles protecting the cooking and ventilating system.

7.9.10 Strainers. [move to 8.9.10]
A listed line strainer shall be installed in the main water supply preceding sprinklers or automatic spray nozzles having nominal K-factors smaller than K-2.8 (40).

7.9.11 Test Connection. [move to 8.9.11]
A system test connection shall be provided to verify proper operation of equipment specified in 7.9.8.3.

7.10 Additives and Coatings. [move to 7.8]

7.10.1 [move to 7.8.1]
Additives to the water supply intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

7.10.2 [move to 7.8.2]
Internal pipe coatings, excluding galvanizing, intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.
See attached file for the reorganization of existing Chapter 8.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_8.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Aug 05 17:21:51 EDT 2016

Committee Statement

Committee Statement: Chapter 8 is a compilation of former Chapter 7 & 8 and includes requirements for system types.
Response Message:
Chapter 8 Installation Requirements  [move to Chapter 9]

8.1* Basic Requirements. [move to 9.1]

8.1.1* [move to 9.1.1]
The requirements for spacing, location, and position of sprinklers shall be based on the following principles:
(1) Sprinklers shall be installed throughout the premises.
(2) Sprinklers shall be located so as not to exceed the maximum protection area per sprinkler.
(3) *Sprinklers shall be positioned and located so as to provide satisfactory performance with respect to activation time and distribution.
(4) Sprinklers shall be permitted to be omitted from areas specifically allowed by this standard.
(5) When sprinklers are specifically tested and test results demonstrate that deviations from clearance requirements to structural members do not impair the ability of the sprinkler to control or suppress a fire, their positioning and locating in accordance with the test results shall be permitted.
(6) Clearance between sprinklers and ceilings exceeding the maximums specified in this standard shall be permitted, provided that tests or calculations demonstrate comparable sensitivity and performance of the sprinklers to those installed in conformance with these sections.
(7) Furniture, such as portable wardrobe units, cabinets, trophy cases, and similar features not intended for occupancy, does not require sprinklers to be installed in them. This type of feature shall be permitted to be attached to the finished structure.
(8) *Sprinklers shall not be required to be installed within electrical equipment, mechanical equipment, or air handling units not intended for occupancy.

8.1.2* [move to 16.1.1]
System valves and gauges shall be accessible for operation, inspection, tests, and maintenance.

8.2 System Protection Area Limitations. [move to 4.5]

8.2.1 [move to 4.5.1]
The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser or combined system riser shall be as follows:
(1) Light hazard — 52,000 ft² (4830 m²)
(2) Ordinary hazard — 52,000 ft² (4830 m²)
(3) *Extra hazard — Hydraulically calculated — 40,000 ft² (3720 m²)
(4) Storage — High-piled storage (as defined in 3.9.1.16) and storage covered by other NFPA standards — 40,000 ft² (3720 m²)

8.2.2 [move to 4.5.2]
The floor area occupied by mezzanines shall not be included in the area limits of 8.2.1.

8.2.3 [move to 4.5.3]
Where single systems protect extra hazard, high-piled storage, or storage covered by other NFPA standards, and ordinary or light hazard areas, the extra hazard or storage area coverage shall not
exceed the floor area specified for that hazard and the total area coverage shall not exceed 52,000 ft² (4830 m²).

8.2.4 Floor Control Valve Assemblies. [move to 16.9.10]

8.2.4.1* [move to 16.9.10.1]
Multistory buildings exceeding two stories in height shall be provided with a floor control valve, check valve, main drain valve, and flow switch for isolation, control, and annunciation of water flow for each individual floor level.

8.2.4.2 [move to 16.9.10.2]
The floor control valve, check valve, main drain valve, and flow switch required by 8.2.4.1 shall not be required where sprinklers on the top level of a multistory building are supplied by piping on the floor below.

8.2.4.3 [move to 16.9.10.3]
The floor control valve, check valve, main drain valve, and flow switch required by 8.2.4.1 shall not be required where the total area of all floors combined does not exceed the system protection area limitations of 8.2.1.

8.2.4.4 [move to 16.9.10.4]
The requirements of 8.2.4 shall not apply to dry systems in parking garages.

8.2.5 [move to 4.5.4.1]
Multiple buildings attached by canopies, covered breezeways, common roofs, or a common wall(s) shall be permitted to be supplied by a single fire sprinkler riser.

8.2.5.1 [move to 4.5.4.2]
The maximum system size shall comply with 8.2.1.

8.2.6* Detached Buildings. [move to 4.5.5]

8.2.6.1 [move to 4.5.5.1]
Unless the requirements of 8.2.6.2 apply, detached buildings, regardless of separation distance, that do not meet the criteria of 8.2.5 shall be provided with separate fire sprinkler systems.

8.2.6.2 [move to 4.5.5.2]
When acceptable to the authority having jurisdiction, detached structures shall be permitted to be supplied by the fire sprinkler system of an adjacent building.

8.3 Use of Sprinklers. [move to 9.4]

8.3.1 General. [move to 9.4.1]

8.3.1.1* [move to 9.4.1.1]
Sprinklers shall be installed in accordance with their listing.
8.3.1.2 [move to 9.4.1.2]
The requirements of 8.3.1.1 shall not apply where construction features or other special situations require unusual water distribution, and listed sprinklers shall be permitted to be installed in positions other than anticipated by their listing to achieve specific results.

8.3.1.3* [move to 9.4.1.3]
Upright sprinklers shall be installed with the frame arms parallel to the branch line, unless specifically listed for other orientation.

8.3.1.4 [move to 9.4.1.4]
Where solvent cement is used as the pipe and fittings bonding agent, sprinklers shall not be installed in the fittings prior to the fittings being cemented in place.

8.3.1.5 Protective Caps and Straps. [move to 9.4.1.5]

8.3.1.5.1* [move to 9.4.1.5.1]
Protective caps and straps shall be removed using means that are in accordance with the manufacturer's installation instructions.

8.3.1.5.2* [move to 9.4.1.5.2]
Protective caps and straps shall be removed from all sprinklers prior to the time when the sprinkler system is placed in service.

8.3.1.5.3 [move to 9.4.1.5.3]
Protective caps and straps on all upright sprinklers or on any sprinklers installed more than 10 ft (3.0 m) above the floor shall be permitted to be removed from sprinklers immediately following their installation.

8.3.2 Temperature Ratings. [move to 9.4.2]

8.3.2.1* [move to 9.4.2.1]
Unless the requirements of 8.3.2.2, 8.3.2.3, 8.3.2.4, or 8.3.2.5 are met, ordinary- and intermediate-temperature sprinklers shall be used throughout buildings.

8.3.2.2 [move to 9.4.2.2]
Where maximum ceiling temperatures exceed 100°F (38°C), sprinklers with temperature ratings in accordance with the maximum ceiling temperatures of Table 6.2.5.1 shall be used.

8.3.2.3 [move to 9.4.2.3]
High-temperature sprinklers shall be permitted to be used throughout ordinary and extra hazard occupancies, storage occupancies, and as allowed in this standard and other NFPA codes and standards.

8.3.2.4 [move to 9.4.2.4]
Sprinklers of intermediate- and high-temperature classifications shall be installed in specific locations as required by 8.3.2.5.

**8.3.2.5** [move to 9.4.2.5]
The following practices shall be observed to provide sprinklers of other than ordinary-temperature classification unless other temperatures are determined or unless high-temperature sprinklers are used throughout, and temperature selection shall be in accordance with Table 8.3.2.5(a), Table 8.3.2.5(b), Table 8.3.2.5(c), and Figure 8.3.2.5:

1. *Sprinklers in the high-temperature zone shall be of the high-temperature classification, and sprinklers in the intermediate-temperature zone shall be of the intermediate-temperature classification.*
2. Sprinklers located within 12 in. (300 mm) to one side or 30 in. (750 mm) above an uncovered steam main, heating coil, or radiator shall be of the intermediate-temperature classification.
3. Sprinklers within 7 ft (2.1 m) of a low-pressure blowoff valve that discharges free in a large room shall be of the high-temperature classification.
4. Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.
5. Sprinklers in an unventilated, concealed space, under an uninsulated roof, or in an unventilated attic shall be of the intermediate-temperature classification.
6. Sprinklers in unventilated show windows having high-powered electric lights near the ceiling shall be of the intermediate-temperature classification.
7. Sprinklers protecting commercial-type cooking equipment and ventilation systems shall be of the high- or extra high-temperature classification as determined by use of a temperature-measuring device. (See 7.9.6.)
8. Sprinklers protecting residential areas installed near specific heat sources identified in Table 8.3.2.5(c) shall be installed in accordance with Table 8.3.2.5(c).
9. Ordinary-temperature sprinklers located adjacent to a heating duct that discharges air that is less than 100°F (38°C) are not required to be separated in accordance with Table 8.3.2.5(a).
10. Sprinklers in walk-in type coolers and freezers with automatic defrosting shall be of the intermediate-temperature classification or higher.

### Table 8.3.2.5(a) Temperature Ratings of Sprinklers Based on Distance from Heat Sources

<table>
<thead>
<tr>
<th>Type of Heat Condition</th>
<th>Ordinary-Temperature Rating</th>
<th>Intermediate-Temperature Rating</th>
<th>High-Temperature Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Heating ducts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Above</td>
<td>More than 2 ft 6 in. (750 mm)</td>
<td>2 ft 6 in. or less (750 mm)</td>
<td></td>
</tr>
<tr>
<td>(b) Side and below</td>
<td>More than 1 ft 0 in. (300 mm)</td>
<td>1 ft 0 in. or less (300 mm)</td>
<td></td>
</tr>
<tr>
<td>(c) Diffuser</td>
<td>Any distance except as shown under Intermediate-</td>
<td>Downward discharge: Cylinder with 1 ft 0 in. (300 mm) radius from edge extending 1 ft 0 in. below and 2 ft 6 in. (750 mm) above</td>
<td></td>
</tr>
<tr>
<td>Type of Heat Condition</td>
<td>Ordinary-Temperature Rating</td>
<td>Intermediate-Temperature Rating</td>
<td>High-Temperature Rating</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td>Rating column</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal discharge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Semicylinder or cylinder with 2 ft 6 in. (750 mm) radius in direction of flow extending 1 ft 0 in. (300 mm) below and 2 ft 6 in. (750 mm) above</em></td>
<td></td>
</tr>
<tr>
<td>(2) Unit heater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Horizontal discharge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Discharge side:</em> 7 ft 0 in. (2.1 m) to 20 ft 0 in. (6.1 m) radius pie-shaped cylinder (<em>see Figure 8.3.2.5</em>) extending 7 ft 0 in. (2.1 m) above and 2 ft 0 (600 mm) in. below heater; also 7 ft 0 in. (2.1 m) radius cylinder more than 7 ft 0 in. (2.1 m) above unit heater</td>
<td></td>
</tr>
<tr>
<td>(b) Vertical downward discharge (<em>for sprinklers below unit heater, see Figure 8.3.2.5</em>)</td>
<td></td>
<td>7 ft 0 in. (2.1 m) radius cylinder extending upward from an elevation 7 ft 0 in. (2.1 m) above unit heater</td>
<td>7 ft 0 in. (2.1 m) radius cylinder extending from the top of the unit heater to an elevation 7 ft 0 in. (2.1 m) above unit heater</td>
</tr>
<tr>
<td>(3) Steam mains (uncovered)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Above</td>
<td>More than 2 ft 6 in. (750 mm)</td>
<td>2 ft 6 in. or less (750 mm)</td>
<td></td>
</tr>
<tr>
<td>(b) Side and below</td>
<td>More than 1 ft 0 in. (300 mm)</td>
<td>1 ft 0 in. or less (300 mm)</td>
<td></td>
</tr>
<tr>
<td>(c) Blowoff valve</td>
<td>More than 7 ft 0 in. (2.1 m)</td>
<td></td>
<td>7 ft 0 in. or less (2.1 m)</td>
</tr>
</tbody>
</table>

Table 8.3.2.5(b) Temperature Ratings of Sprinklers in Specified Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Ordinary-Temperature Rating</th>
<th>Intermediate-Temperature Rating</th>
<th>High-Temperature Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skylights</td>
<td>Glass or plastic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attics</td>
<td>Do not use</td>
<td>Ventilated or unventilated</td>
<td></td>
</tr>
<tr>
<td>Peaked roof: metal or thin boards, concealed or</td>
<td>Ventilated</td>
<td>Unventilated</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Ordinary-Temperature Rating</td>
<td>Intermediate-Temperature Rating</td>
<td>High-Temperature Rating</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------</td>
<td>---------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>not concealed, insulated or uninsulated</td>
<td></td>
<td>Note: For uninsulated roof, climate and insulated or uninsulated occupancy can necessitate intermediate sprinklers. Check on job.</td>
<td></td>
</tr>
<tr>
<td>Flat roof: metal, not concealed</td>
<td>Ventilated or unventilated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flat roof: metal, concealed, insulated or uninsulated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Show windows</td>
<td>Ventilated</td>
<td>Unventilated</td>
<td></td>
</tr>
</tbody>
</table>

Note: A check of job condition by means of thermometers might be necessary.

Table 8.3.2.5(c) Temperature Ratings of Sprinklers in Specified Residential Areas

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler</th>
<th>Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>In.</td>
<td>mm</td>
<td>In.</td>
</tr>
<tr>
<td>Side of open or recessed fireplace</td>
<td>36</td>
<td>915</td>
</tr>
<tr>
<td>Front of recessed fireplace</td>
<td>60</td>
<td>1525</td>
</tr>
<tr>
<td>Coal- or wood-burning stove</td>
<td>42</td>
<td>1070</td>
</tr>
<tr>
<td>Kitchen range</td>
<td>18</td>
<td>460</td>
</tr>
<tr>
<td>Wall oven</td>
<td>18</td>
<td>460</td>
</tr>
<tr>
<td>Hot air flues</td>
<td>18</td>
<td>460</td>
</tr>
<tr>
<td>Uninsulated heat ducts</td>
<td>18</td>
<td>460</td>
</tr>
<tr>
<td>Uninsulated hot water pipes</td>
<td>12</td>
<td>305</td>
</tr>
<tr>
<td>Side of ceiling- or wall-mounted hot air diffusers</td>
<td>24</td>
<td>610</td>
</tr>
<tr>
<td>Front of wall-mounted hot air diffusers</td>
<td>36</td>
<td>915</td>
</tr>
<tr>
<td>Hot water heater or furnace</td>
<td>6</td>
<td>155</td>
</tr>
<tr>
<td>Light fixture: 0 W–250 W</td>
<td>6</td>
<td>155</td>
</tr>
<tr>
<td>250 W–499 W</td>
<td>12</td>
<td>305</td>
</tr>
</tbody>
</table>

Figure 8.3.2.5 High-Temperature and Intermediate-Temperature Zones at Unit Heaters.
8.3.2.6 [move to 9.4.2.6]
In case of occupancy change involving temperature change, the sprinklers shall be changed accordingly.

8.3.2.7* [move to 9.4.2.7]
The minimum temperature rating of ceiling sprinklers in general storage, rack storage, rubber tire storage, roll paper storage, and baled cotton storage applications shall be 150°F (66°C).

8.3.3 Thermal Sensitivity. [move to 9.4.3]

8.3.3.1* [move to 9.4.3.1]
Sprinklers in light hazard occupancies shall be one of the following:
(1) Quick-response type as defined in 3.6.4.8
(2) Residential sprinklers in accordance with the requirements of 8.4.5
(3) Quick response CMSA sprinklers
(4) ESFR sprinklers
(5) Standard-response sprinklers used for modifications or additions to existing light hazard systems equipped with standard-response sprinklers
(6) Standard-response sprinklers used where individual standard-response sprinklers are replaced in existing light hazard systems

8.3.3.2 [move to 9.4.3.2]
Where quick-response sprinklers are installed, all sprinklers within a compartment shall be quick-response unless otherwise permitted in 8.3.3.3, 8.3.3.4, or 8.3.3.5.

8.3.3.3 [move to 9.4.3.3]
Where there are no listed quick-response sprinklers in the temperature range required, standard-response sprinklers shall be permitted to be used.

8.3.3.4 [move to 9.4.3.4]
The provisions of 8.3.3.2 shall not apply to in-rack sprinklers.

8.3.3.5 [move to 9.4.3.5]
Where a sprinkler carries a listing for both standard-response protection and quick-response protection at different coverage areas, that sprinkler shall be permitted to be installed within a compartment at the spacing for both the quick-response and standard-response listings without any separation between the areas so covered.

8.3.3.6 [move to 9.4.3.6]
When existing light hazard systems are converted to use quick-response or residential sprinklers, all sprinklers in a compartment shall be changed.

8.3.4 Sprinklers with K-Factors Less than K-5.6 (80). [move to 9.4.4]

8.3.4.1 [move to 9.4.4.1]
Sprinklers shall have a minimum nominal K-factor of 5.6 (80) unless otherwise permitted by 8.3.4.

8.3.4.2 [move to 9.4.4.2]
For light hazard occupancies not requiring as much water as is discharged by a sprinkler with a nominal K-factor of K-5.6 (80) operating at 7 psi (0.5 bar), sprinklers having a smaller orifice shall be permitted, subject to the following restrictions:
(1) The system shall be hydraulically calculated.
(2) Sprinklers with nominal K-factors of less than K-5.6 (80) shall be installed only in wet pipe sprinkler systems or in accordance with the limitations of 8.3.4.3 or 8.3.4.4.
(3) A listed strainer shall be provided on the supply side of sprinklers with nominal K-factors of less than K-2.8 (40).

8.3.4.3 [move to 9.4.4.3]
Sprinklers with nominal K-factors of less than K-5.6 (80) shall be permitted to be installed in conformance with 11.3.2 for protection against exposure fires.

8.3.4.4 [move to 9.4.4.4]
Sprinklers with nominal K-factors of K-4.2 (57) shall be permitted to be installed on dry pipe and preaction systems protecting light hazard occupancies where piping is corrosion resistant or internally galvanized.

8.3.5 Thread Size Limitations. [move to 9.4.5]
Sprinklers having a K-factor exceeding K-5.6 (80) and having 1⁄2 in. (15 mm) National Pipe Thread (NPT) shall not be installed in new sprinkler systems.

8.4* Application of Sprinkler Types. —being deleted with an FR
Sprinklers shall be selected for use as indicated in this section and shall be positioned and spaced as described in Section 8.5.

8.4.1 Standard Upright and Pendent Spray Sprinklers. —being deleted with an FR

8.4.1.1 [move to 10.2.2]
Upright and pendent spray sprinklers shall be permitted in all occupancy hazard classifications and building construction types unless the requirements of 8.15.1.6 apply.

8.4.1.2 [move to 10.2.3]
Quick-response sprinklers shall not be permitted for use in extra hazard occupancies under the density/area design method.

8.4.2 Sidewall Spray Sprinklers. [move to 10.3.2]
Sidewall sprinklers shall only be installed as follows:
(1) Light hazard occupancies with smooth, horizontal or sloped, flat ceilings
(2) Ordinary hazard occupancies with smooth, flat ceilings where specifically listed for such use
(3) To protect areas below overhead doors

8.4.3 Extended Coverage Sprinklers. [move to 11.2.2]
Extended coverage sprinklers shall only be installed as follows:
(1) In unobstructed construction consisting of flat, smooth ceilings with a slope not exceeding a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
(2) In unobstructed or noncombustible obstructed construction, where specifically listed for such use
(3) Within trusses or bar joists having web members not greater than 1 in. (25 mm) maximum dimension or where trusses are spaced greater than 71⁄2 ft (2.3 m) on center and where the ceiling slope does not exceed a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
(4) Extended coverage upright and pendent sprinklers installed under smooth, flat ceilings that have slopes not exceeding a pitch of 1 in 3 (a rise of 4 units in a run of 12 units, a roof slope of 33.3 percent), where specifically listed for such use
(5) Extended coverage sidewall sprinklers installed in accordance with 8.9.4.2.2 in slopes exceeding a ceiling pitch of 2 in 12
(6) In each bay of obstructed construction consisting of solid structural members that extend below the deflector of the sprinkler
(7) Extended coverage sprinklers installed to protect areas below a single overhead door(s)

8.4.4 Open Sprinklers. [move to 15.1]

8.4.4.1 [move to 15.1.1]
Open sprinklers shall be permitted to be used in deluge systems to protect special hazards or exposures or in other special locations.

8.4.4.2 [move to 15.1.2]
Open sprinklers shall be installed in accordance with all applicable requirements of this standard for their automatic counterpart.

8.4.5 Residential Sprinklers.—being deleted with an FR

8.4.5.1* [moved to 12.1.1]
Residential sprinklers shall be permitted in dwelling units and their adjoining corridors, provided they are installed in conformance with their listing.

8.4.5.2 [moved to 12.1.2]
Residential sprinklers shall be used only in wet systems unless specifically listed for use in dry systems or preaction systems.

8.4.5.3 [moved to 12.1.3]
Where residential sprinklers are installed in a compartment as defined in 3.3.6, all sprinklers within the compartment shall be residential sprinklers.

8.4.6 Early Suppression Fast-Response (ESFR) Sprinklers.—being deleted with an FR

8.4.6.1 [move to 14.2.2]
ESFR sprinklers shall be used only in wet pipe systems unless specifically listed for use in dry systems.

8.4.6.2 [move to 14.2.3]
ESFR sprinklers shall be installed only in buildings where roof or ceiling slope above the sprinklers does not exceed a pitch of 2 in 12 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent).

8.4.6.3* [move to 14.2.4]
ESFR sprinklers shall be permitted for use in buildings with unobstructed and noncombustible obstructed construction.

8.4.6.3.1 [move to 14.2.4.1]
Where depths of the solid structural members (beams, stem, and so forth) exceed 12 in. (300 mm), ESFR sprinklers shall be installed in each channel formed by the solid structural members.

8.4.6.3.2 [move to 14.2.4.2]
Minimum sprinkler spacing and area of coverage shall comply with the requirements of 8.12.2 and 8.12.3.

8.4.6.4 Draft Curtains. [move to 14.2.5]

8.4.6.4.1 [move to 14.2.5.1]
Where ESFR sprinkler systems are installed adjacent to sprinkler systems with standard-response sprinklers, a draft curtain of noncombustible construction and at least 2 ft (600 mm) in depth shall be required to separate the two areas.

8.4.6.4.2 [move to 14.2.5.2]
A clear aisle of at least 4 ft (1.2 m) centered below the draft curtain shall be maintained for separation.

8.4.6.5 Temperature Ratings. [move to 14.2.6]
Sprinkler temperature ratings for ESFR sprinklers shall be ordinary unless 8.3.2 requires intermediate- or high-temperature ratings.

8.4.6.6 Occupancy and Hazard. [move to 14.2.7]
ESFR sprinklers designed to meet any criteria in Chapter 12 through Chapter 20 shall be permitted to protect light and ordinary hazard occupancies.

8.4.7 Control Mode Specific Application (CMSA) Sprinklers. —being deleted with an FR

8.4.7.1 [move to 13.2.2]
CMSA sprinklers shall be permitted to be used in wet, dry, or preaction systems and shall be installed in accordance with their listing.

8.4.7.2 Temperature Ratings. [move to 13.2.3]

8.4.7.2.1 [move to 13.2.3.1]
Unless the requirements of 8.4.7.2.2, 8.4.7.2.3, or 8.4.7.2.4 are met, sprinkler temperature ratings shall be the same as those indicated in Table 8.3.2.5(a) and Table 8.3.2.5(b) or those used in large-scale fire testing to determine the protection requirements for the hazard involved.

8.4.7.2.2 [move to 13.2.3.2]
Sprinklers of intermediate- and high-temperature ratings shall be installed in specific locations as required by 8.3.2.

8.4.7.2.3 [move to 13.2.3.3]
In storage occupancies, ordinary, intermediate, or high temperature–rated sprinklers shall be used for wet pipe systems.

8.4.7.2.4 [move to 13.2.3.4]
In storage occupancies, high temperature–rated sprinklers shall be used for dry pipe systems.

8.4.7.3 Occupancy and Hazard. [move to 13.2.4]

8.4.7.3.1 [move to 13.2.4.1]
Quick-response CMSA sprinklers designed to meet any criteria in Chapter 12 through Chapter 20 shall be permitted to protect light and ordinary hazard occupancies.

8.4.7.3.2 [move to 13.2.4.2]
Standard-response CMSA sprinklers designed to meet any criteria in Chapter 12 through Chapter 20 shall be permitted to protect ordinary hazard occupancies.

8.4.8 Special Sprinklers. [move to 15.2]

8.4.8.1* [move to 15.2.1]
Special sprinklers that are intended for the protection of specific hazards or construction features shall be permitted where such devices have been evaluated and listed for performance under the following conditions:
(1) Fire tests related to the intended hazard
(2) Distribution of the spray pattern with respect to wetting of floors and walls
(3) Distribution of the spray pattern with respect to obstructions
(4) Evaluation of the thermal sensitivity of the sprinkler
(5) Performance under horizontal or sloped ceilings
(6) Area of design
(7) Allowable clearance to ceilings

8.4.8.2 [move to 15.2.2]
Special sprinklers shall maintain the following characteristics:
(1) K-factor size shall be in accordance with 6.2.3.
(2) Temperature ratings shall be in accordance with Table 6.2.5.1.
(3) The protection area of coverage shall not exceed 400 ft² (37 m²) for light hazard and ordinary hazard occupancies.
(4) The protection area of coverage shall not exceed 196 ft² (18.2 m²) for extra hazard and high-piled storage occupancies.

8.4.9 Dry Sprinklers. [move to 15.3]

8.4.9.1* [move to 15.3.1]
Where dry sprinklers are connected to wet pipe sprinkler systems protecting areas subject to freezing temperatures, the minimum exposed length of the barrel of the dry sprinkler shall be in accordance with Table 8.4.9.1(a) or Table 8.4.9.1(b).
Table 8.4.9.1(a) Exposed Barrel Lengths for Dry Sprinklers (U.S. Customary Units)

<table>
<thead>
<tr>
<th>Ambient Temperature Exposed to Discharge End of Sprinkler (°F)</th>
<th>Minimum Exposed Barrel Length when Exposed to 40°F (in.)</th>
<th>Minimum Exposed Barrel Length when Exposed to 50°F (in.)</th>
<th>Minimum Exposed Barrel Length when Exposed to 60°F (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>12</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>−10</td>
<td>14</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>−20</td>
<td>14</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>−30</td>
<td>16</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>−40</td>
<td>18</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>−50</td>
<td>20</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>−60</td>
<td>20</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 8.4.9.1(b) Exposed Barrel Lengths for Dry Sprinklers (Metric Units)

<table>
<thead>
<tr>
<th>Ambient Temperature Exposed to Discharge End of Sprinkler (°C)</th>
<th>Minimum Exposed Barrel Length when Exposed to 4°C (mm)</th>
<th>Minimum Exposed Barrel Length when Exposed to 10°C (mm)</th>
<th>Minimum Exposed Barrel Length when Exposed to 16°C (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>−1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>−7</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>−12</td>
<td>200</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>−18</td>
<td>300</td>
<td>75</td>
<td>0</td>
</tr>
<tr>
<td>−23</td>
<td>350</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>−29</td>
<td>350</td>
<td>150</td>
<td>75</td>
</tr>
<tr>
<td>−34</td>
<td>400</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>−40</td>
<td>450</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>−46</td>
<td>500</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>−51</td>
<td>500</td>
<td>250</td>
<td>150</td>
</tr>
</tbody>
</table>

8.4.9.2 [move to 15.3.2]
The minimum barrel length shall be measured from the face of the fitting to which the dry sprinkler is installed to the inside surface of the insulation, wall, or ceiling leading to the cold space, whichever is closest to the fitting.

8.4.9.3* [move to 15.3.3]
Where dry sprinklers are connected to wet pipe sprinkler systems protecting insulated freezer structures, the clearance space around the sprinkler barrel shall be sealed.
8.5 Position, Location, Spacing, and Use of Sprinklers. [move to 9.5]

8.5.1 General. [move to 9.5.1]

8.5.1.1 Sprinklers shall be located, spaced, and positioned in accordance with the requirements of Section 8.5.

8.5.1.2 Sprinklers shall be positioned to provide protection of the area consistent with the overall objectives of this standard by controlling the positioning and allowable area of coverage for each sprinkler.

8.5.1.3 The requirements of 8.5.2 through 8.5.7 shall apply to all sprinkler types unless modified by more restrictive rules in Section 8.6 through Section 8.12.

8.5.2 Protection Areas per Sprinkler. [move to 9.5.2]

8.5.2.1 Determination of Protection Area of Coverage. [move to 9.5.2.1]

8.5.2.1.1 The protection area of coverage per sprinkler \( A_s \) shall be determined as follows:

(1) Along branch lines as follows:
   (a) Determine distance between sprinklers (or to wall or obstruction in the case of the end sprinkler on the branch line) upstream and downstream
   (b) Choose the larger of either twice the distance to the wall or the distance to the next sprinkler
   (c) Define dimension as \( S \)

(2) Between branch lines as follows:
   (a) Determine perpendicular distance to the sprinkler on the adjacent branch line (or to a wall or obstruction in the case of the last branch line) on each side of the branch line on which the subject sprinkler is positioned
   (b) Choose the larger of either twice the distance to the wall or obstruction or the distance to the next sprinkler
   (c) Define dimension as \( L \)

8.5.2.1.2 The protection area of coverage of the sprinkler shall be established by multiplying the \( S \) dimension by the \( L \) dimension, as follows:

\[ A_s = S \times L \]

8.5.2.2 Maximum Protection Area of Coverage. [move to 9.5.2.2]

8.5.2.2.1 The maximum allowable protection area of coverage for a sprinkler \( A_s \) shall be in accordance with the value indicated in the section for each type or style of sprinkler.
8.5.2.2  The maximum area of coverage of any sprinkler shall not exceed 400 ft² (37 m²).

8.5.3  Sprinkler Spacing.  

8.5.3.1  Maximum Distance Between Sprinklers.  

8.5.3.1.1  The maximum distance permitted between sprinklers shall be based on the centerline distance between adjacent sprinklers.

8.5.3.1.2  The maximum distance shall be measured along the slope of the ceiling.

8.5.3.1.3  The maximum distance permitted between sprinklers shall comply with the value indicated in the applicable section for each type or style of sprinkler.

8.5.3.2  Maximum Distance from Walls.  

8.5.3.2.1  The distance from sprinklers to walls shall not exceed one-half of the allowable maximum distance between sprinklers.

8.5.3.2.2  The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.5.3.2.3  The distance from the wall to the sprinkler shall be measured to the wall behind furniture, such as wardrobes, cabinets, and trophy cases.

8.5.3.2.4  The distance from the wall to the sprinkler shall be measured to the wall when sprinklers are spaced near windows and no additional floor space is created.

8.5.3.3  Minimum Distance from Walls.  

8.5.3.3.1  The minimum distance permitted between a sprinkler and the wall shall comply with the value indicated in the applicable section for each type or style of sprinkler.

8.5.3.3.2  The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.5.3.4  Minimum Distance Between Sprinklers.  

8.5.3.4.1 [move to 9.5.3.4.1]
A minimum distance shall be maintained between sprinklers to prevent operating sprinklers from wetting adjacent sprinklers and to prevent skipping of sprinklers.

8.5.3.4.2 [move to 9.5.3.4.2]
The minimum distance permitted between sprinklers shall comply with the value indicated in the applicable section for each type or style of sprinkler.

8.5.4 Deflector Position. [move to 9.5.4]

8.5.4.1* Distance Below Ceilings. [move to 9.5.4.1]

8.5.4.1.1 [move to 9.5.4.1.1]
The distances between the sprinkler deflector and the ceiling above shall be selected based on the type of sprinkler and the type of construction.

8.5.4.1.2 Corrugated Metal Deck Roofs. [move to 9.5.4.1.2]

8.5.4.1.2.1 [move to 9.5.4.1.2.1]
For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the distance shall be measured to the sprinkler from the bottom of the deck.

8.5.4.1.2.2 [move to 9.5.4.1.2.2]
For decks deeper than 3 in. (75 mm), the distance shall be measured to the highest point on the deck.

8.5.4.1.3 [move to 9.5.4.1.3]
For ceilings that have insulation installed directly against underside of the ceiling or roof structure, the deflector distance shall be measured from the bottom of the insulation and shall be in accordance with 8.5.4.1.3.1 or 8.5.4.1.3.2.

8.5.4.1.3.1 [move to 9.5.4.1.3.1]
For insulation that is installed directly against the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the deflector distance shall be measured to the underside of the insulation.

8.5.4.1.3.2 [move to 9.5.4.1.3.2]
For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the deflector distance shall be measured as half of the distance of the deflection from the insulation high point to the insulation low point.

(A)
If the deflection or sag in the insulation exceeds 6 in. (150 mm), the deflector distance shall be measured to the high point of the insulation.
(B)
The deflector shall not be positioned above the low point of the insulation.

8.5.4.1.4* [move to 9.5.4.1.4]
Heat collectors shall not be used as a means to assist the activation of a sprinkler.

8.5.4.2  Deflector Orientation.  [move to 9.5.4.2]
Deflectors of sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs.

8.5.5  Obstructions to Sprinkler Discharge.  [move to 9.5.5]

8.5.5.1* Performance Objective.  [move to 9.5.5.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.5.5.2 and 8.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.  (See Figure A.8.5.5.1.)

8.5.5.2* Obstructions to Sprinkler Discharge Pattern Development.  [move to 9.5.5.2]

8.5.5.2.1 [move to 9.5.5.2.1]
Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 8.5.5.2.

8.5.5.2.2 [move to 9.5.5.2.2]
Sprinklers shall be positioned in accordance with the minimum distances and special requirements of Section 8.6 through Section 8.12 so that they are located sufficiently away from obstructions such as truss webs and chords, pipes, columns, and fixtures.

8.5.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard.  [move to 9.5.5.3]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 8.5.5.3.

8.5.5.3.1* [move to 9.5.5.3.1]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) in width.

8.5.5.3.1.1 [move to 9.5.5.3.1.1]
Sprinklers shall be located below the obstruction and not more than 3 in. (75 mm) from the outside edge of the obstruction.

8.5.5.3.1.2 [move to 9.5.5.3.1.2]
Where sprinklers are located adjacent to the obstruction, they shall be of the intermediate level rack type.

8.5.5.3.1.3 [move to 9.5.5.3.1.3]
The deflector of automatic sprinklers installed under fixed obstructions shall be positioned no more than 12 in. (300 mm) below the bottom of the obstruction.

8.5.5.3.1.4 [move to 9.5.5.3.1.4]
Sprinklers shall not be required under noncombustible obstructions over 4 ft (1.2 m) wide where the bottom of the obstruction is 24 in. (600 mm) or less above the floor or deck.

8.5.5.3.2 [move to 9.5.5.3.2]
Sprinklers shall not be required under obstructions that are not fixed in place, such as conference tables.

8.5.5.3.3 [move to 9.5.5.3.3]
Sprinklers installed under obstructions shall be of the same type (spray, CMSA, ESFR, residential) as installed at the ceiling except as permitted by 8.5.5.3.3.1.

8.5.5.3.3.1 [move to 9.5.5.3.3.1]
Spray sprinklers shall be permitted to be utilized under overhead doors.

8.5.5.3.4* [move to 9.5.5.3.4]
Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

8.5.5.4 Closets. [move to 9.5.5.4]
In all closets and compartments, including those closets housing mechanical equipment, that are not larger than 400 ft³ (11.3 m³) in size, a single sprinkler at the highest ceiling level shall be sufficient without regard to obstructions or minimum distance to the wall.

8.5.6 Clearance from Deflector to Storage. [move to 9.5.6]

8.5.6.1* [move to 9.5.6.1]
Unless the requirements of 8.5.6.2, 8.5.6.3, 8.5.6.4, or 8.5.6.5 are met, the clearance between the deflector and the top of storage or contents of the room shall be 18 in. (450 mm) or greater.

8.5.6.2 [move to 9.5.6.2]
Where other standards specify greater clearance to storage minimums, they shall be followed.

8.5.6.3 [move to 9.5.6.3]
A minimum clearance to storage of 36 in. (900 mm) shall be permitted for special sprinklers.

8.5.6.4 [move to 9.5.6.4]
A minimum clearance to storage of less than 18 in. (450 mm) between the top of storage and ceiling sprinkler deflectors shall be permitted where proven by successful large-scale fire tests for the particular hazard.

8.5.6.5 [move to 9.5.6.5]
The clearance from the top of storage to sprinkler deflectors shall be not less than 36 in. (900 mm) where rubber tires are stored.

8.5.7 Skylights. [move to 9.3.16]

8.5.7.1 [move to 9.3.16.1]
Sprinklers shall be permitted to be omitted from skylights not exceeding 32 ft² (3.0 m²) in area, regardless of hazard classification, that are separated by at least 10 ft (3.0 m) horizontally from any other unprotected skylight or unprotected ceiling pocket.

8.5.7.1.1 [move to 9.3.16.1.1]
When a sprinkler is installed directly beneath a skylight not exceeding 32 ft² (3.0 m²), the distance to the ceiling shall be measured to the plane of the ceiling as if the skylight was not present.

8.5.7.2 [move to 9.3.16.2]
Skylights not exceeding 32 ft² (3.0 m²) shall be permitted to have a plastic cover.

8.6 Standard Pendent and Upright Spray Sprinklers. [move to 10.2]

8.6.1 General. [move to 10.2.1]
All requirements of Section 8.5 shall apply to standard pendent and upright spray sprinklers except as modified in Section 8.6.

8.6.2 Protection Areas per Sprinkler (Standard Pendent and Upright Spray Sprinklers). [move to 10.2.4]

8.6.2.1 Determination of Protection Area of Coverage. [move to 10.2.4.1]

8.6.2.1.1 [move to 10.2.4.1.1]
Except as permitted by 8.6.2.1.2, the protection area of coverage per sprinkler (As) shall be determined in accordance with 8.5.2.1.

8.6.2.1.2 [move to 10.2.4.1.2]
The requirements of 8.6.2.1.1 shall not apply in a small room as defined in 3.3.22.

8.6.2.1.2.1 [move to 10.2.4.1.2.1]
The protection area of coverage for each sprinkler in the small room shall be the area of the room divided by the number of sprinklers in the room.

8.6.2.2 Maximum Protection Area of Coverage. [move to 10.2.4.2]

8.6.2.2.1* [move to 10.2.4.2.1]
The maximum allowable protection area of coverage for a sprinkler (As) shall be in accordance with the value indicated in Table 8.6.2.2.1(a) through Table 8.6.2.2.1(d).
Table 8.6.2.2.1(a) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Light Hazard

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>System Type</th>
<th>Maximum Protection Area</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft²</td>
<td>m²</td>
</tr>
<tr>
<td>Noncombustible unobstructed</td>
<td>Hydraulically calculated</td>
<td>225</td>
<td>20.9</td>
</tr>
<tr>
<td>Noncombustible unobstructed</td>
<td>Pipe schedule</td>
<td>200</td>
<td>18.6</td>
</tr>
<tr>
<td>Noncombustible obstructed</td>
<td>Hydraulically calculated</td>
<td>225</td>
<td>20.9</td>
</tr>
<tr>
<td>Noncombustible obstructed</td>
<td>Pipe schedule</td>
<td>200</td>
<td>18.6</td>
</tr>
<tr>
<td>Combustible unobstructed with no exposed members</td>
<td>Hydraulically calculated</td>
<td>225</td>
<td>20.9</td>
</tr>
<tr>
<td>Combustible unobstructed with no exposed members</td>
<td>Pipe schedule</td>
<td>200</td>
<td>18.6</td>
</tr>
<tr>
<td>Combustible unobstructed with exposed members 3 ft (910 mm) or more on center</td>
<td>Hydraulically calculated</td>
<td>225</td>
<td>20.9</td>
</tr>
<tr>
<td>Combustible unobstructed with exposed members 3 ft (910 mm) or more on center</td>
<td>Pipe schedule</td>
<td>200</td>
<td>18.6</td>
</tr>
<tr>
<td>Combustible unobstructed with members less than 3 ft (910 mm) on center</td>
<td>All</td>
<td>130</td>
<td>12.1</td>
</tr>
<tr>
<td>Combustible obstructed with exposed members 3 ft (910 mm) or more on center</td>
<td>All</td>
<td>168</td>
<td>15.6</td>
</tr>
<tr>
<td>Combustible obstructed with members less than 3 ft (910 mm) on center</td>
<td>All</td>
<td>130</td>
<td>12.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120</td>
<td>11.1</td>
</tr>
<tr>
<td>*See 8.6.4.1.4.4.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.6.2.2.1(b) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Ordinary Hazard

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>System Type</th>
<th>Protection Area</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft²</td>
<td>m²</td>
</tr>
<tr>
<td>All</td>
<td>All</td>
<td>130</td>
<td>12.1</td>
</tr>
</tbody>
</table>
Table 8.6.2.2.1(c) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Extra Hazard Construction

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>System Type</th>
<th>Protection Area</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft² m²</td>
<td>ft m</td>
</tr>
<tr>
<td>All</td>
<td>Pipe schedule</td>
<td>90 8.4</td>
<td>12* 3.7*</td>
</tr>
<tr>
<td>All</td>
<td>Hydraulically calculated with density ≥0.25</td>
<td>100 9.3</td>
<td>12* 3.7*</td>
</tr>
<tr>
<td>All</td>
<td>Hydraulically calculated with density &lt;0.25</td>
<td>130 12.1</td>
<td>15 4.6</td>
</tr>
</tbody>
</table>

*In buildings where solid structural members create bays up to 25 ft (7.6 m) wide, maximum spacing between sprinklers is permitted up to 12 ft 6 in. (3.8 m).

Table 8.6.2.2.1(d) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for High-Piled Storage

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>System Type</th>
<th>Protection Area</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft² m²</td>
<td>ft m</td>
</tr>
<tr>
<td>All</td>
<td>Hydraulically calculated with density ≥0.25</td>
<td>100 9.3</td>
<td>12* 3.7*</td>
</tr>
<tr>
<td>All</td>
<td>Hydraulically calculated with density &lt;0.25</td>
<td>130 12.1</td>
<td>15 4.6</td>
</tr>
</tbody>
</table>

*In buildings where solid structural members create bays up to 25 ft (7.6 m) wide, maximum spacing between sprinklers is permitted up to 12 ft 6 in. (3.8 m).

8.6.2.2.2 [move to 10.2.4.2.2]
In any case, the maximum area of coverage of a sprinkler shall not exceed 225 ft² (20.9 m²).

8.6.3 Sprinkler Spacing (Standard Pendent and Upright Spray Sprinklers). [move to 10.2.5]

8.6.3.1 Maximum Distance Between Sprinklers. [move to 10.2.5.1]
The maximum distance permitted between sprinklers shall comply with Table 8.6.2.2.1(a) through Table 8.6.2.2.1(d).

8.6.3.2 Maximum Distance from Walls. [move to 10.2.5.2]

8.6.3.2.1 [move to 10.2.5.2.1]
The distance from sprinklers to walls shall not exceed one-half of the allowable distance between sprinklers as indicated in Table 8.6.2.2.1(a) through Table 8.6.2.2.1(d).

8.6.3.2.2 —being deleted with an FR
The distance from the wall to the sprinkler shall be measured perpendicular to the wall.
8.6.3.2.3 [move to 10.2.5.2.2]
The requirements of 8.6.3.2.1 shall not apply where walls are angled or irregular, and the maximum horizontal distance between a sprinkler and any point of floor area protected by that sprinkler shall not exceed 0.75 times the allowable distance permitted between sprinklers, provided the maximum perpendicular distance is not exceeded.

8.6.3.2.4 [move to 10.2.5.2.3]
The requirements of 8.6.3.2.1 shall not apply within small rooms as defined in 3.3.22.

8.6.3.2.4.1 [move to 10.2.5.2.3.1]
Sprinklers shall be permitted to be located not more than 9 ft (2.7 m) from any single wall.

8.6.3.2.4.2 [move to 10.2.5.2.3.2]
Sprinkler spacing limitations of 8.6.3 and area limitations of Table 8.6.2.2.1(a) shall not be exceeded.

8.6.3.2.5 [move to 10.2.5.2.4]
Under curved surfaces, the horizontal distance shall be measured at the floor level from the wall, or the intersection of the curved surface and the floor to the nearest sprinkler shall not be greater than one-half the allowable distance between sprinklers.

8.6.3.3 Minimum Distances from Walls. [move to 10.2.5.3]
Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall.

8.6.3.4 Minimum Distances Between Sprinklers. [move to 10.2.5.4]

8.6.3.4.1 [move to 10.2.5.4.1]
Unless the requirements of 8.6.3.4.2, 8.6.3.4.3, or 8.6.3.4.4 are met, sprinklers shall be spaced not less than 6 ft (1.8 m) on center.

8.6.3.4.2 [move to 10.2.5.4.2]
Sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center where the following conditions are satisfied:
(1) Baffles shall be arranged to protect the actuating elements.
(2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
(3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
(4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
(5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

8.6.3.4.3 [move to 10.2.5.4.3]
In-rack sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center.

8.6.3.4.4 [move to 15.4.3]
Old-style sprinklers protecting fur storage vaults shall be permitted to be placed less than 6 ft (1.8 m) on center.

**8.6.4 Deflector Position (Standard Pendent and Upright Spray Sprinklers). [move to 10.2.6]**

**8.6.4.1 Distance Below Ceilings. [move to 10.2.6.1]**

**8.6.4.1.1 Unobstructed Construction. [move to 10.2.6.1.1]**

**8.6.4.1.1** [move to 10.2.6.1.1.1]
Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) throughout the area of coverage of the sprinkler.

**8.6.4.1.1.2** [move to 10.2.6.1.1.2]
The requirements of 8.6.4.1.1 shall not apply where ceiling-type sprinklers (concealed, recessed, and flush types) have the operating element above the ceiling and the deflector located nearer to the ceiling where installed in accordance with their listing.

**8.6.4.1.1.3** [move to 10.2.6.1.1.3]
The requirements of 8.6.4.1.1 shall not apply for light and ordinary hazard occupancies with ceilings of noncombustible or limited-combustible construction where either 8.6.4.1.1.3(A) or 8.6.4.1.1.3(B) applies.

(A)
Where a vertical change in ceiling elevation within the area of coverage of the sprinkler creates a distance of more than 36 in. (900 mm) between the upper ceiling and the sprinkler deflector, a vertical plane extending down from the ceiling at the change in elevation shall be considered a wall for the purpose of sprinkler spacing as shown in Figure 8.6.4.1.1.3(A).

Figure 8.6.4.1.1.3(A) Vertical Change in Ceiling Elevation Greater Than 36 in. (914 mm).
Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 36 in. (900 mm), the sprinklers shall be permitted to be spaced as though the ceiling was flat, provided the obstruction rules are observed as shown in Figure 8.6.4.1.1.3(B).

Figure 8.6.4.1.1.3(B) Vertical Change in Ceiling Elevation Less Than or Equal to 36 in. (914 mm).

\[ X > 36 \text{ in. (900 mm)} \]
\[ S = \text{maximum allowable distance between sprinklers} \]

(B)
Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 36 in. (900 mm), the sprinklers shall be permitted to be spaced as though the ceiling was flat, provided the obstruction rules are observed as shown in Figure 8.6.4.1.1.3(B).

Figure 8.6.4.1.1.3(B) Vertical Change in Ceiling Elevation Less Than or Equal to 36 in. (914 mm).

\[ X \approx 36 \text{ in. (900 mm)} \]
\[ S = \text{maximum allowable distance between sprinklers} \]
8.6.4.1.2 Obstructed Construction. [move to 10.2.6.1.2]
Under obstructed construction, the sprinkler deflector shall be located in accordance with one of
the following arrangements:
(1) Installed with the deflectors within the horizontal planes of 1 in. to 6 in. (25 mm to 150 mm)
below the structural members and a maximum distance of 22 in. (550 mm) below the ceiling/roof
deck
(2) Installed with the deflectors at or above the bottom of the structural member to a maximum
of 22 in. (550 mm) below the ceiling/roof deck where the sprinkler is installed in conformance
with 8.6.5.1.2
(3) Installed in each bay of obstructed construction, with the deflectors located a minimum of
1 in. (25 mm) and a maximum of 12 in. (300 mm) below the ceiling
(4) Installed with the deflectors within the horizontal planes 1 in. to 6 in. (25 mm to 150 mm)
below composite wood joists to a maximum distance of 22 in. (550 mm) below the ceiling/roof
deck only where joist channels are fire-stopped to the full depth of the joists with material
equivalent to the web construction so that individual channel areas do not exceed 300 ft²
(27.9 m²)
(5) *Installed with deflectors of sprinklers under concrete tee construction with stems spaced
less than 71⁄2 ft (2.3 m) on centers, regardless of the depth of the tee, located at or above a
horizontal plane 1 in. (25 mm) below the bottom of the stems of the tees and complying with
Table 8.6.5.1.2

8.6.4.1.3 Peaked Roofs and Ceilings. [move to 10.2.6.1.3]

8.6.4.1.3.1 [move to 10.2.6.1.3.1]
Unless the requirements of 8.6.4.1.3.2 or 8.6.4.1.3.3 are met, sprinklers under or near the peak of
a roof or ceiling shall have deflectors located not more than 36 in. (900 mm) vertically down
from the peak as indicated in Figure 8.6.4.1.3.1(a) and Figure 8.6.4.1.3.1(b).

Figure 8.6.4.1.3.1(a) Sprinklers Under Pitched Roof with Sprinkler Directly Under Peak; Branch
Lines Run Up Slopes.
Figure 8.6.4.1.3.1(b) Sprinklers at Pitched Roof; Branch Lines Run Up Slopes.
8.6.4.1.3.2* [move to 10.2.6.1.3.2]
Under saw-toothed roofs, sprinklers at the highest elevation shall not exceed a distance of 36 in. (900 mm) measured down the slope from the peak.

8.6.4.1.3.3* [move to 10.2.6.1.3.3]
Under a steeply pitched surface, the distance from the peak to the deflectors shall be permitted to be increased to maintain a horizontal clearance of not less than 24 in. (600 mm) from other structural members as indicated in Figure 8.6.4.1.3.3.

Figure 8.6.4.1.3.3 Horizontal Clearance for Sprinkler at Peak of Pitched Roof.
8.6.4.1.4 [move to 10.2.6.1.4]
Sprinklers under a roof or ceiling in combustible concealed spaces of wood joist or wood truss construction with members less than 3 ft (900 mm) on center with a slope having a pitch of 4 in 12 or greater shall be positioned in accordance with Figure 8.6.4.1.4 and the requirements of 8.6.4.1.4.1 through 8.6.4.1.4.6.

Figure 8.6.4.1.4 Sprinklers Under Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members Less Than 3 ft (0.91 m) on Center with a Slope Having a Pitch of 4 in 12 or Greater.

8.6.4.1.4.1 [move to 10.2.6.1.4.1]
Sprinklers shall be quick-response.

8.6.4.1.4.2 [move to 10.2.6.1.4.2]
Sprinklers shall be installed so that a row of sprinklers is installed within 12 in. (300 mm) horizontally of the peak and between 1 in. and 12 in. (25 mm and 300 mm) down from the bottom of the top chord member.

8.6.4.1.4.3* [move to 10.2.6.1.4.3]
Sprinklers shall be installed so that the sprinklers installed along the eave are located not less than 5 ft (1.5 m) from the intersection of the upper and lower truss chords or the wood rafters and ceiling joists.

8.6.4.1.4.4  [move to 10.2.6.1.4.4]  
Sprinklers installed where the dimension perpendicular to the slope exceeds 8 ft (2.4 m) shall have a minimum pressure of 20 psi (1.4 bar).

8.6.4.1.4.5*  [move to 10.2.6.1.4.5]  
The requirements of 8.6.4.1.4.3 or 8.6.4.1.4.4 shall not apply to sprinklers installed at the corner of the eave of a hip type roof where located directly under the hip line spaced in accordance with 8.6.3.2.3 or located along the eave spaced on the slope plane not less than 5 ft (1.5 m) from the intersection of the upper and lower truss chords or the wood rafters and ceiling joists.

8.6.4.1.4.6  [move to 10.2.6.1.4.6]  
The special requirements of 8.6.2.2.1 and 8.6.4.1.4 shall not apply when the exposed combustible sheathing in the roof or ceiling space are constructed of pressure impregnated fire retardant–treated wood as defined by NFPA 703.

8.6.4.1.5  Double Joist Obstructions.  [move to 10.2.6.1.5]  

8.6.4.1.5.1  [move to 10.2.6.1.5.1]  
Unless the requirements of 8.6.4.1.5.2 are met, where two sets of joists are under a roof or ceiling, and no flooring is over the lower set, sprinklers shall be installed above and below the lower set of joists where a clearance of 6 in. (150 mm) or more is between the top of the lower joist and the bottom of the upper joist as indicated in Figure 8.6.4.1.5.1.

Figure 8.6.4.1.5.1 Arrangement of Sprinklers Under Two Sets of Open Joists — No Sheathing on Lower Joists.

8.6.4.1.5.2  [move to 10.2.6.1.5.2]  
Sprinklers shall be permitted to be omitted from below the lower set of joists where at least 18 in. (450 mm) is maintained between the sprinkler deflector and the top of the lower joist.
8.6.4.2 Deflector Orientation. [move to 10.2.6.2]

8.6.4.2.1 [move to 10.2.6.2.1]
Unless the requirements of 8.6.4.2.2 or 8.6.4.2.3 are met, deflectors of sprinklers shall be aligned parallel to ceilings, roofs, hips, or the incline of stairs.

8.6.4.2.2 [move to 10.2.6.2.2]
Where sprinklers are installed in the peak below a sloped ceiling or roof surface, the sprinkler shall be installed with the deflector horizontal.

8.6.4.2.3 [move to 10.2.6.2.3]
Roofs having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 8.6.4.2, and sprinklers shall be permitted to be installed with deflectors horizontal.

8.6.5 Obstructions to Sprinkler Discharge (Standard Pendent and Upright Spray Sprinklers). [move to 10.2.7]

8.6.5.1 Performance Objective. [move to 10.2.7.1]

8.6.5.1.1 [move to 10.2.7.1.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.6.5.2 and 8.6.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.6.5.1.2* [move to 10.2.7.1.2]
Sprinklers shall be arranged to comply with one of the following arrangements:
(1) Subsection 8.5.5.2, Table 8.6.5.1.2, and Figure 8.6.5.1.2(a) shall be followed.
(2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
(3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 8.6.5.1.2(b).
(4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.6.5.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 8.6.5.1.2 Positioning of Sprinklers to Avoid Obstructions to Discharge [Standard Spray Upright/Standard Spray Pendent (SSU/SSP)]

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft</td>
<td>21/2 (65)</td>
</tr>
<tr>
<td>6 in. (450 mm)</td>
<td></td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>31/2 (90)</td>
</tr>
<tr>
<td>Distance from Sprinklers to Side of Obstruction ((A))</td>
<td>Maximum Allowable Distance of Deflector Above Bottom of Obstruction ((B)) [in. (mm)]</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>51/2 (140)</td>
</tr>
<tr>
<td>2 ft 6 (750 mm) in. to less than 3 ft (900 mm)</td>
<td>71/2 (190)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>91/2 (240)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>161/2 (420)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>18 (450)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>20 (510)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>24 (600)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>30 (750)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>35 (875)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.
Note: For \(A\) and \(B\), refer to Figure 8.6.5.1.2(a).

Figure 8.6.5.1.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (SSU/SSP).
Figure 8.6.5.1.2(b) Obstruction Against Wall (SSU/SSP).

\[ A \geq (D - 8 \text{ in.}) + B \]
\[ [A \geq (D - 200 \text{ mm}) + B] \]
where: \( D \approx 30 \text{ in.} \) (750 mm)
8.6.5.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 10.2.7.2]

8.6.5.2.1 General. [move to 10.2.7.2.1]

8.6.5.2.1.1 [move to 10.2.7.2.1.1] Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 8.6.5.2.

8.6.5.2.1.2 [move to 10.2.7.2.1.2] Regardless of the rules of 8.6.5.2, solid continuous obstructions, where the top of the obstruction is level with or above the plane of the deflector, shall meet the applicable requirements of 8.6.5.1.2.

8.6.5.2.1.3* Minimum Distance from Obstructions. [move to 10.2.7.2.1.3] Unless the requirements of 8.6.5.2.1.4 through 8.6.5.2.1.9 are met, sprinklers shall be positioned away from obstructions a minimum distance of three times the maximum dimension of the obstruction (e.g., structural members, pipe, columns, and fixtures) in accordance with Figure 8.6.5.2.1.3(a) and Figure 8.6.5.2.1.3(b).
Figure 8.6.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (SSU/SSP).

**Plan View of Column**
(Obstruction in vertical orientation)

\[ A \geq 3C \text{ or } 3D \]
(Use dimension \( C \) or \( D \), whichever is greater)

Figure 8.6.5.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (SSU/SSP).
The maximum clear distance required shall be 24 in. (600 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.6.5.2.1.4* [move to 10.2.7.2.1.4]
For light and ordinary hazard occupancies, structural members only shall be considered when applying the requirements of 8.6.5.2.1.3.

8.6.5.2.1.5 [move to 10.2.7.2.1.5]
Sprinklers shall be permitted to be spaced on opposite sides of the obstruction where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

8.6.5.2.1.6 [move to 10.2.7.2.1.6]
Sprinklers shall be permitted to be located one-half the distance between the obstructions where the obstruction consists of open trusses 20 in. (500 mm) or greater apart [24 in. (600 mm) on center], provided that all truss members are not greater than 4 in. (100 mm) (nominal) in width.

8.6.5.2.1.7 [move to 10.2.7.2.1.7]
Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam, provided that the truss chord or beam dimension is not more than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance three times greater than the maximum dimension of the web members away from the web members.

**8.6.5.2.1.8 [move to 10.2.7.2.1.8]**
The requirements of 8.6.5.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

**8.6.5.2.1.9 [move to 10.2.7.2.1.9]**
The requirements of 8.6.5.2.1.3 shall not apply to sprinklers positioned with respect to obstructions in accordance with 8.6.5.1.2.

**8.6.5.2.1.10* [move to 10.2.7.2.1.10]**
Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

**8.6.5.2.2 Suspended or Floor-Mounted Vertical Obstructions. [move to 10.2.7.2.2]**
The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.6.5.2.2 and Figure 8.6.5.2.2.

**Table 8.6.5.2.2 Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (SSU/SSP)**

<table>
<thead>
<tr>
<th>Horizontal Distance $(A)$</th>
<th>Minimum Vertical Distance Below Deflector $(B)$ [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (400 mm)</td>
<td>9 1/2 (240)</td>
</tr>
<tr>
<td>More than 18 in. (400 mm) to 24 in. (600 mm)</td>
<td>12 1/2 (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>15 1/2 (395)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.
Note: For $A$ and $B$, refer to Figure 8.6.5.2.2.
8.6.5.2.2.1* [move to 10.2.7.2.2.1]
In light hazard occupancies, privacy curtains, as shown in Figure 8.6.5.2.2, shall not be considered obstructions where all of the following are met:
(1) The curtains are supported by fabric mesh on ceiling track.
(2) Openings in the mesh are equal to 70 percent or greater.
(3) The mesh extends a minimum of 22 in. (550 mm) down from ceiling.

8.6.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [move to 10.2.7.3]

8.6.5.3.1 [move to 10.2.7.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 8.6.5.3.

8.6.5.3.2—being deleted with an FR
The requirements of 8.6.5.3 shall also apply to obstructions 18 in. (450 mm) or less below the sprinkler for light and ordinary hazard occupancies.

8.6.5.3.3* [move to 10.2.7.3.3]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide.

8.6.5.3.4 —being deleted with an FR
Sprinklers shall not be required below obstructions that are not fixed in place, such as conference tables.
8.6.5.3.5  [move to 10.2.7.3.4]
Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

8.6.5.3.6  [move to 10.2.7.3.5]
The deflector of automatic sprinklers installed under fixed obstructions shall be positioned no more than 12 in. (300 mm) below the bottom of the obstruction.

8.6.5.3.7  [move to 10.2.7.3.6]
Sprinklers installed under round ducts shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

8.6.6  Clearance to Storage (Standard Pendent and Upright Spray Sprinklers).  [move to 10.2.8]

8.6.6.1  [move to 10.2.8.1]
The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

8.6.6.2  [move to 9.5.6.6]
The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 8.6.6, 8.7.6, 8.8.6, and Section 8.9.

8.6.6.2.1  [move to 9.5.6.6.1]
Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

8.6.6.2.2  [move to 9.5.6.6.2]
Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

8.6.6.3  [move to 10.2.8.3]
Where other standards specify greater clearance to storage minimums, they shall be followed.

8.6.7  Ceiling Pockets (Standard Pendent and Upright Spray Sprinklers).  [move to 10.2.9]

8.6.7.1*  [move to 10.2.9.1]
Except as provided in 8.6.7.2 and 8.6.7.3, sprinklers shall be required in all ceiling pockets.

8.6.7.2  [move to 10.2.9.2]
Sprinklers shall not be required in ceiling pockets where all of the following are met:
(1) The total volume of the unprotected ceiling pocket does not exceed 1000 ft³ (28 m³).
(2) The depth of the unprotected ceiling pocket does not exceed 36 in. (900 mm).
(3) The entire floor under the unprotected ceiling pocket is protected by sprinklers at the lower ceiling elevation.
(4) *The total size of all unprotected ceiling pockets in the same compartment within 10 ft (3 m) of each other does not exceed 1000 ft³ (28 m³).
(5) The unprotected ceiling pocket has noncombustible or limited-combustible finishes.
(6) Quick-response sprinklers are utilized throughout the compartment.

8.6.7.3 [move to 10.2.9.3]
Sprinklers shall not be required in skylights and similar pockets in accordance with 8.5.7.

8.7 Sidewall Standard Spray Sprinklers. [move to 10.3]

8.7.1 General. [move to 10.3.1]
All requirements of Section 8.5 shall apply to sidewall standard spray sprinklers except as modified in Section 8.7.

8.7.2 Protection Areas per Sprinkler (Standard Sidewall Spray Sprinklers). [move to 10.3.3]

8.7.2.1 Determination of Protection Area of Coverage. [move to 10.3.3.1]

8.7.2.1.1 [move to 10.3.3.1.1]
The protection area of coverage per sprinkler (As) shall be determined as follows:
1. Along the wall as follows:
   a. Determine the distance between sprinklers along the wall (or to the end wall or obstruction in the case of the end sprinkler on the branch line) upstream and downstream
   b. Choose the larger of either twice the distance to the end wall or the distance to the next sprinkler
   c. Define dimension as S
2. Across the room as follows:
   a. Determine the distance from the wall on which the sprinkler is installed to the wall opposite the sprinklers or to the midpoint of the room where sprinklers are installed on two opposite walls *(see 8.7.3.1.5 and 8.7.3.1.6)*
   b. Define dimension as L

8.7.2.1.2 [move to 10.3.3.1.2]
The protection area of the sprinkler shall be established by multiplying the S dimension by the L dimension, as follows:

\[ A_s = S \times L \]  [8.7.2.1.2]

8.7.2.2 Maximum Protection Area of Coverage. [move to 10.3.3.2]

8.7.2.2.1 [move to 10.3.3.2.1]
The maximum allowable protection area of coverage for a sprinkler (As) shall be in accordance with the value indicated in Table 8.7.2.2.1.

Table 8.7.2.2.1 Protection Areas and Maximum Spacing (Standard Sidewall Spray Sprinkler)
<table>
<thead>
<tr>
<th></th>
<th>Light Hazard</th>
<th>Ordinary Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Combustible Ceiling Finish</td>
<td>Noncombustible or Limited-Combustible Ceiling Finish</td>
</tr>
<tr>
<td>Maximum distance along the wall ((S)) (ft) [m]</td>
<td>14 [4.3]</td>
<td>14 [4.3]</td>
</tr>
<tr>
<td>Maximum room width ((L)) (ft) [m]</td>
<td>12 [3.7]</td>
<td>14 [4.3]</td>
</tr>
<tr>
<td>Maximum protection area ((\text{ft}^2) [\text{m}^2])</td>
<td>120 [11.1]</td>
<td>196 [18.2]</td>
</tr>
</tbody>
</table>

8.7.2.2 [move to 10.3.3.2.2]
In any case, the maximum area of coverage of a sprinkler shall not exceed 196 ft² (18.2 m²).

8.7.3 Sprinkler Spacing (Standard Sidewall Spray Sprinklers). [move to 10.3.4]

8.7.3.1 Maximum Distance Between Sprinklers. [move to 10.3.4.1]

8.7.3.1.1 [move to 10.3.4.1.1]
The maximum distance permitted between sidewall spray sprinklers shall be based on the centerline distance between sprinklers on the branch line.

8.7.3.1.2 [move to 10.3.4.1.2]
The maximum distance between sidewall spray sprinklers or to a wall shall be measured along the slope of the ceiling.

8.7.3.1.3 [move to 10.3.4.1.3]
Where sidewall spray sprinklers are installed along the length of a single wall of rooms or bays, they shall be spaced in accordance with the maximum spacing provisions of Table 8.7.2.2.1.

8.7.3.1.4 [move to 10.3.4.1.4]
Sidewall spray sprinklers shall not be installed back-to-back without being separated by a continuous lintel or soffit.

8.7.3.1.4.1 [move to 10.3.4.1.4.1]
The maximum width of the lintel or soffit shall not exceed 16 in. (400 mm).

8.7.3.1.4.2 [move to 10.3.4.1.4.2]
The maximum width of the lintel or soffit can exceed 16 in. (400 mm) when a pendent sprinkler is installed under the lintel or soffit.

8.7.3.1.5 [move to 10.3.4.1.5]
Where sidewall spray sprinklers are installed on two opposite walls or sides of bays, the maximum width of the room or bay shall be permitted to be up to 24 ft (7.3 m) for light hazard occupancy or 20 ft (6.1 m) for ordinary hazard occupancy, with spacing as required by Table 8.7.2.2.1.

8.7.3.1.6 [move to 10.3.4.1.6]
Sidewall spray sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within the maximum protection area of another sprinkler.

8.7.3.1.7 [move to 10.3.4.1.7]
Where sidewall standard spray sprinklers are installed to protect areas below overhead doors within ordinary hazard occupancy spaces or rooms, protection area and maximum sprinkler spacing for light hazard as specified in Table 8.7.2.2.1 shall be permitted under the overhead doors.

8.7.3.2 Maximum Distance from Walls. [move to 10.3.4.2]
The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 8.7.2.2.1.

8.7.3.3 Minimum Distance from Walls. [move to 10.3.4.3]

8.7.3.3.1 [move to 10.3.4.3.1]
Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

8.7.3.3.2 [move to 10.3.4.3.2]
The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.7.3.4 Minimum Distance Between Sprinklers. [move to 10.3.4.4]
Sprinklers shall be spaced not less than 6 ft (1.8 m) on center unless required by 8.7.4.1.3.1 or unless the sprinklers are separated by baffles that comply with the following:
(1) Baffles shall be arranged to protect the actuating elements.
(2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
(3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
(4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors.
(5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.

8.7.4 Deflector Position from Ceilings and Walls (Standard Sidewall Spray Sprinklers). [move to 10.3.5]

8.7.4.1 Distance Below Ceilings and from Walls. [move to 10.3.5.1]

8.7.4.1.1 Ceilings. [move to 10.3.5.1.1]

8.7.4.1.1.1 [move to 10.3.5.1.1.1]
Unless the requirements of 8.7.4.1.1.2 are met, sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from ceilings.

8.7.4.1.1.2  [move to 10.3.5.1.1.2]
Horizontal sidewall sprinklers shall be permitted to be located in a zone 6 in. to 12 in. (150 mm to 300 mm) or 12 in. to 18 in. (300 mm to 450 mm) below noncombustible and limited-combustible ceilings where listed for such use.

8.7.4.1.2  [move to 10.3.5.1.2]  
Walls.

8.7.4.1.2.1*  [move to 10.3.5.1.2.1]
Vertical sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from the wall from which they are projecting.

8.7.4.1.2.2  [move to 10.3.5.1.2.2]
Horizontal sidewall sprinkler deflectors shall be located no more than 6 in. (150 mm), and shall be permitted to be located with their deflectors less than 4 in. (100 mm), from the wall on which they are mounted.

8.7.4.1.3  [move to 10.3.5.1.3]  
Lintels and Soffits.

8.7.4.1.3.1  [move to 10.3.5.1.3.1]
Where soffits used for the installation of sidewall sprinklers exceed 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall be installed below the soffit.

8.7.4.1.3.2*  [move to 10.3.5.1.3.2]
Where soffits used for the installation of sidewall sprinklers are less than or equal to 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall not be required below the soffit when the sidewall sprinkler is installed on the soffit.

8.7.4.1.3.3*  [move to 10.3.5.1.3.3]
A sidewall sprinkler shall be permitted to be installed under a soffit when both the minimum distance from the sprinkler deflector to the bottom of the soffit and maximum distance from the sprinkler deflector to the high ceiling is maintained.

8.7.4.1.4*  Soffits and Cabinets.  

8.7.4.1.4.1  [move to 10.3.5.1.4.1]
Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

8.7.4.1.4.2  [move to 10.3.5.1.4.2]
Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

8.7.4.1.4.3 [move to 10.3.5.1.4.3]
Where sidewall sprinklers are more than 36 in. (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

8.7.4.2 Deflector Orientation. [move to 10.3.5.2]

8.7.4.2.1 —being deleted with an FR
Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.7.4.2.2 [move to 10.3.5.2.1]
Sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located at the high point of the slope and positioned to discharge downward along the slope.

8.7.5 Obstructions to Sprinkler Discharge (Standard Sidewall Spray Sprinklers). [move to 10.3.6]

8.7.5.1 Performance Objective. [move to 10.3.6.1]

8.7.5.1.1 [move to 10.3.6.1.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.5.5.2 and 8.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.7.5.1.2 [move to 10.3.6.1.2]
Sidewall sprinklers shall be installed no closer than 4 ft (1.2 m) from light fixtures or similar obstructions.

8.7.5.1.3 [move to 10.3.6.1.3]
The distance between light fixtures or similar obstructions located more than 4 ft (1.2 m) from the sprinkler shall be in conformity with Table 8.7.5.1.3 and Figure 8.7.5.1.3.

Table 8.7.5.1.3 Positioning of Sprinklers to Avoid Obstructions (Standard Sidewall Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4 ft (1.2 m)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 5 ft (1.5 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>6 (150)</td>
</tr>
</tbody>
</table>
Distance from Sidewall Sprinkler to Side of Obstruction (A) | Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]
---|---
7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m) | 7 (175)
7 ft 6 in. (2.3 m) to less than 8 ft (2.4 m) | 9 (225)
8 ft (2.4 m) to less than 8 ft 6 in. (2.6 m) | 11 (275)
8 ft 6 in. (2.6 m) or greater | 14 (350)

Note: For A and B, refer to Figure 8.7.5.1.3.

Figure 8.7.5.1.3 Positioning of Sprinkler to Avoid Obstruction (Standard Sidewall Spray Sprinklers).

8.7.5.1.4 Obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with Table 8.7.5.1.4 and Figure 8.7.5.1.4.

Table 8.7.5.1.4 Positioning of Sprinklers to Avoid Obstructions Along Wall (Standard Sidewall Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 in.(100 mm) to less than 6 in. (150 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>Distance from Sidewall Sprinkler to Side of Obstruction ((A))</td>
<td>Maximum Allowable Distance of Deflector Above Bottom of Obstruction ((B)) [in. (mm)]</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>6 in. (150 mm) to less than 1 ft (300 mm)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>41/2(115)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>53/4(145)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 mm) to less than 3 ft (900 mm)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>91/4(230)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>10 (250)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>111/2(290)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>123/4(325)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>15 (380)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.2 m)</td>
<td>161/4(410)</td>
</tr>
<tr>
<td>7 ft (2.2 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>171/2(440)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.
Note: For \(A\) and \(B\), refer to Figure 8.7.5.1.4.

Figure 8.7.5.1.4 Positioning of Sprinkler to Avoid Obstruction Along Wall (Standard Sidewall Spray Sprinklers).
8.7.5.1.4.1 [move to 10.3.6.1.4.1]
Isolated obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be located a minimum of 4 in. (100 mm) from the sidewall sprinkler.

8.7.5.1.5 [move to 10.3.6.1.5]
Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

8.7.5.1.6* [move to 10.3.6.1.6]
Obstructions on the wall opposite from the sidewall sprinkler shall be permitted where the obstruction is up to 2 ft (600 mm) deep and 2 ft (600 mm) wide.

8.7.5.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 10.3.6.2]

8.7.5.2.1 General. [move to 10.3.6.2.1]

8.7.5.2.1.1 [move to 10.3.6.2.1.1]
Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.

8.7.5.2.1.2 [move to 10.3.6.2.1.2]
Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 8.7.5.1.2 and 8.7.5.1.3.

8.7.5.2.1.3* [move to 10.3.6.2.1.3]
Unless the requirements of 8.7.5.2.1.4 or 8.7.5.2.1.5 are met, sprinklers shall be positioned away from obstructions a minimum distance of three times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 8.7.5.2.1.3(a) and Figure 8.7.5.2.1.3(b).
Figure 8.7.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation
(Standard Sidewall Spray Sprinklers).

```
Plan View of Column
(Obstruction in vertical orientation)
A ≥ 3C or 3D
(Use dimension C or D, whichever is greater)
```

Figure 8.7.5.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation
(Standard Sidewall Spray Sprinklers).
The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 24 in. (600 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.7.5.2.1.4 [move to 10.3.6.2.1.4]
The requirements of 8.7.5.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

8.7.5.2.1.5 [move to 10.3.6.2.1.5]
The requirements of 8.7.5.2.1.3 shall not apply where sprinklers are positioned with respect to obstructions in accordance with 8.7.5.1.2, 8.7.5.1.3, and 8.7.5.1.4.

8.7.5.2.1.6* [move to 10.3.6.2.1.6]
Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

---

Elevation View of Pipe Conduit or Light Fixture

\[
A \geq 3C \text{ or } 3D \\
A \leq 24 \text{ in.} \ (600 \text{ mm})
\]

(Use dimension \(C\) or \(D\), whichever is greater)

(A)
The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 24 in. (600 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).
8.7.5.2.2 Suspended or Floor-Mounted Vertical Obstructions. [move to 10.3.6.2.2]
The distance from sprinklers to privacy curtains, free-standing partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.7.5.2.2 and Figure 8.7.5.2.2.

Table 8.7.5.2.2 Suspended or Floor-Mounted Obstructions (Standard Sidewall Spray Sprinklers) in Light Hazard Occupancies Only

<table>
<thead>
<tr>
<th>Horizontal Distance (A)</th>
<th>Minimum Vertical Distance Below Deflector (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>9 1/2 (240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>12 1/2 (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>15 1/2 (390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.
Note: For A and B, refer to Figure 8.7.5.2.2.

Figure 8.7.5.2.2 Suspended or Floor-Mounted Obstruction (Standard Sidewall Spray Sprinklers) in Light Hazard Occupancy Only.
8.7.5.2.2.1* [move to 10.3.6.2.2.1]
In light hazard occupancies, privacy curtains, as shown in Figure 8.7.5.2.2, shall not be considered obstructions where all of the following are met:
(1) The curtains are supported by fabric mesh on ceiling track.
(2) Openings in the mesh are equal to 70 percent or greater.
(3) The mesh extends a minimum of 22 in. (550 mm) down from ceiling.

8.7.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [move to 10.3.6.3]

8.7.5.3.1 [move to 10.3.6.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with this section.

8.7.5.3.2 [move to 10.3.6.3.2]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as ducts, decks, open grate flooring, cutting tables, and overhead doors.

8.7.5.3.3 —being deleted with an FR
Sprinklers shall not be required under obstructions that are not fixed in place such as conference tables.
8.7.6* Clearance to Storage (Standard Sidewall Spray Sprinklers). [move to 10.3.7]
The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

8.8 Extended Coverage Upright and Pendent Spray Sprinklers. [move to 11.2]

8.8.1 General. [move to 11.2.1]
All requirements of Section 8.5 shall apply to extended coverage upright and pendent sprinklers except as modified in Section 8.8.

8.8.2 Protection Areas per Sprinkler (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.3]

8.8.2.1* Determination of Protection Area of Coverage. [move to 11.2.3.1]

8.8.2.1.1 [move to 11.2.3.1.1]
The protection area of coverage \( (A_c) \) for extended coverage sprinklers shall be not less than that prescribed by the listing.

8.8.2.1.2 [move to 11.2.3.1.2]
Listing dimensions shall be even-numbered square protection areas as shown in Table 8.8.2.1.2.

Table 8.8.2.1.2 Protection Areas and Maximum Spacing (Extended Coverage Upright and Pendent Spray Sprinklers)

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>Light Hazard</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protectio</td>
<td>Spacing</td>
<td>Protectio</td>
<td>Spacing</td>
<td>Protectio</td>
<td>Spacing</td>
<td>Protectio</td>
</tr>
<tr>
<td></td>
<td>n Area</td>
<td>ft² (m²)</td>
<td>n Area</td>
<td>ft² (m²)</td>
<td>n Area</td>
<td>ft² (m²)</td>
<td>n Area</td>
</tr>
<tr>
<td></td>
<td>ft (m)</td>
<td></td>
<td>ft (m)</td>
<td></td>
<td>ft (m)</td>
<td></td>
<td>ft (m)</td>
</tr>
<tr>
<td>Unobstructed</td>
<td>400 (37)</td>
<td>20 (6.1)</td>
<td>400 (37)</td>
<td>20 (6.1)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>324 (30)</td>
<td>18 (5.5)</td>
<td>324 (30)</td>
<td>18 (5.5)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>256 (23.8)</td>
<td>16 (4.9)</td>
<td>256 (23.8)</td>
<td>16 (4.9)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>196 (18.2)</td>
<td>14 (4.3)</td>
<td>196 (18.2)</td>
<td>14 (4.3)</td>
<td>196 (18.2)</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>144 (13.4)</td>
<td>12 (3.7)</td>
<td>144 (13.4)</td>
<td>15 (4.6)</td>
<td>144 (13.4)</td>
</tr>
<tr>
<td>Obstructed noncombustibl</td>
<td>400 (37)</td>
<td>20 (6.1)</td>
<td>400 (37)</td>
<td>20 (6.1)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>e (when specifically</td>
<td>324 (30)</td>
<td>18 (5.5)</td>
<td>324 (30)</td>
<td>18 (5.5)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>listed for such use)</td>
<td>256 (23.8)</td>
<td>16 (4.9)</td>
<td>256 (23.8)</td>
<td>16 (4.9)</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>196 (18.2)</td>
<td>14 (4.3)</td>
<td>196 (18.2)</td>
<td>14 (4.3)</td>
<td>196 (18.2)</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>—</td>
<td>144 (13.4)</td>
<td>12 (3.7)</td>
<td>144 (13.4)</td>
<td>15 (4.6)</td>
<td>144 (13.4)</td>
</tr>
<tr>
<td>Obstructed combustible</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

For SI units, 1 ft = 0.3048 m; 1 ft² = 0.0929 m².

8.8.2.1.3 [move to 11.2.3.1.3]
Determination of the protection area of coverage and sprinkler spacing for sprinklers listed for extended coverage extra hazard or high-piled storage shall be permitted to be spaced in accordance with the requirements of 8.5.2 and 8.5.3 and shall not exceed 14 ft (4.3 m) maximum spacing and 196 ft² (18.2 m²) maximum area per sprinkler or 15 ft (4.6 m) maximum spacing and 144 ft² (13.5 m²) maximum area per sprinkler.

8.8.2.2 Maximum Protection Area of Coverage. [move to 11.2.3.2]

8.8.2.2.1* [move to 11.2.3.2.1]
The maximum allowable area of coverage for a sprinkler \( (A_s) \) shall be in accordance with the value indicated in Table 8.8.2.1.2.

8.8.2.2.2 [move to 11.2.3.2.2]
In any case, the maximum area of coverage of a sprinkler shall not exceed 400 ft² (37 m²).

8.8.3 Sprinkler Spacing (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.4]

8.8.3.1 Maximum Distance Between Sprinklers. [move to 11.2.4.1]

8.8.3.1.1 [move to 11.2.4.1.1]
The maximum distance permitted between sprinklers shall be based on the centerline distance between sprinklers on the branch line or on adjacent branch lines.

8.8.3.1.2 [move to 11.2.4.1.2]
The maximum distance shall be measured along the slope of the ceiling.

8.8.3.1.3 [move to 11.2.4.1.3]
The maximum distance permitted between sprinklers shall comply with Table 8.8.2.1.2.

8.8.3.2 Maximum Distance from Walls. [move to 11.2.4.2]

8.8.3.2.1 [move to 11.2.4.2.1]
The distance from sprinklers to walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 8.8.2.1.2.

8.8.3.2.2 —being deleted with an FR
The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.8.3.2.3 [move to 11.2.4.2.2]
Where walls are angled or irregular, the maximum horizontal distance between a sprinkler and any point of floor area protected by that sprinkler shall not exceed 0.75 times the allowable distance permitted between sprinklers.

8.8.3.3 Minimum Distance from Walls. [move to 11.2.4.3]
Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall unless listed for distances less than 4 in. (100 mm).

8.8.3.4 Minimum Distance Between Sprinklers. [move to 11.2.4.4]

8.8.3.4.1 [move to 11.2.4.4.1]
Unless the requirements of 8.8.3.4.2 are met, sprinklers shall be spaced not less than 8 ft (2.4 m) on center.

8.8.3.4.2 [move to 11.2.4.4.2]
Sprinklers shall be permitted to be placed less than 8 ft (2.4 m) on center where the following conditions are satisfied:
1. Baffles shall be arranged to protect the actuating elements.
2. Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
3. Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
4. The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
5. The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

8.8.4 Deflector Position (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.5]

8.8.4.1 Distance Below Ceilings. [move to 11.2.5.1]

8.8.4.1.1 Unobstructed Construction. [move to 11.2.5.1.1]

8.8.4.1.1.1 [move to 11.2.5.1.1.1]
Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) throughout the area of coverage of the sprinkler.

8.8.4.1.1.2 [move to 11.2.5.1.1.2]
The requirements of 8.8.4.1.1 shall not apply where ceiling-type sprinklers (concealed, recessed, and flush types) have the operating element above the ceiling and the deflector located nearer to the ceiling where installed in accordance with their listing.

8.8.4.1.1.3 [move to 11.2.5.1.1.3]
The requirements of 8.8.4.1.1.1 shall not apply where sprinklers are listed for use under other ceiling construction features or for different distances where they shall be permitted to be installed in accordance with their listing.

8.8.4.1.1.4 [move to 11.2.5.1.1.4]
The requirements of 8.8.4.1.1.1 shall not apply for light and ordinary hazard occupancies with ceilings of noncombustible or limited-combustible construction.

(A)*
Where a vertical change in ceiling elevation within the area of coverage of the sprinkler creates a distance of more than 36 in. (900 mm) between the upper ceiling and the sprinkler deflector, a vertical plane extending down from the ceiling at the change in elevation shall be considered a wall for the purpose of sprinkler spacing.

(B)*
Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 36 in. (900 mm), the sprinklers shall be permitted to be spaced as though the ceiling were flat, provided the obstruction rules are observed.

8.8.4.1.2 Obstructed Construction. [move to 11.2.5.1.2]
Under obstructed construction, the sprinkler deflector shall be located in accordance with one of the following arrangements:

1. Installed with the deflectors within the horizontal planes of 1 in. to 6 in. (25 mm to 150 mm) below noncombustible structural members and a maximum distance of 22 in. (550 mm) below the ceiling/roof deck
2. Installed with the deflectors at or above the bottom of noncombustible structural member to a maximum of 22 in. (550 mm) below the noncombustible ceiling/roof deck where the sprinkler is installed in conformance with 8.8.5.1.2
3. Installed in each bay of combustible or noncombustible obstructed construction, with the deflectors located a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) below the ceiling
4. Installed in accordance with their listing where sprinklers are listed for use under other ceiling construction features or for different distances

8.8.4.1.3* Peaked Roofs and Ceilings. [move to 11.2.5.1.3]
Sprinklers under or near the peak of a roof or ceiling shall have deflectors located not more than 3 ft (900 mm) vertically down from the peak in accordance with Figure 8.6.4.1.3.1(a) and Figure 8.6.4.1.3.1(b).

8.8.4.2 Deflector Orientation. [move to 11.2.5.2]
Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.8.4.2.1 [move to 11.2.5.2.1]
Roofs and ceilings having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 8.8.4.2, and sprinklers shall be permitted to be installed with deflectors horizontal.

8.8.5 Obstructions to Sprinkler Discharge (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.6]

8.8.5.1 Performance Objective. [move to 11.2.6.1]
8.8.5.1.1 [move to 11.2.6.1.1]  
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.8.5.2 and 8.8.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.8.5.1.2* [move to 11.2.6.1.2]  
Sprinklers shall be arranged to comply with one of the following arrangements:
(1) Sprinklers shall be in accordance with 8.5.5.2, Table 8.8.5.1.2, and Figure 8.8.5.1.2(a).
(2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
(3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 8.8.5.1.2(b).
(4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.8.5.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 8.8.5.1.2 Position of Sprinklers to Avoid Obstructions to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 m)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 m) to less than 1 ft 6 in. (450 m)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 m) to less than 2 ft (600 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft (600 m) to less than 2 ft 6 in. (750 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 m) to less than 3 ft (900 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 m) to less than 3 ft 6 in. (1.1 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>Distance from Sprinklers to Side of Obstruction (A)</td>
<td>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6 ft 6 in. (2 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>7 ft 6 in. (2.3 m) to less than 8 ft (2.4 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 8 ft 6 in. (2.6 m)</td>
<td>15 (375)</td>
</tr>
<tr>
<td>8 ft 6 in. (2.6 m) to less than 9 ft (2.7 m)</td>
<td>17 (425)</td>
</tr>
<tr>
<td>9 ft (2.7 m) to less than 9 ft 6 in. (2.9 m)</td>
<td>19 (475)</td>
</tr>
<tr>
<td>9 ft 6 in. (2.9 m) in. to less than 10 ft (3.0 m)</td>
<td>21 (525)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.8.5.1.2(a).

Figure 8.8.5.1.2(a) Position of Sprinkler to Avoid Obstruction to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers).

![Elevation View](image)

Figure 8.8.5.1.2(b) Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).
Figure 8.8.5.1.2(c) Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).

Elevation View

\[ A \geq (D - 8 \text{ in.}) + B \]
\[ [A \geq (D - 200 \text{ mm}) + B] \]
where: \( D \leq 30 \text{ in.} (750 \text{ mm}) \)
8.8.5.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 11.2.6.2]

8.8.5.2.1 General. [move to 11.2.6.2.1]

8.8.5.2.1.1 [move to 11.2.6.2.1.1] Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 8.8.5.2.

8.8.5.2.1.2 [move to 11.2.6.2.1.2] Regardless of the rules of this section, solid continuous obstructions shall meet the applicable requirements of 8.8.5.1.2.

8.8.5.2.1.3* [move to 11.2.6.2.1.3] Unless the requirements of 8.8.5.2.1.4 through 8.8.5.2.1.8 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 8.8.5.2.1.3(a) and Figure 8.8.5.2.1.3(b).

Figure 8.8.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Extended Coverage Upright and Pendent Spray Sprinkler).
Figure 8.8.5.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Extended Coverage Upright and Pendent Spray Sprinkler).

(A) The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 36 in. (900 mm).
The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.8.5.2.1.4 [move to 11.2.6.2.1.4]
Sprinklers shall be permitted to be spaced on opposite sides of the obstruction where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

8.8.5.2.1.5 [move to 11.2.6.2.1.5]
Sprinklers shall be permitted to be located one-half the distance between the obstructions where the obstruction consists of wood bar joists 20 in. (500 mm) or greater apart, provided that the top and bottom chords of the wood bar joist are not greater than 4 in. (100 mm) (nominal) in width and bar members do not exceed 1 in. (25 mm) in width.

8.8.5.2.1.6 [move to 11.2.6.2.1.6]
Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam, provided that the truss chord or beam, dimension is not more than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance four times greater than the maximum dimension of the web members away from the web members.

8.8.5.2.1.7 [move to 11.2.6.2.1.7]
The requirements of 8.8.5.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

8.8.5.2.1.8 [move to 11.2.6.2.1.8]
The requirements of 8.8.5.2.1.3 shall not apply to sprinklers positioned with respect to obstructions in accordance with 8.8.5.1.2.

8.8.5.2.1.9* [move to 11.2.6.2.1.9]
Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

8.8.5.2.2 Suspended or Floor-Mounted Vertical Obstructions. [move to 11.2.6.2.2]
The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.8.5.2.2 and Figure 8.8.5.2.2.

Table 8.8.5.2.2 Suspended or Floor-Mounted Obstructions (Extended Coverage Upright and Pendent Spray Sprinklers) in Light Hazard Occupancies Only

<table>
<thead>
<tr>
<th>Horizontal Distance (A)</th>
<th>Minimum Vertical Distance Below Deflector (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Horizontal Distance ($A$)</td>
<td>Minimum Vertical Distance Below Deflector ($B$)[in. (mm)]</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>9½ (240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>12½ (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>15½ (390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

Note: For $A$ and $B$, refer to Figure 8.8.5.2.2.

Figure 8.8.5.2.2 Suspended or Floor-Mounted Obstruction (Extended Coverage Upright and Pendent Spray Sprinklers) in Light Hazard Occupancy Only.

8.8.5.2.2.1 [move to 11.2.6.2.2.1]
In light hazard occupancies, privacy curtains, as shown in Figure 8.8.5.2.2, shall not be considered obstructions where all of the following are met:
1. The curtains are supported by fabric mesh on ceiling track.
2. Openings in the mesh are equal to 70 percent or greater.
3. The mesh extends a minimum of 22 in. (550 mm) down from ceiling.
8.8.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [move to 11.2.6.3]

8.8.5.3.1 [move to 11.2.6.3.1] Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 8.8.5.3.

8.8.5.3.2 [move to 11.2.6.3.2] Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as ducts, decks, open grate flooring, cutting tables, and overhead doors.

8.8.5.3.3 Sprinklers shall not be required under obstructions that are not fixed in place such as conference tables.

8.8.5.3.4 [move to 11.2.6.3.3] Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

8.8.5.3.5 The deflector of automatic sprinklers installed under fixed obstructions shall be positioned no more than 12 in. (300 mm) below the bottom of the obstruction.

8.8.5.3.6 [move to 11.2.6.3.4] Sprinklers installed under round ducts shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

8.8.6* Clearance to Storage (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.7]

8.8.6.1 [move to 11.2.7.1] The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

8.8.6.2 [move to 11.2.7.3] Where other standards specify greater clearance to storage minimums, they shall be followed.

8.8.7 Ceiling Pockets (Extended Coverage Upright and Pendent Spray Sprinklers). [move to 11.2.8]

8.8.7.1* [move to 11.2.8.1] Except as provided in 8.8.7.2 and 8.8.7.3, sprinklers shall be required in all ceiling pockets.

8.8.7.2 [move to 11.2.8.2] Sprinklers shall not be required in ceiling pockets where all of the following are met:
(1) The total volume of the unprotected ceiling pocket does not exceed 1000 ft³ (28 m³).
(2) The depth of the unprotected ceiling pocket does not exceed 36 in. (900 mm).
(3) The entire floor under the unprotected ceiling pocket is protected by sprinklers at the lower ceiling elevation.
(4) *The total size of all unprotected ceiling pockets in the same compartment within 10 ft (3 m) of each other does not exceed 1000 ft³ (28 m³).
(5) The unprotected ceiling pocket has noncombustible or limited-combustible finishes.
(6) Quick-response sprinklers are utilized throughout the compartment.

8.8.7.3 [move to 11.2.8.3]
Sprinklers shall not be required in skylights and similar pockets in accordance with 8.5.7.

8.9* Extended Coverage Sidewall Spray Sprinklers. [move to 11.3]

8.9.1 General. [move to 11.3.1]
All requirements of Section 8.5 shall apply to extended coverage sidewall spray sprinklers except as modified in Section 8.9.

8.9.2 Protection Areas per Sprinkler (Extended Coverage Sidewall Spray Sprinklers). [move to 11.3.3]

8.9.2.1* Determination of Protection Area of Coverage. [move to 11.3.3.1]

8.9.2.1.1 [move to 11.3.3.1.1]
The protection area of coverage per sprinkler (As) for extended coverage sidewall sprinklers shall be not less than that prescribed by the listing.

8.9.2.1.2 [move to 11.3.3.1.2]
Listing dimensions shall be in 2 ft (600 mm) increments up to 28 ft (8.5 m).

8.9.2.2 Maximum Protection Area of Coverage. [move to 11.3.3.2]

8.9.2.2.1 [move to 11.3.3.2.1]
The maximum allowable protection area of coverage for a sprinkler (As) shall be in accordance with the value indicated in Table 8.9.2.2.1.

Table 8.9.2.2.1 Protection Area and Maximum Spacing for Extended Coverage Sidewall Spray Sprinklers

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>Light Hazard</th>
<th></th>
<th>Ordinary Hazard</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protection Area</td>
<td>Spacing</td>
<td>Protection Area</td>
<td>Spacing</td>
</tr>
<tr>
<td>Unobstructed, smooth, flat</td>
<td>ft²  m²  ft  m</td>
<td>ft²  m²  ft  m</td>
<td>ft²  m²  ft  m</td>
<td>ft²  m²  ft  m</td>
</tr>
<tr>
<td></td>
<td>400         37  28  8.5</td>
<td>400         37  24  7.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.9.2.2.2 [move to 11.3.3.2.2]
In any case, the maximum area of coverage of a sprinkler shall not exceed 400 ft² (37.2 m²).
8.9.3 Sprinkler Spacing (Extended Coverage Sidewall Spray Sprinklers). [move to 11.3.4]

8.9.3.1 Maximum Distance Between Sprinklers. [move to 11.3.4.1]

8.9.3.1.1 [move to 11.3.4.1.1]
The maximum distance permitted between sprinklers shall be based on the centerline distance between sprinklers on the branch line along the wall.

8.9.3.1.2 [move to 11.3.4.1.2]
Where sprinklers are installed along the length of a single wall of rooms or bays, they shall be spaced in accordance with the maximum spacing provisions of Table 8.9.2.2.1.

8.9.3.1.3 [move to 11.3.4.1.3]
Sidewall sprinklers shall not be installed back-to-back without being separated by a continuous lintel, soffit, or baffle.

8.9.3.1.4 [move to 11.3.4.1.4]
Sidewall sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within the maximum protection area of another sprinkler.

8.9.3.2 Maximum Distance from Walls. [move to 11.3.4.2]
The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 8.9.2.2.1.

8.9.3.3 Minimum Distance from Walls. [move to 11.3.4.3]

8.9.3.3.1 [move to 11.3.4.3.1]
Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

8.9.3.3.2
The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.9.3.4 Minimum Distance Between Sprinklers. [move to 11.3.4.4]
Sprinklers shall be not located within the maximum protection area of any other sprinkler unless required by 8.9.4.1.4.1 or separated by baffles that comply with the following:
(1) Baffles shall be arranged to protect the actuating elements.
(2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
(3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
(4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors.
(5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.

8.9.4 Deflector Position from Ceilings and Walls (Extended Coverage Sidewall Spray Sprinklers). [move to 11.3.5]
8.9.4.1 Distance Below Ceilings and from Walls to Which Sprinklers Are Mounted. [move to 11.3.5.1]

8.9.4.1.1 Ceilings. [move to 11.3.5.1.1]

8.9.4.1.1.1 Unless the requirements of 8.9.4.1.1.2 are met, sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) nor less than 4 in. (100 mm) from ceilings.

8.9.4.1.1.2 Horizontal sidewall sprinklers shall be permitted to be located in a zone 6 in. to 12 in. (150 mm to 300 mm) or 12 in. to 18 in. (300 mm to 450 mm) below noncombustible or limited-combustible ceilings where listed for such use.

8.9.4.1.2 Walls. [move to 11.3.5.1.2]

8.9.4.1.2.1 Sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from walls on which they are mounted.

8.9.4.1.2.2 Horizontal sidewall sprinklers shall be permitted to be located with their deflectors less than 4 in. (100 mm) from the wall on which they are mounted.

8.9.4.1.3 Lintels and Soffits. [move to 11.3.5.1.3]

8.9.4.1.3.1 Where soffits used for the installation of sidewall sprinklers are less than or equal to 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall not be required below the soffit.

8.9.4.1.3.2 A sidewall sprinkler shall be permitted to be installed under a soffit when both the minimum distance from the sprinkler deflector to the bottom of the soffit and the maximum distance from the sprinkler deflector to the high ceiling are maintained.

8.9.4.1.4 Soffits and Cabinets in Residential Areas/Occupancies. [move to 11.3.5.1.4]

8.9.4.1.4.1 Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

8.9.4.1.4.2
Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

8.9.4.1.4.3  [move to 11.3.5.1.4.3]
Where sidewall sprinklers are more than 3 ft (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

8.9.4.2  Deflector Orientation.  [move to 11.3.5.2]

8.9.4.2.1
Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.9.4.2.2  [move to 11.3.5.2.1]
Sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located at the high point of the slope and positioned to discharge downward along the slope.

8.9.4.2.3  [move to 11.3.5.2.2]
Sidewall sprinklers specifically listed for other ceiling configurations shall be permitted to be installed in accordance with the listing requirements.

8.9.5  Obstructions to Sprinkler Discharge (Extended Coverage Sidewall Spray Sprinklers).  [move to 11.3.6]

8.9.5.1  Performance Objective.  [move to 11.3.6.1]

8.9.5.1.1  [move to 11.3.6.1.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.5.5.2 and 8.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.9.5.1.2  [move to 11.3.6.1.2]
Sidewall sprinklers shall be installed no closer than 8 ft (2.4 m) from light fixtures or similar obstructions.

8.9.5.1.3  [move to 11.3.6.1.3]
The distance between light fixtures or similar obstructions located more than 8 ft (2.4 m) from the sprinkler shall be in conformance with Table 8.9.5.1.3 and Figure 8.9.5.1.3.

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 8 ft (2.4 m)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 10 ft (3.0 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>10 ft (3.0 m) to less than 11 ft (3.3 m)</td>
<td>2 (50)</td>
</tr>
</tbody>
</table>
Table 8.9.5.1.4: Distance from Sidewall Sprinkler to Side of Obstruction (A) vs. Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]

<table>
<thead>
<tr>
<th>Distance from Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 ft (3.3 m) to less than 12 ft (3.7 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>12 ft (3.7 m) to less than 13 ft (4.0 m)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>13 ft (4.0 m) to less than 14 ft (4.3 m)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>14 ft (4.3 m) to less than 15 ft (4.6 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>15 ft (4.6 m) to less than 16 ft (4.9 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>16 ft (4.9 m) to less than 17 ft (5.2 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>17 ft (5.2 m) or greater</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.9.5.1.3.

Continuous obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with one of the following arrangements:

1. Sprinklers shall be installed in accordance with Table 8.9.5.1.4 and Figure 8.9.5.1.4(a).
(2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

(3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 8.9.5.1.4(b).

(4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.9.5.1.4(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 8.9.5.1.4 Positioning of Sprinklers to Avoid Obstructions Along Wall (Extended Coverage Sidewall Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft 6 in. (450 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 3 ft (900 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 6 ft (1.5 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.5 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.9.5.1.4(a).

Figure 8.9.5.1.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Extended Coverage Sidewall Spray Sprinklers).

Figure 8.9.5.1.4(b) Obstruction Against Wall (Extended Coverage Sidewall Spray Sprinklers).
Figure 8.9.5.1.4(c) Obstruction Against Wall (Extended Coverage Sidewall Spray Sprinklers).

\[
A \geq (D - 8 \text{ in.}) + B \\
[A \geq (D - 0.2 \text{ m}) + B] \\
\text{where: } D \leq 30 \text{ in. (0.8 m)}
\]
8.9.5.1.5 Isolated Obstructions. [move to 11.3.6.1.5]
Isolated obstructions projecting from the same wall as the one on which the extended coverage sidewall sprinkler is mounted shall be located a minimum of 6 in. (150 mm) from the sidewall sprinkler.

8.9.5.1.6* [move to 11.3.6.1.6]
Obstructions on the wall opposite from the sidewall sprinkler shall be permitted where the obstruction is up to 2 ft (600 mm) deep and 2 ft (600 mm) wide.
8.9.5.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 11.3.6.2]

8.9.5.2.1 General. [move to 11.3.6.2.1]

8.9.5.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.

8.9.5.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 8.9.5.1.2 and 8.9.5.1.3.

8.9.5.2.1.3* Unless the requirements of 8.9.5.2.1.4 through 8.9.5.2.1.5 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 8.9.5.2.1.3(a) and Figure 8.9.5.2.1.3(b).

Figure 8.9.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Extended Coverage Sidewall).

Figure 8.9.5.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Extended Coverage Sidewall).
The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords), shall be 36 in. (900 mm).

The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.9.5.2.1.4 [move to 11.3.6.2.1.4]
The requirements of 8.9.5.2.1.3 and 8.9.5.2.1.4 shall not apply where sprinklers are positioned with respect to obstructions in accordance with 8.9.5.1.2 and 8.9.5.1.3.

8.9.5.2.1.5 [move to 11.3.6.2.1.5]
The requirements of 8.9.5.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

8.9.5.2.1.6* [move to 11.3.6.2.1.6]
Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

8.9.5.2.2 Suspended or Floor-Mounted Vertical Obstructions. [move to 11.3.6.2.2]
The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.9.5.2.2 and Figure 8.9.5.2.2.

Table 8.9.5.2.2 Suspended or Floor-Mounted Obstructions (Extended Coverage Sidewall Sprinklers) in Light Hazard Occupancies Only

<table>
<thead>
<tr>
<th>Horizontal Distance ((A))</th>
<th>Minimum Allowable Distance Below Deflector ((B)) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>9 1/2 (240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>12 1/2 (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. 750 mm)</td>
<td>15 1/2 (390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

Note: For \(A\) and \(B\), refer to Figure 8.9.5.2.2.

Figure 8.9.5.2.2 Suspended or Floor-Mounted Obstruction (Extended Coverage Sidewall Sprinklers) in Light Hazard Occupancy Only.
8.9.5.2.2.1* [move to 11.3.6.2.2.1]
In light hazard occupancies, privacy curtains, as shown in Figure 8.9.5.2.2, shall not be considered obstructions where all of the following are met:
1. The curtains are supported by fabric mesh on ceiling track.
2. Openings in the mesh are equal to 70 percent or greater.
3. The mesh extends a minimum of 22 in. (550 mm) down from ceiling.

8.9.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [move to 11.3.6.3]

8.9.5.3.1 [move to 11.3.6.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with this section.

8.9.5.3.2 [move to 11.3.6.3.2]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide, such as ducts, decks, open grate flooring, cutting tables, and overhead doors.

8.9.5.3.3 —being deleted with an FR
Sprinklers shall not be required under obstructions that are not fixed in place, such as conference tables.
8.10 Residential Sprinklers. —being deleted with an FR

8.10.1 Reserved. [moved to 12.1.4]

8.10.2* Listings. [moved to 12.1.5]

8.10.2.1 [moved to 12.1.5.1]
Areas of coverage shall be in accordance with the manufacturer's listing.

8.10.2.2 [moved to 12.1.5.2]
Residential sprinklers shall not be permitted to be used on ceilings with slopes greater than 8 in 12 or ceiling with heights greater than 24 ft unless specifically listed for this purpose.

8.10.3 Distances Between Sprinklers. [moved to 12.1.6]

8.10.3.1 [moved to 12.1.6.1]
Maximum distances between sprinklers shall be in accordance with the manufacturer's listing.

8.10.3.2 [moved to 12.1.6.2]
The distance between the sprinkler and the wall shall not exceed half the maximum allowable distance between sprinklers per the manufacturer's listing.

8.10.3.3 [moved to 12.1.6.3]
The minimum distance between sprinklers within a compartment shall be 8 ft (2.4 m), unless the listing of the sprinkler requires a greater distance, unless required by 8.10.7.1.5.1, or unless separated by baffles that comply with the following:
(1) Baffles shall be arranged to protect the actuating elements.
(2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
(3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
(4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
(5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

8.10.3.4 [moved to 12.1.6.4]
Residential sidewall sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within the maximum protection area of another sprinkler or unless separated by baffles that comply with the following:
(1) Baffles shall be arranged to protect the actuating elements.
(2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
(3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
(4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors.
(5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.

8.10.3.5 [moved to 12.1.6.5]
The maximum distance shall be measured along the slope of the ceiling as shown in Figure 8.10.3.5(a) and Figure 8.10.3.5(b).

Figure 8.10.3.5(a) Maximum Distance Between Sprinklers with Sloped Ceilings — Arrangement A.

Figure 8.10.3.5(b) Maximum Distance Between Sprinklers with Sloped Ceilings — Arrangement B.
Where sprinklers are installed along sloped ceilings, the sprinklers shall maintain the minimum listed spacing, but no less than 8 ft (2.4 m), measured in the plan view from one sprinkler to another as shown in Figure 8.10.3.6(a) and Figure 8.10.3.6(b), or unless separated by baffles that comply with the following:

1. Baffles shall be arranged to protect the actuating elements.
2. Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
3. Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
4. The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
5. The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

Figure 8.10.3.6(a) Minimum Distance Between Sprinklers with Sloped Ceilings — Arrangement A.
8.10.4 Deflector Position from Ceilings and Walls. [moved to 12.1.7]

8.10.4.1 [moved to 12.1.7.1]
Pendent and upright sprinklers shall be positioned so that the deflectors are 1 in. to 4 in. (25 mm to 100 mm) from the ceiling unless the listing allows a greater distance.

8.10.4.2 [moved to 12.1.7.2]
Sidewall sprinklers shall be positioned so that the deflectors are within 4 in. to 6 in. (100 mm to 150 mm) from the ceiling unless the listing allows greater distances.
8.10.4.3  [moved to 12.1.7.3]
Where soffits used for the installation of sidewall sprinklers exceed 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall be installed below the soffit.

8.10.4.4  [moved to 12.1.7.4]
Residential horizontal sidewall sprinkler deflectors shall be located no more than 6 in. (150 mm) from the wall on which they are mounted unless listed for greater distances.

8.10.4.5  [moved to 12.1.7.5]
The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in the sprinkler listing.

8.10.4.6  Minimum Distance from Walls. [moved to 12.1.7.6]

8.10.4.6.1  [moved to 12.1.7.6.1]
Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

8.10.4.6.2 —being deleted with an FR
The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.10.4.7  Deflector Orientation (Residential Upright and Pendent Spray).  [moved to 12.1.7.7]

8.10.4.7.1  [moved to 12.1.7.7.1]
Unless the requirements of 8.10.4.7.2 or 8.10.4.7.3 are met, deflectors of upright and pendent sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs.

8.10.4.7.2  [moved to 12.1.7.7.2]
Where upright or pendent sprinklers are installed at the peak below a sloped ceiling or roof surface, the sprinkler shall be installed with the deflector horizontal.

8.10.4.7.3  [moved to 12.1.7.7.3]
Roofs and ceilings having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 8.10.4.7, and upright and pendent sprinklers shall be permitted to be installed with deflectors horizontal.

8.10.5  [moved to 12.1.8]
Residential sprinklers installed in conformance with this standard shall follow the sprinkler obstacle rules of 8.10.6 or 8.10.7 as appropriate for their installation orientation (upright, pendent, or sidewall) and the obstruction criteria specified in the manufacturer's installation instructions.

8.10.6  Obstructions to Sprinkler Discharge (Residential Upright and Pendent Spray Sprinklers).  [moved to 12.1.9]

8.10.6.1  Performance Objective.  [moved to 12.1.9.1]
**8.10.6.1.1 [moved to 12.1.9.1.1]**
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.10.6.2 and 8.10.6.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

**8.10.6.1.2 [moved to 12.1.9.1.2]**
Sprinklers shall be arranged to comply with one of the following arrangements:
1. Sprinklers shall be in accordance with 8.5.5.2, Table 8.10.6.1.2, and Figure 8.10.6.1.2(a).
2. Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
3. Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 8.10.6.1.2(b).
4. Obstructions that are located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.10.6.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 mm) to less than 3 ft (900 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>9 (225)</td>
</tr>
</tbody>
</table>
### Distance from Sprinklers to Side of Obstruction (A) vs. Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) and greater</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.10.6.1.2(a).

Figure 8.10.6.1.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (Residential Upright and Pendent Spray Sprinklers).

![Elevation View](image)

Figure 8.10.6.1.2(b) Obstructions Against Wall (Residential Upright and Pendent Spray Sprinklers).
Figure 8.10.6.1.2(c) Obstructions Against Wall (Measurements for Residential Upright and Pendent Spray Sprinklers).

\[ A \geq (D - 8 \text{ in.}) + B \]
\[ A \geq (D - 200 \text{ mm}) + B \]
where: \( D \leq 30 \text{ in.} \) (750 mm)
8.10.6.2 Obstructions to Sprinkler Discharge Pattern Development. [moved to 12.1.9.2]

8.10.6.2.1 General. [moved to 12.1.9.2.1]

8.10.6.2.1.1 [moved to 12.1.9.2.1.1]
Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 8.10.6.2.

8.10.6.2.1.2 [moved to 12.1.9.2.1.2]
Regardless of the rules of this section, solid continuous obstructions shall meet the applicable requirements of 8.10.6.1.2.

8.10.6.2.1.3* [moved to 12.1.9.2.1.3]
Unless the requirements of 8.10.6.2.1.4 through 8.10.6.2.1.8 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 8.10.6.2.1.3(a) and Figure 8.10.6.2.1.3(b).

Figure 8.10.6.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Residential Upright and Pendent Spray Sprinkler).
Plan View of Column
(Obstruction in vertical orientation)

\[ A \geq 4C \text{ or } 4D \]
(Use dimension \( C \) or \( D \), whichever is greater)

Figure 8.10.6.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Residential Upright and Pendent Spray Sprinkler).
The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixture and truss chords) shall be 36 in. (900 mm).

The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.10.6.2.1.4 [moved to 12.1.9.2.1.4]
Sprinklers shall be permitted to be spaced on opposite sides of the obstruction where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

8.10.6.2.1.5 [moved to 12.1.9.2.1.5]
Sprinklers shall be permitted to be located one-half the distance between the obstructions where the obstruction consists of open trusses 20 in. (500 mm) or greater apart [24 in. (600 mm) on center], provided that all truss members are not greater than 4 in. (100 mm) (nominal) in width and web members do not exceed 1 in. (25 mm) in width.

8.10.6.2.1.6 [moved to 12.1.9.2.1.6]
Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam provided that the truss chord or beam dimension is not more than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance four times greater than the maximum dimension of the web members away from the web members.

8.10.6.2.1.7 [moved to 12.1.9.2.1.7]
The requirements of 8.10.6.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

8.10.6.2.1.8 [moved to 12.1.9.2.1.8]
The requirements of 8.10.6.2.1.3 shall not apply to sprinklers positioned with respect to obstructions in accordance with 8.10.6.1.2.

8.10.6.2.1.9* [moved to 12.1.9.2.1.9]
Sprinklers shall be permitted to be placed without regard to the blades of a ceiling fan, provided the plan view of the fan is at least 50 percent open.

8.10.6.2.2 Suspended or Floor-Mounted Vertical Obstructions. [moved to 12.1.9.2.2]
The distance from sprinklers to privacy curtains, free-standing partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.10.6.2.2 and Figure 8.10.6.2.2.

Table 8.10.6.2.2 Suspended or Floor-Mounted Obstructions (Residential Upright and Pendent Spray Sprinklers) in Light Hazard Occupancies Only

<table>
<thead>
<tr>
<th>Horizontal Distance ((A))</th>
<th>Minimum Vertical Distance Below Deflector ((B)) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>91/2(240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>121/2(315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>151/2(390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

Note: For \(A\) and \(B\), refer to Figure 8.10.6.2.2.

Figure 8.10.6.2.2 Suspended or Floor-Mounted Obstruction (Residential Upright and Pendent Spray Sprinklers) in Light Hazard Occupancy Only.
8.10.6.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [moved to 12.1.9.3]

8.10.6.3.1 [moved to 12.1.9.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 8.10.6.3.

8.10.6.3.2 [moved to 12.1.9.3.2]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as stairs and landings.

8.10.6.3.3 —being deleted with an FR
Sprinklers shall not be required under obstructions that are not fixed in place.

8.10.6.3.4 [moved to 12.1.9.3.3]
Sprinklers installed under open gratings shall be shielded from the discharge of overhead sprinklers.

8.10.7 Obstructions to Sprinkler Discharge (Residential Sidewall Spray Sprinklers). [move to 12.1.10]

8.10.7.1 Performance Objective. [move to 12.1.10.1]

8.10.7.1.1 [move to 12.1.10.1.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.5.5.2 and 8.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.10.7.1.2 [move to 12.1.10.1.2]
Sidewall sprinklers shall be installed no closer than 8 ft (2.4 m) from light fixtures or similar obstructions.

8.10.7.1.3 [move to 12.1.10.1.3]
The distance between light fixtures or similar obstructions located more than 8 ft (2.4 m) from the sprinkler shall be in conformance with Table 8.10.7.1.3 and Figure 8.10.7.1.3.

Table 8.10.7.1.3 Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)</th>
<th>[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 8 ft (2.4 m)</td>
<td>Not allowed</td>
<td></td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 10 ft (3.0 m)</td>
<td>1 (25)</td>
<td></td>
</tr>
<tr>
<td>10 ft (3.0 m) to less than 11 ft (3.3 m)</td>
<td>2 (50)</td>
<td></td>
</tr>
<tr>
<td>11 ft (3.3 m) to less than 12 ft (3.7 m)</td>
<td>3 (75)</td>
<td></td>
</tr>
<tr>
<td>12 ft (3.7 m) to less than 13 ft (4.0 m)</td>
<td>4 (100)</td>
<td></td>
</tr>
<tr>
<td>13 ft (4.0 m) to less than 14 ft (4.3 m)</td>
<td>6 (150)</td>
<td></td>
</tr>
<tr>
<td>14 ft (4.3 m) to less than 15 ft (4.6 m)</td>
<td>7 (175)</td>
<td></td>
</tr>
<tr>
<td>15 ft (4.6 m) to less than 16 ft (4.9 m)</td>
<td>9 (225)</td>
<td></td>
</tr>
<tr>
<td>16 ft (4.9 m) to less than 17 ft (5.2 m)</td>
<td>11 (275)</td>
<td></td>
</tr>
<tr>
<td>17 ft (5.2 m) or greater</td>
<td>14 (350)</td>
<td></td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.10.7.1.3.

Figure 8.10.7.1.3 Positioning of Sprinkler to Avoid Obstruction (Residential Sidewall Sprinklers).
Continuous obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with one of the following arrangements:

1. Sprinklers shall be in accordance with Table 8.10.7.1.4 and Figure 8.10.7.1.4(a).
2. Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.
3. Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 8.10.7.1.4(b).
4. Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.10.7.1.4(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 8.10.7.1.4 Positioning of Sprinklers to Avoid Obstructions Along Wall (Residential Sidewall Sprinklers)
<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft 6 in. (450 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 3 ft (900 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 6 ft (1.8 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.10.7.1.4(a).

Figure 8.10.7.1.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Residential Sidewall Sprinklers).

![Figure 8.10.7.1.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Residential Sidewall Sprinklers).](image)

Figure 8.10.7.1.4(b) Obstruction Against Wall (Residential Sidewall Spray Sprinklers).

![Figure 8.10.7.1.4(b) Obstruction Against Wall (Residential Sidewall Spray Sprinklers).](image)
Figure 8.10.7.1.4(c) Obstruction Against Wall (Residential Sidewall Spray Sprinklers).

Elevation View

\[ A \geq (D - 8 \text{ in.}) + B \]
\[ [A \geq (D - 0.2 \text{ m}) + B] \]
where: \( D \leq 30 \text{ in.} \) (0.8 m)
8.10.7.1.5* Soffits and Cabinets. [move to 12.1.10.1.5]
Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 8.10.7.1.5.1, 8.10.7.1.5.2, or 8.10.7.1.5.3.

8.10.7.1.5.1 [move to 12.1.10.1.5.1]
Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.
8.10.7.1.5.2 [move to 12.1.10.1.5.2] Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

8.10.7.1.5.3 [move to 12.1.10.1.5.3] Where sidewall sprinklers are more than 3 ft (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

8.10.7.1.6* [move to 12.1.10.1.6] Obstructions on the wall opposite from the sidewall sprinkler shall be permitted where the obstruction is up to 2 ft (600 mm) deep and 2 ft (600 mm) wide.

8.10.7.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 12.1.10.2]

8.10.7.2.1 General. [move to 12.1.10.2.1]

8.10.7.2.1.1 [move to 12.1.10.2.1.1] Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.

8.10.7.2.1.2 [move to 12.1.10.2.1.2] Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 8.10.7.1.2 and 8.10.7.1.3.

8.10.7.2.1.3* [move to 12.1.10.2.1.3] Unless the requirements of 8.10.7.2.1.4 through 8.10.7.2.1.7 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures).

(A) The maximum clear distance required from obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 36 in. (900 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

8.10.7.2.1.4 [move to 12.1.10.2.1.4] Sidewall sprinklers shall be positioned in accordance with Figure 8.10.7.2.1.4(a) and Figure 8.10.7.2.1.4(b) when obstructions are present.

Figure 8.10.7.2.1.4(a) Minimum Distance from an Obstruction in the Vertical Orientation (Residential Sidewall Sprinkler).
Figure 8.10.7.2.1.4(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Residential Sidewall Sprinkler).

Plan View of Column
(Obstruction in vertical orientation)

\[ A = 4C \text{ or } 4D \]
(Use dimension \( C \) or \( D \), whichever is greater)
8.10.7.2.1.5 [move to 12.1.10.2.1.5]
The requirements of 8.10.7.2.1.3 and 8.10.7.2.1.4 shall not apply where sprinklers are positioned with respect to obstructions in accordance with 8.10.7.1.2 and 8.10.7.1.3.

8.10.7.2.1.6 [move to 12.1.10.2.1.6]
The requirements of 8.10.7.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

8.10.7.2.1.7* [move to 12.1.10.2.1.7]
Sprinklers shall be permitted to be placed without regard to the blades of a ceiling fan, provided the plan view of the fan is at least 50 percent open.

8.10.7.2.2 Suspended or Floor-Mounted Vertical Obstructions. [move to 12.1.10.2.2]
The distance from sprinklers to privacy curtains, free-standing partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 8.10.7.2.2 and Figure 8.10.7.2.2.

Table 8.10.7.2.2 Suspended or Floor-Mounted Obstructions (Residential Sidewall Sprinklers) in Light Hazard Occupancies Only
<table>
<thead>
<tr>
<th>Horizontal Distance (&lt;i&gt;A&lt;/i&gt;)</th>
<th>Minimum Allowable Distance Below Deflector (&lt;i&gt;B&lt;/i&gt;) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>9 1/2 (240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>12 1/2 (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>15 1/2 (390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.

Note: For <i>A</i> and <i>B</i>, refer to Figure 8.10.7.2.2.

Figure 8.10.7.2.2 Suspended or Floor-Mounted Obstruction (Residential Sidewall Sprinklers) in Light Hazard Occupancy Only.
**8.10.7.3 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard.** [move to 12.1.10.3]

**8.10.7.3.1** [move to 12.1.10.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with this section.

**8.10.7.3.2** [move to 12.1.10.3.2]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide, such as ducts, stairs, and landings.

**8.10.7.3.3** —being deleted with an FR
Sprinklers shall not be required under obstructions that are not fixed in place.

**8.10.7.3.4** [move to 12.1.10.3.3]
Sprinklers installed under open gratings shall be shielded from the discharge of overhead sprinklers.

**8.10.7.3.5** [move to 12.1.10.3.4]
The deflector of automatic sprinklers installed under fixed obstructions shall be positioned below the bottom of the obstruction in accordance with their listed distance below ceilings.

**8.10.7.3.6** [move to 12.1.10.3.5]
Sprinklers installed under round ducts shall be shielded from the discharge of overhead sprinklers.

**8.10.8 Ceiling Pockets.** [move to 12.1.11]

**8.10.8.1** [move to 12.1.11.1]
Sprinklers shall be required in all ceiling pockets.

**8.10.8.2** [move to 12.1.11.2]
The requirement of 8.10.8.1 shall not apply where all of the following requirements are met:
1. The total volume of the unprotected ceiling pocket does not exceed 100 ft³ (2.8 m³).
2. The depth of the unprotected ceiling pocket does not exceed 12 in. (300 mm).
3. The entire floor of the unprotected ceiling pocket is protected by the sprinklers at the lower ceiling elevation.
4. The interior finish of the unprotected ceiling pocket is noncombustible or limited-combustible construction.

**8.11 CMSA Sprinklers.** [move to 13.2]

**8.11.1 General.** [move to 13.2.1]
All requirements of Section 8.5 shall apply to CMSA sprinklers except as modified in Section 8.11.
8.11.1.1 [move to 13.2.1.1]  
CMSA pendent sprinklers shall be installed in accordance with Section 8.5 and the manufacturer's installation instructions in lieu of the requirements in Section 8.11.

8.11.2* Protection Areas per Sprinkler (CMSA Sprinklers). [move to 13.2.5]

8.11.2.1 Determination of Protection Area of Coverage. [move to 13.2.5.1]  
The protection area of coverage per sprinkler ($A_s$) shall be determined in accordance with 8.5.2.1.

8.11.2.2 Maximum Protection Area of Coverage. [move to 13.2.5.2]

8.11.2.2.1 The maximum allowable protection area of coverage for a sprinkler ($A_s$) shall be in accordance with the value indicated in Table 8.11.2.2.1.

Table 8.11.2.2.1 Protection Areas and Maximum Spacing for CMSA Sprinklers

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>Protection Area</th>
<th>Maximum Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncombustible unobstructed</td>
<td>130 ft² (12.1 m²)</td>
<td>12 ft (3.7 m)</td>
</tr>
<tr>
<td>Noncombustible obstructed</td>
<td>130 ft² (12.1 m²)</td>
<td>12 ft (3.7 m)</td>
</tr>
<tr>
<td>Combustible unobstructed</td>
<td>130 ft² (12.1 m²)</td>
<td>12 ft (3.7 m)</td>
</tr>
<tr>
<td>Combustible obstructed</td>
<td>100 ft² (9.3 m²)</td>
<td>10 ft (3.0 m)</td>
</tr>
<tr>
<td>Rack storage combustible obstructed</td>
<td>100 ft² (9.3 m²)</td>
<td>10 ft (3.0 m)</td>
</tr>
<tr>
<td>Rack storage unobstructed and noncombustible obstructed</td>
<td>100 ft² (9.3 m²)</td>
<td>12 ft (3.7 m)</td>
</tr>
</tbody>
</table>

8.11.2.2.2 [move to 13.2.5.2.2]  
In any case, the maximum area of coverage of any sprinkler shall not exceed 130 ft² (12.1 m²).

8.11.2.3 Minimum Protection Area of Coverage. [move to 13.2.5.3]  
The minimum allowable protection area of coverage for a sprinkler ($A_s$) shall be not less than 80 ft² (7.4 m²).

8.11.3 Sprinkler Spacing (CMSA Sprinklers). [move to 13.2.6]

8.11.3.1* Maximum Distance Between Sprinklers. [move to 13.2.6.1]

8.11.3.1.1 [move to 13.2.6.1.1]  
Under unobstructed and obstructed noncombustible construction and unobstructed combustible construction, the distance between sprinklers shall be limited to not more than 12 ft (3.7 m) between sprinklers, as shown in Table 8.11.2.2.1.
Under obstructed combustible construction, the maximum distance shall be limited to 10 ft (3 m).

**8.11.3.2 Maximum Distance from Walls.** [move to 13.2.6.2]
The distance from sprinklers to walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 8.11.2.2.1.

**8.11.3.3 Minimum Distance from Walls.** [move to 13.2.6.3]
Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall.

**8.11.3.4 Minimum Distance Between Sprinklers.** [move to 13.2.6.4]
Sprinklers shall be spaced not less than 8 ft (2.4 m) on center.

**8.11.4 Deflector Position (CMSA Sprinklers).** [move to 13.2.7]

**8.11.4.1* Distance Below Ceilings.** [move to 13.2.7.1]

---

**8.11.4.1.1 Unobstructed Construction.** [move to 13.2.7.1.1]
Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 6 in. (150 mm) and a maximum of 8 in. (200 mm).

**8.11.4.1.2 Obstructed Construction.** [move to 13.2.7.1.2]
Under obstructed construction, the sprinkler deflector shall be located in accordance with one of the following arrangements:
1. Installed with the deflectors located a minimum of 6 in. (150 mm) and a maximum of 12 in. (300 mm) from the ceiling.
2. Installed with the deflectors within the horizontal planes 1 in. to 6 in. (25 mm to 150 mm) below wood joist, composite wood joist, solid obstructed noncombustible, or solid obstructed limited combustible construction, to a maximum distance of 22 in. (550 mm) below the ceiling/roof or deck. Where CMSA sprinklers are installed under open wood joist construction, their minimum operating pressure shall be 50 psi (3.4 bar) for a K-11.2 (160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (240) sprinkler in accordance with 16.2.2.4, 16.3.2.4, and 17.2.2.3.
3. Installed with deflectors of sprinklers under concrete tee construction with stems spaced less than 7 ft 6 in. (2.3 m) but more than 3 ft (900 mm) on centers, regardless of the depth of the tee, located at or above a horizontal plane 1 in. (25 mm) below the bottom of the stems of the tees and in compliance with Table 8.11.5.1.2.

**8.11.4.2 Deflector Orientation.** —being deleted with an FR
Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

---

**8.11.5* Obstructions to Sprinkler Discharge (CMSA Sprinklers).** [move to 13.2.8]

---

**8.11.5.1 Performance Objective.** [move to 13.2.8.1]

---

**8.11.5.1.1** [move to 13.2.8.1.1]
Sprinklers shall be located so as to minimize obstructions to discharge as defined in 8.5.5.2 and 8.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

8.11.5.1.2 [move to 13.2.8.1.2]
Sprinklers shall be arranged to comply with 8.5.5.2, Table 8.11.5.1.2, and Figure 8.11.5.1.2.

Table 8.11.5.1.2 Positioning of Sprinklers to Avoid Obstructions to Discharge (CMSA Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>11/2(35)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>51/2(140)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 mm) to less than 3 ft (900 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>10 (250)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>15 (375)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>18 (450)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>22 (550)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>26 (650)</td>
</tr>
<tr>
<td>6 ft (1.8 m)</td>
<td>31 (775)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.11.5.1.2.

Figure 8.11.5.1.2 Positioning of Sprinkler to Avoid Obstruction to Discharge (CMSA Sprinklers).
8.11.5.1.3 [move to 13.2.8.1.3]
The requirements of 8.11.5.1.2 shall not apply where sprinklers are positioned on opposite sides of the obstruction.

8.11.5.2 Obstructions to Sprinkler Discharge Pattern Development. [move to 13.2.8.2]

8.11.5.2.1 General. [move to 13.2.8.2.1]

8.11.5.2.1.1 [move to 13.2.8.2.1.1]
Continuous or noncontinuous obstructions less than or equal to 36 in. (900 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 8.11.5.2.

8.11.5.2.1.2 [move to 13.2.8.2.1.2]
Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 8.11.5.1.2 or 8.11.5.1.3.

8.11.5.2.1.3* [move to 13.2.8.2.1.3]
Unless the requirements of 8.11.5.1.2 or 8.11.5.1.3 are met, for obstructions 8 in. (200 mm) or less in width, as shown in Figure 8.11.5.2.1.3, sprinklers shall be positioned such that they are located at least a distance three times greater than the maximum dimension of the obstruction from the sprinkler (e.g., webs and chord members, pipe, columns, and fixtures).

Figure 8.11.5.2.1.3 Minimum Distance from Obstruction (CMSA Sprinklers).
8.11.5.2.2 Branch Lines.  [move to 13.2.8.2.2]
Upright sprinklers shall be positioned with respect to branch lines in accordance with one of the following:
(1) Upright sprinklers shall be permitted to be attached directly to branch lines less than or equal to 4 in. (100 mm) nominal in diameter.
(2) Upright sprinklers shall be permitted to be offset horizontally a minimum of 12 in. (300 mm) from the pipe.
(3) Upright sprinklers shall be permitted to be supplied by a riser nipple (sprig) to elevate the sprinkler deflector a minimum of 12 in. (300 mm) from the centerline of any pipe over 4 in. (100 mm) nominal in diameter.

8.11.5.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. [move to 13.2.8.3]

8.11.5.3.1 [move to 13.2.8.3.1]
Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 8.11.5.3.

8.11.5.3.2 [move to 13.2.8.3.2]
Sprinklers shall be positioned with respect to fluorescent lighting fixtures, ducts, and obstructions more than 24 in. (600 mm) wide and located entirely below the sprinklers so that the minimum horizontal distance from the near side of the obstruction to the center of the sprinkler is not less than the value specified in Table 8.11.5.3.2 and Figure 8.11.5.3.2.
Table 8.11.5.3.2 Obstruction Entirely Below Sprinkler (CMSA Sprinklers)

<table>
<thead>
<tr>
<th>Minimum Distance to Side of Obstruction (ft) ((A))</th>
<th>Distance of Deflector Above Bottom of Obstruction ((B)) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 6 in. (150 mm)</td>
<td>11/2 (35)</td>
</tr>
<tr>
<td>6 in. (150 mm) to less than 12 in. (300 mm)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>12 in. (300 mm) to less than 18 in. (450 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>18 in. (450 mm) to less than 24 in. (600 mm)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>24 in. (600 mm) to less than 30 in. (750 mm)</td>
<td>5 1/2 (140)</td>
</tr>
<tr>
<td>30 in. (750 mm) to less than 36 in. (900 mm)</td>
<td>6 (150)</td>
</tr>
</tbody>
</table>

Note: For \(A\) and \(B\), refer to Figure 8.11.5.3.2.

Figure 8.11.5.3.2 Obstruction Entirely Below Sprinkler (CMSA Sprinklers).

8.11.5.3.3 [move to 13.2.8.3.3]
Sprinklers installed under open gratings shall be shielded from the discharge of overhead sprinklers.

8.11.5.3.4 [move to 13.2.8.3.4]
Where the bottom of the obstruction is located 24 in. (600 mm) or more below the sprinkler deflectors, the following shall occur:
(1) Sprinklers shall be positioned so that the obstruction is centered between adjacent sprinklers in accordance with Figure 8.11.5.3.4.
(2) The obstruction width shall meet the following requirements:
(a) The obstruction shall be limited to a maximum width of 24 in. (600 mm) in accordance with Figure 8.11.5.3.4.
(b) Where the obstruction is greater than 24 in. (600 mm) wide, one or more lines of sprinklers shall be installed below the obstruction.
(3) The obstruction extension shall meet the following requirements:
(a) The obstruction shall not extend more than 12 in. (300 mm) to either side of the midpoint between sprinklers in accordance with Figure 8.11.5.3.4.
(b) Where the extensions of the obstruction exceed 12 in. (300 mm), one or more lines of sprinklers shall be installed below the obstruction.
(4) At least 18 in. (450 mm) clearance shall be maintained between the top of storage and the bottom of the obstruction in accordance with Figure 8.11.5.3.4.

Figure 8.11.5.3.4 Obstruction More Than 24 in. (600 mm) Below Sprinklers (CMSA Sprinklers).

8.11.5.3.5 [move to 13.2.8.3.5]
In the special case of an obstruction running parallel to or directly below a branch line, the following shall occur:
(1) The sprinkler shall be located at least 36 in. (900 mm) above the top of the obstruction in accordance with Figure 8.11.5.3.5.
(2) The obstruction shall be limited to a maximum width of 12 in. (300 mm) in accordance with Figure 8.11.5.3.5.
(3) The obstruction shall be limited to a maximum extension of 6 in. (150 mm) to either side of the centerline of the branch line in accordance with Figure 8.11.5.3.5.

Figure 8.11.5.3.5 Obstruction More Than 36 in. (914 mm) Below Sprinklers (CMSA Sprinklers).
8.11.6 Clearance to Storage (CMSA Sprinklers). [move to 13.2.9]
The clearance between the deflector and the top of storage shall be 36 in. (900 mm) or greater.

8.12 Early Suppression Fast-Response Sprinklers. [move to 14.2]

8.12.1 General. [move to 14.2.1]
All requirements of Section 8.5 shall apply except as modified in Section 8.12.

8.12.2 Protection Areas per Sprinkler (Early Suppression Fast-Response Sprinklers). [move to 14.2.8]

8.12.2.1 Determination of Protection Area of Coverage. [move to 14.2.8.1]
The protection area of coverage per sprinkler \((A_s)\) shall be determined in accordance with 8.5.2.1.

8.12.2.2 Maximum Protection Area of Coverage. [move to 14.2.8.2]

8.12.2.2.1 [move to 14.2.8.2.1]
The maximum allowable protection area of coverage for a sprinkler \((A_s)\) shall be in accordance with the value indicated in Table 8.12.2.2.1.

Table 8.12.2.2.1 Protection Areas and Maximum Spacing of ESFR Sprinklers
Ceiling/Roof Heights Up to 30 ft (9.1 m)  
Ceiling/Roof Heights Over 30 ft (9.1 m)

<table>
<thead>
<tr>
<th>Construction Type</th>
<th>Protection Area ft²</th>
<th>Spacing ft</th>
<th>Spacing m</th>
<th>Protection Area ft²</th>
<th>Spacing ft</th>
<th>Spacing m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncombustible unobstructed</td>
<td>100</td>
<td>9.3</td>
<td>12</td>
<td>3.7</td>
<td>100</td>
<td>9.3</td>
</tr>
<tr>
<td>Noncombustible obstructed</td>
<td>100</td>
<td>9.3</td>
<td>12</td>
<td>3.7</td>
<td>100</td>
<td>9.3</td>
</tr>
<tr>
<td>Combustible unobstructed</td>
<td>100</td>
<td>9.3</td>
<td>12</td>
<td>3.7</td>
<td>100</td>
<td>9.3</td>
</tr>
<tr>
<td>Combustible obstructed</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

8.12.2.2 [move to 14.2.8.2.2]

Unless the requirements of 8.12.2.2.3 are met, the maximum area of coverage of any sprinkler shall not exceed 100 ft² (9.3 m²).

8.12.2.2.3* [move to 14.2.8.2.3]

Deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a sprinkler along the branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for that sprinkler does not exceed 110 ft² (10.2 m²) per sprinkler where all of the following conditions are met:

(1) The average actual floor area protected by the moved sprinkler and the adjacent sprinklers shall not exceed 100 ft² (9.3 m²).
(2) Adjacent branch lines shall maintain the same pattern.
(3) In no case shall the distance between sprinklers exceed 12 ft (3.7 m).

8.12.2.4 [move to 14.2.8.2.4]

Deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a single branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for the sprinklers on that branch line and the sprinklers on the branch line it is moving away from does not exceed 110 ft² (10.2 m²) per sprinkler where all of the following conditions are met:

(1) The average actual floor area protected by the sprinklers on the moved branch line and the sprinklers on the adjacent branch lines shall not exceed 100 ft² (9.3 m²) per sprinkler.
(2) In no case shall the distance between sprinklers exceed 12 ft (3.7 m).
(3) It shall not be permitted to move a branch line where there are moved sprinklers on a branch line that exceed the maximum sprinkler spacing.

8.12.2.3 Minimum Protection Area of Coverage. [move to 14.2.8.3]

The minimum allowable protection area of coverage for a sprinkler \( A_s \) shall not be less than 64 ft² (5.9²).

8.12.3 Sprinkler Spacing (Early Suppression Fast-Response Sprinklers). [move to 14.2.9]
8.12.3.1 Maximum Distance Between Sprinklers. [move to 14.2.9.1]
The maximum distance between sprinklers shall be in accordance with the following:
(1) Where the storage height is less than or equal to 25 ft (7.6 m) and the ceiling height is less than or equal to 30 ft (9.1 m), the distance between sprinklers shall be limited to not more than 12 ft (3.7 m) between sprinklers as shown in Table 8.12.2.2.1.
(2) Unless the requirements of 8.12.3.1(3) or 8.12.3.1(4) are met, where the storage height exceeds 25 ft (7.6 m) and ceiling height exceeds 30 ft (9.1 m), the distance between sprinklers shall be limited to not more than 10 ft (3.0 m) between sprinklers.
(3) Regardless of the storage or ceiling height arrangement, deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a sprinkler along the branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for that sprinkler does not exceed 110 ft² (10.2 m²) where all of the following conditions are met:
   (a) The average actual floor area protected by the moved sprinkler and the adjacent sprinklers shall not exceed 100 ft² (9.3 m²).
   (b) Adjacent branch lines shall maintain the same pattern.
   (c) In no case shall the distance between sprinklers exceed 12 ft (3.7 m).
(4) Where branch lines are parallel to trusses and bar joists, deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a single branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for the sprinklers on that branch line and the sprinklers on the branch line it is moving away from does not exceed 110 ft² (10.2 m²) per sprinkler where all of the following conditions are met:
   (a) The average actual floor area protected by the sprinklers on the moved branch line and the sprinklers on the adjacent branch lines shall not exceed 100 ft² (9.3 m²) per sprinkler.
   (b) In no case shall the distance between sprinklers exceed 12 ft (3.7 m).
   (c) It shall not be permitted to move a branch line where there are moved sprinklers on a branch line that exceed the maximum sprinkler spacing.

8.12.3.2 Maximum Distance from Walls. [move to 14.2.9.2]
The distance from sprinklers to walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 8.12.2.2.1.

8.12.3.3 Minimum Distance from Walls. [move to 14.2.9.3]
Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall.

8.12.3.4 Minimum Distance Between Sprinklers. [move to 14.2.9.4]
Sprinklers shall be spaced not less than 8 ft (2.4 m) on center.

8.12.4 Deflector Position (Early Suppression Fast-Response Sprinklers). [move to 14.2.10]

8.12.4.1 Distance Below Ceilings. [move to 14.2.10.1]

8.12.4.1.1 [move to 14.2.10.1.1]
Pendent sprinklers with a nominal K-factor of K-14 (200) shall be positioned so that deflectors are a maximum 14 in. (350 mm) and a minimum 6 in. (150 mm) below the ceiling.
8.12.4.1.2 [move to 14.2.10.1.2]
Pendent sprinklers with a nominal K-factor of K-16.8 (240) shall be positioned so that deflectors are a maximum 14 in. (350 mm) and a minimum 6 in. (150 mm) below the ceiling.

8.12.4.1.3 [move to 14.2.10.1.3]
Pendent sprinklers with a nominal K-factor of K-22.4 (320) and K-25.2 (360) shall be positioned so that deflectors are a maximum 18 in. (450 mm) and a minimum 6 in. (150 mm) below the ceiling.

8.12.4.1.4 [move to 14.2.10.1.4]
Upright sprinklers with a nominal K-factor of K-14 (200) shall be positioned so that the deflector is 3 in. to 12 in. (75 mm to 300 mm) below the ceiling.

8.12.4.1.5 [move to 14.2.10.1.5]
Upright sprinklers with a nominal K-factor of K-16.8 (240) shall be positioned so that the deflector is 3 in. to 12 in. (75 mm to 300 mm) below the ceiling.

8.12.4.1.6 [move to 14.2.10.1.6]
With obstructed construction, the branch lines shall be permitted to be installed across the beams, but sprinklers shall be located in the bays and not under the beams.

8.12.4.2 Deflector Orientation.
Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.12.5* Obstructions to Sprinkler Discharge (Early Suppression Fast-Response Sprinklers). [move to 14.2.11]

8.12.5.1 Obstructions at or Near Ceiling. [move to 14.2.11.1]

8.12.5.1.1 [move to 14.2.11.1.1]
Sprinklers shall be arranged to comply with Table 8.12.5.1.1 and Figure 8.12.5.1.1 for obstructions at the ceiling, such as beams, ducts, lights, and top chords of trusses and bar joists.

Table 8.12.5.1.1 Positioning of Sprinklers to Avoid Obstructions to Discharge (ESFR Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)[in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>11/2(35)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>51/2(140)</td>
</tr>
</tbody>
</table>
### Distance from Sprinkler to Side of Obstruction \((A)\) vs. Maximum Allowable Distance of Deflector Above Bottom of Obstruction \((B)\) [in. (mm)]

<table>
<thead>
<tr>
<th>Distance from Sprinkler to Side of Obstruction ((A))</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction ((B)) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ft 6 in. (750 mm) to less than 3 ft (900 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>10 (250)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>15 (375)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>18 (450)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>22 (550)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>26 (650)</td>
</tr>
<tr>
<td>6 ft (1.8 m)</td>
<td>31 (775)</td>
</tr>
</tbody>
</table>

Note: For \(A\) and \(B\), refer to Figure 8.12.5.1.1.

Figure 8.12.5.1.1 Positioning of Sprinkler to Avoid Obstruction to Discharge (ESFR Sprinklers).

**8.12.5.1.2 [move to 14.2.11.1.2]**

The requirements of 8.12.5.1.1 shall not apply where sprinklers are spaced on opposite sides of obstructions less than 24 in. (600 mm) wide, provided the distance from the centerline on the obstructions to the sprinklers does not exceed one-half the allowable distance between sprinklers.

**8.12.5.1.3 [move to 14.2.11.1.3]**
Sprinklers with a special obstruction allowance shall be installed according to their listing.

8.12.5.2* Isolated Obstructions Below Elevation of Sprinklers. [move to 14.2.11.2]
Sprinklers shall be arranged with respect to obstructions in accordance with one of the following:
1. Sprinklers shall be installed below isolated noncontinuous obstructions that restrict only one sprinkler and are located below the elevation of sprinklers such as light fixtures and unit heaters.
2. Additional sprinklers shall not be required where the obstruction is 2 ft (600 mm) or less in width and the sprinkler is located horizontally 1 ft (300 mm) or greater from the nearest edge of the obstruction.
3. Additional sprinklers shall not be required where sprinklers are positioned with respect to the bottom of obstructions in accordance with 8.12.5.1.
4. Additional sprinklers shall not be required where the obstruction is 2 in. (50 mm) or less in width and is located a minimum of 2 ft (600 mm) below the elevation of the sprinkler deflector or is positioned a minimum of 1 ft (300 mm) horizontally from the sprinkler.
5. Sprinklers with a special obstruction allowance shall be installed according to their listing.

8.12.5.3 Continuous Obstructions Below Sprinklers. [move to 14.2.11.3]

8.12.5.3.1 General Continuous Obstructions. [move to 14.2.11.3.1]
Sprinklers shall be arranged with respect to obstructions in accordance with one of the following:
1. Sprinklers shall be installed below continuous obstructions, or they shall be arranged to comply with Table 8.12.5.1.1 for horizontal obstructions entirely below the elevation of sprinklers that restrict sprinkler discharge pattern for two or more adjacent sprinklers such as ducts, lights, pipes, and conveyors.
2. Additional sprinklers shall not be required where the obstruction is 2 in. (50 mm) or less in width and is located a minimum of 2 ft (600 mm) below the elevation of the sprinkler deflector or is positioned a minimum of 1 ft (300 mm) horizontally from the sprinkler.
3. Additional sprinklers shall not be required where the obstruction is 1 ft (300 mm) or less in width and located a minimum of 1 ft (300 mm) horizontally from the sprinkler.
4. Additional sprinklers shall not be required where the obstruction is 2 ft (600 mm) or less in width and located a minimum of 2 ft (600 mm) horizontally from the sprinkler.
5. Ceiling sprinklers shall not be required to comply with Table 8.12.5.1.1 where a row of sprinklers is installed under the obstruction.

8.12.5.3.2 Bottom Chords of Bar Joists or Open Trusses. [move to 14.2.11.3.2]
ESFR sprinklers shall be positioned a minimum of 1 ft (300 mm) horizontally from the nearest edge to any bottom chord of a bar joist or open truss.

8.12.5.3.2.1 [move to 14.2.11.3.2.1]
The requirements of 8.12.5.3.2 shall not apply where upright sprinklers are located over the bottom chords of bar joists or open trusses that are 4 in. (100 mm) maximum in width.

8.12.5.3.3* [move to 14.2.11.3.3]
For pipes, conduits, or groups of pipes and conduit to be considered individual, they must be separated from the closest adjacent pipe, conduit, cable tray, or similar obstructions by a
minimum of three times the width of the adjacent pipe, conduit, cable tray, or similar
obstruction.

8.12.5.3.4 Open Gratings. [move to 14.2.11.3.4]
Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or
otherwise shielded from the discharge of overhead sprinklers.

8.12.5.3.5 Overhead Doors. [move to 14.2.11.3.5]
Quick-response spray sprinklers shall be permitted to be utilized under overhead doors.

8.12.5.3.6 Special Obstruction Allowance. [move to 14.2.11.3.6]
Sprinklers with a special obstruction allowance shall be installed according to their listing.

8.12.6 Clearance to Storage (Early Suppression Fast-Response Sprinklers). [move to
14.2.12]
The clearance between the deflector and the top of storage shall be 36 in. (900 mm) or greater.

8.13 In-Rack Sprinklers. —being deleted with an FR

8.13.1 System Size. [move to 25.1.2]
The area protected by a single system of sprinklers in racks shall not exceed 40,000 ft² (3720 m²)
of floor area occupied by the racks, including aisles, regardless of the number of levels of in-rack
sprinklers.

8.13.2 Type of In-Rack Sprinklers. —being deleted with an FR

8.13.2.1 [move to 25.3.1]
Sprinklers in racks shall be ordinary-temperature standard-response or quick-response
classification with a nominal K-factor of K-5.6 (80), K-8.0 (115), or K-11.2 (160), pendent or
upright.

8.13.2.2 [move to 25.3.1.1]
Sprinklers with intermediate- and high-temperature ratings shall be used near heat sources as
required by 8.3.2.

8.13.3 In-Rack Sprinkler Water Shields. [move to 25.3.4]

8.13.3.1 In-Rack Sprinkler Water Shields for Storage of Class I Through Class IV
Commodities. [move to 25.3.4.1]
Water shields shall be provided directly above in-rack sprinklers, or listed intermediate
level/rack storage sprinklers shall be used where there is more than one level, if not shielded by
horizontal barriers. (See Section C.3.)

8.13.3.2 In-Rack Sprinkler Water Shields for Plastic Storage. [move to 25.3.4.2]
Where in-rack sprinklers are not shielded by horizontal barriers, water shields shall be provided
above the sprinklers, or listed intermediate level/rack storage sprinklers shall be used.
8.13.4 Location, Position, and Spacing of In-Rack Sprinklers. —being deleted with an FR
The location, position, and spacing of in-rack sprinklers shall comply with the requirements in Chapters 12 through 20 as applicable.

8.13.4.1 Minimum Distance Between In-Rack Sprinklers. —being deleted with an FR
In-rack sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center.

8.13.5 Obstructions to In-Rack Sprinkler Discharge. [move to 25.4.1.1]
In-rack sprinklers shall not be required to meet the obstruction criteria and clearance from storage requirements of Section 8.5.

8.14 Pilot Line Detectors. [move to 8.10]

8.14.1 [move to 8.10.1]
Pilot line detectors and related components including pipe and fittings shall be corrosion resistant when installed in areas exposed to weather or corrosive conditions.

8.14.2 [move to 8.10.2]
Where subject to mechanical or physical damage, pilot line detectors and related detection system components shall be protected.

8.14.3 [move to 8.10.3]
Where spray sprinklers are used as pilot line detectors, they shall be installed in accordance with Section 8.14 and the spacing and location rules of Section 8.6, except that the obstruction to water distribution rules for automatic sprinklers shall not be required to be followed.

8.14.3.1 [move to 8.10.3.1]
Where located under a ceiling, pilot sprinklers shall be positioned in accordance with the requirements of Section 8.6.

8.14.4 [move to 8.10.4]
The temperature rating of spray sprinklers utilized as pilot line detectors shall be selected in accordance with 8.3.2.

8.14.5 [move to 8.10.5]
Maximum horizontal spacing for indoor locations shall not exceed 12 ft (3.7 m).

8.14.6 [move to 8.10.6]
Pilot line detectors shall be permitted to be spaced more than 22 in. (550 mm) below a ceiling or deck where the maximum spacing between pilot line detectors is 10 ft (3.0 m) or less.

8.14.6.1 [move to 8.10.6.1]
Other maximum horizontal spacing differing from those required in 8.14.5 shall be permitted where installed in accordance with their listing.
8.14.7 [move to 8.10.7]
Pilot line detectors located outdoors, such as in open process structures, shall be spaced such that the elevation of a single level of pilot line detectors and between additional levels of pilot line detectors shall not exceed 17 ft (5.2 m).

8.14.8 [move to 8.10.8]
The maximum distance between pilot line detectors installed outdoors shall not exceed 8 ft (2.4 m).

8.14.8.1 [move to 8.10.8.1]
The horizontal distance between pilot line detectors installed outdoors on a given level shall be permitted to be increased to 10 ft (3.0 m) when all of the following conditions are met:
1. The elevation of the first level does not exceed 15 ft (4.6 m).
2. The distance between additional levels does not exceed 12 ft (3.7 m).
3. The pilot line actuators are staggered vertically.

8.14.8.2 [move to 8.10.8.2]
Alternate vertical spacing of pilot line detectors differing from those required in 8.14.8.1 shall be permitted where installed in accordance with their listing.

8.14.9 [move to 8.10.9]
Pilot line detectors located in open-sided buildings shall follow the indoor spacing rules.

8.14.9.1 [move to 8.10.9.1]
A row of pilot line detectors spaced in accordance with the outdoor pilot line detector spacing rules shall be located along the open sides of open-sided buildings.

8.14.9.2 [move to 8.10.9.2]
Pilot line detectors located under open gratings shall be spaced in accordance with the outdoor rules.

8.14.9.3 [move to 8.10.9.3]
Where two or more adjacent water spray systems in one fire area are controlled by separate pilot line detector systems, the detectors on each system shall be spaced independently as if the dividing line between the systems were a wall or draft curtain.

8.14.9.4 [move to 8.10.9.4]
Where pilot line detectors are installed in water cooling tower applications, they shall be in accordance with Section 22.21.

8.14.10 [move to 8.10.10]
Pipe supplying pilot line detectors shall be permitted to be supported from the same points of hanger attachment as the piping system it serves.

8.14.10.1 [move to 8.10.10.1]
Pipe supplying pilot line detectors shall not be required to meet the requirements of 9.3.5.
8.15 Special Situations. [move to 9.3]

8.15.1 Concealed Spaces. [move to 9.3.17]

8.15.1.1 Concealed Spaces Requiring Sprinkler Protection. [move to 9.3.17.1]
Concealed spaces of exposed combustible construction shall be protected by sprinklers except in concealed spaces where sprinklers are not required to be installed by 8.15.1.2.1 through 8.15.1.2.18 and 8.15.6.

8.15.1.2* Concealed Spaces Not Requiring Sprinkler Protection. [move to 9.2.1]

8.15.1.2.1* [move to 9.2.1.1]
Concealed spaces of noncombustible and limited-combustible construction with minimal combustible loading having no access shall not require sprinkler protection.

8.15.1.2.1.1 [move to 9.2.1.1.1]
The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

8.15.1.2.1.2 [move to 9.2.1.1.2]
Small openings with a combined total area of not more than 20 percent of the ceiling, construction feature, or plane used to determine the boundaries of the concealed space shall be permitted where length greater than 4 ft (1.2 m) shall not have a width greater than 8 in. (200 mm).

8.15.1.2.1.3 [move to 9.2.1.1.3]
The space above cloud ceilings meeting the requirements in 8.15.24.1 and having openings with a combined total area of not more than 20 percent of the ceiling, construction feature, or plane used to determine the boundaries of the concealed space shall be permitted.

8.15.1.2.2 [move to 9.2.1.2]
Concealed spaces formed by studs or joists with less than 6 in. (150 mm) between the inside or near edges of the studs or joists shall not require sprinkler protection.

8.15.1.2.2.1 [move to 9.2.1.2.1]
The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

8.15.1.2.3 [move to 9.2.1.3]
Concealed spaces formed by studs or joists with less than 6 in. (150 mm) between the inside or near edges of the studs or joists shall not require sprinkler protection. (See Figure 8.6.4.1.5.1.)

8.15.1.2.4 [move to 9.2.1.4]
Concealed spaces formed by bar joists with less than 6 in. (150 mm) between the roof or floor deck and ceiling shall not require sprinkler protection.
8.15.1.2.5* [move to 9.2.1.5]
Concealed spaces formed by ceilings attached directly to or within 6 in. (150 mm) of wood joist or similar solid member construction shall not require sprinkler protection.

8.15.1.2.6* [move to 9.2.1.6]
Concealed spaces formed by ceilings attached to composite wood joist construction either directly or onto metal channels not exceeding 1 in. (25 mm) in depth, provided the joist channels are firestopped into volumes each not exceeding 160 ft³ (4.5 m³) using materials equivalent to the web construction and at least 3 1/2 in. (90 mm) of batt insulation is installed at the bottom of the joist channels when the ceiling is attached utilizing metal channels, shall not require sprinkler protection.

8.15.1.2.7 [move to 9.2.1.7]
Concealed spaces filled with noncombustible insulation shall not require sprinkler protection.

8.15.1.2.7.1 [move to 9.2.1.7.1]
A maximum 2 in. (50 mm) air gap at the top of the space shall be permitted.

8.15.1.2.8 [move to 9.2.1.8]
Concealed spaces within wood joist construction and composite wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the joist of the roof or floor deck, provided that in composite wood joist construction the joist channels separated into volumes each not exceeding 160 ft³ (4.5 m³) to the full depth of the composite wood joist with material equivalent to the web construction, shall not require sprinkler protection.

8.15.1.2.9 [move to 9.2.1.9]
Concealed spaces over isolated small compartments not exceeding 55 ft² (5.1 m²) in area shall not require sprinkler protection.

8.15.1.2.10 [move to 9.2.1.10]
Concealed spaces where rigid materials are used and the exposed surfaces have a flame spread index of 25 or less, and the materials have been demonstrated not to propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E84, Standard Test Method of Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the form in which they are installed, shall not require sprinkler protection.

8.15.1.2.11* [move to 9.2.1.11]
Concealed spaces in which the exposed materials are constructed entirely of fire retardant–treated wood as defined by NFPA 703 shall not require sprinkler protection.

8.15.1.2.12 [move to 9.2.1.12]
Noncombustible concealed spaces having exposed combustible insulation where the heat content of the facing and substrate of the insulation material does not exceed 1000 Btu/ft² (11,400 kJ/m²) shall not require sprinkler protection.

8.15.1.2.13 [move to 9.2.1.13]
Concealed spaces below insulation that is laid directly on top of or within wood joists or composite wood joists used as ceiling joists in an otherwise sprinklered concealed space, with the ceiling attached directly to the bottom of the joists, shall not require sprinkler protection.

8.15.1.2.14 [move to 9.2.1.14]
Vertical pipe chases under 10 ft² (0.9 m²), where provided in multifloor buildings where the chases are firestopped at each floor using materials equivalent to the floor construction, and where such pipe chases shall contain no sources of ignition, piping shall be water-filled or noncombustible and pipe penetrations at each floor shall be properly sealed and shall not require sprinkler protection.

8.15.1.2.15 [move to 9.2.1.15]
Exterior columns under 10 ft² (0.9 m²) in area, formed by studs or wood joist supporting exterior canopies that are fully protected with a sprinkler system, shall not require sprinkler protection.

8.15.1.2.16* [move to 9.2.1.16]
Concealed spaces formed by noncombustible or limited-combustible ceilings suspended from the bottom of wood joists, composite wood joists, wood bar joists, or wood trusses that have insulation filling all of the gaps between the bottom of the trusses or joists, and where sprinklers are present in the space above the insulation within the trusses or joists, shall not require sprinkler protection.

8.15.1.2.16.1 [move to 9.2.1.16.1]
The heat content of the facing, substrate, and support of the insulation material shall not exceed 1000 Btu/ft² (11,400 kJ/m²).

8.15.1.2.17* [move to 9.2.1.17]
Concealed spaces formed by noncombustible or limited-combustible ceilings suspended from the bottom of wood joists and composite wood joists with a maximum nominal chord width of 2 in. (50 mm), where joist spaces are full of noncombustible batt insulation with a maximum 2 in. (50 mm) air space between the decking material and the top of the batt insulation shall not require sprinklers.

8.15.1.2.17.1 [move to 9.2.1.17.1]
Facing that meets the requirements for noncombustible or limited-combustible material covering the surface of the bottom chord of each joist and secured in place per the manufacturer's recommendations shall not require sprinklers.

8.15.1.2.18 Exterior Soffits, Eaves, Overhangs, and Decorative Frame Elements. [move to 9.2.1.18]
8.15.1.2.18.1  [move to 9.2.1.18.1]  
Sprinklers shall be permitted to be omitted from within combustible soffits, eaves, overhangs, and decorative frame elements that are constructed in accordance with 8.15.1.2.18.2 through 8.15.1.2.18.5.

8.15.1.2.18.2  [move to 9.2.1.18.2]  
Combustible soffits, eaves, overhangs, and decorative frame elements shall not exceed 4 ft 0 in. (1.2 m) in width.

8.15.1.2.18.3  [move to 9.2.1.18.3]  
Combustible soffits, eaves, overhangs, and decorative frame elements shall be draftstopped, with a material equivalent to that of the soffit, into volumes not exceeding 160 ft³ (4.5 m³).

8.15.1.2.18.4  [move to 9.2.1.18.4]  
Combustible soffits, eaves, overhangs, and decorative frame elements shall be separated from the interior of the building by walls or roofs of noncombustible or limited-combustible construction.

8.15.1.2.18.5  [move to 9.2.1.18.5]  
Combustible soffits, eaves, overhangs, and decorative frame elements shall have no openings or unprotected penetrations directly into the building.

8.15.1.3* Concealed Space Design Requirements.  [move to 9.3.17.1.1]  
Sprinklers in concealed spaces having no access for storage or other use shall be installed in accordance with the requirements for light hazard occupancy.

8.15.1.4 Heat-Producing Devices with Composite Wood Joist Construction.  [move to 9.3.1]  
Where heat-producing devices such as furnaces or process equipment are located in the joist channels above a ceiling attached directly to the underside of composite wood joist construction that would not otherwise require sprinkler protection of the spaces, the joist channel containing the heat-producing devices shall be sprinklered by installing sprinklers in each joist channel, on each side, adjacent to the heat-producing device.

8.15.1.5 Localized Protection of Exposed Combustible Construction or Exposed Combustibles.  [move to 9.3.17.1.2]  
When otherwise noncombustible or limited-combustible concealed spaces that would not require sprinkler protection have localized exposed combustible construction, or contain localized areas of exposed combustibles, the combustibles shall be permitted to be protected as follows:  
(1) If the exposed combustibles are in the vertical partitions or walls around all or a portion of the enclosure, a single row of sprinklers spaced not over 12 ft (3.7 m) apart nor more than 6 ft (1.8 m) from the inside of the partition shall be permitted to protect the surface. The first and last sprinklers in such a row shall not be over 5 ft (1.5 m) from the ends of the partitions.  
(2) If the exposed combustibles are in the horizontal plane, the area of the combustibles shall be permitted to be protected with sprinklers on a light hazard spacing. Additional sprinklers shall be installed no more than 6 ft (1.8 m) outside the outline of the area and not more than 12 ft (3.7 m) on center along the outline. When the outline returns to a wall or other obstruction, the last sprinkler shall not be more than 6 ft (1.8 m) from the wall or obstruction.
8.15.1.6 [move to 9.3.2]
Sprinklers used in horizontal combustible concealed spaces (with a slope not exceeding 2 in 12) with combustible wood truss, wood joist construction, or bar joist construction having a combustible upper surface and where the depth of the space is less than 36 in. (900 mm) from deck to deck, from deck to ceiling, or with double wood joist construction with a maximum of 36 in. (900 mm) between the top of the bottom joist and the bottom of the upper joist shall be listed for such use.

8.15.1.6.1 [move to 9.3.2.1]
Sprinklers specifically listed to provide protection of combustible concealed spaces described in 8.15.1.6 shall be permitted to be used in accordance with 8.3.1.2 where the space is less than 12 in. (300 mm) from deck to deck or deck to ceiling.

8.15.1.6.2 [move to 9.3.2.2]
Sprinklers specifically listed to provide protection of combustible concealed spaces described in 8.15.1.6 shall be permitted to be used in accordance with 8.3.1.2 throughout the area when a portion of the area exceeds a depth of 36 in. (900 mm).

8.15.1.7 [move to 9.3.2.3]
Sprinklers specifically listed to provide protection of combustible concealed spaces described in 8.15.1.6 shall be permitted to be used in accordance with 8.3.1.2 to protect composite wood joist construction with a maximum of 36 in. (900 mm) from deck to deck, from deck to ceiling, or with double composite wood joist construction with a maximum of 36 in. (900 mm) between the top of the bottom joist and the bottom of the upper joist.

8.15.2 Vertical Shafts. [move to 9.3.3]

8.15.2.1 General. [move to 9.3.3.1]
Unless the requirements of 8.15.2.1.1 or 8.15.2.1.2 are met, one sprinkler shall be installed at the top of shafts.

8.15.2.1.1 [move to 9.3.3.1.1]
Noncombustible or limited-combustible, nonaccessible vertical duct shafts shall not require sprinkler protection.

8.15.2.1.2 [move to 9.3.3.1.2]
Noncombustible or limited-combustible, nonaccessible vertical electrical or mechanical shafts shall not require sprinkler protection.

8.15.2.2* Shafts with Combustible Surfaces. [move to 9.3.3.2]

8.15.2.2.1 [move to 9.3.3.2.1]
Where vertical shafts have combustible surfaces, one sprinkler shall be installed at each alternate floor level.
8.15.2.2 Where a shaft having combustible surfaces is trapped, an additional sprinkler shall be installed at the top of each trapped section.

8.15.2.3 Accessible Shafts with Noncombustible Surfaces. Where accessible vertical shafts have noncombustible surfaces, one sprinkler shall be installed near the bottom.

8.15.3 Stairways.

8.15.3.1 Combustible Construction.

Sprinklers shall be installed beneath all stairways of combustible construction.

8.15.3.1.1 Sprinklers shall be installed at the top of combustible stair shafts.

8.15.3.1.2* Sprinklers shall be installed under the landings at each floor level.

8.15.3.1.3 Sprinklers shall be installed beneath the lowest intermediate landing.

8.15.3.2 Noncombustible Construction.

8.15.3.2.1 In noncombustible stair shafts having noncombustible stairs with noncombustible or limited-combustible finishes, sprinklers shall be installed at the top of the shaft and under the first accessible landing above the bottom of the shaft.

8.15.3.2.2 Where noncombustible stair shafts are divided by walls or doors, sprinklers shall be provided on each side of the separation.

8.15.3.2.3 Sprinklers shall be installed beneath landings or stairways where the area beneath is used for storage.

8.15.3.2.3.1 Sprinklers shall be permitted to be omitted from the bottom of the stairwell when the space under the stairs at the bottom is blocked off so that storage cannot occur.

8.15.3.2.4 Sprinklers shall be permitted to be omitted from exterior stair towers when the exterior walls of the stair tower are at least 50 percent open and when the stair tower is entirely of noncombustible construction.
8.15.3.3* Stairs Serving Two or More Areas. [move to 9.3.4.3]
When stairs have openings to each side of a fire wall(s), sprinklers shall be installed in the stair shaft at each floor landing with multiple openings.

8.15.4* Vertical Openings. [move to 9.3.5]

8.15.4.1* General. [move to 9.3.5.1]
Unless the requirements of 8.15.4.4 are met, where moving stairways, staircases, or similar floor openings are unenclosed and where sprinkler protection is serving as the alternative to enclosure of the vertical opening, the floor openings involved shall be protected by closely spaced sprinklers in combination with draft stops in accordance with 8.15.4.2 and 8.15.4.3.

8.15.4.2 Draft Stops. [move to 9.3.5.2]
Draft stops shall meet all of the following criteria:
(1) The draft stops shall be located immediately adjacent to the opening.
(2) The draft stops shall be at least 18 in. (450 mm) deep.
(3) The draft stops shall be of noncombustible or limited-combustible material that will stay in place before and during sprinkler operation.

8.15.4.3 Sprinklers. [move to 9.3.5.3]

8.15.4.3.1 [move to 9.3.5.3.1]
Sprinklers shall be spaced not more than 6 ft (1.8 m) apart and placed 6 in. to 12 in. (150 mm to 300 mm) from the draft stop on the side away from the opening.

8.15.4.3.2 [move to 9.3.5.3.2]
Where sprinklers are closer than 6 ft (1.8 m), cross baffles shall be provided in accordance with 8.6.3.4.2.

8.15.4.4 Large Openings. [move to 9.3.5.4]
Closely spaced sprinklers and draft stops are not required around large openings such as those found in shopping malls, atrium buildings, and similar structures where all adjoining levels and spaces are protected by automatic sprinklers in accordance with this standard and where the openings have all horizontal dimensions between opposite edges of 20 ft (6.1 m) or greater and an area of 1000 ft² (95 m²) or greater.

8.15.5 Elevator Hoistways and Machine Rooms. [move to 9.3.6]

8.15.5.1* deleted with an FR
Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft (600 mm) above the floor of the pit.

8.15.5.2 deleted with an FR
The sprinkler required at the bottom of the elevator hoistway by 8.15.5.1 shall not be required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids.
8.15.5.3 [move to 9.3.6.3]
Automatic fire sprinklers shall not be required in elevator machine rooms, elevator machinery spaces, control spaces, or hoistways of traction elevators installed in accordance with the applicable provisions in NFPA 101, or the applicable building code, where all of the following conditions are met:
(1) The elevator machine room, machinery space, control room, control space, or hoistway of traction elevator is dedicated to elevator equipment only.
(2) The elevator machine room, machine room, machinery space, control room, control space, or hoistway of traction elevators are protected by smoke detectors, or other automatic fire detection, installed in accordance with NFPA 72.
(3) The elevator machinery space, control room, control space, or hoistway of traction elevators is separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire resistance rating of not less than that specified by the applicable building code.
(4) No materials unrelated to elevator equipment are permitted to be stored in elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways of traction elevators.
(5) The elevator machinery is not of the hydraulic type.

8.15.5.4* [move to 9.3.6.4]
Automatic sprinklers in elevator machine rooms or at the tops of hoistways shall be of ordinary- or intermediate-temperature rating.

8.15.5.5* [move to 9.3.6.5]
Upright, pendent, or sidewall spray sprinklers shall be installed at the top of elevator hoistways.

8.15.5.6 [move to 9.3.6.6]
The sprinkler required at the top of the elevator hoistway by 8.15.5.5 shall not be required where the hoistway for passenger elevators is noncombustible or limited-combustible and the car enclosure materials meet the requirements of ASME A17.1, Safety Code for Elevators and Escalators.

8.15.5.7 Combustible Suspension in Elevators. [move to 9.3.6.7]

8.15.5.7.1 [move to 9.3.6.7.1]
Sprinklers shall be installed at the top and bottom of elevator hoistways where elevators utilize combustible suspension means such as noncircular elastomeric-coated or polyurethane-coated steel belts.

8.15.5.7.2 [move to 9.3.6.7.2]
The sprinklers in the elevator hoistway shall not be required when the suspension means provide not less than an FT-1 rating when tested to the vertical burn test requirements of UL 62, Flexible Cords and Cables, and UL 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords.

8.15.6 Spaces Under Ground Floors, Exterior Docks, and Platforms. [move to 9.3.18]
8.15.6.1 [move to 9.3.18.1]
Unless the requirements of 8.15.6.2 are met, sprinklers shall be installed in spaces under all combustible ground floors and combustible exterior docks and platforms.

8.15.6.2 [move to 9.2.2]
Sprinklers shall be permitted to be omitted from spaces under ground floors, exterior docks, and platforms where all of the following conditions exist:
1. The space is not accessible for storage purposes and is protected against accumulation of wind-borne debris.
2. The space contains no equipment such as conveyors or fuel-fired heating units.
3. The floor over the space is of tight construction.
4. No combustible or flammable liquids or materials that under fire conditions would convert into combustible or flammable liquids are processed, handled, or stored on the floor above the space.

8.15.7* Exterior Projections. [move to 9.3.19]

8.15.7.1 [move to 9.3.19.1]
Unless the requirements of 8.15.7.2, 8.15.7.3, or 8.15.7.4 are met, sprinklers shall be installed under exterior projections exceeding 4 ft (1.2 m) in width.

8.15.7.2* [move to 9.2.3.1]
Sprinklers shall be permitted to be omitted where the exterior canopies, roofs, porte-cochères, balconies, decks, and similar projections are constructed with materials that are noncombustible, limited-combustible, or fire retardant–treated wood as defined in NFPA 703, or where the projections are constructed utilizing a noncombustible frame, limited-combustibles, or fire retardant–treated wood with an inherently flame-resistant fabric overlay as demonstrated by Test Method 2 in accordance with NFPA 701.

8.15.7.3 [move to 9.2.3.2]
Sprinklers shall be permitted to be omitted from below the exterior projections of combustible construction, provided the exposed finish material on the exterior projections are noncombustible, limited-combustible, or fire retardant–treated wood as defined in NFPA 703, and the exterior projections contain only sprinklered concealed spaces or any of the following unsprinklered combustible concealed spaces:
1. Combustible concealed spaces filled entirely with noncombustible insulation
2. Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are directly attached to the bottom of solid wood joists so as to create enclosed joist spaces 160 ft³ (4.5 m³) or less in volume, including space below insulation that is laid directly on top or within the ceiling joists in an otherwise sprinklered attic [see 11.2.3.1.4(4)(d)]
3. Concealed spaces over isolated small exterior projections not exceeding 55 ft² (5.1 m²) in area

8.15.7.4 [move to 9.2.3.3]
Sprinklers shall be permitted to be omitted from exterior exit corridors when the exterior walls of the corridor are at least 50 percent open and when the corridor is entirely of noncombustible construction.

8.15.7.5* [move to 9.3.19.2] Sprinklers shall be installed under exterior projections greater than 2 ft (600 mm) wide over areas where combustibles are stored.

8.15.8 Dwelling Units. [move to 9.2.4]

8.15.8.1 Bathrooms. [move to 9.2.4.1]

8.15.8.1.1* [move to 9.2.4.1.1] Unless sprinklers are required by 8.15.8.1.2 or 8.15.8.1.3, sprinklers shall not be required in bathrooms that are located within dwelling units, that do not exceed 55 ft² (5.1 m²) in area, and that have walls and ceilings of noncombustible or limited-combustible materials with a 15-minute thermal barrier rating, including the walls and ceilings behind any shower enclosure or tub.

8.15.8.1.2 [move to 9.2.4.1.2] Sprinklers shall be required in bathrooms of limited care facilities and nursing homes, as defined in NFPA 101.

8.15.8.1.3 [move to 9.2.4.1.3] Sprinklers shall be required in bathrooms opening directly onto public corridors or exitways.

8.15.8.2* Closets and Pantries. [move to 9.2.4.2] Sprinklers are not required in clothes closets, linen closets, and pantries within dwelling units in hotels and motels where the area of the space does not exceed 24 ft² (2.2 m²) and the walls and ceilings are surfaced with noncombustible or limited-combustible materials.

8.15.9* Hospital Clothes Closets. [move to 9.2.5] Sprinklers shall not be required in clothes closets of patient sleeping rooms in hospitals where the area of the closet does not exceed 6 ft² (0.5 m²), provided the distance from the sprinkler in the patient sleeping room to the back wall of the closet does not exceed the maximum distance permitted by 8.5.3.2.

8.15.10* Library Stack Areas and Record Storage. [move to 9.3.7] Where books or records are stored in fixed open book shelves, sprinklers shall be installed in accordance with one of the following:

1. Sprinklers shall be permitted to be installed without regard to aisles where clearance between sprinkler deflectors and tops of stacks is 18 in. (450 mm) or more.
2. Where the 18 in. (450 mm) clearance between sprinkler deflectors and tops of stacks cannot be maintained, sprinklers shall be installed in every aisle and at every tier of stacks with distance between sprinklers along aisles not to exceed 12 ft (3.7 m) in accordance with Figure 8.15.10(a).
(3) Where the 18 in. (450 mm) clearance between sprinkler deflectors and tops of stacks cannot be maintained and where vertical shelf dividers are incomplete and allow water distribution to adjacent aisles, sprinklers shall be permitted to be omitted in alternate aisles on each tier, and where ventilation openings are also provided in tier floors, sprinklers shall be staggered vertically in accordance with Figure 8.15.10(b).

Figure 8.15.10(a) Sprinklers in Multitier Bookstacks with Complete Vertical Dividers.

<table>
<thead>
<tr>
<th>First tier</th>
<th>Second tier</th>
<th>Third tier</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Figure 8.15.10(b) Sprinklers in Multitier Bookstacks with Incomplete Vertical Dividers.
8.15.11 Electrical Equipment. [move to 9.3.20]

8.15.11.1 [move to 9.3.20.1]
Unless the requirements of 8.15.11.2 are met, sprinkler protection shall be required in electrical equipment rooms.

8.15.11.2 [move to 9.2.6]
Sprinklers shall not be required in electrical equipment rooms where all of the following conditions are met:
1. The room is dedicated to electrical equipment only.
2. Only dry-type electrical equipment is used.
3. Equipment is installed in a 2-hour fire-rated enclosure including protection for penetrations.
4. No combustible storage is permitted to be stored in the room.

8.15.12* Industrial Ovens and Furnaces. [move to 9.3.8]

8.15.13 Duct Protection. [move to 9.3.9]
Duct protection shall be required to meet the requirements of 8.15.12 where required by the authority having jurisdiction or the applicable referenced code or standard.

8.15.13.1 Sprinkler Location. [move to 9.3.9.1]

8.15.13.1.1 [move to 9.3.9.1.1]
Unless the requirements of 8.15.13.1.2 or 8.15.13.1.3 are met, ducts shall have one sprinkler located at the top of each vertical riser and at the midpoint of each offset.

8.15.13.1.2 [move to 9.3.9.1.2]
Sprinklers shall not be required in a vertical riser located outside of a building, provided the riser does not expose combustible material or provided the interior of the building and the horizontal distance between the hood outlet and the vertical riser is at least 25 ft (7.6 m).

8.15.13.1.3 [move to 9.3.9.1.3]
Horizontal exhaust ducts shall have sprinklers located on 10 ft (3.0 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.

8.15.13.2 Protection Against Freezing. [move to 9.3.9.2]
Sprinklers in exhaust ducts subject to freezing shall be properly protected against freezing. (See 8.16.4.1.)

8.15.13.3 Sprinkler Access. [move to 9.3.9.3]
Access shall be provided to all sprinklers for inspection, testing, and maintenance.

8.15.13.4 Strainers. [move to 9.3.9.4]
A listed line strainer shall be installed in the main water supply preceding sprinklers having nominal K-factors smaller than K-2.8 (40).

8.15.14* Open-Grid Ceilings. [move to 9.3.10]
Open-grid ceilings shall only be installed beneath sprinklers where one of the following is met:
(1) Open-grid ceilings in which the openings are 1/4 in. (6 mm) or larger in the least dimension, where the thickness or depth of the material does not exceed the least dimension of the opening, and where such openings constitute 70 percent of the area of the ceiling material. The spacing of the sprinklers over the open-grid ceiling shall then comply with the following:
(a) In light hazard occupancies where sprinkler spacing (either spray or old-style sprinklers) is less than 10 ft × 10 ft (3 m × 3 m), a minimum clearance of at least 18 in. (450 mm) shall be provided between the sprinkler deflectors and the upper surface of the open-grid ceiling. Where spacing is greater than 10 ft × 10 ft (3 m × 3 m) but less than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 24 in. (600 mm) shall be provided from spray sprinklers and at least 36 in. (900 mm) from old-style sprinklers. Where spacing is greater than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 48 in. (1.2 m) shall be provided.
(b) In ordinary hazard occupancies, open-grid ceilings shall be permitted to be installed beneath spray sprinklers only. Where sprinkler spacing is less than 10 ft × 10 ft (3 m × 3 m), a minimum clearance of at least 24 in. (600 mm) shall be provided between the sprinkler deflectors and the upper surface of the open-grid ceiling. Where spacing is greater than 10 ft × 10 ft (3 m × 3 m), a clearance of at least 36 in. (900 mm) shall be provided.
(2) Other types of open-grid ceilings shall be permitted to be installed beneath sprinklers where they are listed for such service and are installed in accordance with instructions contained in each package of ceiling material.

8.15.15 Drop-Out Ceilings and Ceiling Materials. [move to 9.3.11]
8.15.15.1* [move to 9.3.11.1]
Drop-out ceilings and ceiling materials shall be permitted to be installed beneath sprinklers where the ceiling panels or ceiling materials are listed for that service and are installed in accordance with their listings.

8.15.15.2 [move to 9.3.11.2]
Drop-out ceilings and ceiling materials meeting the criteria in 8.15.15.1 shall not be installed below quick-response or extended coverage sprinklers unless specifically listed for that application.

8.15.15.3 [move to 9.3.11.3]
Drop-out ceilings and ceiling materials meeting the criteria in 8.15.15.1 shall not be considered ceilings within the context of this standard.

8.15.15.4* [move to 9.3.11.4]
Piping installed above drop-out ceilings and ceiling materials meeting the criteria in 8.15.15.1 shall not be considered concealed piping.

8.15.15.5* [move to 9.3.11.5]
Sprinklers shall not be installed beneath drop-out ceilings or ceiling materials meeting the criteria in 8.15.15.1.

8.15.16 Old-Style Sprinklers. [move to 15.4]

8.15.16.1 [move to 15.4.1]
Unless required by 8.15.16.2 or 8.15.16.3, old-style sprinklers shall not be used in a new installation.

8.15.16.2* [move to 9.3.12]
Old-style sprinklers shall be installed in fur storage vaults.

8.15.16.3 [move to 15.4.2]
Use of old-style sprinklers shall be permitted where construction features or other special situations require unique water distribution.

8.15.17 Stages. [move to 9.3.13]

8.15.17.1 [move to 9.3.13.1]
Sprinklers shall be installed under the roof at the ceiling, in spaces under the stage either containing combustible materials or constructed of combustible materials, and in all adjacent spaces and dressing rooms, storerooms, and workshops.

8.15.17.2 [move to 9.3.13.2]
Where proscenium opening protection is required, a deluge system shall be provided with open sprinklers located not more than 3 ft (900 mm) away from the stage side of the proscenium arch and spaced up to a maximum of 6 ft (1.8 m) on center. *(See Chapter 11 for design criteria.)*

**8.15.18 Stair Towers.** *(move to 19.3.3.4.4)*
Stair towers, or other construction with incomplete floors, if piped on independent risers, shall be treated as one area with reference to pipe sizes.

**8.15.19 Return Bends.** *(move to 16.3.11)*

**8.15.19.1** *(move to 16.3.11.1)*
Unless the requirements of 8.15.19.3, 8.15.19.4, or 8.15.19.5 are met, return bends shall be used where pendent sprinklers are supplied from a raw water source, a mill pond, or open-top reservoirs.

**8.15.19.2** *(move to 16.3.11.2)*
Return bends shall be connected to the top of branch lines in order to avoid accumulation of sediment in the drop nipples in accordance with Figure 8.15.19.2.

Figure 8.15.19.2 Return Bend Arrangement.

**8.15.19.3** *(move to 16.3.11.3)*
Return bends shall not be required for deluge systems.

**8.15.19.4** *(move to 16.3.11.4)*
Return bends shall not be required where dry pendent sprinklers are used.
8.15.19.5 [move to 16.3.11.5]
Return bends shall not be required for wet pipe systems where sprinklers with a nominal K-factor of K-11.2 (160) or larger are used.

8.15.20 Piping to Sprinklers Below Ceilings. [move to 16.3.12]

8.15.20.1* [move to 16.3.12.1]
In new installations expected to supply sprinklers below a ceiling, minimum 1 in. (25 mm) outlets shall be provided.

8.15.20.2* [move to 16.3.12.2]
In new installations, it shall be permitted to provide minimum 1 in. (25 mm) outlets with hexagonal bushings to accommodate sprinklers attached directly to branch line fittings to allow for future system modifications.

8.15.20.3 [moved to 28.2.5]
When systems are revamped to accommodate added ceilings, sprinkler outlets utilized for new armover or drop nipples shall have hexagonal bushings removed.

8.15.20.4 Revamping of Pipe Schedule Systems. [move to 28.4]

8.15.20.4.1 [move to 28.4.1]
When pipe schedule systems are revamped, a nipple not exceeding 4 in. (100 mm) in length shall be permitted to be installed in the branch line fitting.

8.15.20.4.2 [move to 28.4.2]
All piping other than the nipple permitted in 8.15.20.4.1 and 8.15.20.4.3 shall be a minimum of 1 in. (25 mm) in diameter in accordance with Figure 8.15.20.4.2.

Figure 8.15.20.4.2 Nipple and Reducing Elbow Supplying Sprinkler Below Ceiling.
When it is necessary to pipe two new ceiling sprinklers from an existing outlet in an overhead system, the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted, provided that a hydraulic calculation verifies that the design flow rate will be achieved in accordance with Figure 8.15.20.4.3.

Figure 8.15.20.4.3 Sprinklers in Concealed Space and Below Ceiling.
8.15.20.4.4 [move to 28.4.4]  
Where an armover is attached to connect to a sprinkler, the use of pipe nipples less than 1 in. (25 mm) in diameter shall not be permitted where seismic design is required on the system.

8.15.20.5 Revamping of Hydraulic Design Systems. [move to 28.5]  

8.15.20.5.1 [move to 28.5.1]  
When hydraulically designed systems are revamped, any existing bushing shall be removed and a nipple not exceeding 4 in. (100 mm) in length shall be permitted to be installed in the branch line fitting.

8.15.20.5.2* [move to 28.5.2]  
Calculations shall be provided to verify that the system design flow rate will be achieved.

8.15.20.5.3 [move to 28.5.3]  
When it is necessary to pipe two new ceiling sprinklers from an existing outlet in an overhead system, any bushings shall be removed and the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted, provided that a hydraulic calculation verifies that the design flow rate will be achieved.

8.15.20.5.4 [move to 28.5.4]  
Where an armover is attached to connect to a sprinkler, the use of pipe nipples less than 1 in. (25 mm) in diameter shall not be permitted where seismic design is required on the system.

8.15.21 Dry Pipe Underground. [move to 6.1.1.3.2]
8.15.21.1  [move to 6.1.1.3.2.1]
Where necessary to place pipe that will be under air pressure underground, the pipe shall be protected against corrosion.

8.15.21.2  [move to 6.1.1.3.2.2]
Unprotected cast-iron or ductile-iron pipe shall be permitted where joined with a gasketed joint listed for air service underground.

8.15.22*  System Subdivision.  [move to 16.9.10.5]
Where individual floor/zone control valves are not provided, a flanged joint or mechanical coupling shall be used at the riser at each floor for connections to piping serving floor areas in excess of 5000 ft² (465 m²).

8.15.23  Spaces Above Ceilings.  [move to 9.3.14]

8.15.23.1  [move to 9.3.14.1]
Where spaces have ceilings that are lower than the rest of the area, the space above this lower ceiling shall be sprinklered unless it complies with the rules of 8.15.1.2 for allowable unsprinklered concealed spaces.

8.15.23.2  [move to 9.3.14.2]
Where the space above a drop ceiling is sprinklered, the sprinkler system shall conform to the rules of 11.1.2 and Section 12.3.

8.15.23.3*  [move to 9.3.14.3]
Where there is a noncombustible space above a noncombustible or limited-combustible drop ceiling that is sprinklered because it is open to an adjacent sprinklered space on only one side and where there is no possibility for storage above the drop ceiling, the sprinkler system shall be permitted to extend only as far into the space as 0.6 times the square root of the design area of the sprinkler system in the adjacent space.

8.15.23.3.1  [move to 9.3.14.3.1]
The sprinkler system shall extend at least 24 ft (7.2 m) into the space above the ceiling.

8.15.24  Cloud Ceilings.  [move to 9.2.7]

8.15.24.1*  [move to 9.2.7.1]
Sprinklers shall be permitted to be omitted above cloud ceilings where both of the following apply:
(1) *The openings around the cloud and the maximum sprinkler protection area meet the requirements of 8.15.1.2.1.2 and Table 8.15.24.1
(2) The requirements of 8.15.24.2 are met.

Table 8.15.24.1 Maximum Sprinkler Protection Area Based on Ceiling Cloud Width and Opening Width
Ceiling Cloud — Minimum Width Dimension (ft) | Maximum Area (ft²) — Opening Width ≤0.5 in./ft of Ceiling Height | Maximum Area (ft²) — Opening Width ≤0.75 in./ft of Ceiling Height | Maximum Area (ft²) — Opening Width ≤1 in./ft of Ceiling Height
---|---|---|---
2–<2.5 | 175 | 70 | NP
2.5–4 | 225 | 120 | 70
>4 | 225 | 150 | 150

8.15.24.2 [move to 9.2.7.2]
When sprinklers are omitted from above a cloud ceiling in accordance with 8.15.24.1, the requirements of this section shall apply.

8.15.24.2.1 [move to 9.2.7.2.1]
All sprinklers shall be quick response standard spray or extended coverage pendent or upright sprinklers.

8.15.24.2.1.1 [move to 9.2.7.2.1.1]
Where extended coverage sprinklers are used, the maximum distance between sprinklers shall not exceed 16 ft (4.9 m).

8.15.24.2.2 [move to 9.2.7.2.2]
Maximum cloud ceiling height shall not exceed 20 ft (6.1 m).

8.15.24.2.3 [move to 9.2.7.2.3]
Maximum spacing shall not exceed the maximum requirements of Table 8.6.2.2.1(a) for light hazard and Table 8.6.2.2.1(b) for ordinary hazard.

8.15.24.2.4 [move to 9.2.7.2.4]
Cloud ceilings shall be of smooth ceiling construction.

8.15.24.2.5* [move to 9.2.7.2.5]
For irregular shaped ceiling clouds (not rectangular) the minimum width dimension shall be the smallest width dimension of the cloud and for the gap shall be the greatest dimension between clouds or adjacent walls as applicable.

8.15.25 Revolving Doors Enclosures. [move to 9.2.8]
Sprinkler protection shall not be required within revolving door enclosures.

8.15.26* Sprinkler-Protected Glazing. [move to 9.3.15]
Where sprinklers are used in combination with glazing as an alternative to a required fire-rated wall or window assembly, the sprinkler-protected assembly shall comply with the following:
(1) Sprinklers shall be listed as specific application window sprinklers unless the standard spray sprinklers are specifically permitted by the building code.
(2) Sprinklers shall be supplied by a wet-pipe system.
(3) Glazing shall be heat-strengthened, tempered, or glass ceramic and shall be fixed.
Where the assembly is required to be protected from both sides, sprinklers shall be installed on both sides of the glazing.

The use of sprinkler-protected glazing shall be limited to non-load-bearing walls.

The glazed assembly shall not have any horizontal members that would interfere with uniform distribution of water over the surface of the glazing, and there shall be no obstructions between sprinklers and glazing that would obstruct water distribution.

The water supply duration for the design area that includes the window sprinklers shall not be less than the required rating of the assembly.

8.16 Piping Installation. [move to 16.3]

8.16.1 Valves. [move to 16.9]

8.16.1.1* Control Valves. [move to 16.9.3]

8.16.1.1.1* General. [move to 16.9.3.1]

Each sprinkler system shall be provided with a listed indicating valve in an accessible location, so located as to control all automatic sources of water supply.

At least one listed indicating valve shall be installed in each source of water supply.

The requirements of 8.16.1.1.2 shall not apply to the fire department connection, and there shall be no shutoff valve in the fire department connection.

8.16.1.2* Supervision. [move to 16.9.3.3]

Valves on connections to water supplies, sectional control and isolation valves, and other valves in supply pipes to sprinklers and other fixed water-based fire suppression systems shall be supervised by one of the following methods:

(1) Central station, proprietary, or remote station signaling service
(2) Local signaling service that will cause the sounding of an audible signal at a constantly attended point
(3) Valves locked in the correct position
(4) Valves located within fenced enclosures under the control of the owner, sealed in the open position, and inspected weekly as part of an approved procedure

Floor control valves in high-rise buildings and valves controlling flow to sprinklers in circulating closed loop systems shall comply with 8.16.1.2.1(1) or 8.16.1.2.1(2).

8.16.1.2.3 [move to 16.9.3.3]
The requirements of 8.16.1.2.1 shall not apply to underground gate valves with roadway boxes.

8.16.1.1.2.4 [move to 16.9.3.3.4]
Where control valves are installed overhead, they shall be positioned so that the indicating feature is visible from the floor below.

8.16.1.1.2.5 [move to 16.9.3.3.5]
A listed backflow prevention assembly shall be permitted to be considered a control valve, provided both control valves are listed for fire protection system use and an additional control valve shall not be required.

8.16.1.1.3*  Check Valves.  [move to 16.9.4]

8.16.1.1.3.1  [move to 16.9.4.1]
Where there is more than one source of water supply, a check valve shall be installed in each connection.

8.16.1.1.3.2  [move to 16.9.4.2]
A listed backflow prevention device shall be considered a check valve, and an additional check valve shall not be required.

8.16.1.1.3.3  [move to 16.9.4.3]
Where cushion tanks are used with automatic fire pumps, no check valve is required in the cushion tank connection.

8.16.1.1.3.4  [move to 16.9.4.4]
Check valves shall be installed in a vertical (flow upwards) or horizontal position in accordance with their listing.

8.16.1.1.3.5*  [move to 16.9.4.5]
Where a single wet pipe sprinkler system is equipped with a fire department connection, the alarm valve is considered a check valve, and an additional check valve shall not be required.

8.16.1.1.4*  Control Valves with Check Valves.  [move to 16.9.5]

8.16.1.1.4.1  [move to 16.9.5.1]
In a connection serving as one source of supply, listed indicating valves or post-indicator valves shall be installed on both sides of all check valves required in 8.16.1.1.3.

8.16.1.1.4.2  [move to 16.9.5.2]
The city services control valve (non-indicating control valve) shall be permitted to serve as the supply side control valve.

8.16.1.1.4.3  [move to 16.9.5.3]
The requirements of 8.16.1.1.4.1 shall not apply to the check valve located in the fire department connection piping, and there shall be no control valves in the fire department connection piping.
**8.16.1.1.4**  [move to 16.9.5.4]
The requirements of 8.16.1.1.4.1 shall not apply where the city connection serves as the only automatic source of supply to a wet pipe sprinkler system; a control valve is not required on the system side of the check valve or the alarm check valve.

**8.16.1.1.5**  [move to 16.9.5.5]
Gravity tanks shall have listed indicating valves installed on both sides of the check valve.

**8.16.1.1.6**  [move to 16.9.6]
When a pump is located in a combustible pump house or exposed to danger from fire or falling walls, or when a tank discharges into a private fire service main fed by another supply, either the check valve in the connection shall be located in a pit or the control valve shall be of the post-indicator type located a safe distance outside buildings.

**8.16.1.1.7**  [move to 16.9.3.4]
All control valves shall be located where accessible and free of obstructions.

**8.16.1.1.8**  [move to 16.9.3.5]
Identification signs shall be provided at each valve to indicate its function and what it controls.

**8.16.1.2**  [move to 16.9.7]

**8.16.1.2.1**  [move to 16.9.7.1]
In portions of systems where all components are not listed for pressure greater than 175 psi (12 bar) and the potential exists for normal (nonfire condition) water pressure in excess of 175 psi (12 bar), a listed pressure-reducing valve shall be installed and set for an outlet pressure not exceeding 165 psi (11 bar) at the maximum inlet pressure.

**8.16.1.2.2**  [move to 16.9.7.2]
Pressure gauges shall be installed on the inlet and outlet sides of each pressure-reducing valve.

**8.16.1.2.3**  [move to 16.9.7.3]
A listed relief valve of not less than 1/2 in. (15 mm) in size shall be provided on the discharge side of the pressure-reducing valve set to operate at a pressure not exceeding the rated pressure of the components of the system.

**8.16.1.2.4**  [move to 16.9.7.4]
A listed indicating valve shall be provided on the inlet side of each pressure-reducing valve, unless the pressure-reducing valve meets the listing requirements for use as an indicating valve.

**8.16.1.2.5**  [move to 16.9.7.5]
Means shall be provided downstream of all pressure-reducing valves for flow tests at sprinkler system demand.

**8.16.1.3**  [move to 16.9.8]
8.16.1.3.1 Where post-indicator valves are used, they shall be set so that the top of the post is 32 in. to 40 in. (800 mm to 1.0 m) above the final grade.

8.16.1.3.2 Post-indicator valves shall be properly protected against mechanical damage where needed.

8.16.1.3.3 The requirements of 8.16.1.3.1 shall not apply to wall post-indicator valves.

8.16.1.4 Valves in Pits.

8.16.1.4.1 General. Where it is impractical to provide a post-indicator valve, valves shall be permitted to be placed in pits with permission of the authority having jurisdiction.

8.16.1.4.2 Valve Pit Construction.

8.16.1.4.2.1 When used, valve pits shall be of adequate size and accessible for inspection, operation, testing, maintenance, and removal of equipment contained therein.

8.16.1.4.2.2 Valve pits shall be constructed and arranged to properly protect the installed equipment from movement of earth, freezing, and accumulation of water.

8.16.1.4.2.3 Poured-in-place or precast concrete, with or without reinforcement, or brick (all depending upon soil conditions and size of pit) shall be appropriate materials for construction of valve pits.

8.16.1.4.2.4 Other approved materials shall be permitted to be used for valve pit construction.

8.16.1.4.2.5 Where the water table is low and the soil is porous, crushed stone or gravel shall be permitted to be used for the floor of the pit. [See Figure A.8.17.2(b) for a suggested arrangement.]

8.16.1.4.2.6 Valve pits located at or near the base of the riser of an elevated tank shall be designed in accordance with Chapter 9 of NFPA 22.

8.16.1.4.3 Valve Pit Marking. The location of the valve shall be clearly marked, and the cover of the pit shall be kept free of obstructions.
8.16.1.5* In-Rack Sprinkler System Control Valves. [move to 25.2]

8.16.1.5.1 [move to 25.2.1]
Unless the requirements of 8.16.1.5.2 or 8.16.1.5.3 are met, where sprinklers are installed in racks, separate indicating control valves and drains shall be provided and arranged so that ceiling and in-rack sprinklers can be controlled independently.

8.16.1.5.2 [move to 25.2.2]
Installation of 20 or fewer in-rack sprinklers supplied by any one ceiling sprinkler system shall not require a separate indicating control valve.

8.16.1.5.3 [move to 25.2.3]
The separate indicating valves shall be permitted to be arranged as sectional control valves supplied from the ceiling sprinkler system where in-rack sprinklers are required and the racks including the adjacent aisles occupy 8000 ft² (740 m²) or less of the area protected by the ceiling sprinklers.

8.16.2 Drainage. [move to 16.10]

8.16.2.1* General. [move to 16.10.1]
All sprinkler pipe and fittings shall be installed so that the system can be drained.

8.16.2.2 Wet Pipe Systems. [move to 16.10.2]

8.16.2.2.1 [move to 16.10.2.1]
On wet pipe systems, sprinkler pipes shall be permitted to be installed level.

8.16.2.2.2 [move to 16.10.2.2]
Trapped piping shall be drained in accordance with 8.16.2.5.

8.16.2.3 Dry Pipe and Preaction Systems. [move to 16.10.3]
Piping shall be pitched to drain as stated in 8.16.2.3.1 through 8.16.2.3.3.

8.16.2.3.1 Dry Pipe Systems in Nonrefrigerated Areas. [move to 16.10.3.1]
In dry pipe system, branch lines shall be pitched at least 1/2 in. per 10 ft (4 mm/m), and mains shall be pitched at least 1/4 in. per 10 ft (2 mm/m) in nonrefrigerated areas.

8.16.2.3.2 Preaction Systems. [move to 16.10.3.2]
In preaction systems, branch lines shall be pitched at least 1/2 in. per 10 ft (4 mm/m), and mains shall be pitched at least 1/4 in. per 10 ft (2 mm/m).

8.16.2.3.3 Dry Pipe and Preaction Systems in Refrigerated Areas. [move to 16.10.3.3]
Branch lines shall be pitched at least 1/2 in. per 10 ft (4 mm/m), and mains shall be pitched at least 1/2 in. per 10 ft (4 mm/m) in refrigerated areas.

8.16.2.4* System, Main Drain, or Sectional Drain Connections. [move to 16.10.4]
8.16.2.4.1* [move to 16.10.4.1]
Provisions shall be made to properly drain all parts of the system.

8.16.2.4.2* [move to 16.10.4.2]
Drain connections for systems supply risers and mains shall be sized as shown in Table 8.16.2.4.2.

Table 8.16.2.4.2 Drain Size

<table>
<thead>
<tr>
<th>Riser or Main Size</th>
<th>Size of Drain Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>[in. (mm)]</td>
<td>[in. (mm)]</td>
</tr>
<tr>
<td>Up to 2 (50)</td>
<td>3/4(20) or larger</td>
</tr>
<tr>
<td>21/2(65), 3 (80), 31/2(90)</td>
<td>11/4(32) or larger</td>
</tr>
<tr>
<td>4 (100) and larger</td>
<td>2 (50) or larger</td>
</tr>
</tbody>
</table>

8.16.2.4.3 [move to 16.10.4.3]
Where an interior sectional or floor control valve(s) is provided, it shall be provided with a drain connection having a minimum size as shown in Table 8.16.2.4.2 to drain that portion of the system controlled by the sectional valve.

8.16.2.4.4 [move to 16.10.4.4]
Drains shall discharge outside or to a drain connection capable of handling the flow of the drain. [See Figure A.8.17.4.1(b).]

8.16.2.4.5 [move to 16.10.4.5]
For those drains serving pressure-reducing valves, the drain, drain connection, and all other downstream drain piping shall be sized to permit a flow of at least the greatest system demand supplied by the pressure-reducing valve.

8.16.2.4.6* Main Drain Test Connections. [move to 16.10.4.6]

8.16.2.4.6.1 [move to 16.10.4.6.1]
Main drain test connections shall be provided at locations that will permit flow tests of water supplies and connections.

8.16.2.4.6.2 [move to 16.10.4.6.2]
Main drain test connections shall be installed that the valve can be opened wide for a sufficient time to assure a proper test without causing water damage.

8.16.2.4.6.3 [move to 16.10.4.6.3]
Main drain connections shall be sized in accordance with 8.12.4.2.

8.16.2.4.7 [move to 16.10.4.7]
The test connections required by 8.16.2.4.6 shall be permitted to be used as main drain connections.
8.16.2.4.8 [move to 16.10.4.8]
Where drain connections for floor control valves are tied into a common drain riser, the drain riser shall be one pipe size larger downstream of each size drain connection tying into it.

8.16.2.4.9 [move to 16.10.4.9]
Where subject to freezing, a minimum 4 ft (1.2 m) of exposed drain pipe shall be in a heated area between the drain valve and the exterior wall when drain piping extends through the wall to the outside.

8.16.2.5 Auxiliary Drains. [move to 16.10.5]

8.16.2.5.1 [move to 16.10.5.1]
Auxiliary drains shall be provided where a change in piping direction prevents drainage of system piping through the main drain valve.

8.16.2.5.2 Auxiliary Drains for Wet Pipe Systems and Preaction Systems in Areas Not Subject to Freezing. [move to 16.10.5.2]

8.16.2.5.2.1* [move to 16.10.5.2.1]
Where the capacity of isolated trapped sections of pipe is 50 gal (200 L) or more, the auxiliary drain shall consist of a valve not smaller than 1 in. (25 mm), piped to an accessible location.

8.16.2.5.2.2 [move to 16.10.5.2.2]
Where the capacity of isolated trapped sections of pipe is more than 5 gal (20 L) and less than 50 gal (200 L), the auxiliary drain shall consist of a valve 3⁄4 in. (20 mm) or larger and a plug or a nipple and cap.

8.16.2.5.2.3 [move to 16.10.5.2.3]
Where the capacity of trapped sections of pipes in wet systems is less than 5 gal (20 L), one of the following arrangements shall be provided:
(1) An auxiliary drain shall consist of a nipple and cap or plug not less than 1⁄2 in. (15 mm) in size.
(2) An auxiliary drain shall not be required for trapped sections less than 5 gal (20 L) where the system piping can be drained by removing a single pendent sprinkler.
(3) Where flexible couplings or other easily separated connections are used, the nipple and cap or plug shall be permitted to be omitted.

8.16.2.5.2.4 [move to 16.10.5.2.4]
Tie-in drains shall not be required on wet pipe systems and preaction systems protecting nonfreezing environments.

8.16.2.5.3 Auxiliary Drains for Dry Pipe Systems and Preaction Systems. [move to 16.10.5.3]

8.16.2.5.3.1 [move to 16.10.5.3.1]
Auxiliary drains located in areas subject to freezing shall be accessible.
8.16.2.5.3.2 [move to 16.10.5.3.2]
Auxiliary drains located in areas maintained at freezing temperatures shall be accessible and shall consist of a valve not smaller than 1 in. (25 mm) and a plug or a nipple and cap.

8.16.2.5.3.3 [move to 16.10.5.3.3]
Where the capacity of trapped sections of pipe is less than 5 gal (20 L), the auxiliary drain shall consist of a valve not smaller than 1/2 in. (15 mm) and a plug or a nipple and cap.

8.16.2.5.3.4 [move to 16.10.5.3.4]
Auxiliary drains are not for pipe drops supplying dry pendent sprinklers installed in accordance with 7.2.2.

8.16.2.5.3.5* [move to 16.10.5.3.5]
Where the capacity of isolated trapped sections of system piping is more than 5 gal (20 L), the auxiliary drain shall consist of two 1 in. (25 mm) valves and one 2 in. × 12 in. (50 mm × 300 mm) condensate nipple or equivalent, accessibly located in accordance with Figure 8.16.2.5.3.5, or a device listed for this service.

Figure 8.16.2.5.3.5 Dry System Auxiliary Drain.

8.16.2.5.3.6 [move to 16.10.5.3.6]
Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be only 1 in. (25 mm). Tie-in drain lines shall be pitched a minimum of 1/2 in. per 10 ft (4 mm/m).

8.16.2.5.3.7 [move to 16.10.5.3.7]
Systems with low point drains shall have a sign at the dry pipe or preaction valve indicating the number of low point drains and the location of each individual drain.

8.16.2.6 Discharge of Drain Valves. [move to 16.10.6]

8.16.2.6.1* [move to 16.10.6.1]
Direct interconnections shall not be made between sprinkler drains and sewers.

8.16.2.6.2 [move to 16.10.6.2]
The drain discharge shall conform to any health or water department regulations.

8.16.2.6.3 [move to 16.10.6.3]
Where drain pipes are buried underground, approved corrosion-resistant pipe shall be used.

8.16.2.6.4 [move to 16.10.6.4]
Drain pipes shall not terminate in blind spaces under the building.

8.16.2.6.5 [move to 16.10.6.5]
Where exposed to the atmosphere, drain pipes shall be fitted with a turned-down elbow.

8.16.2.6.6 [move to 16.10.6.6]
Drain pipes shall be arranged to avoid exposing any of the water-filled portion of the sprinkler system to freezing conditions.

8.16.3 Provision for Flushing Systems. [move to 16.6]

8.16.3.1 [move to 16.6.1]
All sprinkler systems shall be arranged for flushing.

8.16.3.2 [move to 16.6.2]
Readily removable fittings shall be provided at the end of all cross mains.

8.16.3.3 [move to 16.6.3]
All cross mains shall terminate in 11/4 in. (32 mm) or larger pipe.

8.16.3.4 [move to 16.6.4]
All branch lines on gridded systems shall be arranged to facilitate flushing.

8.16.4 Protection of Piping. [move to 16.4]

8.16.4.1 Protection of Piping Against Freezing. [move to 16.4.1]
8.16.4.1.1* [move to 16.4.1.1]
The requirements of 8.16.4.1.1 shall not apply where alternate methods of freeze prevention are provided in accordance with one of the methods described in 8.16.4.1.2 through 8.16.4.1.4.1.

8.16.4.1.2 [move to 16.4.1.2]
Unheated areas shall be permitted to be protected by antifreeze systems or by other systems specifically listed for the purpose.

8.16.4.1.3 [move to 16.4.1.3]
Where aboveground water-filled supply pipes, risers, system risers, or feed mains pass through open areas, cold rooms, passageways, or other areas exposed to temperatures below 40°F (4°C), the pipe shall be permitted to be protected against freezing by insulating coverings, frostproof casings, or other means of maintaining a minimum temperature between 40°F and 120°F (4°C and 49°C).

8.16.4.1.4 [move to 16.4.1.4]
Listed heat-tracing systems shall be permitted in accordance with 8.16.4.1.4.1 and 8.16.4.1.4.2.

8.16.4.1.4.1 [move to 16.4.1.4.1]
Where used to protect branch lines, the heat-tracing system shall be specifically listed for use on branch lines.

8.16.4.1.4.2 [move to 16.4.1.4.2]
Electric supervision of the heat-tracing system shall provide positive confirmation that the circuit is energized.

8.16.4.1.5 [move to 16.4.1.5]
Water-filled piping shall be permitted to be installed in areas where the temperature is less than 40°F (4°C) when heat loss calculations performed by a professional engineer verify that the system will not freeze.

8.16.4.2* Protection of Piping Against Corrosion. [move to 16.4.2]

8.16.4.2.1* [move to 16.4.2.1]
Where corrosive conditions are known to exist due to moisture or fumes from corrosive chemicals or both, special types of fittings, pipes, and hangers that resist corrosion shall be used, or a protective coating shall be applied to all unprotected exposed surfaces of the sprinkler system.

8.16.4.2.2 [move to 16.4.2.2]
Where water supplies or environmental conditions are known to have unusual corrosive properties, piping shall have a corrosion resistance ratio (CRR) of 1 or more, and the system shall be treated in accordance with 24.1.5.

8.16.4.2.3 [move to 16.4.2.3] Where corrosive conditions exist or piping is exposed to the weather, corrosion-resistant types of pipe, fittings, and hangers or protective corrosion-resistant coatings shall be used.

8.16.4.2.4 [move to 16.4.2.4] Where steel pipe is used underground, the pipe shall be protected against corrosion.

8.16.4.3* Protection of Piping in Hazardous Areas. [move to 16.4.3]

8.16.4.3.1 [move to 16.4.3.1] Private service main aboveground piping shall not pass through hazardous areas and shall be located so that it is protected from mechanical and fire damage.

8.16.4.3.2 [move to 16.4.3.2] Private service main aboveground piping shall be permitted to be located in hazardous areas protected by an automatic sprinkler system.

8.16.5 Protection of Risers Subject to Mechanical Damage. [move to 16.5] Sprinkler risers subject to mechanical damage shall be protected by steel posts, concrete barriers, or other approved means.

8.16.6* Air Venting. [move to 16.7] The vent required by 7.1.5 shall be located near a high point in the system to allow air to be removed from that portion of the system by one of the following methods:
(1) Manual valve, minimum 1/2 in. (15 mm) size
(2) Automatic air vent
(3) Other approved means

8.17 System Attachments. [move to 16.11]

8.17.1* Sprinkler Alarms/Waterflow Alarms. [move to 16.11.2]

8.17.1.1 Local Waterflow Alarms. [move to 16.11.2.1] A local waterflow alarm shall be provided on every sprinkler system having more than 20 sprinklers.

8.17.1.2 Retarding Devices. [move to 16.11.4] On each alarm check valve used under conditions of variable water pressure, a retarding device shall be installed.

8.17.1.3 Alarm Bypass Test Connections. [move to 16.11.5]
8.17.1.3.1 [move to 16.11.5.1]
Alarm, dry pipe, preaction, and deluge valves shall be fitted with an alarm bypass test connection for an electric alarm switch, water motor gong, or both.

8.17.1.3.2 [move to 16.11.5.2]
The alarm bypass test connection for alarm, dry pipe, preaction, and deluge valves shall be made on the water supply side of the system and provided with a control valve and drain for the alarm piping.

8.17.1.3.3 [move to 16.11.5.3]
The alarm bypass test connection for alarm valves at the riser shall be permitted to be made on the system side of an alarm valve.

8.17.1.3.4 [move to 16.11.5.4]
A check valve shall be installed between the intermediate chamber of a dry pipe valve and the waterflow alarm device so as to prevent flow from the alarm bypass test connection from entering the intermediate chamber of a dry pipe valve during an alarm test via the alarm bypass test connection.

8.17.1.4 Indicating Control Valves. [move to 16.11.6]

8.17.1.4.1 [move to 16.11.6.1]
Where a control valve is installed in the connection to pressure-type contactors or water motor-operated alarm devices, it shall be of the indicating type.

8.17.1.4.2 [move to 16.11.6.1.1]
Such valves shall be sealed, locked, or electrically supervised in the open position.

8.17.1.5* Attachments — Mechanically Operated. [move to 16.11.8]

8.17.1.5.1 [move to 16.11.8.1]
For all types of sprinkler systems employing water motor-operated alarms, a listed 3/4 in. (20 mm) strainer shall be installed at the alarm outlet of the waterflow detecting device.

8.17.1.5.2 [move to 16.11.8.2]
Where a retarding chamber is used in connection with an alarm valve, the strainer shall be located at the outlet of the retarding chamber unless the retarding chamber is provided with an approved integral strainer in its outlet.

8.17.1.6* Alarm Attachments — High-Rise Buildings. [move to 16.11.10]
When a fire must be fought internally due to the height of a building, the following additional alarm apparatus shall be provided:
(1) Each sprinkler system on each floor shall be equipped with a separate waterflow device. The waterflow device shall be connected to an alarm system in such a manner that operation of one sprinkler will actuate the alarm system, and the location of the operated flow device shall be indicated on an annunciator and/or register. The annunciator or register shall be located at grade
level at the normal point of fire department access, at a constantly attended building security control center, or at both locations.

(2) Where the location within the protected buildings where supervisory or alarm signals are received is not under constant supervision by qualified personnel in the employ of the owner, a connection shall be provided to transmit a signal to a remote central station.

(3) A distinct trouble signal shall be provided to indicate a condition that will impair the satisfactory operation of the sprinkler system.

8.17.1.7 Sprinkler Waterflow Alarm for In-Rack Sprinklers. [move to 25.2.4]
See Section C.4.

8.17.2* Fire Department Connections. [move to 16.12]

8.17.2.1* [move to 16.12.1]
Unless the requirements of 8.17.2.2 are met, a fire department connection shall be provided as described in 8.17.2 in accordance with Figure 8.17.2.1.

Figure 8.17.2.1 Fire Department Connection.
8.17.2.2 [move to 16.12.1.1]  
The following systems shall not require a fire department connection:
(1) Buildings located in remote areas that are inaccessible for fire department support
(2) Large-capacity deluge systems exceeding the pumping capacity of the fire department
(3) Single-story buildings not exceeding 2000 ft² (185 m²) in area

8.17.2.3* Size. [move to 16.12.3]  
The size of the pipe for the fire department connection shall be in accordance with one of the following:
(1) Pipe size shall be a minimum of 4 in. (100 mm) for fire engine connections.
(2) Pipe size shall be a minimum of 6 in. (150 mm) for fire boat connections.
(3) For hydraulically calculated systems, the pipe size shall be permitted to be less than 4 in. (100 mm), but not less than the largest riser being served by that connection.

8.17.2.4* Arrangement. [move to 16.12.4]
See Figure 8.17.2.1.

8.17.2.4.1* [move to 16.12.4.1]
The fire department connection shall be on the system side of the water supply check valve.

8.17.2.4.1.1 [move to 16.12.4.1.1]
The fire department connection shall not be attached to branch line piping.

8.17.2.4.1.2 [move to 16.12.4.1.2]
The fire department connection shall be permitted to be connected to main piping on the system it serves.

8.17.2.4.2 [move to 16.12.4.2]
For single systems, the fire department connection shall be installed as follows:
(1) Wet system — on the system side of system control, check, and alarm valves (see Figure A.8.16.1.1)
(2) Dry system — between the system control valve and the dry pipe valve
(3) Preaction system — between the preaction valve and the check valve on the system side of the preaction valve
(4) Deluge system — on the system side of the deluge valve

8.17.2.4.3 [move to 16.12.4.3]
For multiple systems, the fire department connection shall be connected between the supply control valves and the system control valves.

8.17.2.4.4* [move to 16.12.4.4]
The requirements of 8.17.2.4.2 and 8.17.2.4.3 shall not apply where the fire department connection is connected to the underground piping.

8.17.2.4.5 [move to 16.12.4.5]
Where a fire department connection services only a portion of a building, a sign shall be attached indicating the portions of the building served.

8.17.2.4.6* [move to 16.12.4.6]
Fire department connections shall be located at the nearest point of fire department apparatus accessibility or at a location approved by the authority having jurisdiction.

8.17.2.4.7 Signs. [move to 16.12.4.7]

8.17.2.4.7.1 [move to 16.12.4.7.1]
Each fire department connection to sprinkler systems shall be designated by a sign having raised or engraved letters at least 1 in. (25 mm) in height on plate or fitting reading service design — for example, AUTOSPKR., OPEN SPKR., AND STANDPIPE.

8.17.2.4.7.2 [move to 16.12.4.7.2]
A sign shall also indicate the pressure required at the inlets to deliver the greatest system demand.

8.17.2.4.7.3 [move to 16.12.4.7.3]
The sign required in 8.17.2.4.7.2 shall not be required where the system demand pressure is less than 150 psi (10.3 bar).

8.17.2.4.8 [move to 16.12.4.8]
Fire department connections shall not be connected on the suction side of fire pumps.

8.17.2.4.9 [move to 16.12.4.9]
Fire department connections shall be properly supported.

8.17.2.5 Valves. [move to 16.12.5]

8.17.2.5.1 [move to 16.12.5.1]
A listed check valve shall be installed in each fire department connection and shall be located in an accessible location.

8.17.2.5.2 [move to 16.12.5.2]
There shall be no shutoff valve in the fire department connection piping.

8.17.2.6* Drainage. [move to 16.12.6]
The piping between the check valve and the outside hose coupling shall be equipped with an approved automatic drain valve in areas subject to freezing.

8.17.2.6.1 [move to 16.12.6.1]
The automatic drain valve shall be installed in a location that permits inspection and testing as required by NFPA 25.

8.17.3 Gauges. [move to 16.13]

8.17.3.1 [move to 16.13.1]
A pressure gauge with a connection not smaller than 1/4 in. (6 mm) shall be installed at the system main drain, at each main drain associated with a floor control valve, and on the inlet and outlet side of each pressure-reducing valve.

8.17.3.2 [move to 16.13.2]
Each gauge connection shall be equipped with a shutoff valve and provisions for draining.

8.17.3.3 [move to 16.13.3]
The required pressure gauges shall be approved and shall have a maximum limit not less than twice the normal system working pressure at the point where installed.

8.17.3.4 [move to 16.13.4]
Gauges shall be installed to permit removal and shall be located where they will not be subject to freezing.

8.17.4 System Connections. [move to 16.14]

8.17.4.1* Wet Pipe Systems. [move to 16.14.1]

8.17.4.1.1 [move to 16.14.1.1]  
An alarm test connection not less than 1 in. (25 mm) in diameter, terminating in a smooth bore corrosion-resistant orifice, giving a flow equal to or less than one sprinkler of a type having the smallest K-factor installed on the particular system, shall be provided to test each waterflow alarm device for each system.

8.17.4.1.2 [move to 16.14.1.2]  
The test connection valve shall be accessible.

8.17.4.1.3 [move to 16.14.1.3]  
The discharge shall be to the outside, to a drain connection capable of accepting full flow under system pressure, or to another location where water damage will not result.

8.17.4.1.4 [move to 16.14.1.4]  
The alarm test connection shall be permitted to be installed in any location on the fire sprinkler system downstream of the waterflow alarm.

8.17.4.2* Dry Pipe Systems. [move to 16.14.2]

8.17.4.2.1 [move to 16.14.2.1]  
A trip test connection or manifold not less than 1 in. (25 mm) in diameter, terminating in a smooth bore corrosion-resistant orifice, to provide a flow equivalent to one sprinkler of a type installed on the particular system, shall be installed.

8.17.4.2.2 [move to 16.14.2.2]  
The trip test connection or manifold shall be located on the end of the most distant sprinkler pipe in the upper story and shall be equipped with an accessible shutoff valve and a plug not less than 1 in. (25 mm), of which at least one shall be brass.

8.17.4.2.3 [move to 16.14.2.3]  
In lieu of a plug, a nipple and cap shall be acceptable.

8.17.4.2.4 [move to 16.14.2.4]  
When the capacity (volume) of the dry pipe system has been determined in accordance with 7.2.3.2, 7.2.3.3, 7.2.3.4 or 7.2.3.5, a trip test connection shall be permitted to provide a flow equivalent to one sprinkler in accordance with 8.17.4.2.1 through 8.17.4.2.3.

8.17.4.2.5 [move to 16.14.2.5]
When the capacity (volume) of the dry pipe system has been determined in accordance with 7.2.3.7, the following shall apply:

1. When flow is from four sprinklers, the trip test manifold shall be arranged to simulate two sprinklers on each of two sprinkler branch lines.
2. When flow is from three sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line and one sprinkler on the next adjacent branch line.
3. When flow is from two sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line.
4. When flow is from one sprinkler, the test manifold shall be installed per the requirements for a trip test connection in accordance with 8.17.4.2.1 through 8.17.4.2.3.

8.17.4.3 Preaction Systems. [move to 16.14.4.3]

8.17.4.3.1 [move to 16.14.3.1]
A test connection shall be provided on a preaction system using supervisory air.

8.17.4.3.2 [move to 16.14.3.2]
The connection used to control the level of priming water shall be considered adequate to test the operation of the alarms monitoring the supervisory air pressure.

8.17.4.3.3 [move to 16.14.3.3]
For double interlock preaction systems, a trip test connection or manifold not less than 1 in. (25 mm) in diameter, terminating in a smooth bore corrosion-resistant orifice to provide a flow equivalent to one sprinkler of a type installed on the particular system, shall be installed.

8.17.4.3.4 [move to 16.14.3.4]
For double interlock preaction systems, the trip test connection or manifold shall be located on the end of the most distant sprinkler pipe in the upper story and shall be equipped with an accessible shutoff valve and a plug not less than 1 in. (25 mm), of which at least one shall be brass.

8.17.4.3.5 [move to 16.14.3.5]
In lieu of a plug, a nipple and cap shall be acceptable.

8.17.4.3.6 [move to 16.14.3.6]
When the capacity (volume) of the double interlock preaction system has been determined in accordance with 7.3.2.3.1.1, 7.3.2.3.1.2, or 7.3.2.3.1.3, a trip test connection shall be permitted to provide a flow equivalent to one sprinkler in accordance with 8.17.4.3.3 through 8.17.4.3.5.

8.17.4.3.7 [move to 16.14.3.7]
When the capacity (volume) of the double interlock preaction system has been determined in accordance with 7.3.2.3.1.4, the following shall apply:

1. When flow is from four sprinklers, the trip test manifold shall be arranged to simulate two sprinklers on each of two sprinkler branch lines.
2. When flow is from three sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line and one sprinkler on the next adjacent branch line.
(3) When flow is from two sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line.
(4) When flow is from one sprinkler, the test manifold shall be installed as per the requirements for a trip test connection in accordance with 8.17.4.3.3 through 8.17.4.3.5.

8.17.4.4 Deluge Systems. [move to 16.14.4]
A test connection shall not be required on a deluge system.

8.17.4.5* Backflow Devices. [move to 16.14.5]

8.17.4.5.1* Backflow Prevention Valves. [move to 16.14.5.1]
Means shall be provided downstream of all backflow prevention valves for forward flow tests at a minimum flow rate of the system demand including hose allowance where applicable.

8.17.4.5.2 Retroactive Installation. [move to 28.6.4]
When backflow prevention devices are to be retroactively installed on existing systems, a thorough hydraulic analysis, including revised hydraulic calculations, new fire flow data, and all necessary system modifications to accommodate the additional friction loss, shall be completed as a part of the installation.

8.17.5 Hose Connections. [move to 16.15]

8.17.5.1 Small [1 1/2 in. (40 mm)] Hose Connections. [move to 16.15.1]
See Section C.5.

8.17.5.1.1* [move to 16.15.1.1]
Where required, small [1 1/2 in. (40 mm)] hose connections shall be installed.

8.17.5.1.1.1 [move to 16.15.1.1.1]
Valves shall be available to reach all portions of the area with 100 ft (30 m) of hose plus 30 ft (9.1 m) of hose stream distance.

8.17.5.1.1.2 [move to 16.15.1.1.2]
Where the building is protected throughout by an approved automatic sprinkler system, the presence of 1 1/2 in. (40 mm) hose lines for use by the building occupants shall not be required, subject to the approval of the authority having jurisdiction.

8.17.5.1.1.3 [move to 16.15.1.1.3]
Where approved by the authority having jurisdiction, the location of valves shall be permitted to exceed the distances specified in 8.17.5.1.1.1.

8.17.5.1.2 [move to 16.15.1.2]
The hose connections shall not be required to meet the requirements of Class II hose systems defined by NFPA 14.

8.17.5.1.3 [move to 16.15.1.3]
Hose connections shall be supplied from one of the following:

1. Outside hydrants
2. Separate piping system for small hose connections
3. Valved hose connections on sprinkler risers where such connections are made upstream of all sprinkler control valves
4. Adjacent sprinkler systems
5. In rack storage areas, the ceiling sprinkler system in the same area (as long as in-rack sprinklers are provided in the same area and are separately controlled)
6. In nonstorage occupancies that are not a part of a standpipe system, ceiling sprinkler piping in the same area as the hose connection

8.17.5.1.4* [move to 16.15.1.4]
Hose connections used for fire purposes only shall be permitted to be connected to wet pipe sprinkler systems only, subject to the following restrictions:

1. Hose connection's supply pipes shall not be connected to any pipe smaller than 2½ in. (65 mm) in diameter.
2. The requirements of 8.17.5.1.4(1) shall not apply to hydraulically designed loops and grids, where the minimum size pipe between the hose connection's supply pipe and the source shall be permitted to be 2 in. (50 mm).
3. For piping serving a single hose connection, pipe shall be a minimum of 1 in. (25 mm) for horizontal runs up to 20 ft (6.1 m), a minimum of 1½ in. (32 mm) for the entire run for runs between 20 ft and 80 ft (6.1 m and 24 m), and a minimum of 1½ in. (40 mm) for the entire run for runs greater than 80 ft (24 m). For piping serving multiple hose connections, runs shall be a minimum of 1½ in. (40 mm) throughout.
4. Piping shall be at least 1 in. (25 mm) for vertical runs.
5. Where the residual pressure at a 2½ in. (40 mm) outlet on a hose connection exceeds 100 psi (7 bar), an approved pressure-regulating device shall be provided to limit the residual pressure at the outlet to 100 psi (7 bar).
6. Where the static pressure at a 2½ in. (40 mm) hose connection exceeds 175 psi (12 bar), an approved pressure-regulating device shall be provided to limit static and residual pressures at the outlet to 100 psi (7 bar).

8.17.5.2 Hose Connections for Fire Department Use. [move to 16.15.2]

8.17.5.2.1 [move to 16.15.2.1]
In buildings of light or ordinary hazard occupancy, 2½ in. (65 mm) hose valves for fire department use shall be permitted to be attached to wet pipe sprinkler system risers.

8.17.5.2.2* [move to 16.15.2.2]
The following restrictions shall apply:

1. Each connection from a standpipe that is part of a combined system to a sprinkler system shall have an individual control valve and check valve of the same size as the connection.
2. The minimum size of the riser shall be 4 in. (100 mm) unless hydraulic calculations indicate that a smaller size riser will satisfy sprinkler and hose stream allowances.
3. Each combined sprinkler and standpipe riser shall be equipped with a riser control valve to permit isolating a riser without interrupting the supply to other risers from the same source of
supply. (For fire department connections serving standpipe and sprinkler systems, refer to Section 6.7.)

8.18 Electrical Bonding and Grounding. [move to 16.16]

8.18.1 [move to 16.16.1]
In no case shall sprinkler system piping be used for the grounding of electrical systems.

8.18.2* [move to 16.16.2]
The requirement of 8.18.1 shall not preclude the bonding of the sprinkler system piping to the lightning protection grounding system as required by NFPA 780 in those cases where lightning protection is provided for the structure.
First Revision No. 637-NFPA 13-2016 [ Global Input ]

See attached file for the reorganization of existing Chapter 9.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_9.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: [ Not Specified ]
City: [ Not Specified ]
State: [ Not Specified ]
Zip: [ Not Specified ]
Submittal Date: Fri Aug 05 17:22:59 EDT 2016

Committee Statement

Committee Statement: Chapter 9 contains the general requirements/allowances for all sprinklers related to:

• The specific locations in which sprinklers are required to be installed.

• A consolidated list of specific locations where sprinklers may be omitted was developed into Section 9.2 to compile all of the specific allowances that were previously scattered throughout the 2016 Chapter 8.

• The requirements for special situations were all consolidated into Section 9.3 to combine each of the previously scattered provisions from the 2016 Chapter 8 into one location.

• The general requirements for the usage for sprinklers from the 2016 Section 8.3 were incorporated into the new Section 9.4.

• The general requirements for the position, location and spacing for sprinklers from the 2016 Section 8.3 were incorporated into the new Section 9.5.

Chapter 9  Hanging, Bracing, and Restraint of System Piping

9.1  Hangers. —being deleted with an FR

9.1.1*  General. [move to 17.1]

9.1.1.1 [move to 17.1.1]
Unless the requirements of 9.1.1.2 are met, types of hangers shall be in accordance with the requirements of Section 9.1.

9.1.1.2 [move to 17.1.2]
Hangers certified by a registered professional engineer to include all of the following shall be an acceptable alternative to the requirements of Section 9.1:
(1) Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lb (115 kg) at each point of piping support.
(2) These points of support shall be adequate to support the system.
(3) The spacing between hangers shall not exceed the value given for the type of pipe as indicated in Table 9.2.2.1(a) or Table 9.2.2.1(b).
(4) Hanger components shall be ferrous.
(5) Detailed calculations shall be submitted, when required by the reviewing authority, showing stresses developed in hangers, piping, and fittings, and safety factors allowed.

9.1.1.3 [move to 17.1.4]
Shared support structures shall be certified by a registered professional engineer in accordance with 9.1.1.2 and 9.1.1.3.

9.1.1.3.1* [move to 17.1.4.1]
The design of a shared support structure shall be based on either 9.1.1.3.1.1 or 9.1.1.3.1.2.

9.1.1.3.1.1 [move to 17.1.4.1.1]
Sprinkler pipe and other distribution systems shall be permitted to be supported from a shared support structure designed to support five times the weight of water-filled sprinkler pipe and other supported distribution systems plus 250 lb (115 kg), based on the allowable ultimate stress.

9.1.1.3.1.2 [move to 17.1.4.1.2]
Sprinkler pipe and other distribution systems shall be permitted to be supported from a shared support structure designed to support five times the weight of the water-filled sprinkler pipe plus 250 lb (115 kg), and one and one-half times the weight of all other supported distribution systems.

9.1.1.3.3 [move to 17.1.4.1.3]
The building structure shall not be considered a shared support structure.

9.1.1.3.4* [move to 17.1.4.1.4]
The requirements of 9.1.1.3.1 shall not apply to 9.2.1.3.3.
9.1.1.3.1.5 Systems that are incompatible with the fire sprinkler systems based on vibration, thermal expansion and contraction, or other factors shall not share support structures.

9.1.1.4 Where water-based fire protection systems are required to be protected against damage from earthquakes, hangers shall also meet the requirements of 9.3.7.

9.1.1.5 Listing

9.1.1.5.1 Unless permitted by 9.1.1.5.2 or 9.1.1.5.3, the components of hanger assemblies that directly attach to the pipe or to the building structure shall be listed.

9.1.1.5.2 Mild steel hanger rods and hangers formed from mild steel rods shall be permitted to be not listed.

9.1.1.5.3 Fasteners as specified in 9.1.3, 9.1.4, and 9.1.5 shall be permitted to be not listed.

9.1.1.5.4 Other fasteners shall be permitted as part of a hanger assembly that has been tested, listed, and installed in accordance with the listing requirements.

9.1.1.6 Component Material

9.1.1.6.1 Unless permitted by 9.1.1.6.2 or 9.1.1.6.3, hangers and their components shall be ferrous.

9.1.1.6.2 Nonferrous components that have been proven by fire tests to be adequate for the hazard application, that are listed for this purpose, and that are in compliance with the other requirements of this section shall be acceptable.

9.1.1.6.3 Holes through solid structural members shall be permitted to serve as hangers for the support of system piping, provided such holes are permitted by applicable building codes and the spacing and support provisions for hangers of this standard are satisfied.

9.1.1.7 Trapeze Hangers

9.1.1.7.1 For trapeze hangers, the minimum size of steel angle or pipe span between structural members shall be such that the section modulus required in Table 9.1.1.7.1(a) does not exceed the available section modulus of the trapeze member from Table 9.1.1.7.1(b) or Table 9.1.1.7.1(c).
<table>
<thead>
<tr>
<th>Span (ft)</th>
<th>1</th>
<th>1.25</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>3.5</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>0.08</td>
<td>0.09</td>
<td>0.09</td>
<td>0.10</td>
<td>0.11</td>
<td>0.12</td>
<td>0.13</td>
<td>0.15</td>
<td>0.18</td>
<td>0.26</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>0.11</td>
<td>0.12</td>
<td>0.13</td>
<td>0.14</td>
<td>0.15</td>
<td>0.16</td>
<td>0.17</td>
<td>0.20</td>
<td>0.24</td>
<td>0.34</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>0.14</td>
<td>0.15</td>
<td>0.16</td>
<td>0.18</td>
<td>0.21</td>
<td>0.23</td>
<td>0.25</td>
<td>0.30</td>
<td>0.36</td>
<td>0.50</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>0.16</td>
<td>0.17</td>
<td>0.18</td>
<td>0.20</td>
<td>0.22</td>
<td>0.24</td>
<td>0.26</td>
<td>0.31</td>
<td>0.36</td>
<td>0.51</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>0.19</td>
<td>0.20</td>
<td>0.21</td>
<td>0.22</td>
<td>0.24</td>
<td>0.26</td>
<td>0.28</td>
<td>0.36</td>
<td>0.42</td>
<td>0.60</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>0.22</td>
<td>0.23</td>
<td>0.24</td>
<td>0.26</td>
<td>0.29</td>
<td>0.32</td>
<td>0.34</td>
<td>0.41</td>
<td>0.48</td>
<td>0.68</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>4.5</td>
<td>0.24</td>
<td>0.25</td>
<td>0.27</td>
<td>0.28</td>
<td>0.30</td>
<td>0.33</td>
<td>0.36</td>
<td>0.46</td>
<td>0.54</td>
<td>0.77</td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>0.27</td>
<td>0.28</td>
<td>0.30</td>
<td>0.31</td>
<td>0.34</td>
<td>0.37</td>
<td>0.40</td>
<td>0.51</td>
<td>0.60</td>
<td>0.85</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>0.30</td>
<td>0.31</td>
<td>0.33</td>
<td>0.34</td>
<td>0.37</td>
<td>0.41</td>
<td>0.44</td>
<td>0.56</td>
<td>0.66</td>
<td>0.94</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>0.33</td>
<td>0.34</td>
<td>0.35</td>
<td>0.38</td>
<td>0.41</td>
<td>0.44</td>
<td>0.48</td>
<td>0.61</td>
<td>0.71</td>
<td>1.02</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>0.35</td>
<td>0.36</td>
<td>0.38</td>
<td>0.41</td>
<td>0.44</td>
<td>0.48</td>
<td>0.52</td>
<td>0.66</td>
<td>0.77</td>
<td>1.11</td>
<td>1.45</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>0.38</td>
<td>0.39</td>
<td>0.41</td>
<td>0.44</td>
<td>0.47</td>
<td>0.52</td>
<td>0.56</td>
<td>0.71</td>
<td>0.83</td>
<td>1.19</td>
<td>1.56</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>0.41</td>
<td>0.42</td>
<td>0.44</td>
<td>0.47</td>
<td>0.51</td>
<td>0.55</td>
<td>0.60</td>
<td>0.76</td>
<td>0.89</td>
<td>1.28</td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td>8.0</td>
<td>0.43</td>
<td>0.45</td>
<td>0.47</td>
<td>0.50</td>
<td>0.54</td>
<td>0.59</td>
<td>0.63</td>
<td>0.82</td>
<td>0.95</td>
<td>1.36</td>
<td>1.79</td>
<td></td>
</tr>
<tr>
<td>8.5</td>
<td>0.46</td>
<td>0.48</td>
<td>0.50</td>
<td>0.53</td>
<td>0.58</td>
<td>0.63</td>
<td>0.67</td>
<td>0.87</td>
<td>1.01</td>
<td>1.45</td>
<td>1.90</td>
<td></td>
</tr>
<tr>
<td>9.0</td>
<td>0.49</td>
<td>0.50</td>
<td>0.53</td>
<td>0.56</td>
<td>0.61</td>
<td>0.66</td>
<td>0.71</td>
<td>0.92</td>
<td>1.07</td>
<td>1.53</td>
<td>2.01</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>0.52</td>
<td>0.53</td>
<td>0.56</td>
<td>0.60</td>
<td>0.64</td>
<td>0.70</td>
<td>0.75</td>
<td>0.97</td>
<td>1.13</td>
<td>1.62</td>
<td>2.12</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>0.54</td>
<td>0.56</td>
<td>0.59</td>
<td>0.63</td>
<td>0.68</td>
<td>0.74</td>
<td>0.79</td>
<td>0.95</td>
<td>1.02</td>
<td>1.19</td>
<td>1.70</td>
<td></td>
</tr>
<tr>
<td>10.5</td>
<td>0.57</td>
<td>0.59</td>
<td>0.62</td>
<td>0.66</td>
<td>0.71</td>
<td>0.78</td>
<td>0.83</td>
<td>1.07</td>
<td>1.25</td>
<td>1.79</td>
<td>2.35</td>
<td></td>
</tr>
<tr>
<td>11.0</td>
<td>0.60</td>
<td>0.62</td>
<td>0.65</td>
<td>0.69</td>
<td>0.74</td>
<td>0.81</td>
<td>0.87</td>
<td>1.12</td>
<td>1.31</td>
<td>1.87</td>
<td>2.46</td>
<td></td>
</tr>
<tr>
<td>11.5</td>
<td>0.63</td>
<td>0.64</td>
<td>0.68</td>
<td>0.72</td>
<td>0.78</td>
<td>0.85</td>
<td>0.91</td>
<td>1.17</td>
<td>1.37</td>
<td>1.96</td>
<td>2.57</td>
<td></td>
</tr>
<tr>
<td>12.0</td>
<td>0.65</td>
<td>0.67</td>
<td>0.71</td>
<td>0.75</td>
<td>0.81</td>
<td>0.89</td>
<td>0.95</td>
<td>1.12</td>
<td>1.43</td>
<td>2.04</td>
<td>2.68</td>
<td></td>
</tr>
<tr>
<td>12.5</td>
<td>0.68</td>
<td>0.70</td>
<td>0.74</td>
<td>0.78</td>
<td>0.85</td>
<td>0.92</td>
<td>0.99</td>
<td>1.07</td>
<td>1.49</td>
<td>2.13</td>
<td>2.79</td>
<td></td>
</tr>
<tr>
<td>13.0</td>
<td>0.71</td>
<td>0.73</td>
<td>0.77</td>
<td>0.81</td>
<td>0.88</td>
<td>0.96</td>
<td>1.03</td>
<td>1.11</td>
<td>1.53</td>
<td>2.21</td>
<td>2.90</td>
<td></td>
</tr>
<tr>
<td>13.5</td>
<td>0.73</td>
<td>0.76</td>
<td>0.80</td>
<td>0.85</td>
<td>0.91</td>
<td>1.00</td>
<td>1.07</td>
<td>1.15</td>
<td>1.61</td>
<td>2.30</td>
<td>3.02</td>
<td></td>
</tr>
<tr>
<td>14.0</td>
<td>0.76</td>
<td>0.78</td>
<td>0.83</td>
<td>0.88</td>
<td>0.95</td>
<td>1.03</td>
<td>1.11</td>
<td>1.20</td>
<td>1.67</td>
<td>2.38</td>
<td>3.13</td>
<td></td>
</tr>
<tr>
<td>14.5</td>
<td>0.79</td>
<td>0.81</td>
<td>0.86</td>
<td>0.91</td>
<td>0.98</td>
<td>1.07</td>
<td>1.15</td>
<td>1.24</td>
<td>1.73</td>
<td>2.47</td>
<td>3.24</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td>0.82</td>
<td>0.84</td>
<td>0.89</td>
<td>0.94</td>
<td>1.02</td>
<td>1.11</td>
<td>1.19</td>
<td>1.28</td>
<td>1.79</td>
<td>2.56</td>
<td>3.35</td>
<td></td>
</tr>
<tr>
<td>15.5</td>
<td>0.84</td>
<td>0.87</td>
<td>0.92</td>
<td>0.97</td>
<td>1.05</td>
<td>1.14</td>
<td>1.23</td>
<td>1.32</td>
<td>1.85</td>
<td>2.64</td>
<td>3.46</td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td>0.87</td>
<td>0.90</td>
<td>0.95</td>
<td>1.00</td>
<td>1.08</td>
<td>1.18</td>
<td>1.27</td>
<td>1.37</td>
<td>1.91</td>
<td>2.73</td>
<td>3.58</td>
<td></td>
</tr>
</tbody>
</table>

Table 9.1.1.7.1(a) Section Modulus Required for Trapeze Members (in.³)

Nominal Diameter of Pipe Being Supported – Schedule 10 Steel

Nominal Diameter of Pipe Being Supported – Schedule 40 Steel
<table>
<thead>
<tr>
<th>Span (ft)</th>
<th>1</th>
<th>1.25</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>3.5</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>0.25</td>
<td>0.26</td>
<td>0.27</td>
<td>0.29</td>
<td>0.33</td>
<td>0.37</td>
<td>0.41</td>
<td>0.45</td>
<td>0.54</td>
<td>0.65</td>
<td>0.90</td>
<td>1.23</td>
</tr>
<tr>
<td>5.0</td>
<td>0.27</td>
<td>0.29</td>
<td>0.30</td>
<td>0.33</td>
<td>0.37</td>
<td>0.41</td>
<td>0.45</td>
<td>0.49</td>
<td>0.60</td>
<td>0.72</td>
<td>1.00</td>
<td>1.37</td>
</tr>
<tr>
<td>5.5</td>
<td>0.30</td>
<td>0.31</td>
<td>0.33</td>
<td>0.36</td>
<td>0.40</td>
<td>0.45</td>
<td>0.50</td>
<td>0.54</td>
<td>0.66</td>
<td>0.79</td>
<td>1.10</td>
<td>1.51</td>
</tr>
<tr>
<td>6.0</td>
<td>0.33</td>
<td>0.34</td>
<td>0.36</td>
<td>0.39</td>
<td>0.44</td>
<td>0.49</td>
<td>0.54</td>
<td>0.59</td>
<td>0.72</td>
<td>0.87</td>
<td>1.20</td>
<td>1.64</td>
</tr>
<tr>
<td>6.5</td>
<td>0.36</td>
<td>0.37</td>
<td>0.40</td>
<td>0.42</td>
<td>0.48</td>
<td>0.54</td>
<td>0.59</td>
<td>0.64</td>
<td>0.78</td>
<td>0.94</td>
<td>1.31</td>
<td>1.78</td>
</tr>
<tr>
<td>7.0</td>
<td>0.38</td>
<td>0.40</td>
<td>0.43</td>
<td>0.46</td>
<td>0.52</td>
<td>0.58</td>
<td>0.63</td>
<td>0.69</td>
<td>0.84</td>
<td>1.01</td>
<td>1.41</td>
<td>1.92</td>
</tr>
<tr>
<td>7.5</td>
<td>0.41</td>
<td>0.43</td>
<td>0.46</td>
<td>0.49</td>
<td>0.55</td>
<td>0.62</td>
<td>0.68</td>
<td>0.74</td>
<td>0.90</td>
<td>1.08</td>
<td>1.51</td>
<td>2.06</td>
</tr>
<tr>
<td>8.0</td>
<td>0.44</td>
<td>0.46</td>
<td>0.49</td>
<td>0.52</td>
<td>0.59</td>
<td>0.66</td>
<td>0.72</td>
<td>0.79</td>
<td>0.96</td>
<td>1.16</td>
<td>1.61</td>
<td>2.19</td>
</tr>
<tr>
<td>8.5</td>
<td>0.47</td>
<td>0.48</td>
<td>0.52</td>
<td>0.56</td>
<td>0.63</td>
<td>0.70</td>
<td>0.77</td>
<td>0.84</td>
<td>1.02</td>
<td>1.23</td>
<td>1.71</td>
<td>2.33</td>
</tr>
<tr>
<td>9.0</td>
<td>0.49</td>
<td>0.51</td>
<td>0.55</td>
<td>0.59</td>
<td>0.66</td>
<td>0.74</td>
<td>0.81</td>
<td>0.89</td>
<td>1.08</td>
<td>1.30</td>
<td>1.81</td>
<td>2.47</td>
</tr>
<tr>
<td>9.5</td>
<td>0.52</td>
<td>0.54</td>
<td>0.58</td>
<td>0.62</td>
<td>0.70</td>
<td>0.78</td>
<td>0.86</td>
<td>0.94</td>
<td>1.14</td>
<td>1.37</td>
<td>1.91</td>
<td>2.60</td>
</tr>
<tr>
<td>10.0</td>
<td>0.55</td>
<td>0.57</td>
<td>0.61</td>
<td>0.65</td>
<td>0.74</td>
<td>0.82</td>
<td>0.90</td>
<td>0.99</td>
<td>1.20</td>
<td>1.45</td>
<td>2.01</td>
<td>2.74</td>
</tr>
<tr>
<td>10.5</td>
<td>0.58</td>
<td>0.60</td>
<td>0.64</td>
<td>0.69</td>
<td>0.77</td>
<td>0.86</td>
<td>0.95</td>
<td>1.04</td>
<td>1.26</td>
<td>1.52</td>
<td>2.11</td>
<td>2.88</td>
</tr>
<tr>
<td>11.0</td>
<td>0.60</td>
<td>0.63</td>
<td>0.67</td>
<td>0.72</td>
<td>0.81</td>
<td>0.91</td>
<td>0.99</td>
<td>1.09</td>
<td>1.32</td>
<td>1.59</td>
<td>2.21</td>
<td>3.01</td>
</tr>
<tr>
<td>11.5</td>
<td>0.63</td>
<td>0.66</td>
<td>0.70</td>
<td>0.75</td>
<td>0.85</td>
<td>0.95</td>
<td>1.04</td>
<td>1.14</td>
<td>1.38</td>
<td>1.66</td>
<td>2.31</td>
<td>3.15</td>
</tr>
<tr>
<td>12.0</td>
<td>0.66</td>
<td>0.68</td>
<td>0.73</td>
<td>0.78</td>
<td>0.88</td>
<td>0.99</td>
<td>1.08</td>
<td>1.19</td>
<td>1.44</td>
<td>1.73</td>
<td>2.41</td>
<td>3.29</td>
</tr>
<tr>
<td>12.5</td>
<td>0.69</td>
<td>0.71</td>
<td>0.76</td>
<td>0.82</td>
<td>0.92</td>
<td>1.03</td>
<td>1.13</td>
<td>1.24</td>
<td>1.51</td>
<td>1.81</td>
<td>2.51</td>
<td>3.43</td>
</tr>
<tr>
<td>13.0</td>
<td>0.71</td>
<td>0.74</td>
<td>0.79</td>
<td>0.85</td>
<td>0.96</td>
<td>1.07</td>
<td>1.17</td>
<td>1.29</td>
<td>1.56</td>
<td>1.88</td>
<td>2.61</td>
<td>3.56</td>
</tr>
<tr>
<td>13.5</td>
<td>0.74</td>
<td>0.77</td>
<td>0.82</td>
<td>0.88</td>
<td>0.99</td>
<td>1.11</td>
<td>1.22</td>
<td>1.34</td>
<td>1.62</td>
<td>1.95</td>
<td>2.71</td>
<td>3.70</td>
</tr>
<tr>
<td>14.0</td>
<td>0.77</td>
<td>0.80</td>
<td>0.85</td>
<td>0.91</td>
<td>1.03</td>
<td>1.15</td>
<td>1.26</td>
<td>1.39</td>
<td>1.68</td>
<td>2.02</td>
<td>2.81</td>
<td>3.84</td>
</tr>
<tr>
<td>14.5</td>
<td>0.80</td>
<td>0.83</td>
<td>0.88</td>
<td>0.95</td>
<td>1.07</td>
<td>1.19</td>
<td>1.31</td>
<td>1.43</td>
<td>1.74</td>
<td>2.1</td>
<td>2.91</td>
<td>3.97</td>
</tr>
<tr>
<td>15.0</td>
<td>0.82</td>
<td>0.86</td>
<td>0.91</td>
<td>0.98</td>
<td>1.10</td>
<td>1.24</td>
<td>1.35</td>
<td>1.48</td>
<td>1.8</td>
<td>2.17</td>
<td>3.01</td>
<td>4.11</td>
</tr>
<tr>
<td>15.5</td>
<td>0.85</td>
<td>0.88</td>
<td>0.94</td>
<td>1.01</td>
<td>1.14</td>
<td>1.28</td>
<td>1.4</td>
<td>1.53</td>
<td>1.86</td>
<td>2.24</td>
<td>3.11</td>
<td>4.25</td>
</tr>
<tr>
<td>16.0</td>
<td>0.88</td>
<td>0.91</td>
<td>0.97</td>
<td>1.05</td>
<td>1.18</td>
<td>1.32</td>
<td>1.44</td>
<td>1.58</td>
<td>1.92</td>
<td>2.31</td>
<td>3.21</td>
<td>4.39</td>
</tr>
</tbody>
</table>

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

Note: The table is based on a maximum bending stress of 15 ksi and a midspan concentrated load from 15 ft (4.6 m) of water-filled pipe, plus 250 lb (114 kg).

Table 9.1.1.7.1(b) Available Section Modulus of Common Trapeze Hangers (in.³)

<table>
<thead>
<tr>
<th>Pipe</th>
<th>in. mm</th>
<th>Modulus (in.³)</th>
<th>Angles (in.)</th>
<th>Modulus (in.³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>0.12</td>
<td>11/2 × 11/2 × 3/16</td>
<td>0.10</td>
</tr>
<tr>
<td>11/4</td>
<td>32</td>
<td>0.19</td>
<td>2 × 2 × 1/8</td>
<td>0.13</td>
</tr>
<tr>
<td>11/2</td>
<td>40</td>
<td>0.26</td>
<td>2 × 11/2 × 3/16</td>
<td>0.18</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>0.42</td>
<td>2 × 2 × 3/16</td>
<td>0.19</td>
</tr>
<tr>
<td>21/2</td>
<td>65</td>
<td>0.69</td>
<td>2 × 2 × 1/4</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>1.04</td>
<td>21/2 × 11/2 × 3/16</td>
<td>0.28</td>
</tr>
<tr>
<td>31/2</td>
<td>90</td>
<td>1.38</td>
<td>21/2 × 2 × 3/16</td>
<td>0.29</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>1.76</td>
<td>2 × 2 × 5/16</td>
<td>0.30</td>
</tr>
<tr>
<td>Pipe</td>
<td>Modulus (in.³)</td>
<td>Angles (in.)</td>
<td>Modulus (in.³)</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>--------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3.03</td>
<td>2 1/2 × 2 1/2 × 3/16</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4.35</td>
<td>2 × 2 × 3/8</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 1/2 × 2 1/2 × 1/4</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 × 2 × 3/16</td>
<td>0.41</td>
<td></td>
</tr>
</tbody>
</table>

**Schedule 40**

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Modulus (cm³)</th>
<th>Angles (mm)</th>
<th>Modulus (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.13</td>
<td>40 × 40 × 5</td>
<td>1.64</td>
</tr>
<tr>
<td>1 1/4</td>
<td>0.23</td>
<td>3 × 3 × 3/16</td>
<td>0.44</td>
</tr>
<tr>
<td>1 1/2</td>
<td>0.33</td>
<td>2 1/2 × 2 1/2 × 5/16</td>
<td>0.48</td>
</tr>
<tr>
<td>2</td>
<td>0.56</td>
<td>3 × 2 × 1/4</td>
<td>0.54</td>
</tr>
<tr>
<td>2 1/2</td>
<td>1.06</td>
<td>2 1/2 × 2 × 3/8</td>
<td>0.55</td>
</tr>
<tr>
<td>3</td>
<td>1.72</td>
<td>2 1/2 × 2 1/2 × 3/8</td>
<td>0.57</td>
</tr>
<tr>
<td>3 1/2</td>
<td>2.39</td>
<td>3 × 3 × 1/4</td>
<td>0.58</td>
</tr>
<tr>
<td>4</td>
<td>3.21</td>
<td>3 × 3 × 5/16</td>
<td>0.71</td>
</tr>
<tr>
<td>5</td>
<td>5.45</td>
<td>3 1/2 × 2 1/2 × 1/2</td>
<td>0.72</td>
</tr>
<tr>
<td>6</td>
<td>8.50</td>
<td>3 1/2 × 2 1/2 × 3/8</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Table 9.1.1.7.1(c) Available Section Modulus of Common Trapeze Hangers (cm³)
<table>
<thead>
<tr>
<th>Pipe in.</th>
<th>Modulus (cm³)</th>
<th>Angles (mm)</th>
<th>Modulus (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11⁄4</td>
<td>32</td>
<td>3.11</td>
<td>50 × 50 × 3</td>
</tr>
<tr>
<td>11⁄2</td>
<td>40</td>
<td>4.26</td>
<td>50 × 40 × 5</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>6.88</td>
<td>50 × 50 × 5</td>
</tr>
<tr>
<td>21⁄2</td>
<td>65</td>
<td>11.3</td>
<td>50 × 50 × 6</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>17.0</td>
<td>65 × 40 × 5</td>
</tr>
<tr>
<td>31⁄2</td>
<td>90</td>
<td>22.6</td>
<td>65 × 50 × 5</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>28.8</td>
<td>50 × 50 × 5</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>49.7</td>
<td>65 × 65 × 5</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>71.3</td>
<td>50 × 50 × 10</td>
</tr>
</tbody>
</table>

<p>| Schedule 40 |
| 1        | 25            | 2.1         | 80 × 65 × 10  | 7.05 |
| 11⁄4     | 32            | 3.8         | 3 × 3 × 3⁄16  | 7.21 |
| 11⁄2     | 40            | 5.4         | 65 × 65 × 8   | 7.87 |
| 2        | 50            | 9.2         | 3 × 2 × 1⁄4   | 8.85 |
| 21⁄2     | 65            | 17.4        | 65 × 50 × 10  | 9.01 |
| 3        | 80            | 28.2        | 65 × 65 × 10  | 9.34 |
| 31⁄2     | 90            | 39.2        | 80 × 80 × 6   | 9.50 |
| 4        | 100           | 52.6        | 80 × 80 × 8   | 11.6 |
| 5        | 125           | 89.3        | 65 × 65 × 15  | 11.8 |
| 6        | 150           | 139.3       | 90 × 65 × 6   | 12.3 |
|          |               |             | 80 × 65 × 10  | 13.3 |
|          |               |             | 80 × 80 × 10  | 13.6 |
|          |               |             | 90 × 65 × 8   | 15.2 |
|          |               |             | 80 × 80 × 11  | 15.6 |
|          |               |             | 100 × 100 × 6 | 17.2 |
|          |               |             | 80 × 80 × 15  | 17.5 |
|          |               |             | 100 × 80 × 8  | 20.2 |
|          |               |             | 100 × 100 × 10| 21.1 |
|          |               |             | 100 × 80 × 10 | 23.9 |
|          |               |             | 100 × 100 × 10| 24.9 |
|          |               |             | 125 × 90 × 8  | 31.8 |
|          |               |             | 100 × 100 × 16| 32.3 |
|          |               |             | 100 × 100 × 8 | 39.3 |
|          |               |             | 100 × 100 × 20| 46.0 |
|          |               |             | 150 × 100 × 10| 54.4 |
|          |               |             | 150 × 100 × 15| 71.0 |
|          |               |             | 150 × 100 × 20| 102 |</p>
<table>
<thead>
<tr>
<th>Pipe</th>
<th>Modulus (cm³)</th>
<th>Angles (mm)</th>
<th>Modulus (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 10</td>
<td></td>
<td>150 x 150 x 25</td>
<td>140</td>
</tr>
</tbody>
</table>

9.1.1.7.2 [move to 17.3.2]
Any other sizes or shapes giving equal or greater section modulus shall be acceptable.

9.1.1.7.3 [move to 17.3.3]
All angles shall be installed with the longer leg vertical.

9.1.1.7.4 [move to 17.3.4]
The trapeze member shall be secured to prevent slippage.

9.1.1.7.5* [move to 17.3.5]
All components of each hanger assembly that attach to a trapeze member shall conform to 9.1.1.5 and be sized to support the suspended sprinkler pipe.

9.1.1.7.6 [move to 17.3.6]
The ring, strap, or clevis installed on a pipe trapeze shall be manufactured to fit the pipe size of the trapeze member.

9.1.1.7.7 [move to 17.3.7]
Holes for bolts or rods shall not exceed 1/16 in. (1.6 mm) greater than the diameter of the bolt or rod.

9.1.1.7.8 [move to 17.3.8]
Bolts and rods shall be provided with flat washers and nuts.

9.1.1.7.9 [move to 17.3.9]
Where angles are used for trapeze hangers and slotted holes are used, the slotted holes shall meet all of the following:

1) The length of each slotted hole shall not exceed 3 in. (80 mm)
2) The width of the slotted hole shall not exceed 1/16 in. (1.6 mm) greater than the bolt or rod diameter.
3) The minimum distance between slotted holes shall be 3 in. (80 mm) edge to edge.
4) The minimum distance from the end of the angle to the edge of the slotted hole shall be 3 in. (80 mm)
5) The number of slots shall be limited to three per section of angle.
6) The washer(s) required by 9.1.1.7.8 shall have a minimum thickness of one-half the thickness of the angle.
7) Washers and nuts required by 9.1.1.7.8 shall be provided on both the top and bottom of the angle.

9.1.1.8 Support of Non-System Components.  [move to 17.1.3]
9.1.1.8.1* [move to 17.1.3.1]
Sprinkler piping or hangers shall not be used to support non-system components.

9.1.1.8.2 [move to 17.1.3.2]
Sprinkler piping shall be permitted to utilize shared support structures in accordance with 9.1.1.3.

9.1.2 Hanger Rods. [move to 17.2.1]

9.1.2.1 [move to 17.2.1.1]
Unless the requirements of 9.1.2.2 are met, hanger rod size shall be the same as that approved for use with the hanger assembly, and the size of rods shall not be less than that given in Table 9.1.2.1.

Table 9.1.2.1 Hanger Rod Sizes

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Diameter of Rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm in. mm</td>
</tr>
<tr>
<td>Up to and including 4</td>
<td>100 3/8 10</td>
</tr>
<tr>
<td>5</td>
<td>125 1/2 12</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>250 5/8 16</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
</tr>
</tbody>
</table>

9.1.2.2 [move to 17.2.1.2]
Rods of smaller diameters than indicated in Table 9.1.2.1 shall be permitted where the hanger assembly has been tested and listed by a testing laboratory and installed within the limits of pipe sizes expressed in individual listings.

9.1.2.3 [move to 17.2.1.3]
Where the pitch of the branch line is 6 in 12 or greater, a reduction in the lateral loading on branch line hanger rods shall be done by one of the following:
(1) *Second hanger installed in addition to the required main hangers
(2) Lateral sway brace assemblies on the mains
(3) Branch line hangers utilizing an articulating structural attachment
(4) Equivalent means providing support to the branch line hanger rods

9.1.2.4 U-Hooks. [move to 17.2.1.4]
The size of the rod material of U-hooks shall not be less than that given in Table 9.1.2.4.

Table 9.1.2.4 U-Hook Rod Sizes

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Hook Material Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>in. mm</td>
<td>in. mm</td>
</tr>
<tr>
<td>Up to and including 2</td>
<td>50 5/16 8</td>
</tr>
<tr>
<td>21/2 to 6</td>
<td>65 to 150 3/8 10</td>
</tr>
</tbody>
</table>
Pipe Size | Hook Material Diameter
---------|---------------------
         | in. mm in. mm       |
8        | 200 1/2 12          |

9.1.2.5 Eye Rods. [move to 17.2.1.5]

9.1.2.5.1 [move to 17.2.1.5.1]
The size of the rod material for eye rods shall not be less than specified in Table 9.1.2.5.1.

Table 9.1.2.5.1 Eye Rod Sizes

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Diameter of Rod</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Bent Eye</td>
</tr>
<tr>
<td>in. mm</td>
<td>in. mm</td>
</tr>
<tr>
<td>Up to and including 4</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
</tbody>
</table>

9.1.2.5.2 [move to 17.2.1.5.2]
Eye rods shall be secured with lock washers to prevent lateral motion.

9.1.2.5.3 [move to 17.2.1.5.3]
Where eye rods are fastened to wood structural members, the eye rod shall be backed with a large flat washer bearing directly against the structural member, in addition to the lock washer.

9.1.2.6 Threaded Sections of Rods. [move to 17.2.1.6]
Threaded sections of rods shall not be formed or bent.

9.1.3* Fasteners in Concrete. [move to 17.2.2]

9.1.3.1 [move to 17.2.2.1]
Unless prohibited by 9.1.3.2 or 9.1.3.3, the use of listed inserts set in concrete and listed post-installed anchors to support hangers shall be permitted for mains and branch lines.

9.1.3.2 [move to 17.2.2.2]
Post-installed anchors shall not be used in cinder concrete, except for branch lines where the post-installed anchors are alternated with through-bolts or hangers attached to beams.

9.1.3.3 [move to 17.2.2.3]
Post-installed anchors shall not be used in ceilings of gypsum or other similar soft material.

9.1.3.4 [move to 17.2.2.4]
Unless the requirements of 9.1.3.5 are met, post-installed anchors shall be installed in a horizontal position in the sides of concrete beams.
9.1.3.5 [move to 17.2.2.5]
Post-installed anchors shall be permitted to be installed in the vertical position under any of the following conditions:
(1) When used in concrete having gravel or crushed stone aggregate to support pipes 4 in. (100 mm) or less in diameter
(2) When post-installed anchors are alternated with hangers connected directly to the structural members, such as trusses and girders, or to the sides of concrete beams [to support pipe 5 in. (125 mm) or larger]
(3) When post-installed anchors are spaced not over 10 ft (3 m) apart [to support pipe 4 in. (100 mm) or larger]

9.1.3.6 [move to 17.2.2.6]
Holes for post-installed anchors in the side of beams shall be above the centerline of the beam or above the bottom reinforcement steel rods.

9.1.3.7 [move to 17.2.2.7]
Holes for post-installed anchors used in the vertical position shall be drilled to provide uniform contact with the shield over its entire circumference.

9.1.3.8 [move to 17.2.2.8]
The depth of the post-installed anchor hole shall not be less than specified for the type of shield used.

9.1.3.9 Powder-Driven Studs. [move to 17.2.2.9]

9.1.3.9.1 [move to 17.2.2.9.1]
Powder-driven studs, welding studs, and the tools used for installing these devices shall be listed.

9.1.3.9.2 [move to 17.2.2.9.2]
Pipe size, installation position, and construction material into which they are installed shall be in accordance with individual listings.

9.1.3.9.3* [move to 17.2.2.9.3]
Representative samples of concrete into which studs are to be driven shall be tested to determine that the studs will hold a minimum load of 750 lb (340 kg) for 2 in. (50 mm) or smaller pipe; 1000 lb (454 kg) for 21/2 in., 3 in., or 31/2 in. (65 mm, 80 mm, or 90 mm) pipe; and 1200 lb (544 kg) for 4 in. or 5 in. (100 mm or 125 mm) pipe.

9.1.3.9.4 [move to 17.2.2.9.4]
Increaser couplings shall be attached directly to the powder-driven studs.

9.1.3.10 Minimum Bolt or Rod Size for Concrete. [move to 17.2.2.10]

9.1.3.10.1 [move to 17.2.2.10.1]
The size of a bolt or rod used with a hanger and installed through concrete shall not be less than specified in Table 9.1.3.10.1.
Table 9.1.3.10.1 Minimum Bolt or Rod Size for Concrete

<table>
<thead>
<tr>
<th>Pipe Size in.</th>
<th>Size of Bolt or Rod mm</th>
<th>Size of Bolt or Rod in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 4</td>
<td>100</td>
<td>3/8</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>1/2</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>250</td>
<td>5/8</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>3/4</td>
</tr>
</tbody>
</table>

9.1.3.10.2 [move to 17.2.2.10.2]
Holes for bolts or rods shall not exceed 1/16 in. (1.6 mm) greater than the diameter of the bolt or rod.

9.1.3.10.3 [move to 17.2.2.10.3]
Bolts and rods shall be provided with flat washers and nuts.

9.1.4 Fasteners in Steel. [move to 17.2.3]

9.1.4.1* [move to 17.2.3.1]
Powder-driven studs, welding studs, and the tools used for installing these devices shall be listed.

9.1.4.2 [move to 17.2.3.2]
Pipe size, installation position, and construction material into which they are installed shall be in accordance with individual listings.

9.1.4.3 [move to 17.2.3.3]
Increaser couplings shall be attached directly to the powder-driven studs or welding studs.

9.1.4.4 [move to 17.2.3.4]
Welding studs or other hanger parts shall not be attached by welding to steel less than U.S. Standard, 12 gauge (2.8 mm).

9.1.4.5 Minimum Bolt or Rod Size for Steel. [move to 17.2.3.5]

9.1.4.5.1 [move to 17.2.3.5.1]
The size of a bolt or rod used with a hanger and installed through steel shall not be less than specified in Table 9.1.4.5.1.

Table 9.1.4.5.1 Minimum Bolt or Rod Size for Steel

<table>
<thead>
<tr>
<th>Pipe Size in.</th>
<th>Size of Bolt or Rod mm</th>
<th>Size of Bolt or Rod in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 4</td>
<td>100</td>
<td>3/8</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>1/2</td>
</tr>
</tbody>
</table>
### Pipe Size

<table>
<thead>
<tr>
<th>Pipe Size in.</th>
<th>Size of Bolt or Rod mm</th>
<th>Size of Bolt or Rod in.</th>
<th>Size of Bolt or Rod mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>150</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
<td>5/8</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>3/4</td>
<td>20</td>
</tr>
</tbody>
</table>

9.1.4.5.2 [move to 17.2.3.5.2]  
Holes for bolts or rods shall not exceed 1/16 in. (1.6 mm) greater than the diameter of the bolt or rod.

9.1.4.5.3 [move to 17.2.3.5.3]  
Bolts and rods shall be provided with flat washers and nuts.

9.1.5 Fasteners in Wood. [move to 17.2.4]

9.1.5.1 Drive Screws. [move to 17.2.4.1]

9.1.5.1.1 [move to 17.2.4.1.1]  
Drive screws shall be used only in a horizontal position as in the side of a beam and only for 2 in. (50 mm) or smaller pipe.

9.1.5.1.2 [move to 17.2.4.1.2]  
Drive screws shall only be used in conjunction with hangers that require two points of attachments.

9.1.5.2 Ceiling Flanges and U-Hooks with Screws. [move to 17.2.4.2]

9.1.5.2.1 [move to 17.2.4.2.1]  
Unless the requirements of 9.1.5.2.2 or 9.1.5.2.3 are met, for ceiling flanges and U-hooks, screw dimensions shall not be less than those given in Table 9.1.5.2.1.

Table 9.1.5.2.1 Screw Dimensions for Ceiling Flanges and U-Hooks

<table>
<thead>
<tr>
<th>Pipe Size in.</th>
<th>Two Screw Ceiling Flanges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 2</td>
<td>Wood screw No. 18 × 11/2 in.</td>
</tr>
<tr>
<td></td>
<td>or Lag screw 5/16 in. × 11/2 in.</td>
</tr>
<tr>
<td></td>
<td>Three Screw Ceiling Flanges</td>
</tr>
<tr>
<td>Up to and including 2</td>
<td>Wood screw No. 18 × 11/2 in.</td>
</tr>
<tr>
<td>21/2</td>
<td>Lag screw 3/8 in. × 2 in.</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>31/2</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
</tbody>
</table>
### Pipe Size Two Screw Ceiling Flanges

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>mm</th>
<th>Two Screw Ceiling Flanges</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>125</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
</tbody>
</table>

### Four Screw Ceiling Flanges

<table>
<thead>
<tr>
<th>Size</th>
<th>mm</th>
<th>Screw Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2</td>
<td>50</td>
<td>Wood screw No. 18 × 1 1/2 in.</td>
</tr>
<tr>
<td>2 1/2</td>
<td>65</td>
<td>Lag screw 3/8 in. × 1 1/2 in.</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>Lag screw 1/2 in. × 2 in.</td>
</tr>
<tr>
<td>3 1/2</td>
<td>90</td>
<td>Lag screw 1/2 in. × 2 in.</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>Lag screw 5/8 in. × 2 in.</td>
</tr>
</tbody>
</table>

### U-Hooks

<table>
<thead>
<tr>
<th>Size</th>
<th>mm</th>
<th>Screw Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2</td>
<td>50</td>
<td>Drive screw No. 16 × 2 in.</td>
</tr>
<tr>
<td>2 1/2</td>
<td>65</td>
<td>Lag screw 3/8 in. × 21/2 in.</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>Lag screw 1/2 in. × 3 in.</td>
</tr>
<tr>
<td>3 1/2</td>
<td>90</td>
<td>Lag screw 1/2 in. × 3 in.</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>Lag screw 5/8 in. × 3 in.</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>Lag screw 5/8 in. × 3 in.</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>Lag screw 5/8 in. × 3 in.</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>Lag screw 5/8 in. × 3 in.</td>
</tr>
</tbody>
</table>

9.1.5.2.2 [move to 17.2.4.2.2]
When the thickness of planking and thickness of flange do not permit the use of screws 2 in. (50 mm) long, screws 13/4 in. (45 mm) long shall be permitted with hangers spaced not over 10 ft (3 m) apart.

9.1.5.2.3 [move to 17.2.4.2.3]
When the thickness of beams or joists does not permit the use of screws 2 1/2 in. (65 mm) long, screws 2 in. (50 mm) long shall be permitted with hangers spaced not over 10 ft (3 m) apart.

9.1.5.3 Bolts, Rods, or Lag Screws. [move to 17.2.4.3]

9.1.5.3.1 [move to 17.2.4.3.1]
Unless the requirements of 9.1.5.3.2 are met, the size of bolt, rod, or lag screw used with a hanger and installed on the side of the beam shall not be less than specified in Table 9.1.5.3.1.

Table 9.1.5.3.1 Minimum Bolt, Rod, or Lag Screw Sizes for Side of Beam Installation
<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Size of Bolt, Rod or Lag Screw</th>
<th>Length of Lag Screw Used with Wood Beams</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
<td>in. mm</td>
</tr>
<tr>
<td>Up to and including 2</td>
<td>50</td>
<td>3/8</td>
</tr>
<tr>
<td>21/2 to 6 (inclusive)</td>
<td>65 to 150</td>
<td>1/2</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>5/8</td>
</tr>
</tbody>
</table>

9.1.5.3.2 [move to 17.2.4.3.2]
Where the thickness of beams or joists does not permit the use of screws 2 1/2 in. (65 mm) long, screws 2 in. (50 mm) long shall be permitted with hangers spaced not over 10 ft (3 m) apart.

9.1.5.3.3 [move to 17.2.4.3.3]
All holes for lag screws shall be pre-drilled 1/8 in. (3 mm) less in diameter than the maximum root diameter of the lag screw thread.

9.1.5.3.4 [move to 17.2.4.3.4]
Holes for bolts or rods shall not exceed 1/16 in. (1.6 mm) greater than the diameter of the bolt or rod.

9.1.5.3.5 [move to 17.2.4.3.5]
Bolts and rods shall be provided with flat washers and nuts.

9.1.5.4 Wood Screws. [move to 17.2.4.4]
Wood screws shall be installed with a screwdriver.

9.1.5.5 Nails. [move to 17.2.4.5]
Nails shall not be acceptable for fastening hangers.

9.1.5.6 Screws in Side of Timber or Joists. [move to 17.2.4.6]

9.1.5.6.1 [move to 17.2.4.6.1]
Screws in the side of a timber or joist shall be not less than 2 1/2 in. (65 mm) from the lower edge where supporting pipe is up to and including nominal 2 1/2 in. and not less than 3 in. (75 mm) where supporting pipe is greater than nominal 2 1/2 in.

9.1.5.6.2 [move to 17.2.4.6.2]
The requirements of 9.1.5.6.1 shall not apply to 2 in. (50 mm) or thicker nailing strips resting on top of steel beams.

9.1.5.7 Coach Screw Rods. [move to 17.2.4.7]

9.1.5.7.1 Minimum Coach Screw Rod Size. [move to 17.2.4.7.1]
The size of coach screw rods shall not be less than the requirements of Table 9.1.5.7.1.
Table 9.1.5.7.1 Minimum Coach Screw Rod Size

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Diameter of Rod</th>
<th>Minimum Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to and including 4</td>
<td>100 in. 3/8</td>
<td>10 in. 75 mm</td>
</tr>
<tr>
<td>Larger than 4</td>
<td>100 in. NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

NP: Not permitted.

9.1.5.7.2 [move to 17.2.4.7.2]
The minimum plank thickness and the minimum width of the lower face of beams or joists in which coach screw rods are used shall be not less than that specified in Table 9.1.5.7.2 and shown in Figure 9.1.5.7.2.

Table 9.1.5.7.2 Minimum Plank Thicknesses and Beam or Joist Widths

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Nominal Plank Thickness</th>
<th>Nominal Width of Beam or Joist Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
<td>in. mm</td>
</tr>
<tr>
<td>Up to and including 2</td>
<td>50 3 75</td>
<td>2 50</td>
</tr>
<tr>
<td>21/2</td>
<td>65 4 100</td>
<td>2 50</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>31/2</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>100 4 100</td>
<td>3 75</td>
</tr>
</tbody>
</table>

Figure 9.1.5.7.2 Dimensions for Structural Members with Coach Screw Rods.

9.1.5.7.3 [move to 17.2.4.7.3]
Coach screw rods shall not be used for support of pipes larger than 4 in. (100 mm) in diameter.
9.1.5.7.4 [move to 17.2.4.7.4]  
All holes for coach screw rods shall be predrilled 1/8 in. (3 mm) less in diameter than the maximum root diameter of the wood screw thread.

9.2* Installation of Pipe Hangers. [move to 17.4]

9.2.1 General. [move to 17.4.1]

9.2.1.1 Ceiling Sheathing. [move to 17.4.1.1]

9.2.1.1* [move to 17.4.1.1.1]  
Unless the requirements of 9.2.1.1.2 are met, sprinkler piping shall be supported independently of the ceiling sheathing.

9.2.1.1.2 [move to 17.4.1.1.2]  
Toggle hangers shall be permitted only for the support of pipe 1 1/2 in. (40 mm) or smaller in size under ceilings of hollow tile or metal lath and plaster.

9.2.1.2 Storage Racks. [move to 17.4.1.2]  
Where sprinkler piping is installed in storage racks, piping shall be supported from the storage rack structure or building in accordance with all applicable provisions of Sections 9.2 and 9.3.

9.2.1.3* Building Structure. [move to 17.4.1.3]

9.2.1.3.1 [move to 17.4.1.3.1]  
Sprinkler piping shall be substantially supported from the building structure, which must support the added load of the water-filled pipe plus a minimum of 250 lb (115 kg) applied at the point of hanging, except where permitted by 9.2.1.1.2, 9.2.1.3.3, and 9.2.1.4.1.

9.2.1.3.2 [move to 17.4.1.3.2]  
Trapeze hangers shall be used where necessary to transfer loads to appropriate structural members.

9.2.1.3.3* Flexible Sprinkler Hose Fittings. [move to 17.4.1.3.3]

9.2.1.3.3.1 [move to 17.4.1.3.3.1]  
Listed flexible sprinkler hose fittings and their anchoring components intended for use in installations connecting the sprinkler system piping to sprinklers shall be installed in accordance with the requirements of the listing, including any installation instructions.

9.2.1.3.3.2 [move to 17.4.1.3.3.2]  
When installed and supported by suspended ceilings, the ceiling shall meet ASTM C635, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, and shall be installed in accordance with

9.2.1.3.3.3* [move to 17.4.1.3.3.3] Where flexible sprinkler hose fittings exceed 6 ft (1.8 m) in length and are supported by a suspended ceiling in accordance with 9.2.1.3.3.2, a hanger(s) attached to the structure shall be required to ensure that the maximum unsupported length does not exceed 6 ft (1.8 m).

9.2.1.3.3.4* [move to 17.4.1.3.3.4] Where flexible sprinkler hose fittings are used to connect sprinklers to branch lines in suspended ceilings, a label limiting relocation of the sprinkler shall be provided on the anchoring component.

9.2.1.4 Metal Deck. [move to 17.4.1.4]

9.2.1.4.1* [move to 17.4.1.4.1] Branch line hangers attached to metal deck shall be permitted only for the support of pipe 1 in. (25 mm) or smaller in size, by drilling or punching the vertical portion of the metal deck and using through bolts.

9.2.1.4.2 [move to 17.4.1.4.2] The distance from the bottom of the bolt hole to the bottom of the vertical member shall be not less than 3/8 in. (10 mm).

9.2.1.5 [move to 17.4.1.5] Where sprinkler piping is installed below ductwork, piping shall be supported from the building structure or from the ductwork supports, provided such supports are capable of handling both the load of the ductwork and the load specified in 9.2.1.3.1.

9.2.2* Maximum Distance Between Hangers. [move to 17.4.2]

9.2.2.1 [move to 17.4.2.1] The maximum distance between hangers shall not exceed that specified in Table 9.2.2.1(a) or Table 9.2.2.1(b), except where the provisions of 9.2.4 apply.

Table 9.2.2.1(a) Maximum Distance Between Hangers (ft-in.)

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.)</th>
<th>3/4</th>
<th>1</th>
<th>11/4</th>
<th>11/2</th>
<th>2</th>
<th>21/2</th>
<th>3</th>
<th>31/2</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel pipe except threaded lightwall</td>
<td>NA 12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
</tr>
<tr>
<td>Threaded lightwall steel pipe</td>
<td>NA 12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Copper tube</td>
<td>8-0</td>
<td>8-0</td>
<td>10-0</td>
<td>10-0</td>
<td>12-0</td>
<td>12-0</td>
<td>12-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
<td>15-0</td>
</tr>
<tr>
<td>CPVC</td>
<td>5-6</td>
<td>6-6</td>
<td>7-0</td>
<td>8-0</td>
<td>9-0</td>
<td>10-0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Ductile-iron pipe</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>15-0</td>
<td>NA</td>
<td>15-0</td>
<td>NA</td>
<td>15-0</td>
<td>15-0</td>
</tr>
</tbody>
</table>

NA: Not applicable.

Table 9.2.2.1(b) Maximum Distance Between Hangers (m)

[move to 17.4.2.1(b)]
### Nominal Pipe Size (mm)

<table>
<thead>
<tr>
<th></th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
<th>50</th>
<th>65</th>
<th>80</th>
<th>90</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel pipe except threaded lightwall</td>
<td>NA</td>
<td>3.7</td>
<td>3.7</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Threaded lightwall steel pipe</td>
<td>NA</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Copper tube</td>
<td>2.4</td>
<td>2.4</td>
<td>3.0</td>
<td>3.0</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>CPVC</td>
<td>1.7</td>
<td>1.8</td>
<td>2.0</td>
<td>2.1</td>
<td>2.4</td>
<td>2.7</td>
<td>3.0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Ductile-iron pipe</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>4.6</td>
<td>NA</td>
<td>4.6</td>
<td>NA</td>
<td>4.6</td>
<td>4.6</td>
</tr>
</tbody>
</table>

NA: Not applicable.

**9.2.2.2** [move to 17.4.2.2]

The maximum distance between hangers for listed nonmetallic pipe shall be modified as specified in the individual product listings.

**9.2.3** Location of Hangers on Branch Lines. [move to 17.4.3]

**9.2.3.1** [move to 17.4.3.1]

Subsection 9.2.3 shall apply to the support of steel pipe or copper tube as specified in 6.3.1 and subject to the provisions of 9.2.2.

**9.2.3.2** Minimum Number of Hangers. [move to 17.4.3.2]

**9.2.3.2.1** [move to 17.4.3.2.1]

Unless the requirements of 9.2.3.2 through 9.2.3.2.5 are met, there shall be not less than one hanger for each section of pipe.

**9.2.3.2.2** Minimum Number of Hangers. [move to 17.4.3.2.2]

Unless the requirements of 9.2.3.2.3 are met, where sprinklers are spaced less than 6 ft (1.8 m) apart, hangers spaced up to a maximum of 12 ft (3.7 m) shall be permitted.

**9.2.3.2.3** [move to 17.4.3.2.3]

For welded or mechanical outlets on a continuous section of pipe, hanger spacing shall be according to Table 9.2.2.1(a) or Table 9.2.2.1(b).

**9.2.3.2.4** [move to 17.4.3.2.4]

Starter lengths less than 6 ft (1.8 m) shall not require a hanger, unless on the end line of a sidefeed system or where an intermediate cross main hanger has been omitted.

**9.2.3.2.5** [move to 17.4.3.2.5]

A single section of pipe shall not require a hanger when the cumulative distance between hangers on the branch line does not exceed the spacing required by Table 9.2.2.1(a) and Table 9.2.2.1(b).

**9.2.3.3** Clearance to Hangers. [move to 17.4.3.3]

The distance between a hanger and the centerline of an upright sprinkler shall not be less than 3 in. (75 mm).
9.2.3.4* Unsupported Lengths. [move to 17.4.3.4]

9.2.3.4.1 [move to 17.4.3.4.1]
For steel pipe, the unsupported horizontal length between the end sprinkler and the last hanger on the line shall not be greater than 36 in. (900 mm) for 1 in. (25 mm) pipe, 48 in. (12 m) for 1 1/4 in. (32 mm) pipe, and 60 in. (1.5 m) for 1 1/2 in. (40 mm) or larger pipe.

9.2.3.4.2 [move to 17.4.3.4.2]
For copper tube, the unsupported horizontal length between the end sprinkler and the last hanger on the line shall not be greater than 18 in. (450 mm) for 1 in. (25 mm) pipe, 24 in. (600 mm) for 1 1/4 in. (32 mm) pipe, and 30 in. (750 mm) for 1 1/2 in. (40 mm) or larger pipe.

9.2.3.4.3 [move to 17.4.3.4.3]
Where the limits of 9.2.3.4.1 and 9.2.3.4.2 are exceeded, the pipe shall be extended beyond the end sprinkler and shall be supported by an additional hanger.

9.2.3.4.4* Unsupported Length with Maximum Pressure Exceeding 100 psi (6.9 bar) and Branch Line Above Ceiling Supplying Sprinklers in Pendent Position Below Ceiling. [move to 17.4.3.4.4]

9.2.3.4.4.1 [move to 17.4.3.4.4.1]
Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 100 psi (6.9 bar) and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the hanger assembly supporting the pipe supplying an end sprinkler in a pendent position shall be of a type that prevents upward movement of the pipe.

9.2.3.4.4.2 [move to 17.4.3.4.4.2]
The unsupported length between the end sprinkler in a pendent position or drop nipple and the last hanger on the branch line shall not be greater than 12 in. (300 mm) for steel pipe or 6 in. (150 mm) for copper pipe.

9.2.3.4.4.3 [move to 17.4.3.4.4.3]
When the limit of 9.2.3.4.4.2 is exceeded, the pipe shall be extended beyond the end sprinkler and supported by an additional hanger.

9.2.3.4.4.4 [move to 17.4.3.4.4.4]
Unless flexible sprinkler hose fittings in accordance with 9.2.1.3.3.1 are used, the hanger closest to the sprinkler shall be of a type that prevents upward movement of the pipe.

9.2.3.5* Unsupported Armover Length. [move to 17.4.3.5]

9.2.3.5.1 [move to 17.4.3.5.1]
The cumulative horizontal length of an unsupported armover to a sprinkler, sprinkler drop, or sprig shall not exceed 24 in. (600 mm) for steel pipe or 12 in. (300 mm) for copper tube.
9.2.3.5.2* Unsupported Armover Length with Maximum Pressure Exceeding 100 psi (6.9 bar) and Branch Line Above Ceiling Supplying Sprinklers in Pendent Position Below Ceiling. [move to 17.4.3.5.2]

9.2.3.5.2.1 [move to 17.4.3.5.2.1]
Where the maximum static or flowing pressure, whichever is greater at the sprinkler, applied other than through the fire department connection, exceeds 100 psi (6.9 bar) and a branch line above a ceiling supplies sprinklers in a pendent position below the ceiling, the cumulative horizontal length of an unsupported armover to a sprinkler or sprinkler drop shall not exceed 12 in. (300 mm) for steel pipe and 6 in. (150 mm) for copper tube.

9.2.3.5.2.2 [move to 17.4.3.5.2.2]
Unless flexible sprinkler hose fittings in accordance with 9.2.1.3.3.1 are used, the hanger closest to the sprinkler shall be of a type that prevents upward movement of the pipe.

9.2.3.5.2.3 [move to 17.4.3.5.2.3]
Where the armover exceeds the maximum unsupported length of 9.2.3.5.2.1, a hanger shall be installed so that the distance from the end sprinkler or drop nipple to the hanger is not greater than 12 in. (300 mm) for steel or 6 in. (150 mm) for copper, or the pipe shall be extended beyond the end sprinkler and shall be supported by an additional hanger.

9.2.3.6* [move to 17.4.3.6]
Wall-mounted sidewall sprinklers shall be restrained to prevent movement.

9.2.3.7 Sprigs. [move to 17.4.3.7]
Sprigs 4 ft (1.2 m) or longer shall be restrained against lateral movement.

9.2.4 Location of Hangers on Mains. [move to 17.4.4]

9.2.4.1 [move to 17.4.4.1]
Unless any of the requirements of 9.2.4.2 through 9.2.4.6 are met, hangers for mains shall be in accordance with 9.2.2, between each branch line, or on each section of pipe, whichever is the lesser dimension.

9.2.4.2 [move to 17.4.4.2]
For welded or mechanical outlets on a continuous section of pipe, hanger spacing shall be according to Table 9.2.2.1(a) or Table 9.2.2.1(b).

9.2.4.3 [move to 17.4.4.3]
For cross mains in steel pipe systems in bays having two branch lines, the intermediate hanger shall be permitted to be omitted, provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits.

9.2.4.3.1 [move to 17.4.4.3.1]
The remaining branch line hangers shall be installed in accordance with 9.2.3.
9.2.4.4 [move to 17.4.4.4]
For cross mains in steel pipe systems only in bays having three branch lines, either side or center feed, one (only) intermediate hanger shall be permitted to be omitted, provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits.

9.2.4.4.1 [move to 17.4.4.4.1]
The remaining branch line hangers shall be installed in accordance with 9.2.3.

9.2.4.5 [move to 17.4.4.5]
For cross mains in steel pipe systems only in bays having four or more branch lines, either side or center feed, two intermediate hangers shall be permitted to be omitted, provided the maximum distance between hangers does not exceed the distances specified in 9.2.2 and a hanger attached to a purlin on each branch line is located as near to the cross main as the purlin permits.

9.2.4.6 [move to 17.4.4.6]
At the end of the main, intermediate trapeze hangers shall be installed unless the main is extended to the next framing member with a hanger installed at this point, in which event an intermediate hanger shall be permitted to be omitted in accordance with 9.2.4.3, 9.2.4.4, and 9.2.4.5.

9.2.4.7* [move to 17.4.4.7]
A single section of pipe shall not require a hanger when the cumulative distance between hangers on the main does not exceed the spacing required by Table 9.2.2.1(a) and Table 9.2.2.1(b).

9.2.5 Support of Risers. [move to 17.4.5]

9.2.5.1 [move to 17.4.5.1]
Risers shall be supported by riser clamps or by hangers located on the horizontal connections within 24 in. (600 mm) of the centerline of the riser.

9.2.5.2 [move to 17.4.5.2]
Riser clamps supporting risers by means of set screws shall not be used.

9.2.5.3* [move to 17.4.5.3]
Riser clamps anchored to walls using hanger rods in the horizontal position shall not be permitted to vertically support risers.

9.2.5.4 Multistory Buildings. [move to 17.4.5.4]

9.2.5.4.1 [move to 17.4.5.4.1]
In multistory buildings, riser supports shall be provided at the lowest level, at each alternate level above, above and below offsets, and at the top of the riser.

9.2.5.4.2* [move to 17.4.5.4.2]
Supports above the lowest level shall also restrain the pipe to prevent movement by an upward thrust where flexible fittings are used.

9.2.5.4.3 [move to 17.4.5.4.3]
Where risers are supported from the ground, the ground support shall constitute the first level of riser support.

9.2.5.4.4 [move to 17.4.5.4.4]
Where risers are offset or do not rise from the ground, the first ceiling level above the offset shall constitute the first level of riser support.

9.2.5.5 [move to 17.4.5.5]
Distance between supports for risers shall not exceed 25 ft (7.6 m).

9.2.6* Pipe Stands. [move to 17.5]

9.2.6.1 General. [move to 17.5.1]

9.2.6.1.1 [move to 17.5.1.1]
Where pipe stands are used to support system piping, the requirements of 9.2.6 shall apply unless the requirements of 9.2.6.1.2 are met.

9.2.6.1.2 [move to 17.5.1.2]
Pipe stands certified by a registered professional engineer to include all of the following shall be an acceptable alternative to the requirements of 9.2.6:

1. Pipe stands shall be designed to support five times the weight of water-filled pipe plus 250 lb (115 kg) at each point of piping support.
2. These points of support shall be adequate to support the system.
3. The spacing between pipe stands shall not exceed the value given for the type of pipe as indicated in Table 9.2.2.1(a) or Table 9.2.2.1(b).
4. Pipe stand components shall be ferrous.
5. Detailed calculations shall be submitted, when required by the reviewing authority, showing stresses developed in the pipe stand, the system piping and fittings, and safety factors allowed.

9.2.6.1.3 [move to 17.5.1.3]
Where water-based fire protection systems are required to be protected against damage from earthquakes, pipe stands shall also meet the requirements of 9.3.8.

9.2.6.2 Component Material. [move to 17.5.2]

9.2.6.2.1 [move to 17.5.2.1]
Pipe stands and their components shall be ferrous unless permitted by 9.2.6.2.2.

9.2.6.2.2 [move to 17.5.2.2]
Nonferrous components that have been proven by fire tests to be adequate for the hazard application and that are in compliance with the other requirements of this section shall be acceptable.

9.2.6.3 Sizing. [move to 17.5.3]

9.2.6.3.1* [move to 17.5.3.1]
The maximum heights for pipe stands shall be in accordance with Table 9.2.6.3.1 unless the requirements of 9.2.6.3.2 are met.

Table 9.2.6.3.1 Maximum Pipe Stand Heights

<table>
<thead>
<tr>
<th>System Pipe Diameter</th>
<th>Pipe Stand Diameter*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 1/2 in.</td>
</tr>
<tr>
<td>1 1/2 in.</td>
<td>6.6 ft</td>
</tr>
<tr>
<td>2 in.</td>
<td>4.4 ft</td>
</tr>
<tr>
<td>2 1/2 in.</td>
<td>—</td>
</tr>
<tr>
<td>3 in.</td>
<td>—</td>
</tr>
<tr>
<td>4 in. up to and including 8 in.</td>
<td>—</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm; 1 ft = 0.305 m.
*Pipe stands are Schedule 40 pipe.
†System piping is assumed to be Schedule 40 (8 in. is Schedule 30).

9.2.6.3.2* [move to 17.5.3.2]
Pipe diameters up to and including 10 in. (200 mm) Schedule 40 are permitted to be supported by 2 in. (50 mm) diameter pipe stands when all of the following conditions are met:

(1) The maximum height shall be 4 ft (1.2 m), as measured from the base of the pipe stand to the centerline of the pipe being supported.

(2) The pipe stand shall be axially loaded.

9.2.6.3.3 [move to 17.5.3.3]
The distance between pipe stands shall not exceed the values in Table 9.2.2.1(a) or Table 9.2.2.1(b).

9.2.6.4 Pipe Stand Base. [move to 17.5.4]

9.2.6.4.1 [move to 17.5.4.1]
The pipe stand base shall be secured by an approved method.

9.2.6.4.2* [move to 17.5.4.2]
Pipe stand base plates shall be threaded malleable iron flanges or welded steel flanges in accordance with Table 6.4.1.

9.2.6.4.2.1 [move to 17.5.4.2.1]
Pipes stands installed in accordance with 9.2.6.3.2 shall be permitted to use a welded steel plate.
9.2.6.4.3* [move to 17.5.4.3]
Pipe stands shall be fastened to a concrete floor or footing using listed concrete anchors or other approved means.

9.2.6.4.4 [move to 17.5.4.4]
A minimum of four anchors shall be used to attach the base plate to the floor.

9.2.6.4.4.1 [move to 17.5.4.4.1]
Pipe stands installed in accordance with 9.2.6.3.2 shall be permitted to use a minimum of two anchors to attach the base plate to the floor.

9.2.6.4.5 [move to 17.5.4.5]
The minimum diameter for the anchors shall be 1/2 in. for pipe stand diameters up to and including 3 in. and 5/8 in. for pipe stands 4 in. diameter and larger.

9.2.6.4.5.1 [move to 17.5.4.5.1]
Where the pipe stand complies with 9.2.6.3.2, 3/8 in. anchors shall be permitted.

9.2.6.5 Attaching to System Piping. [move to 17.5.5]

9.2.6.5.1 [move to 17.5.5.1]
Piping shall be attached to the pipe stand with U-bolts or equivalent attachment.

9.2.6.5.2* [move to 17.5.5.2]
Where a horizontal bracket is used to attach the system piping to the pipe stand, it shall not be more than 1 ft (0.3 m) as measured horizontally from the centerline of the pipe stand to the centerline of the supported pipe.

9.2.6.5.3 [move to 17.5.5.3]
Horizontal support brackets shall be sized such that the section modulus required in Table 9.2.6.5.3 does not exceed the available section modulus from Table 9.1.1.7.1(b).

Table 9.2.6.5.3 Required Section Modulus for Pipe Stand Horizontal Support Arms (in.³)

<table>
<thead>
<tr>
<th>Nominal Diameter of Pipe Being Supported (in.)</th>
<th>1</th>
<th>1/4</th>
<th>1/2</th>
<th>2</th>
<th>2 1/2</th>
<th>3</th>
<th>3 1/2</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section Modulus – Schedule 10 Steel</td>
<td>0.22</td>
<td>0.24</td>
<td>0.25</td>
<td>0.30</td>
<td>0.36</td>
<td>0.42</td>
<td>0.49</td>
<td>0.60</td>
<td>0.66</td>
<td>0.85</td>
<td>1.40</td>
</tr>
<tr>
<td>Section Modulus – Schedule 40 Steel</td>
<td>0.22</td>
<td>0.24</td>
<td>0.27</td>
<td>0.36</td>
<td>0.45</td>
<td>0.54</td>
<td>0.63</td>
<td>0.86</td>
<td>1.13</td>
<td>1.64</td>
<td></td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.

Note: The table is based on the controlling section modulus determined for a concentrated load at a 1 ft (0.3 m) cantilever using one of the following: (1) a maximum bending stress of 15 ksi (103 MPa) and a concentrated load equal to the weight of 15 ft (4.6 m) of water-filled pipe plus 250 lb (114 kg), or (2) a maximum bending stress of 28 ksi (193 MPa) and a concentrated load equal to five times the weight of 15 ft (4.6 m) of water-filled pipe plus 250 lb (114 kg).

9.2.6.6 Thrust. [move to 17.5.6]
9.2.6.6.1* [move to 17.5.6.1]
System piping shall be supported and restrained to restrict movement due to sprinkler/nozzle reaction and water surges.

9.2.6.6.2* [move to 17.5.6.2]
Where thrust forces are anticipated to be high, a pipe ring or clamp shall secure the system piping to the pipe stand.

9.2.6.7 Exterior Applications. [move to 17.5.7]

9.2.6.7.1 [move to 17.5.7.1]
Where required, pipe stands used in exterior applications shall be made of galvanized steel or other suitable corrosion-resistant materials.

9.2.6.7.2 [move to 17.5.7.2]
A welded, threaded, grooved, or other approved cap shall be securely attached to the top of the pipe stand.

9.3 Protection of Piping Against Damage Where Subject to Earthquakes. [move to 18.1]

9.3.1* General. —being deleted with an FR

9.3.1.1 [move to 18.1.1]
Where water-based fire protection systems are required to be protected against damage from earthquakes, the requirements of Section 9.3 shall apply, unless the requirements of 9.3.1.2 are met.

9.3.1.2 [move to 18.1.2]
Alternative methods of providing earthquake protection of sprinkler systems based on a seismic analysis certified by a registered professional engineer such that system performance will be at least equal to that of the building structure under expected seismic forces shall be permitted.

9.3.1.3 Obstructions to Sprinklers. [move to 18.1.3]
Braces and restraints shall not obstruct sprinklers and shall comply with the obstruction rules of Chapter 8.

9.3.2* Couplings. [move to 18.2]

9.3.2.1 [move to 18.2.1]
Listed flexible pipe couplings joining grooved end pipe shall be provided as flexure joints to allow individual sections of piping 21/2 in. (65 mm) or larger to move differentially with the individual sections of the building to which it is attached.

9.3.2.2 [move to 18.2.2]
Couplings shall be arranged to coincide with structural separations within a building.
9.3.2.3 [move to 18.2.3]
Systems having more flexible couplings than required by this section shall be provided with additional sway bracing as required in 9.3.5.5.9.

9.3.2.3.1 [move to 18.2.3.1]
The flexible couplings shall be installed as follows:
(1) *Within 24 in. (600 mm) of the top and bottom of all risers, unless the following provisions are met:
   (a) In risers less than 3 ft (900 mm) in length, flexible couplings are permitted to be omitted.
   (b) In risers 3 ft to 7 ft (900 mm to 2.1 m) in length, one flexible coupling is adequate.
(2) Within 12 in. (300 mm) above and within 24 in. (600 mm) below the floor in multistory buildings
(3) On both sides of concrete or masonry walls within 1 ft (300 mm) of the wall surface, unless clearance is provided in accordance with 9.3.4
(4) *Within 24 in. (600 mm) of building expansion joints
(5) Within 24 in. (600 mm) of the top of drops exceeding 15 ft (4.6 m) in length to portions of systems supplying more than one sprinkler, regardless of pipe size
(6) Within 24 in. (600 mm) above and 24 in. (600 mm) below any intermediate points of support for a riser or other vertical pipe

9.3.2.3.2 [move to 18.2.3.2]
When the flexible coupling below the floor is above the tie-in main to the main supplying that floor, a flexible coupling shall be provided in accordance with one of the following:
(1) *On the horizontal portion within 24 in. (600 mm) of the tie-in where the tie-in is horizontal
(2) *On the vertical portion of the tie-in where the tie-in incorporates a riser

9.3.2.4* Flexible Couplings for Drops. [move to 18.2.4]
Flexible couplings for drops to hose lines, rack sprinklers, mezzanines, and free-standing structures shall be installed regardless of pipe sizes as follows:
(1) Within 24 in. (600 mm) of the top of the drop
(2) Within 24 in. (600 mm) above the uppermost drop support attachment, where drop supports are provided to the structure, rack, or mezzanine
(3) Within 24 in. (600 mm) above the bottom of the drop where no additional drop support is provided

9.3.3* Seismic Separation Assembly. [move to 18.3]

9.3.3.1 [move to 18.3.1]
An approved seismic separation assembly shall be installed where sprinkler piping, regardless of size, crosses building seismic separation joints at ground level and above.

9.3.3.2 [move to 18.3.2]
Seismic separation assemblies shall consist of flexible fittings or flexible piping so as to allow movement sufficient to accommodate closing of the separation, opening of the separation to twice its normal size, and movement relative to the separation in the other two dimensions in an amount equal to the separation distance.
9.3.3.3* [move to 18.3.3]
The seismic separation assembly shall include a four-way brace upstream and downstream within 6 ft (1.8 m) of the seismic separation assembly.

9.3.3.4 [move to 18.3.4]
Bracing shall not be attached to the seismic separation assembly.

9.3.4* Clearance. [move to 18.4]

9.3.4.1 [move to 18.4.1]
Clearance shall be provided around all piping extending through walls, floors, platforms, and foundations, including drains, fire department connections, and other auxiliary piping.

9.3.4.2 [move to 18.4.2]
Unless any of the requirements of 9.3.4.3 through 9.3.4.7 or 9.3.4.10 are met, where pipe passes through holes in platforms, foundations, walls, or floors, the holes shall be sized such that the diameter of the holes is nominally 2 in. (50 mm) larger than the pipe for pipe 1 in. (25 mm) nominal to 3 1/2 in. (90 mm) nominal and 4 in. (100 mm) larger than the pipe for pipe 4 in. (100 mm) nominal and larger.

9.3.4.3 [move to 18.4.3]
Where clearance is provided by a pipe sleeve, a nominal diameter 2 in. (50 mm) larger than the nominal diameter of the pipe shall be acceptable for pipe sizes 1 in. (25 mm) through 3 1/2 in. (90 mm), and the clearance provided by a pipe sleeve of nominal diameter 4 in. (100 mm) larger than the nominal diameter of the pipe shall be acceptable for pipe sizes 4 in. (100 mm) and larger.

9.3.4.4 [move to 18.4.4]
No clearance shall be required for piping passing through gypsum board or equally frangible construction that is not required to have a fire resistance rating.

9.3.4.5 [move to 18.4.5]
No clearance shall be required if flexible couplings are located within 1 ft (300 mm) of each side of a wall or if the requirements of 9.3.2.3.1(2) are met.

9.3.4.6 [move to 18.4.6]
No clearance shall be required where horizontal piping passes perpendicularly through successive studs or joists that form a wall or floor/ceiling assembly.

9.3.4.7 [move to 18.4.7]
No clearance shall be required where nonmetallic pipe has been demonstrated to have inherent flexibility equal to or greater than the minimum provided by flexible couplings located within 1 ft (300 mm) of each side of a wall, floor, platform, or foundation.

9.3.4.8 [move to 18.4.8]
Where required, the clearance shall be filled with a flexible material that is compatible with the piping material.

**9.3.4.9** [move to 18.4.9]  
The installed horizontal and upward vertical clearance between horizontal sprinkler piping and structural members not penetrated or used, collectively or independently, to support the piping shall be at least 2 in. (50 mm).

**9.3.4.10** [move to 18.4.10]  
No clearance shall be required where piping is supported by holes through structural members as permitted by 9.1.1.6.3.

**9.3.4.11** [move to 18.4.11]  
The installed clearance between a sprinkler and structural elements not used collectively or independently to support the sprinklers shall be at least 3 in. (75 mm).

**9.3.4.11.1** [move to 18.4.11.1]  
Where sprinklers are installed using flexible sprinkler hose, clearance for the sprinkler shall not be required.

**9.3.4.12** [move to 18.4.12]  
Clearance shall not be required for piping that is vertically supported by the bottom edge of holes through structural members as permitted by 9.1.1.6.3.

**9.3.4.13** [move to 18.4.13]  
No horizontal clearance (tight fit) shall be provided for piping that is laterally supported by the side edges of holes through structural members.

**9.3.4.13.1** [move to 18.4.13.1]  
Clearance shall be permitted where piping is secured to the structural member with an approved hanger or restraint.

**9.3.5**  Sway Bracing. [move to 18.5]

**9.3.5.1**  General. [move to 18.5.1]

**9.3.5.1.1** [move to 18.5.1.1]  
The system piping shall be braced to resist both lateral and longitudinal horizontal seismic loads and to prevent vertical motion resulting from seismic loads.

**9.3.5.1.2** [move to 18.5.1.2]  
The structural components to which bracing is attached shall be determined to be capable of resisting the added applied seismic loads.

**9.3.5.1.3** [move to 18.5.1.3]  
Horizontal loads on system piping shall be determined in accordance with 9.3.5.9.
9.3.5.1.4* [move to 18.5.1.4]
A shared support structure shall be permitted to support both the gravity loads addressed in 9.1.1.3.1 and the seismic loads addressed in 9.3.5.9.

9.3.5.1.4.1 [move to 18.5.1.4.1]
When a shared support structure is used to support gravity and seismic loads, the structure shall be designed to support these loads for all pipe and distribution systems on the structure using either 9.3.5.9.3 or 9.3.5.9.4 with an importance factor, \( I_p \), of 1.5 being applied to all of the distribution systems.

9.3.5.1.5* [move to 18.5.1.5]
If a shared support structure is used to support sprinkler pipe and other distribution systems per 9.1.1.3.1 and that structure does not provide seismic resistance as required in 9.3.5.1.4, the following shall be met:

1. The sprinkler pipe shall be braced using the method in 9.3.5.6 with the zone of influence including the water-filled sprinkler pipe and all other distribution systems that are not independently equipped with seismic protection and attached to the shared support structure.
2. The sprinkler sway bracing attachment shall be connected to the same building or structure as the shared support structure.

9.3.5.1.6 [move to 18.5.1.6]
Bracing requirements of 9.3.5 shall not apply to drain piping downstream of the drain valve.

9.3.5.2 Listing. [move to 18.5.2]

9.3.5.2.1 [move to 18.5.2.1]
Sway bracing assemblies shall be listed for a maximum load rating, unless the requirements of 9.3.5.2.2 are met.

9.3.5.2.2 [move to 18.5.2.2]
Where sway bracing utilizing pipe, angles, flats, or rods as shown in Table 9.3.5.11.8(a), Table 9.3.5.11.8(b), and Table 9.3.5.11.8(c) is used, the components shall not require listing.

9.3.5.2.2.1 [move to 18.5.2.2.1]
Bracing fittings and connections used with those specific materials shall be listed.

9.3.5.2.3* [move to 18.5.2.3]
The listed load rating shall be reduced as shown in Table 9.3.5.2.3 to determine the allowable load for installations where the brace is less than 90 degrees from vertical.

<table>
<thead>
<tr>
<th>Brace Angle Degrees from Vertical</th>
<th>Allowable Horizontal Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 to 44</td>
<td>Listed load rating divided by 2.000</td>
</tr>
<tr>
<td>45 to 59</td>
<td>Listed load rating divided by 1.414</td>
</tr>
<tr>
<td>Brace Angle Degrees from Vertical</td>
<td>Allowable Horizontal Load</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>60 to 89</td>
<td>Listed load rating divided by 1.155</td>
</tr>
<tr>
<td>90</td>
<td>Listed load rating</td>
</tr>
</tbody>
</table>

9.3.5.2.3.1* [move to 18.5.2.3.1]  
Maximum allowable horizontal loads shall be determined by testing at angles of 30, 45, 60, and 90 degrees from vertical and confirmed to be equal to or greater than those calculated using 9.3.5.2.3.

9.3.5.2.3.2 [move to 18.5.2.3.2]  
For attachments to structures, additional tests shall be performed at 0 degrees.

9.3.5.3 Component Material. [move to 18.5.3]

9.3.5.3.1 [move to 18.5.3.1]  
Unless permitted by 9.3.5.3.2, components of sway brace assemblies shall be ferrous.

9.3.5.3.2 [move to 18.5.3.2]  
Nonferrous components that have been proven by fire tests to be adequate for the hazard application, that are listed for this purpose, and that are in compliance with the other requirements of this section shall be acceptable.

9.3.5.4 Sway Bracing Design. [move to 18.5.4]

9.3.5.4.1 [move to 18.5.4.1]  
Sway braces shall be designed to withstand forces in tension and compression, unless the requirements of 9.3.5.4.2 are met.

9.3.5.4.2* [move to 18.5.4.2]  
Tension-only bracing systems shall be permitted for use where listed for this service and where installed in accordance with their listing limitations, including installation instructions.

9.3.5.4.3 [move to 18.5.4.3]  
For all braces, whether or not listed, the maximum allowable load shall be based on the weakest component of the brace with safety factors.

9.3.5.5 Lateral Sway Bracing. [move to 18.5.5]

9.3.5.5.1* [move to 18.5.5.1]  
Lateral sway bracing shall be provided on all feed and cross mains regardless of size and all branch lines and other piping with a diameter of 2 1/2 in. (65 mm) and larger.
Where branch lines are not provided with lateral sway bracing, they shall be provided with restraint in accordance with 9.3.6.

9.3.5.5.2* [move to 18.5.5.2]
Lateral sway bracing shall be in accordance with either Table 9.3.5.5.2(a) through Table 9.3.5.5.2(l), or 9.3.5.5.3, based on the piping material of the sprinkler system.

Table 9.3.5.5.2(a) Maximum Load ($F_{pw}$) in Zone of Influence (lb), ($F_y = 30$ ksi) Schedule 10 Steel Pipe

<table>
<thead>
<tr>
<th>Pipe (in.)</th>
<th>Lateral Sway Brace Spacing (ft)$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20$^b$</td>
</tr>
<tr>
<td>1</td>
<td>111</td>
</tr>
<tr>
<td>11/4</td>
<td>176</td>
</tr>
<tr>
<td>11/2</td>
<td>241</td>
</tr>
<tr>
<td>2</td>
<td>390</td>
</tr>
<tr>
<td>21/2</td>
<td>641</td>
</tr>
<tr>
<td>3</td>
<td>966</td>
</tr>
<tr>
<td>31/2</td>
<td>1281</td>
</tr>
<tr>
<td>4</td>
<td>1634</td>
</tr>
<tr>
<td>5</td>
<td>2814</td>
</tr>
<tr>
<td>6 and larger$^e$</td>
<td>4039</td>
</tr>
</tbody>
</table>

Note: ASTM A106 Grade B or ASTM A53 Grade B has an $F_y = 35$ ksi. An $F_y = 30$ ksi was used as a conservative value to account for differences in material properties as well as other operational stresses.

$^a$The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

$^b$Assumes branch lines at center of pipe span and near each support.

$^c$Assumes branch lines at third-points of pipe span and near each support.

$^d$Assumes branch lines at quarter-points of pipe span and near each support.

$^e$Larger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(b) Maximum Load ($F_{pw}$) in Zone of Influence (kg), ($F_y = 207$ N/mm$^2$) Schedule 10 Steel Pipe

<table>
<thead>
<tr>
<th>Pipe (mm)</th>
<th>Lateral Sway Brace Spacing (m)$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.1$^b$</td>
</tr>
<tr>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>32</td>
<td>80</td>
</tr>
<tr>
<td>40</td>
<td>109</td>
</tr>
<tr>
<td>50</td>
<td>177</td>
</tr>
<tr>
<td>65</td>
<td>291</td>
</tr>
<tr>
<td>80</td>
<td>438</td>
</tr>
<tr>
<td>90</td>
<td>581</td>
</tr>
<tr>
<td>100</td>
<td>741</td>
</tr>
<tr>
<td>Pipe (mm)</td>
<td>Lateral Sway Brace Spacing (m)^a</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td></td>
<td>6.1^b</td>
</tr>
<tr>
<td>125</td>
<td>1276</td>
</tr>
<tr>
<td>150^e</td>
<td>1832</td>
</tr>
</tbody>
</table>

Note: ASTM A 106 Grade B or ASTM A 53 Grade B has an $F_y = 241$ N/mm$^2$. An $F_y = 207$N/mm$^2$ was used also as a conservative value to account for differences in material properties as well as other operational stresses.

^aThe tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

^bAssumes branch lines at center of pipe span and near each support.

^cAssumes branch lines at third-points of pipe span and near each support.

^dAssumes branch lines at quarter-points of pipe span and near each support.

^eLarger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(c) Maximum Load ($F_{pw}$) in Zone of Influence (lb), ($F_y= 30$ ksi) Schedule 40 Steel Pipe

<table>
<thead>
<tr>
<th>Pipe (in.)</th>
<th>Lateral Sway Brace Spacing (ft)^a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20^b</td>
</tr>
<tr>
<td>1</td>
<td>121</td>
</tr>
<tr>
<td>11/4</td>
<td>214</td>
</tr>
<tr>
<td>11/2</td>
<td>306</td>
</tr>
<tr>
<td>2</td>
<td>520</td>
</tr>
<tr>
<td>21/2</td>
<td>984</td>
</tr>
<tr>
<td>3</td>
<td>1597</td>
</tr>
<tr>
<td>31/2</td>
<td>2219</td>
</tr>
<tr>
<td>4</td>
<td>2981</td>
</tr>
<tr>
<td>5</td>
<td>5061</td>
</tr>
<tr>
<td>6 and larger^e</td>
<td>7893</td>
</tr>
</tbody>
</table>

Note: ASTM A106 Grade B or ASTM A53 Grade B has an $F_y = 35$ ksi. An $F_y = 30$ ksi was used as a conservative value to account for differences in material properties as well as other operational stresses.

^aThe tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

^bAssumes branch lines at center of pipe span and near each support.

^cAssumes branch lines at third-points of pipe span and near each support.

^dAssumes branch lines at quarter-points of pipe span and near each support.

^eLarger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(d) Maximum Load ($F_{pw}$) in Zone of Influence (kg), ($F_y = 207$ N/mm$^2$) Schedule 40 Steel Pipe

<table>
<thead>
<tr>
<th>Pipe (mm)</th>
<th>Lateral Sway Brace Spacing (m)^a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.1^b</td>
</tr>
<tr>
<td>25</td>
<td>55</td>
</tr>
<tr>
<td>Pipe (mm)</td>
<td>Lateral Sway Brace Spacing (m)(^a)</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td></td>
<td>6.1(^b)</td>
</tr>
<tr>
<td>32</td>
<td>97</td>
</tr>
<tr>
<td>40</td>
<td>139</td>
</tr>
<tr>
<td>50</td>
<td>236</td>
</tr>
<tr>
<td>65</td>
<td>446</td>
</tr>
<tr>
<td>80</td>
<td>724</td>
</tr>
<tr>
<td>90</td>
<td>1007</td>
</tr>
<tr>
<td>100</td>
<td>1352</td>
</tr>
<tr>
<td>125</td>
<td>2296</td>
</tr>
<tr>
<td>150(^e)</td>
<td>3580</td>
</tr>
</tbody>
</table>

Note: ASTM A 106 Grade B or ASTM A 53 Grade B has an \(F_y\) = 241 N/mm\(^2\). An \(F_y\) = 207 N/mm\(^2\) was used also as a conservative value to account for differences in material properties as well as other operational stresses.

\(^a\)The tables for the maximum load, \(F_{pw}\), in zone of influence are based on specific configurations of mains and branch lines.

\(^b\)Assumes branch lines at center of pipe span and near each support.

\(^c\)Assumes branch lines at third-points of pipe span and near each support.

\(^d\)Assumes branch lines at quarter-points of pipe span and near each support.

\(^e\)Larger diameter pipe can be used when justified by engineering analysis.

---

<table>
<thead>
<tr>
<th>Pipe (in.)</th>
<th>Lateral Sway Brace Spacing (ft)(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20(^b)</td>
</tr>
<tr>
<td>1</td>
<td>71</td>
</tr>
<tr>
<td>11/4</td>
<td>116</td>
</tr>
<tr>
<td>11/2</td>
<td>154</td>
</tr>
<tr>
<td>2</td>
<td>246</td>
</tr>
<tr>
<td>21/2</td>
<td>459</td>
</tr>
<tr>
<td>3</td>
<td>691</td>
</tr>
<tr>
<td>31/2</td>
<td>910</td>
</tr>
<tr>
<td>4(^e)</td>
<td>1160</td>
</tr>
</tbody>
</table>

Note: ASTM A106 Grade B or ASTM A53 Grade B has an \(F_y\) = 35 ksi. An \(F_y\) = 30 ksi was used as a conservative value to account for differences in material properties as well as other operational stresses.

\(^a\)The tables for the maximum load, \(F_{pw}\), in zone of influence are based on specific configurations of mains and branch lines.

\(^b\)Assumes branch lines at center of pipe span and near each support.

\(^c\)Assumes branch lines at third-points of pipe span and near each support.

\(^d\)Assumes branch lines at quarter-points of pipe span and near each support.

\(^e\)Larger diameter pipe can be used when justified by engineering analysis.
### Table 9.3.5.5.2(f) Maximum Load ($F_{pw}$) in Zone of Influence (kg), ($F_y = 207$ N/mm$^2$) Schedule 5 Steel Pipe

<table>
<thead>
<tr>
<th>Pipe (mm)</th>
<th>Lateral Sway Brace Spacing (m)$^a$</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6.1$^b$</td>
<td>7.6$^b$</td>
<td>9.1$^c$</td>
<td>10.7$^c$</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>32</td>
<td>25</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>53</td>
<td>42</td>
<td>34</td>
<td>29</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>70</td>
<td>56</td>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>112</td>
<td>89</td>
<td>73</td>
<td>63</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>208</td>
<td>166</td>
<td>137</td>
<td>117</td>
</tr>
<tr>
<td>80</td>
<td></td>
<td>313</td>
<td>250</td>
<td>205</td>
<td>176</td>
</tr>
<tr>
<td>90</td>
<td></td>
<td>413</td>
<td>330</td>
<td>271</td>
<td>232</td>
</tr>
<tr>
<td>100$^e$</td>
<td></td>
<td>526</td>
<td>421</td>
<td>345</td>
<td>296</td>
</tr>
</tbody>
</table>

Note: ASTM A 106 Grade B or ASTM A 53 Grade B has an $F_y = 241$ N/mm$^2$. An $F_y = 207$ N/mm$^2$ was used also as a conservative value to account for differences in material properties as well as other operational stresses.

$^a$The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

$^b$Assumes branch lines at center of pipe span and near each support.

$^c$Assumes branch lines at third-points of pipe span and near each support.

$^d$Assumes branch lines at quarter-points of pipe span and near each support.

$^e$Larger diameter pipe can be used when justified by engineering analysis.

### Table 9.3.5.5.2(g) Maximum Load ($F_{pw}$) in Zone of Influence (lb), ($F_y = 8$ ksi) CPVC Pipe

<table>
<thead>
<tr>
<th>Pipe (in.)</th>
<th>Lateral Sway Brace Spacing (ft)$^a$</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20$^b$</td>
<td>25$^b$</td>
<td>30$^c$</td>
<td>35$^c$</td>
</tr>
<tr>
<td>3/4</td>
<td></td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>28</td>
<td>22</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>1 1/4</td>
<td></td>
<td>56</td>
<td>45</td>
<td>37</td>
<td>30</td>
</tr>
<tr>
<td>1 1/2</td>
<td></td>
<td>83</td>
<td>67</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>161</td>
<td>129</td>
<td>105</td>
<td>87</td>
</tr>
<tr>
<td>2 1/2</td>
<td></td>
<td>286</td>
<td>229</td>
<td>188</td>
<td>154</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>516</td>
<td>413</td>
<td>338</td>
<td>278</td>
</tr>
</tbody>
</table>

$^a$The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

$^b$Assumes branch lines at center of pipe span and near each support.

$^c$Assumes branch lines at third-points of pipe span and near each support.

$^d$Assumes branch lines at quarter-points of pipe span and near each support.

### Table 9.3.5.5.2(h) Maximum Load ($F_{pw}$) in Zone of Influence (kg), ($F_y = 55$ N/mm$^2$) CPVC Pipe

<table>
<thead>
<tr>
<th>Pipe (mm)</th>
<th>Lateral Sway Brace Spacing (m)$^a$</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6.1$^b$</td>
<td>7.6$^b$</td>
<td>9.1$^c$</td>
<td>10.7$^c$</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>13</td>
<td>10</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Pipe (mm)</td>
<td>Lateral Sway Brace Spacing (m)&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.1&lt;sup&gt;c&lt;/sup&gt;</td>
<td>10.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12.2&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>32</td>
<td>25</td>
<td>20</td>
<td>17</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>40</td>
<td>38</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>50</td>
<td>73</td>
<td>59</td>
<td>48</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td>65</td>
<td>130</td>
<td>104</td>
<td>85</td>
<td>70</td>
<td>61</td>
</tr>
<tr>
<td>80</td>
<td>234</td>
<td>187</td>
<td>153</td>
<td>126</td>
<td>110</td>
</tr>
</tbody>
</table>

<sup>a</sup>The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

<sup>b</sup>Assumes branch lines at center of pipe span and near each support.

<sup>c</sup>Assumes branch lines at third-points of pipe span and near each support.

<sup>d</sup>Assumes branch lines at quarter-points of pipe span and near each support.

Table 9.3.5.5.2(i) Maximum Load ($F_{pw}$) in Zone of Influence (lb), ($F_y = 30$ ksi) Type M Copper Tube (with Soldered Joints)

<table>
<thead>
<tr>
<th>Pipe (in.)</th>
<th>Lateral Sway Brace Spacing (ft)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3/4</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>1 1/4</td>
<td>53</td>
</tr>
<tr>
<td>1 1/2</td>
<td>86</td>
</tr>
<tr>
<td>2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>180</td>
</tr>
</tbody>
</table>

<sup>a</sup>The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

<sup>b</sup>Assumes branch lines at center of pipe span and near each support.

<sup>c</sup>Assumes branch lines at third-points of pipe span and near each support.

<sup>d</sup>Assumes branch lines at quarter-points of pipe span and near each support.

<sup>e</sup>Larger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(j) Maximum Load ($F_{pw}$) in Zone of Influence (kg), ($F_y = 3207$ N/mm$^2$) Type M Copper Tube (with Soldered Joints)

<table>
<thead>
<tr>
<th>Pipe (mm)</th>
<th>Lateral Sway Brace Spacing (m)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.1&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>20</td>
<td>7.3</td>
</tr>
<tr>
<td>25</td>
<td>13.2</td>
</tr>
<tr>
<td>32</td>
<td>24</td>
</tr>
<tr>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>50&lt;sup&gt;e&lt;/sup&gt;</td>
<td>81.6</td>
</tr>
</tbody>
</table>

<sup>a</sup>The tables for the maximum load, $F_{pw}$, in zone of influence are based on specific configurations of mains and branch lines.

<sup>b</sup>Assumes branch lines at center of pipe span and near each support.

<sup>c</sup>Assumes branch lines at third-points of pipe span and near each support.

<sup>d</sup>Assumes branch lines at quarter-points of pipe span and near each support.
Larger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(k) Maximum Load \( (F_{pw}) \) in Zone of Influence (lbs), \( (F_y = 9 \text{ ksi}) \) Type M Copper Tube (with Brazed Joints)

<table>
<thead>
<tr>
<th>Lateral Sway Spacing (ft)a</th>
<th>Diameter</th>
<th>20a</th>
<th>25b</th>
<th>30c</th>
<th>35c</th>
<th>40d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>11</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>1 1/4</td>
<td>20</td>
<td>16</td>
<td>13</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>1 1/2</td>
<td>33</td>
<td>27</td>
<td>22</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>2e</td>
<td>70</td>
<td>56</td>
<td>46</td>
<td>39</td>
<td>33</td>
</tr>
</tbody>
</table>

aThe tables for the maximum load, \( F_{pw} \), in zone of influence are based on specific configurations of mains and branch lines.
bAssumes branch lines at center of pipe span and near each support.
cAssumes branch lines at third-points of pipe span and near each support.
dAssumes branch lines at quarter-points of pipe span and near each support.
eLarger diameter pipe can be used when justified by engineering analysis.

Table 9.3.5.5.2(l) Maximum Load \( (F_{pw}) \) in Zone of Influence (lbs), \( (F_y = 9 \text{ ksi}) \) Red Brass Pipe (with Brazed Joints)

<table>
<thead>
<tr>
<th>Lateral Sway Spacing (ft)a</th>
<th>Diameter</th>
<th>20a</th>
<th>25b</th>
<th>30c</th>
<th>35c</th>
<th>40d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>34</td>
<td>27</td>
<td>22</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>61</td>
<td>49</td>
<td>40</td>
<td>35</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>1 1/4</td>
<td>116</td>
<td>93</td>
<td>76</td>
<td>65</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>1 1/2</td>
<td>161</td>
<td>129</td>
<td>105</td>
<td>90</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>2e</td>
<td>272</td>
<td>218</td>
<td>178</td>
<td>153</td>
<td>128</td>
</tr>
</tbody>
</table>

aThe tables for the maximum load, \( F_{pw} \), in zone of influence are based on specific configurations of mains and branch lines.
bAssumes branch lines at center of pipe span and near each support.
cAssumes branch lines at third-points of pipe span and near each support.
dAssumes branch lines at quarter-points of pipe span and near each support.
eLarger diameter pipe can be used when justified by engineering analysis.

9.3.5.5.2.1 [move to 18.5.5.2.1]
Specially listed nonstandard pipe shall be permitted using the values in Table 9.3.5.5.2(e) and Table 9.3.5.5.2(f) or with values provided by the manufacturer.

9.3.5.5.2.2 [move to 18.5.5.2.2]
Spacing shall not exceed a maximum interval of 40 ft (12 m) on center.

9.3.5.5.2.3 [move to 18.5.5.2.3]
The maximum permissible load in the zone of influence of a sway brace shall not exceed the values given in Table 9.3.5.5.2(a) through Table 9.3.5.5.2(l) or the values calculated in accordance with 9.3.5.5.3.

9.3.5.5.2.4 [move to 18.5.5.2.4]
When determining permissible loads in accordance with 9.3.5.5.2 or 9.3.5.5.2.1 on a main with varying sizes, the allowable load shall be based on the smallest pipe size within the zone of influence.

9.3.5.5.3 [move to 18.5.5.3]
The maximum load \(F_{pw}\) in the zone of influence for specially listed pipe shall be calculated. (See Annex E.)

9.3.5.5.4 [move to 18.5.5.4]
The requirements of 9.3.5.5.1 shall not apply to 21⁄2 in. (65 mm) starter pieces that do not exceed 12 ft (3.7 m) in length.

9.3.5.5.5 [move to 18.5.5.5]
The distance between the last brace and the end of the pipe shall not exceed 6 ft (1.8 m).

9.3.5.5.6 [move to 18.5.5.6]
Where there is a change in direction of the piping, the cumulative distance between consecutive lateral sway braces shall not exceed the maximum permitted distance in accordance with 9.3.5.5.2.2.

9.3.5.5.7 [move to 18.5.5.7]
The last length of pipe at the end of a feed or cross main shall be provided with a lateral brace.

9.3.5.5.8 [move to 18.5.5.8]
Lateral braces shall be allowed to act as longitudinal braces if they are within 24 in. (600 mm) of the centerline of the piping braced longitudinally and the lateral brace is on a pipe of equal or greater size than the pipe being braced longitudinally.

9.3.5.5.9 [move to 18.5.5.9]
Where flexible couplings are installed on mains other than as required in 9.3.2, a lateral brace shall be provided within 24 in. (600 mm) of every other coupling, including flexible couplings at grooved fittings, but not more than 40 ft (12 m) on center.

9.3.5.5.10* [move to 18.5.5.10]
The lateral sway bracing required by 9.3.5.5 shall be permitted to be omitted when 9.3.5.5.10.1 for branch lines or 9.3.5.5.10.2 for mains is met.

9.3.5.5.10.1 [move to 18.5.5.10.1]
Branch lines shall comply with the following:
(1) *The branch lines shall be individually supported within 6 in. (150 mm) of the structure, measured between the top of the pipe and the point of attachment to the building structure.
(2) At least 75 percent of all the hangers on the branch line shall meet the requirements of 9.3.5.5.10.1(1).
(3) Consecutive hangers on the branch line shall not be permitted to exceed the limitation in 9.3.5.5.10.1(1).

9.3.5.5.10.2 [move to 18.5.5.10.2]
Mains shall comply with all the following:
(1) *The main piping shall be individually supported within 6 in. (150 mm) of the structure, measured between the top of the pipe and the point of attachment to the building structure.
(2) At least 75 percent of all the hangers on the main shall meet the requirements of 9.3.5.5.10.2(1).
(3) Consecutive hangers on the main shall not be permitted to exceed the limitation in 9.3.5.5.10.2(1).
(4) The seismic coefficient ($C_p$) shall not exceed 0.5.
(5) The nominal pipe diameter shall not exceed 6 in. (152 mm) for feed mains and 4 in. (102 mm) for cross mains.
(6) Hangers shall not be omitted in accordance with 9.2.4.3, 9.2.4.4, or 9.2.4.5.

9.3.5.5.10.3 [move to 18.5.5.10.3]
Branch lines permitted to omit lateral sway bracing by 9.3.5.5.10 shall not be omitted from load calculations for the mains serving them in 9.3.5.9.6.

9.3.5.5.11 [move to 18.5.5.11]
The requirements of 9.3.5.5 shall not apply where U-type hooks of the wraparound type or those U-type hooks arranged to keep the pipe tight to the underside of the structural element shall be permitted to be used to satisfy the requirements for lateral sway bracing, provided the legs are bent out at least 30 degrees from the vertical and the maximum length of each leg and the rod size satisfies the conditions of Table 9.3.5.11.8(a), Table 9.3.5.11.8(b), and Table 9.3.5.11.8(c).

9.3.5.6 Longitudinal Sway Bracing. [move to 18.5.6]

9.3.5.6.1 [move to 18.5.6.1]
Longitudinal sway bracing spaced at a maximum of 80 ft (24 m) on center shall be provided for feed and cross mains.

9.3.5.6.2 [move to 18.5.6.2]
Longitudinal braces shall be allowed to act as lateral braces if they are within 24 in. (600 mm) of the centerline of the piping braced laterally.

9.3.5.6.3 [move to 18.5.6.3]
The distance between the last brace and the end of the pipe or a change in direction shall not exceed 40 ft (12 m).

9.3.5.7 Pipe with Change(s) in Direction. [move to 18.5.7]

9.3.5.7.1 [move to 18.5.7.1]
Each run of pipe between changes in direction shall be provided with both lateral and longitudinal bracing, unless the requirements of 9.3.5.7.2 are met.

9.3.5.7.2* [move to 18.5.7.2]
Pipe runs less than 12 ft (3.7 m) in length shall be permitted to be supported by the braces on adjacent runs of pipe.

9.3.5.8 Sway Bracing of Risers. [move to 18.5.8]

9.3.5.8.1* [move to 18.5.8.1]
Tops of risers exceeding 3 ft (900 mm) in length shall be provided with a four-way brace.

9.3.5.8.2 [move to 18.5.8.2]
Riser nipples shall be permitted to omit the four-way brace required by 9.3.5.8.1.

9.3.5.8.3 [move to 18.5.8.3]
When a four-way brace at the top of a riser is attached on the horizontal piping, it shall be within 24 in. (600 mm) of the centerline of the riser and the loads for that brace shall include both the vertical and horizontal pipe.

9.3.5.8.4 [move to 18.5.8.4]
Distance between four-way braces for risers shall not exceed 25 ft (7.6 m).

9.3.5.8.5 [move to 18.5.8.5]
Four-way bracing shall not be required where risers penetrate intermediate floors in multistory buildings where the clearance does not exceed the limits of 9.3.4.

9.3.5.9* Horizontal Seismic Loads. [move to 18.5.9]

9.3.5.9.1* [move to 18.5.9.1]
The horizontal seismic load for the braces shall be as determined in 9.3.5.9.6 or 9.3.5.9.7, or as required by the authority having jurisdiction.

9.3.5.9.2 [move to 18.5.9.2]
The weight of the system being braced ($W_p$) shall be taken as 1.15 times the weight of the water-filled piping. (See A.9.3.5.9.1.)

9.3.5.9.3 [move to 18.5.9.3]
The horizontal force, $F_{pw}$, acting on the brace shall be taken as $F_{pw} = C_p W_p$, where $C_p$ is the seismic coefficient selected in Table 9.3.5.9.3 utilizing the short period response parameter, $S_s$.

<table>
<thead>
<tr>
<th>$S_s$</th>
<th>$C_p$</th>
<th>$S_s$</th>
<th>$C_p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.33 or less</td>
<td>0.35</td>
<td>2.2</td>
<td>1.03</td>
</tr>
<tr>
<td>0.4</td>
<td>0.38</td>
<td>2.3</td>
<td>1.07</td>
</tr>
<tr>
<td>0.5</td>
<td>0.4</td>
<td>2.4</td>
<td>1.12</td>
</tr>
<tr>
<td>$S_S$</td>
<td>$C_p$</td>
<td>$S_S$</td>
<td>$C_p$</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>0.6</td>
<td>0.42</td>
<td>2.5</td>
<td>1.17</td>
</tr>
<tr>
<td>0.7</td>
<td>0.42</td>
<td>2.6</td>
<td>1.21</td>
</tr>
<tr>
<td>0.8</td>
<td>0.44</td>
<td>2.7</td>
<td>1.26</td>
</tr>
<tr>
<td>0.9</td>
<td>0.48</td>
<td>2.8</td>
<td>1.31</td>
</tr>
<tr>
<td>1</td>
<td>0.51</td>
<td>2.9</td>
<td>1.35</td>
</tr>
<tr>
<td>1.1</td>
<td>0.54</td>
<td>3</td>
<td>1.4</td>
</tr>
<tr>
<td>1.2</td>
<td>0.57</td>
<td>3.1</td>
<td>1.45</td>
</tr>
<tr>
<td>1.3</td>
<td>0.61</td>
<td>3.2</td>
<td>1.49</td>
</tr>
<tr>
<td>1.4</td>
<td>0.65</td>
<td>3.3</td>
<td>1.54</td>
</tr>
<tr>
<td>1.5</td>
<td>0.7</td>
<td>3.4</td>
<td>1.59</td>
</tr>
<tr>
<td>1.6</td>
<td>0.75</td>
<td>3.5</td>
<td>1.63</td>
</tr>
<tr>
<td>1.7</td>
<td>0.79</td>
<td>3.6</td>
<td>1.68</td>
</tr>
<tr>
<td>1.8</td>
<td>0.84</td>
<td>3.7</td>
<td>1.73</td>
</tr>
<tr>
<td>1.9</td>
<td>0.89</td>
<td>3.8</td>
<td>1.77</td>
</tr>
<tr>
<td>2</td>
<td>0.93</td>
<td>3.9</td>
<td>1.82</td>
</tr>
<tr>
<td>2.1</td>
<td>0.98</td>
<td>4</td>
<td>1.87</td>
</tr>
</tbody>
</table>

9.3.5.9.3.1 [move to 18.5.9.3.1]
The value of $S_s$ used in Table 9.3.5.9.3 shall be obtained from the authority having jurisdiction or from seismic hazard maps.

9.3.5.9.3.2* [move to 18.5.9.3.2]
Linear interpolation shall be permitted to be used for intermediate values of $S_s$.

9.3.5.9.4* [move to 18.5.9.4]
The horizontal force, $F_{pw}$, acting on the brace shall be permitted to be determined in accordance with Section 13.3.1 of SEI/ASCE 7, *Minimum Design Loads of Buildings and Other Structures*, multiplied by 0.7 to convert to allowable stress design (ASD).

9.3.5.9.5* [move to 18.5.9.5]
Where data for determining $C_p$ are not available, the horizontal seismic force acting on the braces shall be determined as specified in 9.3.5.9.3 with $C_p = 0.5$.

9.3.5.9.6* [move to 18.5.9.6]
The zone of influence for lateral braces shall include all branch lines and mains tributary to the brace, except branch lines that are provided with longitudinal bracing or as prohibited by 9.3.5.9.6.1.

9.3.5.9.6.1* [move to 18.5.9.6.1]
When riser nipples are provided in systems requiring seismic protection, they shall satisfy the following equation, unless one of the following conditions is met:
(1) Where riser nipples are 4 ft (1.2 m) or less in length and $C_p$ is 0.50 or less
(2) Where riser nipples are 3 ft (900 mm) or less in length and $C_p$ is less than 0.67
(3) Where riser nipples are 2 ft (600 mm) in length or less and \( C_p \) is less than is 1.0

\[
\frac{(H_r \cdot W_p \cdot C_p)}{S} \geq F_y
\]  

[9.3.5.9.6.1]

where:

- \( H_r \) = length of riser nipple piping (in inches)
- \( W_p \) = tributary weight (in pounds) for the branch line or portion of branch line within the zone of influence including the riser nipple
- \( C_p \) = seismic coefficient
- \( S \) = sectional modulus of the riser nipple pipe
- \( F_y \) = allowable yield strength of 30,000 psi (2070 bar) for steel, 30,000 psi for copper (soldered), 8000 psi (550 bar) for CPVC

9.3.5.9.6.2 [move to 18.5.9.6.2]
If the calculated value is equal to or greater than the yield strength of the riser nipple, the longitudinal seismic load of each line shall be evaluated individually, and branch lines shall be provided with longitudinal sway bracing per 9.3.5.6.

9.3.5.9.7 [move to 18.5.9.7]
The zone of influence for longitudinal braces shall include all mains tributary to the brace.

9.3.5.10 Net Vertical Reaction Forces. [move to 18.5.10]
Where the horizontal seismic loads used exceed 0.5 \( W_p \) and the brace angle is less than 45 degrees from vertical or where the horizontal seismic load exceeds 1.0 \( W_p \) and the brace angle is less than 60 degrees from vertical, the braces shall be arranged to resist the net vertical reaction produced by the horizontal load.

9.3.5.11* Sway Brace Installation. [move to 18.5.11]

9.3.5.11.1* [move to 18.5.11.1]
Bracing shall be attached directly to the system pipe.

9.3.5.11.2 [move to 18.5.11.2]
Sway bracing shall be tight.

9.3.5.11.3 [move to 18.5.11.3]
For individual braces, the slenderness ratio \((l/r)\) shall not exceed 300, where \( l \) is the length of the brace and \( r \) is the least radius of gyration.

9.3.5.11.4 [move to 18.5.11.4]
Where threaded pipe is used as part of a sway brace assembly, it shall not be less than Schedule 30.

9.3.5.11.5 [move to 18.5.11.5]
All parts and fittings of a brace shall lie in a straight line to avoid eccentric loadings on fittings and fasteners.

**9.3.5.11.6 [move to 18.5.11.6]**
For longitudinal braces only, the brace shall be permitted to be connected to a tab welded to the pipe in conformance to 6.5.2.

**9.3.5.11.7 [move to 18.5.11.7]**
For tension-only braces, two tension-only brace components opposing each other must be installed at each lateral or longitudinal brace location.

**9.3.5.11.8 [move to 18.5.11.8]**
The loads determined in 9.3.5.9 shall not exceed the lesser of the maximum allowable loads provided in Table 9.3.5.11.8(a), Table 9.3.5.11.8(b), and Table 9.3.5.11.8(c) and the manufacturer’s certified maximum allowable horizontal loads for brace angles of 30 to 44 degrees, 45 to 59 degrees, 60 to 89 degrees, or 90 degrees.

Table 9.3.5.11.8(a) Maximum Horizontal Loads for Sway Braces with $l/r = 100$ for Steel Braces with $F_y = 36$ ksi

<table>
<thead>
<tr>
<th>Brace Shape and Size (in.)</th>
<th>Area (in.$^2$)</th>
<th>Least Radius of Gyration ($r$) (in.)</th>
<th>Maximum Length for $l/r = 100$</th>
<th>Maximum Horizontal Load (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30° to 44° Angle from Vertical</td>
<td>45° to 59° Angle from Vertical</td>
<td>60° to 90° Angle from Vertical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe Schedule 40</td>
<td>1</td>
<td>0.494</td>
<td>0.421</td>
<td>3</td>
</tr>
<tr>
<td>11⁄4</td>
<td>0.669</td>
<td>0.540</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>11⁄2</td>
<td>0.799</td>
<td>0.623</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1.07</td>
<td>0.787</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Angles</td>
<td>11⁄2 × 11⁄2 × 1⁄4</td>
<td>0.688</td>
<td>0.292</td>
<td>2</td>
</tr>
<tr>
<td>2 × 2 × 1⁄4</td>
<td>0.938</td>
<td>0.391</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>21⁄2 × 2 × 1⁄4</td>
<td>1.06</td>
<td>0.424</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>21⁄2 × 21⁄2 × 1⁄4</td>
<td>1.19</td>
<td>0.491</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3 × 21⁄2 × 1⁄4</td>
<td>1.31</td>
<td>0.528</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3 × 3 × 1⁄4</td>
<td>1.44</td>
<td>0.592</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Brace Shape and Size (in.)</td>
<td>Area (in.²)</td>
<td>Least Radius of Gyration (r) (in.)</td>
<td>Maximum Length for ( l/r = 100 ) ft</td>
<td>Maximum Horizontal Load (lb)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------</td>
<td>-------------------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ft</td>
<td>in.</td>
</tr>
<tr>
<td>Rods (all thread)</td>
<td>3/8</td>
<td>0.07</td>
<td>0.075</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>0.129</td>
<td>0.101</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5/8</td>
<td>0.207</td>
<td>0.128</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>0.309</td>
<td>0.157</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7/8</td>
<td>0.429</td>
<td>0.185</td>
<td>1</td>
</tr>
<tr>
<td>Rods (threaded at ends only)</td>
<td>3/8</td>
<td>0.11</td>
<td>0.094</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>0.196</td>
<td>0.125</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5/8</td>
<td>0.307</td>
<td>0.156</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>0.442</td>
<td>0.188</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7/8</td>
<td>0.601</td>
<td>0.219</td>
<td>1</td>
</tr>
<tr>
<td>Flats</td>
<td>11/2 × 1/4</td>
<td>0.375</td>
<td>0.0722</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2 × 1/4</td>
<td>0.5</td>
<td>0.0722</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2 × 3/8</td>
<td>0.75</td>
<td>0.1082</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 9.3.5.11.8(b) Maximum Horizontal Loads for Sway Braces with \( l/r = 200 \) for Steel Braces with \( F_y = 36 \text{ ksi} \)
<table>
<thead>
<tr>
<th>Brace Shape and Size (in.)</th>
<th>Area (in.²)</th>
<th>Least Radius of Gyration (r) (in.)</th>
<th>Maximum Length for (l/r = 200)</th>
<th>Maximum Horizontal Load (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ft</td>
<td>in.</td>
</tr>
<tr>
<td>2 1/2 × 2 x 1/4</td>
<td>1.06</td>
<td>0.424</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>2 1/2 × 1/4</td>
<td>1.19</td>
<td>0.491</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>3 × 2 1/2 × 1/4</td>
<td>1.31</td>
<td>0.528</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>3 × 3 × 1/4</td>
<td>1.44</td>
<td>0.592</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Rods (all thread)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>0.07</td>
<td>0.075</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1/2</td>
<td>0.129</td>
<td>0.101</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>5/8</td>
<td>0.207</td>
<td>0.128</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3/4</td>
<td>0.309</td>
<td>0.157</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>7/8</td>
<td>0.429</td>
<td>0.185</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Rods (threaded at ends only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>0.11</td>
<td>0.094</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>1/2</td>
<td>0.196</td>
<td>0.125</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5/8</td>
<td>0.307</td>
<td>0.156</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>3/4</td>
<td>0.442</td>
<td>0.188</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>7/8</td>
<td>0.601</td>
<td>0.219</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Flats</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 × 1/4</td>
<td>0.375</td>
<td>0.0722</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2 × 1/4</td>
<td>0.5</td>
<td>0.0722</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2 × 3/8</td>
<td>0.75</td>
<td>0.1082</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 9.3.5.11.8(c) Maximum Horizontal Loads for Sway Braces with \(l/r = 300\) for Steel Braces with \(F_y = 36 \text{ ksi}\)
<table>
<thead>
<tr>
<th>Brace Shape and Size (in.)</th>
<th>Area (in.²)</th>
<th>Least Radius of Gyration (r) (in.)</th>
<th>Maximum Length for ( l/r = 300 )</th>
<th>Maximum Horizontal Load (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ft</td>
<td>in.</td>
</tr>
<tr>
<td>Pipe Schedule</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/4</td>
<td>0.669</td>
<td>0.540</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>11/2</td>
<td>0.799</td>
<td>0.623</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>1.07</td>
<td>0.787</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Angles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/2 × 1/4</td>
<td>0.688</td>
<td>0.292</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>11/2 × 1/4</td>
<td>0.938</td>
<td>0.391</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>2 × 2 × 1/4</td>
<td>1.06</td>
<td>0.424</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>21/2 × 1/4</td>
<td>1.19</td>
<td>0.491</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>3 × 1/4</td>
<td>1.31</td>
<td>0.528</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>3 × 3 × 1/4</td>
<td>1.44</td>
<td>0.592</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Rods (all thread)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>0.07</td>
<td>0.075</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>1/2</td>
<td>0.129</td>
<td>0.101</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5/8</td>
<td>0.207</td>
<td>0.128</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3/4</td>
<td>0.309</td>
<td>0.157</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>7/8</td>
<td>0.429</td>
<td>0.185</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Rods (threaded at ends only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>0.11</td>
<td>0.094</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1/2</td>
<td>0.196</td>
<td>0.125</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5/8</td>
<td>0.307</td>
<td>0.156</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>3/4</td>
<td>0.442</td>
<td>0.188</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>7/8</td>
<td>0.601</td>
<td>0.219</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Flats</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/2 × 1/4</td>
<td>0.375</td>
<td>0.0722</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2 × 1/4</td>
<td>0.5</td>
<td>0.0722</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>2 × 3/8</td>
<td>0.75</td>
<td>0.1082</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 9.3.5.11.8(d) Maximum Horizontal Loads for Sway Braces with \( l/r = 100 \) for Steel Braces with \( F_y = 248 \text{ N/mm}^2 \)
<table>
<thead>
<tr>
<th>Brace Shape and Size (mm)</th>
<th>Area (mm²)</th>
<th>Least Radius of Gyration ( (r) ) (mm)</th>
<th>Maximum Length for ( l/r = 100 ) (meters)</th>
<th>Maximum Horizontal Load (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipe Schedule 40</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>318.7</td>
<td>11</td>
<td>1.0</td>
<td>1,429</td>
</tr>
<tr>
<td>32</td>
<td>431.6</td>
<td>14</td>
<td>1.2</td>
<td>1,935</td>
</tr>
<tr>
<td>40</td>
<td>515.5</td>
<td>16</td>
<td>1.5</td>
<td>2,311</td>
</tr>
<tr>
<td>50</td>
<td>690.3</td>
<td>20</td>
<td>1.8</td>
<td>3,095</td>
</tr>
<tr>
<td>30° to 44° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45° to 59° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60° to 90° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Angles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 × 6</td>
<td>443.9</td>
<td>7</td>
<td>0.6</td>
<td>1,990</td>
</tr>
<tr>
<td>60 × 6</td>
<td>605.2</td>
<td>10</td>
<td>1.0</td>
<td>2,713</td>
</tr>
<tr>
<td>65 × 6</td>
<td>683.9</td>
<td>11</td>
<td>1.0</td>
<td>3,066</td>
</tr>
<tr>
<td>80 × 6</td>
<td>767.7</td>
<td>12</td>
<td>1.2</td>
<td>3,442</td>
</tr>
<tr>
<td>45° to 59° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60° to 90° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rods (all thread)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>45.2</td>
<td>2</td>
<td>0.0</td>
<td>202</td>
</tr>
<tr>
<td>15</td>
<td>83.2</td>
<td>3</td>
<td>0.0</td>
<td>373</td>
</tr>
<tr>
<td>16</td>
<td>133.5</td>
<td>3</td>
<td>0.3</td>
<td>599</td>
</tr>
<tr>
<td>20</td>
<td>199.4</td>
<td>4</td>
<td>0.3</td>
<td>894</td>
</tr>
<tr>
<td>22</td>
<td>276.8</td>
<td>5</td>
<td>0.3</td>
<td>1,241</td>
</tr>
<tr>
<td>50° to 59° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60° to 90° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rods (threaded at ends only)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>71.0</td>
<td>2</td>
<td>0.0</td>
<td>318</td>
</tr>
<tr>
<td>15</td>
<td>126.5</td>
<td>3</td>
<td>0.3</td>
<td>567</td>
</tr>
<tr>
<td>16</td>
<td>198.1</td>
<td>4</td>
<td>0.3</td>
<td>888</td>
</tr>
<tr>
<td>20</td>
<td>285.2</td>
<td>5</td>
<td>0.3</td>
<td>1,279</td>
</tr>
<tr>
<td>22</td>
<td>387.7</td>
<td>5</td>
<td>0.3</td>
<td>1,739</td>
</tr>
<tr>
<td>50° to 59° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60° to 90° Angle from Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flats</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 × 6</td>
<td>241.9</td>
<td>2</td>
<td>0.0</td>
<td>1,085</td>
</tr>
<tr>
<td>50 × 6</td>
<td>322.6</td>
<td>2</td>
<td>0.0</td>
<td>1,447</td>
</tr>
<tr>
<td>Brace Shape and Size (mm)</td>
<td>Area (mm²)</td>
<td>Least Radius of Gyration (r) (mm)</td>
<td>Maximum Length for $l/r = 100$ (meters)</td>
<td>Maximum Horizontal Load (kg)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------</td>
<td>-----------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Pipe Schedule 40</td>
<td>25</td>
<td>318.7</td>
<td>2.1</td>
<td>420</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>431.6</td>
<td>2.7</td>
<td>569</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>515.5</td>
<td>3</td>
<td>679</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>690.3</td>
<td>4.0</td>
<td>910</td>
</tr>
<tr>
<td>Angles</td>
<td>40 × 6</td>
<td>443.9</td>
<td>1.2</td>
<td>585</td>
</tr>
<tr>
<td></td>
<td>50 × 6</td>
<td>605.2</td>
<td>1.8</td>
<td>798</td>
</tr>
<tr>
<td></td>
<td>65 × 6</td>
<td>683.9</td>
<td>2.1</td>
<td>902</td>
</tr>
<tr>
<td></td>
<td>65 × 6</td>
<td>767.7</td>
<td>2.4</td>
<td>1012</td>
</tr>
<tr>
<td></td>
<td>65 × 8</td>
<td>845.2</td>
<td>2.4</td>
<td>1114</td>
</tr>
<tr>
<td></td>
<td>80 × 6</td>
<td>929.0</td>
<td>2.7</td>
<td>1225</td>
</tr>
<tr>
<td>Rods (all thread)</td>
<td>10</td>
<td>45.2</td>
<td>0.3</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>83.2</td>
<td>0.3</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>133.5</td>
<td>0.6</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>199.4</td>
<td>0.6</td>
<td>175</td>
</tr>
</tbody>
</table>

Table 9.3.5.11.8(e) Maximum Horizontal Loads for Sway Braces with $l/r = 200$ for Steel Braces with $F_y = 248 \text{ N/mm}^2$
<table>
<thead>
<tr>
<th>Brace Shape and Size (mm)</th>
<th>Area (mm²)</th>
<th>Least Radius of Gyration (r) (mm)</th>
<th>Maximum Length for l/r = 200 (meters)</th>
<th>Maximum Horizontal Load (kg)</th>
<th>Brace Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>365</td>
<td>516</td>
</tr>
<tr>
<td>Rods (threaded at ends only)</td>
<td>10</td>
<td>2</td>
<td>0.3</td>
<td>150</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>3</td>
<td>0.6</td>
<td>0</td>
<td>167</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>4</td>
<td>0.6</td>
<td>175</td>
<td>261</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>5</td>
<td>0.9</td>
<td>25</td>
<td>376</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>5</td>
<td>0.9</td>
<td>175</td>
<td>511</td>
</tr>
<tr>
<td>Flats</td>
<td>40 × 6</td>
<td>2</td>
<td>0.3</td>
<td>50</td>
<td>319</td>
</tr>
<tr>
<td></td>
<td>50 × 6</td>
<td>2</td>
<td>0.3</td>
<td>50</td>
<td>425</td>
</tr>
<tr>
<td></td>
<td>50 × 10</td>
<td>3</td>
<td>0.3</td>
<td>225</td>
<td>638</td>
</tr>
</tbody>
</table>

Table 9.3.5.11.8(f) Maximum Horizontal Loads for Sway Braces with l/r = 300 for Steel Braces with $F_y = 248$ N/mm²

<table>
<thead>
<tr>
<th>Brace Shape and Size (mm)</th>
<th>Area (mm²)</th>
<th>Least Radius of Gyration (r) (mm)</th>
<th>Maximum Length for l/r = 300 (meters)</th>
<th>Maximum Horizontal Load (kg)</th>
<th>Brace Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Schedule 40</td>
<td>25</td>
<td>10.5</td>
<td>3</td>
<td>150</td>
<td>187</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>13.5</td>
<td>4</td>
<td>150</td>
<td>253</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>15.6</td>
<td>4.6</td>
<td>150</td>
<td>302</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>19.7</td>
<td>5.8</td>
<td>200</td>
<td>405</td>
</tr>
<tr>
<td>Angles</td>
<td>40 × 6</td>
<td>7.3</td>
<td>2.1</td>
<td>75</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>50 × 6</td>
<td>9.8</td>
<td>2.7</td>
<td>225</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>65 × 6</td>
<td>9.8</td>
<td>2.7</td>
<td>225</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>50 × 10</td>
<td>10.6</td>
<td>3</td>
<td>175</td>
<td>401</td>
</tr>
<tr>
<td>Brace Shape and Size (mm)</td>
<td>Area (mm²)</td>
<td>Least Radius of Gyration (r) (mm)</td>
<td>Maximum Length for $l/r = 300$ (meters)</td>
<td>Maximum Horizontal Load (kg)</td>
<td>Brace Angle</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>----------------------------------</td>
<td>------------------------------------------</td>
<td>----------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>65 × 6</td>
<td>767.7</td>
<td>12.3</td>
<td>3.7</td>
<td>75</td>
<td>450</td>
</tr>
<tr>
<td>80 × 6</td>
<td>845.2</td>
<td>13.2</td>
<td>4</td>
<td>50</td>
<td>495</td>
</tr>
<tr>
<td>80 × 6</td>
<td>929.0</td>
<td>14.8</td>
<td>4.3</td>
<td>225</td>
<td>544</td>
</tr>
<tr>
<td>80 × 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rods (all thread)</td>
<td>10</td>
<td>45.2</td>
<td>1.9</td>
<td>0.3</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>83.2</td>
<td>2.5</td>
<td>0.6</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>133.5</td>
<td>3.2</td>
<td>0.9</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>199.4</td>
<td>3.9</td>
<td>0.9</td>
<td>275</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>276.8</td>
<td>4.6</td>
<td>1.2</td>
<td>175</td>
</tr>
<tr>
<td>Rods (threaded at ends only)</td>
<td>10</td>
<td>71.0</td>
<td>2.4</td>
<td>0.6</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>126.5</td>
<td>3.1</td>
<td>0.9</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>198.1</td>
<td>3.9</td>
<td>0.9</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>285.2</td>
<td>4.7</td>
<td>1.2</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>387.7</td>
<td>5.5</td>
<td>1.5</td>
<td>125</td>
</tr>
<tr>
<td>Flats</td>
<td>40 × 6</td>
<td>241.9</td>
<td>1.8</td>
<td>0.3</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>50 × 6</td>
<td>322.6</td>
<td>1.8</td>
<td>0.3</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>50 × 10</td>
<td>483.9</td>
<td>2.7</td>
<td>0.6</td>
<td>200</td>
</tr>
</tbody>
</table>

9.3.5.11.9* [move to 18.5.11.9]

Other pipe schedules and materials not specifically included in Table 9.3.5.11.8(a), Table 9.3.5.11.8(b), and Table 9.3.5.11.8(c) shall be permitted to be used if certified by a registered professional engineer to support the loads determined in accordance with the criteria in the tables.

9.3.5.11.9.1 [move to 18.5.11.9.1]

Calculations shall be submitted where required by the authority having jurisdiction.

9.3.5.11.10 [move to 18.5.11.10]
C-type clamps including beam and large flange clamps, with or without restraining straps, shall not be used to attach braces to the building structure.

9.3.5.11.11  [move to 18.5.11.11]
Powder-driven fasteners shall not be used to attach braces to the building structure, unless they are specifically listed for service in resisting lateral loads in areas subject to earthquakes.

9.3.5.12*  Fasteners.  [move to 18.5.12]

9.3.5.12.1  [move to 18.5.12.1]
The designated angle category for the fastener(s) used in the sway brace installation shall be determined in accordance with Figure 9.3.5.12.1.

Figure 9.3.5.12.1 Designation of Angle Category Based on Angle of Sway Brace and Fastener Orientation.
9.3.5.12.2*  [move to 18.5.12.2]
For individual fasteners, unless alternative allowable loads are determined and certified by a registered professional engineer, the loads determined in 9.3.5.9 shall not exceed the allowable loads provided in Table 9.3.5.12.2(a) through Table 9.3.5.12.2(i).

Table 9.3.5.12.2(a) Maximum Load for Wedge Anchors in 3000 psi (207 bar) Lightweight Cracked Concrete on Metal Deck

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>≤2.0</td>
<td>≤1.1</td>
<td>≤0.7</td>
<td>≤1.2</td>
<td>≤1.1</td>
<td>≤1.1</td>
<td>≤1.4</td>
<td>≤0.9</td>
<td>≤0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter (in.)</td>
<td>Embedment (in.)</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>117</td>
<td>184</td>
<td>246</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1/2</td>
<td>23/8</td>
<td>164</td>
<td>257</td>
<td>344</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5/8</td>
<td>31/8</td>
<td>214</td>
<td>326</td>
<td>424</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>2.1–3.5</td>
<td>1.2–1.8</td>
<td>0.8–1.0</td>
<td>1.3–1.7</td>
<td>1.2–1.8</td>
<td>1.2–2.0</td>
<td>1.5–1.9</td>
<td>1.0–1.3</td>
<td>0.9–1.1</td>
</tr>
<tr>
<td>1/2</td>
<td>23/8</td>
<td>3.6–5.0</td>
<td>1.9–2.5</td>
<td>1.1–1.3</td>
<td>1.8–2.2</td>
<td>1.9–2.5</td>
<td>2.1–2.9</td>
<td>2.0–2.4</td>
<td>1.4–1.7</td>
<td>1.2–1.4</td>
</tr>
<tr>
<td>5/8</td>
<td>31/8</td>
<td>5.1–6.5</td>
<td>2.6–3.2</td>
<td>1.4–1.6</td>
<td>2.3–2.7</td>
<td>2.6–3.2</td>
<td>3.0–3.8</td>
<td>2.5–2.9</td>
<td>1.8–2.1</td>
<td>1.5–1.7</td>
</tr>
</tbody>
</table>

*Pr = Prying Factor Range. (Refer to Annex for additional information.)

1 lb = 0.45 kg

Table 9.3.5.12.2(b) Maximum Load for Wedge Anchors in 3000 psi (207 bar) Lightweight Cracked Concrete
### Table 9.3.5.12.2 Maximum Load for Wedge Anchors in 3000 psi (207 bar) Normal Weight Cracked Concrete (lbs.)

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>52</td>
<td>88</td>
<td>132</td>
<td>76</td>
<td>88</td>
<td>90</td>
<td>68</td>
<td>97</td>
<td>118</td>
</tr>
<tr>
<td>1/2</td>
<td>23/8</td>
<td>71</td>
<td>121</td>
<td>180</td>
<td>104</td>
<td>121</td>
<td>124</td>
<td>93</td>
<td>132</td>
<td>161</td>
</tr>
<tr>
<td>5/8</td>
<td>31/4</td>
<td>114</td>
<td>192</td>
<td>284</td>
<td>165</td>
<td>192</td>
<td>198</td>
<td>185</td>
<td>208</td>
<td>254</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>162</td>
<td>280</td>
<td>427</td>
<td>249</td>
<td>280</td>
<td>281</td>
<td>223</td>
<td>315</td>
<td>385</td>
</tr>
</tbody>
</table>

*Pr = Prying Factor Range. (Refer to Annex for additional information.)

1 lb = 0.45 kg

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>41</td>
<td>74</td>
<td>117</td>
<td>68</td>
<td>74</td>
<td>70</td>
<td>61</td>
<td>86</td>
<td>106</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>56</td>
<td>101</td>
<td>160</td>
<td>93</td>
<td>101</td>
<td>97</td>
<td>84</td>
<td>118</td>
<td>145</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>91</td>
<td>161</td>
<td>253</td>
<td>148</td>
<td>161</td>
<td>157</td>
<td>172</td>
<td>186</td>
<td>230</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>124</td>
<td>233</td>
<td>378</td>
<td>221</td>
<td>233</td>
<td>214</td>
<td>200</td>
<td>279</td>
<td>344</td>
</tr>
</tbody>
</table>

### Table 9.3.5.12.2(c) Maximum Load for Wedge Anchors in 3000 psi (207 bar) Normal Weight Cracked Concrete

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>171</td>
<td>240</td>
<td>292</td>
<td>169</td>
<td>240</td>
<td>307</td>
<td>145</td>
<td>214</td>
<td>254</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>412</td>
<td>567</td>
<td>682</td>
<td>394</td>
<td>567</td>
<td>735</td>
<td>340</td>
<td>498</td>
<td>592</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>480</td>
<td>668</td>
<td>809</td>
<td>468</td>
<td>668</td>
<td>859</td>
<td>479</td>
<td>591</td>
<td>703</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>545</td>
<td>780</td>
<td>965</td>
<td>559</td>
<td>780</td>
<td>976</td>
<td>482</td>
<td>709</td>
<td>839</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>116</td>
<td>183</td>
<td>252</td>
<td>146</td>
<td>183</td>
<td>203</td>
<td>128</td>
<td>184</td>
<td>223</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>282</td>
<td>438</td>
<td>592</td>
<td>344</td>
<td>438</td>
<td>493</td>
<td>302</td>
<td>434</td>
<td>523</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>327</td>
<td>512</td>
<td>699</td>
<td>406</td>
<td>512</td>
<td>571</td>
<td>438</td>
<td>512</td>
<td>618</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>363</td>
<td>584</td>
<td>819</td>
<td>477</td>
<td>584</td>
<td>634</td>
<td>420</td>
<td>604</td>
<td>727</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
<td>Pr</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
<td>87</td>
<td>148</td>
<td>221</td>
<td>128</td>
<td>148</td>
<td>152</td>
<td>114</td>
<td>162</td>
<td>198</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>214</td>
<td>357</td>
<td>523</td>
<td>305</td>
<td>357</td>
<td>371</td>
<td>271</td>
<td>384</td>
<td>469</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>247</td>
<td>415</td>
<td>615</td>
<td>359</td>
<td>415</td>
<td>428</td>
<td>404</td>
<td>452</td>
<td>551</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>271</td>
<td>467</td>
<td>712</td>
<td>416</td>
<td>467</td>
<td>468</td>
<td>371</td>
<td>526</td>
<td>641</td>
</tr>
</tbody>
</table>
### Wedge Anchors in 3000 psi Normal Weight Cracked Concrete (lbs.)

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A Pr</th>
<th>B Pr</th>
<th>C Pr</th>
<th>D Pr</th>
<th>E Pr</th>
<th>F Pr</th>
<th>G Pr</th>
<th>H Pr</th>
<th>I Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
<td>69</td>
<td>124</td>
<td>197</td>
<td>115</td>
<td>124</td>
<td>118</td>
<td>103</td>
<td>145</td>
<td>178</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>173</td>
<td>301</td>
<td>469</td>
<td>274</td>
<td>301</td>
<td>296</td>
<td>247</td>
<td>345</td>
<td>425</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>197</td>
<td>349</td>
<td>549</td>
<td>321</td>
<td>349</td>
<td>337</td>
<td>374</td>
<td>404</td>
<td>498</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>208</td>
<td>389</td>
<td>629</td>
<td>369</td>
<td>389</td>
<td>357</td>
<td>333</td>
<td>465</td>
<td>573</td>
</tr>
</tbody>
</table>

*Pr = Prying Factor Range. (Refer to Annex for additional information.)*

1 lb = 0.45 kg

### Table 9.3.5.12.2(d) Maximum Load for Wedge Anchors in 4000 psi (276 bar) Normal Weight Cracked Concrete

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A Pr</th>
<th>B Pr</th>
<th>C Pr</th>
<th>D Pr</th>
<th>E Pr</th>
<th>F Pr</th>
<th>G Pr</th>
<th>H Pr</th>
<th>I Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
<td>200</td>
<td>282</td>
<td>344</td>
<td>199</td>
<td>282</td>
<td>359</td>
<td>171</td>
<td>251</td>
<td>299</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>430</td>
<td>607</td>
<td>742</td>
<td>430</td>
<td>607</td>
<td>770</td>
<td>370</td>
<td>544</td>
<td>645</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>532</td>
<td>729</td>
<td>872</td>
<td>505</td>
<td>729</td>
<td>950</td>
<td>511</td>
<td>636</td>
<td>758</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>630</td>
<td>903</td>
<td>1117</td>
<td>647</td>
<td>903</td>
<td>1129</td>
<td>558</td>
<td>821</td>
<td>971</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A Pr</th>
<th>B Pr</th>
<th>C Pr</th>
<th>D Pr</th>
<th>E Pr</th>
<th>F Pr</th>
<th>G Pr</th>
<th>H Pr</th>
<th>I Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
<td>135</td>
<td>214</td>
<td>295</td>
<td>171</td>
<td>214</td>
<td>236</td>
<td>150</td>
<td>216</td>
<td>261</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>289</td>
<td>460</td>
<td>636</td>
<td>370</td>
<td>460</td>
<td>506</td>
<td>325</td>
<td>467</td>
<td>563</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>367</td>
<td>566</td>
<td>760</td>
<td>442</td>
<td>566</td>
<td>642</td>
<td>470</td>
<td>557</td>
<td>672</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>419</td>
<td>676</td>
<td>948</td>
<td>552</td>
<td>676</td>
<td>733</td>
<td>486</td>
<td>699</td>
<td>841</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A Pr</th>
<th>B Pr</th>
<th>C Pr</th>
<th>D Pr</th>
<th>E Pr</th>
<th>F Pr</th>
<th>G Pr</th>
<th>H Pr</th>
<th>I Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
<td>101</td>
<td>172</td>
<td>258</td>
<td>150</td>
<td>172</td>
<td>176</td>
<td>134</td>
<td>190</td>
<td>232</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>218</td>
<td>370</td>
<td>556</td>
<td>325</td>
<td>370</td>
<td>377</td>
<td>290</td>
<td>410</td>
<td>500</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>280</td>
<td>463</td>
<td>674</td>
<td>393</td>
<td>463</td>
<td>484</td>
<td>435</td>
<td>494</td>
<td>603</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>313</td>
<td>540</td>
<td>824</td>
<td>481</td>
<td>540</td>
<td>541</td>
<td>430</td>
<td>608</td>
<td>741</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A Pr</th>
<th>B Pr</th>
<th>C Pr</th>
<th>D Pr</th>
<th>E Pr</th>
<th>F Pr</th>
<th>G Pr</th>
<th>H Pr</th>
<th>I Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
<td>79</td>
<td>144</td>
<td>230</td>
<td>134</td>
<td>144</td>
<td>137</td>
<td>121</td>
<td>169</td>
<td>209</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>170</td>
<td>310</td>
<td>494</td>
<td>289</td>
<td>310</td>
<td>292</td>
<td>261</td>
<td>365</td>
<td>449</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>226</td>
<td>391</td>
<td>605</td>
<td>354</td>
<td>391</td>
<td>389</td>
<td>406</td>
<td>445</td>
<td>547</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>241</td>
<td>449</td>
<td>728</td>
<td>427</td>
<td>449</td>
<td>413</td>
<td>386</td>
<td>538</td>
<td>663</td>
</tr>
</tbody>
</table>
Table 9.3.5.12.2(e) Maximum Load for Wedge Anchors in 6000 psi (414 bar) Normal Weight Cracked Concrete

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pr ≤ 2.0</td>
<td>Pr ≤ 1.1</td>
<td>Pr ≤ 0.7</td>
<td>Pr ≤ 1.2</td>
<td>Pr ≤ 1.1</td>
<td>Pr ≤ 1.4</td>
<td>Pr ≤ 0.9</td>
<td>Pr ≤ 0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>21/4</td>
<td>254</td>
<td>354</td>
<td>428</td>
<td>199</td>
<td>354</td>
<td>585</td>
<td>213</td>
<td>313</td>
<td>372</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>527</td>
<td>744</td>
<td>910</td>
<td>418</td>
<td>744</td>
<td>1227</td>
<td>454</td>
<td>667</td>
<td>791</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>652</td>
<td>893</td>
<td>1069</td>
<td>504</td>
<td>893</td>
<td>1481</td>
<td>626</td>
<td>780</td>
<td>928</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>772</td>
<td>1106</td>
<td>1369</td>
<td>622</td>
<td>1106</td>
<td>1819</td>
<td>684</td>
<td>1005</td>
<td>1190</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.1–3.5</td>
<td>1.2–1.8</td>
<td>0.8–1.0</td>
<td>1.3–1.7</td>
<td>1.2–1.8</td>
<td>1.2–2.0</td>
<td>1.5–1.9</td>
<td>1.0–1.3</td>
<td>0.9–1.1</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>21/4</td>
<td>172</td>
<td>271</td>
<td>370</td>
<td>215</td>
<td>271</td>
<td>302</td>
<td>188</td>
<td>271</td>
<td>327</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>355</td>
<td>564</td>
<td>780</td>
<td>453</td>
<td>564</td>
<td>621</td>
<td>399</td>
<td>573</td>
<td>690</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>450</td>
<td>694</td>
<td>932</td>
<td>542</td>
<td>694</td>
<td>786</td>
<td>576</td>
<td>682</td>
<td>823</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>514</td>
<td>828</td>
<td>1162</td>
<td>676</td>
<td>828</td>
<td>898</td>
<td>595</td>
<td>856</td>
<td>1030</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.6–5.0</td>
<td>1.9–2.5</td>
<td>1.1–1.3</td>
<td>1.8–2.2</td>
<td>1.9–2.5</td>
<td>2.1–2.9</td>
<td>2.0–2.4</td>
<td>1.4–1.7</td>
<td>1.2–1.4</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>21/4</td>
<td>130</td>
<td>219</td>
<td>325</td>
<td>189</td>
<td>219</td>
<td>226</td>
<td>169</td>
<td>239</td>
<td>292</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>267</td>
<td>454</td>
<td>682</td>
<td>398</td>
<td>454</td>
<td>462</td>
<td>355</td>
<td>502</td>
<td>613</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>343</td>
<td>567</td>
<td>826</td>
<td>481</td>
<td>567</td>
<td>593</td>
<td>534</td>
<td>606</td>
<td>739</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>384</td>
<td>662</td>
<td>1009</td>
<td>590</td>
<td>662</td>
<td>663</td>
<td>527</td>
<td>745</td>
<td>909</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.1–6.5</td>
<td>2.6–3.2</td>
<td>1.4–1.6</td>
<td>2.3–2.7</td>
<td>2.6–3.2</td>
<td>3.0–3.8</td>
<td>2.5–2.9</td>
<td>1.8–2.1</td>
<td>1.5–1.7</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>21/4</td>
<td>103</td>
<td>184</td>
<td>290</td>
<td>170</td>
<td>184</td>
<td>178</td>
<td>153</td>
<td>214</td>
<td>263</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>209</td>
<td>380</td>
<td>606</td>
<td>355</td>
<td>380</td>
<td>358</td>
<td>320</td>
<td>447</td>
<td>551</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>277</td>
<td>480</td>
<td>741</td>
<td>433</td>
<td>480</td>
<td>476</td>
<td>497</td>
<td>545</td>
<td>671</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>295</td>
<td>551</td>
<td>892</td>
<td>523</td>
<td>551</td>
<td>506</td>
<td>473</td>
<td>660</td>
<td>813</td>
</tr>
</tbody>
</table>

*Pr = Prying Factor Range. (Refer to Annex for additional information.)
1 lb = 0.45 kg

Table 9.3.5.12.2(f) Maximum Load for Undercut Anchors in 3000 psi (207 bar) Normal Weight Cracked Concrete

<table>
<thead>
<tr>
<th>Diameter (in.)</th>
<th>Embedment (in.)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pr ≤ 2.0</td>
<td>Pr ≤ 1.1</td>
<td>Pr ≤ 0.7</td>
<td>Pr ≤ 1.2</td>
<td>Pr ≤ 1.1</td>
<td>Pr ≤ 1.4</td>
<td>Pr ≤ 0.9</td>
<td>Pr ≤ 0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>21/4</td>
<td>103</td>
<td>184</td>
<td>290</td>
<td>170</td>
<td>184</td>
<td>178</td>
<td>153</td>
<td>214</td>
<td>263</td>
</tr>
<tr>
<td>1/2</td>
<td>35/8</td>
<td>209</td>
<td>380</td>
<td>606</td>
<td>355</td>
<td>380</td>
<td>358</td>
<td>320</td>
<td>447</td>
<td>551</td>
</tr>
<tr>
<td>5/8</td>
<td>37/8</td>
<td>277</td>
<td>480</td>
<td>741</td>
<td>433</td>
<td>480</td>
<td>476</td>
<td>497</td>
<td>545</td>
<td>671</td>
</tr>
<tr>
<td>3/4</td>
<td>41/8</td>
<td>295</td>
<td>551</td>
<td>892</td>
<td>523</td>
<td>551</td>
<td>506</td>
<td>473</td>
<td>660</td>
<td>813</td>
</tr>
<tr>
<td>Diameter (in.)</td>
<td>Embedment (in.)</td>
<td>2.1–3.5</td>
<td>1.2–1.8</td>
<td>0.8–1.0</td>
<td>1.3–1.7</td>
<td>1.2–1.8</td>
<td>1.2–2.0</td>
<td>1.5–1.9</td>
<td>1.0–1.3</td>
<td>0.9–1.1</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>3/8</td>
<td>43/8</td>
<td>368</td>
<td>526</td>
<td>658</td>
<td>381</td>
<td>526</td>
<td>643</td>
<td>333</td>
<td>477</td>
<td>578</td>
</tr>
<tr>
<td>1/2</td>
<td>7</td>
<td>505</td>
<td>738</td>
<td>942</td>
<td>547</td>
<td>738</td>
<td>882</td>
<td>479</td>
<td>685</td>
<td>829</td>
</tr>
<tr>
<td>5/8</td>
<td>91/2</td>
<td>754</td>
<td>1179</td>
<td>1604</td>
<td>933</td>
<td>1179</td>
<td>1318</td>
<td>1005</td>
<td>1177</td>
<td>1419</td>
</tr>
<tr>
<td>3/4</td>
<td>12</td>
<td>1143</td>
<td>1819</td>
<td>2520</td>
<td>1468</td>
<td>1819</td>
<td>1996</td>
<td>1291</td>
<td>1854</td>
<td>2233</td>
</tr>
<tr>
<td>Diameter (in.)</td>
<td>Embedment (in.)</td>
<td>3.6–5.0</td>
<td>1.9–2.5</td>
<td>1.1–1.3</td>
<td>1.8–2.2</td>
<td>1.9–2.5</td>
<td>2.1–2.9</td>
<td>2.0–2.4</td>
<td>1.4–1.7</td>
<td>1.2–1.4</td>
</tr>
<tr>
<td>3/8</td>
<td>43/8</td>
<td>291</td>
<td>447</td>
<td>601</td>
<td>350</td>
<td>447</td>
<td>504</td>
<td>309</td>
<td>437</td>
<td>534</td>
</tr>
<tr>
<td>1/2</td>
<td>7</td>
<td>395</td>
<td>620</td>
<td>854</td>
<td>497</td>
<td>620</td>
<td>683</td>
<td>440</td>
<td>622</td>
<td>760</td>
</tr>
<tr>
<td>5/8</td>
<td>91/2</td>
<td>572</td>
<td>957</td>
<td>1413</td>
<td>825</td>
<td>957</td>
<td>989</td>
<td>927</td>
<td>1039</td>
<td>1268</td>
</tr>
<tr>
<td>3/4</td>
<td>12</td>
<td>860</td>
<td>1463</td>
<td>2202</td>
<td>1287</td>
<td>1463</td>
<td>1486</td>
<td>1149</td>
<td>1624</td>
<td>1980</td>
</tr>
<tr>
<td>Diameter (in.)</td>
<td>Embedment (in.)</td>
<td>5.1–6.5</td>
<td>2.6–3.2</td>
<td>1.4–1.6</td>
<td>2.3–2.7</td>
<td>2.6–3.2</td>
<td>3.0–3.8</td>
<td>2.5–2.9</td>
<td>1.8–2.1</td>
<td>1.5–1.7</td>
</tr>
<tr>
<td>3/8</td>
<td>43/8</td>
<td>241</td>
<td>389</td>
<td>554</td>
<td>323</td>
<td>389</td>
<td>414</td>
<td>287</td>
<td>403</td>
<td>496</td>
</tr>
<tr>
<td>1/2</td>
<td>7</td>
<td>324</td>
<td>535</td>
<td>780</td>
<td>455</td>
<td>535</td>
<td>557</td>
<td>407</td>
<td>570</td>
<td>701</td>
</tr>
<tr>
<td>5/8</td>
<td>91/2</td>
<td>456</td>
<td>806</td>
<td>1263</td>
<td>739</td>
<td>806</td>
<td>781</td>
<td>859</td>
<td>931</td>
<td>1145</td>
</tr>
<tr>
<td>3/4</td>
<td>12</td>
<td>670</td>
<td>1223</td>
<td>1955</td>
<td>1146</td>
<td>1223</td>
<td>1147</td>
<td>1035</td>
<td>1444</td>
<td>1778</td>
</tr>
</tbody>
</table>

*Pr = Prying Factor Range. (Refer to Annex for additional information.)

1 lb = 0.45 kg

Table 9.3.5.12.2(g) Maximum Load for Connections to Steel Using Unfinished Steel Bolts

<table>
<thead>
<tr>
<th>Diameter of Unfinished Steel Bolt (in.)</th>
<th>1/4</th>
<th>3/8</th>
<th>5/8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>1/4</td>
<td>400</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>3/8</td>
<td>900</td>
<td>1200</td>
<td>1400</td>
</tr>
<tr>
<td>5/8</td>
<td>1600</td>
<td>2050</td>
<td>2550</td>
</tr>
</tbody>
</table>

Connections to Steel (Values Assume Bolt Perpendicular to Mounting Surface)
# Table 9.3.5.12.2(h) Maximum Load for Through-Bolts in Sawn Lumber or Glue-Laminated Timbers

<table>
<thead>
<tr>
<th>Bolt Diameter (in.)</th>
<th>Length of Bolt in Timber (in.)</th>
<th>1/2</th>
<th>5/8</th>
<th>3/4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>1/2</td>
<td>11/2</td>
<td>11</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>11/2</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>1/2</td>
<td>21/2</td>
<td>14</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>21/2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1/2</td>
<td>31/2</td>
<td>17</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>31/2</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1/2</td>
<td>51/2</td>
<td>34</td>
<td>48</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>51/2</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: Wood fastener maximum capacity values are based on the 2001 National Design Specifications (NDS) for wood with a specific gravity of 0.35. Values for other types of wood can be obtained by multiplying the above values by the factors in Table 9.3.5.12.2(j).

# Table 9.3.5.12.2(i) Maximum Load for Lag Screws and Lag Bolts in Wood

<table>
<thead>
<tr>
<th>Lag Bolt Diameter (in.)</th>
<th>Length of Bolt in Timber (in.)</th>
<th>1/2</th>
<th>5/8</th>
<th>3/4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31/2</td>
<td>16</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>31/2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>18/2</td>
<td>20</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>18/2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>19/2</td>
<td>20</td>
<td>17</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>19/2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>19/2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>19/2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5/8</td>
<td>31</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>31</td>
<td>38</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: Wood fastener maximum capacity values are based on the 2001 National Design Specifications (NDS) for wood with a specific gravity of 0.35. Values for other types of wood can be obtained by multiplying the above values by the factors in Table 9.3.5.12.2(j).

# Table 9.3.5.12.2(j) Factors for Wood Based on Specific Gravity

<table>
<thead>
<tr>
<th>Specific Gravity of Wood</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.36 thru 0.49</td>
<td>1.17</td>
</tr>
<tr>
<td>0.50 thru 0.65</td>
<td>1.25</td>
</tr>
<tr>
<td>0.66 thru 0.73</td>
<td>1.50</td>
</tr>
</tbody>
</table>
9.3.5.12.3* [move to 18.5.12.3]
The type of fasteners used to secure the bracing assembly to the structure shall be limited to those shown in Table 9.3.5.12.2(a) through Table 9.3.5.12.2(i) or to listed devices.

9.3.5.12.4* [move to 18.5.12.4]
For connections to wood, through-bolts with washers on each end shall be used, unless the requirements of 9.3.5.12.5 are met.

9.3.5.12.5 [move to 18.5.12.5]
Where it is not practical to install through-bolts due to the thickness of the wood member in excess of 12 in. (300 mm) or inaccessibility, lag screws shall be permitted and holes shall be pre-drilled 1/8 in. (3 mm) smaller than the maximum root diameter of the lag screw.

9.3.5.12.6 [move to 18.5.12.6]
Holes for through-bolts and similar listed attachments shall be 1/16 in. (1.6 mm) greater than the diameter of the bolt.

9.3.5.12.7 [move to 18.5.12.6.1]
The requirements of 9.3.5.12 shall not apply to other fastening methods, which shall be acceptable for use if certified by a registered professional engineer to support the loads determined in accordance with the criteria in 9.3.5.9.

9.3.5.12.7.1 [move to 18.5.12.6.2]
Calculations shall be submitted where required by the authority having jurisdiction.

9.3.5.12.8 Concrete Anchors. [move to 18.5.12.7]

9.3.5.12.8.1* [move to 18.5.12.7.1]
Concrete anchors shall be prequalified for seismic applications in accordance with ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary, and installed in accordance with the manufacturer's instructions.

9.3.5.12.8.2 [move to 18.5.12.7.2]
Unless the requirements of 9.3.5.12.8.3 are met, concrete anchors shall be selected from Table 9.3.5.12.2(a) through Table 9.3.5.12.2(f) based on concrete strength, anchor type, designated angle category A through I, prying factor (Pr) range, and allowable maximum load.

(A)
Sway brace manufacturers shall provide prying factors (Pr) based on geometry of the structure attachment fitting and the designated angle category A through I as shown in Figure 9.3.5.12.1.

(B)
Where the prying factor for the fitting is unknown, the largest prying factor range in Table 9.3.5.12.2(a) through Table 9.3.5.12.2(f) for the concrete strength and designated angle category A through I shall be used.
9.3.5.12.8.3  [move to 18.5.12.7.3]
In lieu of using the concrete anchor loads in Table 9.3.5.12.2(a) through Table 9.3.5.12.2(f), the allowable maximum load may be calculated.

(A)
Allowable concrete anchor loads shall be permitted to be determined using approved software that considers the effects of prying for concrete anchors.

(B)
Anchors shall be seismically prequalified per 9.3.5.12.8.1.

(C)
Allowable maximum loads shall be based on the anchor capacities given in approved evaluation service reports, where the calculation of ASD allowable shear and tension values are determined in accordance with ACI 318, Chapter 17 and include the effects of prying, brace angle, and the over strength factor ($\Omega=2.0$).

(D)*
The shear and tension values determined in 9.3.5.12.8.3(C) using ACI 318, Chapter 17 shall be multiplied by 0.43.

9.3.5.12.8.4  [move to 18.5.12.7.4]
Concrete anchors other than those shown in Table 9.3.5.12.2(a) through Table 9.3.5.12.2(f) shall be acceptable for use where designed in accordance with the requirements of the building code and certified by a registered professional engineer.

9.3.5.13  Braces to Buildings with Differential Movement.  [move to 18.5.13]
A length of pipe shall not be braced to sections of the building that will move differentially.

9.3.6  Restraint of Branch Lines.  [move to 18.6]

9.3.6.1*  [move to 18.6.1]
Restraint is considered a lesser degree of resisting loads than bracing and shall be provided by use of one of the following:
(1) Listed sway brace assembly
(2) Wraparound U-hook satisfying the requirements of 9.3.5.5.11
(3) No. 12, 440 lb (200 kg) wire installed at least 45 degrees from the vertical plane and anchored on both sides of the pipe
(4) CPVC hangers listed to provide restraint
(5) *Hanger not less than 45 degrees from vertical installed within 6 in. (150 mm) of the vertical hanger arranged for restraint against upward movement, provided it is utilized such that $l/r$ does not exceed 400, where the rod extends to the pipe or a surge clip has been installed
(6) Other approved means

9.3.6.2  Wire Restraint.  [move to 18.6.2]
9.3.6.2.1 [move to 18.6.2.1]
Wire used for restraint shall be located within 2 ft (600 mm) of a hanger.

9.3.6.2.2 [move to 18.6.2.2]
The hanger closest to a wire restraint shall be of a type that resists upward movement of a branch line.

9.3.6.3 [move to 18.6.3]
The end sprinkler on a branch line shall be restrained.

9.3.6.4* [move to 18.6.4]
Branch lines shall be laterally restrained at intervals not exceeding those specified in Table 9.3.6.4(a) or Table 9.3.6.4(b) based on branch line diameter and the value of \( C_p \).

<table>
<thead>
<tr>
<th>Pipe (in.) (mm)</th>
<th>Seismic Coefficient, ( C_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( C_p \leq 0.50 )</td>
</tr>
<tr>
<td>1/2 (15)</td>
<td>34 (10.3)</td>
</tr>
<tr>
<td>3/4 (20)</td>
<td>38 (11.6)</td>
</tr>
<tr>
<td>1 (25)</td>
<td>43 (13.1)</td>
</tr>
<tr>
<td>1 1/4 (32)</td>
<td>46 (14.0)</td>
</tr>
<tr>
<td>1 1/2 (40)</td>
<td>49 (14.9)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>53 (16.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pipe (in.) (mm)</th>
<th>Seismic Coefficient, ( C_p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( C_p \leq 0.50 )</td>
</tr>
<tr>
<td>1/2 (15)</td>
<td>26 (7.9)</td>
</tr>
<tr>
<td>3/4 (20)</td>
<td>31 (9.4)</td>
</tr>
<tr>
<td>1 (25)</td>
<td>34 (10.3)</td>
</tr>
<tr>
<td>1 1/4 (32)</td>
<td>37 (11.3)</td>
</tr>
<tr>
<td>1 1/2 (40)</td>
<td>40 (12.2)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>45 (13.7)</td>
</tr>
</tbody>
</table>

9.3.6.5 [move to 18.6.5]
Where the branch lines are supported by rods less than 6 in. (150 mm) long measured between the top of the pipe and the point of attachment to the building structure, the requirements of 9.3.6.1 through 9.3.6.4 shall not apply and additional restraint shall not be required for the branch lines.

9.3.6.6* [move to 18.6.6]
Sprigs 4 ft (1.2 m) or longer shall be restrained against lateral movement.
9.3.6.7 [move to 18.6.7]
Drops and armovers shall not require restraint.

9.3.7 Hangers and Fasteners Subject to Earthquakes. [move to 18.7]

9.3.7.1 [move to 18.7.1]
Where seismic protection is provided, C-type clamps (including beam and large flange clamps) used to attach hangers to the building structure shall be equipped with a restraining strap unless the provisions of 9.3.7.1.1 are satisfied.

9.3.7.1.1 [move to 18.7.1.1]
As an alternative to the installation of a required restraining strap, a device investigated and specifically listed to restrain the clamp to the structure is permitted where the intent of the device is to resist the worst-case expected horizontal load.

9.3.7.2 [move to 18.7.2]
The restraining strap shall be listed for use with a C-type clamp or shall be a steel strap of not less than 16 gauge (1.57 mm) thickness and not less than 1 in. (25 mm) wide for pipe diameters 8 in. (200 mm) or less and 14 gauge (1.98 mm) thickness and not less than 1 1/4 in. (32 mm) wide for pipe diameters greater than 8 in. (200 mm).

9.3.7.3 [move to 18.7.3]
The restraining strap shall wrap around the beam flange not less than 1 in. (25 mm).

9.3.7.4 [move to 18.7.4]
A lock nut on a C-type clamp shall not be used as a method of restraint.

9.3.7.5 [move to 18.7.5]
A lip on a “C” or “Z” purlin shall not be used as a method of restraint.

9.3.7.6 [move to 18.7.6]
Where purlins or beams do not provide a secure lip to a restraining strap, the strap shall be through-bolted or secured by a self-tapping screw.

9.3.7.7 [move to 18.7.7]
In areas where the horizontal force factor exceeds 0.50 $W_p$, powder-driven studs shall be permitted to attach hangers to the building structure where they are specifically listed for use in areas subject to earthquakes.

9.3.7.8* [move to 18.7.8]
Where seismic protection is provided, concrete anchors used to secure hangers to the building structure shall be in accordance with ACI 355.2, *Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary*, and installed in accordance with manufacturer's instructions.

9.3.8* Pipe Stands Subject to Earthquakes. [move to 18.8]
9.3.8.1 [move to 18.8.1]
In areas where the horizontal force factor exceeds 0.5 $W_p$, pipe stands over 4 ft (1.2 m) in height shall be certified by a registered professional engineer to be adequate for the seismic forces.

9.3.8.2 [move to 18.8.2]
Where seismic protection is provided, concrete anchors used to secure pipe stands to their bases shall be in accordance with ACI 355.2, *Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary*, and shall be installed in accordance with manufacturer’s instructions.
See that attached file for the reorganization of existing Chapter 10.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_10.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City: 
State: 
Zip: 
Submittal Date: Fri Aug 05 17:23:56 EDT 2016

Committee Statement

Committee Statement: Chapter 10 contains the specific requirements for the installation of standard pendent, upright and sidewall sprinklers that were previously contained in the 2016 Sections 8.4, 8.6, and 8.7. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.
Chapter 10 Underground Requirements [move to Chapter 6]

10.1* Piping. [move to 6.1]
[24:10.1]

10.1.1* [move to 6.1.1]
All piping used in private fire service mains shall be in accordance with 10.1.1.1, 10.1.1.2 or 10.1.1.3. [24:10.1.1]

10.1.1.1 Listing. [move to 6.1.1.1]
Piping manufactured in accordance with Table 10.1.1.1 shall be permitted to be used. [24:10.1.1.1]

Table 10.1.1.1 Manufacturing Standards for Underground Pipe

<table>
<thead>
<tr>
<th>Materials and Dimensions</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ductile Iron</strong></td>
<td></td>
</tr>
<tr>
<td>Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water</td>
<td>AWWA C104</td>
</tr>
<tr>
<td>Polyethylene Encasement for Ductile Iron Pipe Systems</td>
<td>AWWA C105</td>
</tr>
<tr>
<td>Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings</td>
<td>AWWA C111</td>
</tr>
<tr>
<td>Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges</td>
<td>AWWA C115</td>
</tr>
<tr>
<td>Thickness Design of Ductile Iron Pipe</td>
<td>AWWA C150</td>
</tr>
<tr>
<td>Ductile Iron Pipe, Centrifugally Cast for Water</td>
<td>AWWA C151</td>
</tr>
<tr>
<td><strong>Concrete</strong></td>
<td></td>
</tr>
<tr>
<td>Reinforced Concrete Pressure Pipe, Steel-Cylinder Type</td>
<td>AWWA C300</td>
</tr>
<tr>
<td>Prestressed Concrete Pressure Pipe, Steel-Cylinder Type</td>
<td>AWWA C301</td>
</tr>
<tr>
<td>Reinforced Concrete Pressure Pipe, Non-Cylinder Type</td>
<td>AWWA C302</td>
</tr>
<tr>
<td>Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, Pretensioned</td>
<td>AWWA C303</td>
</tr>
<tr>
<td>Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in., for Water Distribution Systems</td>
<td>AWWA C400</td>
</tr>
<tr>
<td>Cement-Mortar Lining of Water Pipe Lines 4 in. and Larger — in Place</td>
<td>AWWA C602</td>
</tr>
<tr>
<td><strong>Plastic</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Materials and Dimensions

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution</td>
<td>AWWA C900</td>
</tr>
<tr>
<td>Polyvinyl Chloride (PVC) Pressure Pipe, 14 in. Through 48 in., for Water Distribution</td>
<td>AWWA C905</td>
</tr>
<tr>
<td>Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1575 mm) for Water Distribution</td>
<td>AWWA C906</td>
</tr>
<tr>
<td>Molecularly Oriented Polyvinyl Chloride (PVCO) 4-24 in.</td>
<td>AWWA C909</td>
</tr>
<tr>
<td>Brass Specification for Seamless Red Brass Pipe</td>
<td>ASTM B43</td>
</tr>
<tr>
<td>Copper Specification for Seamless Copper Tube</td>
<td>ASTM B75</td>
</tr>
<tr>
<td>Specification for Seamless Copper Water Tube</td>
<td>ASTM B88</td>
</tr>
<tr>
<td>Requirements for Wrought Seamless Copper and Copper-Alloy Tube</td>
<td>ASTM B251</td>
</tr>
</tbody>
</table>

[24:Table 10.1.1.1]

**10.1.1.2** [move to 6.1.1.2]

Piping specifically listed for use in private fire service mains shall be permitted to be used.  
[24:10.1.1.2]

**10.1.1.2.1** [move to 6.1.1.2.1]

Where listed pipe is used, it shall be installed in accordance with the listing limitations including installation instructions.  [24:10.1.1.2.1]

**10.1.1.2.2** [move to 6.1.1.2.2]

Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply.  [24:10.1.1.2.2]

**10.1.1.3** [move to 6.1.1.3]

Steel piping manufactured in accordance with Table 10.1.1.3 that is externally coated and wrapped and internally galvanized shall be permitted to be used between the hose coupling(s) on the fire department connection and the check valve installed in the fire department connection piping.  [24:10.1.1.3]

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use</td>
<td>ASTM A795</td>
</tr>
<tr>
<td>Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless</td>
<td>ASTM A53</td>
</tr>
</tbody>
</table>

[24:Table 10.1.1.3]
10.1.1.3.1  [move to 6.1.1.3.1]
External coating and wrapping as required by 10.1.1.3 shall be approved. [24:10.1.1.3.1]

10.1.2*  [move to 6.1.2]
All piping used in private fire service mains shall be rated for the maximum system working pressure to which the piping is exposed to but shall not be rated at less than 150 psi (10 bar). [24:10.1.2]

10.1.3*  [move to 6.1.3]
When lined piping is used, the manufacturer’s literature for internal diameter shall be used for all hydraulic calculations. [24:10.1.3]

10.1.4  [move to 6.1.4]
Where piping installed in a private fire service main must be installed above grade, the piping materials shall conform to NFPA 13. [24:10.1.4]

10.1.4.1*  [move to 6.1.4.1]
Underground piping shall be permitted to extend into the building through the slab or wall not more than 24 in. (600 mm). [24:10.1.4.1]

10.2  Fittings.  [move to 6.2]
[24:10.2]

10.2.1  [move to 6.2.1]
All fittings used in private fire service mains shall be in accordance with 10.2.1.1 or 10.2.1.2. [24:10.2.1]

10.2.1.1  [move to 6.2.1.1]
Fittings manufactured in accordance with Table 10.2.1.1 shall be permitted to be used. [24:Table 10.2.1.1]

<table>
<thead>
<tr>
<th>Table 10.2.1.1 Fittings Materials and Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials and Dimensions</strong></td>
</tr>
<tr>
<td><strong>Cast Iron</strong></td>
</tr>
<tr>
<td>Gray Iron Threaded Fittings, Classes 125 and 250</td>
</tr>
<tr>
<td>Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250</td>
</tr>
<tr>
<td><strong>Ductile Iron</strong></td>
</tr>
<tr>
<td>Ductile Iron and Gray Iron Fittings, 3 in. Through 48 in., for Water and other Liquids</td>
</tr>
<tr>
<td>Ductile Iron Compact Fittings, 3 in. Through 24 in. and 54 in. through 64 in. for Water Service</td>
</tr>
<tr>
<td><strong>Malleable Iron</strong></td>
</tr>
<tr>
<td>Materials and Dimensions</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Malleable Iron Threaded Fittings, Class 150 and 300</em></td>
</tr>
<tr>
<td><strong>Steel</strong></td>
</tr>
<tr>
<td><em>Factory-Made Wrought Steel Buttweld Fittings</em></td>
</tr>
<tr>
<td><em>Buttwelding Ends</em></td>
</tr>
<tr>
<td><em>Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures</em></td>
</tr>
<tr>
<td><em>Pipe Flanges and Flanged Fittings, NPS 1/2 Through 24</em></td>
</tr>
<tr>
<td><em>Forged Steel Fittings, Socket Welded and Threaded</em></td>
</tr>
<tr>
<td><em>Steel Pipe Flanges for Waterworks Service — Sizes 4 in. Through 144 in.</em></td>
</tr>
<tr>
<td><em>Dimensions for Fabricated Steel Water Pipe Fittings</em></td>
</tr>
<tr>
<td><strong>Copper</strong></td>
</tr>
<tr>
<td><em>Wrought Copper and Bronze Solder Joint Pressure Fittings</em></td>
</tr>
<tr>
<td><em>Cast Cast Bronze Solder Joint Pressure Fittings</em></td>
</tr>
<tr>
<td><strong>Bronze Fittings</strong></td>
</tr>
<tr>
<td><em>Cast Bronze Threaded Fittings</em></td>
</tr>
</tbody>
</table>

[24:Table 10.2.2.1]

10.2.1.2 [move to 6.2.1.2]

Fittings specifically listed for use in private fire service mains shall be permitted to be used. [24:10.2.1.2]

10.2.1.2.1 [move to 6.2.1.2.1]

Where listed fittings are used, they shall be installed in accordance with their listing limitations including installation instructions. [24:10.2.1.2.1]

10.2.1.2.2 [move to 6.2.1.2.2]

Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply. [24:10.2.1.2.2]

10.2.2 [move to 6.2.2]

All fittings used in private fire service mains shall be rated for the maximum system working pressure to which the fittings are exposed, but shall not be rated at less than 150 psi (10 bar). [24:10.2.2]
10.2.3  [move to 6.2.3]
Where fittings installed in a private fire service main must be installed above grade, the fittings shall conform to NFPA 13. [24:10.2.3]

10.2.3.1  [move to 6.2.3.1]
Fittings in accordance with 10.2.1 shall be permitted for the transition to the above ground piping or fittings. [24:10.2.3.1]

10.3  Connection of Pipe Fittings and Appurtenances.  [move to 6.3] [24:10.3]

10.3.1*  [move to 6.3.1]
Connection of all fittings and appurtenances to piping shall be in accordance with Section 10.3. [24:10.3.1]

10.3.2  [move to 6.3.2]
Connections of pipe and fittings indicated in Table 10.1.1.1 and Table 10.2.1.1 shall be in accordance with the referenced standard in the Table. [24:10.3.2]

10.3.3  Listed Connections.  [move to 6.3.3]
Connections utilizing listed products shall be in accordance with the listing limitations and the manufacturer’s installation instructions. [24:10.3.3]

10.3.3.1  [move to 6.3.3.1]
Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply. [24:10.3.3.1]

10.3.4  [move to 6.3.4]
Where pipe, fittings or appurtenances are connected using threads, all threads shall be in accordance with ANSI/ASME B1.20.1. [24:10.3.4]

10.3.5  Grooved Connections.  [move to 6.3.5]
Where pipe, fittings or appurtenances are connected using grooves, they shall be connected in accordance with 10.3.5.1 through 10.3.5.3. [24:10.3.5]

10.3.5.1  [move to 6.3.5.1]
Pipe, fittings, and appurtenances to be joined with grooved couplings shall contain cut, rolled, or cast grooves that are dimensionally compatible with the couplings. [24:10.3.5.1]

10.3.5.2  [move to 6.3.5.2]
Pipe, fittings, and appurtenances that are connected with grooved couplings and are part of a listed assembly shall be permitted to be used. [24:10.3.5.2]

10.3.5.3*  [move to 6.3.5.3]
Pipe joined with grooved fittings shall be joined by a listed combination of fittings, gaskets, and grooves. [24:10.3.5.3]

10.3.6  [move to 6.3.6]
All joints for the connection of copper tube shall be brazed or joined using pressure fittings as specified in Table 10.2.1.1. [24:10.3.6]

10.4  Protection of Private Fire Service Mains. [24:10.4]  [move to 6.4]

10.4.1  Protection from Corrosion. [move to 6.4.1]  [24:10.4.1]

10.4.1.1  Coatings.  [move to 6.4.1.1]
All bolted joint accessories shall be cleaned and thoroughly coated with asphalt or other corrosion-retarding material after installation. [24:10.4.1.1]

10.4.1.2  [move to 6.4.1.2]
The requirements of 10.4.1.1 shall not apply to epoxy coated fittings, valves, glands, or other accessories. [24:10.4.1.2]

10.4.1.3*  [move to 6.4.1.3]
Where it is necessary to join metal pipe with pipe of dissimilar metal, the joint shall be insulated against the passage of an electric current using an approved method. [24:10.4.1.3]

10.4.2*  Protection of Piping. [24:10.4.2]  [move to 6.4.2]

10.4.2.1  Protection from Freezing.  [move to 6.4.2.1]
The depth of cover for private fire service mains and their appurtenances to protect against freezing shall be in accordance with 10.4.2. [24:10.4.2.1]

10.4.2.1.1*  [move to 6.4.2.1.1]
The top of the pipe shall be buried not less than 1 ft (300 mm) below the frost line for the locality. [24:10.4.2.1.1]

10.4.2.1.2  [move to 6.4.2.1.2]
The depth of piping shall be measured from the top of the piping to the final grade.  [24:10.4.2.1.2]

10.4.2.1.3  [move to 6.4.2.1.3]
Where listed piping is used and the bury depth differs from this standard, the listing limitations shall apply. [24:10.4.2.1.3]

10.4.2.1.4  [move to 6.4.2.1.4]
Where private fire service mains are installed above ground, they shall be protected from freezing in accordance with NFPA 13. [24:10.4.2.1.4]
10.4.2.1.5 [move to 6.4.2.1.5]
Private fire service mains installed in water raceways or shallow streams shall be installed so that the piping will remain in the running water throughout the year. [24:10.4.2.1.5]

10.4.2.1.6 [move to 6.4.2.1.6]
Where piping is installed adjacent to a vertical face, it shall be installed from the vertical face at the same distance as if the piping were buried. [24:10.4.2.1.6]

10.4.2.1.7 [move to 6.4.2.1.7]
Protection of private fire service mains from freezing using heat tracing shall be permitted when the heat tracing is specifically listed for underground use. [24:10.4.2.1.7]

10.4.2.1.7.1 [move to 6.4.2.1.7.1]
Heat tracing not listed for underground use shall be permitted when piping is installed in accordance with 10.1.4. [24:10.4.2.1.7.1]

10.4.2.2 Protection from Mechanical Damage. [move to 6.4.2.2]
The depth of cover for private fire service mains and their appurtenances to protect against mechanical damage shall be in accordance with 10.4.2.2.3. [24:10.4.2.2]

10.4.2.2.1 [move to 6.4.2.2.1]
The depth of piping shall be measured from the top of the piping to the final grade. [24:10.4.2.2.1]

10.4.2.2.2 [move to 6.4.2.2.2]
In locations where freezing is not a factor, the depth of cover shall not be less than 30 in. (0.8 m) below grade to prevent mechanical damage. [24:10.4.2.2.2]

10.4.2.2.2.1 [move to 6.4.2.2.2.1]
Where listed piping is used and the bury depth differs from this standard, the listing limitations shall apply. [24:10.4.2.2.2.1]

10.4.2.2.3 [move to 6.4.2.2.3]
Private fire service mains installed under driveways or roadways shall be buried at a minimum depth of 3 ft (900 mm). [24:10.4.2.2.3]

10.4.2.2.3.1 [move to 6.4.2.2.3.1]
Sidewalks, walkways and other paved or concrete pedestrian passageways shall not be required to comply with 10.4.2.2.3. [24:10.4.2.2.3.1]

10.4.2.2.4 [move to 6.4.2.2.4]
Private fire service mains installed under railroad tracks shall be buried at a minimum depth of 4 ft (1.2 m). [24:10.4.2.2.4]

10.4.2.2.4.1 [move to 6.4.2.2.4.1]
Where railroad operators require a greater depth of bury, the greater depth shall apply. [24:10.4.2.2.4.1]

10.4.2.2.5 [move to 6.4.2.2.5]
Private fire service mains installed under large piles of heavy commodities or subject to heavy shock and vibrations shall be buried at a minimum depth of 4 ft (1.2 m). [24:10.4.2.2.5]

10.4.2.2.6 [move to 6.4.2.2.6]
Where private fire service mains are installed above ground, they shall be protected with bollards or other means as approved by the AHJ when subject to mechanical damage. [24:10.4.2.2.6]

10.4.3 Private Fire Service Mains Under Buildings. [move to 6.4.3]
Except as allowed by 10.4.3, private fire service mains shall not be allowed to run under buildings. [24:10.4.3]

10.4.3.1* [move to 6.4.3.1]
Private fire service mains supplying fire protection systems within the building shall be permitted to extend no more than 10 ft (3 m), as measured from the outside of the building, under the building to the riser location. [24:10.4.3.1]

10.4.3.1.1* [move to 6.4.3.1.1]
Pipe joints shall not be located directly under foundation fittings. [24:10.4.3.1.1]

10.4.3.1.2* [move to 6.4.3.1.2]
Piping shall be installed a minimum of 12 in. (300 mm) below the bottom of building foundations or footers. [24:10.4.3.1.2]

10.4.3.1.2.1 [move to 6.4.3.1.2.1]
The requirements of 10.4.3.1.2 shall not apply when the piping is sleeved with an approved material. [24:10.4.3.1.2.1]

10.4.3.2* [move to 6.4.3.2]
Where approved, private fire service mains supplying systems within the building shall be permitted to extend more than 10 ft (3 m) under the building when all the requirements of 10.4.3.2.1, through 10.4.3.2.4 are met. [24:10.4.3.2]

10.4.3.2.1 [move to 6.4.3.2.1]
Where the piping is installed under the building, all foundations or footers over the private fire service main shall be arched to create a minimum of 24 in. (600 mm) clearance. [24:10.4.3.2.1]

10.4.3.2.2 [move to 6.4.3.2.2]
It shall be acceptable to install the piping in covered trenches where the trenches are accessible from within the building. [24:10.4.3.2.2]

10.4.3.2.3 [move to 6.4.3.2.3]
All joints shall be mechanically restrained. [24:10.4.3.2.3]
10.4.3.2.4  [move to 6.4.3.2.4]
A valve shall be installed before the piping enters under the building and within 24 in. (600 mm) of where the piping enters the building. [24:10.4.3.2.4]

10.5  Grounding and Bonding.  [move to 6.5]
[24:10.5]

10.5.1*  [move to 6.5.1]
In no case shall the underground piping be used as a grounding electrode for electrical systems. [24:10.5.1]

10.5.1.1*  [move to 6.5.1.1]
The requirement of 10.5.1 shall not preclude the bonding of the underground piping to the lightning protection grounding system as required by NFPA 780 in those cases where lightning protection is provided for the structure. [24:10.5.1.1]

10.6*  Restraint.  [move to 6.6]
Private fire service mains shall be restrained against movement at changes in direction in accordance with 10.6.1, 10.6.2 or 10.6.3. [24:10.6]

10.6.1*  Thrust Blocks.  [move to 6.6.1]

10.6.1.1  [move to 6.6.1.1]
Thrust blocks shall be permitted where soil is stable and capable of resisting the anticipated thrust forces. [24:10.6.1.1]

10.6.1.2  [move to 6.6.1.2]
Thrust blocks shall be of concrete, of a mix not leaner than one part cement, two and one-half parts sand, and five parts stone.[24:10.6.1.2]

10.6.1.3  [move to 6.6.1.3]
Thrust blocks shall be placed between undisturbed earth and the fitting to be restrained and shall be capable of resisting the calculated thrust forces. [24:10.6.1.3]

10.6.1.4  [move to 6.6.1.4]
Wherever possible, thrust blocks shall be located so that the joints are accessible for repair. [24:10.6.1.4]

10.6.2*  Restrained Joint Systems.  [move to 6.6.2]
Private fire service mains using restrained joint systems shall include one or more of the following:
(1)  Locking mechanical or push-on joints
(2)  Mechanical joints utilizing setscrew retainer glands
(3)  Bolted flange joints
(4)  Pipe clamps and tie rods
10.6.2.1 Sizing Clamps, Rods, Bolts, and Washers.  [move to 6.6.2.1]

10.6.2.1.1 Clamps.  [move to 6.6.2.1.1]

Clamps shall have the following dimensions:
(1) 1/2 in. × 2 in. (12 mm × 50 mm) for 4 in. (100 mm) to 6 in. (150 mm) pipe
(2) 5/8 in. × 2 1/2 in. (16 mm × 65 mm) for 8 in. (200 mm) to 10 in. (250 mm) pipe
(3) 5/8 in. × 3 in. (16 mm × 75 mm) for 12 in. (300 mm) pipe

The diameter of a bolt hole shall be 1/8 in. (3 mm) larger than that of the corresponding bolts.

10.6.2.1.2 Rods.  [move to 6.6.2.1.2]

Rods shall be not less than 5/8 in. (16 mm) in diameter.  [24:10.6.2.1.2.1]

Table 10.6.2.1.2.2 provides numbers of various diameter rods that shall be used for a given pipe size.  [24:10.6.2.1.2.2]

<table>
<thead>
<tr>
<th>Nominal Pipe Size (in.) (mm)</th>
<th>5/8 in. (16 mm)</th>
<th>3/4 in. (20 mm)</th>
<th>7/8 in. (22 mm)</th>
<th>1 in. (25 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (100)</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6 (150)</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>8 (200)</td>
<td>3</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>10 (250)</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>12 (300)</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>14 (350)</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>16 (400)</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: This table has been derived using pressure of 225 psi (15.5 bar) and design stress of 25,000 psi (172.4 MPa).  [24:Table 10.6.2.1.2.2]
When using bolting rods, the diameter of mechanical joint bolts shall limit the diameter of rods to 3/4 in. (20 mm). [24:10.6.2.1.2.3]

10.6.2.1.2.4 [move to 6.6.2.1.2.4]
Threaded sections of rods shall not be formed or bent. [24:10.6.2.1.2.4]

10.6.2.1.2.5 [move to 6.6.2.1.2.5]
Where using clamps, rods shall be used in pairs for each clamp. [24:10.6.2.1.2.5]

10.6.2.1.2.6 [move to 6.6.2.1.2.6]
Assemblies in which a restraint is made by means of two clamps canted on the barrel of the pipe shall be permitted to use one rod per clamp if approved for the specific installation by the AHJ. [24:10.6.2.1.2.6]

10.6.2.1.2.7 [move to 6.6.2.1.2.7]
Where using combinations of rods, the rods shall be symmetrically spaced. [24:10.6.2.1.2.7]

10.6.2.1.3 Clamp Bolts. [move to 6.6.2.1.3]
Clamp bolts shall have the following diameters:
(1) 5/8 in. (16 mm) for pipe 4 in. (100 mm), 6 in. (150 mm), and 8 in. (200 mm)
(2) 3/4 in. (20 mm) for 10 in. (250 mm) pipe
(3) 7/8 in. (22.2 mm) for 12 in. (300 mm) pipe
[24:10.6.2.1.3]

10.6.2.1.4 Washers. [move to 6.6.2.1.4]
[24:10.6.2.1.4]

10.6.2.1.4.1 [move to 6.6.2.1.4.1]
Washers shall be permitted to be cast iron or steel and round or square. [24:10.6.2.1.4.1]

10.6.2.1.4.2 [move to 6.6.2.1.4.2]
Cast-iron washers shall have the following dimensions:
(1) 5/8 in. × 3 in. (16 mm × 75 mm) for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe
(2) 3/4 in. × 3 1/2 in. (20 mm × 90 mm) for 12 in. (300 mm) pipe
[24:10.6.2.1.4.2]

10.6.2.1.4.3 [move to 6.6.2.1.4.3]
Steel washers shall have the following dimensions:
(1) 1/2 in. × 3 in. (12 mm × 75 mm) for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe
(2) 1/2 in. × 3 1/2 in. (12 mm × 90 mm) for 12 in. (300 mm) pipe
[24:10.6.2.1.4.3]

10.6.2.1.4.4 [move to 6.6.2.1.4.4]
The diameter of holes shall be 1/8 in. (3.2 mm) larger than that of bolts or rods. [24:10.6.2.1.4.4]
10.6.2.2 Sizes of Restraint Straps for Tees. [move to 6.6.2.2]

10.6.2.2.1 [move to 6.6.2.2.1]
Restraint straps for tees shall have the following dimensions:
(1) 5/8 in. (16 mm) thick and 21/2 in. (65 mm) wide for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe
(2) 5/8 in. (16 mm) thick and 3 in. (75 mm) wide for 12 in. (300 mm) pipe

10.6.2.2.2 [move to 6.6.2.2.2]
The diameter of rod holes shall be 1/16 in. (1.6 mm) larger than that of rods. [24:10.6.2.2.2]

10.6.2.2.3 [move to 6.6.2.2.3]
Figure 10.6.2.2.3 and Table 10.6.2.2.3 shall be used in sizing the restraint straps for both mechanical and push-on joint tee fittings. [24:10.6.2.2.3]

Figure 10.6.2.2.3 Restraint Straps for Tees. [24:Figure 10.6.2.2.3]

Table 10.6.2.2.3 Restraint Straps for Tees

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
<td>in.</td>
<td>mm</td>
<td>in.</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>121/2</td>
<td>318</td>
<td>101/8</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>141/2</td>
<td>368</td>
<td>121/8</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
<td>163/4</td>
<td>425</td>
<td>143/8</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
<td>191/16</td>
<td>484</td>
<td>1611/16</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>225/16</td>
<td>567</td>
<td>193/16</td>
</tr>
</tbody>
</table>

[24:Table 10.6.2.2.3]

10.6.2.3 Sizes of Plug Strap for Bell End of Pipe. [move to 6.6.2.3]

10.6.2.3.1 [move to 6.6.2.3.1]
The strap shall be 3/4 in. (20 mm) thick and 21/2 in. (65 mm) wide. [24:10.6.2.3.1]

10.6.2.3.2 [move to 6.6.2.3.2]
The strap length shall be the same as dimension $A$ for tee straps as shown in Figure 10.6.2.2.3. [24:10.6.2.3.2]

10.6.2.3.3 [move to 6.6.2.3.3]
The distance between the centers of rod holes shall be the same as dimension $B$ for tee straps as shown in Figure 10.6.2.2.3. [24:10.6.2.3.31]

10.6.2.4* Material. [move to 6.6.2.4]
Clamps, rods, rod couplings or turnbuckles, bolts, washers, restraint straps, and plug straps shall be of a material that has physical and chemical characteristics that indicate its deterioration under stress can be predicted with reliability. [24:10.6.2.4]

10.6.2.5 Corrosion Resistance. [move to 6.6.2.5]
After installation, rods, nuts, bolts, washers, clamps, and other restraining devices shall be cleaned and thoroughly coated with a bituminous or other acceptable corrosion-retarding material. [24:10.6.2.5]

10.6.2.5.1 [move to 6.6.2.5.1]
The requirements of 10.6.2.5 shall not apply to epoxy coated fittings, valves, glands or other accessories. [24:10.6.2.5.1]

10.6.3* [move to 6.6.3]
Private fire service mains utilizing one or more of the following connection methods shall not require additional restraint, provided that such joints can pass the hydrostatic test of 10.10.2.2 without shifting of piping.
(1) Threaded connections
(2) Grooved connections
(3) Welded connections
(4) Heat fused connections
(5) Chemical or solvent cemented connections
[24:10.6.3]

10.7 Steep Grades. [move to 6.7]
[24:10.7]

10.7.1 [move to 6.7.1]
On steep grades, mains shall be additionally restrained to prevent slipping. [24:10.7.1]

10.7.1.1 [move to 6.7.1.1]
Pipe shall be restrained at the bottom of a hill and at any turns (lateral or vertical). [24:10.7.1.1]

10.7.1.1.1 [move to 6.7.1.1.1]
The restraint specified in 10.7.1.1 shall be to natural rock or to suitable piers built on the downhill side of the bell. [24:10.7.1.1.1]

10.7.1.2 [move to 6.7.1.2]
Bell ends shall be installed facing uphill. [24:10.7.1.2]

10.7.1.3 [move to 6.7.1.3]
Straight runs on hills shall be restrained as determined by a design professional. [24:10.7.1.3]

10.8 Installation Requirements. [move to 6.8]
[24:10.8]

10.8.1 [move to 6.8.1]
Piping, valves, hydrants, gaskets, and fittings shall be inspected for damage when received and shall be inspected prior to installation. [24:10.8.1]

10.8.2 [move to 6.8.2]
The tightness of bolted joints shall be verified by the bolt torque or by the method described in the listing information or manufacturer’s installation instructions. [24:10.8.2]

10.8.3 [move to 6.8.3]
Pipe, valves, hydrants, and fittings shall be clean and free from internal debris. [24:10.8.3]

10.8.4 [move to 6.8.4]
When work is stopped, the open ends of piping, valves, hydrants, and fittings shall be plugged or covered to prevent foreign materials from entering. [24:10.8.4]

10.8.5 [move to 6.8.5]
All piping, fittings, valves, and hydrants shall be examined for cracks or other defects while suspended above the trench and lowered into the trench using appropriate equipment. [24:10.8.5]

10.8.6 [move to 6.8.6]
Plain ends shall be inspected for signs of damage prior to installation. [24:10.8.6]

10.8.7 [move to 6.8.7]
Piping, fittings, valves and appurtenances shall not be dropped, dumped or rolled or skidded against other materials. [24:10.8.7]

10.8.8 [move to 6.8.8]
Pipes shall be supported in the trench throughout their full length and shall not be supported by the bell ends only or by blocks. [24:10.8.8]

10.8.9 [move to 6.8.9]
If the ground is soft, other means shall be provided to support the pipe. [24:10.8.9]

10.8.10 [move to 6.8.10]
Valves and fittings used with nonmetallic pipe shall be supported and restrained in accordance with the manufacturer's installation instructions. [24:10.8.10]

10.9 Backfilling. [move to 6.9]
10.9.1 Backfill material shall be tamped in layers or puddled under and around pipes to prevent settlement or lateral movement.

10.9.2 Backfill material shall not contain ash, cinders, refuse, organic matter or other corrosive materials.

10.9.3 Rocks shall not be used for backfill.

10.9.4 Frozen earth shall not be used as backfill material.

10.9.5 In trenches cut through rock, tamped backfill shall be used for at least 6 in. (150 mm) under and around the pipe and for at least 2 ft (600 mm) above the pipe.

10.9.6 Where using piping listed for private fire service mains, the manufacturer’s installation instructions for backfill shall be followed.

10.10 Testing and Acceptance.

10.10.1 Approval of Underground Piping.

The installing contractor shall be responsible for the following:

1. Notifying the AHJ and the owner's representative of the time and date testing is to be performed
2. Performing all required acceptance tests
3. Completing and signing the contractor's material and test certificate(s) shown in Figure 10.10.1.

Figure 10.10.1 Sample of Contractor's Material and Test Certificate for Underground Piping.
## Contractor's Material and Test Certificate for Underground Piping

### Procedure
Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

<table>
<thead>
<tr>
<th>Property name</th>
<th>Date</th>
</tr>
</thead>
</table>

| Property address | |

<table>
<thead>
<tr>
<th>Plans</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Accepted by approving authorities (names)</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td></td>
</tr>
<tr>
<td>Installation conforms to accepted plans</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Equipment used is approved</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, state deviations</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
<tr>
<td>Have copies of appropriate instructions and care and maintenance charts been left on premises?</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
</tbody>
</table>

| Location | Supplies buildings |

<table>
<thead>
<tr>
<th>Underground pipes and joints</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe types and class</td>
<td>Type joint</td>
</tr>
<tr>
<td>Pipe conforms to standard</td>
<td>Yes  No</td>
</tr>
<tr>
<td>Fittings conform to standard</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
<tr>
<td>Joints needing anchorage clamped, strapped, or blocked in accordance with standard</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush in accordance with the requirements of 10.10.2.1.3.</td>
<td></td>
</tr>
<tr>
<td>Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.4 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ±5 psi (0.34 bar) for 2 hours. Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 10.10.2.2.6):</td>
<td></td>
</tr>
<tr>
<td>$L = \frac{S \times D \times P}{148,000}$</td>
<td>$L$ = testing allowance (makeup water), in gallons per hour</td>
</tr>
<tr>
<td>$S$ = length of pipe tested, in feet</td>
<td></td>
</tr>
<tr>
<td>$D$ = nominal diameter of the pipe, in inches</td>
<td></td>
</tr>
<tr>
<td>$P$ = average test pressure during the hydrostatic test, in pounds per square inch (gauge)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flushing tests</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New underground piping flushed according to standard by (company)</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
<tr>
<td>How flushing flow was obtained</td>
<td></td>
</tr>
<tr>
<td>Public water</td>
<td>Hydrant butt</td>
</tr>
<tr>
<td>Tank or reservoir</td>
<td>Open pipe</td>
</tr>
<tr>
<td>Fire pump</td>
<td></td>
</tr>
<tr>
<td>Through what type opening</td>
<td></td>
</tr>
<tr>
<td>Y connection to flange and spigot</td>
<td></td>
</tr>
<tr>
<td>Lead-ins flushed according to standard by (company)</td>
<td>Yes  No</td>
</tr>
<tr>
<td>If no, explain</td>
<td></td>
</tr>
<tr>
<td>How flushing flow was obtained</td>
<td></td>
</tr>
<tr>
<td>Public water</td>
<td>Hydrant butt</td>
</tr>
<tr>
<td>Tank or reservoir</td>
<td>Open pipe</td>
</tr>
<tr>
<td>Fire pump</td>
<td></td>
</tr>
<tr>
<td>Through what type opening</td>
<td></td>
</tr>
<tr>
<td>Y connection to flange and spigot</td>
<td></td>
</tr>
</tbody>
</table>

© 2015 National Fire Protection Association
### 10.10.2 Acceptance Requirements. [move to 6.10.2]

<table>
<thead>
<tr>
<th>Hydrostatic test</th>
<th>All new underground piping hydrostatically tested at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>__________ psi for __________ hours</td>
</tr>
<tr>
<td>Joints covered</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Leaks test</td>
<td>Total amount of leakage measured</td>
</tr>
<tr>
<td></td>
<td>__________ gallons __________ hours</td>
</tr>
<tr>
<td></td>
<td>Allowable leakage</td>
</tr>
<tr>
<td></td>
<td>__________ gallons __________ hours</td>
</tr>
<tr>
<td>Forward flow</td>
<td>Forward flow test performed in accordance with 10.10.2.5.2:</td>
</tr>
<tr>
<td>test of backflow</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>preventer</td>
<td></td>
</tr>
<tr>
<td>Hydrants</td>
<td>Number installed</td>
</tr>
<tr>
<td></td>
<td>Type and make</td>
</tr>
<tr>
<td></td>
<td>All operate satisfactorily</td>
</tr>
<tr>
<td></td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Control valves</td>
<td>Water control valves left wide open</td>
</tr>
<tr>
<td></td>
<td>If no, state reason</td>
</tr>
<tr>
<td></td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td></td>
<td>Hose threads of fire department connections and hydrants interchangeable with those of fire department answer ing alarm</td>
</tr>
<tr>
<td>Remarks</td>
<td>Date left in service</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Signatures</td>
<td>Name of installing contractor</td>
</tr>
<tr>
<td></td>
<td>Tests witnessed by</td>
</tr>
<tr>
<td></td>
<td>For property owner (signed)</td>
</tr>
<tr>
<td></td>
<td>Title</td>
</tr>
<tr>
<td></td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td>For installing contractor (signed)</td>
</tr>
<tr>
<td></td>
<td>Title</td>
</tr>
<tr>
<td></td>
<td>Date</td>
</tr>
</tbody>
</table>

Additional explanation and notes

© 2015 National Fire Protection Association

NFPA 13 (p. 2 of 2)
10.10.2.1* Flushing of Piping. [move to 6.10.2.1]

10.10.2.1.1 Underground piping, from the water supply to the system riser, and lead-in connections to the system riser, including all hydrants, shall be completely flushed before connection is made to downstream fire protection system piping. [24:10.10.2.1.1]

10.10.2.1.2 The flushing operation shall continue until water flow is verified to be clear of debris. [24:10.10.2.1.2]

10.10.2.1.3 The minimum rate of flow shall be in accordance with Table 10.10.2.1.3. [24:10.10.2.1.3]

Table 10.10.2.1.3 Flow Required to Produce a Velocity of 10 ft/sec (3 m/sec) in Pipes

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>in.</td>
<td>mm</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>21/2</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
</tr>
</tbody>
</table>

[24: Table 10.10.2.1.3]

10.10.2.1.3.1 Where the flow rates established in Table 10.10.2.1.3 are not attainable, the maximum flow rate available to the system shall be acceptable. [24:10.10.2.1.3.1]

10.10.2.1.4 Provision shall be made for the proper disposal of water used for flushing or testing. [24:10.10.2.1.4]

10.10.2.2 Hydrostatic Test. [move to 6.10.2.2]

10.10.2.2.1 All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at gauge pressure of 200 psi (13.8 bar) or 50 psi (3.4 bar) in excess of the
system working pressure, whichever is greater, and shall maintain that pressure at gauge pressure of ±5 psi (0.34 bar) for 2 hours. [24:10.10.2.2.1]

10.10.2.2.2 [move to 6.10.2.2.2]
Acceptable test results shall be determined by indication of either a pressure loss less than gauge pressure of 5 psi or by no visual leakage. [24:10.10.2.2.2]

10.10.2.2.3 [move to 6.10.2.2.3]
The test pressure shall be read from one of the following, located at the lowest elevation of the system or the portion of the system being tested:
(1) A gauge located at one of the hydrant outlets
(2) A gauge located at the lowest point where no hydrants are provided [24:10.10.2.2.3]

10.10.2.2.4* [move to 6.10.2.2.4]
The trench shall be backfilled between joints before testing to prevent movement of pipe. [24:10.10.2.2.4]

10.10.2.2.5 [move to 6.10.2.2.5]
Where required for safety measures presented by the hazards of open trenches, the pipe and joints shall be permitted to be backfilled, provided the installing contractor takes the responsibility for locating and correcting leakage. [24:10.10.2.2.5]

10.10.2.2.6* Hydrostatic Testing Allowance. [move to 6.10.2.2.6]
Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of Table 10.10.2.2.6, which are based upon the following equation:

U.S. Customary Units:
\[
L = \frac{SD\sqrt{P}}{148,000} \quad [10.10.2.2.6a]
\]
where:
\(L\) = testing allowance (makeup water) [gph (gal/hr)]
\(S\) = length of pipe tested (ft)
\(D\) = nominal diameter of the pipe (in.)
\(P\) = average test pressure during hydrostatic test (gauge psi)

Metric Units:
\[
L = \frac{SD\sqrt{P}}{794,797} \quad [10.10.2.2.6b]
\]
where:
\(L\) = testing allowance (makeup water) (L/hr)
\(S\) = length of pipe tested (m)
\(D\) = nominal diameter of the pipe (mm)
\(P\) = average test pressure during the hydrostatic test (kPa)
Table 10.10.2.2.6 Hydrostatic Testing Allowance at 200 psi (gph/100 ft of Pipe)

<table>
<thead>
<tr>
<th>Nominal Pipe Diameter</th>
<th>Testing Allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>in. (mm)</td>
<td>in. (mm)</td>
</tr>
<tr>
<td>2 (50)</td>
<td>0.019 (0.236)</td>
</tr>
<tr>
<td>4 (100)</td>
<td>0.038 (0.472)</td>
</tr>
<tr>
<td>6 (150)</td>
<td>0.057 (0.708)</td>
</tr>
<tr>
<td>8 (200)</td>
<td>0.076 (0.944)</td>
</tr>
<tr>
<td>10 (250)</td>
<td>0.096 (1.19)</td>
</tr>
<tr>
<td>12 (300)</td>
<td>0.115 (1.43)</td>
</tr>
<tr>
<td>14 (350)</td>
<td>0.134 (1.66)</td>
</tr>
<tr>
<td>16 (400)</td>
<td>0.153 (1.90)</td>
</tr>
<tr>
<td>18 (450)</td>
<td>0.172 (2.14)</td>
</tr>
<tr>
<td>20 (500)</td>
<td>0.191 (2.37)</td>
</tr>
<tr>
<td>24 (600)</td>
<td>0.229 (2.84)</td>
</tr>
</tbody>
</table>

Notes:
(1) For other length, diameters, and pressures, utilize Equation 10.10.2.2.6a or 10.10.2.2.6b to determine the appropriate testing allowance.
(2) For test sections that contain various sizes and sections of pipe, the testing allowance is the sum of the testing allowances for each size and section.

10.10.2.3 Other Means of Hydrostatic Tests. [move to 6.10.2.3]
Where required by the AHJ, hydrostatic tests shall be permitted to be completed in accordance with the requirements of AWWA C600, AWWA C602, AWWA C603, and AWWA C900.

10.10.2.4 Operating Test. [move to 6.10.2.4]

10.10.2.4.1 Each hydrant shall be fully opened and closed under system water pressure. [24:10.10.2.4.1]

10.10.2.4.2 Dry barrel hydrants shall be checked for proper drainage. [24:10.10.2.4.2]

10.10.2.4.3 All control valves shall be fully closed and opened under system water pressure to ensure proper operation. [24:10.10.2.4.3]

10.10.2.4.4 Where fire pumps supply the private fire service main, the operating tests required by 10.10.2.4 shall be completed with the pumps running. [24:10.10.2.4.4]
10.10.2.5 Backflow Prevention Assemblies. [move to 6.10.2.5] [24:10.10.2.5]

10.10.2.5.1 [move to 6.10.2.5.1]
The backflow prevention assembly shall be forward flow tested to ensure proper operation. [24:10.10.2.5.1]

10.10.2.5.2 [move to 6.10.2.5.2]
The minimum flow rate required by 10.10.2.5.1 shall be the system demand, including hose stream demand where applicable. [24:10.10.2.5.2]
See the attached file for the reorganization of existing Chapter 11.

**Supplemental Information**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_11.docx</td>
<td></td>
</tr>
</tbody>
</table>

**Submitter Information Verification**

- **Submitter Full Name:** AUT-SSI
- **Organization:** [Not Specified]
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Fri Aug 05 17:24:51 EDT 2016

**Committee Statement**

- **Committee Statement:** Chapter 11 contains the specific requirements for the installation of extended coverage pendent, upright and sidewall sprinklers that were previously contained in the 2016 Sections 8.4, 8.8, and 8.9. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

**Response Message:**
Chapter 11  Design Approaches

11.1  General. [move to 19.2]
The requirements of Section 11.1 shall apply to all sprinkler systems unless modified by a specific section of Chapter 11 or Chapter 12.

11.1.1  [move to 19.2.1]
A building or portion thereof shall be permitted to be protected in accordance with any applicable design approach at the discretion of the designer.

11.1.2*  Adjacent Hazards or Design Methods. [move to 19.2.2]
For buildings with two or more adjacent hazards or design methods, the following shall apply:
(1) Where areas are not physically separated by a draft curtain, barrier, or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding design basis shall extend 15 ft (4.6 m) beyond its perimeter.
(2) The requirements of 11.1.2(1) shall not apply where the areas are separated by a draft curtain, or barrier located above an aisle, where the aisle has a minimum 2 ft (600 mm) horizontal separation from the adjacent hazard on each side, or a partition that is capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area.
(3) The requirements of 11.1.2(1) shall not apply to the extension of more demanding criteria from an upper ceiling level to beneath a lower ceiling level where the difference in height between the ceiling levels is at least 2 ft (600 mm), located above an aisle, where the aisle has a minimum 2 ft (600 mm) horizontal separation from the adjacent hazard on each side.

11.1.3  [move to 19.2.3]
For hydraulically calculated systems, the total system water supply requirements for each design basis shall be determined in accordance with the procedures of Section 23.4 unless modified by a section of Chapter 11 or Chapter 12.

11.1.4  Water Demand.  [move to 19.2.4]

11.1.4.1*  [move to 19.2.4.1]
The water demand requirements shall be determined from the following:
(1) Occupancy hazard fire control approach and special design approaches of Chapter 11
(2) Storage design approaches of Chapter 12 through Chapter 20
(3) Special occupancy approaches of Chapter 22

11.1.4.2*  [move to 19.2.4.2]
The minimum water demand requirements for a sprinkler system shall be determined by adding the hose stream allowance to the water demand for sprinklers.

11.1.5  Water Supplies.  [move to 19.2.5]

11.1.5.1  [move to 19.2.5.1]
The minimum water supply shall be available for the minimum duration specified in Chapter 11.
11.1.5.2* [move to 19.2.5.2]
Tanks shall be sized to supply the equipment that they serve.

11.1.5.3* [move to 19.2.5.3]
Pumps shall be sized to supply the equipment that they serve.

11.1.6 Hose Allowance. [move to 19.2.6]

11.1.6.1 Systems with Multiple Hazard Classifications. [move to 19.2.6.1]
For systems with multiple hazard classifications, the hose stream allowance and water supply duration shall be in accordance with one of the following:
(1) The water supply requirements for the highest hazard classification within the system shall be used.
(2) The water supply requirements for each individual hazard classification shall be used in the calculations for the design area for that hazard.
(3) *For systems with multiple hazard classifications where the higher classification only lies within single rooms less than or equal to 400 ft² (37 m²) in area with no such rooms adjacent, the water supply requirements for the principal occupancy shall be used for the remainder of the system.

11.1.6.2* [move to 19.2.6.2]
Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a private fire hydrant, whichever is closer to the system riser.

11.1.6.3 [move to 19.2.6.3]
Where inside hose connections are planned or are required, the following shall apply:
(1) A total water allowance of 50 gpm (190 L/min) for a single hose connection installation shall be added to the sprinkler requirements.
(2) A total water allowance of 100 gpm (380 L/min) for a multiple hose connection installation shall be added to the sprinkler requirements.
(3) The water allowance shall be added in 50 gpm (190 L/min) increments beginning at the most remote hose connection, with each increment added at the pressure required by the sprinkler system design at that point.

11.1.6.3.1 [move to 19.2.6.3.1]
Where the system is a combined sprinkler/standpipe system (Class I or Class III) and the building is fully sprinklered in accordance with NFPA 13, no inside hose demand shall be required at any of the standpipe outlets.

11.1.6.4* [move to 19.2.6.4]
When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 8.17.5.2, the following shall apply:
(1) The sprinkler system demand shall not be required to be added to standpipe demand as determined from NFPA 14.
(2) Where the combined sprinkler system demand and hose stream allowance of Table 11.2.3.1.2 exceeds the requirements of NFPA 14, this higher demand shall be used.
(3) For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Figure 11.2.3.1.1 shall be added to the requirements given in NFPA 14.

11.1.7* High Volume Low Speed (HVLS) Fans. [move to 19.2.7]
The installation of HVLS fans in buildings equipped with sprinklers, including ESFR sprinklers, shall comply with the following:
(1) The maximum fan diameter shall be 24 ft (7.3 m).
(2) The HVLS fan shall be centered approximately between four adjacent sprinklers.
(3) The vertical clearance from the HVLS fan to sprinkler deflector shall be a minimum of 3 ft (0.9 mm).
(4) All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72.

11.2 Occupancy Hazard Fire Control Approach for Spray Sprinklers. [move to 19.3]

11.2.1 General. [move to 19.3.1]

11.2.1.1* [move to 19.3.1.1]
The water demand requirements shall be determined by either the pipe schedule method in accordance with 11.2.2 or the hydraulic calculation method in accordance with 11.2.3.

11.2.1.2 Occupancy Classifications. [move to 19.3.1.2]

11.2.1.2.1 [move to 19.3.1.2.1]
Occupancy classifications for this standard shall relate to sprinkler installations and their water supplies only.

11.2.1.2.2 [move to 19.3.1.2.2]
Occupancy classifications shall not be used as a general classification of occupancy hazards.

11.2.1.2.3 [move to 19.3.1.2.3]
Occupancies or portions of occupancies shall be classified according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles, and the presence of flammable and combustible liquids, using the definitions contained in Section 5.2 through Section 5.5.

11.2.1.2.4 [move to 19.3.1.2.4]
Classifications shall be as follows:
(1) Light hazard
(2) Ordinary hazard (Groups 1 and 2)
(3) Extra hazard (Groups 1 and 2)
(4) Special occupancy hazard (see Chapter 22)
11.2.2 Water Demand Requirements — Pipe Schedule Method. [move to 19.3.2]

11.2.2.1 [move to 19.3.2.1]
Table 11.2.2.1 shall be used in determining the minimum water supply requirements for light and ordinary hazard occupancies protected by systems with pipe sized according to the pipe schedules of Section 23.7.

Table 11.2.2.1 Water Supply Requirements for Pipe Schedule Sprinkler Systems

<table>
<thead>
<tr>
<th>Occupancy Classification</th>
<th>Minimum Residual Pressure Required</th>
<th>Acceptable Flow at Base of Riser (Including Hose Stream Allowance)</th>
<th>Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light hazard</td>
<td>psi 15</td>
<td>bar 1</td>
<td>gpm 500–750</td>
</tr>
<tr>
<td>Ordinary hazard</td>
<td>psi 20</td>
<td>bar 1.4</td>
<td>gpm 850–1500</td>
</tr>
</tbody>
</table>

11.2.2.2 [move to 19.3.2.2]
Pressure and flow requirements for extra hazard occupancies shall be based on the hydraulic calculation methods of 11.2.3.

11.2.2.3 [move to 19.3.2.3]
The pipe schedule method shall be permitted as follows:
(1) Additions or modifications to existing pipe schedule systems sized according to the pipe schedules of Section 23.7
(2) Additions or modifications to existing extra hazard pipe schedule systems
(3) New systems of 5000 ft² (465 m²) or less
(4) New systems exceeding 5000 ft² (465 m²) where the flows required in Table 11.2.2.1 are available at a minimum residual pressure of 50 psi (3.4 bar) at the highest elevation of sprinkler

11.2.2.4 [move to 19.3.2.4]
Table 11.2.2.1 shall be used in determining the minimum water supply requirements.

11.2.2.5 [move to 19.3.2.5]
The lower duration value of Table 11.2.2.1 shall be acceptable only where the sprinkler system waterflow alarm device(s) and supervisory device(s) are electrically supervised and such supervision is monitored at an approved, constantly attended location.

11.2.2.6* Residual Pressure. [move to 19.3.2.6]

11.2.2.6.1 [move to 19.3.2.6.1]
The residual pressure requirement of Table 11.2.2.1 shall be met at the elevation of the highest sprinkler.

11.2.2.6.2 Friction Loss Due to Backflow Prevention Valves. [move to 19.3.2.6.2]

11.2.2.6.2.1 [move to 19.3.2.6.2.1]
When backflow prevention valves are installed on pipe schedule systems, the friction losses of the device shall be accounted for when determining acceptable residual pressure at the top level of sprinklers.

11.2.2.6.2.2 [move to 19.3.2.6.2.2]
The friction loss of this device [in psi (bar)] shall be added to the elevation loss and the residual pressure at the top row of sprinklers to determine the total pressure needed at the water supply.

11.2.2.7 [move to 19.3.2.7]
The lower flow figure of Table 11.2.2.1 shall be permitted only where the building is of noncombustible construction or the potential areas of fire are limited by building size or compartmentation such that no open areas exceed 3000 ft² (280 m²) for light hazard or 4000 ft² (370 m²) for ordinary hazard.

11.2.3 Water Demand Requirements — Hydraulic Calculation Methods. [move to 19.3.3]

11.2.3.1 General. [move to 19.3.3.1]

11.2.3.1.1 [move to 19.3.3.1.1]
The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer:
(1) Density/area curves of Figure 11.2.3.1.1 in accordance with the density/area method of 11.2.3.2
(2) The room that creates the greatest demand in accordance with the room design method of 11.2.3.3
(3) Special design areas in accordance with 11.2.3.4

Figure 11.2.3.1.1 Density/Area Curves.
11.2.3.1.2 [move to 19.3.3.1.2]
The minimum water supply shall be available for the minimum duration specified in Table 11.2.3.1.2.

Table 11.2.3.1.2 Hose Stream Allowance and Water Supply Duration Requirements for Hydraulically Calculated Systems

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Inside Hose</th>
<th>Total Combined Inside and Outside Hose</th>
<th>Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gpm</td>
<td>L/min</td>
<td>gpm</td>
</tr>
<tr>
<td>Light hazard</td>
<td>0, 50, or 100</td>
<td>0, 190, or 380</td>
<td>100</td>
</tr>
<tr>
<td>Ordinary hazard</td>
<td>0, 50, or 100</td>
<td>0, 190, or 380</td>
<td>250</td>
</tr>
<tr>
<td>Extra hazard</td>
<td>0, 50, or 100</td>
<td>0, 190, or 380</td>
<td>500</td>
</tr>
</tbody>
</table>

11.2.3.1.3 [move to 19.3.3.1.3]
The lower duration values in Table 11.2.3.1.2 shall be permitted where the sprinkler system waterflow alarm device(s) and supervisory device(s) are electrically supervised and such supervision is monitored at an approved, constantly attended location.

11.2.3.1.4 Restrictions. [move to 19.3.3.1.4]
When either the density/area method or room design method is used, the following shall apply:
(1) *For areas of sprinkler operation less than 1500 ft² (139 m²) used for light and ordinary hazard occupancies, the density for 1500 ft² (139 m²) shall be used.
(2) For areas of sprinkler operation less than 2500 ft² (232 m²) for extra hazard occupancies, the density for 2500 ft² (232 m²) shall be used.

11.2.3.1.5 Unsprinklered Combustible Concealed Spaces. [move to 19.3.3.1.5]

11.2.3.1.5.1* [move to 19.3.3.1.5.1]
When using the density/area or room design method, unless the requirements of 11.2.3.1.5.2 are met for buildings having unsprinklered combustible concealed spaces, as described in 8.15.1.2 and 8.15.6, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft² (280 m²).

(A)
The design area of 3000 ft² (280 m²) shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed space.

(B)
The term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

11.2.3.1.5.2 [move to 19.3.3.1.5.2]
The following unsprinklered concealed spaces shall not require a minimum area of sprinkler operation of 3000 ft² (280 m²):
(1) Noncombustible and limited-combustible concealed spaces with minimal combustible loading having no access. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.
(2) Noncombustible and limited-combustible concealed spaces with limited access and not permitting occupancy or storage of combustibles. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.
(3) Combustible concealed spaces filled entirely with noncombustible insulation.
(4) *Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are directly attached to the bottom of solid wood joists or solid limited-combustible construction or noncombustible construction so as to create enclosed joist spaces 160 ft³ (4.5 m³) or less in volume, including space below insulation that is laid directly on top or within the ceiling joists in an otherwise sprinklered concealed space.
(5) Concealed spaces where rigid materials are used and the exposed surfaces have a flame spread index of 25 or less and the materials have been demonstrated to not propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the form in which they are installed in the space.
(6) Concealed spaces in which the exposed materials are constructed entirely of fire-retardant-treated wood as defined by NFPA 703.
(7) Concealed spaces over isolated small rooms not exceeding 55 ft² (5.1 m²) in area.
(8) Vertical pipe chases under 10 ft² (0.9 m²), provided that in multifloor buildings the chases are firestopped at each floor using materials equivalent to the floor construction, and where such pipe chases contain no sources of ignition, piping shall be noncombustible, and pipe penetrations at each floor shall be properly sealed.

(9) Exterior columns under 10 ft² (0.9 m²) in area formed by studs or wood joists, supporting exterior canopies that are fully protected with a sprinkler system.

(10) *Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are attached to the bottom of composite wood joists either directly or on to metal channels not exceeding 1 in. (25 mm) in depth, provided the adjacent joist channels are firestopped into volumes not exceeding 160 ft³ (4.5 m³) using materials equivalent to 1⁄2 in. (13 mm) gypsum board, and at least 31⁄2 in. (90 mm) of batt insulation is installed at the bottom of the joist channels when the ceiling is attached utilizing metal channels.

11.2.3.2 Density/Area Method. [move to 19.3.3.2]

11.2.3.2.1 Water Supply. [move to 19.3.3.2.1]

11.2.3.2.1.1 [move to 19.3.3.2.1.1]
The water supply requirement for sprinklers only shall be calculated from the density/area curves of Figure 11.2.3.1.1 or from Chapter 22 where density/area criteria are specified for special occupancy hazards.

11.2.3.2.1.2 [move to 19.3.3.2.1.2]
When using Figure 11.2.3.1.1, the calculations shall satisfy any single point on the appropriate density/area curve.

11.2.3.2.1.3 [move to 19.3.3.2.1.3]
When using Figure 11.2.3.1.1, it shall not be necessary to meet all points on the selected curves.

11.2.3.2.2 Sprinklers. [move to 19.3.3.2.2]

11.2.3.2.2.1 [move to 19.3.3.2.2.1]
The densities and areas provided in Figure 11.2.3.1.1 shall be for use only with spray sprinklers.

11.2.3.2.2.2 [move to 19.3.3.2.2.2]
Quick-response sprinklers shall not be permitted for use in extra hazard occupancies or other occupancies where there are substantial amounts of flammable liquids or combustible dusts.

11.2.3.2.2.3 [move to 19.3.3.2.2.3]
For extended coverage sprinklers, the minimum design area shall be that corresponding to the hazard in Figure 11.2.3.1.1 or the area protected by five sprinklers, whichever is greater.

11.2.3.2.2.4 [move to 19.3.3.2.2.4]
Extended coverage sprinklers shall be listed with and designed for the minimum flow corresponding to the density for the hazard as specified in Figure 11.2.3.1.1.
11.2.3.2.3 Quick-Response Sprinklers. [move to 19.3.3.2.3]

11.2.3.2.3.1 [move to 19.3.3.2.3.1]
Where listed quick-response sprinklers, including extended coverage quick-response sprinklers, are used throughout a system or portion of a system having the same hydraulic design basis, the system area of operation shall be permitted to be reduced without revising the density as indicated in Figure 11.2.3.2.3.1 when all of the following conditions are satisfied:
(1) Wet pipe system
(2) Light hazard or ordinary hazard occupancy
(3) 20 ft (6.1 m) maximum ceiling height
(4) No unprotected ceiling pockets as allowed by 8.6.7 and 8.8.7 exceeding 32 ft² (3.0 m²)
(5) No unprotected areas above cloud ceilings as allowed by 8.15.24

Figure 11.2.3.2.3.1 Design Area Reduction for Quick-Response Sprinklers.

![Graph showing design area reduction for quick-response sprinklers]

Note: \( y = \frac{-3x}{2} + 55 \) for U.S. Customary Units
Note: \( y = -4.8x + 54.6 \) for S.I. Units
For ceiling height \( \geq 10 \) ft and \( \leq 20 \) ft, \( y = \frac{-3x}{2} + 55 \)
For ceiling height \( < 10 \) ft, \( y = 40 \)
For ceiling height \( > 20 \), \( y = 0 \)
For SI units, 1 ft = 0.31 m.

11.2.3.2.3.2 [move to 19.3.3.2.3.2]
The number of sprinklers in the design area shall never be less than five.

11.2.3.2.3.3 [move to 19.3.3.2.3.3]
Where quick-response sprinklers are used on a sloped ceiling or roof, the maximum ceiling or roof height shall be used for determining the percent reduction in design area.
11.2.3.2.4 Sloped Ceilings. [move to 19.3.3.2.4]
The system area of operation shall be increased by 30 percent without revising the density when
the following types of sprinklers are used on sloped ceilings with a pitch exceeding 1 in 6 (a rise
of 2 units in a run of 12 units, a roof slope of 16.7 percent) in nonstorage applications:
(1) Spray sprinklers, including extended coverage sprinklers listed in accordance with 8.4.3(4),
and quick-response sprinklers
(2) CMSA sprinklers

11.2.3.2.5* Dry Pipe and Double Interlock Preaction Systems. [move to 19.3.3.2.5]
For dry pipe systems and double interlock preaction systems, the area of sprinkler operation shall
be increased by 30 percent without revising the density.

11.2.3.2.6 High-Temperature Sprinklers. [move to 19.3.3.2.6]
Where high-temperature sprinklers are used for extra hazard occupancies, the area of sprinkler
operation shall be permitted to be reduced by 25 percent without revising the density, but not to
less than 2000 ft² (186 m²).

11.2.3.2.7* Multiple Adjustments. [move to 19.3.3.2.8]

11.2.3.2.7.1 [move to 19.3.3.2.8.1]
Where multiple adjustments to the area of operation are required to be made in accordance with
11.2.3.2.3, 11.2.3.2.4, 11.2.3.2.5, or 11.2.3.2.6, these adjustments shall be compounded based on
the area of operation originally selected from Figure 11.2.3.1.1.

11.2.3.2.7.2 [move to 19.3.3.2.8.2]
If the building has unsprinklered combustible concealed spaces, the rules of 11.2.3.1.4 shall be
applied after all other modifications have been made.

11.2.3.3 Room Design Method. [move to 19.3.3.3]

11.2.3.3.1* [move to 19.3.3.3.1]
The water supply requirements for sprinklers only shall be based upon the room that creates the
greatest demand.

11.2.3.3.2 [move to 19.3.3.3.2]
The density selected shall be that from Figure 11.2.3.1.1 corresponding to the occupancy hazard
classification and room size.

11.2.3.3.3 [move to 19.3.3.3.3]
To utilize the room design method, all rooms shall be enclosed with walls having a fire-
resistance rating equal to the water supply duration indicated in Table 11.2.3.1.2.

11.2.3.3.4 [move to 19.3.3.3.4]
If the room is smaller than the area specified in Figure 11.2.3.1.1, the provisions of 11.2.3.1.4(1)
and 11.2.3.1.4(2) shall apply.
11.2.3.3.5 [move to 19.3.3.3.5]
Minimum protection of openings shall be as follows:
(1) Light hazard — Nonrated automatic or self-closing doors.
(2) Light hazard with no opening protection — Where openings are not protected, calculations shall include the sprinklers in the room plus two sprinklers in the communicating space nearest each such unprotected opening unless the communicating space has only one sprinkler, in which case calculations shall be extended to the operation of that sprinkler. The selection of the room and communicating space sprinklers to be calculated shall be that which produces the greatest hydraulic demand. For light hazard occupancies with unprotected openings in walls, a minimum lintel of depth of 8 in. (200 mm) is required for openings and the opening shall not exceed 8 ft (2.4 m) in width. It shall be permitted to have a single opening of 36 in. (900 mm) or less without a lintel, provided there are no other openings to adjoining spaces.
(3) Ordinary and extra hazard — Automatic or self-closing doors with appropriate fire resistance ratings for the enclosure.

11.2.3.3.6 [move to 19.3.3.3.6]
Where the room design method is used and the area under consideration is a corridor protected by a single row of sprinklers with protected openings in accordance with 11.2.3.3.5, the maximum number of sprinklers that needs to be calculated is five or, when extended coverage sprinklers are installed, all sprinklers contained within 75 linear feet (23 linear meters) of the corridor.

11.2.3.3.7 [move to 19.3.3.3.7]
Where the area under consideration is a corridor protected by a single row of sprinklers with unprotected openings, in a light hazard occupancy, the design area shall include all sprinklers in the corridor to a maximum of five or, when extended coverage sprinklers are installed, all sprinklers within 75 linear feet (23 linear meters) of the corridor.

11.2.3.4 Special Design Areas. [move to 19.3.3.4]

11.2.3.4.1 [move to 19.3.3.4.1]
Where the design area consists of a building service chute supplied by a separate riser, the maximum number of sprinklers that needs to be calculated is three, each with a minimum discharge of 15 gpm (57 L/min).

11.2.3.4.2* [move to 19.3.3.4.2]
Where an area is to be protected by a single line of sprinklers, the design area shall include all sprinklers on the line up to a maximum of seven.

11.2.3.4.3 [move to 19.3.3.4.3]
Sprinklers in ducts as described in Section 7.9 and 8.15.13 shall be hydraulically designed to provide a discharge pressure of not less than 7 psi (0.5 bar) at each sprinkler with all sprinklers within the duct flowing.

11.3 Special Design Approaches. [move to 19.4]
11.3.1 Residential Sprinklers. [move to 19.4.1]

11.3.1.1* [move to 19.4.1.1]
The design area shall be the area that includes the four adjacent sprinklers that produce the greatest hydraulic demand.

11.3.1.2* [move to 19.4.1.2]
Unless the requirements of 11.2.3.1.4(4) are met for buildings having unsprinklered combustible concealed spaces, as described in 8.15.1.2 and 8.15.6, the minimum design area of sprinkler operation for that portion of the building shall be eight sprinklers.

11.3.1.2.1* [move to 19.4.1.2.1]
The design area of eight sprinklers shall be applied only to the portion of the residential sprinklers that are adjacent to the qualifying combustible concealed space.

11.3.1.2.2 [move to 19.4.1.2.2]
The term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

11.3.1.3 [move to 19.4.1.3]
Unless the requirements of 11.3.1.4 are met, the minimum required discharge from each design area sprinkler shall be the greater of the following:
(1) In accordance with minimum flow rates indicated in the sprinkler listings
(2) In rooms or compartments greater than 800 ft² (74.3 m²), calculated based on delivering a minimum of 0.1 gpm/ft² (4.1 mm/min) over the design area in accordance with the provisions of 8.5.2.1
(3) In rooms or compartments 800 ft² (74.3 m²) or less calculated based on delivering a minimum of 0.1 gpm/ft² (4.1 mm/min) over the room or the compartment using the area of the room divided by the number of sprinklers in the room

11.3.1.4 [move to 19.4.1.4]
For modifications or additions to existing systems equipped with residential sprinklers, the listed discharge criteria less than 0.1 gpm/ft² (4.1 mm/min) shall be permitted to be used.

11.3.1.4.1 [move to 19.4.1.4.1]
Where replacing residential sprinklers manufactured prior to 2003 that are no longer available from the manufacturer and that are installed using a design density less than 0.05 gpm/ft² (2.04 mm/min), a residential sprinkler with an equivalent K-factor (± 5 percent) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

11.3.1.5 [move to 19.4.1.5]
Where areas such as attics, basements, or other types of occupancies are outside of dwelling units but within the same structure, these areas shall be protected as a separate design basis in accordance with Section 11.1.

11.3.1.6 [move to 19.4.1.6]
Hose stream allowance and water supply duration requirements shall be in accordance with those for light hazard occupancies in Table 11.2.3.1.2.

11.3.2 Exposure Protection. [move to 19.4.2]

11.3.2.1* [move to 19.4.2.1]
Piping shall be hydraulically calculated in accordance with Section 23.4 to furnish a minimum of 7 psi (0.5 bar) at any sprinkler with all sprinklers facing the exposure operating.

11.3.2.2 [move to 19.4.2.2]
Where the water supply feeds other fire protection systems, it shall be capable of furnishing total demand for such systems as well as the exposure system demand.

11.3.3 Water Curtains. [move to 19.4.3]

11.3.3.1 [move to 19.4.3.1]
Sprinklers in a water curtain such as described in 8.15.4 or 8.15.17.2 shall be hydraulically designed to provide a discharge of 3 gpm per lineal foot (37 L/min per lineal meter) of water curtain, with no sprinklers discharging less than 15 gpm (57 L/min).

11.3.3.2 [move to 19.4.3.2]
For water curtains employing automatic sprinklers, the number of sprinklers calculated in this water curtain shall be the number in the length corresponding to the length parallel to the branch lines in the area determined by 23.4.4.2.

11.3.3.3 [move to 19.4.3.3]
If a single fire can be expected to operate sprinklers within the water curtain and within the design area of a hydraulically calculated system, the water supply to the water curtain shall be added to the water demand of the hydraulic calculations and shall be balanced to the calculated area demand.

11.3.3.4 [move to 19.5.3.4]
Hydraulic design calculations shall include a design area selected to include ceiling sprinklers adjacent to the water curtain.

11.3.4 Sprinklers Under Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members 3 ft (0.9 m) or Less on Center and Slope Having Pitch of 4 in 12 or Greater. [move to 19.4.4]

11.3.4.1 [move to 19.4.4.1]
Where sprinkler spacing does not exceed 8 ft (2.4 m) measured perpendicular to the slope, the minimum sprinkler discharge pressure shall be 7 psi (0.5 bar).

11.3.4.2 [move to 19.4.4.2]
Where sprinkler spacing exceeds 8 ft (2.4 m) measured perpendicular to the slope, the minimum sprinkler discharge pressure shall be 20 psi (1.4 bar).

11.3.4.3 [move to 19.4.4.3]
Hose stream allowance and water supply duration requirements shall be in accordance with those for light hazard occupancies in Table 11.2.3.1.2.

11.3.5 Sprinkler-Protected Glazing. [move to 19.4.5]
Where the sprinkler-protected glazing is required to comply with 8.15.26, the water supply duration for the design area that includes the window sprinklers shall be not less than the required rating of the assembly.
See the attached file for the reorganization of existing Chapter 12.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_12.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Aug 05 17:25:42 EDT 2016

Committee Statement

Committee Statement: Chapter 12 contains the specific requirements for the installation of residential sprinklers that were previously contained in the 2016 Sections 8.4 and 8.10. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.
Chapter 12  General Requirements for Storage

12.1  General. —being deleted with an FR
The requirements of Section 12.1 shall apply to all storage arrangements and commodities other than miscellaneous storage (see Chapter 13) and as modified by specific sections in Chapter 14 through Chapter 20.

12.1.1  Roof Vents and Draft Curtains. [move to 20.6.5]
See Section C.6.

12.1.1.1* [move to 20.6.5.1]—double check text for this
Manually operated roof vents or automatic roof vents with operating elements that have a higher temperature classification than the automatic sprinklers shall be permitted.

12.1.1.2 [move to 20.6.5.2]
Early suppression fast-response (ESFR) sprinklers shall not be used in buildings with automatic heat or smoke vents unless the vents use a high-temperature rated, standard-response operating mechanism.

12.1.1.3* [move to 20.6.5.3]
Draft curtains shall not be used within ESFR sprinkler systems.

12.1.1.3.1 [move to 20.6.5.3.1]
Draft curtains separating ESFR sprinklers at system breaks or from control mode sprinklers or between hazards shall be permitted. (See 8.4.6.4.)

12.1.2  Ceiling Slope. [move to 20.6.1]
The sprinkler system criteria specified in Chapter 12 and Chapters 14 through 20 are intended to apply to buildings with ceiling slopes not exceeding 2 in 12 (16.7 percent) unless modified by a specific section in Chapter 12 and Chapters 14 through 20.

12.1.3*  Building and Storage Height. [move to 20.6.2]

12.1.3.1 [move to 20.6.2.1]
The maximum building height shall be measured to the underside of the roof deck or ceiling or in accordance with 12.1.3.1.1 through 12.1.3.1.3.

12.1.3.1.1 [move to 20.6.2.2]
For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the maximum roof height shall be measured from floor to the bottom of the deck.

12.1.3.1.2 [move to 20.6.2.3]
For decks deeper than 3 in. (75 mm), the maximum roof height shall be measured to the highest point on the deck.

12.1.3.1.3 [move to 20.6.2.4]
For ceilings that have insulation installed directly against underside of the ceiling or roof structure, the maximum roof height shall be measured to the bottom of insulation and shall be in accordance with 12.1.3.1.3.1 or 12.1.3.1.3.2.

12.1.3.1.3.1 [move to 20.6.2.4.1]
For insulation that is installed directly against the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the maximum roof height shall be measured to the underside of the insulation.

12.1.3.1.3.2 [move to 20.6.2.4.2]
For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the maximum roof height shall be measured as half of the distance of the deflection from the insulation high point to the insulation low point. If the deflection or sag in the insulation exceeds 6 in. (150 mm), the maximum roof height shall be measured to the high point of the insulation.

12.1.3.1.4* [move to 20.6.2.5]
Where the building height changes within a compartment, the sprinklers directly over the storage shall be capable of protecting storage directly beneath.

12.1.3.1.4.1 [move to 20.6.2.5.1]
Where a barrier to heat and smoke in accordance with 12.3(2) or 12.3(3) is not present, the sprinkler criteria 15 ft (4.6 m) into the perimeter of the lower ceiling area shall be the same as the sprinkler protection for the high ceiling area.

12.1.3.2 [move to 20.6.2.6]
ESFR sprinklers shall be used only in buildings equal to, or less than, the height of the building for which they have been listed.

12.1.3.3 [move to 20.6.3.2]
The sprinkler system design shall be based on the storage height and clearance to ceiling that routinely or periodically exist in the building and create the greatest water demand. Where storage is placed above doors, the storage height shall be calculated from the base of storage above the door.

12.1.3.4 Clearance to Ceiling. [move to 20.6.4]

12.1.3.4.1* [move to 20.6.4.1]
The clearance to ceiling shall be measured in accordance with 12.1.3.4.1.1 through 12.1.3.4.1.3.

12.1.3.4.1.1 [move to 20.6.4.1.1]
For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the clearance to ceiling shall be measured from the top of storage to the bottom of the deck.

12.1.3.4.1.2 [move to 20.6.4.1.2]
For corrugated metal deck roofs deeper than 3 in. (75 mm), the clearance to ceiling shall be measured to the highest point on the deck.

12.1.3.4.1.3 [move to 20.6.4.1.3]
For ceilings that have insulation attached directly to underside of the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to the bottom of the insulation and shall be in accordance with 12.1.3.4.1.3(A) or 12.1.3.4.1.3(B).

(A)
For insulation that is attached directly to the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to the underside of the insulation.

(B)
For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to a point half of the distance of the deflection from the insulation high point to the insulation low point. If the deflection or sag in the insulation exceeds 6 in. (150 mm), the clearance to ceiling shall be measured from the top of storage to the high point of the insulation.

12.1.3.4.2 [move to 20.6.4.2]
For spray sprinkler criteria where the clearance to ceiling exceeds those identified in this section, the requirements of 12.1.3.4.3 through 12.1.3.4.8 shall apply.

12.1.3.4.3 [move to 20.6.4.3]
Where the clearance to ceiling exceeds 20 ft (6.1 m) for Chapters 14 and 15, protection shall be based upon the storage height that would result in a clearance to ceiling of 20 ft (6.1 m).

12.1.3.4.4 [move to 20.6.4.4]
Where the clearance to ceiling exceeds 20 ft (6.1 m) for Section 16.2, protection shall be based upon the storage height that would result in a clearance to ceiling of 20 ft (6.1 m) or providing one level of supplemental, quick-response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

12.1.3.4.5 [move to 20.6.4.5]
Where the clearance to ceiling exceeds 10 ft (3.0 m) for Section 16.3 or Section 17.2, protection shall be based upon the storage height that would result in a clearance to ceiling of 10 ft (3.0 m) or providing one level of supplemental, quick-response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

12.1.3.4.6 [move to 20.6.4.6]
Where the clearance exceeds 10 ft (3.0 m) for Section 17.3, protection shall be based upon providing one level of supplemental, quick-response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

12.1.3.4.7 [move to 20.6.4.7]
When applying the supplemental in-rack sprinkler option, the ceiling density shall be based upon the given storage height with an assumed acceptable clearance to ceiling.

12.1.3.4.8  [move to 20.6.4.8]
If in-rack sprinklers are required for the actual storage height with an acceptable clearance to ceiling, in-rack sprinklers shall be installed as indicated by that criteria.

12.1.4*  High Volume Low Speed (HVLS) Fans.  [move to 20.6.6]

12.1.4.1  [move to 20.6.6.1]
The installation of HVLS fans in buildings equipped with sprinklers, including ESFR sprinklers, shall comply with the following:
(1) The maximum fan diameter shall be 24 ft (7.3 m).
(2) The HVLS fan shall be centered approximately between four adjacent sprinklers.
(3) The vertical clearance from the HVLS fan to sprinkler deflector shall be a minimum of 3 ft (900 mm).
(4) All HVLS fans shall be interlocked to shut down immediately upon receiving a waterflow signal from the alarm system in accordance with the requirements of NFPA 72.

12.2*  Hose Connections.  [move to 20.11]

12.2.1  [move to 20.11.1.1]
Small hose connections [1 1/2 in. (38 mm)] shall be provided where required by the authority having jurisdiction in accordance with 8.17.5 for first-aid fire-fighting and overhaul operations.

12.2.2  [move to 20.11.1.2]
Small hose connections shall not be required for the protection of Class I, II, III, and IV commodities stored 12 ft (3.7 m) or less in height.

12.3*  Adjacent Hazards or Design Methods.  [move to 20.10.1]—title to 20.10
For buildings with two or more adjacent hazards or design methods, the following shall apply:
(1) Where areas are not physically separated by a barrier or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding design basis shall extend 15 ft (4.6 m) beyond its perimeter.
(2) The requirements of 12.3(1) shall not apply where the areas are separated by a draft curtain or barrier located above an aisle, horizontally a minimum of 2 ft (600 mm) from the adjacent hazard on each side, or a partition that is capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area.
(3) The requirements of 12.3(1) shall not apply to the extension of more demanding criteria from an upper ceiling level to beneath a lower ceiling level where the difference in height between the ceiling levels is at least 2 ft (600 mm), located above an aisle, horizontally a minimum 2 ft (600 mm) from the adjacent hazard on each side.

12.4*  Wet Pipe Systems.  [move to 20.13.2]

12.4.1  [move to 20.13.2.1]
Sprinkler systems shall be wet pipe systems.

12.4.2* [move to 20.13.2.2]
In areas that are subject to freezing or where special conditions exist, dry pipe systems and preaction systems shall be permitted to protect storage occupancies.

12.5  Dry Pipe and Preaction Systems. [move to 20.13.3]
For dry pipe systems and preaction systems, the area of sprinkler operation shall be increased by 30 percent without revising the density.

12.6* Storage Applications. —being deleted with an FR

12.6.1 [move to 21.1.2]
For storage applications with densities of 0.2 gpm/ft² (8.1 mm/min) or less, standard-response sprinklers with a K-factor of K-5.6 (80) or larger shall be permitted.

12.6.2 [move to 21.1.3]
For general storage applications, rack storage, rubber tire storage, roll paper storage, and baled cotton storage being protected with upright and pendent spray sprinklers with required densities of greater than 0.2 gpm/ft² to 0.34 gpm/ft² (8.1 mm/min to 13.9 mm/min), standard-response sprinklers with a nominal K-factor of K-8.0 (115) or larger shall be used.

12.6.3 [move to 21.1.4]
For general storage applications, rack storage, rubber tire storage, roll paper storage, and baled cotton storage being protected with upright and pendent spray sprinklers with required densities greater than 0.34 gpm/ft² (13.9 mm/min), standard-response spray sprinklers with a K-factor of K-11.2 (161) or larger that are listed for storage applications shall be used.

12.6.4* [move to 21.1.5]
Unless the requirements of 12.6.5 are met, the requirements of 12.6.2 and 12.6.3 shall not apply to modifications to existing storage application systems, using sprinklers with K-factors of K-8.0 (115) or less.

12.6.5 [move to 21.1.6]
Where applying the requirements of Figure 17.2.1.2.1(b) and Figure 17.2.1.2.1(c) utilizing the design criteria of 0.6 gpm/ft² per 2000 ft² (24.4 mm/min per 186 m²) to existing storage applications, the requirements of 12.6.3 shall apply.

12.6.6 [move to 21.1.7]
The use of quick-response spray sprinklers for storage applications shall be permitted when listed for such use.

12.6.7 [move to 20.10.3]
CMSA and ESFR sprinklers shall be permitted to protect storage of Class I through Class IV commodities, Group A plastic commodities, miscellaneous storage, and other storage as specified in Chapter 12 through Chapter 20 or by other NFPA standards.
12.6.7.1  [move to 23.1.1]
ESFR sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:
(1) Light hazard occupancies
(2) Ordinary hazard occupancies
(3) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

12.6.7.2  [move to 22.1.1]
Quick-response CMSA sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:
(1) Light hazard occupancies
(2) Ordinary hazard occupancies
(3) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

12.6.7.3  [move to 22.1.2]
Standard-response CMSA sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:
(1) Ordinary hazard occupancies
(2) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

12.6.8  [move to 21.1.8]
The design figures indicate water demands for ordinary-temperature-rated and nominal high-temperature-rated sprinklers at the ceiling.

12.6.8.1  [move to 21.1.8.1]
The ordinary-temperature design densities correspond to ordinary-temperature-rated sprinklers and shall be used for sprinklers with ordinary- and intermediate-temperature classification.

12.6.8.2  [move to 21.1.8.2]
The high-temperature design densities correspond to high-temperature-rated sprinklers and shall be used for sprinklers having a high-temperature rating.

12.6.9  [move to 21.1.9]
Ordinary- and intermediate-temperature sprinklers with K-factors of K-11.2 (161) or larger, where listed for storage, shall be permitted to use the densities for high-temperature sprinklers.

12.7  Discharge Considerations.  [move to 21.1.10]

12.7.1  [move to 21.1.10.1]
The water supply for sprinklers only shall be determined either from the density/area requirements of Chapter 12 through Chapter 20 or shall be based upon the room design method in accordance with Section 12.10, at the discretion of the designer.
12.7.2* Systems with Multiple Hazard Classifications. [move to 20.10.4]
For systems with multiple hazard classifications, the hose stream allowance and water supply
duration shall be in accordance with Section 12.8 as well as one of the following:
(1) The water supply requirements for the highest hazard classification within the system shall
be used.
(2) The water supply requirements for each individual hazard classification shall be used in the
calculations for the design area for that hazard.
(3) *For systems with multiple hazard classifications where the higher classification only lies
within single rooms less than or equal to 400 ft² (37.2 m²) in area with no such rooms adjacent,
the water supply requirements for the principal occupancy shall be used for the remainder of the
system.

12.7.3 [move to 21.1.10.2]
The calculations shall satisfy any single point on appropriate density/area curves.

12.7.4 [move to 20.12.3]
The minimum water supply requirements shall be determined by adding the hose stream
allowance from Section 12.8 to the water supply for sprinklers as determined by Chapter 12
through Chapter 20.

12.7.5 [move to 20.12.4]
The minimum water supply requirements determined from 12.7.4 shall be available for the
minimum duration specified in Section 12.8.

12.7.6 [move to 20.12.5]
Total system water supply requirements shall be determined in accordance with the hydraulic
calculation procedures of Chapter 23.

12.7.6.1 [move to 21.1.10.3]
When using the density/area method, the design area shall meet the requirements of 23.4.4.2.1.

12.7.6.2 [move to 22.1.3]
When using CMSA, the design area shall meet the requirements of 23.4.4.3.1.

12.7.6.3 [move to 23.1.2]
When using ESFR sprinklers, the design area shall consist of the most hydraulically demanding
area of 12 sprinklers, consisting of four sprinklers on each of three branch lines, unless other
specific numbers of design sprinklers are required in other sections of this standard.

12.7.7 Multiple Adjustments. [move to 20.13.1]

12.7.7.1 [move to 20.13.1.1]
Where multiple adjustments to the area of operation are required to be made, these adjustments
shall be compounded based on the area of operation originally selected.
12.7.7.2  If the building has unsprinklered combustible concealed spaces, the rules of Section 12.9 shall be applied after all other modifications have been made.

12.7.7.3  The minimum design density for any sprinkler system installed in a storage occupancy shall be not less than 0.15 gpm/ft² (6.1 mm/min) after all adjustments are made.

12.8  Hose Stream Allowance and Water Supply Duration.

12.8.1*  Tanks shall be sized to supply the equipment that they serve.

12.8.2*  Pumps shall be sized to supply the equipment that they serve.

12.8.3  Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a yard hydrant, whichever is closer to the system riser.

12.8.4  Where inside hose connections are planned or are required, the following shall apply:
(1) A total water allowance of 50 gpm (190 L/min) for a single hose connection installation shall be added to the sprinkler requirements.
(2) A total water allowance of 100 gpm (380 L/min) for a multiple hose connection installation shall be added to the sprinkler requirements.
(3) The water allowance shall be added in 50 gpm (190 L/min) increments beginning at the most remote hose connection, with each increment added at the pressure required by the sprinkler system design at that point.

12.8.5  When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 8.17.5.2, the following shall apply:
(1) The water supply shall not be required to be added to standpipe demand as determined from NFPA 14.
(2) Where the combined sprinkler system demand and hose stream allowance of Chapter 12 and Chapters 14 through 20 exceeds the requirements of NFPA 14, this higher demand shall be used.
(3) For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Chapter 12 and Chapters 14 through 20 shall be added to the requirements given in NFPA 14.

12.8.6  Unless indicated otherwise, the minimum water supply requirements for a hydraulically designed sprinkler system shall be determined by adding the hose stream allowance from Table 12.8.6 to the water demand for sprinklers.
<table>
<thead>
<tr>
<th>Commodity</th>
<th>Sprinkler Type</th>
<th>Sprinkler Spacing Type</th>
<th>Number of Ceiling Sprinklers in Design Area*</th>
<th>Size of Design Area at Ceiling</th>
<th>Hose Stream Allowance gpm L/min</th>
<th>Water Supply Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I-IV Commodities, Group A plastics, idle wood pallets, idle plastic pallets and miscellaneous storage</td>
<td>Control mode density/area (CMDA)</td>
<td>Standard and extended-coverage</td>
<td>NA</td>
<td>1200 ft² (110 m²)</td>
<td>250 950 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 1200 ft² (111 m²) up to 1500 ft² (140 m²)</td>
<td>500 1900 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 1500 ft² (139 m²) up to 2600 ft² (240 m²)</td>
<td>500 1900 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Over 2600 ft² (240 m²)</td>
<td>500 1900 150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td></td>
<td>Up to 12</td>
<td>NA</td>
<td>250 950 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 12 to 15</td>
<td>NA</td>
<td>500 1900 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 15 to 25</td>
<td>NA</td>
<td>500 1900 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 25</td>
<td>NA</td>
<td>500 1900 150</td>
<td></td>
</tr>
<tr>
<td>Early Suppression Fast Response (ESFR)</td>
<td></td>
<td>Extended-coverage</td>
<td>Up to 6</td>
<td>NA</td>
<td>250 950 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Up to 8†</td>
<td>NA</td>
<td>250 950 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 6 to 8</td>
<td>NA</td>
<td>500 1900 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 8 to 12</td>
<td>NA</td>
<td>500 1900 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Over 12</td>
<td>NA</td>
<td>500 1900 150</td>
<td></td>
</tr>
<tr>
<td>On-floor rubber tire storage up to 5 ft (1.5 m) in height</td>
<td>CMDA &amp; CMSA</td>
<td>Standard and extended-coverage</td>
<td>Any</td>
<td>Any</td>
<td>250 950 120</td>
<td></td>
</tr>
<tr>
<td>Rubber tire storage</td>
<td>CMDA</td>
<td>Standard and extended-coverage</td>
<td>NA</td>
<td>Up to 5000 ft² (372 m²)</td>
<td>750 2850 180</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CMSA</td>
<td>Standard</td>
<td>Up to 15</td>
<td>NA</td>
<td>500 1900 180</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESFR</td>
<td>Standard</td>
<td>Up to 12</td>
<td>NA</td>
<td>250 950 180</td>
<td></td>
</tr>
<tr>
<td>Commodity</td>
<td>Sprinkler Type</td>
<td>Sprinkler Spacing Type</td>
<td>Number of Ceiling Sprinklers in Design Area*</td>
<td>Size of Design Area at Ceiling</td>
<td>Hose Stream Allowance gpm L/min</td>
<td>Water Supply Duration (minutes)</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>---------------------------------------------</td>
<td>--------------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Roll paper</td>
<td>CMDA Standard</td>
<td>NA</td>
<td>Over 12 to 20</td>
<td>NA</td>
<td>500 1900</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>CMSA Standard</td>
<td>Up to 25</td>
<td>Up to 4000 ft² (372 m²)</td>
<td>500 1900</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ESFR Standard</td>
<td>Up to 12</td>
<td>NA</td>
<td>250 950</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Alternative Protection per 16.1.2.4 or 17.1.2.9</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>500 1900</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

NA: Not applicable.

*For CSMA and ESFR sprinklers, the additional sprinklers included in the design area for obstructions do not need to be considered in determining the total number of sprinklers in this column.

†Limited to a maximum of 144 ft² (13.4 m²) per sprinkler.

### 12.9 Unsprinklered Combustible Concealed Spaces. [move to 20.7]

#### 12.9.1* [move to 20.7.1]

When using the density/area method or room design method, unless the requirements of 12.9.2 are met for buildings having unsprinklered combustible concealed spaces as described in 8.15.1.2 and 8.15.6, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft² (280 m²).

#### 12.9.1.1 [move to 20.7.1.1]

The design area of 3000 ft² (280 m²) shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed space.

#### 12.9.1.2 [move to 20.7.1.2]

The term *adjacent* shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

#### 12.9.2 [move to 20.7.2]

The following unsprinklered combustible concealed spaces shall not require a minimum design area of sprinkler operation of 3000 ft² (280 m²):

1. Noncombustible and limited-combustible concealed spaces with minimal combustible loading having no access. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.
(2) Noncombustible and limited-combustible concealed spaces with limited access and not permitting occupancy or storage of combustibles. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.
(3) Combustible concealed spaces filled entirely with noncombustible insulation.
(4) Concealed spaces where rigid materials are used and the exposed surfaces have a flame spread index of 25 or less and the materials have been demonstrated to not propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the form in which they are installed in the space.
(5) Concealed spaces in which the exposed materials are constructed entirely of fire retardant–treated wood as defined by NFPA 703.
(6) Concealed spaces over isolated small compartments not exceeding 55 ft² (5.1 m²) in area.
(7) Vertical pipe chases under 10 ft² (0.9 m²), provided that in multifloor buildings the chases are firestopped at each floor using materials equivalent to the floor construction. Such pipe chases shall contain no sources of ignition, piping shall be noncombustible, and pipe penetrations at each floor shall be properly sealed.
(8) Exterior columns under 10 ft² (0.9 m²) in area formed by studs or wood joists, supporting exterior canopies that are fully protected with a sprinkler system.

12.10 Room Design Method. [move to 20.8]

12.10.1* [move to 20.8.1]
The water supply requirements for sprinklers only shall be based upon the room that creates the greatest demand.

12.10.2 [move to 20.8.2]
To utilize the room design method, all rooms shall be enclosed with walls having a fire resistance rating equal to the required water supply duration.

12.10.2.1 [move to 20.8.2.1]
Minimum protection of openings shall include automatic- or self-closing doors with the appropriate fire protection rating for the enclosure.

12.10.3 [move to 20.8.3]
Where the room design method is used, the density shall correspond to that required for the smallest area acceptable under the density/area method.

12.11* High-Expansion Foam Systems. [move to 20.9]

12.11.1 [move to 20.9.1.1]
High-expansion foam systems that are installed in addition to automatic sprinklers shall be installed in accordance with NFPA 11.

12.11.2 [move to 20.9.1.2]
High-expansion foam systems shall be automatic in operation.
12.11.3  [move to 20.9.1.3]
High-expansion foam used to protect the idle pallet shall have a maximum fill time of 4 minutes.

12.11.4  [move to 20.9.1.4]
Detectors for high-expansion foam systems shall be listed and shall be installed at no more than one-half the listed spacing.

12.11.5  [move to 20.9.1.5]
The release system for the high expansion foam deluge system shall be designed to operate prior to the sprinklers installed in the area.

12.12*  Protection of Idle Pallets.  [move to 20.14]

12.12.1  Wood Pallets.  [move to 20.14.1]

12.12.1.1*  [move to 20.14.1.1]
Wood pallets shall be permitted to be stored in the following arrangements:
   (1)   Stored outside
   (2)   Stored in a detached structure
   (3)   Stored indoors where arranged and protected in accordance with 12.12.1.2

12.12.1.2  [move to 20.14.1.2]
Wood pallets, where stored indoors, shall be protected in accordance with one of the following:
   (1)   Control mode density/area sprinkler protection as specified in Table 12.12.1.2(a).
   (2)   CMSA sprinkler protection in accordance with Table 12.12.1.2(b).
   (3)   ESFR sprinkler protection in accordance with Table 12.12.1.2(c).
   (4)   Control mode density/area sprinkler protection in accordance with the OH2 curve of Figure 13.2.1 existing with a hose stream demand of at least 250 gpm (950 L/min) for a duration of at least 60 minutes when pallets are stored no higher than 6 ft (1.8 m) and each pile of no more than four stacks is separated from other pallet piles by at least 8 ft (2.4 m) of clear space or 25 ft (7.6 m) of commodity. The maximum clearance to ceiling of 20 ft (6.1 m) specified in 12.1.3.4 shall not apply to arrangement 12.12.1.2(4).

Table 12.12.1.2(a) Control Mode Density/Area Sprinkler Protection for Indoor Storage of Idle Wood Pallets

<table>
<thead>
<tr>
<th>Type of Sprinkler</th>
<th>Location of Storage</th>
<th>Nominal K-Factor</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>Sprinkler Density gpm/ft$^2$ mm/min</th>
<th>Areas of Operation ft$^2$ m$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control mode density/area</td>
<td>On floor</td>
<td>8 (115) or larger</td>
<td>Up to 6 ft</td>
<td>Up to 1.8 m</td>
<td>20</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>On floor</td>
<td>11.2 (160) or larger</td>
<td>Up to 8 ft</td>
<td>Up to 2.4 m</td>
<td>30</td>
<td>0.45</td>
</tr>
<tr>
<td>Type of Sprinkler</td>
<td>Location of Storage</td>
<td>Nominal K-Factor</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/Roof Height</td>
<td>Sprinkler Density</td>
<td>Areas of Operation</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>---------------------------</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
</tr>
<tr>
<td>On floor or rack without solid shelves</td>
<td>11.2 (160) or larger</td>
<td>8 to 12</td>
<td>2.4 to 3.7</td>
<td>30</td>
<td>9.1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 to 20</td>
<td>3.7 to 6.1</td>
<td>30</td>
<td>9.1</td>
<td>0.6</td>
</tr>
<tr>
<td>On floor</td>
<td>16.8 (240) or larger</td>
<td>Up to 20</td>
<td>Up to 6.1</td>
<td>30</td>
<td>9.1</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*The area of sprinkler operation should be permitted to be reduced to 2000 ft² (186 m²) when sprinklers having a nominal K-factor of 11.2 or larger are used or if high temperature–rated sprinklers with a nominal K-factor of 8.0 are used.

Table 12.12.1.2(b) CMSA Sprinkler Protection for Indoor Storage of Idle Wood Pallets

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity Class</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>K-Factor/Orientation</th>
<th>Type of System</th>
<th>Number of Design Sprinklers</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Idle wood pallets</td>
<td>20</td>
<td>6.1</td>
<td>30</td>
<td>9.1</td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
</tr>
</tbody>
</table>

Table 12.12.1.2(c) ESFR Sprinkler Protection for Indoor Storage of Idle Wood Pallets

<table>
<thead>
<tr>
<th>Type of Sprinkler (Orientation)</th>
<th>Location of Storage</th>
<th>Nominal K-Factor</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESFR (pendent)</td>
<td>On floor or rack without solid shelves</td>
<td>14.0 (200)</td>
<td>25</td>
<td>7.6</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td>40</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>25</td>
<td>7.6</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>Type of Sprinkler (Orientation)</td>
<td>Location of Storage</td>
<td>Nominal K-Factor</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof Height</td>
<td>Minimum Operating Pressure</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
</tr>
<tr>
<td>ESFR (upright)</td>
<td>On floor</td>
<td>25.2 (360)</td>
<td>35</td>
<td>11</td>
<td>40</td>
</tr>
<tr>
<td>ESFR (upright)</td>
<td>On floor</td>
<td>14.0 (200)</td>
<td>20</td>
<td>6.1</td>
<td>30</td>
</tr>
<tr>
<td>ESFR (upright)</td>
<td>On floor</td>
<td>16.8 (240)</td>
<td>20</td>
<td>6.1</td>
<td>30</td>
</tr>
</tbody>
</table>

12.12.1.2.1 [move to 20.14.1.2.1]
The maximum clearance to ceiling of 20 ft (6.1 m) specified in 12.1.3.4 shall not apply to arrangement 12.12.1.2(4).

12.12.1.3 [move to 20.14.1.3]
Idle wood pallets shall not be stored in racks unless they are protected in accordance with the appropriate requirements of Table 12.12.1.2(a) or Table 12.12.1.2(c). (See Section C.7.)


12.12.2.1 [move to 20.14.2.1]
Plastic pallets shall be permitted to be stored in the following manner:
(1) Plastic pallets shall be permitted to be stored outside.
(2) Plastic pallets shall be permitted to be stored in a detached structure.
(3) Plastic pallets shall be permitted to be stored indoors where arranged and protected in accordance with the requirements of 12.12.2.2.

12.12.2.2 Protection Criteria for Plastic Pallets Stored Indoors. [move to 20.14.2.2]

12.12.2.2.1 [move to 20.14.2.2.1]
Plastic pallets having a demonstrated fire hazard that is equal to or less than idle wood pallets and is listed for such equivalency shall be permitted to be protected in accordance with 12.12.1.

12.12.2.2.2 [move to 20.14.2.2.2]
When specific test data are available, the data shall take precedence in determining the required protection of idle plastic pallets.

12.12.2.2.3 [move to 20.14.2.2.3]
Protection with ESFR sprinklers shall be in accordance with the requirements of Table 12.12.2.2.3.

Table 12.12.2.2.3 ESFR Sprinkler Protection for Indoor Storage of Idle Plastic Pallets
<table>
<thead>
<tr>
<th>Type of Sprinkler (Orientation)</th>
<th>Location of Storage</th>
<th>Nominal K-Factor</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESFR (pendent)</td>
<td>On floor or rack without solid shelves</td>
<td>14.0 (200)</td>
<td>25 ft 7.6 m</td>
<td>30 ft 9.1 m</td>
<td>50 psi 3.4 bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>25 ft 7.6 m</td>
<td>32 ft 10 m</td>
<td>60 psi 4.1 bar</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35 ft 11 m</td>
<td>40 ft 12 m</td>
<td>52 psi 3.6 bar</td>
</tr>
</tbody>
</table>

12.12.2.2.4 [move to 20.14.2.2.4.4]
Protection with spray sprinklers shall be in accordance with one of the scenarios in 12.12.2.2.4.1 through 12.12.2.2.4.3.

12.12.2.2.4.1 [move to 20.14.2.2.4.1]
Where plastic pallets are stored in cutoff rooms, the following shall apply:
1) The cutoff rooms shall have at least one exterior wall.
2) The plastic pallet storage shall be separated from the remainder of the building by 3 hour–rated fire walls.
3) The storage shall be protected by sprinklers designed to deliver 0.6 gpm/ft² (24.4 mm/min) for the entire room or by high-expansion foam and sprinklers designed to deliver 0.3 gpm/ft² (12.2 mm/min) for the entire room.
4) The storage shall be piled no higher than 12 ft (3.7 m).
5) Any steel columns shall be protected by 1-hour fireproofing or a sidewall sprinkler directed to one side of the column at the top or at the 15 ft (4.6 m) level, whichever is lower. Flow from these sprinklers shall be permitted to be omitted from the sprinkler system demand for hydraulic calculations.

12.12.2.2.4.2 [move to 20.14.2.2.4.2]
Where plastic pallets are stored without cutoffs from other storage, the following shall apply:
1) Maximum storage height of 10 ft (3.0 m)
2) Maximum ceiling height of 30 ft (9.1 m)
3) Sprinkler density 0.6 gpm/ft² over 2000 ft² (24.4 mm/min over 186 m²)
4) Minimum sprinkler K-factor of 16.8 (240)

12.12.2.2.4.3 [move to 20.14.2.2.4.3]
Plastic pallets shall have no impact on the required sprinkler protection when stored as follows:
1) Storage shall be piled no higher than 4 ft (1.2 m).
2) Sprinkler protection shall employ high temperature–rated sprinklers.
3) Each pallet pile of no more than two stacks shall be separated from other pallet piles by at least 8 ft (2.4 m) of clear space or 25 ft (7.6 m) of stored commodity.
4) Minimum ceiling design of OH2 shall be used.

12.12.2.3 [move to 20.14.2.3]
Idle plastic pallets shall be stored only in racks where protected in accordance with the requirements of Table 12.12.2.2.3.

12.12.2.3.1 [move to 20.14.2.3.1]
When specific test data and a product listing are available, the data shall take precedence in determining the required protection of idle plastic pallets stored in racks.

12.12.3 Idle Pallets Stored on Racks, on Shelves, and Above Doors. [move to 20.14.3]

12.12.3.1 [move to 20.14.3.1]
Idle pallets shall not be stored on racks or shelves, except where permitted in 12.12.1.3, 12.12.2.3, and 12.12.3.2.

12.12.3.2 [move to 20.14.3.2]
Idle pallets shall be permitted to be stored on the lowest level of storage only where no storage or shelves are located above the stored pallets and the applicable protection criteria referenced for on-floor storage in Section 12.12 are applied.

12.12.3.3 [move to 20.14.3.3]
Where idle pallet storage is above a door, the idle pallet storage height and ceiling height shall be calculated from the base of storage above the door using the applicable protection criteria referenced in Section 12.12.

12.12.4 High-Expansion Foam — Reduction in Ceiling Density. —being deleted with an FR
A reduction in ceiling density to one-half that required for idle pallets shall be permitted without revising the design area, but the density shall be no less than 0.15 gpm/ft² (6.1 mm/min).
See attached file for the reorganization of existing Chapter 13.

### Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_13.1470432441236.docx</td>
<td>Removes text that was previously moving to Chapter 25.</td>
</tr>
</tbody>
</table>

### Submitter Information Verification

- **Submitter Full Name:** AUT-SSI
- **Organization:** [Not Specified]
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Fri Aug 05 17:26:38 EDT 2016

### Committee Statement

**Committee Statement:** Chapter 13 contains the specific requirements for the installation of CMSA sprinklers that were previously contained in the 2016 Sections 8.4 and 8.11. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

**Response Message:**
Chapter 13 Protection of Miscellaneous and Low-Piled Storage

13.1 General. —being deleted with an FR

13.1.1 being deleted with an FR

This chapter shall apply to any of the following situations:
(1) Miscellaneous storage of Class I through Class IV commodities up to 12 ft (3.7 m) in height
(2) Miscellaneous storage of Group A plastics up to 12 ft (3.7 m) in height
(3) Miscellaneous storage of rubber tires up to 12 ft (3.7 m) in height
(4) Miscellaneous storage of rolled paper up to 12 ft (3.7 m) in height
(5) Storage of Class I through Class IV commodities up to 12 ft (3.7 m) in height as directed by 14.2.3.1 and 16.2.1.2.1
(6) Storage of Group A plastics up to 5 ft (1.5 m) in height as directed by 15.2.1 and 17.2.1.1

13.1.2 Hose Connections. [move to 4.4]

Hose connections shall not be required for the protection of miscellaneous storage.

13.1.3 Solid Shelf Racks. —being deleted with an FR

13.1.3.1 [move to 4.3.1.5.1]

For storage of Class I through Class IV 12 ft (3.7 m) or less in height that does not meet the definition of Miscellaneous Storage that is on solid shelf racks, in-rack sprinklers shall be provided in accordance with 16.1.6, and ceiling sprinkler protection shall be provided in accordance with Chapter 13.

13.1.3.2 [move to 4.3.1.5.2]

For storage of Group A Plastics 5 ft (1.5 m) or less in height that does not meet the definition of Miscellaneous Storage that is on solid shelf racks, in-rack sprinklers shall be provided in accordance with 17.1.5, and ceiling sprinkler protection shall be provided in accordance with Chapter 13.

13.2 Design Basis. Being deleted with an FR

13.2.1 being deleted with an FR

The protection criteria shall be selected from Table 13.2.1 and Figure 13.2.1.

Table 13.2.1 Discharge Criteria for Miscellaneous Storage Up to 12 ft (3.7 m) in Height

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Type of Storage</th>
<th>Storage Height ft</th>
<th>Maximum Ceiling Height m</th>
<th>Design Curve Figure 13.2.1 Note</th>
<th>Inside Hose gp m</th>
<th>L/min</th>
<th>Total Combined Inside and Outside Hose gp m</th>
<th>L/min</th>
<th>Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I to Class IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commodity</td>
<td>Type of Storage</td>
<td>Storage Height</td>
<td>Maximum Ceiling Height</td>
<td>Design Curve Figure</td>
<td>Inside Hose</td>
<td>Total Combined Inside and Outside Hose</td>
<td>Duration (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>--------------------</td>
<td>------------</td>
<td>----------------------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft  m</td>
<td>ft  m</td>
<td></td>
<td></td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>≤1/2</td>
<td>≤3.7</td>
<td>—</td>
<td>—</td>
<td>OH1</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Class II</td>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>≤1/0</td>
<td>≤3.0</td>
<td>—</td>
<td>—</td>
<td>OH1</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Class II</td>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>&gt;1/0 to ≤1/2</td>
<td>&gt;3.0 to ≤3.7</td>
<td>—</td>
<td>—</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Class III</td>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>≤1/2</td>
<td>≤3.7</td>
<td>—</td>
<td>—</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Class IV</td>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>≤1/0 to ≤1/2</td>
<td>&gt;3.0 to ≤3.7</td>
<td>32</td>
<td>10</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Group A Plastic Storage</td>
<td>Cartoned Unexpanded and expanded</td>
<td>Solid-piled, palletized, bin box, shelf, single-</td>
<td>≤5</td>
<td>≤1.5</td>
<td>—</td>
<td>—</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;5/0 to &gt;1.5</td>
<td>15</td>
<td>4.6</td>
<td>EH1</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500</td>
</tr>
<tr>
<td>Commodity</td>
<td>Type of Storage</td>
<td>Storage Height</td>
<td>Maximum Ceiling Height</td>
<td>Design Curve Figure 13.2.1</td>
<td>Inside Hose</td>
<td>Total Combined Inside and Outside Hose</td>
<td>Duration (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------</td>
<td>----------------</td>
<td>-------------------------</td>
<td>-----------------------------</td>
<td>------------</td>
<td>--------------------------------------</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft m</td>
<td>ft m</td>
<td></td>
<td>gp m L/mi n</td>
<td>gp m L/mi n</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>double-, multiple-, row rack, and back-to-back shelf storage</td>
<td>≤1</td>
<td>≤3.0</td>
<td>≤1</td>
<td>≤3.0</td>
<td>0</td>
<td>0</td>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;5 to ≤10</td>
<td>&gt;1.5 to ≤3.0</td>
<td>20</td>
<td>6.1</td>
<td>EH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500</td>
<td>1900</td>
</tr>
<tr>
<td></td>
<td>&gt;11 to ≤15</td>
<td>&gt;3.0 to ≤3.7</td>
<td>17</td>
<td>5.2</td>
<td>EH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500</td>
<td>1900</td>
</tr>
<tr>
<td>Solid- piled, palletized, bin box, shelf, and back-to-back shelf storage</td>
<td>&gt;11</td>
<td>&gt;3.0 to ≤3.7</td>
<td>32</td>
<td>10</td>
<td>EH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500</td>
<td>1900</td>
</tr>
<tr>
<td>Single-, double-, multiple- row rack</td>
<td>&gt;11</td>
<td>&gt;3.0 to ≤3.7</td>
<td>32</td>
<td>10</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
<td>950</td>
</tr>
<tr>
<td>Exposed</td>
<td>Unexpanded and expanded</td>
<td>≤5</td>
<td>≤1.5</td>
<td>—</td>
<td>—</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250</td>
</tr>
<tr>
<td>Commodity</td>
<td>Type of Storage</td>
<td>Storage Height</td>
<td>Maximum Ceiling Height</td>
<td>Design Curve Figure 13.2.1</td>
<td>Inside Hose</td>
<td>Total Combined Inside and Outside Hose</td>
<td>Duration (minutes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>----------------------------</td>
<td>-------------</td>
<td>----------------------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>shelf storage</td>
<td></td>
<td></td>
<td></td>
<td>gp L/min</td>
<td>gp L/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid-piled, palletized, bin box, shelf, and back-to-back shelf storage</td>
<td>&gt;5 to ≤8</td>
<td>&gt;1.5 to ≤2.4</td>
<td>28</td>
<td>8.5</td>
<td>EH2</td>
<td>0, 50</td>
<td>0, 190, 380</td>
<td>500, 1900</td>
<td>120</td>
</tr>
<tr>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>&gt;5 to ≤10</td>
<td>&gt;1.5 to ≤3.0</td>
<td>15</td>
<td>4.6</td>
<td>EH2</td>
<td>0, 50</td>
<td>0, 190, 380</td>
<td>500, 1900</td>
<td>120</td>
</tr>
<tr>
<td>Solid-piled, palletized, bin box, shelf, single-, double-, multiple-row rack, and back-to-back shelf storage</td>
<td>&gt;5 to ≤10</td>
<td>&gt;1.5 to ≤3.0</td>
<td>20</td>
<td>6.1</td>
<td>EH2</td>
<td>0, 50</td>
<td>0, 190, 380</td>
<td>500, 1900</td>
<td>120</td>
</tr>
<tr>
<td>Commodity</td>
<td>Type of Storage</td>
<td>Storage Height</td>
<td>Maximum Ceiling Height</td>
<td>Design Curve Figure</td>
<td>Note</td>
<td>Inside Hose</td>
<td>Total Combined Inside and Outside Hose</td>
<td>Duration (minutes)</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>------</td>
<td>-------------</td>
<td>----------------------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expanded</td>
<td>&gt;5 ft, to ≤1 m</td>
<td>&gt;1.5 ft, to ≤3 m</td>
<td>+1 level of in-rack</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250, 950, 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid-piled, palletized, bin box, shelf, and back-to-back shelf storage</td>
<td>&gt;1 ft, to ≤1 m</td>
<td>&gt;3 m, to ≤3.7 m</td>
<td>EH2</td>
<td></td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500, 1900, 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unexpanded and expanded</td>
<td>&gt;1 ft, to ≤1 m</td>
<td>&gt;3 m, to ≤3.7 m</td>
<td>EH2</td>
<td></td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>500, 1900, 120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single-, double-, multiple-row rack</td>
<td>&gt;1 ft, to ≤1 m</td>
<td>&gt;3 m, to ≤3.7 m</td>
<td>+1 level of in-rack</td>
<td>OH2</td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250, 950, 90</td>
<td></td>
</tr>
</tbody>
</table>

Tire Storage

<table>
<thead>
<tr>
<th>Tires</th>
<th>On floor, on side</th>
<th>&gt;5 ft, to ≤1 m</th>
<th>&gt;1.5 ft, to ≤3 m</th>
<th>EH1</th>
<th></th>
<th>0, 50, 100</th>
<th>0, 190, 380</th>
<th>500, 1900, 120</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On floor, on tread, or on side</td>
<td>≤5 m</td>
<td>≤1.5 m</td>
<td>OH2</td>
<td></td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250, 950, 90</td>
</tr>
<tr>
<td></td>
<td>Single-, double-, or multiple-row racks</td>
<td>≤5 m</td>
<td>≤1.5 m</td>
<td>OH2</td>
<td></td>
<td>0, 50, 100</td>
<td>0, 190, 380</td>
<td>250, 950, 90</td>
</tr>
<tr>
<td>Commodity</td>
<td>Type of Storage</td>
<td>Storage Height</td>
<td>Maximum Ceiling Height</td>
<td>Design Curve Figure 13.2.1</td>
<td>Inside Hose</td>
<td>Total Combined Inside and Outside Hose</td>
<td>Duration (minutes)</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>----------------------------</td>
<td>-------------</td>
<td>----------------------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>inside hose</td>
<td>ft  m</td>
<td>ft  m</td>
<td></td>
<td>gp m L/min</td>
<td>gp m L/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single-row rack, portable, on tread or on side</td>
<td>&gt;5 to ≤1 2</td>
<td>&gt;1. 5 to ≤3. 7</td>
<td>32 10</td>
<td>EH1</td>
<td>0, 50, 100 0, 190, 380 500 1900</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single-row rack, fixed, on tread or on side</td>
<td>&gt;5 to ≤1 2</td>
<td>&gt;1. 5 to ≤3. 7</td>
<td>32 10</td>
<td>EH1</td>
<td>0, 50, 100 0, 190, 380 500 1900</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rolled Paper Storage</td>
<td>On end</td>
<td>≤1 0</td>
<td>30 9.1</td>
<td>OH2</td>
<td>0, 50, 100 0, 190, 380 250 950</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Heavyweight and mediumweight</td>
<td>On end</td>
<td>≤1 0</td>
<td>≤3. 0</td>
<td>30 9.1</td>
<td>EH1</td>
<td>0, 50, 100 0, 190, 380 250 950</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Tissue and lightweight</td>
<td>On end</td>
<td>≤1 0</td>
<td>≤3. 0</td>
<td>30 9.1</td>
<td>EH1</td>
<td>0, 50, 100 0, 190, 380 250 950</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

Figure 13.2.1 Miscellaneous Storage Up to 12 ft (3.7 m) in Height — Design Curves (see Table 13.2.1).
13.2.2—being deleted with an FR
Installation criteria as permitted by NFPA 13 and design criteria and modifiers as permitted by the density/area method of Chapter 11 for ordinary hazard Group 1, ordinary hazard Group 2, extra hazard Group 1, and extra hazard Group 2 occupancies shall be applicable.

13.2.3 [move to 19.3.3.2.7]
Where K-11.2 (160) or larger sprinklers are used with EH1 or EH2 design curves from Figure 13.2.1, the design area shall be permitted to be reduced by 25 percent but not below 2000 ft² (186 m²), regardless of temperature rating.

13.3 In-Rack Sprinklers. being deleted with an FR

13.3.1 General. being deleted with an FR
In-rack sprinklers required by Table 13.2.1 shall meet the requirements of this section and the applicable storage protection and arrangement sections of this chapter.

13.3.2 Discharge Criteria. being deleted with an FR
In-rack sprinklers shall have a K-factor of 5.6 (80) or larger and operate at a minimum of 15 psi (1 bar).

13.3.3 Water Demand. being deleted with an FR
Where one level of in-rack sprinklers is installed for miscellaneous storage, water demand shall be based on simultaneous operation of the hydraulically most demanding four adjacent sprinklers.

13.3.4 In-Rack Sprinkler Locations. —being deleted with an FR

13.3.4.1 being deleted with an FR
In-rack sprinklers for miscellaneous storage shall be located at the first tier level at or above one-half of the storage height.
13.3.4.2 being deleted with an FR
Horizontal spacing of in-rack sprinklers shall not exceed 8 ft (2.4 m).

13.3.4.3 being deleted with an FR
In-rack sprinklers shall be located in the longitudinal flue at the intersection of the transverse flues while not exceeding the maximum spacing rules.

13.3.4.3.1 being deleted with an FR
If no longitudinal flue is provided in single- and double-row racks, in-rack sprinklers shall be located within 12 in. (300 mm) of the center of the rack while not exceeding the maximum spacing.

13.3.4.4 being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

13.3.4.5 being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.
See the attached file for the reorganization of existing Chapter 14.

### Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_14.docx</td>
<td></td>
</tr>
</tbody>
</table>

### Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City:
State:
Zip:
Submittal Date: Fri Aug 05 17:27:34 EDT 2016

### Committee Statement

Committee Statement: Chapter 14 contains the specific requirements for the installation of ESFR sprinklers that were previously contained in the 2016 Sections 8.4 and 8.12. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.
14.1 General. —being deleted with an FR

14.1.1 —being deleted with an FR
This chapter shall apply to palletized, solid-piled, bin box, shelf, or back-to-back shelf storage for a broad range of combustibles.

14.1.2 —being deleted with an FR
The requirements of Chapter 12 shall apply unless modified by this chapter.

14.1.3 —being deleted with an FR
Protection criteria for Group A plastics shall be permitted to be used for Class I, II, III, and IV commodities with the same storage and height configuration.

14.2* Control Mode Density/Area Sprinkler Protection Criteria for Palletized, Solid-Piled, Bin Box, Shelf, or Back-to-Back Shelf Storage of Class I Through Class IV Commodities. [move to 21.2]

14.2.1 [move to 21.2.1]
Protection for Class I through Class IV commodities in the following configurations shall be provided in accordance with this section:
(1) Nonencapsulated commodities that are solid-piled, palletized, or bin box storage up to 30 ft (9.1 m) in height
(2) Nonencapsulated commodities on shelf storage up to 15 ft (4.6 m) in height
(3) *Encapsulated commodities that are solid-piled, palletized, bin box, or shelf storage up to 15 ft (4.6 m) in height
(4) Back-to-back shelf storage up to 15 ft (4.6 m) in height
(5) Encapsulated storage of solid-piled and palletized Class I through IV commodities permitted in accordance with 14.2.5 for storage heights over 15 ft (4.6 m) up to and including 20 ft (6.1 m)

14.2.2 —being deleted with an FR
The area and density for the hydraulically remote area and the water supply shall be determined as specified in 14.2.3 for storage up to and including 12 ft (3.7 m) and 14.2.4 for storage over 12 ft (3.7 m).

14.2.3 Protection Criteria for Palletized, Solid-Piled, Bin Box, Shelf, or Back-to-Back Shelf Storage of Class I Through Class IV Commodities Stored Up to 12 ft (3.7 m) in Height. — being deleted with an FR

14.2.3.1 —being deleted with an FR
The protection criteria for storage up to and including 12 ft (3.7 m) shall be the same as for miscellaneous storage selected from Chapter 13.

14.2.3.2 —being deleted with an FR
The protection criteria in Chapter 13 shall be acceptable for storage of Class I to Class IV commodities up to and including 12 ft (3.7 m) in height (see Table 13.2.1).

14.2.4 Protection Criteria for Palletized, Solid-Piled, Bin Box, Shelf, or Back-to-Back Shelf Storage of Class I Through Class IV Commodities Stored Over 12 ft (3.7 m) in Height. [move to 21.2.2]

14.2.4.1 [move to 21.2.2.1]
Where using ordinary temperature-rated sprinklers, a single point shall be selected from the appropriate commodity curve on Figure 14.2.4.1.

Figure 14.2.4.1 Sprinkler System Design Curves for 20 ft (6.1 m) High Storage — Ordinary Temperature-Rated Sprinklers.

14.2.4.2 [move to 21.2.2.2]
Where using high temperature-rated sprinklers, a single point shall be selected from the appropriate commodity curve on Figure 14.2.4.2.

Figure 14.2.4.2 Sprinkler System Design Curves for 20 ft (6.1 m) High Storage — High Temperature-Rated Sprinklers.
14.2.4.3 [move to 21.2.2.3]
The densities selected in accordance with 14.2.4.1 or 14.2.4.2 shall be modified in accordance with Figure 14.2.4.3 without revising the design area.

Figure 14.2.4.3 Ceiling Sprinkler Density vs. Storage Height.

14.2.4.4 [move to 21.2.2.4]
In the case of metal bin boxes with face areas not exceeding 16 ft² (1.5 m²) and metal closed shelves with face areas not exceeding 16 ft² (1.5 m²), the area of application shall be permitted to be reduced by 33 percent, provided the minimum requirements of 14.2.4.5 and 14.2.4.6 are met.

14.2.4.5 [move to 21.2.2.5]
For storage greater than 12 ft (3.7 m), the design density shall not be less than 0.15 gpm/ft² (6.1 mm/min), and the design area shall not be less than 2000 ft² (186 m²) for wet systems or 2600 ft² (242 m²) for dry systems for any commodity, class, or group.

14.2.4.6 [move to 21.2.2.6]
For storage greater than 12 ft (3.7 m), the sprinkler design density for any given area of operation for a Class III or Class IV commodity, calculated in accordance with 14.2.4, shall not be less than the density for the corresponding area of operation for ordinary hazard Group 2.
14.2.4.7  [move to 21.2.2.7]
For back-to-back shelf storage, the design density shall be taken from Figure 14.2.4.1 for storage
greater than 12 ft (3.7 m) and up to 15 ft (4.6 m) with no reduction for design density referenced
in Figure 14.2.4.3.

14.2.5  Encapsulated Storage Over 15 ft (4.6 m) in Height Up to and Including 20 ft (6.1 m)
in Height. [move to 21.2.3]

14.2.5.1  [move to 21.2.3.1]
Encapsulated storage over 15 ft (4.6 m) in height up to and including 20 ft (6.1 m) in height shall
be limited to solid-piled and palletized storage.

14.2.5.2  [move to 21.2.3.2]
Encapsulated storage over 15 ft (4.6 m) in height up to and including 20 ft (6.1 m) in height shall
be protected by sprinklers with a K-factor of 11.2 (160) or larger.

14.2.5.3  [move to 21.2.3.3]
Encapsulated storage over 15 ft (4.6 m) in height up to and including 20 ft (6.1 m) in height of
Class I commodity shall be protected with a density/area of at least 0.46 gpm/ft² over 2000 ft²
(18.7 mm/min over 186 m²).

14.2.5.4  [move to 21.2.3.4]
Encapsulated storage over 15 ft (4.6 m) in height up to and including 20 ft (6.1 m) in height of
Class II commodity shall be protected with a density/area of at least 0.53 gpm/ft² over 2000 ft²
(21.6 mm/min over 186 m²).

14.2.5.5  [move to 21.2.3.5]
Encapsulated storage over 15 ft (4.6 m) in height up to and including 20 ft (6.1 m) in height of
Class III and Class IV commodity shall be protected with a density/area of at least 0.6 gpm/ft²
over 2000 ft² (24.4 mm/min over 186 m²).

14.3  CMSA Sprinklers for Palletized or Solid-Piled Storage of Class I Through Class IV
Commodities. —being deleted with an FR

14.3.1  [move to 22.2]
Protection of palletized and solid-piled storage of Class I through Class IV commodities shall be
in accordance with Table 14.3.1.

Table 14.3.1 CMSA Sprinkler Design Criteria for Palletized and Solid-Piled Storage of Class I
Through Class IV Commodities (Encapsulated and Nonencapsulated)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Commodity Class</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/ Roof Height</th>
<th>K-Factor/ Orientation</th>
<th>Type of System</th>
<th>Number of Design Sprinklers</th>
<th>Minimum Operating Pressure psi bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palletized</td>
<td>Class I or II</td>
<td>25 7.6 30 9.1</td>
<td>Wet</td>
<td>15 25 1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configuration</td>
<td>Commodity Class</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/ Roof Height ft</td>
<td>K-Factor/ Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Dry</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class IV</td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Configuration</td>
<td>Commodity Class</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/Roof Height</td>
<td>K-Factor/Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>---------------------</td>
<td>-----------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft m ft m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid piled</td>
<td>Class I or II</td>
<td>30 9.1 35 11</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 11 40 12</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 30</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 6.1 30 9.1</td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15 10</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25 15</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 16</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 7.6 30 9.1</td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15 10</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 9.1 35 11</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 11 40 12</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 30</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>20 6.1 30 9.1</td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15 15</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25 15</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 16</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 7.6 30 9.1</td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15 22</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 9.1 35 11</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 11 40 12</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 30</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Class IV</td>
<td>20 6.1 30 9.1</td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15 50</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15 16</td>
</tr>
<tr>
<td>Configuration</td>
<td>Commodity Class</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/Roof Height ft</td>
<td>K-Factor / Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

14.3.2 [move to 22.1.4]
Protection shall be provided as specified in Table 14.3.1 or appropriate NFPA standards in terms of minimum operating pressure and the number of sprinklers to be included in the design area.

14.3.3 Open Wood Joist Construction. [move to 22.1.5]

14.3.3.1 [move to 22.1.5.1]
Where CMSA sprinklers are installed under open wood joist construction, their minimum operating pressure shall be 50 psi (3.4 bar) for a K-11.2 (160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (240) sprinkler.

14.3.3.2—being deleted with an FR
For CMSA sprinklers, where each joist channel of open wood joist construction is fully firestopped to its full depth at intervals not exceeding 20 ft (6.1 m), the lower pressures specified in Table 14.3.1 shall be permitted to be used.

14.3.4 —being deleted with an FR
Hose stream allowance and water supply duration requirements shall be in accordance with Table 14.3.1.

14.3.5 Preaction Systems. [move to 22.1.5.3]

14.3.5.1 [move to 22.1.5.3.1]
For the purpose of using Table 14.3.1, preaction systems shall be classified as dry pipe systems.

14.3.6 [move to 22.1.5.4]
Building steel shall not require special protection where Table 14.3.1 are applied as appropriate for the storage configuration.

14.4 Early Suppression Fast-Response (ESFR) Sprinklers for Palletized or Solid-Piled Storage of Class I Through Class IV Commodities. [move to 23.3]
Protection of palletized and solid-piled storage of Class I through Class IV commodities shall be in accordance with Table 14.4.1.

Table 14.4.1 ESFR Protection of Palletized and Solid-Piled Storage of Class I Through Class IV Commodities

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>Nominal K-Factor</th>
<th>Orientation</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td>psi</td>
<td>bar</td>
</tr>
<tr>
<td>Class I, II, III, or IV, encapsulated and nonencapsulated (no open-top containers)</td>
<td>20</td>
<td>6.1</td>
<td>25</td>
<td>7.6</td>
<td>14.0 (200)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
<td>14.0 (200)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>10</td>
<td>35</td>
<td>11</td>
<td>14.0 (200)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>11</td>
<td>40</td>
<td>12</td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td>Commodity</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/Roof Height</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>45</td>
<td>14</td>
<td></td>
<td>22.4 (320) Pendent</td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>45</td>
<td>14</td>
<td></td>
<td>25.2 (360) Pendent</td>
</tr>
</tbody>
</table>

14.4.2 [move to 23.1.4]
ESFR sprinkler systems shall be designed such that the minimum operating pressure is not less than that indicated in Table 14.4.1 for commodity, storage height, and building height involved.

14.4.3 —being deleted with an FR
The design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines.

14.5 Special Design for Palletized, Solid-Piled, Bin Box, or Shelf Storage of Class I Through Class IV Commodities. [move to 21.2.4]

14.5.1 Bin Box and Shelf Storage. [move to 21.2.4.1]

14.5.1.1 [move to 21.2.4.1.1]
Bin box and shelf storage that is over 12 ft (3.7 m) but not in excess of the height limits of 14.2.1 and that is provided with walkways at vertical intervals of not over 12 ft (3.7 m) shall be protected with automatic sprinklers under the walkway(s).

14.5.1.2 [move to 21.2.4.1.2]
Protection shall be as follows:
(1) Ceiling design density shall be based on the total height of storage within the building.
(2) Automatic sprinklers under walkways shall be designed to maintain a minimum discharge pressure of 15 psi (1.0 bar) for the most hydraulically demanding six sprinklers on each level. Walkway sprinkler demand shall not be required to be added to the ceiling sprinkler demand. Sprinklers under walkways shall not be spaced more than 8 ft (2.4 m) apart horizontally.

14.6 High-Expansion Foam — Reduction to Ceiling Density. —being deleted with an FR
A reduction in ceiling density to one-half that required for Class I through Class IV commodities, idle pallets, or plastics shall be permitted without revising the design area, but the density shall be no less than 0.15 gpm/ft² (6.1 mm/min).
See attached file for the reorganization of existing Chapter 15.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_15.docx</td>
<td></td>
</tr>
</tbody>
</table>

Committee Statement:
Chapter 15 contains the specific requirements for the installation of open, special, dry and old style sprinklers that were previously contained in the 2016 Sections 8.4.
Chapter 15  Protection for Palletized, Solid-Piled, Bin Box, Shelf, or Back-to-Back Shelf Storage of Plastic and Rubber Commodities

15.1  General. —being deleted with an FR
This chapter shall apply to palletized, solid-piled, bin box, shelf, or back-to-back shelf storage of plastic and rubber commodities. The requirements of Chapter 12 shall apply unless modified by this chapter.

15.1.1*  Storage Conditions. [move to 22.1.5.5]
The design of the sprinkler system shall be based on those conditions that routinely or periodically exist in a building and create the greatest water demand, which include the following:
(1) Pile height
(2) Clearance to ceiling
(3) Pile stability
(4) Array

15.2*  Control Mode Density/Area Sprinkler Protection Criteria for Palletized, Solid-Piled, Bin Box, Shelf, or Back-to-Back Shelf Storage of Plastic and Rubber Commodities. [move to 21.3]

15.2.1  Storage 5 ft (1.5 m) or Less in Height. —being deleted with an FR
For the storage of Group A plastics stored 5 ft (1.5 m) or less in height, the sprinkler design criteria for miscellaneous storage specified in Chapter 13 shall be used. The protection criteria in Chapter 13 shall be acceptable for storage of Group A plastic commodities up to and including 5 ft (1.5 m) in height. (See Table 13.2.1 for specific Group A plastic storage height protection criteria.)

15.2.2*  Storage Over 5 ft (1.5 m) in Height. —being deleted with an FR

15.2.2.1  [move to 21.3.1]
Protection for plastic and rubber commodities shall be in accordance with Section 15.2. The decision tree shown in Figure 15.2.2.1 shall be used to determine the protection in each specific situation, subject to the following limitations:
(1) Commodities that are stored palletized, solid piled, or in bin boxes up to 25 ft (7.6 m) in height.
(2) Commodities that are stored in shelf storage up to 15 ft (4.6 m) in height.
(3) Commodities that are stored using back-to-back shelf storage up to 15 ft (4.6 m) in height. The minimum aisle width shall be 60 in. (1.5 m). The design criteria shall be in accordance with Table 15.2.2.1. The back-to-back shelf shall have a full height solid vertical transverse barrier of 3/8 in. (10 mm) plywood or particleboard, 22 gauge sheet metal, or equivalent, from face of aisle to face of aisle, spaced at a maximum 45 ft (14 m) interval. The transverse barrier shall be permitted to terminate at the longitudinal barrier.

Table 15.2.2.1 Back-to-Back Shelf Storage of Cartoned Unexpanded Group A Plastics
### Table 15.2.2.1 Decision Tree

<table>
<thead>
<tr>
<th>Storage Height</th>
<th>Ceiling Height</th>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>m</td>
<td>ft</td>
</tr>
<tr>
<td>Over 5 up to 8</td>
<td>1.5/2.4</td>
<td>Up to 14</td>
</tr>
<tr>
<td>Up to 12</td>
<td>3.7</td>
<td>Up to 15</td>
</tr>
<tr>
<td>Up to 12</td>
<td>3.7</td>
<td>Up to 30</td>
</tr>
<tr>
<td>Up to 15</td>
<td>4.6</td>
<td>Up to 30</td>
</tr>
</tbody>
</table>

**Factors affecting protection requirements such as closed/open array, clearance to ceiling, and stable/unstable piles shall be applicable only to storage of Group A plastics. This decision tree also shall be used to determine protection for commodities that are not wholly Group A plastics but contain such quantities and arrangements of the same that they are deemed more hazardous than Class IV commodities.**

**15.2.2.2* [move to 21.3.2]**

Factors affecting protection requirements such as closed/open array, clearance to ceiling, and stable/unstable piles shall be applicable only to storage of Group A plastics. This decision tree also shall be used to determine protection for commodities that are not wholly Group A plastics but contain such quantities and arrangements of the same that they are deemed more hazardous than Class IV commodities.

**15.2.2.3 —being deleted with an FR**

Group B plastics and free-flowing Group A plastics shall be protected in the same manner as a Class IV commodity. (See Chapter 14 for protection of these storage commodities with spray sprinklers.)

**15.2.2.4 —being deleted with an FR**

Group C plastics shall be protected in the same manner as a Class III commodity. (See Chapter 14 for protection of these storage commodities with spray sprinklers.)

**15.2.2.5* [move to 21.3.3]**

Note: Cartons that contain Group A plastic material are permitted to be treated as Class IV commodities under the following conditions:

1. There are multiple layers of corrugation or equivalent outer material that would significantly delay fire involvement of the Group A plastic.
2. The amount and arrangement of Group A plastic material within an ordinary carton would not be expected to significantly increase the fire hazard.
Design areas and densities for the appropriate storage configuration shall be selected from Table 15.2.2.5(a) or Table 15.2.2.5(b) as appropriate.

Table 15.2.2.5(a) Design Densities for Palletized, Solid-Piled, Bin Box, or Shelf Storage of Group A Plastic Commodities (U.S. Customary Units)

<table>
<thead>
<tr>
<th>Maximum Storage Height (ft)</th>
<th>Roof/Ceiling Height (ft)</th>
<th>Density (gpm/ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>&gt;5 to ≤12</td>
<td>Up to 15</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>&gt;15 to 20</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>&gt;20 to 32</td>
<td>0.4</td>
</tr>
<tr>
<td>15</td>
<td>Up to 20</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>&gt;20 to 25</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>&gt;25 to 35</td>
<td>0.45</td>
</tr>
<tr>
<td>20</td>
<td>Up to 25</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>&gt;25 to 30</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>&gt;30 to 35</td>
<td>0.6</td>
</tr>
<tr>
<td>25</td>
<td>Up to 30</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>&gt;30 to 35</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Notes:
1. Minimum clearance between sprinkler deflector and top of storage shall be maintained as required.
2. Column designations correspond to the configuration of plastics storage as follows:
   A: (1) Nonexpanded, unstable
      (2) Nonexpanded, stable, solid unit load
   B: Expanded, exposed, stable
   C: (1) Expanded, exposed, unstable
      (2) Nonexpanded, stable, cartoned
   D: Expanded, cartoned, unstable
   E: (1) Expanded, cartoned, stable
      (2) Nonexpanded, stable, exposed
3. EH1 = Density required by Figure 13.2.1 for Curve EH1
   EH2 = Density required by Figure 13.2.1 for Curve EH2
4. Roof/ceiling height >35 ft is not permitted.

Table 15.2.2.5(b) Design Densities for Palletized, Solid-Piled, Bin Box, or Shelf Storage of Group A Plastic Commodities (S.I. Units)

<table>
<thead>
<tr>
<th>Maximum Storage Height (m)</th>
<th>Roof/Ceiling Height (m)</th>
<th>Density (mm/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>&gt;1.5 to ≤3.6</td>
<td>Up to 4.6</td>
<td>8.1</td>
</tr>
<tr>
<td></td>
<td>&gt;4.6 to 6.1</td>
<td>12.2</td>
</tr>
<tr>
<td></td>
<td>&gt;6.1 to 9.7</td>
<td>16.3</td>
</tr>
<tr>
<td>4.6</td>
<td>Up to 6.1</td>
<td>12.2</td>
</tr>
<tr>
<td></td>
<td>&gt;6.1 to 7.6</td>
<td>16.3</td>
</tr>
<tr>
<td>Maximum Storage Height (m)</td>
<td>Roof/Ceiling Height (m)</td>
<td>Density (mm/min)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>&gt;7.6 to 11</td>
<td>18.3 36.7 28.5 22.4 34.6</td>
</tr>
<tr>
<td></td>
<td>Up to 7.6</td>
<td>16.3 32.6 24.4 18.3 28.5</td>
</tr>
<tr>
<td>6.1</td>
<td>&gt;7.6 to 9.1</td>
<td>18.3 36.7 28.5 22.4 34.6</td>
</tr>
<tr>
<td></td>
<td>&gt;9.1 to 11</td>
<td>24.4 48.9 34.6 28.5 44.8</td>
</tr>
<tr>
<td></td>
<td>Up to 9.1</td>
<td>18.3 36.7 28.5 22.4 34.6</td>
</tr>
<tr>
<td></td>
<td>&gt;9.1 to 11</td>
<td>24.4 48.9 34.6 28.5 44.8</td>
</tr>
</tbody>
</table>

Notes:
(1) Minimum clearance between sprinkler deflector and top of storage shall be maintained as required.
(2) Column designations correspond to the configuration of plastics storage as follows:
   A: (1) Nonexpanded, unstable
       (2) Nonexpanded, stable, solid unit load
   B: Expanded, exposed, stable
   C: (1) Expanded, exposed, unstable
       (2) Nonexpanded, stable, cartoned
   D: Expanded, cartoned, unstable
   E: (1) Expanded, cartoned, stable
       (2) Nonexpanded, stable, exposed
(3) EH1 = Density required by Figure 13.2.1 for Curve EH1
     EH2 = Density required by Figure 13.2.1 for Curve EH2
(4) Roof/ceiling height >35 ft is not permitted.

15.2.2.6 [move to 21.3.4]
The ceiling-only protection criteria specified in Chapter 17 for rack storage of Group A plastic commodities shall be permitted to be used for solid-piled and palletized storage of the same commodity at the same height and clearance to ceiling.

15.2.2.7* [move to 21.3.5]
For Table 15.2.2.5(a) and Table 15.2.2.5(b), the design areas shall be as follows:
(1) The area shall be a minimum of 2500 ft² (232 m²).
(2) Where Table 15.2.2.5(a) and Table 15.2.2.5(b) allow densities and areas to be selected in accordance with Curve EH1 and Curve EH2 of Figure 13.2.1, any density/area from the curves in Figure 13.2.1 shall be permitted. When selecting a point from the EH1 or EH2 density/area curves of Figure 13.2.1, the following area reductions shall be permitted:
   (a) For K-8.0 (115) sprinklers used with Curve EH1, the design area shall be permitted to be reduced by 25 percent, but not below 2000 ft² (186 m²), where high temperature sprinklers are used.
   (b) For K-11.2 (160) or larger sprinklers, the design area shall be permitted to be reduced by 25 percent, but not below 2000 ft² (186 m²), regardless of temperature rating.
   (3) For closed arrays, the area shall be permitted to be reduced to 2000 ft² (186 m²).

15.2.2.8* [move to 21.3.6]
Interpolation of densities between storage heights shall be permitted.

15.2.2.8.1 [move to 21.3.6.1]
Densities shall be based on the 2500 ft² (232 m²) design area.

15.2.2.8.2 [move to 21.3.6.2]
Interpolation of ceiling/roof heights shall not be permitted.

15.2.2.9 [move to 21.3.7]
For storage of Group A plastics between 5 ft (1.5 m) and 12 ft (3.7 m) in height, the installation requirements for extra hazard systems shall apply.

15.3 CMSA Sprinklers for Palletized or Solid-Piled Storage of Group A Plastic Commodities. —being deleted with an FR

15.3.1 [move to 22.3]
Protection of palletized and solid-piled storage of unexpanded and expanded Group A plastic commodities shall be in accordance with Table 15.3.1.

Table 15.3.1 CMSA Sprinkler Design Criteria for Palletized and Solid-Piled Storage of Group A Plastic Commodities

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity Class</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/ Roof of Height</th>
<th>K-Factor/Orientation Type of System</th>
<th>Number of Design Sprinklers</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft m</td>
<td>ft m</td>
<td></td>
<td></td>
<td>psi bar</td>
</tr>
<tr>
<td>Palletized</td>
<td>Cartoned unexpanded plastics</td>
<td>20 6.1 30 9.1</td>
<td>11.2 (160) Upright Wet</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 7.6 30 9.1</td>
<td>16.8 (240) Upright Wet</td>
<td>15</td>
<td>22</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 9.1 35 11</td>
<td>19.6 (280) Pendent Wet</td>
<td>15</td>
<td>16</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 11 40 12</td>
<td>19.6 (280) Pendent Wet</td>
<td>15</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td>Solid piled</td>
<td>Cartoned unexpanded plastics</td>
<td>20 6.1 30 9.1</td>
<td>11.2 (160) Upright Wet</td>
<td>15</td>
<td>50</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright Wet</td>
<td>15</td>
<td>22</td>
<td>1.5</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity Class</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof of Height</td>
<td>K-Factor/Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft  m</td>
<td>ft  m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 7.6</td>
<td>30 9.1</td>
<td>16.8 (240) Upright Wet 15 22 1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cartoned or exposed expanded plastics</td>
<td>18 5.5</td>
<td>26 7.9</td>
<td>11.2 (160) Upright Wet 15 50 3.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 6.1</td>
<td>30 9.1</td>
<td>16.8 (240) Upright Wet 15 22 1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid piled</td>
<td>Cartoned or exposed unexpanded plastics</td>
<td>20 6.1</td>
<td>30 9.1</td>
<td>11.2 (160) Upright Wet 15 50 3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 7.6</td>
<td>30 9.1</td>
<td>16.8 (240) Upright Wet 15 22 1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15.3.2 — being deleted with an FR
Protection shall be provided as specified in Table 15.3.1 or appropriate NFPA standards in terms of minimum operating pressure and the number of sprinklers to be included in the design area.

15.3.3 Open Wood Joist Construction. — being deleted with an FR

15.3.3.1 — being deleted with an FR
Where CMSA sprinklers are installed under open wood joist construction, their minimum operating pressure shall be 50 psi (3.4 bar) for a K-11.2 (160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (240) sprinkler.

15.3.3.2 — being deleted with an FR
Where each joist channel of open wood joist construction is fully firestopped to its full depth at intervals not exceeding 20 ft (6.1 m), the lower pressures specified in Table 15.3.1 shall be permitted to be used.

**15.3.4 Preaction Systems. —being deleted with an FR**

For the purpose of using Table 15.3.1, preaction systems shall be classified as dry pipe systems.

**15.3.5 —being deleted with an FR**

Building steel shall not require special protection where Table 15.3.1 is applied as appropriate for the storage configuration.

**15.4 Early Suppression Fast-Response (ESFR) Sprinklers for Palletized or Solid-Piled Storage of Group A Plastic Commodities. [move to 23.4]**

**15.4.1 [move to 23.4.2]**

Protection of palletized and solid-piled storage of cartoned or exposed unexpanded plastic and cartoned expanded or exposed expanded plastic shall be in accordance with Table 15.4.1.

Table 15.4.1 ESFR Protection of Palletized and Solid-Piled Storage of Group A Plastic Commodities

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/ Roof Height</th>
<th>Nominal K-Factor</th>
<th>Orientation</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palletized and solid-piled storage (no open-top containers)</td>
<td>Cartoned unexpanded plastic</td>
<td>20 6.1</td>
<td>25 7.6</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35 2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25 1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15 1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30 9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35 2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25 1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15 1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>75 5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>52 3.6</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/Roof Height</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>20</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20.0 (200)</td>
<td>Upright/pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/pendent</td>
<td>35</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Upright/pendent</td>
<td>60</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/pendent</td>
<td>42</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Upright or pendent</td>
<td>75</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>35</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>20</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td></td>
</tr>
</tbody>
</table>

Note: The pressures are in psi and bar.
<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/roof Height</th>
<th>Nominal K-Factor</th>
<th>Orientation</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
<td>14</td>
<td>45</td>
<td>14</td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>11</td>
<td>35</td>
<td>11</td>
<td>14.0 (200)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>30</td>
<td>9.1</td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>12</td>
<td>40</td>
<td>12</td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>10.7</td>
<td>35</td>
<td>10.7</td>
<td>16.8 (240)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
<td>14</td>
<td>45</td>
<td>14</td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>12.2</td>
<td>45</td>
<td>14</td>
<td>22.4 (320)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
</tr>
<tr>
<td>Exposed unexpanded plastic</td>
<td></td>
<td>20</td>
<td>6.1</td>
<td>25</td>
<td>7.6</td>
<td>14.0 (200)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/Roof Height ft</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
<td>------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>30</td>
<td>9.1</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>35</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>9.1</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>35</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>75</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>9.7</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>60</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>42</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>75</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>75</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>50</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>11</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof Height</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft m</td>
<td>ft m</td>
<td></td>
<td></td>
<td>psi bar</td>
</tr>
<tr>
<td>Cartoned expanded</td>
<td></td>
<td>20 6.1</td>
<td>25 7.6</td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td>expanded plastic</td>
<td></td>
<td>30 9.1</td>
<td>25 7.6</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35 2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 9.1</td>
<td></td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35 2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 10</td>
<td></td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>60 4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>42 2.9</td>
</tr>
<tr>
<td>Exposed* expanded</td>
<td></td>
<td>25 7.6</td>
<td>40 12</td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>60 4.1</td>
</tr>
<tr>
<td>expanded plastic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Applies to closed array storage only.

**15.4.2 [move to 23.1.6.1]**
ESFR sprinkler systems shall be designed such that the minimum operating pressure is not less than that indicated in Table 15.4.1 for type of storage, commodity, storage height, and building height involved.

**15.4.3 —being deleted with an FR**
The design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines.

**15.4.4 Special Design for Palletized, Solid-Piled, Bin Box, or Shelf Storage of Group A Plastic Commodities. (Reserved) —being deleted with an FR**

**15.5 High-Expansion Foam — Reduction in Ceiling Density. [move to 20.9.2.1]**
A reduction in ceiling density to one-half that required for Class I through Class IV commodities, idle pallets, or plastics shall be permitted without revising the design area, but the density shall be no less than 0.15 gpm/ft² (6.1 mm/min).
See attached file for the reorganization of existing Chapter 16.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_16.1470432609329.1472648035989.1475091632835.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City:
State:
Zip:
Submittal Date: Fri Aug 05 17:29:28 EDT 2016

Committee Statement

Committee Statement: Chapter 16 is a compilation of Chapter 6 and 8 consolidating requirements for installation of pipe, valves and appurtenances.
Response Message: N
Chapter 16 Protection of Rack Storage of Class I Through Class IV Commodities

16.1 General. — being deleted with an FR

16.1.1 – being deleted with an FR
This section shall apply to storage of materials representing the broad range of combustibles stored in racks. The requirements of Chapter 12 shall apply unless modified by this chapter. (See Section C.9.)

16.1.2* Sprinkler Protection Criteria. being deleted with an FR

16.1.2.1 – being deleted with an FR
Sprinkler protection criteria for the storage of materials on racks shall be in accordance with Section 16.2 for storage up to 25 ft (7.6 m) and Section 16.3 for storage over 25 ft (7.6 m).

16.1.2.2* [move to 20.10.2]
Protection criteria for Group A plastics shall be permitted for the protection of the same storage height and configuration of Class I, II, III, and IV commodities.

16.1.2.3* [move to 22.1.6]
The ceiling design criteria for single-, double-, and multiple-row racks in Chapter 16 shall be based on open rack configurations as defined in 3.9.3.7.4.

16.1.2.4 Alternative Protection. [move to 20.16]
Class I, II, III, IV commodities requiring a greater level of protection than is available from the overhead sprinkler system shall be permitted to be protected in accordance with 16.1.2.4.1 through 16.1.2.4.7.

16.1.2.4.1 [move to 20.16.1.1]
Where the storage rack will not be solely dedicated to the storage of commodities requiring a greater level of protection than is available from the overhead sprinkler system, either of the following shall apply:
(1) Extend the protection prescribed by 16.1.2.4 horizontally one pallet load in all directions beyond the commodity storage area requiring the higher level of protection.
(2) Install a vertical barrier to segregate the commodities requiring the higher level of protection from any adjacent commodities.

16.1.2.4.2 [move to 20.16.1.2]
Commodities that can be protected by the ceiling-level sprinkler system shall be permitted to be stored vertically above and horizontally adjacent to the portions of the storage rack equipped as prescribed by 16.1.2.4.

16.1.2.4.3 Horizontal Barriers. [move to 20.16.1.3]
Horizontal barriers shall be installed at every tier level of the dedicated storage rack where the rack is equipped with solid shelves.
16.1.2.4.3.1 [move to 20.16.1.3.1]
Where the dedicated storage rack is open-frame, horizontal barriers shall be installed at vertical increments not exceeding 12 ft (3.6 m).

16.1.2.4.3.2 [move to 20.16.1.3.2]
The barriers shall span horizontally so that all flue spaces within the rack bay are covered.

16.1.2.4.3.3 [move to 20.16.1.3.3]
A maximum 3 in. (75 mm) wide gap shall be permitted at rack uprights.

16.1.2.4.3.4 [move to 20.16.1.3.4]
The solid barrier shall be installed on a horizontal plane within a rack, beneath which in-rack sprinklers shall be installed, as follows:
(1) The barrier shall be constructed of minimum 22 gauge (0.7 mm) sheet metal or of minimum 3/8 in. (10 mm) plywood.
(2) The barrier shall extend to both aisle faces of the racks, covering up both the longitudinal and the transverse flue spaces of the rack bays in which they are installed.
(3) The barrier shall be fitted to within 3 in. (75 mm) of any vertical rack member or other equipment that would create an opening, such as vertical in-rack sprinkler pipe drops.

16.1.2.4.4 [move to 20.16.1.4]
In-Rack Sprinklers. [move to 20.16.1.4]
Minimum K-8.0 (K-115) quick-response sprinklers (ceiling-level or in-rack) shall be installed beneath each horizontal barrier. The deflector of the sprinkler shall be located as close to the underside of the horizontal barrier as possible.

16.1.2.4.4.1 Single-Row Racks. [move to 20.16.1.4.1]

(A)
For single-row racks, sprinklers shall be installed at each rack upright and at each rack mid-bay as shown in Figure 16.1.2.4.4.1(A).

Figure 16.1.2.4.4.1(A) Alternative Protection for Single-Row Racks.
(B) The maximum linear spacing between sprinklers shall not exceed 5 ft (1.5 m).

16.1.2.4.4.2 Double-Row Racks. [move to 20.16.1.4.2]

(A) For double-row racks, sprinklers shall be installed at each rack upright within the longitudinal flue space and at the face of the rack and at the mid-bay face of each rack bay as shown in Figure 16.1.2.4.4.2(A).

Figure 16.1.2.4.4.2(A) Alternative Protection for Double-Row Racks.
The maximum linear spacing between sprinklers shall not exceed 5 ft (1.5 m) at the rack face and 10 ft (3.0 m) within the longitudinal flue space.
16.1.2.4.4.3 Multiple-Row Racks. [move to 20.16.1.4.3]

(A) For multiple-row racks, an alternating sprinkler arrangement shall be installed within adjacent transverse flue spaces as shown in Figure 16.1.2.4.4.3(A), with sprinklers at the face of each flue space.

Figure 16.1.2.4.4.3(A) Alternative Protection for Multiple-Row Racks.
Plan View

Elevation View

5 ft (1.5 m) max

10 ft (3 m) max

Horizontal barrier

.3 in. (75 mm) max gap at rack upright

12 ft (3.7 m) max

12 ft (3.7 m) max

(B)
The maximum linear spacing between sprinklers at the face and at each alternating bay shall not exceed 5 ft (1.5 m) and shall not exceed 10 ft (3.0 m) between sprinklers at every other bay.

16.1.2.4.5 [move to 20.16.1.5]
The design of an in-rack sprinkler system shall be based on a minimum flow of 60 gpm (230 L/min) from the most remote six sprinklers for single-row racks or the most remote eight sprinklers for both double-row and multiple-row racks.

16.1.2.4.6 [move to 20.16.1.6]
The in-rack sprinkler demand shall not be required to be hydraulically balanced with the ceiling-level sprinkler system.

16.1.2.4.7 Ceiling Sprinkler System. [move to 20.16.1.7]
The ceiling-level sprinkler system shall be designed based on the highest commodity hazard not protected by the criteria prescribed by 16.1.2.4.

16.1.3 Movable Racks. [move to 20.5.7.10.1]
Rack storage in movable racks shall be protected in the same manner as multiple-row racks.

16.1.4 Fire Protection of Steel Columns — Columns Within Storage Racks. —being deleted with an FR
See Section C.10.

16.1.4.1* [move to 20.15.1]
Where fireproofing of building columns is not provided and storage heights are in excess of 15 ft (4.6 m), protection of building columns located wholly or partially within the rack footprint inclusive of flue spaces or within 12 in. (300 mm) of the footprint shall be protected in accordance with one of the following:
(1) In-rack sprinklers
(2) Sidewall sprinklers at the 15 ft (4.6 m) elevation, pointed toward one side of the steel column
(3) Provision of ceiling sprinkler density for a minimum of 2000 ft² (186 m²) with ordinary 165°F (74°C) or high-temperature 286°F (140°C) rated sprinklers as shown in Table 16.1.4.1 for storage heights above 15 ft (4.6 m), up to and including 20 ft (6.1 m)
(4) Provision of CMSA or ESFR ceiling sprinkler protection

Table 16.1.4.1 Ceiling Sprinkler Densities for Protection of Steel Building Columns

<table>
<thead>
<tr>
<th>Commodity Classification</th>
<th>4 ft (1.2 m)</th>
<th>Aisle Width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 ft (2.4 m)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gpm/ft²</td>
<td>(L/min)/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gpm/ft²</td>
</tr>
<tr>
<td>Class I</td>
<td>0.37</td>
<td>15.1</td>
</tr>
<tr>
<td>Class II</td>
<td>0.44</td>
<td>17.9</td>
</tr>
<tr>
<td>Class III</td>
<td>0.49</td>
<td>20.0</td>
</tr>
<tr>
<td>Class IV</td>
<td>0.68</td>
<td>27.7</td>
</tr>
</tbody>
</table>
16.1.4.2 [move to 20.15.1.1]
Where storage heights are in excess of 15 ft (4.6 m) and vertical rack members support the building structure, the vertical rack members shall be protected in accordance with one of the options in 16.1.4.1.

16.1.4.3 [move to 20.15.1.2]
The flow from a column sprinkler(s) shall be permitted to be omitted from the sprinkler system hydraulic calculations.

16.1.5 High-Expansion Foam. —being deleted with an FR

16.1.5.1 High-Expansion Foam Ceiling Sprinkler Density. —being deleted with an FR

16.1.5.1.1 [move to 20.9.2.2]
Where high-expansion foam systems are used in combination with ceiling sprinklers, the minimum ceiling sprinkler design density shall be 0.2 gpm/ft² (8.1 mm/min) for Class I, Class II, or Class III commodities or 0.25 gpm/ft² (10.2 mm/min) for Class IV commodities for the most hydraulically remote 2000 ft² (186 m²) operating area.

16.1.5.1.2 [move to 20.9.2.3]
Where high-expansion foam systems are used in combination with ceiling sprinklers, the maximum submergence time shall be 7 minutes for Class I, Class II, or Class III commodities and 5 minutes for Class IV commodities.

16.1.5.1.3 [move to 20.9.2.4]
Where high-expansion foam systems are used for storage over 25 ft (7.6 m) high up to and including 35 ft (11 m) high, they shall be used in combination with ceiling sprinklers.

16.1.5.1.3.1 [move to 20.9.1.5.1]
The maximum submergence time for the high-expansion foam shall be 5 minutes for Class I, Class II, or Class III commodities and 4 minutes for Class IV commodities.

16.1.5.2 [move to 20.9.2.6]
In-rack sprinklers shall not be required where high-expansion foam systems are used in combination with ceiling sprinklers.

16.1.5.3 Detectors for High-Expansion Foam Systems. [move to 20.9.2.7]

16.1.5.3.1 [move to 20.9.2.7.1]
Detectors shall be listed and shall be installed in one of the following configurations:
(1) At the ceiling only where installed at one-half the listed linear spacing [e.g., 15 ft × 15 ft (4.6 m × 4.6 m) rather than at 30 ft × 30 ft (9.1 m × 9.1 m)]; at the ceiling at the listed spacing and in racks at alternate levels
(2) Where listed for rack storage installation and installed in accordance with the listing to provide response within 1 minute after ignition using an ignition source that is equivalent to that used in a rack storage testing program
16.1.5.3.2 [move to 20.9.2.7.2]
Ceiling detectors alone shall not be used where the clearance to ceiling exceeds 10 ft (3.0 m) or
the height of the storage exceeds 25 ft (7.6 m).

16.1.5.4 [move to 20.9.2.7.3]
Detectors for preaction systems shall be installed in accordance with 16.1.5.3.

16.1.6 Solid Shelving. Being deleted by an FR

16.1.6.1 being deleted with an FR
Where solid shelving in single-, double-, and multiple-row racks exceeds 20 ft² (1.9 m²) in area
but does not exceed 64 ft² (5.9 m²) in area, sprinklers shall not be required below every shelf but
shall be installed at the ceiling and below shelves at intermediate levels not more than 6 ft
(1.8 m) apart vertically. (See Section C.11.)

16.1.6.2 being deleted with an FR
Where solid shelving in single-, double-, and multiple-row racks exceeds 64 ft² (5.9 m²) in area
or where the levels of storage exceed 6 ft (1.8 m), sprinklers shall be installed at the ceiling and
below each level of shelving.

16.1.6.3 [move to 20.5.7.2.4.1]
Where multiple-row racks of any height have no longitudinal flue or where double-row racks
with storage up 25 ft (7.6 m) in height have no longitudinal flue, the situation shall not be
considered solid shelves where transverse flues exist at maximum 5 ft (1.5 m) intervals, and
additional in-rack sprinklers shall not be required in accordance with 16.1.6.1 and 16.1.6.2.

16.1.6.4 [move to 25.6.4.1]
The maximum horizontal spacing between in-rack sprinklers shall be 10 ft (3.0 m).

16.1.6.5 being deleted with an FR
Where the criteria in 16.1.6.6 are not met, the water demand for the in-rack sprinklers shall be
based on a minimum flow of 30 gpm (115 L/min) discharging from the following number of
sprinklers balanced to the ceiling sprinkler demand in accordance with 23.4.5:
(1) Six sprinklers where only one level of in-rack sprinklers is installed to protect Class I,
Class II, or Class III commodity
(2) Eight sprinklers where only one level of in-rack sprinklers is installed to protect Class IV
commodity
(3) Ten sprinklers (five on each of the top two levels) where more than one level of in-rack
sprinklers is installed to protect Class I, Class II, or Class III commodity
(4) Fourteen sprinklers (seven on each of the top two levels) where more than one level of in-
rack sprinklers is installed to protect Class IV commodity

16.1.6.6 [move to 25.8.2.9]
The water demand for in-rack sprinklers shall not be required to be balanced to the ceiling
sprinkler demand where additional face sprinklers are installed under each solid shelf at rack
uprights, and the in-rack sprinklers are calculated to discharge at least 60 gpm (230 L/min) from eight sprinklers.

16.1.6.7* being deleted with an FR
Where solid shelves obstruct only a portion of the rack, in-rack sprinklers shall be installed horizontally, within the flue a minimum of 4 ft (1.2 m) beyond the end of the solid shelf, and vertically as follows:
(1) In accordance with 16.1.6.1 and 16.1.6.2 for CMDA sprinklers
(2) Beneath all tiers under the highest solid shelf for CMSA and ESFR sprinklers

A.16.1.6.7 being deleted with an FR

16.1.6.8 being deleted with an FR
Ceiling design criteria for CMDA, CMSA, and ESFR sprinklers shall be an applicable option for open racks combined with in-rack sprinklers installed in accordance with the criteria for solid shelving.

16.1.7 Open-Top Containers. —being deleted with an FR
The protection of open-top containers shall be considered outside the scope of Chapter 16. See Section C.12.

16.1.8 In-Rack Sprinklers. —being deleted with an FR

16.1.8.1 – being deleted with an FR
The number of sprinklers and the pipe sizing on a line of sprinklers in racks shall be restricted only by hydraulic calculations and not by any piping schedule.

16.1.8.2 – being deleted with an FR
When in-rack sprinklers are necessary to protect a higher-hazard commodity that occupies only a portion of the length of a rack, in-rack sprinklers shall be extended a minimum of 8 ft (2.4 m) or one bay, whichever is greater, in each direction along the rack on either side of the higher hazard. The in-rack sprinklers protecting the higher hazard shall not be required to extend across the aisle.

16.1.8.3 being deleted with an FR
Where a storage rack, due to its length, requires less than the number of in-rack sprinklers specified, only those in-rack sprinklers in a single rack shall be included in the calculation.

16.1.8.4* —being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues while not exceeding the maximum spacing rules.

A.16.1.8.4 being deleted with an FR

(A) —being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

(B) being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.1.9* Horizontal Barriers and In-Rack Sprinklers. being deleted with an FR

16.1.9.1 being deleted with an FR
Where required by other sections of this standard, horizontal barriers used in conjunction with in-rack sprinklers to impede vertical fire development shall be constructed of sheet metal, wood, or similar material and shall extend the full length and depth of the rack.

16.1.9.2 being deleted with an FR
Barriers shall be fitted within 2 in. (50 mm) horizontally around rack uprights.

16.1.10 Flue Space Requirements for Storage Up to and Including 25 ft (7.6 m). —being deleted with an FR
See Section C.13.

16.1.10.1 [move to 20.5.7.4.1.1]
In double-row and multiple-row open racks, a longitudinal (back-to-back clearance between loads) flue space shall not be required.

16.1.10.2 [move to 20.5.7.4.2.1]
Nominal 6 in. (150 mm) transverse flue spaces between loads and at rack uprights shall be maintained in single-row, double-row, and multiple-row racks.

16.1.10.3 [move to 20.5.7.4.2.2]
Random variations in the width of flue spaces or in their vertical alignment shall be permitted.

16.1.11 Flue Space Requirements for Storage Over 25 ft (7.6 m). —being deleted with an FR

16.1.11.1 —being deleted with an FR
Nominal 6 in. (150 mm) transverse flue spaces between loads and at rack uprights shall be maintained in single-row, double-row, and multiple-row racks.

16.1.11.1.1 [move to 20.5.7.4.1.2]
Nominal 6 in. (150 mm) longitudinal flue spaces shall be provided in double-row racks.

16.1.11.2 —being deleted with an FR
Random variations in the width of the flue spaces or in their vertical alignment shall be permitted.
16.2 Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. —being deleted with an FR

16.2.1 Control Mode Density/Area Sprinkler Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. [move to 21.4]

16.2.1.1 —being deleted with an FR
The area and density for the hydraulically remote area and the water supply shall be determined as specified in 16.2.1.2 for storage up to 12 ft (3.7 m) and 16.2.1.3 to 16.2.1.3.4 for storage over 12 ft (3.7 m).

16.2.1.2 Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Up to 12 ft (3.7 m) in Height. —being deleted with an FR

16.2.1.2.1 —being deleted with an FR
The protection criteria for storage up to and including 12 ft (3.7 m) shall be the same as miscellaneous storage from Chapter 13.

16.2.1.2.2 —being deleted with an FR
The protection criteria in Chapter 13 shall be acceptable for storage of Class I through Class IV commodities up to and including 12 ft (3.7 m) in height. (See Table 13.2.1 for specific Class I through Class IV storage height protection criteria.)

16.2.1.3 Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Over 12 ft (3.7 m) in Height. [move to 21.4.1]

16.2.1.3.1* [move to 21.4.1.1]
Ceiling sprinkler water demand shall be determined in accordance with 16.2.1.3.2 for single- and double-row racks or 16.2.1.3.3 for multiple-row racks. (See Section C.14.)

A.16.2.1.3.1 being deleted with an FR

16.2.1.3.2* [move to 21.4.1.2]
For single- or double-row racks for Class I, Class II, Class III, or Class IV commodities, encapsulated or nonencapsulated in single- or double-row racks, ceiling sprinkler water demand in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof] shall be selected from the density/area curves of Figure 16.2.1.3.2(a) through Figure 16.2.1.3.2(g) that are appropriate for each commodity and configuration as shown in Table 16.2.1.3.2 and shall be modified as appropriate by 16.2.1.3.4. These requirements shall apply to portable racks arranged in the same manner as single- or double-row racks.
<table>
<thead>
<tr>
<th>Height</th>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Sprinklers Mandatory In-Rack</th>
<th>Ceiling Sprinkler Water Demand</th>
<th>With In-Rack Sprinklers</th>
<th>Without In-Rack Sprinklers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aisle s*</td>
<td>ft</td>
<td>m</td>
<td>Figure</td>
<td>Curves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (a)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (e)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td>II</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (b)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (e)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td>III</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (c)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (f)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td>IV</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (d)</td>
<td>C and D</td>
<td>A</td>
</tr>
<tr>
<td>Height Class</td>
<td>Commodity Class</td>
<td>Encapsulated ft/m</td>
<td>Aisles*</td>
<td>Sprinklers Mandatory In-Rack</td>
<td>Ceiling Sprinkler Water Demand</td>
<td>With In-Rack Sprinklers</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>--------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 level</td>
<td>16.2.1.3.2</td>
<td>C and D</td>
</tr>
<tr>
<td>I</td>
<td>Yes</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>16.2.1.3.2 (g)</td>
<td>Apply Figure 16.2.1.3.4.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>No</td>
<td>16.2.1.3.2 (a)</td>
<td>C and D</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>16.2.1.3.2 (e)</td>
<td>No</td>
<td>G and H</td>
</tr>
<tr>
<td>II</td>
<td>No</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>No</td>
<td>16.2.1.3.2 (b)</td>
<td>G and H</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>16.2.1.3.2 (e)</td>
<td>No</td>
<td>G and H</td>
</tr>
<tr>
<td>III</td>
<td>No</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>No</td>
<td>16.2.1.3.2 (c)</td>
<td>G and H</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>16.2.1.3.2 (f)</td>
<td>No</td>
<td>G and H</td>
</tr>
<tr>
<td>IV</td>
<td>No</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>No</td>
<td>16.2.1.3.2 (d)</td>
<td>G and H</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>8 2.4</td>
<td>16.2.1.3.2 (g)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Height</td>
<td>Commodity Class</td>
<td>Encapsulated</td>
<td>Aisle(s) ft/m</td>
<td>Sprinklers Mandatory In-Rack</td>
<td>Ceiling Sprinkler Water Demand With In-Rack Sprinklers</td>
<td>Without In-Rack Sprinklers</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>--------------</td>
<td>--------------</td>
<td>------------------------------</td>
<td>--------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>I</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (a) C and D</td>
<td>Apply Figure 16.2.1.3.4.1 A and B</td>
<td>16.2.1.3.2 (a) F and H E and G Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (e) C and D</td>
<td>A and B</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (b) C and D</td>
<td>Apply Figure 16.2.1.3.4.1 A and B</td>
<td>16.2.1.3.2 (b) G and H E and F Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (e) C and D</td>
<td>A and B</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>No</td>
<td>4 1.2</td>
<td>No</td>
<td>16.2.1.3.2 (c) C and D</td>
<td>Apply Figure 16.2.1.3.4.1 A and B</td>
<td>16.2.1.3.2 (c) G and H E and F Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (f) C and D</td>
<td>A and B</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>No</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (d) C and D</td>
<td>Apply Figure 16.2.1.3.4.1 A and B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>4 1.2</td>
<td>1 level</td>
<td>16.2.1.3.2 (g) C and D</td>
<td>A and B</td>
<td></td>
</tr>
</tbody>
</table>

*See 16.2.1.3.2.1 for interpolation of aisle widths.
Figure 16.2.1.3.2(a) Sprinkler System Design Curves — 20 ft (6.1 m) High Rack Storage — Class I Nonencapsulated Commodities — Conventional Pallets. [(A), (B), (C), (D) move to 25.2.3.2.3, (E), (F), (G), (H), (I) & (J) move to 21.4.1.2.]

Figure 16.2.1.3.2(b) Sprinkler System Design Curves — 20 ft (6.1 m) High Rack Storage — Class II Nonencapsulated Commodities — Conventional Pallets. [(A), (B), (C), (D) move to 25.2.3.2.3, (E), (F), (G), (H), (I) & (J) move to 21.4.1.2.]

<table>
<thead>
<tr>
<th>Curve</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Single- or double-row racks with 6 ft (2.4 m) aisles with high-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers</td>
</tr>
<tr>
<td>B</td>
<td>Single- or double-row racks with 8 ft (2.4 m) aisles with ordinary-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers</td>
</tr>
<tr>
<td>C</td>
<td>Single- or double-row racks with 4 ft (1.2 m) aisles or multiple-row racks with high-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers</td>
</tr>
<tr>
<td>D</td>
<td>Single- or double-row racks with 4 ft (1.2 m) aisles or multiple-row racks with ordinary-temperature ceiling sprinklers and ordinary-temperature in-rack sprinklers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Curve</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Single- or double-row racks with 6 ft (2.4 m) aisles and high-temperature ceiling sprinklers</td>
</tr>
<tr>
<td>F</td>
<td>Single- or double-row racks with 8 ft (2.4 m) aisles and ordinary-temperature ceiling sprinklers</td>
</tr>
<tr>
<td>G</td>
<td>Single- or double-row racks with 4 ft (1.2 m) aisles and ordinary-temperature ceiling sprinklers</td>
</tr>
<tr>
<td>H</td>
<td>Single- or double-row racks with 4 ft (1.2 m) aisles and ordinary-temperature ceiling sprinklers</td>
</tr>
<tr>
<td>I</td>
<td>Multiple-row racks with 8 ft (2.4 m) or wider aisles and ordinary-temperature ceiling sprinklers</td>
</tr>
<tr>
<td>J</td>
<td>Multiple-row racks with 8 ft (2.4 m) or wider aisles and ordinary-temperature ceiling sprinklers</td>
</tr>
</tbody>
</table>
Figure 16.2.1.3.2(c) Sprinkler System Design Curves — 20 ft (6.1 m) High Rack Storage — Class III Nonencapsulated Commodities — Conventional Pallets. [(A), (B), (C), (D) move to 25.2.3.2.3, (E), (F), (G), (H), (I) & (J) move to 21.4.1.2.]

Figure 16.2.1.3.2(d) Sprinkler System Design Curves — 20 ft (6.1 m) High Rack Storage — Class IV Nonencapsulated Commodities — Conventional Pallets. [(A), (B), (C), (D) move to 25.2.3.2.3, (E), (F), (G), (H) move to 21.4.1.2.]

Figure 16.2.1.3.2(e) Single- or Double-Row Racks — 20 ft (6.1 m) High Rack Storage — Sprinkler System Design Curves — Class I and Class II Encapsulated Commodities —
Conventional Pallets. [(A), (B), (C), (D) move to 25.2.3.2.3, (E), (F), (G), (H) move to 21.4.1.2.]

Figure 16.2.1.3.2(f) Single- or Double-Row Racks — 20 ft (6.1 m) High Rack Storage — Sprinkler System Design Curves — Class III Encapsulated Commodities — Conventional Pallets. [move to 25.2.3.2.3(f)]

Figure 16.2.1.3.2(g) Single- or Double-Row Racks — 20 ft (6.1 m) High Rack Storage — Sprinkler System Design Curves — Class IV Encapsulated Commodities — Conventional Pallets. [move to 25.2.3.2.3(g)]
16.2.1.3.2.1* [move to 21.4.1.2.1]
Design densities for single- and double-row racks shall be selected to correspond to aisle width. 
(See Section C.15.)

(A)
For aisle widths between 4 ft (1.2 m) and 8 ft (2.4 m), the rules for 4 ft (1.2 m) aisle width shall 
be used or direct linear interpolation between the densities shall be permitted.

(B)
The density given for 8 ft (2.4 m) wide aisles shall be applied to aisles wider than 8 ft (2.4 m).

(C)
The density given for 4 ft (1.2 m) wide aisles shall be applied to aisles more narrow than 4 ft 
(1.2 m) down to 3 1/2 ft (1.1 m).

(D)
Where aisles are more narrow than 3 1/2 ft (1.1 m), racks shall be considered to be multiple-row 
racks.

16.2.1.3.3 Multiple-Row Racks — Storage Height Over 12 ft (3.7 m) Up to and Including 
25 ft (7.6 m). [move to 21.4.1.3]

16.2.1.3.3.1 Multiple-Row Racks — Rack Depth Up to and Including 16 ft (4.9 m) with 
Aisles 8 ft (2.4 m) or Wider. [move to 21.4.1.3.1]
For Class I, Class II, Class III, or Class IV commodities, encapsulated or nonencapsulated, 
ceiling sprinkler water demand in terms of density [gpm/ft² (mm/min)] and area of sprinkler 
operation [ft² (m²) of ceiling or roof] shall be selected from the density/area curves of Figure 
16.2.1.3.2(a) through Figure 16.2.1.3.2(d) that are appropriate for each commodity and 
configuration as shown in Table 16.2.1.3.3.1 and shall be modified as appropriate by 16.2.1.3.4. 
The protection criteria shall apply to portable racks arranged in the same manner as multiple-row 
racks.

<table>
<thead>
<tr>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Sprinklers Mandatory In-Rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Figure</td>
<td>Curves</td>
</tr>
<tr>
<td>I</td>
<td>16.2.1.3.2(a)</td>
<td>C and D</td>
</tr>
<tr>
<td>II</td>
<td>16.2.1.3.2(b)</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 16.2.1.3.3.1 Multiple-Row Racks — Rack Depth Up to and Including 16 ft (4.9 m), Aisles 
8 ft (2.4 m) or Wider and Storage Height Over 12 ft (3.7 m) Up to 25 ft (7.6 m)
<table>
<thead>
<tr>
<th>Height</th>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Sprinklers Mandatory In-Rack</th>
<th>Ceiling Sprinkler Water Demand</th>
<th>1.25 × Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>ng 15 ft (4.6 m)</td>
<td>III</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>16.2.1.3. 2(b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3. 2(d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(d)</td>
<td>1.50 × density</td>
<td></td>
</tr>
<tr>
<td>Over 15 ft (4.6 m)</td>
<td>I</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3. 2(a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>16.2.1.3. 2(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>No</td>
<td>16.2.1.3. 2(b)</td>
<td>No</td>
<td>16.2.1.3. 2(b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>16.2.1.3. 2(b)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>No</td>
<td>16.2.1.3. 2(c)</td>
<td>No</td>
<td>16.2.1.3. 2(c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(c)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>No</td>
<td>16.2.1.3. 2(d)</td>
<td>No</td>
<td>16.2.1.3. 2(d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(d)</td>
<td>1.50 × density</td>
<td></td>
</tr>
<tr>
<td>Over 20 ft (6.1 m)</td>
<td>I</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3. 2(a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>No</td>
<td>16.2.1.3. 2(b)</td>
<td>No</td>
<td>16.2.1.3. 2(b)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes 1 level</td>
<td>16.2.1.3. 2(b)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NA: Not applicable.

16.2.1.3.3.2 Multiple-Row Racks — Rack Depth Over 16 ft (4.9 m) or Aisles More Narrow Than 8 ft (2.4 m). [move to 21.4.1.3.2]

For Class I, Class II, Class III, or Class IV commodities, encapsulated or nonencapsulated, ceiling sprinkler water demand in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof] shall be selected from the density/area curves of Figure 16.2.1.3.2(a) through Figure 16.2.1.3.2(g) that are appropriate for each commodity and configuration as shown in Table 16.2.1.3.3.2 and shall be modified as appropriate by 16.2.1.3.4. The protection criteria shall apply to portable racks arranged in the same manner as multiple-row racks.

Table 16.2.1.3.3.2 Multiple-Row Racks — Rack Depth Over 16 ft (4.9 m) or Aisles Narrower Than 8 ft (2.4 m), Storage Height Over 12 ft (3.7 m) Up to and Including 25 ft (7.6 m)
<table>
<thead>
<tr>
<th>Height and including 15 ft (4.6 m)</th>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Sprinklers Mandatory In-Rack</th>
<th>Ceiling Sprinkler Water Demand</th>
<th>With In-Rack Sprinklers</th>
<th>Without In-Rack Sprinklers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Figure Curves</td>
<td>1.25 × Density</td>
<td>Apply Figure 16.2.1.3.4.1</td>
<td>1.25 × Density</td>
<td>Figure Curves</td>
<td>Apply Figure 16.2.1.3.4.1</td>
</tr>
<tr>
<td>II</td>
<td>16.2.1.3.2(b)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(b)</td>
<td>I and J</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(b)</td>
<td>Yes</td>
<td>Yes</td>
<td>16.2.1.3.2(b)</td>
<td>I and J</td>
<td>Yes</td>
</tr>
<tr>
<td>III</td>
<td>16.2.1.3.2(c)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(c)</td>
<td>I and J</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(c)</td>
<td>Yes 1 level</td>
<td>Yes</td>
<td>16.2.1.3.2(c)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IV</td>
<td>16.2.1.3.2(d)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(d)</td>
<td>C and D</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(d)</td>
<td>Yes 1 level</td>
<td>1.50 × density</td>
<td>16.2.1.3.2(d)</td>
<td>C and D</td>
<td>No</td>
</tr>
<tr>
<td>I</td>
<td>16.2.1.3.2(a)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(a)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(a)</td>
<td>Yes</td>
<td>Yes</td>
<td>16.2.1.3.2(a)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>II</td>
<td>16.2.1.3.2(b)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(b)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(b)</td>
<td>Yes</td>
<td>Yes</td>
<td>16.2.1.3.2(b)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>III</td>
<td>16.2.1.3.2(c)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(c)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(c)</td>
<td>Yes</td>
<td>Yes</td>
<td>16.2.1.3.2(c)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IV</td>
<td>16.2.1.3.2(d)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(d)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(d)</td>
<td>Yes</td>
<td>1.50 × density</td>
<td>16.2.1.3.2(d)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>I</td>
<td>16.2.1.3.2(a)</td>
<td>No</td>
<td>No</td>
<td>16.2.1.3.2(a)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>16.2.1.3.2(a)</td>
<td>Yes</td>
<td>Yes</td>
<td>16.2.1.3.2(a)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Over 15 ft (4.6 m) up to and including 20 ft (6.1 m)

Over 20 ft (6.1 m) up to
### Ceiling Sprinkler Water Demand

<table>
<thead>
<tr>
<th>Height and including 25 ft (7.6 m)</th>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Sprinklers Mandatory In-Rack</th>
<th>Ceiling Sprinkler Water Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>No</td>
<td>Yes</td>
<td>16.2.1.3.2(b)</td>
<td>1.25×Density</td>
</tr>
<tr>
<td>III</td>
<td>No</td>
<td>Yes</td>
<td>16.2.1.3.2(c)</td>
<td>No</td>
</tr>
<tr>
<td>IV</td>
<td>No</td>
<td>Yes</td>
<td>16.2.1.3.2(d)</td>
<td>1.50×Density</td>
</tr>
</tbody>
</table>

NA: Not applicable.

**16.2.1.3.3** [move to 21.4.1.3.3]

Where Class I, Class II, and Class III commodities are encapsulated, ceiling sprinkler density shall be 25 percent greater than for nonencapsulated.

**16.2.1.3.4** [move to 21.4.1.3.4]

Where Class IV commodities are encapsulated, ceiling sprinkler density shall be 50 percent greater than for nonencapsulated.

**16.2.1.3.4 Ceiling Sprinkler Density Adjustments.** [move to 21.4.1.4]

**16.2.1.3.4.1** [move to 21.4.1.4.1]

For storage height over 12 ft (3.7 m) up to and including 25 ft (7.6 m) protected with ceiling sprinklers only and for storage height over 12 ft (3.7 m) up to and including 20 ft (6.1 m) protected with ceiling sprinklers and minimum required in-rack sprinklers, densities obtained from design curves shall be adjusted in accordance with Figure 16.2.1.3.4.1.

Figure 16.2.1.3.4.1 Ceiling Sprinkler Density vs. Storage Height.
16.2.1.3.4.2 [move to 21.4.1.4.2]
For storage height over 20 ft (6.1 m) up to and including 25 ft (7.6 m) protected with ceiling sprinklers and minimum required in-rack sprinklers, densities obtained from design curves shall be used. Densities shall not be adjusted in accordance with Figure 16.2.1.3.4.1.

16.2.1.3.4.3 [move to 21.4.1.4.3]
For storage height over 12 ft (3.7 m) up to and including 20 ft (6.1 m) protected with ceiling sprinklers and with more than one level of in-rack sprinklers, but not in every tier, densities obtained from design curves and adjusted in accordance with Figure 16.2.1.3.4.1 shall be permitted to be reduced an additional 20 percent, as indicated in Table 16.2.1.3.4.3.

Table 16.2.1.3.4.3 Adjustment to Ceiling Sprinkler Density for Storage Height and In-Rack Sprinklers
<table>
<thead>
<tr>
<th>Storage Height</th>
<th>In-Rack Sprinklers</th>
<th>Apply Figure 16.2.1.3.4.1 for Storage Height Adjustment</th>
<th>Permitted Ceiling Sprinklers Density Adjustments Where In-Rack Sprinklers Are Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 12 ft (3.7 m) through 25 ft (7.6 m)</td>
<td>None</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Over 12 ft (3.7 m) through 20 ft (6.1 m)</td>
<td>Minimum required</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>More than minimum, but not in every tier</td>
<td></td>
<td>Reduce density 20% from that of minimum in-rack sprinklers</td>
</tr>
<tr>
<td></td>
<td>In every tier except above the top tier</td>
<td>Yes</td>
<td>Reduce density 40% from that of minimum in-rack sprinklers</td>
</tr>
<tr>
<td>Over 20 ft (6.1 m) through 25 ft (7.3 m)</td>
<td>Minimum required</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>More than minimum, but not in every tier</td>
<td>No</td>
<td>Reduce density 20% from that of minimum in-rack sprinklers</td>
</tr>
<tr>
<td></td>
<td>In every tier except above the top tier</td>
<td>No</td>
<td>Reduce density 40% from that of minimum in-rack sprinklers</td>
</tr>
</tbody>
</table>

**16.2.1.3.4.4 [move to 21.4.1.4.4]**
For storage height over 20 ft (6.1 m) up to and including 25 ft (7.6 m) protected with ceiling sprinklers and with more than the minimum required level of in-rack sprinklers, but not in every tier, densities obtained from design curves shall be permitted to be reduced 20 percent, as indicated in Table 16.2.1.3.4.3. Densities shall not be adjusted in accordance with Figure 16.2.1.3.4.1 for storage height.

**16.2.1.3.4.5* [move to 21.4.1.4.5]**
For storage height over 12 ft (3.7 m) up to and including 20 ft (6.1 m) protected with ceiling sprinklers and in-rack sprinklers at each tier, densities obtained from design curves and adjusted in accordance with Figure 16.2.1.3.4.1 shall be permitted to be reduced an additional 40 percent, as indicated in Table 16.2.1.3.4.3.

**16.2.1.3.4.6* [move to 21.4.1.4.6]**
For storage height over 20 ft (6.1 m) up to and including 25 ft (7.6 m) protected with ceiling sprinklers and in-rack sprinklers at each tier except above the top tier, densities obtained from design curves shall be permitted to be reduced 40 percent, as indicated in Table 16.2.1.3.4.3. Densities shall not be adjusted in accordance with Figure 16.2.1.3.4.1 for storage height.

**16.2.1.3.4.7 [move to 21.4.1.4.7]**
Where solid, flat-bottom, combustible pallets (slave pallets) are used with storage height up to and including 25 ft (7.6 m), the densities that are indicated in the design curves shown in Figure 16.2.1.3.2(a) through Figure 16.2.1.3.2(g), based on conventional pallets, shall be increased 20 percent for the given area.
The percentage shall be applied to the density determined in accordance with 16.2.1.3.4.

The increase in density shall not apply where in-rack sprinklers are utilized in the design.

16.2.1.4 In-Rack Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. —being deleted with an FR

16.2.1.4.1 In-Rack Sprinkler Location for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. —being deleted with an FR

16.2.1.4.1.1 In single- or double-row racks, in-rack sprinklers shall be installed in accordance with Table 16.2.1.3.2.

16.2.1.4.1.2 In multiple-row racks no deeper than 16 ft (4.9 m) with aisles 8 ft (2.4 m) or more in width, in-rack sprinklers shall be installed in accordance with Table 16.2.1.3.3.1.

16.2.1.4.1.3 In multiple-row racks deeper than 16 ft (4.9 m) or with aisles less than 8 ft (2.4 m) wide, in-rack sprinklers shall be installed in accordance with Table 16.2.1.3.3.2.

16.2.1.4.1.4 In-rack sprinklers at one level only for storage up to and including 25 ft (7.6 m) high shall be located at the first tier level at or above one-half of the storage height.

16.2.1.4.1.5 In-rack sprinklers at two levels only for storage up to and including 25 ft (7.6 m) high shall be located at the first tier level at or above one-third and two-thirds of the storage height.

16.2.1.4.2 In-Rack Sprinkler Spacing for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Protected by Control Mode Density/Area Sprinklers at the Ceiling. —being deleted with an FR

16.2.1.4.2.1 Maximum horizontal spacing of in-rack sprinklers in single- or double-row racks up to and including 25 ft (7.6 m) in height shall be in accordance with Table 16.2.1.4.2.1.
### Table 16.2.1.4.2.2 In-Rack Sprinkler Spacing for Class I, II, III, and IV Commodities Stored in Multi-Row Racks Up to 25 ft (7.6 m) in Height Protected by Control Mode Density/Area Sprinklers at the Ceiling

<table>
<thead>
<tr>
<th>Encapsulated</th>
<th>Aisle Widths</th>
<th>Commodity Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ft</td>
<td>ft m</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>2.4</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>1.2</td>
</tr>
<tr>
<td>Yes</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

16.2.1.4.2.2* being deleted with an FR

Maximum horizontal spacing and maximum area of coverage of in-rack sprinklers on branch lines, in multiple-row racks with storage up to and including 25 ft (7.6 m) in height, shall be in accordance with Table 16.2.1.4.2.2.

Table 16.2.1.4.2.2 In-Rack Sprinkler Spacing for Class I, II, III, and IV Commodities Stored in Multi-Row Racks Up to 25 ft (7.6 m) in Height Protected by Control Mode Density/Area Sprinklers at the Ceiling

<table>
<thead>
<tr>
<th>Commodity Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing</td>
</tr>
<tr>
<td>ft m</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

(A) The rack plan view shall be considered in determining the area covered by each sprinkler.

(B) The aisles shall not be included in area calculations.

16.2.1.4.2.3* being deleted with an FR

The elevation of in-rack sprinkler deflectors with respect to storage shall not be a consideration in single- or double-row rack storage up to and including 20 ft (6.1 m) high. *(See Section C.16.)*

16.2.1.4.2.4* being deleted with an FR

In single- or double-row racks without solid shelves with storage over 20 ft (6.1 m) high, or in multiple-row racks, or in single- or double-row racks with solid shelves and storage height up to and including 25 ft (7.6 m), a minimum of 6 in. (150 mm) vertical clear space shall be maintained between the in-rack sprinkler deflectors and the top of a tier of storage.

A.16.2.1.4.2.4 being deleted with an FR

(A) Sprinkler discharge shall not be obstructed by horizontal rack members.

16.2.1.4.2.5 being deleted with an FR

For multiple-row racks, a minimum of 6 in. (150 mm) shall be maintained between the in-rack sprinkler deflector and the top of a tier of storage.
Sprinkler discharge shall not be obstructed by horizontal rack members.

16.2.1.4.2.6 being deleted with an FR
Sprinklers installed in racks shall be spaced without regard to rack uprights. (See Section C.17.)

16.2.1.4.3 In-Rack Sprinkler Water Demand for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Protected by Control Mode Density/Area Sprinklers in the Ceiling. —being deleted with an FR
See Section C.18.

16.2.1.4.3.1 being deleted with an FR
The water demand for sprinklers installed in racks shall be based on simultaneous operation of the most hydraulically remote sprinklers as follows:
(1) Six sprinklers where only one level is installed in racks with Class I, Class II, or Class III commodities
(2) Eight sprinklers where only one level is installed in racks with Class IV commodities
(3) Ten sprinklers (five on each two top levels) where more than one level is installed in racks with Class I, Class II, or Class III commodities
(4) Fourteen sprinklers (seven on each two top levels) where more than one level is installed in racks with Class IV commodities

16.2.1.4.4 In-Rack Sprinkler Discharge Pressure for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Protected by Control Mode Density/Area Sprinklers at the Ceiling. —being deleted with an FR
Sprinklers in racks shall discharge at not less than 15 psi 1.0 bar) for all classes of commodities. (See Section C.19.)

16.2.2 CMSA Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. —being deleted with an FR

16.2.2.1 [move to 22.4]
Protection of single-, double-, and multiple-row rack storage for Class I through Class IV commodities shall be in accordance with Table 16.2.2.1.

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity Class</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/Roof Height</th>
<th>K-Factor/Orientation</th>
<th>Type of System</th>
<th>Number of Design Sprinklers</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft m</td>
<td>ft m</td>
<td></td>
<td></td>
<td></td>
<td>psi bar</td>
</tr>
<tr>
<td>Single-, double-, and multiple-row</td>
<td>Class I or II</td>
<td>20 6.1</td>
<td>30 9.1</td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25 1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25 1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>10 0.7</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity Class</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof Height</td>
<td>K-Factor/ Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>----------------------------</td>
<td>----------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>racks (no open-top containers)</td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Dry</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class III</td>
<td></td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>6.1</td>
<td>30</td>
<td>9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>30</td>
<td>9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>25</td>
<td>25</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>10.7</td>
<td>30</td>
<td>9.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity Class</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/ Roof Height ft</td>
<td>K-Factor/ Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
<td>---------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>m</td>
<td>m</td>
<td></td>
<td>Dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 + 1 level of in-rack</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Class IV</td>
<td>20</td>
<td>6.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>Wet</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.2 (160) Upright</td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.6 (280) Pendent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>Wet</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>Wet</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>15 + 1 level of in-rack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>35</td>
<td>10.7</td>
<td>Wet</td>
<td>15</td>
<td>20 + 1 level of in-rack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>15 + 1 level of in-rack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>20 + 1 level of in-rack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>15 + 1 level of in-rack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wet</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity Class</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/ Roof Height ft</td>
<td>K-Factor/ Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
<td>---------------</td>
<td>-----------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>12.2</td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

**16.2.2.1.1 being deleted with an FR**
CMSA sprinklers shall not be permitted to protect storage on solid shelf racks unless the solid shelf racks are protected within-rack sprinklers in accordance with 16.1.6.

**16.2.2.1.1 being deleted with an FR**
Where solid shelves are used, in-rack sprinklers shall be installed in every level below the highest solid shelf.

**16.2.2.2 —being deleted with an FR**
Where in-rack sprinklers are required by Table 16.2.2.1, in-rack sprinkler spacing, design pressure, and hydraulic calculation criteria shall be in accordance with the requirements of 16.2.2.7 as applicable for the commodity.

**16.2.2.3 being deleted with an FR**
Protection shall be provided as specified in Table 16.2.2.1 or appropriate NFPA standards in terms of minimum operating pressure and the number of sprinklers to be included in the design area.

**16.2.2.4 Open Wood Joist Construction. being deleted with an FR**

**16.2.2.4.1 —being deleted with an FR**
Where CMSA sprinklers are installed under open wood joist construction, their minimum operating pressure shall be 50 psi (3.4 bar) for a K-11.2 (160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (240) sprinkler.

**16.2.2.4. being deleted with an FR**
Where each joist channel of open wood joist construction is fully firestopped to its full depth at intervals not exceeding 20 ft (6.1 m), the lower pressures specified in Table 16.2.2.1 shall be permitted to be used.

**16.2.2.5 Preaction Systems. being deleted with an FR**
For the purpose of using Table 16.2.2.1, preaction systems shall be classified as dry pipe systems.

**16.2.2.6 —being deleted with an FR**
Building steel shall not require special protection where Table 16.2.2.1 is applied as appropriate for the storage configuration.
16.2.2.7 In-Rack Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Protected with Control Mode Specific Application Sprinklers at the Ceiling. —being deleted with an FR

16.2.2.7.1 being deleted with an FR
Where in-rack sprinklers are required by Table 16.2.2.1, in-rack sprinklers shall be installed at the first tier level at or above one-half of the storage height.

16.2.2.7.2 being deleted with an FR
The minimum of 6 in. (150 mm) vertical clear space shall be maintained between the sprinkler deflectors and the top of a tier of storage.

(A)
Sprinkler discharge shall not be obstructed by horizontal rack members.

16.2.2.7.3* —being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues.

16.2.2.7.4 being deleted with an FR
The maximum horizontal distance between in-rack sprinklers shall be 8 ft (2.4 m).

16.2.2.7.5 being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues, and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

16.2.2.7.6 —being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.2.2.7.7 In-Rack Sprinkler Water Demand. being deleted with an FR
The water demand for in-rack sprinklers shall be based on simultaneous operation of the most hydraulically remote eight sprinklers.

16.2.2.7.8 In-Rack Sprinkler Discharge Pressure. being deleted with an FR
In-rack sprinklers shall discharge at not less than 15 psi (1.0 bar) for all classes of commodities. *(See Section C.19.)*

16.2.3* Early Suppression Fast-Response (ESFR) Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. [move to 23.5]

16.2.3.1 [move to 23.5.1]
Protection of single-, double-, and multiple-row rack storage of Class I through Class IV commodities shall be in accordance with Table 16.2.3.1.
<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity</th>
<th>Maximum Storage Height ft</th>
<th>Maximum Ceiling/ Roof of Height ft</th>
<th>Nomin al K-Factor</th>
<th>Orientatio n</th>
<th>Minimum Operating Pressure psi</th>
<th>Minimum Operating Pressure bar</th>
<th>In-Rack Sprinkler Requiremen ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-row, double-row, and multiple-row racks (no open-top containers)</td>
<td>Class I, II, III, or IV, encapsulated or nonencapsulated</td>
<td>20</td>
<td>6.1</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50</td>
<td>3.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>7.6</td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35</td>
<td>2.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15</td>
<td>1.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>9.1</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50</td>
<td>3.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35</td>
<td>2.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15</td>
<td>1.0</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>10.7</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>75</td>
<td>5.2</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>52</td>
<td>3.6</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>35</td>
<td>2.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>20</td>
<td>1.4</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>12.2</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
<td>13.7</td>
<td>14.0</td>
<td>Pendent</td>
<td>90</td>
<td>6.2</td>
<td>Yes</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/ Roof of Height ft</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure psi</td>
<td>Minimum Operating Pressure bar</td>
<td>In-Rack Sprinkler Requirements</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>-----------------------------------</td>
<td>-----------------</td>
<td>-------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.4</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>7.6</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>50</td>
<td>3.4</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>9.1</td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>35</td>
<td>2.4</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>15</td>
<td>1.0</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>9.8</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>60</td>
<td>4.1</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>10.7</td>
<td>16.8 (240)</td>
<td>Upright/ pendent</td>
<td>42</td>
<td>2.9</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12.2</td>
<td>14.0 (200)</td>
<td>Upright/ pendent</td>
<td>75</td>
<td>5.2</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>13.7</td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12.2</td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>13.7</td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>90</td>
<td>6.2</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.3</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.4</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height ft</td>
<td>Maximum Ceiling/Roof Height ft</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure psi</td>
<td>In-Rack Sprinkler Requirements</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>---------------------------</td>
<td>--------------------------------</td>
<td>------------------</td>
<td>------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16.2.3.2 [move to 23.1.5.1]
ESFR sprinklers shall not be permitted to protect storage on solid shelf racks unless the solid shelf racks are protected with in-rack sprinklers in accordance with 16.1.6.

16.2.3.2.1 [move to 23.1.5.1.1]
Where solid shelves are used, in-rack sprinklers shall be installed in every level below the highest solid shelf.

16.2.3.3 [move to 23.1.6]
ESFR sprinklers shall not be permitted to protect storage with open top containers.

16.2.3.4 being deleted with an FR
ESFR sprinkler systems shall be designed such that the minimum operating pressure is not less than that indicated in Table 16.2.3.1 for type of storage, commodity, storage height, and building height involved.

16.2.3.5 being deleted with an FR
The design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines.

16.2.3.6 In-Rack Sprinkler Requirements for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height Where ESFR Sprinklers Are Being Used at the Ceiling. —being deleted with an FR

16.2.3.6.1 —being deleted with an FR
Where required by Table 16.2.3.1, in-rack sprinklers shall be installed at the first tier level at or above one-half of the storage height.

16.2.3.6.2 being deleted with an FR
In-rack sprinklers shall be K-8.0 (115) or K-11.2 (160) quick-response, ordinary-temperature sprinklers.

16.2.3.6.3 —being deleted with an FR
The minimum of 6 in. (150 mm) vertical clear space shall be maintained between the sprinkler deflectors and the top of a tier of storage.
(A) —being deleted with an FR
Sprinkler discharge shall not be obstructed by horizontal rack members.

16.2.3.6.4 being deleted with an FR
The maximum horizontal distance between in-rack sprinklers shall be 5 ft (1.5 m).

16.2.3.6.5* —being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues while not exceeding the maximum spacing rules.

16.2.3.6.6 —being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues, and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

16.2.3.6.7 —being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.2.3.6.8 —being deleted with an FR
The water demand for sprinklers installed in racks shall be based on simultaneous operation of the most hydraulically remote eight sprinklers.

16.2.3.6.9 being deleted with an FR
Each of the in-rack sprinklers described in 16.2.3.6.8 shall discharge at a minimum of 60 gpm (230 L/min).

16.2.4 Special Design for Rack Storage of Class I Through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height. [move to 21.9]

16.2.4.1 Slatted Shelves. [move to 21.9.1]

16.2.4.1.1* [move to 21.9.1.1]
Slatted rack shelves shall be considered equivalent to solid rack shelves where the shelving is not considered open rack shelving or where the requirements of 16.2.4.1.2 are not met. (See Section C.20.)

16.2.4.1.2 [move to 21.9.1.2]
A wet pipe system that is designed to provide a minimum of 0.6 gpm/ft² (24.4 mm/min) density over a minimum area of 2000 ft² (186 m²) or K-14.0 (200) ESFR sprinklers operating at a minimum of 50 psi (3.4 bar), K-16.8 (240) sprinklers operating at a minimum of 32 psi (2.2 bar), K-22.4 (320) ESFR sprinklers operating at a minimum of 25 psi (1.7 bar), or K-25.2 (360) ESFR sprinklers operating at a minimum of 15 psi (1.0 bar) shall be permitted to protect single-row and double-row racks with slatted rack shelving where all of the following conditions are met:

(1) Sprinklers shall be K-11.2 (160), K-14.0 (200), or K-16.8 (240) orifice spray sprinklers with a temperature rating of ordinary, intermediate, or high and shall be listed for storage occupancies or shall be K-14.0 (200), K-16.8 (240), K-22.4 (320) ESFR, or K-25.2 (360) ESFR.
(2) The protected commodities shall be limited to Class I through Class IV, Group B plastics, Group C plastics, cartoned (expanded and unexpanded) Group A plastics, and exposed (unexpanded) Group A plastics.

(3) Slats in slatted rack shelving shall be a minimum nominal 2 in. (50 mm) thick by maximum nominal 6 in. (150 mm) wide, with the slats held in place by spacers that maintain a minimum 2 in. (50 mm) opening between each slat.

(4) Where K-11.2 (160), K-14.0 (200), or K-16.8 (240) orifice sprinklers are used, there shall be no slatted shelf levels in the rack above 12 ft (3.7 m). Open rack shelving using wire mesh shall be permitted for shelf levels above 12 ft (3.7 m).

(5) Transverse flue spaces at least 3 in. (75 mm) wide shall be provided at least every 10 ft (3.0 m) horizontally.

(6) Longitudinal flue spaces at least 6 in. (150 mm) wide shall be provided for double-row racks. Longitudinal flue spaces shall not be required where ESFR sprinklers are used.

(7) The aisle widths shall be at least 71/2 ft (2.3 m).

(8) The maximum roof height shall be 27 ft (8.2 m) or 30 ft (9.1 m) where ESFR sprinklers are used.

(9) The maximum storage height shall be 20 ft (6.1 m).

(10) Solid plywood or similar materials shall not be placed on the slatted shelves so that they block the 2 in. (50 mm) spaces between slats, nor shall they be placed on wire mesh shelves.

16.3 Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height.—being deleted with an FR

16.3.1 Control Mode Density/Area Sprinkler Protection Criteria for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height. [move to 21.4.2]

16.3.1.1* [move to 21.4.2.1]
For single- and double-row racks, the water demand for nonencapsulated storage separated by aisles at least 4 ft (1.2 m) wide and with a clearance to ceiling up to and including 10 ft (3.0 m) shall be in accordance with Table 16.3.1.1.

A.16.3.1.1 being deleted with an FR

Table 16.3.1.1 Single- or Double-Row Racks of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height with Aisles 4 ft (1.2 m) or More in Width [move to 21.4.2.1]
| Commodity Class | Longitudinal Flue  
|-----------------|---------------------|
| I               | Vertical 20 ft (6.1 m)  
|                 | Horizontal 10 ft (3.0 m)  
|                 | under horizontal barriers  
|                 | None  
| Figure          | 16.3.1.3.1.1(A)(a)  
| Maximum Storage Height | 30 ft (9.1 m)  
| Stagger         | No  
| Ceiling Sprinkler Operating Area | 0.25  
| Clearance to Ceiling Up to 10 ft (3 m) | 200  
| Ordinary Temperature | gpm/ft²  
| High Temperature | gpm/mm/m  
| I, II, III      | Vertical 10 ft (3.0 m)  
|                 | or at 15 ft (4.6 m)  
|                 | and 25 ft (7.6 m)  
|                 | None  
| Figure          | 16.3.1.3.1.1(A)(e)  
| Maximum Storage Height | 30 ft (9.1 m)  
| Stagger         | Yes  
| Ceiling Sprinkler Operating Area | 0.3  
| Clearance to Ceiling Up to 10 ft (3 m) | 200  
| Ordinary Temperature | gpm/ft²  
| High Temperature | gpm/mm/m  
| I, II, III      | Vertical 10 ft (3.0 m)  
|                 | Horizontal 10 ft (3.0 m)  
|                 | Vertical 30 ft (9.1 m)  
|                 | Horizontal 10 ft (3.0 m)  
|                 | 16.3.1.3.1.1(A)(d)  
| Higher than 25 ft (7.6 m) | Yes  
| Ceiling Sprinkler Operating Area | 0.3  
| Clearance to Ceiling Up to 10 ft (3 m) | 200  
| Ordinary Temperature | gpm/ft²  
| High Temperature | gpm/mm/m  
| I, II, III      | Vertical 20 ft (6.1 m)  
|                 | Horizontal 10 ft (3.0 m)  
|                 | Vertical 20 ft (6.1 m)  
|                 | Horizontal 5 ft (1.5 m)  
|                 | 16.3.1.3.1.1(A)(e)  
| Higher than 25 ft (7.6 m) | Yes  
| Ceiling Sprinkler Operating Area | 0.3  
| Clearance to Ceiling Up to 10 ft (3 m) | 200  
| Ordinary Temperature | gpm/ft²  
| High Temperature | gpm/mm/m  

### Notes

- Flue
- Longitudinal
- Vertical
- Horizontal
- Face
- Staggered
- Maximum
- Storage Height
- Sprinkler Operating Area
- Ceiling Sprinkler Density
- Clearance to Ceiling Up to 10 ft (3 m)

### References

- 16.3.1.3.1.1(A)(a)
- 16.3.1.3.1.1(A)(b)
- 16.3.1.3.1.1(A)(c)
- 16.3.1.3.1.1(A)(d)
- 16.3.1.3.1.1(A)(e)
<table>
<thead>
<tr>
<th>Commodity Class</th>
<th>Longitudinal Flue (^d)</th>
<th>Face (^e,f)</th>
<th>Figure</th>
<th>Maximum Storage Height</th>
<th>Staggered</th>
<th>Ceiling Sprinkler Operating Area</th>
<th>Ceiling Sprinkler Density Clearance to Ceiling Up to 10 ft (3 m)(^g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ordinary Temperature</td>
<td>High Temperature</td>
</tr>
<tr>
<td>I, II, III, IV</td>
<td>Vertical 15 ft (4.6 m)</td>
<td>Vertical 20 ft (6.1 m)</td>
<td>16.3.1.3.1.1(A)(h)</td>
<td>Higher than 25 ft (7.6 m)</td>
<td>Yes</td>
<td>200</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Vertical 20 ft (6.1 m)</td>
<td>Vertical 20 ft (6.1 m)</td>
<td>16.3.1.3.1.1(A)(i)</td>
<td>No</td>
<td></td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>Vertical 25 ft (7.6 m)</td>
<td>Vertical 25 ft (7.6 m)</td>
<td>16.3.1.3.1.1(A)(f)</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Vertical 25 ft (7.6 m)</td>
<td>Horizontal 5 ft (1.5 m)</td>
<td>16.3.1.3.1.1(A)(g)</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Horizontal barriers at 20 ft (6.1 m) Vertical intervals — two lines of sprinklers under barriers — maximum horizontal spacing 10 ft (3.0 m), staggered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Several lines of sprinklers under barriers.
\(^b\) Several lines of sprinklers under barriers.
\(^c\) Several lines of sprinklers under barriers.
\(^d\) Longitudinal flue.
\(^e\) Face.
\(^f\) Figure.
\(^g\) Table values apply to horizontal spacing not greater than 10 ft (3 m) and vertical spacing not greater than 25 ft (7.6 m) within this table.
\(^h\) Indicates whether or not the sprinkler operating area is used to determine sprinkler density.
<table>
<thead>
<tr>
<th>Commodity Class</th>
<th>Longitudinal Flue</th>
<th>Face</th>
<th>Figure</th>
<th>Maximum Storage Height</th>
<th>Staggerer</th>
<th>Ceiling Sprinkler Density</th>
<th>Ordinary Temperature</th>
<th>High Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizonta...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal 5 ft (1.5 m)</td>
<td>Horizonta...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal barriers at 15 ft (4.6 m) Vertical intervals — two lines of sprinklers under barriers — maximum horizontal spacing 10 ft (3.0 m), staggered</td>
<td>16.3.1.3.1.1(A)(j)</td>
<td>Yes</td>
<td>0.35</td>
<td>14.2</td>
<td>0.45</td>
<td>18.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aMinimum in-rack sprinkler discharge, 30 gpm (114 L/min).
bWater shields required.
cAll in-rack sprinkler spacing dimensions start from the floor.
dInstall sprinklers at least 3 in. (75 mm) from uprights.
eFace sprinklers shall not be required for a Class I commodity consisting of noncombustible products on wood pallets (without combustible containers), except for arrays shown in Figure 16.3.1.3.1.1(A)(g) and Figure 16.3.1.3.1.1(A)(j).
fIn Figure 16.3.1.3.1.1(A)(a) through Figure 16.3.1.3.1.1(A)(j), each square represents a storage cube that measures 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there can be one load to six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
gFor encapsulated commodity, increase density 25 percent.

16.3.1.1 [move to 21.4.2.1.1]
Where storage as described in 16.3.1.1 is encapsulated, ceiling sprinkler density shall be 25 percent greater than for nonencapsulated storage.

16.3.1.2 [move to 21.4.2.2.1]
For multiple-row racks, the water demand for nonencapsulated storage separated by aisles at least 4 ft (1.2 m) wide and with a clearance to ceiling up to and including 10 ft (3.0 m) shall be in accordance with Table 16.3.1.2.

Table 16.3.1.2 Multiple-Row Racks of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height being [move to 21.4.2.2]

<table>
<thead>
<tr>
<th>Commodity Class</th>
<th>Encapsulated</th>
<th>Maximum Vertical Spacing</th>
<th>Maximum Horizontal Spacing in A Flue</th>
<th>Maximum Horizontal Spacing across Flue</th>
<th>Height Limit (ft)</th>
<th>Stagger</th>
<th>Figure</th>
<th>Maximum Spacing from Top of Storage to Highest In-Rack Sprinklers</th>
<th>Ceiling Sprinkler Operating Area</th>
<th>165°F (74°C) Rating</th>
<th>286°F (141°C) Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No</td>
<td>20</td>
<td>6.1</td>
<td>12</td>
<td>3.7</td>
<td>10</td>
<td>3.0</td>
<td>16.3.1.3.1.3(A)(a)</td>
<td>10</td>
<td>3.0</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>15</td>
<td>4.6</td>
<td>10</td>
<td>3.0</td>
<td>10</td>
<td>3.0</td>
<td>16.3.1.3.1.3(A)(b)</td>
<td>10</td>
<td>3.0</td>
<td>0.30</td>
</tr>
<tr>
<td>I, II, and III</td>
<td>No</td>
<td>10</td>
<td>3.1</td>
<td>10</td>
<td>3.0</td>
<td>Non</td>
<td>1.5</td>
<td>16.3.1.3.1.3(A)(c)</td>
<td>5</td>
<td>1.5</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For SI units, °C = 5⁄9 (°F-32); 1 gpm/ft² = 40.746 mm/min.

a All four rack faces shall be protected by sprinklers located within the racks and no more than 18 in. (450 mm) from the faces, as indicated in Figure 16.3.1.3.1.3(A)(a) through Figure 16.3.1.3.1.3(A)(c). It shall not be required for each sprinkler level to protect all faces.

b All in-rack sprinkler spacing dimensions start from the floor.

c In Figure 16.3.1.3.1.3(A)(a) through Figure 16.3.1.3.1.3(A)(c), each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.1 m) apart vertically.

16.3.1.2.1 [move to 21.4.2.2.1]
Where such storage is encapsulated, ceiling sprinkler density shall be 25 percent greater than for nonencapsulated storage.

16.3.1.3 In-Rack Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. —being deleted with an FR

16.3.1.3.1 In-Rack Sprinkler Location for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. —being deleted with an FR

16.3.1.3.1* Double-Row Racks. being deleted with an FR

(A) being deleted with an FR

In double-row racks and with a maximum of 10 ft (3.0 m) between the top of storage and the ceiling, in-rack sprinklers shall be installed in accordance with Table 16.3.1.1 and Figure 16.3.1.3.1.1(A)(a) through Figure 16.3.1.3.1.1(A)(j). The highest level of in-rack sprinklers shall be not more than 10 ft (3.1 m) below the top of storage. Where a single-row rack is mixed with double-row racks, Table 16.3.1.1 and Figure 16.3.1.3.1.1(A)(a) through Figure 16.3.1.3.1.1(A)(j) shall be used.

Figure 16.3.1.3.1.1(A)(a) In-Rack Sprinkler Arrangement, Class I Commodities, Storage Height 25 ft to Maximum 30 ft (7.6 m to Maximum 9.1 m).

Notes:
1. Symbol x indicates in-rack sprinklers.
2. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1(A)(b) In-Rack Sprinkler Arrangement, Class I Commodities, Storage Height Over 25 ft (7.6 m).

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled C or D represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required where loads labeled E or F represent top of storage.
4. For storage higher than represented by loads labeled F, the cycle defined by Notes 2 and 3 is repeated, with stagger as indicated.
5. Symbol Δ or x indicates sprinklers on vertical or horizontal stagger.
6. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 16.3.1.3.1(A)(c) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Storage Height 25 ft to Maximum 30 ft (7.6 m to Maximum 9.1 m).
Figure 16.3.1.3.1.1(A)(d) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Storage Height Over 25 ft (7.6 m) — Option 1.

Notes:
1. Alternate location of in-rack sprinklers. Sprinklers shall be permitted to be installed above loads A and C or above loads B and D.
2. Symbol Δ or x indicates sprinklers on vertical or horizontal stagger.
3. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Notes:
1. Sprinklers labeled 1 shall be required where loads labeled A represent the top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled B or C represent top of storage.
3. Sprinklers labeled 1, 2, and 3 shall be required where loads labeled D or E represent top of storage.
4. Sprinklers labeled 1, 2, 3, and 4 shall be required where loads labeled F or G represent top of storage.
5. Sprinklers labeled 1, 2, 3, 4, and 5 shall be required where loads labeled H represent top of storage.
6. For storage higher than represented by loads labeled H, the cycle defined by Notes 3, 4, and 5 is repeated with stagger as indicated.
7. The indicated face sprinklers shall be permitted to be omitted where commodity consists of unwrapped or unpackaged metal parts on wood pallets.
8. Symbol ∆ or x indicates sprinklers on vertical or horizontal stagger.
9. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1(A)(e) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Storage Height Over 25 ft (7.6 m) — Option 2.

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled C or D represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required where loads labeled E or F represent top of storage.
4. For storage higher than represented by loads labeled F, the cycle defined by Notes 2 and 3 is repeated, with stagger as indicated.
5. Symbol Δ or X indicates sprinklers on vertical or horizontal stagger.
6. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 16.3.1.3.1(A)(f) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Storage Height Over 25 ft (7.6 m) — Option 3.
Figure 16.3.1.3.1(A)(g) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Storage Height Over 25 ft (7.6 m) — Option 4.

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled C or D represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required where loads labeled E represent top of storage.
4. Sprinklers labeled 1 and 4 shall be required where loads labeled F or G represent top of storage.
5. For storage higher than represented by loads labeled G, the cycle defined by Notes 2, 3, and 4 is repeated.
6. Symbol x indicates face and in-rack sprinklers.
7. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1(A)(h) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Storage Height Over 25 ft (7.6 m) — Option 1.

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled C or D represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required where loads labeled E or F represent top of storage.
4. For storage higher than represented by loads labeled F, the cycle defined by Notes 2 and 3 is repeated.
5. Symbols o, Δ, and x indicate sprinklers on vertical or horizontal stagger.
6. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.1(A)(i) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Storage Height Over 25 ft (7.6 m) — Option 2.
Figure 16.3.1.3.1(A)(j) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Storage Height Over 25 ft (7.6 m) — Option 3.

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required where loads labeled C or D represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required where loads labeled E or F represent top of storage.
4. For storage higher than represented by loads labeled F, the cycle defined by Notes 2 and 3 is repeated.
5. Symbol x indicates face and in-rack sprinklers.
6. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.2(A)(a) through Figure 16.3.1.3.1.2(A)(c) shall be permitted to be used for the protection of the single-row racks.

Notes:
1. Sprinklers labeled 1 (the selected array from Table 16.3.1.1) shall be required where loads labeled A or B represent top of storage.
2. Sprinklers labeled 1 and 2 and barrier labeled 1 shall be required where loads labeled C represent top of storage.
3. Sprinklers and barriers labeled 1 and 3 shall be required where loads labeled D or E represent top of storage.
4. For storage higher than represented by loads labeled E, the cycle defined by Notes 2 and 3 is repeated.
5. Symbol $\Delta$ or $\times$ indicates sprinklers on vertical or horizontal stagger.
6. Symbol $\circ$ indicates longitudinal flue space sprinklers.
7. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

(B)
Figure 16.3.1.3.1.2(A)(a) through Figure 16.3.1.3.1.2(A)(c) shall be permitted to be used for the protection of the single-row racks.

16.3.1.3.1.2* Single-Row Racks. being deleted with an FR

A.16.3.1.3.1.2 being deleted with an FR

(A)
In single-row racks with storage height over 25 ft (7.6 m) and a maximum of 10 ft (3.0 m) between the top of storage and the ceiling, sprinklers shall be installed in accordance with Figure 16.3.1.3.1.2(A)(a) through Figure 16.3.1.3.1.2(A)(e).

Figure 16.3.1.3.1.2(A)(a) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Single-Row Racks, Storage Height Over 25 ft (7.6 m) — Option 1.

Notes:
1. For all storage heights, sprinklers shall be installed in every other tier and staggered as indicated.
2. Symbol Δ or x indicates sprinklers on vertical or horizontal stagger.
3. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.2(A)(b) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Single-Row Racks, Storage Height Over 25 ft (7.6 m) — Option 1.

Elevation Plan View

Note: Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 16.3.1.3.1.2(A)(c) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Single-Row Racks, Storage Height Over 25 ft (7.6 m) — Option 2.
Elevation  Plan View

Note: Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.2(A)(d) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Single-Row Racks, Storage Height Over 25 ft (7.6 m) — Option 2.

Elevation Plan View

Note: Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 16.3.1.3.1.2(A)(e) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Single-Row Racks, Storage Height Over 25 ft (7.6 m) — Option 3.
In single-row racks, where figures show in-rack sprinklers in transverse flue spaces centered between the rack faces, it shall be permitted to position these in-rack sprinklers in the transverse flue at any point between the load faces.

16.3.1.3.1.3* In-Rack Sprinkler Location — Multiple-Row Racks for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. [move to 25.4.7.1]

(B) being deleted with an FR

In single-row racks, where figures show in-rack sprinklers in transverse flue spaces centered between the rack faces, it shall be permitted to position these in-rack sprinklers in the transverse flue at any point between the load faces.

16.3.1.3.1.3* In-Rack Sprinkler Location — Multiple-Row Racks for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. [move to 25.4.7.1]

(A) being deleted with an FR
In multiple-row racks with a maximum of 10 ft (3.0 m) between the top of storage and the
ceiling, protection shall be in accordance with Table 16.3.1.2 and in-rack sprinklers shall be
installed as indicated in Figure 16.3.1.3.1.3(A)(a) through Figure 16.3.1.3.1.3(A)(c).

Figure 16.3.1.3.1.3(A)(a) In-Rack Sprinkler Arrangement, Class I Commodities, Multiple-Row
Racks, Storage Height Over 25 ft (7.6 m).
Notes:
1. Sprinklers labeled 1 shall be required if loads labeled A represent top of storage.
2. Sprinklers labeled 1 and 2 shall be required if loads labeled B or C represent top of storage.
3. Sprinklers labeled 1 and 3 shall be required if loads labeled D or E represent top of storage.
4. For storage higher than represented by loads labeled E, the cycle defined by Notes 2 and 3 is repeated, with stagger as indicated.
5. Symbol ∆ or x indicates sprinklers on vertical or horizontal stagger.
6. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.3(A)(b) In-Rack Sprinkler Arrangement, Class I, II, or III Commodities, Multiple-Row Racks, Storage Height Over 25 ft (7.6 m).
Notes:
1. Sprinklers labeled 1 and 2 shall be required if loads labeled A represent top of storage.
2. Sprinklers labeled 1 and 3 shall be required if loads labeled B or C represent top of storage.
3. For storage higher than represented by loads labeled C, the cycle defined by Notes 2 and 3 is repeated, with stagger as indicated.
4. Symbol Δ or x indicates sprinklers on vertical or horizontal stagger.
5. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
Figure 16.3.1.3.1.3(A)(c) In-Rack Sprinkler Arrangement, Class I, II, III, or IV Commodities, Multiple-Row Racks, Storage Height Over 25 ft (7.6 m).
Notes:
1. Sprinklers labeled 1, 2, and 3 shall be required if loads labeled A represent top of storage.
2. Sprinklers labeled 1, 2, and 4 shall be required if loads labeled B represent top of storage.
3. For storage higher than represented by loads labeled B, the cycle defined by Notes 1 and 2 is repeated, with stagger as indicated.
4. Symbol \( \triangle \) or \( x \) indicates sprinklers on vertical or horizontal stagger.
5. Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.
The highest level of in-rack sprinklers shall be not more than 10 ft (3.0 m) below maximum storage height for Class I, Class II, or Class III commodities or 5 ft (1.5 m) below the top of storage for Class IV commodities.

16.3.1.3.2 In-Rack Sprinkler Spacing for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at Ceiling. —being deleted with an FR

16.3.1.3.2.1 In-Rack Sprinkler Spacing. being deleted with an FR
In-rack sprinklers shall be staggered horizontally and vertically where installed in accordance with Table 16.3.1.1, Figure 16.3.1.3.1.1(A)(a) through Figure 16.3.1.3.1.1(A)(j), and Figure 16.3.1.3.1.2(A)(a) through Figure 16.3.1.3.1.2(A)(e).

16.3.1.3.2.2 being deleted with an FR
In-rack sprinklers for storage higher than 25 ft (7.6 m) in double-row racks shall be spaced horizontally and located in the horizontal space nearest the vertical intervals specified in Table 16.3.1.1 and Figure 16.3.1.3.1.1(A)(a) through Figure 16.3.1.3.1.1(A)(j).

16.3.1.3.2.3 In-Rack Sprinkler Spacing. —being deleted with an FR
Maximum horizontal spacing of sprinklers in multiple-row racks with storage higher than 25 ft (7.6 m) shall be in accordance with Figure 16.3.1.3.1.3(A)(a) through Figure 16.3.1.3.1.3(A)(c).

16.3.1.3.2.4* —being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues while not exceeding the maximum spacing rules.

(A) —being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues, and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

(B) —being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.3.1.3.2.5 —being deleted with an FR
The minimum of 6 in. (150 mm) vertical clear space shall be maintained between the sprinkler deflectors and the top of a tier of storage.

(A) —being deleted with an FR
Sprinkler discharge shall not be obstructed by horizontal rack members.

16.3.1.3.2.6 being deleted with an FR
In-rack sprinklers shall be a minimum of 3 in. (75 mm) radially from the side of the rack uprights.
16.3.1.3.2.7 being deleted with an FR
Face sprinklers in such racks shall be located within the rack a minimum of 3 in. (75 mm) from rack uprights and no more than 18 in. (450 mm) from the aisle face of storage.

16.3.1.3.3 In-Rack Sprinkler Water Demand for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at the Ceiling. —being deleted with an FR
The water demand for sprinklers installed in racks shall be based on simultaneous operation of the most hydraulically remote sprinklers as follows:
(1) Six sprinklers where only one level is installed in racks with Class I, Class II, or Class III commodities
(2) Eight sprinklers where only one level is installed in racks with Class IV commodities
(3) Ten sprinklers (five on each two top levels) where more than one level is installed in racks with Class I, Class II, or Class III commodities
(4) Fourteen sprinklers (seven on each two top levels) where more than one level is installed in racks with Class IV commodities

16.3.1.3.3.1 In-Rack Sprinkler Discharge for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with Control Mode Density/Area Sprinklers at the Ceiling. —being deleted with an FR
Sprinklers in racks shall discharge at a rate not less than 30 gpm (115 L/min) for all classes of commodities.

16.3.2 CMSA Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height. —being deleted with an FR

16.3.2.1 —being deleted with an FR
Protection of single-, double-, and multiple-row rack storage Class I through Class IV commodities shall be in accordance with Table 16.3.2.1.

Table 16.3.2.1 CMSA Sprinkler Design Criteria for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height (Encapsulated and Nonencapsulated)

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity Class</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/ Roof Height</th>
<th>K-Factor/ Orientation</th>
<th>Type of System</th>
<th>Number of Design Sprinklers</th>
<th>Minimum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td></td>
<td>psi</td>
</tr>
<tr>
<td>Single-, double-, and multiple-row racks (no open-top containers)</td>
<td>Class I or II</td>
<td>30</td>
<td>9.1</td>
<td>35</td>
<td>10.7</td>
<td>11.2 (160) Upright</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8 (240) Upright</td>
<td>Wet</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity Class</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof Height</td>
<td>K-Factor/ Orientation</td>
<td>Type of System</td>
<td>Number of Design Sprinklers</td>
<td>Minimum Operating Pressure psi</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>----------------------------</td>
<td>----------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft  m</td>
<td>ft  m</td>
<td></td>
<td>Dry</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 10.7 40 12.2</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>Class III or IV</td>
<td>30 9.1 35 10.7</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35 10.7 40 12.2</td>
<td></td>
<td>19.6 (280) Pendent</td>
<td>Wet</td>
<td>15</td>
<td>15.0</td>
</tr>
</tbody>
</table>

*High temperature–rated sprinklers shall be used. Dry system water delivery shall be determined in accordance with 7.2.3.6 with a maximum time of water delivery of 30 seconds with four sprinklers initially open.

16.3.2.1.1 [move to 22.1.7]
CMSA sprinklers shall not be permitted to protect storage on solid shelf racks unless the solid shelf racks are protected with in-rack sprinklers in accordance with 16.1.6.

16.3.2.1.1.1 [move to 22.1.7.1]
Where solid shelves are used, in-rack sprinklers shall be installed in every level below the highest solid shelf.

16.3.2.2 —being deleted with an FR
Where in-rack sprinklers are required by Table 16.3.2.1, in-rack sprinkler spacing, design pressure, and hydraulic calculation criteria shall be in accordance with the requirements of 16.3.2.7 as applicable for the commodity.

16.3.2.3 —being deleted with an FR
Protection shall be provided as specified in Table 16.3.2.1 or appropriate NFPA standards in terms of minimum operating pressure and the number of sprinklers to be included in the design area.

16.3.2.4 Open Wood Joist Construction. —being deleted with an FR

16.3.2.4.1 —being deleted with an FR
Where CMSA sprinklers are installed under open wood joist construction, their minimum operating pressure shall be 50 psi (3.4 bar) for a K-11.2 (160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (240) sprinkler.

16.3.2.4.2 being deleted with an FR
Where each joist channel of open wood joist construction is fully firestopped to its full depth at intervals not exceeding 20 ft (6.1 m), the lower pressures specified in Table 16.3.2.1 shall be permitted to be used.

16.3.2.5 Preaction Systems. being deleted with an FR
For the purpose of using Table 16.3.2.1, preaction systems shall be classified as dry pipe systems.

16.3.2.6 being deleted with an FR
Building steel shall not require special protection where Table 16.3.2.1 are applied as appropriate for the storage configuration.

16.3.2.7 In-Rack Sprinklers for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height Protected with CMSA Sprinklers at the Ceiling. being deleted with an FR

16.3.2.7.1 being deleted with an FR
Where in-rack sprinklers are required by Table 16.3.2.1 in-rack sprinklers shall be installed at the first tier level at or above one-half of the storage height.

16.3.2.7.2 being deleted with an FR
The minimum of 6 in. (150 mm) vertical clear space shall be maintained between the sprinkler deflectors and the top of a tier of storage.

(A) Sprinkler discharge shall not be obstructed by horizontal rack members.

16.3.2.7.3 being deleted with an FR
In-rack sprinklers shall be a minimum of 3 in. (75 mm) radially from the side of the rack uprights.

16.3.2.7.4 being deleted with an FR
Face sprinklers in such racks shall be located within the rack a minimum of 3 in. (76 mm) from rack uprights and no more than 18 in. (460 mm) from the aisle face of storage.

16.3.2.7.5 being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues.

16.3.2.7.6 being deleted with an FR
The maximum horizontal distance between in-rack sprinklers shall be 5 ft (1.5 m).
16.3.2.7.7 —being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers
shall be installed at the intersection of the transverse and longitudinal flues, and additional
sprinklers shall be installed between transverse flues to meet the maximum distance rules.

16.3.2.7.8 —being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.3.2.7.9 In-Rack Sprinkler Water Demand. —being deleted with an FR
The water demand for sprinklers installed in racks shall be based on simultaneous operation of
the most hydraulically remote eight sprinklers.

16.3.2.7.10 In-Rack Sprinkler Discharge Pressure. —being deleted with an FR
Sprinklers in racks shall discharge at not less than 15 psi (1.0 bar) for all classes of commodities.
(See Section C.19.)

16.3.3* Early Suppression Fast-Response (ESFR) Sprinklers for Rack Storage of Class I
Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height. —being deleted with
an FR

16.3.3.1 —being deleted with an FR
Protection of single-, double-, and multiple-row rack storage of Class I through Class IV
commodities shall be in accordance with Table 16.3.3.1.

Table 16.3.3.1 ESFR Sprinkler Protection of Rack Storage of Class I Through Class IV
Commodities Stored Over 25 ft (7.6 m) in Height

<table>
<thead>
<tr>
<th>Storage Arrangement</th>
<th>Commodity</th>
<th>Maximum Storage Height</th>
<th>Maximum Ceiling/ Roof Height</th>
<th>Nominal K-Factor</th>
<th>Orientation</th>
<th>Minimum Operating Pressure</th>
<th>In-Rack Sprinkler Requirements</th>
<th>Hose Stream Allowance (gpm)</th>
<th>Water Supply Duration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-, double-, and multiple-row rack (no open-top containers)</td>
<td>Class I, II, III, or IV, encapsulated or nonencapsulated</td>
<td>30 ft (9.1 m)</td>
<td>9.1 ft (2.7 m)</td>
<td>14.0 (200) K</td>
<td>Upright/pendent</td>
<td>75 psi (5.2 bar)</td>
<td>No</td>
<td>250 gpm</td>
<td>946 L/min</td>
</tr>
<tr>
<td>Storage Arrangement</td>
<td>Commodity</td>
<td>Maximum Storage Height</td>
<td>Maximum Ceiling/ Roof Height</td>
<td>Nominal K-Factor</td>
<td>Orientation</td>
<td>Minimum Operating Pressure</td>
<td>In-Rack Sprinkler Requirements</td>
<td>Hose Stream Allowance</td>
<td>Water Supply Duration (hours)</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>---------------------------</td>
<td>------------------------------</td>
<td>------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ft</td>
<td>m</td>
<td>ft</td>
<td>m</td>
<td>psi</td>
<td>bar</td>
<td>gp</td>
<td>L/m</td>
</tr>
<tr>
<td>45 13.7</td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>90</td>
<td>6.2</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.3</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>52</td>
<td>3.6</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 12.2</td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>25</td>
<td>1.7</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.0 (200)</td>
<td>Pendent</td>
<td>90</td>
<td>6.2</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.3</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.3</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8 (240)</td>
<td>Pendent</td>
<td>63</td>
<td>4.3</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.4 (320)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.2 (360)</td>
<td>Pendent</td>
<td>40</td>
<td>2.8</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16.3.3.2 —being deleted with an FR
ESFR protection as defined shall not apply to the following:
(1) Rack storage involving solid shelves, except for situations complying with 16.3.3.2.1
(2) Rack storage involving open-top cartons or containers
16.3.3.2.1 —being deleted with an FR
ESFR sprinklers shall not be permitted to protect storage on solid shelf racks unless the solid shelf racks are protected with in-rack sprinklers in accordance with 16.1.6.

16.3.3.2.1.1 —being deleted with an FR
Where solid shelves are used, in-rack sprinklers shall be installed in every level below the highest solid shelf.

16.3.3.3 —being deleted with an FR
ESFR sprinkler systems shall be designed such that the minimum operating pressure is not less than that indicated in Table 16.3.3.1 for type of storage, commodity, storage height, and building height involved.

16.3.3.4 —being deleted with an FR
The design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branch lines.

16.3.3.5 —being deleted with an FR
Where required by Table 16.3.3.1, one level of K-8.0 (115) or K-11.2 (160) quick-response, ordinary-temperature in-rack sprinklers shall be installed at the tier level closest to but not exceeding one-half of the maximum storage height.

16.3.3.5.1 —being deleted with an FR
In-rack sprinkler hydraulic design criteria shall be the most hydraulically remote eight sprinklers at 60 gpm (230 L/min).

16.3.3.5.2 —being deleted with an FR
In-rack sprinklers shall be located at the intersection of the longitudinal and transverse flue space.

16.3.3.5.3 —being deleted with an FR
Horizontal spacing shall not be permitted to exceed 5 ft (1.5 m) intervals.

16.3.3.5.4 —being deleted with an FR
The minimum of 6 in. (150 mm) vertical clear space shall be maintained between the sprinkler deflectors and the top of a tier of storage.

(A) —being deleted with an FR
Sprinkler discharge shall not be obstructed by horizontal rack members.

16.3.3.5.5 —being deleted with an FR
In-rack sprinklers shall be located at an intersection of transverse and longitudinal flues while not exceeding the maximum spacing rules.

16.3.3.5.6 —being deleted with an FR
Where distances between transverse flues exceed the maximum allowable distances, sprinklers shall be installed at the intersection of the transverse and longitudinal flues, and additional sprinklers shall be installed between transverse flues to meet the maximum distance rules.

16.3.3.5.7 —being deleted with an FR
Where no transverse flues exist, in-rack sprinklers shall not exceed the maximum spacing rules.

16.3.3.5.8 —being deleted with an FR
In-rack sprinklers shall be a minimum of 3 in. (76 mm) radially from the side of the rack uprights.

16.3.3.5.9 —being deleted with an FR
Face sprinklers in such racks shall be located within the rack a minimum of 3 in. (76 mm) from rack uprights and no more than 18 in. (460 mm) from the aisle face of storage.

16.3.4 Special Design for Rack Storage of Class I Through Class IV Commodities Stored Over 25 ft (7.6 m) in Height. —being deleted with an FR

16.3.4.1 —being deleted with an FR
Where high-expansion foam systems are used for storage over 25 ft (7.6 m) high up to and including 35 ft (11 m) high, they shall be used in combination with ceiling sprinklers.

16.3.4.2 —being deleted with an FR
The maximum submergence time for the high-expansion foam shall be 5 minutes for Class I, Class II, or Class III commodities and 4 minutes for Class IV commodities.
First Revision No. 655-NFPA 13-2016 [ Global Input ]

See attached file for the reorganization of existing Chapter 27.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-Chapter_27.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Aug 05 17:41:37 EDT 2016

Committee Statement

Response Message:
Chapter 27  System Inspection, Testing, and Maintenance

27.1*  General. [move to 30.1]
A sprinkler system installed in accordance with this standard shall be properly inspected, tested, and maintained by the property owner or their authorized representative in accordance with NFPA 25 to provide at least the same level of performance and protection as designed.

27.2*  Inactive Sprinkler Systems Abandoned in Place. —being deleted with an FR

27.2.1  [move to 28.2.2]
Where all or part of an inactive sprinkler system is abandoned in place, components including sprinklers, hose valves and hoses, and alarm devices shall be removed.

27.2.2  [move to 28.2.3]
Control valves abandoned in place shall have the operating mechanisms removed.

27.2.3  [move to 28.2.4]
Sprinkler system piping and/or valves abandoned in place shall be uniquely identified to differentiate them from active system piping and valves.
First Revision No. 858-NFPA 13-2016 [ Global Input ]

See attached word doc

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_8_Deletions.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 31 08:56:36 EDT 2016

Committee Statement

Committee Statement: Deletes text that is moving to Chapter 25 as new text.
Response Message:
Chapter 8 - Installation Requirements

8.4 Application of Sprinkler Types. Sprinklers shall be selected for use as indicated in this section and shall be positioned and spaced as described in Section 8.5.

8.4.1 Standard Upright and Pendent Spray Sprinklers.

8.4.5 Residential Sprinklers.

8.4.6 Early Suppression Fast-Response (ESFR) Sprinklers.

8.4.7 Control Mode Specific Application (CMSA) Sprinklers.

8.6.3.2.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.6.3.4.3 In-rack sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center.

8.6.5.3.4 Sprinklers shall not be required below obstructions that are not fixed in place, such as conference tables.

8.7.4.2.1 Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.7.5.3.3 Sprinklers shall not be required under obstructions that are not fixed in place such as conference tables.

8.8.3.2.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.9.5.3.3 Sprinklers shall not be required under obstructions that are not fixed in place, such as conference tables.

8.10 Residential Sprinklers.

8.10.4.6.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

8.10.6.3.3 Sprinklers shall not be required under obstructions that are not fixed in place.

8.10.7.3.3 Sprinklers shall not be required under obstructions that are not fixed in place.

8.11.4.2 Deflector Orientation. Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

8.13 In-Rack Sprinklers.
8.13.1 System Size. The area protected by a single system of sprinklers in racks shall not exceed 40,000 ft² (3720 m²) of floor area occupied by the racks, including aisles, regardless of the number of levels of in-rack sprinklers.

8.13.2 Type of In-Rack Sprinklers.

8.13.2.1 Sprinklers in racks shall be ordinary-temperature standard-response or quick-response classification with a nominal K-factor of K-5.6 (80), K-8.0 (115), or K-11.2 (160), pendent or upright.

8.13.2.2 Sprinklers with intermediate- and high-temperature ratings shall be used near heat sources as required by 8.3.2.

8.13.3 In-Rack Sprinkler Water Shields.

8.13.3.1 In-Rack Sprinkler Water Shields for Storage of Class I Through Class IV Commodities. Water shields shall be provided directly above in-rack sprinklers, or listed intermediate level/rack storage sprinklers shall be used where there is more than one level, if not shielded by horizontal barriers. (See Section C.3.)

8.13.3.2 In-Rack Sprinkler Water Shields for Plastic Storage. Where in-rack sprinklers are not shielded by horizontal barriers, water shields shall be provided above the sprinklers, or listed intermediate level/rack storage sprinklers shall be used.

8.13.4 Location, Position, and Spacing of In-Rack Sprinklers. The location, position, and spacing of in-rack sprinklers shall comply with the requirements in Chapters 12 through 20 as applicable.

8.13.4.1 Minimum Distance Between In-Rack Sprinklers. In-rack sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center.

8.13.5 Obstructions to In-Rack Sprinkler Discharge. In-rack sprinklers shall not be required to meet the obstruction criteria and clearance from storage requirements of Section 8.5.

8.16.1.5* In-Rack Sprinkler System Control Valves.

8.16.1.5.1 Unless the requirements of 8.16.1.5.2 or 8.16.1.5.3 are met, where sprinklers are installed in racks, separate indicating control valves and drains shall be provided and arranged so that ceiling and in-rack sprinklers can be controlled independently.

8.16.1.5.2 Installation of 20 or fewer in-rack sprinklers supplied by any one ceiling sprinkler system shall not require a separate indicating control valve.

8.16.1.5.3 The separate indicating valves shall be permitted to be arranged as sectional control valves supplied from the ceiling sprinkler system where in-rack sprinklers are required and the
racks including the adjacent aisles occupy 8000 ft² (740 m²) or less of the area protected by the ceiling sprinklers.
Reorganize Chapter 3 as per the attached word doc..

Committee Statement

Committee Statement: The new Chapter 3 is changed in structure to alphabetize the list, similar to a dictionary. This resulted in a complete renumber sequence. Definitions for Occupancies (Extra Hazard Group 1 & 2, Light Hazard and Ordinary Hazard Group 1 & 2) were relocated from Chapter 5 to Chapter 3.
Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. Merriam-Webster's Collegiate Dictionary, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Should. Indicates a recommendation or that which is advised but not required.
3.2.6 **Standard.** An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 **General Definitions.**

3.3.1 **A-Class Boundary.** See 3.3.118.1

3.3.2 **Air Receiver.** A chamber, compatible with an air compressor, that can store air under pressure that is higher in pressure than that in the dry pipe or preaction system piping.

3.3.3 **Air Reservoir.** A chamber that can store air at the same pressure that is in the wet pipe system piping.

3.3.4 **Aisle Width.** The horizontal dimension between the face of the loads in racks under consideration.

A.3.3.4 Aisle Width. See Figure A.3.9.1.

FIGURE A 3.9.1 Illustration of Aisle Width.

3.3.5 **Antifreeze Sprinkler System.** See 3.3.204.1

3.3.6 **Appurtenance.** An accessory or attachment that enables the private fire service main to perform its intended function. [24, 2013]

3.3.7 **Arm-Over.** A horizontal pipe that extends from the branch line to a single sprinkler or a sprinkler above and below a ceiling.

3.3.8 **Array.**

3.3.8.1 **Closed Array.** A storage arrangement where air movement through the pile is restricted because of 6 in. (150 mm) or less vertical flues.

3.3.8.2 **Closed Array (Paper).** A vertical storage arrangement in which the distances between columns in both directions are short [not more than 2 in. (50 mm) in one direction and 1 in. (25 mm) in the other].

3.3.8.3 **Open Array.** A storage arrangement where air movement through the pile is enhanced because of vertical flues larger than 6 in. (150 mm).

A.3.3.8.3 **Open Array.** Fire tests conducted to represent a closed array utilized 6 in. (150 mm) longitudinal flues and no transverse flues. Fire tests conducted to represent an open array utilized 12 in. (300 mm) longitudinal flues.

3.3.8.4 **Open Array (Paper).** A vertical storage arrangement in which the distance between columns in both directions is lengthy (all vertical arrays other than closed or standard).

3.3.8.5 **Standard Array (Paper).** A vertical storage arrangement in which the distance between columns in one direction is short [1 in. (25 mm) or less] and is in excess of 2 in. (50 mm) in the other direction.

A.3.3.8.5 **Standard Array (Paper).** The occasional presence of partially used rolls on top of columns of otherwise uniform diameter rolls does not appreciably affect the burning characteristics.

3.3.9 **Automatic Sprinkler.** See 3.3.204.1
3.9.3.23.10 **Components on Portable Racks.** Instrument panels, windshields, metal and plastic gasoline tanks, heater housings, door panels, interior trim, bumper facia, wiring harnesses, sheet metal, body components, engines, driveline components, steering mechanisms, auxiliary motors, and lighting — all with or without expanded Group A plastic dunnage. This definition does not include the storage of air bags, tires, and seats on portable racks.

3.3.11 **B-Class Boundary.** See 3.3.118.2.

3.9.2.6.13.12 **Back-to-Back Shelf Storage.** Two solid or perforated shelves up to 30 in. (750 mm) in depth each, not exceeding a total depth of 60 in. (1.5 m), separated by a longitudinal vertical barrier such as plywood, particleboard, sheet metal, or equivalent, with a maximum 0.25 in. (6 mm) diameter penetrations and no longitudinal flue space and a maximum storage height of 15 ft (4.6 m).

3.9.2.6.13.12 **Back-to-Back Shelf Storage.** The requirement for the lack of a longitudinal flue space does not prohibit a small gap between the units or a small gap between the shelves and the vertical barrier. See Figure A.3.9.2.6.13.12.

A.3.9.2.6.13.12 **Back-to-Back Shelf Storage.**

FIGURE A.3.9.2.6.13.12 **Back-Shelf Storage.** Two solid or perforated shelves up to 30 in. (750 mm) in depth each, not exceeding a total depth of 60 in. (1.5 m), separated by a longitudinal vertical barrier such as plywood, particleboard, sheet metal, or equivalent, with a maximum 0.25 in. (6 mm) diameter penetrations and no longitudinal flue space and a maximum storage height of 15 ft (4.6 m).

A.3.9.2.6.13.12 **Back-to-Back Shelf Storage.** The requirement for the lack of a longitudinal flue space does not prohibit a small gap between the units or a small gap between the shelves and the vertical barrier. See Figure A.3.9.2.6.13.12.


A.3.9.6.13.13 **Baled Cotton.** A natural seed fiber wrapped and secured in industry-accepted materials, usually consisting of burlap, woven polypropylene, or sheet polyethylene, and secured with steel, synthetic or wire bands, or wire; also includes linters (lint removed from the cottonseed) and motes (residual materials from the ginning process). (See Table A.3.9.6.13.13.)


Table A.3.9.6.13.13 Typical Cotton Bale Types and Approximate Sizes

3.9.4.3.15 **Banded Tires.** A storage method in which a number of tires are strapped together.

A.3.9.4.3.15 **Banded Tires.** A storage method in which a number of tires are strapped together.

3.3.16 **Bathroom.** Within a dwelling unit, any room or compartment dedicated to personal hygiene, containing a toilet, sink, or bathing capability such as a shower or tub.

A.3.3.16 **Bathroom.** A room is still considered a bathroom if it contains just a toilet. Additionally, two bathrooms can be adjacent to each other and are considered separate rooms, provided they are enclosed with the required level of construction. A compartment containing only a toilet, regardless of its intended use, is considered a bathroom.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

A.3.9.2.17 **Bin Box Storage.** Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles in which boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.
of Group A or Group B plastics. Materials stored include Class I and II commodities, paper business records, books, magazines, stationery, newspapers, cardboard dividers, and cartons. See Table A.5.6.3.3.  

3.3.2.23 Catwalk. For the purposes of carton records storage, a storage aid consisting of either open metal grating or solid horizontal barriers supported from a rack storage system that is utilized as a walkway for access to storage at elevated levels. Catwalks are accessed using stairs and are not separate floors of a building.  

3.3.2.24 Ceiling Height. The distance between the floor and the underside of the ceiling above (or roof deck) within the area.  

3.3.2.25 Ceiling Pocket. An architectural ceiling feature that consists of a bounded area of ceiling located at a higher elevation than the attached lower ceiling.  

A.3.3.4.25 Ceiling Pocket. It is not the intent of this definition to be applied to structural and/or framing members otherwise used to define obstructed or unobstructed construction. Ceiling pockets can be protected or unprotected. A ceiling pocket where the upper ceiling is within the allowable vertical distance from the sprinkler deflector should be considered a protected ceiling pocket. Buildings with protected ceiling pockets greater than 32 ft (3.0 m) are not allowed to use the quick-response reduction of 11.2.3.2.3. Buildings with unprotected ceiling pockets are permitted to use the quick-response reduction of 11.2.3.2.3.  

3.3.5.26 Ceiling Types.  

3.3.5.26.1 Flat Ceiling. A continuous ceiling in a single plane.  

3.3.5.26.2 Horizontal Ceiling. A ceiling with a slope not exceeding 2 in 12.  

3.3.5.26.3 Sloped Ceiling. A ceiling with a slope exceeding 2 in 12.  

3.3.5.26.4 Smooth Ceiling. A continuous ceiling free from significant irregularities, lumps, or indentations.  

3.3.27 Central Safety Station. See 3.3.118.3.  

3.3.4.14.3.28 Check Valve. A valve that allows flow in one direction only. [24, 2016]  

3.3.4.3.29 Clearance to Ceiling. The distance from the top of storage to the ceiling above.  

3.3.30 Circulating Closed-Loop Sprinkler System. See 3.3.204.4.2.  

3.3.31 Closed Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). See 3.3.8.1.  

3.3.32 Closed Array (Paper). See 3.3.8.2.  

3.3.43 Cloud Ceiling. Any ceiling system installed in the same plane with horizontal openings to the structure above on all sides. This does not include sloped ceilings as defined in 3.3.4.26.3.  

3.3.34 Combined Dry Pipe-Reaction Sprinkler System. See 3.3.204.4.3.  

3.9.1.3.35 Commodity. The combination of products, packing material, and container that determines commodity classification.  

3.9.1.6.3.36 Compact Storage. Storage on solid shelves not exceeding 36 in. (900 mm) in total depth, arranged as part of a compact storage module, with no more than 30 in. (750 mm) between shelves vertically and with no internal vertical flue spaces other than those between individual shelving sections.  

3.9.1.7.3.37 Compact Storage Module. A type of shelving unit consisting of compact storage whereby the units move to allow for storage to be pushed together creating a storage unit with no flues or minimal spaces between units. Aisles are created by moving the shelving unit. Compact storage modules can be manual or electric in operation.  

3.9.1.3.38 Column. A single vertical stack of rolls.  

3.9.1.6.3.39 Compartment. A space completely enclosed by walls and a ceiling. Each wall in the compartment is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (200 mm) from the ceiling and the total width of the openings in each wall does not exceed 8 ft (2.4 m). A
single opening of 36 in. (900 mm) or less in width without a lintel is permitted when there are no other openings to adjoining spaces.

3.9.1.83.40 * Compartmented. The rigid separation of the products in a container by dividers that form a stable unit under fire conditions.

A.3.9.1.83.40 Compartmented. Cartons used in most of the FM Global-sponsored plastic tests involved an ordinary 200 lb (91 kg) test of outside corrugated cartons with five layers of vertical pieces of corrugated carton used as dividers on the inside. There were also single horizontal pieces of corrugated carton between each layer.

3.3.2.0 Concealed Sprinkler. See 3.3.2.04.3.1.

3.7.3.42 Construction Definitions.

7.1.4.1.2.2 * Obstructed Construction. Panel construction and other construction where beams, trusses, or other members impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire.

A.3.7.13.42.1 Obstructed Construction. The following examples of obstructed construction are provided to assist the user in determining the type of construction feature:

1. Beam and Girder Construction. The term beam and girder construction as used in this standard includes noncombustible and combustible roof or floor decks supported by wood beams of 4 in. (100 mm) or greater nominal thickness or concrete or steel beams spaced 3 ft to 7½ ft (900 mm to 2.3 m) on center and either supported on or framed into girders. [Where supporting a wood plank deck, this includes semi-mill and panel construction, and where supporting (with steel framing) gypsum plank, steel deck, concrete, tile, or similar material, this includes much of the so-called noncombustible construction.]

2. Concrete Tee Construction. The term concrete tee construction as it is used in this standard refers to solid concrete members with stems (legs) having a nominal thickness less than the nominal height. [See Figure A.3.7.13.42.1(a) for examples of concrete tee construction.]

3. Composite Wood Joist Construction. The term composite wood joist construction refers to wood beams of "I" cross section constructed of wood flanges and solid wood web, supporting a floor or roof deck. Composite wood joists can vary in depth up to 48 in. (1.2 m), can be spaced up to 48 in. (1.2 m) on centers, and can span up to 60 ft (18 m) between supports. Joist channels should be firestopped to the full depth of the joists with material equivalent to the web construction so that individual channel areas do not exceed 300 ft² (28 m²). [See Figure A.3.7.13.42.1(b) for an example of composite wood joist construction.]

4. Panel Construction. The term panel construction as used in this standard includes ceiling panels formed by members capable of trapping heat to aid the operation of sprinklers and limited to a maximum of 300 ft² (28 m²) in area. There should be no unfilled penetrations in the cross-sectional area of the bounding structural members including the interface at the roof. Beams spaced more than 7½ ft (2.3 m) apart and framed into girders qualify as panel construction, provided the 300 ft² (28 m²) area limitation is met.

5. Semi-Mill Construction. The term semi-mill construction as used in this standard refers to a modified standard mill construction, where greater column spacing is used and beams rest on girders.

6. Wood Joist Construction. The term wood joist construction refers to solid wood members of rectangular cross section, which can vary from 2 in. to 4 in. (50 mm to 100 mm) nominal width and can be up to 14 in. (350 mm) nominal depth, spaced up to 3 ft (900 mm) on centers, and can span up to 40 ft (12 m) between supports, supporting a floor or roof deck. Solid wood members less than 4 in. (100 mm) nominal width and up to 14 in. (350 mm) nominal depth, spaced more than 3 ft (900 mm) on centers, are also considered as wood joist construction. Wood joists can exceed 14 in. (350 mm) in nominal depth.
Bar Joist Construction with Fireproofing. In order to meet building codes, bar joists are often covered with fireproofing materials. In such an event, if greater than 30 percent of the area of the joist is obstructed, it should be considered obstructed construction.

Steel Purlin Construction. This term refers to clear span or multiple span buildings with straight or tapered columns and frames supporting C- or Z-type purlins greater than 4 in. (100 mm) in depth spaced up to 7½ ft (2.3 m) on center.

Truss Construction (Wood or Steel). The term truss construction refers to parallel or pitched chord members connected by open web members supporting a roof or floor deck with top and bottom members greater than 4 in. (100 mm) in depth. [See Figure A.3.7.13.42.1(c).]

Bar Joist Construction (Wood or Steel). The term bar joist construction refers to construction employing joists consisting of steel truss-shaped members. Wood truss-shaped members, which consist of wood top and bottom chord members with steel tube or bar webs, are also defined as bar joists. Bar joists include noncombustible or combustible roof or floor decks on bar joist construction with top and bottom chord members greater than 4 in. (100 mm) in depth. [See Figure A.3.7.23.42.2(a) and Figure A.3.7.23.42.2(b) for examples of bar joist construction.]

Unobstructed Construction. Construction where beams, trusses, or other members do not impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire. Unobstructed construction has horizontal structural members that are not solid, where the openings are at least 70 percent of the cross-section area and the depth of the member does not exceed the least dimension of the openings, or all construction types, with the exception of panel construction, where the spacing of structural members exceeds 7½ ft (2.3 m) on center.

A.3.7.23.42.2 Unobstructed Construction. The following examples of unobstructed construction are provided to assist the user in determining the type of construction feature:

1. Bar Joist Construction. The term bar joist construction refers to construction employing joists consisting of steel truss-shaped members. Wood truss-shaped members, which consist of wood top and bottom chord members with steel tube or bar webs, are also defined as bar joists. Bar joists include noncombustible or combustible roof or floor decks on bar joist construction with top and bottom chord members not exceeding 4 in. (100 mm) in depth. [See Figure A.3.7.23.42.2(a) and Figure A.3.7.23.42.2(b) for examples of bar joist construction.]

2. Open-Grid Ceilings. The term open-grid ceilings as used in this standard refers to ceilings in which the openings are ¾ in. (6 mm) or larger in the least dimension, the thickness of the ceiling material does not exceed the least dimension of the openings, and the openings constitute at least 70 percent of the ceiling area.

3. Smooth Ceiling Construction. The term smooth ceiling construction as used in this standard includes the following:
   a. Flat slab, pan-type reinforced concrete
   b. Continuous smooth bays formed by wood, concrete, or steel beams spaced more than 7½ ft (2.3 m) on centers — beams supported by columns, girders, or trusses
   c. Smooth roof or floor decks supported directly on girders or trusses spaced more than 7½ ft (2.3 m) on center
(d) Smooth monolithic ceilings of at least ¾ in. (20 mm) of plaster on metal lath or a combination of materials of equivalent fire-resistive rating attached to the underside of wood joists, wood trusses, and bar joists.

(e) Open-web-type steel beams, regardless of spacing.

(f) Smooth shell-type roofs, such as folded plates, hyperbolic paraboloids, saddles, domes, and long barrel shells.

(g) Suspended ceilings of combustible or noncombustible construction.

(h) Smooth monolithic ceilings with fire resistance less than that specified under item A.3.7.23.42.2(d) and attached to the underside of wood joists, wood trusses, and bar joists.

Combustible or noncombustible floor decks are permitted in the construction specified in A.3.7.23.42.2(b) through A.3.7.23.42.2(f). A.3.7.23.42.2(b) would include standard mill construction.

(4) Standard Mill Construction. The term standard mill construction as used in this standard refers to heavy timber construction as defined in NFPA 220.

(5) Truss Construction (Wood or Steel). The term truss construction refers to parallel or pitched chord members connected by open web members supporting a roof or floor deck with top and bottom members not exceeding 4 in. (100 mm) in depth. [See Figure A.3.7.23.42.2(c).]

FIGURE A.3.7.23.42.2(a) Wood Bar Joist Construction.

FIGURE A.3.7.23.42.2(b) Open-Web Bar Joist Construction.

FIGURE A.3.7.23.42.2(c) Examples of Wood Truss Construction.

3.9.1.93.43 Container (Shipping, Master, or Outer Container). A receptacle strong enough, by reason of material, design, and construction, to be shipped safely without further packaging.

A.3 9.1.93.43 Container (Shipping, Master, or Outer Container). The term container includes items such as cartons and wrappings. Fire-retardant containers or tote boxes do not by themselves create a need for automatic sprinklers unless coated with oil or grease. Containers can lose their fire-retardant properties if washed. For obvious reasons, they should not be exposed to rainfall.

3.3.44 Continuous Obstruction. See 3.3.132.1.

3.3.45 Control Mode Density/Area (CMDA) Sprinkler. See 3.3.204.5.1.

3.3.46 Control Mode Specific Application (CMSA) Sprinkler. See 3.3.204.5.2.

3.3.47 Control Valve. A valve controlling flow to water-based fire protection systems and devices.

A.3 3.3.47 Control Valve. Control valves do not include hose valves, inspector's test valves, drain valves, trim valves for dry pipe, preaction and deluge valves, check valves, or relief valves.

3.3.48 Conventional Pallet. See 3.3.146.1.

3.9.5.4 3.49 Core. The central tube around which paper is wound to form a roll.

3.8.1.2 3.50 Corrosion-Resistant Piping. Piping that has the property of being able to withstand deterioration of its surface or its properties when exposed to its environment. [24, 2016]

3.3.51 Corrosion-Resistant Sprinkler. See 3.3.204.5.3.

3.8.1.3 3.52 Corrosion-Retarding Material. A lining or coating material that when applied to piping or appurtenances has the property of reducing or slowing the deterioration of the object's surface or properties when exposed to its environment. [24, 2016]

3.5.53.53 Cross Mains. The pipes supplying the branch lines, either directly or through riser nipples.

3.3.54 Deluge Sprinkler System. See 3.3.204.4.4.
3.9.3.4 Double-Row Racks. Racks less than or equal to 12 ft (300 mm) in depth or single-row racks placed back to back having an aggregate depth up to 12 ft (300 mm), with aisles having an aisle width of at least 3.5 ft (1.1 m) between loads on racks.

3.8.56 Draft Curtain. A continuous material protruding downward from the ceiling to create a reservoir for collecting smoke and heat.

A.3.3.856 Draft Curtain. Additional information about the size and installation of draft curtains can be found in NFPA 204.

3.9.57 Drop-Out Ceiling. A suspended ceiling system, which is installed below the sprinklers, with listed translucent or opaque panels that are heat sensitive and fall from their setting when exposed to heat.

3.3.58 Dry Barrel Hydrant (Frostproof Hydrant). See 3.3.100.1.
3.3.59 Dry Pipe Sprinkler System. See 3.3.204.4.5.
3.3.60 Dry Sprinkler. See 3.3.204.5.4.

3.3.1061 Dwelling Unit (for sprinkler system installations). One or more rooms arranged for the use of one or more individuals living together, as in a single housekeeping unit normally having cooking, living, sanitary, and sleeping facilities that include, but are not limited to, hotel rooms, dormitory rooms, apartments, condominiums, sleeping rooms in nursing homes, and similar living units.

3.3.62 Early Suppression Fast-Response (ESFR) Sprinkler. See 3.3.204.5.5.

3.9.113.63 Encapsulation. A method of packaging that either consists of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity, a combustible package, or a group of combustible commodities or combustible packages, or consists of combustible commodities individually wrapped in plastic sheeting and stored exposed in a pallet load.

A.3.9.113.63 Encapsulation. Totally noncombustible commodities on wood pallets enclosed only by a plastic sheet as described are not covered under this definition. Banding (i.e., stretch-wrapping around the sides only of a pallet load) is not considered to be encapsulation. Where there are holes or voids in the plastic or waterproof cover on the top of the carton that exceed more than half of the area of the cover, the term encapsulated does not apply. The term encapsulated does not apply to plastic-enclosed products or packages inside a large, nonplastic, enclosed container.

3.9.113.64 Expanded (Foamed or Cellular) Plastics. Those plastics, the density of which is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout their mass.

3.9.113.65 Exposed Group A Plastic Commodities. Those plastics not in packaging or coverings that absorb water or otherwise appreciably retard the burning hazard of the commodity. (Paper wrapped or encapsulated, or both, should be considered exposed.)

3.3.66 Extended Coverage Sprinkler. See 3.3.204.5.6.

3.5.63.67 Extension Fitting. A male by female adapter intended to be used with a sprinkler to adjust the final fit where the sprinkler is installed in a finished ceiling or wall.

3.3.68 Extra Hazard (Group 1). See 3.3.133.1.
3.3.69 Extra Hazard (Group 2). See 3.3.133.2.

3.13.370 Fpw. The horizontal force due to seismic load acting on a brace at working stress levels.

3.9.3.71* Face Sprinklers. Standard sprinklers that are located in transverse flue spaces along the aisle or in the rack, are within 18 in. (450 mm) of the aisle face of storage, and are used to oppose vertical development of fire on the external face of storage.
A.3.9.3.43.71  **Face Sprinklers.** All face sprinklers should be located within the rack structure. The flue spaces are generally created by the arrangement of the racks, and “walkways” should not be considered flue spaces.

3.5.73.72  **Feed Mains.** The pipes supplying cross mains, either directly or through risers.

3.3.14.73  **Fire Control.** Limiting the size of a fire by distribution of water so as to decrease the heat release rate and pre-wet adjacent combustibles, while controlling ceiling gas temperatures to avoid structural damage.

3.9.1.16.4.43.74  **Fire Department Connection.** A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other water-based fire protection systems, furnishing water for fire extinguishment to supplement existing water supplies. [24, 2016]

3.8.1.53.75  **Fire Pump.** A pump that is a provider of liquid flow and pressure dedicated to fire protection. [20, 2013]

3.3.17  **Fire Suppression.** Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of water through the fire plume to the burning fuel surface.

3.3.77  **Flat Ceiling.** See 3.3.204.3.2.

3.8.1.14.13.80  **Flow Test.** A test performed by the flow and measurement of water from one hydrant and the static and residual pressures from an adjacent hydrant for the purpose of determining the available water supply at that location. [24, 2016]

3.3.81  **Flush Sprinkler.** See 3.3.204.3.2.

3.8.1.14.23.82  **Flushing Test.** A test of a piping system using flow rates intended to remove debris from the piping system prior to it being placed in service. [24, 2016]

3.3.3.5  **Four-Way Bracing.** Adjacent sway braces or a sway brace assembly intended to resist differential movement of the system piping in all horizontal directions.

A.3.11.33.83  **Four-Way Bracing.** A sway brace assembly could include a lateral and longitudinal brace in combination.

3.0.1.143.84  **Free-Flowing Plastic Materials.** Those plastics that fall out of their containers during a fire, fill flue spaces, and create a smothering effect on the fire. Examples include powder, pellets, flakes, or randomly-packed small objects [e.g., razor blade dispensers, 1 oz to 2 oz (28 g to 57 g) bottles].

3.3.48  **Fuel-Fired Heating Unit.** An appliance that produces heat by burning fuel.

3.3.86  **General Sprinkler Characteristics.** See 3.3.204.2.

3.3.87  **Gridded Sprinkler System.** See 3.3.204.4.6.

3.11.4.88  **Hanger.** A device or assembly used to support the gravity load of the system piping.

3.3.89  **Heat-Sensitive Material.** See 3.3.118.4.

3.3.90  **Heel.** See 3.3.118.5.

3.3.91  **Heel Angle.** See 3.3.118.6.

3.0.1.153.92  **High-Challenge Fire Hazard.** A fire hazard typical of that produced by fires in combustible high-piled storage.
3.9.1.163.93 High-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage in excess of 12 ft (3.7 m) in height.

3.9.4.13.100.1 High Volume Low Speed Fan. A ceiling fan that is approximately 6 ft (1.8 m) to 24 ft (7.3 m) in diameter with a rotational speed of approximately 30 to 70 revolutions per minute.

3.9.53.95 Horizontal Barrier. A solid barrier in the horizontal position covering the entire rack, including all flue spaces at certain height increments, to prevent vertical fire spread.

3.9.6 Horizontal Ceiling. See 3.3.26.2.

3.9.7 Horizontal Channel. Any uninterrupted space in excess of 5 ft (1.5 m) in length between horizontal layers of stored tires. Such channels can be formed by pallets, shelving, racks, or other storage arrangements.

3.9.8 Horizontal Roll Paper Storage. See 3.3.180.2.

3.9.9 Hose House. An enclosure located over or adjacent to a hydrant or other water supply designed to contain the necessary hose nozzles, hose wrenches, gaskets, and spanners to be used in fire fighting in conjunction with and to provide aid to the local fire department. [24, 2016]

3.9.10 Hydrant. An exterior valved connection to a water supply system that provides hose connections. [24, 2016]

3.9.11 Dry Barrel Hydrant (Frostproof Hydrant) A type of hydrant with the main control valve below the frost line between the footpiece and the barrel. [24, 2016]

3.9.12 Flow Hydrant. The hydrant that is used for the flow and flow measurement of water during a flow test. [24, 2016]

3.9.13 Private Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water on private property. [24, 2016]

3.9.14 Public Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water. [24, 2016]

3.9.15 Residual Hydrant. The hydrant that is used for measuring static and residual pressures during a flow test. [24, 2016]

3.9.16 Wet Barrel Hydrant. A type of hydrant that is intended for use where there is no danger of freezing weather, where each outlet is provided with a valve and an outlet. [24, 2016]

3.9.17 Hydrant Butt. The hose connection outlet of a hydrant. [24, 2016]

3.9.18 Hydraulically Calculated Water Demand Flow Rate. The water flow rate for a system or hose stream that has been calculated using accepted engineering practices. [24, 2016]

3.9.19 Hydraulically Designed System. A calculated sprinkler system in which pipe sizes are selected on a pressure loss basis to provide a prescribed water density, in gallons per minute per square foot (mm/min), or a prescribed minimum discharge pressure or flow per sprinkler, distributed with a reasonable degree of uniformity over a specified area.

3.9.20 Hydrostatic Test. A test of a closed piping system and its attached appurtenances consisting of subjecting the piping to an increased internal pressure for a specified period of duration to verify system integrity and leakage rates. [24, 2016]

3.9.21 Indicating Valve. A valve that has components that provide the valve operating position, open or closed. [24, 2016]
Examples are outside screw and yoke (OS&Y) gate valves, butterfly valves, and underground gate valves with indicator posts.

**Valve.** Examples are outside screw and yoke (OS&Y) gate valves, butterfly valves, and underground gate valves with indicator posts.

**3.3.106 Installation Orientation.** See 3.3.204.3.

**3.3.107 Institutional Sprinkler.** See 3.3.204.5.7.

**3.3.108 Intermediate Level Sprinkler/Rack Storage Sprinkler.** See 3.3.204.5.8.

**3.3.109 International Shore Connection.** See 3.3.118.7.

**3.4.3** Laced Tire Storage. Tires stored where the sides of the tires overlap, creating a woven or laced appearance. [See Figure A.3.9.4.9(g).]

**3.11.5** Lateral Brace. A sway brace intended to resist differential movement perpendicular to the axis of the system piping.

**3.11.6** Light Hazard. See 3.3.133.3.

**3.11.8** Limited-Combustible (Material). Refers to a building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8100 kJ/kg), where tested in accordance with NFPA 259, and includes either of the following:

1. materials having a structural base of noncombustible material, with a surfaced not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread index not greater than 50; or
2. materials, in the form and thickness used, having neither a flame spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion, when tested in accordance with ASTM E84, Standard Test Method of Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard Test Method of Surface Burning Characteristics of Building Materials.

**3.11.8** Limited-Combustible (Material). Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. See NFPA 259 and NFPA 220.

**3.11.8** Looped Sprinkler System. See 3.3.204.4.7.

**3.11.11** Longitudinal Brace. A sway brace intended to resist differential movement parallel to the axis of the system piping.

**3.11.12** Longitudinal Flue Space. The space between rows of storage perpendicular to the direction of loading with a width not exceeding 24 in. (600 mm) between storage.

**3.11.2** Longitudinal Flue Space. See Figure A.3.9.3.6.

**3.11.2** Typical Double-Row (Back-to-Back) Rack Arrangement.

**3.11.3** Low-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage up to 12 ft (3.7 m) in height.

**3.11.3** Low-Piled Storage. This definition is not intended to address allowable design approaches and protection schemes.

**3.11.8** Marine Definitions. These definitions apply to Chapter 26 only.

**3.11.10** A-Class Boundary. A boundary designed to resist the passage of smoke and flame for 1 hour when tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
3.10.23.118.2 **B-Class Boundary.** A boundary designed to resist the passage of flame for ½ hour when tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

3.10.33.118.3 **Central Safety Station.** A continuously manned control station from which all of the fire control equipment is monitored. If this station is not the bridge, direct communication with the bridge must be provided by means other than the ship’s service telephone.

3.10.43.118.4 **Heat-Sensitive Material.** A material whose melting point is below 1700°F (927°C).

A.3.10.43.118.4 **Heat-Sensitive Material.** The backbone of the fire protection philosophy for U.S. flagged vessels and passenger vessels that trade internationally is limiting a fire to the compartment of origin by passive means. Materials that do not withstand a 1-hour fire exposure when tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, are considered “heat sensitive.”

3.10.53.118.5 **Heel.** The inclination of a ship to one side.

3.10.63.118.6 **Heel Angle.** The angle defined by the intersection of a vertical line through the center of a vessel and a line perpendicular to the surface of the water.

3.10.73.118.7 **International Shore Connection.** A universal connection to the vessel’s fire main to which a shoreside fire-fighting water supply can be connected.

A.3.10.73.118.7 **International Shore Connection.** See Figure A.3.10.7.

FIGURE A.3.10.73.118.7 International Shore Fire Connection.

3.10.83.118.8 **Marine System.** A sprinkler system installed on a ship, boat, or other floating structure that takes its supply from the water on which the vessel floats.

A.3.10.83.118.8 **Marine System.** Some types of sprinkler systems can closely resemble marine systems, such as a system installed on a floating structure that has a permanent water supply connection to a public main. For these types of systems, judgment should be used in determining if certain aspects of Chapter 26 are applicable.

3.10.93.118.9 **Marine Thermal Barrier.** An assembly that is constructed of noncombustible materials and made intact with the main structure of the vessel, such as shell, structural bulkheads, and decks; meets the requirements of a B-Class boundary; and is insulated such that, if tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, for 15 minutes, the average temperature of the unexposed side does not rise more than 250°F (139°C) above the original temperature, nor does the temperature at any one point, including any joint, rise more than 405°F (225°C) above the original temperature.

A.3.10.93.118.9 **Marine Thermal Barrier.** A marine thermal barrier is typically referred to as a B-15 boundary.

3.10.103.118.10 **Marine Water Supply.** The supply portion of the sprinkler system from the water pressure tank or the sea suction of the designated sprinkler system pump up to and including the valve that isolates the sprinkler system from these two water sources.

3.10.113.118.11 **Supervision.** A visual and audible alarm signal given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists. Supervisory alarms must give a distinct indication for each individual system component that is monitored.

3.10.123.118.12 **Survival Angle.** The maximum angle to which a vessel is permitted to heel after the assumed damage required by stability regulations is imposed.
3.10-13  **3.118.13** Type 1 Stair. A fully enclosed stair that serves all levels of a vessel in which persons can be employed.

3.3.119 Marine System. See 3.3.118.8.

3.3.120 Marine Thermal Barrier. See 3.3.118.9.
3.3.121 Marine Water Supply. See 3.3.118.10.
3.9.1.123** Miscellaneous Storage.** Storage that does not exceed 12 ft (3.66 m) in height, is incidental to another occupancy use group, does not constitute more than 10 percent of the building area or 4000 ft2 (372 m2) of the sprinklered area, whichever is greater, does not exceed 1000 ft2 (93 m2) in one pile or area, and is separated from other storage areas by at least 25 ft (7.62 m).

3.3.122 **Miscellaneous Storage.** The sprinkler system design criteria for miscellaneous storage at heights below 12 ft (3.7 m) are covered by this standard in Chapter 13. Chapter 13 describes design criteria, and Section 8.2 describes installation requirements (area limits). These requirements apply to all storage of 12 ft (3.7 m) or less in height.

3.9.4-123** Miscellaneous Tire Storage.** The storage of rubber tires that is incidental to the main use of the building; storage areas do not exceed 2000 ft2 (186 m2), and on-tread storage piles, regardless of storage method, do not exceed 25 ft (7.6 m) in the direction of the wheel holes. Acceptable storage arrangements include (a) on-floor, on-side storage up to 12 ft (300 mm) high; (b) on-floor, on-tread storage up to 5 ft (1.5 m) high; (c) double-row or multirow fixed or portable rack storage on-side or on-tread up to 5 ft (1.5 m) high; (d) single-row fixed or portable rack storage on-side or on-tread up to 12 ft (300 mm) high; and (e) laced tires in racks up to 5 ft (1.5 m) in height.

3.3.123 **Miscellaneous Tire Storage.** The limitations on the type and size of storage are intended to identify those situations where tire storage is present in limited quantities and incidental to the main use of the building. Occupancies such as aircraft hangars, automobile dealers, repair garages, retail storage facilities, automotive and truck assembly plants, and mobile home assembly plants are types of facilities where miscellaneous storage could be present.

3.3.7-124** Movable Racks.** Racks on fixed rails or guides that can be moved back and forth only in a horizontal, two-dimensional plane. A moving aisle is created as abutting racks are either loaded or unloaded, then moved across the aisle to abut other racks.

3.3.125** Multicycle System.** See 3.3.204.4.8.

3.3.126** Multiple-Row Racks.** Racks greater than 12 ft (300 mm) in depth or single- or double-row racks separated by aisles less than 3.5 ft (1.1 m) wide having an overall width greater than 12 ft (300 mm).

3.11-73.127** Net Vertical Force.** The vertical reaction due to the angle of installation of sway braces on system piping resulting from earthquake motion.

3.128** Noncombustible Material.** A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat; materials that are reported as passing ASTM E136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, shall be considered noncombustible materials.

3.3.129** Noncontinuous Obstruction.** See 3.3.132.2.

3.3.130 Nozzles. See 3.3.204.5.9.

3.3.131** Obstructed Construction.** See 3.3.42.1.

3.132** Obstruction.
3.3.182 1 Continuous Obstruction. An obstruction located at or below the level of sprinkler deflectors that affect the discharge pattern of two or more adjacent sprinklers.

3.3.182 2 Noncontinuous Obstruction. An obstruction at or below the level of the sprinkler deflector that affects the discharge pattern of a single sprinkler.

3.3.133 Occupancies

3.3.133.1* Extra Hazard (Group 1). Extra hazard (Group 1) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are very high and dust, lint, or other materials are present, introducing the probability of rapidly developing fires with high rates of heat release but with little or no combustible or flammable liquids.

3.3.133.2 Extra Hazard (Group 2). Extra hazard (Group 2) occupancies shall be defined as occupancies or portions of other occupancies with moderate to substantial amounts of flammable or combustible liquids or occupancies where shielding of combustibles is extensive.

3.3.133.3 Light Hazard Occupancies. Light hazard occupancies shall be defined as occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected.

3.3.133.4 Ordinary Hazard (Group 1). Ordinary hazard (Group 1) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of the contents does not exceed the amount of miscellaneous storage of Class 2, 3, 4, plastics, tires and roll paper provided in Table 13.2.1.

3.3.133.5 Ordinary Hazard (Group 2). Ordinary hazard (Group 2) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are moderate to high, stockpiles of contents with moderate rates of heat release do not exceed 12 ft (3.66 m), and stockpiles of contents with high rates of heat release do not exceed 8 ft (2.4 m).

3.3.134 Old-Style/Conventional Sprinkler. See 3.3.204.5.10.

3.9.4.5 3.135 On-Side Tire Storage. Tires stored horizontally or flat.

3.9.4.6 3.136 On-Tread Tire Storage. Tires stored vertically or on their treads.

3.137 Open Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). See 3.3.8.3.

3.138 Open Array (Paper). See 3.3.8.4.

3.139 Open Rack. Racks without shelving or with shelving in racks that are fixed in place with shelves having a solid surface and a shelf area equal to or less than 20 ft2 (1.9 m2) or with shelves having a wire mesh, slatted surface, or other material with openings representing at least 50 percent of the shelf area including the horizontal area of rack members and where the flue spaces are maintained.

3.140 Open Sprinkler. See 3.3.204.5.11.

3.141 Open-Top Container. A container of any shape that is entirely or partially open on the top and arranged so as to allow for the collection of discharging sprinkler water cascading through the storage array.

A.3.1.141 Open-Top Container. Open-top containers can prevent water from running across the top to storage and down the flues and can also collect water. The container will prevent water penetration to a fire in lower levels where it is needed. Rack or flue collapse can also occur if too much water is collected. Consideration should be given to the potential degree of water collection possible within the container when applying the definition of an open-top container. The following conditions should be considered:

1. Small openings at the top of containers containing such items as fresh produce are quite common and should not be considered as an open-top container.
(2) Arrangements that include open-top containers that are all located on the bottom tier of rack storage do not prevent penetration of water and should not be considered an open-top container.

(3) Containers having either wire mesh siding or large uniform openings along the bottom perimeter of each container, such that water enters the container at the same flow rate and discharge evenly into the flue spaces should not be considered as an open-top container provided the contents of the container are not water absorbent and are not capable of blocking such container openings.

(4) Open-top containers that are stored in fixed location on racks equipped with flat or domed-shaped fixed-in-place lids that are provided directly above the open-top containers and prevent water from entering the open-top container, as well as distribute water equally into all flue spaces should not be considered an open-top container.

3.3.142 Ordinary Hazard (Group 1). See 3.3.133.4.
3.3.143 Ordinary Hazard (Group 2). See 3.3.133.5.
3.3.144 Ornamental/Decorative Sprinkler. See 3.3.204.5.12.

3.9.1.103.145 Packaging. A commodity wrapping, cushioning, or container.

3.3.146 Pallet

3.9.1.103.146.1* Conventional Pallets. A material-handling aid designed to support a unit load with openings to provide access for material-handling devices. (See Figure A.3.9.1.103.146.1.)

A.3.9.1.103.146.1 Conventional Pallets. See Figure A.3.9.1.103.146.1.

FIGURE A.3.9.1.103.146.1 Typical Pallets.

3.9.1.213.146.2 Plastic Pallet. A pallet having any portion of its construction consisting of a plastic material.

3.9.1.223.146.3* Reinforced Plastic Pallet. A plastic pallet incorporating a secondary reinforcing material (such as steel or fiberglass) within the pallet.

A.3.9.1.223.146.3 Reinforced Plastic Pallet. See Figure A.3.9.1.223.146.3(a) and Figure A.3.9.1.223.146.3(b).

FIGURE A.3.9.1.223.146.3(a) Cut-Away Reinforced Plastic Pallet.
FIGURE A.3.9.1.223.146.3(b) Assembled Reinforced Plastic Pallet.

3.9.1.243.146.4 Slave Pallet. A special pallet captive to a material-handling system. (See Figure A.3.9.1.10.)

3.9.1.273.146.5 Wood Pallet. A pallet constructed entirely of wood with metal fasteners.

3.9.2.33.147 Palletized Storage. Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage.

3.9.4.73.148 Palletized Tire Storage. Storage on portable racks of various types utilizing a conventional pallet as a base.

3.9.5.53.149 Paper (General Term). The term for all kinds of felted sheets made from natural fibrous materials, usually vegetable but sometimes mineral or animal, and formed on a fine wire screen from water suspension.

3.3.150 Pendent Sprinkler. See 3.3.204.3.3.

3.9.2.43.151* Pile Stability, Stable Piles. Those arrays where collapse, spillage of content, or leaning of stacks across flue spaces is not likely to occur soon after initial fire development.

A.3.9.2.43.151 Pile Stability, Stable Piles. Pile stability performance has been shown to be a difficult factor to judge prior to a pile being subjected to an actual fire. In the test work completed, compartmented cartons (see A.3.9.1.83.40, Compartmented) have been shown to be stable under fire conditions. Tests also indicated cartons that were not compartmented tended to be unstable under fire conditions.
3.9.2.5  Pile Stability, Unstable Piles. Those arrays where collapse, spillage of contents, or leaning of stacks across flue spaces occurs soon after initial fire development.

A.3.9.2.5  Pile Stability, Unstable Piles. Leaning stacks, crushed bottom cartons, and reliance on combustible bands for stability are examples of potential pile instability under a fire condition. An increase in pile height tends to increase instability.

3.3.153  Pilot Line Detector. See 3.3.204.5.13.
3.3.154  Pipe Schedule System. See 3.3.204.4.9.
3.3.155  Plastic Pallet. See 3.3.146.2.

3.3.156  Portable Racks. Racks that are not fixed in place and can be arranged in any number of configurations.

A.3.157  Post-Installed Anchors. A device used for fastening pipe to the building structure, installed in hardened concrete.

3.3.158  Private Fire Hydrant. See 3.3.100.3.

3.3.162  Private Fire Service Main. Private fire service main, as used in this standard, is that pipe and its appurtenances on private property

(1) between a source of water and the base of the system riser for water-based fire protection systems,
(2) between a source of water and inlets to foam-making systems,
(3) between a source of water and the base elbow of private hydrants or monitor nozzles, and
(4) used as fire pump suction and discharge piping,
(5) beginning at the inlet side of the check valve on a gravity or pressure tank. [24, 2016]

A.3.162  Private Fire Service Main. See Figure A.3.3.162

FIGURE A.3.3.162  Typical Private Fire Service Main.

3.3.163  Public Hydrant. See 3.3.100.4.

3.3.164  Pumper Outlet. The hydrant outlet intended to be connected to a fire department pumper for use in taking supply from the hydrant for pumpers. [24, 2016]

3.9.3.7  Pyramid Tire Storage. On-floor storage in which tires are formed into a pyramid to provide pile stability.

3.3.165  Quick-Response (QR) Sprinkler. See 3.3.204.5.14.
3.3.166  Quick-Response Early Suppression (QRES) Sprinkler. See 3.3.204.5.15.
3.3.168  Quick-Response Extended Coverage Sprinkler. See 3.3.204.5.16.

A.3.3.169  Rack. Any combination of vertical, horizontal, and diagonal members that supports stored materials. [1, 2015]

A.3.3.23  Rack. Shelving can be solid, slatted, or open. Racks can be fixed, portable, or movable. Loading can be either manual, using lift trucks, stacker cranes, or hand placement, or automatic, using machine-controlled storage and retrieval systems.
Rack storage as referred to in this standard contemplates commodities in a rack structure, usually steel. Many variations of dimensions are found. Racks can be single-, double-, or multiple-row, with or without solid shelving. The standard commodity used in most of the tests was 42 in. (1.1 m) on a side. Examples of the types of racks covered in this standard are as follows:

1. **Double-Row Racks.** Pallets rest on two beams parallel to the aisle. Any number of pallets can be supported by one pair of beams. [See Figure A.3.9.3.73.169(a) through Figure A.3.9.3.73.169(d).]

2. **Automatic Storage-Type Rack.** The pallet is supported by two rails running perpendicular to the aisle. [See Figure A.3.9.3.73.169(e).]

3. **Multiple-Row Racks More Than Two Pallets Deep, Measured Aisle to Aisle.** These racks include drive-in racks, drive-through racks, flow-through racks, portable racks arranged in the same manner, and conventional or automatic racks with aisles less than 42 in. (1.1 m) wide. [See Figure A.3.9.3.73.169(f) through Figure A.3.9.3.73.169(i).]

4. **Movable Racks.** Movable racks are racks on fixed rails or guides. They can be moved back and forth only in a horizontal, two-dimensional plane. A moving aisle is created as abutting racks are either loaded or unloaded, then moved across the aisle to abut other racks. [See Figure A.3.9.3.73.169(k).]

5. **Cantilever Rack.** The load is supported on arms that extend horizontally from columns. The load can rest on the arms or on shelves supported by the arms. [See Figure A.3.9.3.73.169(j).]

When catwalks are installed between racks, these areas are not to be considered flue spaces.

**FIGURE A.3.9.3.73.169**
- **(a)** Conventional Pallet Rack.
- **(b)** Double-Row Racks Without Solid or Slatted Shelves.
- **(c)** Double-Row Racks with Solid Shelves.
- **(d)** Double-Row Racks with Slatted Shelves.
- **(e)** Automatic Storage-Type Rack.
- **(f)** Multiple-Row Rack Served by Reach Truck.
- **(g)** Flow-Through Pallet Rack.
- **(h)** Drive-In Rack — Two or More Pallets Deep (Fork Truck Drives into Rack to Deposit and Withdraw Loads in Depth of Rack).
- **(i)** Flow-Through Racks (Top) and Portable Racks (Bottom).
- **(j)** Cantilever Rack.
- **(k)** Movable Rack.

**3.9.3.170 Rack Shelf Area.** The area of the horizontal surface of a shelf in a rack defined by perimeter aisle(s) or nominal 6 in. (150 mm) flue spaces on all four sides, or by the placement of loads that block openings that would otherwise serve as the required flue spaces.

**3.8.1.133.171 Rated Capacity.** The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated. [24, 2013]

**3.49.172 Raw Water Source.** A water supply that has not been treated and could contain foreign material that could enter the sprinkler system.

**A.3.3.10172 Raw Water Source.** Examples of raw water sources are mill ponds, lakes, streams, open-top reservoirs, and so forth. Examples of non-rain water sources can include city water supplies, cisterns, pressure tanks, gravity tanks, break tanks, aquifers, and so forth. Water sources that are closed or protected from direct contact with the environment should not be considered raw.
3.3.173 Recessed Sprinkler. See 3.3.204.3.4.
3.3.174 Residential Sprinkler. See 3.3.204.5.17.
3.3.175 Residual Hydrant. See 3.3.100.5.

3.8.1.0 Residual Pressure. The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants. [24, 2013]

3.3.177 Reinforced Plastic Pallet. See 3.3.146.3.

3.5.93.178 Riser Nipple. A vertical pipe between the cross main and branch line.

3.5.103.179 Risers. The vertical supply pipes in a sprinkler system.

3.9.5.63.180 Roll Paper Storage.

3.9.5.23.180.1 Banded Roll Paper Storage. Rolls provided with a circumferential steel strap [3/8 in. (9.5 mm) or wider] at each end of the roll.

3.9.5.6.33.180.2 Horizontal Roll Paper Storage. Rolls stored with the cores in the horizontal plane (on-side storage).

3.9.5.6.33.180.3* Roll Paper Storage Height. The maximum vertical distance above the floor at which roll paper is normally stored.

A.3.9.5.6.33.180.3 Roll Paper Storage Height. The size of rolls and limitations of mechanical handling equipment should be considered in determining maximum storage height.

3.9.5.6.33.180.4 Vertical Roll Paper Storage. Rolls stored with the cores in the vertical plane (on-end storage).

3.9.5.6.33.180.5* Wrapped Roll Paper Storage. Rolls provided with a complete heavy kraft covering around both sides and ends.

A.3.9.5.6.33.180.5 Wrapped Roll Paper Storage. Rolls that are completely protected with a heavyweight kraft wrapper on both sides and ends are subject to a reduced degree of fire hazard. Standard methods for wrapping and capping rolls are outlined in Figure A.3.9.5.6.33.180.5.

FIGURE A.3.9.5.6.33.180.5 Wrapping and Capping Terms and Methods.

3.3.181 Roll Paper Storage Height. See 3.3.180.3.

3.9.23.182 Roof Height. The distance between the floor and the underside of the roof deck within the storage area.

3.9.103.183 Rubber Tires. Pneumatic tires for passenger automobiles, aircraft, light and heavy trucks, trailers, farm equipment, construction equipment (off-the-road), and buses.

3.9.4.93.184* Rubber Tire Rack Illustrations. See Figure A.3.9.4.93.184(a) through Figure A.3.9.4.93.184(g).

A.3.9.4.93.184 Rubber Tire Rack Illustrations. Figure A.3.9.4.93.184(a) through Figure A.3.9.4.93.184(g) do not necessarily cover all possible rubber tire storage configurations.

FIGURE A.3.9.4.93.184(a) Typical Open Portable Tire Rack Unit.

FIGURE A.3.9.4.93.184(b) Typical Palletized Portable Tire Rack Units.

FIGURE A.3.9.4.93.184(c) Open Portable Tire Rack.

FIGURE A.3.9.4.93.184(d) Double-Row Fixed Tire Rack Storage.

FIGURE A.3.9.4.93.184(e) Palletized Portable Tire Rack, On-Side Storage Arrangement (Banded or Unbanded).

FIGURE A.3.9.4.93.184(f) On-Floor Storage; On-Tread, Normally Banded.

FIGURE A.3.9.4.93.184(g) Typical Laced Tire Storage.
3.11.93.185* Prying Factor. A factor based on fitting geometry and brace angle from vertical that results in an increase in tension load due to the effects of prying between the upper seismic brace attachment fitting and the structure.

A.3.11.93.185 Prying Factor. Prying factors in NFPA 13 are utilized to determine the design loads for attachments to concrete. Prying is a particular concern for anchorage to concrete because the anchor could fail in a brittle fashion.

3.11.103.186 $S_v$. The maximum considered earthquake ground motion for 0.2-second spectral response acceleration (5 percent of critical damping), site Class B for a specific site.

3.2.6.3.187* Shelf Storage. Storage on structures up to and including 30 in. (750 mm) deep and separated by aisles at least 30 in. (750 mm) wide.

A.3.2.6 3.187 Shelf Storage. Shelves are usually 2 ft. (600 mm) apart vertically.

3.3.201* Shop-Welded. As used in this standard, shop in the term shop-welded means either (1) a sprinkler contractor’s or fabricator’s premise or (2) an area specifically designed or authorized for welding, such as a detached outside location, maintenance shop, or other area (either temporary or permanent) of noncombustible or fire-resistant construction free of combustible and flammable contents and suitably segregated from adjacent areas.

3.3.189 Sidewall Sprinkler. See 3.3.204.5.

3.3.2.73.190* Single-Row Racks. Racks that have no longitudinal flue space and that have a depth up to 6 ft (1.8 m) with aisles having a width of at least 3.5 ft (1.1 m) between loads on racks.

A.3.3.2.73 190 Single-Row Racks. When a narrow rack with a depth up to 6 ft (1.8 m) is located within 24 in. (600 mm) of a wall, it is considered to have a longitudinal flue and is treated as a double-row rack.

3.3.2.83.191 Slatted Shelf Rack. A rack where shelves are fixed in place with a series of narrow individual solid supports used as the shelf material and spaced apart with regular openings.

3.3.192 Slave Pallet. See 3.3.146.4.

3.3.193 Sloped Ceiling. See 3.3.26.3.

3.3.3.21* Small Openings. Openings in the ceiling or construction features of a concealed space that allow limited amounts of heat to enter the concealed space.

A.3.3.2194 Small Openings. A return air diffuser can be 4 ft by 2 ft (1.2 m by 600 mm) and meet the definition of a small opening. A linear diffuser can be longer than 4 ft (1.2 m) but is then limited to 8 in. (200 mm) in width (or least dimension). Spaces between ceiling panels of architectural features that create a concealed space must meet the same criteria.

3.3.22 Small Room. A compartment of light hazard occupancy classification having unobstructed construction and a floor area not exceeding 800 ft2 (74 m2).

3.3.196 Smooth Ceiling. See 3.3.26.4.

3.3.2.3.197 Solid-Piled Storage. Storage of commodities stacked on each other.

3.3.2.73.198 Solid Shelf Rack. A rack that is not defined as an open rack where shelves are fixed in place with a solid, slatted, or wire mesh barrier used as the shelf material and having limited openings in the shelf area.

3.3.3.219 Solid Shelving. Shelving that is fixed in place, slatted, wire mesh, or other type of shelves located within racks. The area of a solid shelf is defined by perimeter aisle or flue space on all four sides or by the placement of loads that block openings that would otherwise serve as the required flue spaces. Solid shelves having an area equal to or less than 20 ft2 (1.9 m2) are defined as open racks. Shelves of wire mesh,
slats, or other materials more than 50 percent open and where the flue spaces are maintained are defined as open racks.

A.3.2.4.3.199  **Solid Shelving.** The placement of loads affects the calculated area of the shelf. It is the intent to apply this definition to loads on the rack where 6 in. (150 mm) nominal flues are not provided on all four sides, regardless of whether shelving materials are present. See 16.1.6.3 and 17.1.5.3 for additional allowances for double-row racks up 25 ft (7.6 m) and for multiple-row racks of any height without a longitudinal flue space.

3.9.2.83.200  **Solid Unit Load of Unexpanded Plastic (Either Cartoned or Exposed).** A load that does not have voids (air) within the load and that burns only on the exterior of the load; water from sprinklers might reach most surfaces available to burn.

3.3.201 Special Sprinkler. See 3.3.204.5.18.
3.3.202 Spray Sprinkler. See 3.3.204.5.19.
3.5.143.203  **Sprig.** A pipe that rises vertically and supplies a single sprinkler.

3.3.204 Sprinkler Definitions.

3.3.204.1  **Automatic Sprinkler.** A fire suppression or control device that operates automatically when its heat-activated element is heated to its thermal rating or above, allowing water to discharge over a specified area.

3.6.13.204.2  **General Sprinkler Characteristics.** The following are characteristics of a sprinkler that define its ability to control or extinguish a fire. (1) Thermal sensitivity. A measure of the rapidity with which the thermal element operates as installed in a specific sprinkler or sprinkler assembly. One measure of thermal sensitivity is the response time index (RTI) as measured under standardized test conditions. (a) Sprinklers defined as fast response have a thermal element with an RTI of 50 (meters-seconds)1/2 or less. (b) Sprinklers defined as standard response have a thermal element with an RTI of 80 (meters-seconds)1/2 or more. (2) Temperature rating. (3) K-factor (see Chapter 6). (4) Installation orientation (see 3.6.3.204.3). (5) Water distribution characteristics (i.e., application rate, wall wetting). (6) Special service conditions (see 3.6.3).

A.3.6.13.204.2  **General Sprinkler Characteristics.** The response time index (RTI) is a measure of the sensitivity of the sprinkler's thermal element as installed in a specific sprinkler. It is usually determined by plunging a sprinkler into a heated laminar airflow within a test oven. The plunge test is not currently applicable to certain sprinklers.

The RTI is calculated using the following:

(1) The operating time of the sprinkler
(2) The operating temperature of the sprinkler's heat-responsive element (as determined in a bath test)
(3) The air temperature of the test oven
(4) The air velocity of the test oven
(5) The sprinkler's conductivity (c) factor, which is the measure of conductance between the sprinkler's heat-responsive element and the sprinkler oven mount

Other factors affecting response include the temperature rating, sprinkler position, fire exposure, and radiation.

ISO 6182-1, Fire protection — Automatic sprinkler systems — Part 1: Requirements and test methods for sprinklers, currently recognizes the RTI range of greater than 50 (meters-seconds)1/2 and less than 80 (meters-seconds)1/2 as special response. Such sprinklers can be recognized as special sprinklers under 8.4.8.1.
It should be recognized that the term fast response (like the term quick response used to define a particular type of sprinkler) refers to the thermal sensitivity within the operating element of a sprinkler, not the time of operation in a particular installation. Many other factors, such as ceiling height, spacing, ambient room temperature, and distance below ceiling, affect the time of response of sprinklers. In most fire scenarios, sprinkler activation times will be shortest where the thermal elements are located 1 in. (25 mm) to 3 in. (75 mm) below the ceiling. A fast-response sprinkler is expected to operate quicker than a standard-response sprinkler in the same installation orientation. For modeling purposes, concealed sprinklers can be considered equivalent to pendent sprinklers having a similar thermal response sensitivity installed 12 in. (300 mm) below smooth unobstructed ceilings, and recessed sprinklers can be considered equivalent to pendent sprinklers having a similar thermal response sensitivity installed 8 in. (200 mm) below smooth unobstructed ceilings.

3.6.2.3.204 3 Installation Orientation. The following sprinklers are defined according to orientation.

3.6.2.3.204.1 Concealed Sprinkler. A recessed sprinkler with cover plate.

3.6.2.3.204.2 Flush Sprinkler. A sprinkler in which all or part of the body, including the shank thread, is mounted above the lower plane of the ceiling.

3.6.2.3.204.3 Pendant Sprinkler. A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector.

3.6.2.3.204.4 Recessed Sprinkler. A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing.

3.6.2.5 3.204 3.5 Sidewall Sprinkler. A sprinkler having special deflectors that are designed to discharge most of the water away from the nearby wall in a pattern resembling one-quarter of a sphere, with a small portion of the discharge directed at the wall behind the sprinkler.

3.6.2.6 3.204 3.6 Upright Sprinkler. A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector.

3.3.24 3.204 4* Sprinkler System. A system that consists of an integrated network of piping designed in accordance with fire protection engineering standards that includes a water supply source, a water control valve, a water flow alarm, and a drain. The portion of the sprinkler system above ground is a network of specifically sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. The system is commonly activated by heat from a fire and discharges water over the fire area.

A.3.3.22 3.204 4 Sprinkler System. As applied to the definition of a sprinkler system, each system riser serving a portion of a single floor of a facility or where individual floor control valves are used in a multistory building should be considered a separate sprinkler system. Multiple sprinkler systems can be supplied by a common supply main.

3.4.13 3.204.4.1 Antifreeze Sprinkler System. A wet pipe system using automatic sprinklers that contains a liquid solution to prevent freezing of the system, intended to discharge the solution upon sprinkler operation, followed immediately by water from a water supply.

3.4.23 3.204.4.2 Circulating Closed-Loop Sprinkler System. A wet pipe sprinkler system having non–fire protection connections to automatic sprinkler systems in a closed-loop piping arrangement for the purpose of utilizing sprinkler piping to conduct water for heating or cooling, where water is not removed or used from the system but only circulated through the piping system.

3.4.33 3.204 4.3 Combined Dry Pipe–Reaction Sprinkler System. A sprinkler system employing automatic sprinklers attached to a piping system containing air under pressure with a supplemental detection system
installed in the same areas as the sprinklers. Operation of the detection system actuates tripping devices that open dry pipe valves simultaneously and without loss of air pressure in the system. The detection system also serves as an automatic fire alarm system.

3.4.3 204.4.4 Deluge Sprinkler System. A sprinkler system employing open sprinklers or nozzles that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers or the nozzles. When this valve opens, water flows into the piping system and discharges from all sprinklers or nozzles attached thereto.

3.4.5 204.4.4 Dry Pipe Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinklers.

3.4.6 204.4.4.6* Gridded Sprinkler System. A sprinkler system in which parallel cross mains are connected by multiple branch lines, causing an operating sprinkler to receive water from both ends of its branch line while other branch lines help transfer water between cross mains.

A.3 4.6 204.4.6 Gridded Sprinkler System. See Figure A.3.4.63.204.4.6.

FIGURE A.3.4.63.204.4.6 Gridded System.

3.4.7 204.4.4.7* Loop Sprinkler System. A sprinkler system in which multiple cross mains are tied together so as to provide more than one path for water to flow to an operating sprinkler and branch lines are not tied together.

A.3 4.7 204.4.7 Loop Sprinkler System. See Figure A.3.4.73.204.4.7.

FIGURE A.3.4.73.204.4.7 Loop System.

3.4.8 204.4.4.8 Multicycle System. A type of sprinkler system capable of repeated on–off flow cycles in response to heat.

A.3 4.83.204.4.8 Multicycle System. See Figure A.3.4.83.204.4.8.

FIGURE A.3.4.83.204.4.8 Multicycle System.

3.4.9 204.4.4.9 Tube Schedule System. A sprinkler system in which the pipe sizing is selected from a schedule that is determined by the occupancy classification and in which a given number of sprinklers are allowed to be supplied from specific sizes of pipe.

3.4.10 204.4.4.10* Pile Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

A.3 4.103.204.4.10 Pile Sprinkler System. The actuating means of the valve are described in Chapter 7.

3.2.1. Actuation of the detection system and sprinklers in the case of double-interlocked systems opens a valve that permits water to flow into the sprinkler piping system and to be discharged from any sprinklers that are open.

A.3 4.113.204.4.11 Wet Pipe Sprinkler System. A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

3.4.13 204.5.1 Control Mode Density/Area (CMDA) Sprinkler. A type of spray sprinkler intended to provide fire control in storage applications using the design density/area criteria described in this standard.

A.3 4.13204.5.1 Control Mode Density/Area (CMDA) Sprinkler. This definition is focused on the storage application since the term CMDA is used in the storage chapters. As indicated in Chapter 12, spray sprinklers intended for storage applications requiring a design density greater than 0.34 gpm/ft should have a nominal K-factor of 11.2 or larger and be listed for storage applications. Spray sprinklers having a nominal
K-factor of 5.6 or 8.0 are permitted to be used for storage applications as a CMDA sprinkler within certain design densities as described in Chapter 12.

Spray type sprinklers intended for use in accordance with the occupancy hazard density/area curves could also be considered CMDA sprinklers. However, the CMDA terminology is generally not referenced in the non-storage chapters, and this term is not used to describe these sprinklers in the product listings.

3.6.4.2 204.5.2* Control Mode Specific Application (CMSA) Sprinkler. A type of spray sprinkler that is capable of producing characteristic large water droplets and that is listed for its capability to provide fire control of specific high-challenge fire hazards.

A.3.6.4.2204.5.2 Control Mode Specific Application (CMSA) Sprinkler. A large drop sprinkler is a type of CMSA sprinkler that is capable of producing characteristic large water droplets and that is listed for its capability to provide fire control of specific high-challenge fire hazards.

3.6.3.13.204.5.3 Corrosion-Resistant Sprinkler. A sprinkler fabricated with corrosion-resistant material, or with special coatings or platings, to be used in an atmosphere that would normally corrode sprinklers.

3.6.3.23.204.5.4* Dry Sprinkler. A sprinkler secured in an extension nipple that has a seal at the inlet end to prevent water from entering the nipple until the sprinkler operates.

A.3.6.3.23.204.5.4 Dry Sprinkler. Under certain ambient conditions, wet pipe systems having dry pendant (or upright) sprinklers can freeze due to heat loss by conduction. Therefore, due consideration should be given to the amount of heat maintained in the heated space, the length of the nipple in the heated space, and other relevant factors.

Dry sprinklers are intended to extend into an unheated area from a wet pipe system or to be used on a dry pipe system.

3.6.4.3 204.5.5* Early Suppression Fast-Response (ESFR) Sprinkler. A type of fast-response sprinkler that has a thermal element with an RTI of 50 (meters-seconds)1/2 or less and is listed for its capability to provide fire suppression of specific high-challenge fire hazards.

A.3.6.4.3 204.5.5 Early Suppression Fast-Response (ESFR) Sprinkler. It is important to realize that the effectiveness of these highly tested and engineered sprinklers depends on the combination of fast response and the quality and uniformity of the sprinkler discharge. It should also be realized that ESFR sprinklers cannot be relied upon to provide fire control, and alone suppression, if they are used outside the guidelines specified in Chapter 12.

3.6.4.4 204.5.6 Extended Coverage Sprinkler. A type of spray sprinkler with maximum coverage areas as specified in Sections 8.8 and 8.9 of this standard.

3.6.3.3 204.5.7 Institutional Sprinkler. A sprinkler specially designed for resistance to load-bearing purposes and with components not readily converted for use as weapons.

3.6.4.4 204.5.8 Intermediate Level Sprinkler/Rack Storage Sprinkler. A sprinkler equipped with integral shields to protect its operating elements from the discharge of sprinklers installed at higher elevations.

3.6.4.5 204.5.9 Nozzles. A device for use in applications requiring special water discharge patterns, directional spray, or other unusual discharge characteristics.

3.6.4.6 204.5.10 Old-Style/Conventional Sprinkler. A sprinkler that directs from 40 percent to 60 percent of the total water initially in a downward direction and that is designed to be installed with the deflector either upright or pendant.

3.6.4.7 204.5.11 Open Sprinkler. A sprinkler that does not have actuators or heat-responsive elements.

3.6.3.5 204.5.12 Ornamental/Decorative Sprinkler. A sprinkler that has been painted or plated by the manufacturer.
3.6.3.6.3.204.5.13  **Pilot Line Detector.** A standard spray sprinkler or thermostatic fixed-temperature release device used as a detector to pneumatically or hydraulically release the main valve, controlling the flow of water into a fire protection system.

3.6.4.8.3.204.5.14*  **Quick-Response (QR) Sprinkler.** A type of spray sprinkler that has a thermal element with an RTI of 50 (meter-seconds)1/2 or less and is listed as a quick-response sprinkler for its intended use.

A.3.6.4.8.3.204.5.14  **Quick-Response (QR) Sprinkler.** Quick response is a listing for sprinklers that combines the deflector, frame, and body of a spray sprinkler with a fast-response element [see 3.6.1(1)(a)] to create a technology that will respond quickly in the event of a fire and deliver water in the same fashion as other types of spray sprinklers.

3.6.4.8.3.204.5.15*  **Quick-Response Early Suppression (QRES) Sprinkler.** A type of quick-response sprinkler that has a thermal element with an RTI of 50 (meter-seconds)1/2 or less and is listed for its capability to provide fire suppression of specific fire hazards.

A.3.6.4.8.8.3.204.5.15  **Quick-Response Early Suppression (QRES) Sprinkler.** Research into the development of QRES sprinklers is continuing under the auspices of the National Fire Protection Research Foundation. It is expected that the proposed design criteria will be added to the standard when a thorough analysis of the test data is completed.

3.6.4.8.3.204.5.16  **Quick-Response Extended Coverage Sprinkler.** A type of quick-response sprinkler that has a thermal element with an RTI of 50 (meter-seconds)1/2 or less and complies with the extended protection areas defined in Chapter 8.

3.6.4.9.3.204.5.17  **Residential Sprinkler.** A type of fast-response sprinkler having a thermal element with an RTI of 50 (meters-seconds)1/2 or less that has been specifically investigated for its ability to enhance survivability in the room of fire origin, and that is listed for use in the protection of dwelling units.

3.6.4.103.204.5.18  **Special Sprinkler.** A sprinkler that has been tested and listed as prescribed in 8.4.8.

3.6.4.113.204.5.19  **Spray Sprinkler.** A type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards.

3.6.4.113.204.5.20  **Standard Spray Sprinkler.** A spray sprinkler with maximum coverage areas as specified in Sections 8.6 and 8.7 of this standard.

3.3.205  **Sprinkler System.** See 3.3.204.4.

3.3.206  **Standard Array (Paper).** See 3.3.8.5.

3.3.207  **Standard Spray Sprinkler.** See 3.3.204.5.20.

3.8.1.93.208  **Static Pressure.** The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing. [24, 2013]

3.9.1.253.209  **Storage Aids.** Commodity storage devices, such as pallets, dunnage, separators, and skids.

3.3.210  **Supervision (Marine System).** See 3.3.118.11.

3.5.123.211  **Supervisory Device.** A device arranged to supervise the operative condition of automatic sprinkler systems.

3.3.212  **Survival Angle.** See 3.3.118.12.

3.113.213  **Seismic Separation Assembly.** An assembly of fittings, pipe, flexible pipe, and/or couplings that permits movement in all directions to accommodate seismic differential movement across building seismic separation joints.

A.3.113.213  **Seismic Separation Assembly.** Seismic separation assemblies include traditional assemblies as shown in Figure A.9.3.3(a) and seismic loops as shown in Figure A.9.3.3(b).
3.5.133.214 System Riser. The aboveground horizontal or vertical pipe between the water supply and the mains (cross or feed) that contains a control valve (either directly or within its supply pipe), a pressure gauge, a main drain, and a waterflow alarm device.

3.3.24215 System Working Pressure. The maximum anticipated static (nonflowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures and exclusive of pressure from the fire department connection.

3.11.123.216 Sway Brace. An assembly intended to be attached to the system piping to resist horizontal earthquake loads in two directions.

3.3.25217 Thermal Barrier. A material that limits the average temperature rise of the unexposed surface to not more than 250°F (121°C) above ambient for a specified fire exposure duration using the standard time-temperature curve of ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

3.9.6.23.218* Tiered Storage. An arrangement in which bales are stored directly on the floor, two or more bales high.

A.3.9.6.23.218 Tiered Storage. Untiered storage limits storage to the height of one bale, on side or on end. Sprinkler protection designed on this basis would likely prohibit future tiering without redesign of the sprinkler system.

3.9.3.93.219 Transverse Flue Space. The space between rows of storage parallel to the direction of loading. (See Figure A.3.9.3.6.)

3.3.220 Type 1 Stair. See 3.3.118.13

3.9.1.263.221 Unit Load. A pallet load or module held together in some manner and normally transported by material-handling equipment.

3.3.222 Unobstructed Construction. See 3.3.42.2

3.3.223 Upright Sprinkler. See 3.3.204.3.6

3.3.224 Vertical Roll Paper Storage. See 3.3.180.4

3.5.143.225 Waterflow Alarm Device. An attachment to the sprinkler system that detects a predetermined water flow and is connected to a fire alarm system to initiate an alarm condition or is used to mechanically or electrically initiate a fire pump or local audible or visual alarm.
See attached file for new text for Chapter 9

### Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_9_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

### Submitter Information Verification

- **Submitter Full Name:** AUT-SSI
- **Organization:** [Not Specified]
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Thu Sep 08 16:22:06 EDT 2016

### Committee Statement

- **Committee Statement:** Due to reorganization.
- **Response Message:**
9.2 Allowable Sprinkler Omission Locations

9.2.28.15.6.2 Spaces Under Ground Floors, Exterior Docks, and Platforms. Sprinklers shall be permitted to be omitted from spaces under ground floors, exterior docks, and platforms where all of the following conditions exist:

9.2.3 Exterior Projections.

9.2.9 Furniture, such as portable wardrobe units, cabinets, trophy cases, and similar features not intended for occupancy, does not require sprinklers to be installed in them. This type of feature shall be permitted to be attached to the finished structure.

9.2.10* Equipment Enclosures Sprinklers shall not be required to be installed within electrical equipment, mechanical equipment, or air handling units not intended for occupancy.

A.9.2.10 Equipment having access for routine maintenance should not be considered as intended for occupancy.

9.2.11 Noncombustible Vertical Shafts. Sprinklers shall not be required at the top of noncombustible or limited-combustible, nonaccessible vertical duct, electric and mechanical shafts as permitted by 9.3.3.1.1 and 9.3.3.1.2.

9.2.12 Noncombustible Stairways.

9.2.12.1 Sprinklers shall not be required at the bottom of stairwells complying with the provisions of 9.3.4.2.3.1.

9.2.12.2 Sprinkler shall not be required for exterior stair towers complying with the provisions of 9.3.4.2.4.

9.2.13 Elevator Hoistways and Machine Rooms. Sprinklers shall not be required in locations complying with 9.3.6.2, 9.3.6.3 or 9.3.6.6.

9.2.14 Duct Protection. Sprinklers shall not be required in vertical duct risers complying with 9.3.9.1.2.

9.2.15 Open-Grid Ceilings. Sprinklers shall not be required below open grid ceiling installations complying with 9.3.10.

9.2.16 Drop-Out Ceilings. Sprinklers shall not be required below drop-out ceiling complying with 9.3.11.

9.2.17 Skylights. Sprinklers shall not be required in skylights complying with 9.3.16.
Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_16_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 08 16:26:05 EDT 2016

Committee Statement

Committee Statement: Reformating combines requirements for installation of piping, valves and appurtenances form several existing chapter of NFPA 13.
Response Message:
16.1 Basic Requirements.

16.2 Sprinkler Installation.

16.2.2* Corrosion Resistant.

16.2.3* Painting.

16.2.5 Escutcheons and Cover Plates.

16.2.5.1 Plates, escutcheons, or other devices used to cover the annular space around a sprinkler shall be metallic or shall be listed for use around a sprinkler.

16.2.5.2* Escutcheons used with recessed, flush-type, or concealed sprinklers shall be part of a listed sprinkler assembly.

A.16.2.5.2 The use of the wrong type of escutcheon with recessed or flush-type sprinklers can result in severe disruption of the spray pattern, which can destroy the effectiveness of the sprinkler.

16.2.5.3 Cover plates used with concealed sprinklers shall be part of the listed sprinkler assembly.

16.3.1 General.

16.3.9* Nonmetallic Pipe and Tubing.

16.3.10* Listed Metallic Pipe and Tubing.

16.8 Fitting Installation.

16.8.1 Metallic Fittings (Reserved)

16.8.2 Nonmetallic Fittings.

16.8.7 Threaded Pipe and Fittings.

16.9.1 General.
First Revision No. 893-NFPA 13-2016 [ Global Input ]

See attached file for new text in Chapter 10

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_10_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City:  
State:  
Zip:  
Submittal Date: Thu Sep 08 16:55:49 EDT 2016

Committee Statement

Committee Statement: The new Chapter 10 contains the specific requirements for the installation of standard pendent, upright and sidewall sprinklers that were previously contained in the 2016 Sections 8.4, 8.6, and 8.7. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

Response Message:  

Chapter 10 Installation Requirements for Standard Pendent, Upright and Sidewall Sprinklers

10.1 General. Standard pendent, upright and sidewall sprinklers shall be selected for use and installation as indicated in this Chapter and shall be positioned and spaced in accordance with Section 9.5.

10.3.7.1 The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

10.3.7.2 The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 8.6.6, 10.3.78.7.6, 8.8.6, and Section 8.9.

10.3.7.2.1 Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

10.3.7.2.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.
First Revision No. 894-NFPA 13-2016 [ Global Input ]

See attached file for new text in Chapter 11

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_11_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 08 17:01:19 EDT 2016

Committee Statement

Committee Statement: The new Chapter 11 contains the specific requirements for the installation of extended coverage pendant, upright and sidewall sprinklers that were previously contained in the 2016 Sections 8.4, 8.8, and 8.9. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

Response Message:
Chapter 11 Installation Requirements for Extended Coverage Upright, Pendent and Sidewall Sprinklers

11.1 General. Extended coverage pendent, upright and sidewall sprinklers shall be selected for use and installation as indicated in this Chapter and shall be positioned and spaced in accordance with Section 9.5.

11.2.7.2 The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 8.6.6, 8.7.6, 11.2.7, 8.8.6, and Section 8.9.

11.2.7.2.1 Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

11.2.7.2.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

11.3.2 Extended coverage sidewall spray sprinklers shall only be installed as follows:

(1) Light hazard occupancies with smooth, horizontal or sloped, flat ceilings

(2) Ordinary hazard occupancies with smooth, flat ceilings where specifically listed for such use

(3) In unobstructed construction consisting of flat, smooth ceilings with a slope not exceeding a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)

(4) In unobstructed or noncombustible obstructed construction, where specifically listed for such use

(5) Within trusses or bar joists having web members not greater than 1 in. (25 mm) maximum dimension or where trusses are spaced greater than 71/2 ft (2.3 m) on center and where the ceiling slope does not exceed a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)

(6) Extended coverage sidewall sprinklers installed in accordance with 11.3.5.2.28.9.4.2.2 in slopes exceeding a ceiling pitch of 2 in 12

(7) In each bay of obstructed construction consisting of solid structural members that extend below the deflector of the sprinkler

(8) Extended coverage sprinklers installed to protect areas below a single overhead door(s)
First Revision No. 895-NFPA 13-2016 [ Global Input ]

See attached for new text in Chapter 13

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_13_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 08 17:11:24 EDT 2016

Committee Statement

Committee Statement: The new Chapter 13 contains the specific requirements for the installation of CMSA sprinklers that were previously contained in the 2016 Sections 8.4 and 8.11. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

Response Message:
13.1 General. Control Mode Specific Application (CMSA) sprinklers shall be selected for use and installation as indicated in this Chapter and shall be positioned and spaced in accordance with Section 9.5.
See attached file for new text in Chapter 14.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_14_New_Text.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:  
City: 
State: 
Zip:  
Submittal Date: Thu Sep 08 17:13:47 EDT 2016

Committee Statement

Committee Statement: The new Chapter 14 contains the specific requirements for the installation of ESFR sprinklers that were previously contained in the 2016 Sections 8.4 and 8.12. Redundant provisions that are included verbatim in the new Chapter 9 were deleted.

Response Message:
14.1 General. Early Suppression Fast-Response (ESFR sprinklers shall be selected for use and installation as indicated in this Chapter and shall be positioned and spaced in accordance with Section 8.5.
First Revision No. 912-NFPA 13-2016 [ Global Input ]

Add new text per re-org

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_28_New_Text.1473448088329.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Sep 09 15:07:35 EDT 2016

Committee Statement

Committee Statement: per re-org
Response Message:
Chapter 28 Existing System Modifications

28.1 General

28.1.1 In addition to the applicable requirements of this standard, the requirements of Chapter 28 shall apply when modifications or additions are made to existing systems.

28.1.2 Torch cutting and welding shall not be permitted as a means of modifying or repairing sprinkler systems.

28.1.3 Additives to existing systems intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

28.2 Reconditioned Components

28.2.1 The use of reconditioned valves and devices as replacement equipment in existing systems shall be permitted.

28.2.5 8.15.20.3 When pipe schedule or hydraulically designed systems are revamped to accommodate added ceilings, sprinkler outlets utilized for new armover or drop nipples shall have hexagonal bushings removed when present.

28.3 Sprinklers

28.3.1 Reconditioned sprinklers shall not be permitted on any new or existing system.

28.3.2 When a sprinkler is removed from a fitting or welded outlet, it shall not be reinstalled except as permitted by 28.3.2.1. 6.2.1.1.1

28.3.2.1 Dry sprinklers shall be permitted to be reinstalled when removed in accordance with the manufacturer’s installation and maintenance instructions.

28.3.3 Where modifications or additions are made to existing light hazard systems equipped with standard response sprinklers, new standard response sprinklers shall be permitted to be used.

28.3.4 Where individual standard response sprinklers are replaced in existing light hazard systems, new standard response sprinklers shall be permitted to be used.

28.3.5 8.3.3.6 When existing light hazard systems are converted to use quick-response or residential sprinklers, all sprinklers in a compartment shall be changed.

28.3.6 Where replacing residential sprinklers manufactured prior to 2003 that are no longer available from the manufacturer and that are installed using a design density less than 0.05 gpm/ft² (2.04mm/min), a residential sprinkler with an equivalent K-factor (± 5 percent) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

28.3.7 Where cover plates on concealed sprinklers have been painted by other than the sprinkler manufacturer, the cover plate shall be replaced.

28.4.3 8.15.20.4.3 When it is necessary to pipe two new sprinklers from an existing outlet in an overhead system, the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted in accordance with Figure 28.4.3, provided that a
hydraulic calculation verifies that the design flow rate will be achieved. in accordance with Figure 8.15.20.4.3.

28.6 System Design

28.6.1 Where the equipment is to be installed as an addition or modifications are made to an existing system, enough of the existing system shall be indicated on the plans to make all conditions clear.

28.6.2 The pipe schedule method shall be permitted as follows:

1. Additions or modifications to existing pipe schedule systems sized according to the pipe schedules of Section 23.7

2. Additions or modifications to existing extra hazard pipe schedule systems

28.6.3 For modifications or additions to existing systems equipped with residential sprinklers, the listed discharge criteria less than 0.1 gpm/ft² (4.1mm/min) shall be permitted to be used.

28.6.5 A hydraulically calculated system for a building, or a hydraulically calculated addition to a system in an existing sprinklered building using the pipe schedule method, shall supersede the rules in this standard governing pipe schedules, except that all systems shall continue to be limited by area.

28.6.6 Unless permitted by 28.6.6.1 Unless the requirements of 12.6.5 are met, when modifying existing systems protecting general storage, rack storage, rubber tire storage, roll paper storage, and baled cotton storage, using sprinklers with K-factors K-8.0 (115) or less, the requirements of 12.6.2 and 12.6.3 shall not apply to modifications to existing storage application systems, using sprinklers with K-factors K-8.0 (115) or less.

28.6.6.1 Where applying the requirements of Figure 17.2.1.2.1(b) and Figure 17.2.1.2.1(c) utilizing the design criteria of 0.6 gpm/ft² per 2000 ft² (24.4 mm/min per 186 m²) to existing storage applications, standard-response spray sprinklers with a K-factor of K-11.2 (161) or larger that are listed for storage applications shall be used the requirements of 12.6.3 shall apply.

28.7 Testing

28.7.2 25.2.2.1.1 Modifications to existing dry pipe or double interlock preaction systems shall be tested for air leakage using one of the following test methods:

(1) An air pressure test at 40 psi (3.2 bar) shall be performed for 2 hours.

(a) The system shall be permitted to lose up to 3 psi (0.2 bar) during the duration of the test.

(b) Air leaks shall be addressed if the system loses more than 3 psi (0.2 bar) during this test.

(2) With the system at normal system air pressure, the air source shall be shut off for 4 hours. If the low pressure alarm goes off within this period, the leaks shall be addressed.
12.1 General. Residential sprinklers shall be selected for use and installation as indicated in this Chapter and shall be positioned and spaced in accordance with Section 9.5.

12.1.10.3.2 [8.10.6.3.2] Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR_913.docx</td>
<td>Annex material for Section 12.1.10.3.2</td>
</tr>
</tbody>
</table>

Submitter Information Verification

- **Submitter Full Name:** AUT-SSI
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Fri Sep 09 15:10:56 EDT 2016

Committee Statement

- **Committee Statement:** New language needed per re-org
  
  During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now. See PI 503 & 504.

Response

- **Message:**

http://submittals.nfpa.org/TerraViewWeb/ContentFetcher?commentPara...
A.12.1.10.3.2 When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1219 mm) wide do not require additional protection underneath. Examples are ducts, stairs, landings, and other similar obstructions.
First Revision No. 915-NFPA 13-2016 [ Global Input ]

Reformat NFPA 13 as per the attached Table of Contents

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOC_for_FR.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Sep 09 15:27:36 EDT 2016

Committee Statement

Committee Statement: At its first draft meeting in December 2013, the Technical Correlating Committee for NFPA 13 instructed all Sprinkler Technical Committees to develop a plan for streamlining the standard to make it easier to follow; indicating that there are redundancies throughout the standard that have increased the length of the document without adding clarification of the requirements. Since that time a reformatting Task Group has been formed to completely reformat NFPA 13 to follow the logic behind designing a sprinkler system. The Table of Contents in the FR is the result of that effort.

Response Message:
<table>
<thead>
<tr>
<th></th>
<th>Administration</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Referenced Publications</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Definitions</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>General Requirements</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Water Supplies</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Installation Underground Piping</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Requirements for System Components and Hardware</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>System Types and Requirements</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sprinkler Location Requirements</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Installation Requirements for Standard Spray Sprinklers</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Installation Requirements for Extended Spray Sprinkler</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Installation Requirements for Residential Sprinklers</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Installation Requirements for CMSA Sprinklers</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Installation Requirements for ESFR Sprinklers</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Installation Requirements for Special Sprinklers</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Installation of Piping, Valves and Appurtenances</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Installation Requirements for Hanging and Support of System Piping</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Installation Requirements for Seismic Protection</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Design Approaches and Calculations</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>General Requirements for Storage</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Standard Spray Sprinkler Requirements for Storage Applications</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>CMSA Requirements for Storage Applications</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>ESFR Requirements for Storage Applications</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Alternative Sprinkler System Designs for Chapters 21 Through 23</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>In-rack Sprinklers</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Special Occupancy Requirements</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Systems Acceptance</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Existing System Modifications</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Marine Systems</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>System Inspection, Testing, and Maintenance</td>
<td></td>
</tr>
</tbody>
</table>
1.1.2* This standard shall not provide requirements for the design or installation of water mist fire protection systems, which are not considered fire sprinkler systems and are addressed by NFPA 750.

1.1.2.1 Water mist fire protection systems shall not be considered fire sprinkler systems.

1.1.2.2 The design and installation of water mist fire protection systems shall comply with NFPA 750.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 10:39:49 EDT 2016

Committee Statement

Committee Statement: The current 1.1.2 is a run-on sentence with three requirements in it. Breaking it down into three separate requirements/thoughts complies with the NFPA manual of style. The annex text elaborates on the fact that fire sprinkler systems and water mist fire protection systems are different with different installation requirements and operating characteristics.

Response Message: [Public Input No. 96-NFPA 13-2016 [Section No. 1.1.2] ]
1.3.2 Level of Protection.

A building, where protected by an automatic sprinkler system installation, shall be provided with sprinklers in all areas except where specific sections of this standard permit the omission of sprinklers.
1.5* Equivalency.

Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1

Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2

The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-904_A.1.5.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Sep 09 08:54:08 EDT 2016

Committee Statement

Committee Statement: Many AHJ's will not recognize future editions. This annex note is intended to give guidance that use of an entire future edition of the standard could be considered an equivalency as allowed in 1.5. This language will be proposed to other sprinkler standards and has been accepted by NFPA 14 & NFPA 25.

Response Message: Public Input No. 7-NFPA 13-2015 [New Section after A.1.2]
A.1.5

It is the intent of the committee to recognize that future editions of this standard are a further refinement of this edition and earlier editions. The changes in future editions will reflect the continuing input of the fire protection community in its attempt to meet the purpose stated in this standard. Compliance with all requirements of a future edition could be considered as providing an equivalent level of system integrity and performance of the system.
1.7.2
Materials or devices not specifically designated by this standard shall be utilized in complete accord with all conditions, requirements, and limitations of their listings.

1.7.2.1*
Devices and equipment utilized to perform automated inspection and testing procedures that are not subjected to system pressure shall not be required to be listed.

1.7.2.2*
Devices and equipment utilized to perform distance monitoring of system or component status that are not subjected to system pressure shall not be required to be listed.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-834_A.1.7.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 13:11:39 EDT 2016

Committee Statement

Committee Statement: Technology now allows for monitoring certain conditions of a sprinkler system from a distance as well as automated inspection and testing procedures. When the device is external to the sprinkler system, doesn't enter the system piping and is not subject to system pressure there isn’t a need to have it listed.

Response Message:

Public Input No. 405-NFPA 13-2016 [Section No. 1.7.2]
A.1.7.2.1  
Certain devices and equipment that might be used to perform inspection and testing procedures from a distant location are not integral to the system and do not affect system performance. Automated inspection and testing devices and equipment, such as a digital camera, could be in the riser room or attached to the system externally but are not an integral part of the system. Such devices do not need to be listed.

A.1.7.2.2  
Certain devices and equipment that might be used to monitor system or component status from a distance are not integral to the system and do not affect system performance. Distance monitoring devices, such as an external thermometer, could be attached to the system externally and therefore are not subjected to system pressure. Such devices do not need to be listed.
Chapter 2  Referenced Publications

2.1 General.

The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.
2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.


2.3 Other Publications.
2.3.1 ACI Publications.
American Concrete Institute, P.O. Box 9094 38800 Country Club Drive, Farmington Hills, MI 48334-3831.

2.3.2 ASCE Publications.
American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

2.3.3 ASME Publications.
American Society of Mechanical Engineers, ASME International, Two Park Avenue, New York, NY 10016-5990.
ASME B16.15, Cast Copper Alloy Threaded Fittings Classes 125 and 250, 2011 2013.
ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings, 1994 2012.
2.3.4 ASTM Publications.
ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.


2.3.5 AWS Publications.

American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126, 8869 NW 36 Street, #130, Miami, FL 33166-6672.

AWS A5.8M/ A5.8, Specification for Filler Metals for Brazing and Braze Welding, 1992 2011.

2.3.6 AWWA Publications.
American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.
AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 in. (100 mm) and Larger — Shop Applied, 2000 2012.
AWWA C207, Steel Pipe Flanges for Waterworks Service — Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm), 1994, 2013.
AWWA C300, Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids, 1997 2011.
AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids, 1999 2014.
AWWA C302, Reinforced Concrete Pressure Pipe, Non-Cylinder Type, for Water and Other Liquids, 1995 2011.
AWWA C303, Reinforced Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type, Pretensioned, for Water and Other Liquids, 1995 2008.
AWWA C400, Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm), for Water and Other Liquids, 1998, Withdrawn.
AWWA C401, Standard Practice for the Selection of Asbestos-Cement Water Pipe, 4 in. Through 16 in. (100 mm Through 400 mm), 1998, Withdrawn.
AWWA C602, Cement-Mortar Lining of Water Pipe Lines 4 in. (100 mm) and Larger — in Place, 2000 2011.
AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1,575 mm), for Water Distribution and Transportation (100 mm Through 1,650 mm), for Waterworks, 1999 2015.
2.3.7  ICC-ES Publications.
ICC Evaluation Service, 900 Montclair Road, Suite A, Birmingham, AL 35213.

2.3.8  IEEE Publications.
IEEE, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

2.3.9  UL Publications.
Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

2.3.10  U.S. Government Publications.
Title 46, CFR, Parts 54.15-10 Safety and Relief Valves, 56.20 Valves, 56.20-5(a) Markings, 56.50-95 Overboard Discharges and Shore Connections, 56.60 Materials, and 58.01-40 Machinery, Angle of Inclination.
Title 46, CFR, Subchapter F, “Marine Engineering.”
Title 46, CFR, Subchapter J, “Electrical Engineering.”

2.3.11  Other Publications.
2.4 References for Extracts in Mandatory Sections.

**NFPA 70®, National Electrical Code®, 2014 2017 edition.**


<table>
<thead>
<tr>
<th><strong>Submitter Information Verification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submitter Full Name:</strong> AUT-SSI</td>
</tr>
<tr>
<td><strong>Organization:</strong> National Fire Protection Assoc</td>
</tr>
<tr>
<td><strong>Street Address:</strong></td>
</tr>
<tr>
<td><strong>City:</strong></td>
</tr>
<tr>
<td><strong>State:</strong></td>
</tr>
<tr>
<td><strong>Zip:</strong></td>
</tr>
<tr>
<td><strong>Submittal Date:</strong> Mon Aug 15 11:31:48 EDT 2016</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Committee Statement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Committee Statement:</strong> Referenced current SDO names, addresses, standard names, numbers, and editions.</td>
</tr>
<tr>
<td><strong>Response Message:</strong></td>
</tr>
<tr>
<td>Public Input No. 15-NFPA 13-2016 [Section No. 2.3.4]</td>
</tr>
<tr>
<td>Public Input No. 10-NFPA 13-2016 [Section No. 2.3.4]</td>
</tr>
<tr>
<td>Public Input No. 1-NFPA 13-2015 [Chapter 2]</td>
</tr>
<tr>
<td>Public Input No. 404-NFPA 13-2016 [Section No. 2.3.8]</td>
</tr>
<tr>
<td>Public Input No. 376-NFPA 13-2016 [Section No. 2.3.6]</td>
</tr>
<tr>
<td>Public Input No. 192-NFPA 13-2016 [Section No. 2.3.8]</td>
</tr>
<tr>
<td>Public Input No. 540-NFPA 13-2016 [Section No. 2.3.8]</td>
</tr>
</tbody>
</table>
3.3.9 Automated Inspection and Testing.

The use of procedures or equipment for the performance of inspections and testing of components through the use of electronic devices or equipment installed for the purpose.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 19:42:37 EDT 2016

Committee Statement

Committee Statement: Technology now allows for inspecting and testing a sprinkler system from a distant location. New text has been added to NFPA 13 allowing for the installation and requirements for the devices and equipment used for this purpose. A definition is needed to describe the intent of the new requirements and allowances.

Response Message:

Public Input No. 411-NFPA 13-2016 [New Section after 3.3.2]
3.3.40 Compartment.

A space completely enclosed by walls and a ceiling. Each wall in the compartment is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (200 mm) from the ceiling and the total width of the openings in each wall does not exceed 8 ft (2.4 m) every 40 linear feet. A single opening of 36 in. (900 mm) or less in width without a lintel is permitted where there are no other openings to adjoining spaces every 40 linear feet.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 18 13:35:47 EDT 2016

Committee Statement

Committee Statement: A compartment should be allowed greater openings if they are spaced far enough apart and do not make up a significant percentage of their perimeter. As an example, if the openings are over 40 feet apart. The NFSA has modeling research ongoing using CFAST. This is a placeholder to see what the data shows.

Response Message:

Public Input No. 444-NFPA 13-2016 [Section No. 3.3.6]
3.3.56 Distance Monitoring

The monitoring of various conditions of a system or component from a location distant from the component through the use of electronic devices, meters, or equipment installed for the purpose.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 20:04:25 EDT 2016

Committee Statement

Committee Statement: Technology now allows for monitoring certain conditions of a sprinkler system or component from a distant location. New text has been added to NFPA 13 allowing for the installation and requirements for the devices, meters and equipment used for this purpose. A definition is needed to describe the intent of the new requirements and allowances.

Response Message:

Public Input No. 412-NFPA 13-2016 [New Section after 3.3.7]
### 3.3.219 Thermal Barrier.

---

**Submitter Information Verification**

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>AUT-SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>National Fire Protection Assoc</td>
</tr>
<tr>
<td>Street Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>State:</td>
<td></td>
</tr>
<tr>
<td>Zip:</td>
<td></td>
</tr>
<tr>
<td>Submittal Date:</td>
<td>Thu Aug 18 13:41:35 EDT 2016</td>
</tr>
</tbody>
</table>

**Committee Statement**

Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.

Response Message:

Public Input No. 541-NFPA 13-2016 [Section No. 3.3.25]
3.3.80 Flexible Listed Pipe Coupling.
A listed coupling or fitting that allows axial displacement, rotation, and at least 1 degree of angular movement of the pipe without inducing harm on the pipe. For pipe diameters of 8 in. (200 mm) and larger, the angular movement shall be permitted to be less than 1 degree but not less than 0.5 degree.

Committee Statement
Throughout section 9.3.2 there are several different terms intended to be the same thing ("coupling", "listed flexible pipe coupling", and "flexible coupling"). The most frequently used of these terms is "flexible coupling" so I am attempting to standardize the terminology by using this term exclusively.

Response Message:
Public Input No. 144-NFPA 13-2016 [Section No. 3.5.8]
3.3.216 System Riser.

The aboveground horizontal or vertical pipe between the water supply and the mains (cross or feed) that contains a control valve (either directly or within its supply pipe), a pressure gauge, a main drain, and a waterflow alarm device.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 10:49:21 EDT 2016

Committee Statement

Committee Statement: This proposal is asking that the definition of a system riser be returned to the way it was in the 2013 edition of NFPA 13.

During the previous cycle the definition was revised by changing the word “drain” to the term “main drain”, but this was an unfortunate decision, because the main drain cannot always be located at the riser. There are many occasions where the riser must be located at a basement level, or in a closet, or under a stair landing, or other area(s), where it is not possible to discharge to the outside or to a suitably sized drain location. However, as per Section 8.16.2.4.6, the main drain test connection must be provided at locations that will permit flow testing, with the valve opened wide, without causing water damage. With this it is sometimes necessary to locate the main drain downstream of the system riser, so the testing can be properly accomplished. Therefore, the location for a main drain connection should not be tied exclusively to the system riser.

Response Message:

Public Input No. 439-NFPA 13-2016 [Section No. 3.5.13]
3.3.97 Horizontal Barrier.
A solid barrier in the horizontal position covering the entire rack, including all flue spaces at certain height increments to prevent vertical fire spread.

Committee Statement

Committee Statement: The definition is in conflict with Figures 16.1.2.4.4.1 (A), 16.1.2.4.4.2 (A), 16.1.2.4.4.3 (A), 17.1.2.9.4.1 (A), 17.1.2.9.4.2(A) and 17.1.2.9.4.3(A) which show a 3" gap down the length of the rack. The proposed change is made to be consistent with the figures.

Response Message:

Public Input No. 321-NFPA 13-2016 [Section No. 3.9.3.5]
3.3.120.1 A-Class Boundary.


Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 10:50:48 EDT 2016

Committee Statement

Committee Statement: Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.

Response Message:

Public Input No. 542-NFPA 13-2016 [Section No. 3.10.1]
3.3.120.2 B-Class Boundary.


Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 10:51:05 EDT 2016

Committee Statement

Committee Statement: Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.

Response Message:

Public Input No. 543-NFPA 13-2016 [Section No. 3.10.2]
3.3.120.9* Marine Thermal Barrier.

An assembly that is constructed of noncombustible materials and made intact with the main structure of the vessel, such as shell, structural bulkheads, and decks; meets the requirements of a B-Class boundary; and is insulated such that, if tested in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or ANSI/UL 263, *Standard for Fire Tests of Building Construction Materials*, for 15 minutes, the average temperature of the unexposed side does not rise more than 250°F (139°C) above the original temperature, nor does the temperature at any one point, including any joint, rise more than 405°F (225°C) above the original temperature.
First Revision No. 722-NFPA 13-2016 [Section No. 6.1.1.5]

7.1.1.5*
Components that do not affect system performance such as drain piping, drain valves, and signs shall not be required to be listed.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-722_A.7.1.1.5.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 11:33:04 EDT 2016

Committee Statement

Committee Statement: Manual of style indicates that examples should be in the annex. This input moves the examples in 6.1.1.5 to the annex and adds others that are missing.

Explanatory material on the potential use of remote inspection and testing equipment that might be incorporated in the initial installation has been added.

Response Message:

Public Input No. 17-NFPA 13-2016 [Section No. 6.1.1.5]
Public Input No. 559-NFPA 13-2016 [Section No. 6.1.1.5]
A.7.1.1.5
Certain components installed in sprinkler systems are not required to be listed as their improper operation will not detrimentally affect the automatic system performance. Examples include but are not limited to drain valves, drain piping, signs, gauges, automated inspection and test devices, distance monitoring devices, fire department connections that do not use threadless couplings, and so forth.

Certain devices and equipment that could be used to perform inspection and testing procedures from a distant location are not integral to the system and do not affect system performance. Automated inspection and testing devices and equipment, such as a digital camera, might be in the riser room or attached to the system externally but are not an integral part of the system. Such devices do not need to be listed.

Certain devices and equipment that could be used to monitor system or component status from a distance are not integral to the system and do not affect system performance. Distance monitoring devices, such as an external thermometer, might be attached to the system externally and therefore are not subjected to system pressure. Such devices do not need to be listed.
# Sprinkler Identification

All sprinklers shall be permanently marked with one or two English uppercase alphabetic characters to identify the manufacturer, immediately followed by three or four numbers, to uniquely identify a sprinkler as to K-factor (orifice size) or orifice shape, deflector characteristic, pressure rating, and thermal sensitivity.

## Submitter Information Verification

**Submitter Full Name:** AUT-SSI  
**Organization:** National Fire Protection Assoc  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Thu Aug 18 13:51:37 EDT 2016

## Committee Statement

**Committee Statement:** The use of the term orifice has been phased out of the standard.  
**Response Message:**

*Public Input No. 598-NFPA 13-2016 [Section No. 6.2.2]*
First Revision No. 817-NFPA 13-2016 [Section No. 6.2.9.7.1]

16.2.7.7.1*
The list shall include the following:

1. Sprinkler Identification Number (SIN) if equipped; or the manufacturer, model, deflector type, thermal sensitivity, and pressure rating
2. General description
3. Quantity of each type to be contained in the cabinet
4. Issue or revision date of the list

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 18 14:21:16 EDT 2016

Committee Statement

Committee Statement: K-factor is the correct term based on recent editions of the standard.
Response Message:

Public Input No. 565-NFPA 13-2016 [Section No. 6.2.9.7.1]
16.3.9.6.2
Nonmetallic pipe installed in accordance with 16.3.9.6 shall be permitted to be installed in ordinary hazard rooms larger than 400 ft² (37 m²) where the pipe is concealed within a 1-hour fire resistance-rated assembly.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:

Committee Statement

Committee Statement: In residential buildings with ordinary hazard rooms larger than 400 square feet, the installer is required to transition from listed nonmetallic pipe to metallic pipe. This change will eliminate that issue. The requirement to install the nonmetallic pipe within a 1-hour fire resistance-rated assembly will insure the integrity of the piping systems until the sprinkler heads activate.

Response Message:

Public Input No. 260-NFPA 13-2016 [New Section after 6.3.9.6.1]
First Revision No. 920-NFPA 13-2016 [ Section No. 6.4.1 ]

7.4.1*
Fittings used in sprinkler systems shall meet or exceed the standards in Table 7.4.1 or be in accordance with 7.4.2 or 7.4.4.

Table 7.4.1 Fittings Materials and Dimensions

<table>
<thead>
<tr>
<th>Materials and Dimensions</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast Iron</td>
<td></td>
</tr>
<tr>
<td>Cast Iron Threaded Fittings, Class 125 and 250</td>
<td>ASME B16.4</td>
</tr>
<tr>
<td>Cast Iron Pipe Flanges and Flanged Fittings</td>
<td>ASME B16.1</td>
</tr>
<tr>
<td>Malleable Iron</td>
<td></td>
</tr>
<tr>
<td>Malleable Iron Threaded Fittings, Class 150 and 300</td>
<td>ASME B16.3</td>
</tr>
<tr>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>Factory-Made Wrought Steel Butt weld Fittings</td>
<td>ASME B16.9</td>
</tr>
<tr>
<td>Buttwelding Ends for Pipe, Valves, Flanges, and Fittings</td>
<td>ASME B16.25</td>
</tr>
<tr>
<td>Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures</td>
<td>ASTM A234</td>
</tr>
<tr>
<td>Steel Pipe Flanges and Flanged Fittings</td>
<td>ASME B16.5</td>
</tr>
<tr>
<td>Forged Steel Fittings, Socket Welded and Threaded</td>
<td>ASME B16.11</td>
</tr>
<tr>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>Wrought Copper and Copper Alloy Solder Joint Pressure Fittings</td>
<td>ASME B16.22</td>
</tr>
<tr>
<td>Cast Copper Alloy Solder Joint Pressure Fittings</td>
<td>ASME B16.18</td>
</tr>
<tr>
<td>CPVC</td>
<td></td>
</tr>
<tr>
<td>Chlorinated Polyvinyl Chloride (CPVC) Specification for Schedule 80 CPVC Threaded Fittings</td>
<td>ASTM F437</td>
</tr>
<tr>
<td>Specification for Schedule 40 CPVC Socket Type Fittings</td>
<td>ASTM F438</td>
</tr>
<tr>
<td>Specification for Schedule 80 CPVC Socket Type Fittings</td>
<td>ASTM F439</td>
</tr>
<tr>
<td>Bronze Fittings</td>
<td></td>
</tr>
<tr>
<td>Cast Copper Alloy Threaded Fittings Classes 125 and 250</td>
<td>ASTM B16.15</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td></td>
</tr>
<tr>
<td>Specification for Wrought Austenitic Stainless Steel Pipe Fittings</td>
<td>ASTM A403/A403M</td>
</tr>
<tr>
<td>Ductile Iron Fittings</td>
<td>ASTM A536</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Sep 20 13:39:16 EDT 2016
## Committee Statement

<table>
<thead>
<tr>
<th>Committee Statement:</th>
<th>Ductile iron fittings are part of usual and customary installations. Table 6.4.1 does not specifically include ductile iron fittings; however, these fittings may meet ASTM B.16.3 which is the reference standard for malleable iron fittings. Ductile Iron fittings meeting B.16.2 should be permitted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Message:</td>
<td>Public Input No. 424-NFPA 13-2016 [Section No. A.6.4.1]</td>
</tr>
</tbody>
</table>
Pipe, fittings, valves, and devices to be joined with grooved couplings shall contain cut, rolled, *swaged*, or cast grooves that are dimensionally compatible with the couplings, in accordance with standard grooved coupling manufacturer dimensions.

Submitter Information Verification

Submitter Full Name: AUT-SSI  
Organization: National Fire Protection Assoc  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Thu Aug 18 13:54:55 EDT 2016

Committee Statement

Committee Statement: Clarification of "roll groove" as a dimension/performance requirement rather than a type of manufacturing process.

Swage grooving is a method by which to deform the pipe ends during the pipe manufacturing process. It produces a groove keyway that meets dimensional and performance requirements of grooved fitting/coupling manufacturers. The swage groove was independently tested by Factory Mutual to meet all performance requirements including roll groove dimension, bending moment, hydrostatic and vibration testing. FM Swage groove listing and full report has been submitted electronically.

The TC revises the text to provide for swaged pipe and to require dimension .

Response Message:

Public Input No. 351-NFPA 13-2016 [Section No. 6.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 215-NFPA 13-2016 [Section No. 6.5.3.1 [Excluding any Sub-Sections]]
7.5.5.1
Other joining methods investigated for suitability in automatic sprinkler installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions.

Committee Statement
Committee Statement: This deleted text is not necessary.
The change adds clarity to the standard

Response Message:
Public Input No. 602-NFPA 13-2016 [Section No. 6.5.5.1]
### 16.9.4 Automated Valves

**16.9.4.1** A listed indicating valve with automated controls shall be permitted.

**16.9.4.2** A listed automated water control valve assembly with a reliable position indication connected to a remote supervisory station shall be permitted.

**16.9.4.3** An automated water control valve shall be able to be operated manually as well as automatically.

---

**Submitter Information Verification**

- **Submitter Full Name:** AUT-SSI
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Thu Aug 11 20:26:21 EDT 2016

---

**Committee Statement**

- **Committee Statement:** Technology now allows for automated valves to be used in systems. These requirements for these valves need to be included in this section. The valve must indicate whether it’s open or closed, or a means of supervision that indicates its position must be provided just like a standard control valve. If an automated valve is provided it still needs to be able to be opened and closed manually.

- **Response Message:**

---

Public Input No. 473-NFPA 13-2016 [New Section after 6.6.1.3.3]
8.2.6.4.1*

Connection pipe The connection from the air supply to the dry pipe valve shall not be less than \( \frac{1}{2} \) in. (158 mm) in diameter and shall enter the system above the priming water level of the dry pipe valve.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-819_A.8.2.6.4.1.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 18 14:27:24 EDT 2016

Committee Statement

Committee Statement: The language of “connection pipe” has brought into question whether a flexible “hose” connection would not be an acceptable connection means, even though it is commonly supplied by manufacturers. As this section’s purpose is to address the connection diameter and point of the connection with the dry pipe valve, the word “pipe” is not necessary. In conjunction with the removal of the word “pipe” annex language is then proposed to indicate that the type of connection is recommended by the manufacturer of the air compressor and approved by the authority having jurisdiction. The recommended connection takes into account the pressures, temperatures and vibrations that the connection will undergo.

Response Message:

Public Input No. 451-NFPA 13-2016 [Section No. 7.2.6.4.1]
A.8.2.6.4.1
The connection from an air compressor to the dry pipe valve should be of a type recommended by the manufacturer and approved by the authority having jurisdiction, taking into consideration the pressures, temperatures, and vibrations that the connection and adjacent equipment will endure.
8.2.6.4.2
A check valve shall be installed in the air filling connection, and:

8.2.6.4.2.1
For systems that are filled manually, a listed or approved shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of this check valve and shall remain closed unless filling the system.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 18 14:30:24 EDT 2016

Committee Statement

Committee Statement: Current wording appears to be legacy language for systems that utilize a non-automatic air/nitrogen source; however, without clarification this section conflicts with requirements for (most) systems that utilize an automatic pneumatic source.

Response Message:

Public Input No. 393-NFPA 13-2016 [Section No. 7.2.6.4.2]
First Revision No. 821-NFPA 13-2016 [ New Section after 7.2.6.6 ]

8.2.6.6.5
Where an air compressor is the dedicated air supply, it shall be installed in accordance with NFPA 70, Article 430.

8.2.6.6.5.1
The disconnecting means for an automatic air compressor shall not be a general-use light switch or a cord-and-plug connected motor.

Submitter Information Verification
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 18 14:38:51 EDT 2016

Committee Statement
Committee Statement: NFPA 70, article 430 provides requirements for general use motors, motor circuits and controllers. Section 430.109 provides requirements for disconnecting means and requires you to meet 430.109(A) unless certain provisions are met to meet the disconnecting means of 430.109(B)-(G). The use of a general-use light switch and cord-and-plug connected air supplies is bad practice even though NFPA 70 permits general use light switches (NEC 430.109(C)(1)) and cord-and-plug-connected motors (NEC 430.109(F)). Field service shows that many false trips are due to a general-use light switch disconnecting the air compressor or a cord-and-plug being disconnected. The equipment called out by the term “general use light switch” is too broad, most general use light switches do not have the capability to handle the amp load of an industrial air compressor regardless of motor horsepower. Furthermore, cord-and-plug does not fit within the definition of a permanently installed air supply from an electrical perspective. The disconnecting means must also have the capacity to be locked and tagged both according to the NEC’s definition of system isolation equipment for motors, motor circuits, and controllers (430.2) and according to OSHA’s standard for The Control of Hazardous Energy, Title 29 (29 CFR 1910.147, CFR 1910.333)

- There is precedent for referencing electrical requirements in NFPA 13 – NFPA 13.6.8.4.2 refers to NFPA 70 as well as 13.2.4 Reference in Mandatory Sections
- The best practice for the electrical installation of an air supply is to hardwire the air compressor to an industrial disconnect switch located within 6 feet of the unit as shown below.
- While the air compressor does not need to be a listed component, poor installation practices lead to increased failures of a system. A higher level on installation should be required similarly to the requirements a pump for an NFPA 13D system, which is also not required to be listed.

Response Message:
Public Input No. 264-NFPA 13-2016 [New Section after 7.2.6.6]
8.2.6.8.4*

When nitrogen or other approved gas is the only source of gas for pressurizing a system, it shall have a capacity capable of restoring normal gas pressure in the system within 30 minutes.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-888_A.8.2.6.8.4.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:       
City:                 
State:                
Zip:                  
Submittal Date: Thu Sep 08 13:48:07 EDT 2016

Committee Statement

Committee Statement: The addition of this section and annex material matches for nitrogen or other approved gas match the same existing requirement for any air supply in section 7.2.6.3.2. If restoring normal pressure in 30 minutes is required for air it should also be required for nitrogen or other approved gas.

Response Message:
Public Input No. 214-NFPA 13-2016 [Section No. 7.2.6.8]
When a single nitrogen or other approved gas source serves multiple dry pipe systems, the 30-minute fill time is based on the single largest system.
The system size controlled by a double interlock preaction valve shall be determined by either 8.3.2.3.1.1, 8.3.2.3.1.2, 8.3.2.3.1.3, and or 8.3.2.3.1.4.

Committee Statement

Committee Statement: This should read or verses and.

Response Message:

Public Input No. 58-NFPA 13-2016 [Section No. 7.3.2.3.1 [Excluding any Sub-Sections]]
Public Input No. 143-NFPA 13-2016 [Section No. 7.3.2.3.1 [Excluding any Sub-Sections]]
Where the connection between the antifreeze system and the wet pipe system supply piping incorporates a backflow prevention device, and the conditions of 8.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 8.6.3.3 or Figure 8.6.3.4.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 11:09:42 EDT 2016

Committee Statement

Committee Statement: The wording in the existing language for 7.6.3.2 implies that the required arrangement would only be applicable to an auxiliary antifreeze system that is fed from a wet pipe system. The proposed language would include the requirements of 7.6.3.2 to apply to a stand-alone antifreeze system as well.

Response Message: Public Input No. 361-NFPA 13-2016 [Section No. 7.6.3.2 [Excluding any Sub-Sections]]
8.7.7 Gauge Connections.

A listed An approved pressure gauge conforming with to 16.13 shall be installed immediately below the control valve of each system.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 11:10:33 EDT 2016

Committee Statement

Committee Statement: During the cycle leading up to the 2013 edition of the standard, Comment 13-87 was accepted to change the requirement for pressure gauges to be "listed" to be "approved" instead. In consequence, sections such as: 7.1.1, 7.2.1, 7.3.1.3, and 8.17.3.3 were revised accordingly. However, the requirement for gauges on exposure protection sprinkler systems was overlooked. To accord with the other gauge requirements within NFPA 13, that omission should be rectified now.

Additionally, the term "conforming with" is suggested to be altered to say "conforming to" as a grammatical correction and to align with the verbiage of Section 7.1.1.1.

Response Message:

Public Input No. 440-NFPA 13-2016 [Section No. 7.7.7]
8.8.2.1.1*
Where sprinkler pipe passes through a wall or floor into the refrigerated space, a section of pipe arranged for removal shall be provided immediately inside the space.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-831_A.8.8.2.1.1.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 11:14:34 EDT 2016

Committee Statement

Committee Statement: This section requires a piece of removable pipe for all situations including dry-pendent and dry-sidewall sprinklers. Such sprinklers do not have removable sections of pipe and cannot comply with this section. An exception needs to be added.

Response Message:

Public Input No. 147-NFPA 13-2016 [Section No. 7.8.2.1.1]
A.8.8.2.1.1
It is not the intent of this section to apply to a dry sprinkler. An additional pipe is not needed when a dry sprinkler penetrates a refrigerated space.
9.1.1*
The requirements for spacing, location, and position of sprinklers shall be based on the following principles:

1. Sprinklers shall be installed throughout the premises.
2. Sprinklers shall be located so as not to exceed the maximum protection area per sprinkler.
3. Sprinklers shall be positioned and located so as to provide satisfactory performance with respect to activation time and distribution.
4. Sprinklers shall be permitted to be omitted from areas specifically allowed by this standard.
5. When sprinklers are specifically tested and test results demonstrate that deviations from clearance requirements to structural members do not impair the ability of the sprinkler to control or suppress a fire, their positioning and locating in accordance with the test results shall be permitted.
6. Clearance between sprinklers and ceilings exceeding the maximums specified in this standard shall be permitted, provided that tests or calculations demonstrate comparable sensitivity and performance of the sprinklers to those installed in conformance with these sections.

Furniture, such as portable wardrobe units, cabinets, trophy cases, and similar features not intended for occupancy, does not require sprinklers to be installed in them. This type of feature shall be permitted to be attached to the finished structure.

Sprinklers shall not be required to be installed within electrical equipment, mechanical equipment, or air handling units not intended for occupancy.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 31 15:45:17 EDT 2016

Committee Statement

Committee Statement: Due to reorganization
Response Message:
**8.1.1.2**
Pressure gauges shall be installed above and below each alarm check valve or system riser check valve where such devices are present.

**8.1.1.2.1**
A single pressure gauge shall be permitted to be installed on a manifold below multiple riser check valves or alarm check valves.

**8.1.1.2.2**
Pressure gauges below check valves required by 16.15.2.2(1) shall not be required.

---

**Supplemental Information**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-928_A.8.1.1.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

**Submitter Information Verification**

- **Submitter Full Name:** AUT-SSI
- **Organization:** [Not Specified]
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Wed Nov 02 15:11:51 EDT 2016

**Committee Statement**

- **Committee Statement:** The current text can be interpreted as requiring a gauge under each riser check even if installed on a manifold.
- **Response Message:**

Public Input No. 371-NFPA 13-2016 [Section No. 7.1.1.2 [Excluding any Sub-Sections]]
A.8.1.1.2
Pressure gauges installed on both sides of a check valve are necessary for several reasons. They can quickly indicate an abnormal condition such as a closed valve or an inoperable check valve. If the pressure on the downstream side of a check valve is less than the pressure on the upstream side, either the pressure gauges are faulty or the check valve is inoperable. If the pressure on the upstream side of a check valve is less than the pressure on the downstream side, the pressure is trapped indicating a higher than normal pressure. This erroneous pressure will then be part of a main drain test. If a pressure gauge is installed only on the downstream side of the check valve a pressure would be indicated but the pressure on the upstream side could be 0.0 psi indicating a severe problem.
9.4.1.2

Where no sprinklers are specifically listed for construction features or other special situations that require unusual water distribution, the requirements of 9.4.1.1 shall not apply, and listed sprinklers shall be permitted to be installed in positions other than anticipated by their listing to achieve specific results.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Aug 10 23:35:59 EDT 2016

Committee Statement

Committee Statement: This section currently would allow the user to use a sprinkler not listed for a situation even if other listed sprinklers were available.

Listed sprinklers should be utilized when available.

Response Message:

Public Input No. 59-NFPA 13-2016 (Section No. 8.3.1.2)
9.4.2.5*
The following practices shall be observed to provide sprinklers of other than ordinary-temperature classification unless other temperatures are determined or unless high-temperature sprinklers are used throughout, and temperature selection shall be in accordance with Table 9.4.2.5(a), Table 9.4.2.5(b), Table 9.4.2.5(c), and Figure 9.4.2.5:

(1)* Sprinklers in the high-temperature zone shall be of the high-temperature classification, and sprinklers in the intermediate-temperature zone shall be of the intermediate-temperature classification.

(2) Sprinklers located within 12 in. (300 mm) to one side or 30 in. (750 mm) above an uncovered steam main, heating coil, or radiator shall be of the intermediate-temperature classification.

(3) Sprinklers within 7 ft (2.1 m) of a low-pressure blowoff valve that discharges free in a large room shall be of the high-temperature classification.

(4) Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.

(5) Sprinklers in an unventilated, concealed space, under an uninsulated roof, or in an unventilated attic shall be of the intermediate-temperature classification.

(6) Sprinklers in unventilated show windows having high-powered electric lights near the ceiling shall be of the intermediate-temperature classification.

(7) Sprinklers protecting commercial-type cooking equipment and ventilation systems shall be of the high- or extra high-temperature classification as determined by use of a temperature-measuring device. (See 8.9.6.)

(8) Sprinklers protecting residential areas installed near specific heat sources identified in Table 9.4.2.5(c) shall be installed in accordance with Table 9.4.2.5(c).

(9) Ordinary-temperature sprinklers located adjacent to a heating duct that discharges air that is less than 100°F (38°C) are not required to be separated in accordance with Table 9.4.2.5(a) or Table 9.4.2.5(c).

(10) Sprinklers in walk-in type coolers and freezers with automatic defrosting shall be of the intermediate-temperature classification or higher.

(11) Sprinklers in closets containing ventless clothes dryers shall be of the intermediate-temperature classification or higher.

Table 9.4.2.5(a) Temperature Ratings of Sprinklers Based on Distance from Heat Sources

<table>
<thead>
<tr>
<th>Type of Heat Condition</th>
<th>Ordinary-Temperature Rating</th>
<th>Intermediate-Temperature Rating</th>
<th>High-Temperature Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Heating ducts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Above</td>
<td>More than 2 ft 6 in. (750 mm)</td>
<td>2 ft 6 in. or less (750 mm)</td>
<td></td>
</tr>
<tr>
<td>(b) Side and below</td>
<td>More than 1 ft 0 in. (300 mm)</td>
<td>1 ft 0 in. or less (300 mm)</td>
<td></td>
</tr>
<tr>
<td>(c) Diffuser</td>
<td>Any distance except as shown under Intermediate-Temperature Rating column</td>
<td>Downward discharge: Cylinder with 1 ft 0 in. (300 mm) radius from edge extending 1 ft 0 in. below and 2 ft 6 in. (750 mm) above</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal discharge: Semicylinder or cylinder with 2 ft 6 in. (750 mm) radius in direction of flow extending 1 ft 0 in. (300 mm) below and 2 ft 6 in. (750 mm) above</td>
<td></td>
</tr>
<tr>
<td>(2) Unit heater and radiant heater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Heat Condition</td>
<td>Ordinary-Temperature Rating</td>
<td>Intermediate-Temperature Rating</td>
<td>High-Temperature Rating</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>--------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>(a) Horizontal discharge</td>
<td></td>
<td>Discharge side: 7 ft 0 in. (2.1 m) to 20 ft 0 in. (6.1 m) radius pie-shaped cylinder (see Figure 8.3.2.5)</td>
<td>7 ft 0 in. (2.1 m) radius cylinder extending 7 ft 0 in. (2.1 m) above and 2 ft 0 in. (600 mm) below heater; also 7 ft 0 in. (2.1 m) radius cylinder more than 7 ft 0 in. (2.1 m) above unit heater</td>
</tr>
<tr>
<td>(b) Vertical downward discharge (for sprinklers below unit heater, see Figure 8.3.2.5)</td>
<td></td>
<td>7 ft 0 in. (2.1 m) radius cylinder extending upward from an elevation 7 ft 0 in. (2.1 m) above unit heater</td>
<td>7 ft 0 in. (2.1 m) radius cylinder extending from the top of the unit heater to an elevation 7 ft 0 in. (2.1 m) above unit heater</td>
</tr>
<tr>
<td>(3) Steam mains (uncovered)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Above More than 2 ft 6 in. (750 mm)</td>
<td>2 ft 6 in. or less (750 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Side and below More than 1 ft 0 in. (300 mm)</td>
<td>1 ft 0 in. or less (300 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Blowoff valve More than 7 ft 0 in. (2.1 m)</td>
<td>7 ft 0 in. or less (2.1 m)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9.4.2.5(b) Temperature Ratings of Sprinklers in Specified Locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Ordinary-Temperature Rating</th>
<th>Intermediate-Temperature Rating</th>
<th>High-Temperature Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skylights</td>
<td>Glass or plastic</td>
<td>Do not use</td>
<td>Ventilated or unventilated</td>
</tr>
<tr>
<td>Attics</td>
<td></td>
<td>Do not use</td>
<td>Ventilated or unventilated</td>
</tr>
<tr>
<td>Peaked roof: metal or thin boards, concealed or not concealed, insulated or uninsulated</td>
<td>Ventilated</td>
<td>Unventilated</td>
<td>Note: For uninsulated roof, climate and insulated or uninsulated occupancy can necessitate intermediate sprinklers. Check on job.</td>
</tr>
<tr>
<td>Flat roof: metal, not concealed</td>
<td>Ventilated or unventilated</td>
<td>Note: For uninsulated roof, climate and insulated or uninsulated occupancy can necessitate intermediate sprinklers. Check on job.</td>
<td></td>
</tr>
<tr>
<td>Flat roof: metal, concealed, insulated or uninsulated</td>
<td>Ventilated</td>
<td>Unventilated</td>
<td></td>
</tr>
<tr>
<td>Show windows</td>
<td>Ventilated</td>
<td>Unventilated</td>
<td></td>
</tr>
</tbody>
</table>

Note: A check of job condition by means of thermometers might be necessary.

Table 9.4.2.5(c) Temperature Ratings of Sprinklers in Specified Residential Areas

<table>
<thead>
<tr>
<th>Heat Source</th>
<th>Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler</th>
<th>Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side of open or recessed fireplace</td>
<td>36 in. (915 mm)</td>
<td>12 in. (300 mm)</td>
</tr>
<tr>
<td>Front of recessed fireplace</td>
<td>60 in. (1525 mm)</td>
<td>36 in. (915 mm)</td>
</tr>
<tr>
<td>Heat Source</td>
<td>Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler</td>
<td>Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Coal- or wood-burning stove</td>
<td>42 in. (1070 mm)</td>
<td>12 in. (305 mm)</td>
</tr>
<tr>
<td>Kitchen range</td>
<td>18 in. (460 mm)</td>
<td>9 in. (230 mm)</td>
</tr>
<tr>
<td>Wall oven</td>
<td>18 in. (460 mm)</td>
<td>9 in. (230 mm)</td>
</tr>
<tr>
<td>Hot air flues</td>
<td>18 in. (460 mm)</td>
<td>9 in. (230 mm)</td>
</tr>
<tr>
<td>Uninsulated heat ducts</td>
<td>18 in. (460 mm)</td>
<td>9 in. (230 mm)</td>
</tr>
<tr>
<td>Uninsulated hot water pipes</td>
<td>12 in. (305 mm)</td>
<td>6 in. (155 mm)</td>
</tr>
<tr>
<td>Side of ceiling- or wall-mounted hot air diffusers</td>
<td>24 in. (610 mm)</td>
<td>12 in. (305 mm)</td>
</tr>
<tr>
<td>Front of wall-mounted hot air diffusers</td>
<td>36 in. (915 mm)</td>
<td>18 in. (460 mm)</td>
</tr>
<tr>
<td>Hot water heater or furnace</td>
<td>6 in. (155 mm)</td>
<td>3 in. (75 mm)</td>
</tr>
<tr>
<td>Light fixture: 0 W–250 W</td>
<td>6 in. (155 mm)</td>
<td>3 in. (75 mm)</td>
</tr>
<tr>
<td>250 W–499 W</td>
<td>12 in. (305 mm)</td>
<td>6 in. (155 mm)</td>
</tr>
</tbody>
</table>

Figure 9.4.2.5 High-Temperature and Intermediate-Temperature Zones at Unit Heaters and Radiant Heaters.
Committee Statement

Ventless clothes dryers placed within closets have the potential to raise ceiling temperatures above 100 F (38 C) for sustained periods of time, potentially weakening the operating mechanisms of ordinary temperature rated fire sprinklers over months or years of use, leading to inadvertent operations. While ventless clothes dryers have been used in Europe for many years, they are fairly new to the North American market, where vented clothes dryers have been the norm. More expensive than vented dryers, they generally incorporate condensers in a “two-loop” system to first heat some incoming air, allowing it to absorb moisture from the damp clothes, then continually condense the heated moist air to release the water before recirculating the resulting dry air within the clothes dryer. Unlike vented dryers, where moist heated air is exhausted to the building exterior, these devices capture the water to a drain or pan, while the heat from the condensing cycle is exhausted into the immediate area.

The condensers in combination machines that both wash and dry the clothes are generally water-cooled, such that quantities of cold water are used to condense the moisture evaporated from the clothes during the drying cycle, and pumped away through the drain line. But the standalone dryer units are air-cooled, using the ambient air as a heat sink. While this heat can be dissipated in a large laundry room, it can be expected to raise the temperatures within a laundry closet to levels unacceptable for ordinary temperature rated sprinklers. All standalone ventless dryers in the market are reportedly of this type.

Agree that closets containing ventless dryers need intermediate temp sprinklers.

Similar situation exists in Table C which needs to be included.

In Table 8.3.2.5(a) Item 2 Unit heater and radiant heater

Response Message:

Public Input No. 591-NFPA 13-2016 [New Section after 8.3.2.5]
9.4.3.5

Where in other than light hazard occupancies, where a sprinkler carries a listing for both standard-response protection and quick-response protection at different coverage areas, that sprinkler shall be permitted to be installed within a compartment at the spacing for both the quick-response and standard-response listings without any separation between the areas so covered.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 00:03:56 EDT 2016

Committee Statement

Committee Statement: 8.3.3.1 requires sprinklers installed in light hazard occupancies to be quick-response. The current language in 8.3.3.5 is being interpreted to indicate that extended coverage sprinklers can be installed in a light hazard compartment on a spacing in which they are listed as standard-response, so long as one of the sprinklers has an area of coverage consistent with the quick-response listing. Please see NFSA TechNotes/March 8, 2016 question 8. For example, assume a sprinkler is listed as quick-response up to a 16 ft spacing, and listed as standard-response on 18 ft and 20 ft spacing. If a long corridor (light hazard compartment) is being protected with 15 of these sprinklers, this section is being interpreted to mean that if 1 of these sprinklers is on 16 ft spacing (quick-response) then the other 14 of these sprinklers can be on 20 ft spacing (standard-response).

The original intent of this section was to not apply it to light hazard.

Response Message:

Public Input No. 95-NFPA 13-2016 [Section No. 8.3.3.5]
9.4.4.2

For light hazard occupancies not requiring as much water as is discharged by a sprinkler with a sprinklers having a nominal K-factor of smaller than K-5.6 (80) operating at 7 psi (0.5 bar), sprinklers having a smaller orifice shall be permitted, subject to the following restrictions:

1. The system shall be hydraulically calculated.
2. Sprinklers with nominal K-factors of less than K-5.6 (80) shall be installed only in wet pipe sprinkler systems or in accordance with the limitations of 9.4.4.3 or 9.4.4.4.
3. A listed strainer shall be provided on the supply side of sprinklers with nominal K-factors of less than K-2.8 (40).

Committee Statement

This is explanatory information and does not belong in the body of the standard. Additionally, it is being literally interpreted as one of the restrictions whereby a smaller K-factor can not be used if it flows 14.8 gpm or more (the discharge for K-5.6 at 7 psi). This can occur for a area with multiple sprinkler flowing less water but due to spacing issues a single sprinkler must flow more water.

14.8 gpm is not required at each sprinkler
10.3.2 Sidewall Spray Sprinklers.
Sidewall sprinklers shall only be installed as follows:

1. Light hazard occupancies with smooth, horizontal or sloped, flat ceilings
2. Ordinary hazard occupancies with smooth, flat ceilings where specifically listed for such use
3. To protect areas below overhead doors
4. At the top and bottom of elevator hoistways
5. For the protection of steel building columns

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 00:06:46 EDT 2016

Committee Statement

Committee Statement: This proposal is offered to recognize that the standard also allows the use of sidewall sprinklers to protect the top and the bottom of elevator hoistways, as per Sections 8.15.5.1 and 8.15.5.5 and to protect steel columns as per Sections 12.12.2.2.4.1, 16.1.4, 17.1.4.1 and 18.2.1

Item #4 singular for top and bottom

Response Message:

Public Input No. 442-NFPA 13-2016 [Section No. 8.4.2]
12.1.1* Residential sprinklers shall be permitted in dwelling units and their adjoining corridors, provided they are installed in conformance with their listing, and when installed under the following conditions:

1. A flat, smooth, horizontal ceiling with no beams up to a maximum of 24 ft (7.3 m) above the floor.

2. A flat, horizontal, beamed ceiling, with a maximum ceiling height of 24 ft (7.3 m), with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the beamed ceiling shall be a maximum of 600 ft² (55 m²) in area. The highest sprinkler in the compartment shall be above all openings from the compartment into any communicating spaces.

3. A smooth, flat, sloped ceiling with no beams up to a maximum slope of 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.

4. A sloped ceiling with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (55 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.

5. A sloped ceiling with beams of any depth with sidewall or pendent sprinklers in each pocket formed by the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (55 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.

12.1.2 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 when acceptable to the authority having jurisdiction.
ESFR sprinklers shall be used only in wet pipe systems unless specifically listed for use in dry systems or preaction systems.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 00:08:45 EDT 2016

Committee Statement

Committee Statement: ESFR sprinklers can be installed in a preaction system, however, the standard does not currently identify this allowance.

This proposal was developed by the NFSA Engineering and Standards Committee.

Committee does not agree with substantiation, however the proposed text is acceptable.

Response Message:

Public Input No. 445-NFPA 13-2016 [Section No. 8.4.6.1]
### First Revision No. 842-NFPA 13-2016 [Section No. 8.4.9.2]

<table>
<thead>
<tr>
<th>15.3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The minimum barrel exposed length shall be measured along the length of the dry sprinkler from the face of the fitting to which the dry sprinkler is installed to the inside surface of the insulation, wall, or ceiling leading to the cold space, whichever is closest to the fitting.</td>
</tr>
</tbody>
</table>

### Submitter Information Verification

- **Submitter Full Name:** AUT-SSI
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Tue Aug 23 15:00:35 EDT 2016

### Committee Statement

- **Committee Statement:** Not all dry sprinklers are straight and barrel can be interpreted as a straight section of pipe.
- **Response Message:**

  **Public Input No. 272-NFPA 13-2016 [Section No. 8.4.9.2]**
15.3.4*

Dry sprinklers shall only be installed in fittings as specified by the manufacturer.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-674_A.15.3.4.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 00:10:58 EDT 2016

Committee Statement

Committee Statement: The standard does not address the importance of installing a dry sprinkler into the proper fitting.
The manufacturer's data sheets discuss proper installation but the standard should include this reference.

Response Message: Public Input No. 443-NFPA 13-2016 [New Section after 8.4.9.3]
A.15.3.4
Generally dry sprinklers are installed in tees. Dry sprinklers should never be installed in 90-degree elbows. Some manufacturers allow installation of dry sprinklers in couplings, CPVC adapters, and so forth.
First Revision No. 892-NFPA 13-2016 [ New Section after 8.5.3.1 ]

9.5.5.3.1.1*
Open grate flooring over 4 ft (1.2 m) in width shall require sprinkler protection below the grating.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-892_A.9.5.5.3.1.1.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [ Not Specified ]
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 08 16:45:55 EDT 2016

Committee Statement

Committee Statement: This proposal seeks to rectify a mistake that was made during the First Draft for the 2016 edition of NFPA 13, whereby 8.5.5.3.1.1 was erroneously deleted/overwritten instead of having new text inserted after 8.5.5.3.1.1 (covered in TIA-16-6).

Public Input No. 474 and First Revision No. 90 both called for a “New Section 8.5.5.3.1.1”, but the First Draft Report shows the new verbiage of FR 90 replacing the original text. With this, the provision that requires sprinklers under open grate flooring that is more than 4 ft in width, was lost.

This deletion was inadvertent. None of the public inputs and none of the discussions at the Technical Committee meetings suggested that the text should be deleted. It should therefore be added back in.

Annex: The current language in the standard is silent on how to address multiple levels of obstructions to sprinkler discharge that are over 4 feet in width. It is unnecessary to require sprinkler protection between multiple levels of noncombustible ductwork simply because each duct is over 4 feet wide.

Response Message:

Public Input No. 358-NFPA 13-2016 [New Section after A.8.5.5.3.1]
Public Input No. 495-NFPA 13-2016 [Section No. 8.5.5.3.1]
A.9.5.5.3.1.1
Where multiple levels of ducts, pipes, or other similar horizontal obstructions that are over 4 ft (1.2 m) wide are stacked vertically, additional levels of sprinkler protection between the vertical levels are not required. A single level of sprinklers beneath the lowest level of the obstruction is adequate, provided that the obstructions are noncombustible and that combustible materials are not stored between the levels.
## Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-907_A.9.5.5.3.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

## Submitter Information Verification

**Submitter Full Name:** AUT-SSI  
**Organization:** [Not Specified]  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Fri Sep 09 11:39:50 EDT 2016

## Committee Statement

**Committee Statement:** During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now.

**Response Message:**

Public Input No. 500-NFPA 13-2016 [New Section after A.8.8.5.3]
Where obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1.2 m) wide do not require additional protection underneath. Examples are ducts, decks, open grate flooring, catwalks, cutting tables, overhead doors, soffits, ceiling panels, and other similar obstructions.
10.2.6.1.3.3*

Under a steeply pitched surface, the distance from the peak to the deflectors shall be permitted to be increased to maintain a horizontal clearance of not less than 24 in. (600 mm) from other structural members as indicated in Figure 10.2.6.1.3.3.

**Figure 10.2.6.1.3.3 Horizontal Clearance for Sprinkler at Peak of Pitched Roof.**
<table>
<thead>
<tr>
<th>Submittal Date:</th>
<th>Wed Oct 05 08:06:40 EDT 2016</th>
</tr>
</thead>
</table>

**Committee Statement**

<table>
<thead>
<tr>
<th>Committee Statement:</th>
<th>The Figure 8.6.4.1.3.3 should be modified to show a slope greater than 18 in 12. The current figure shows a 12 in 12 slope and does not reflect steeply pitched. The effects of cold soldering for sprinklers should not be considered when proper sprinkler spacing is provided along the slope of the ceiling.</th>
</tr>
</thead>
</table>

**Response Message:**

Public Input No. 383-NFPA 13-2016 [Section No. A.8.6.4.1.3.3]
10.2.6.1.4.4*
Sprinklers installed where the dimension perpendicular to the slope exceeds 8 ft (2.4 m) shall have a minimum pressure of 20 psi (1.4 bar).

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-678_A.10.2.6.1.4.4.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

- **Submitter Full Name:** AUT-SSI
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Thu Aug 11 11:51:56 EDT 2016

Committee Statement

- **Committee Statement:** There is a lot of confusion between perpendicular to the slope and parallel to the slope in Table 8.6.2.2.1(a). This figure will provide clarification.
- **Response Message:**
A.10.2.6.1.4.4
See Figure A.10.2.6.1.4.4.
Figure A.10.2.6.1.4.4 Protection Area and Maximum Spacing of Sprinklers Under Sloped Roof.

Truss members less than 3 ft (900 mm) on center with a pitch 4 in 12 or greater
10.2.6.1.4.5*

The requirements of 10.2.6.1.4.3 or 10.2.6.1.4.4 shall not apply to sprinklers installed at the corner of the eave of a hip type roof where located directly under the hip line spaced in accordance with 10.2.5.2.2 or located along the eave spaced on the slope plane not less than 5 ft (1.5 m) from the intersection of the upper and lower truss chords or the wood rafters and ceiling joists. On the eave and no more than 5 ft (1.5 m) from the hip line.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 11:53:03 EDT 2016

Committee Statement

Committee Statement: The current text references eave and should reference slope plane.
Response Message:

Public Input No. 263-NFPA 13-2016 [Section No. 8.6.4.1.4.5]
Sprinklers shall be arranged to comply with one of the following arrangements:

1. Subsection 9.5.5.2, Table 10.2.7.1.2, and Figure 10.2.7.1.2(a) shall be followed.

2. Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.

3. Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 10.2.7.1.2(b).

4. Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 10.2.7.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 10.2.7.1.2 Positioning of Sprinklers to Avoid Obstructions to Discharge [Standard Spray Upright/Standard Spray Pendent (SSU/SSP)]

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>2 1/2 (65)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>3 1/2 (90)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>5 1/2 (140)</td>
</tr>
<tr>
<td>2 ft 6 (750 mm) in. to less than 3 ft (900 mm)</td>
<td>7 1/2 (190)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>9 1/2 (240)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>16 1/2 (420)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>18 (450)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>20 (510)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>24 (600)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>30 (750)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>35 (875)</td>
</tr>
</tbody>
</table>

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

Note: For A and B, refer to Figure 8.6.5.1.2(a).

Figure 10.2.7.1.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (SSU/SSP).
Figure 10.2.7.1.2(b) Obstruction Against Wall (SSU/SSP).

Figure 10.2.7.1.2(c) Obstructions Against Walls (SSU/SSP).
Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 11:58:20 EDT 2016

Committee Statement

Committee Statement: This proposal seeks to rectify a discrepancy that was introduced during the Second Draft of the cycle leading up to the 2016 edition of the standard, whereby the figure that was imaged in the First Draft Report was not consistent with the image illustrated in the Second Draft Report (covered in TIA 16-7).

Public Input No. 289 and First Revision No. 105 and 106 sought to correct typographical errors in the Obstructions Against Walls figures, relating to the distance from the wall and to correct the misconception that a sprinkler deflector would need to be at least 18 inches above the bottom of the obstruction/soffit. The revisions were agreed to during the First Revision Meeting and shown correctly in the First Draft Report. During the Second Draft Meeting, the subject was not discussed again, but for some reason, in the Second Draft Report the figures reverted to show the incorrect information. It appears to be a mistake that was made when the figures were edited to show the metric conversions.

Additionally, in its current state Figure 8.6.5.1.2(c) is inconsistent with the similar new Figure 8.9.5.1.4(c) and Figure 8.10.7.1.4(c), which properly indicate the "½ S" and the "No maximum" dimensions.

This change was inadvertent. The Technical Committee did not take any action to change the figure after the First Draft. They should therefore be corrected again.

Response
Message:

Public Input No. 620-NFPA 13-2016 [Section No. 8.6.5.1.2]
Unless the requirements of 10.2.7.2.1.4 through 10.2.7.2.1.9 are met, sprinklers shall be positioned away from obstructions a minimum distance of three times the maximum dimension of the obstruction (e.g., structural members, pipe, columns, and fixtures) in accordance with Figure 10.2.7.2.1.3(a) and Figure 10.2.7.2.1.3(b).

Figure 10.2.7.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (SSU/SSP).

Figure 10.2.7.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (SSU/SSP).
Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-681_Figure_8.6.5.2.1.3.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 12:09:33 EDT 2016

Committee Statement

Committee Statement: The figure shown is for the 3 times rule for SSU/SSP sprinklers but the figure shows a sidewall sprinkler. Delete incorrect figure and substitute correct figure as shown in the uploaded document. This was submitted NFPA as an Erratum. This PI is in case this erratum is not corrected.

Response Message:

Public Input No. 428-NFPA 13-2016 [Section No. 8.6.5.2.1.3 [Excluding any Sub-Sections]]
NFPA 13, Figure 8.6.5.2.1.3(a)

Problem: Figure 8.6.3.2.1.3(a) is the 3 times rule for SSU/SSP sprinklers but figure shows sidewall sprinkler
Proposal: Submit correct figure

Figure 8.6.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (SSU/SSP).

Substantiation:
This figure is for 3 times rule for SSU/SSP sprinklers but figure shows a sidewall sprinkler. Delete incorrect figure and substitute correct figure as shown. This was submitted NFPA as an Erratum. This PI is in case this erratum is not corrected.
10.2.7.2.1.5
Sprinklers shall be permitted to be spaced on opposite sides of the obstruction not exceeding 4 ft (1.2 m) in width, where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

Submitter Information Verification
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 12:20:53 EDT 2016

Committee Statement
Committee Statement: This change correlates with the similar restriction in 8.6.5.1.2(2) and the bounding requirement in 8.6.5.3.2
The figure will clarify the requirements of this section.

Response Message:
Public Input No. 475-NFPA 13-2016 [Section No. 8.6.5.2.1.5]
The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 10.2.7.2.2 and Figure 10.2.7.2.2.

Table 10.2.7.2.2 Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (SSU/SSP)

<table>
<thead>
<tr>
<th>Horizontal Distance (A)</th>
<th>Minimum Vertical Distance Below Deflector (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>More than 15 in. (375 mm) to 18 in. (400 mm)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 24 in. (600 mm)</td>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.

Note: For A and B, refer to Figure 8.6.5.2.2.

Figure 10.2.7.2.2 Suspended or Floor-Mounted Obstruction in Light Hazard Occupancies Only (SSU/SSP).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
| State:      |                             |
| Zip:       |                             |
| Submittal Date: | Thu Aug 11 12:27:53 EDT 2016 |

**Committee Statement**

<table>
<thead>
<tr>
<th>Committee Statement:</th>
<th>The chart can be difficult to interpret and apply. Please make this change to every location of the rule known as the &quot;Partition Rule&quot;.</th>
</tr>
</thead>
</table>

**Response Message:**

Public Input No. 600-NFPA 13-2016 [Section No. 8.6.5.2.2 [Excluding any Sub-Sections]]
8.6.5.3.2
The requirements of 8.6.5.3 shall also apply to obstructions 18 in. (450 mm) or less below the sprinkler for light and ordinary hazard occupancies.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 12:29:01 EDT 2016

Committee Statement

Committee Statement: Creates a more restrictive requirement for light and ordinary hazard.
Response Message:

Public Input No. 477-NFPA 13-2016 [Section No. 8.6.5.3.2]
First Revision No. 677-NFPA 13-2016 [Section No. 8.6.6.2]

9.5.6.6
The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 10.2.8, 10.3.7, 11.2.6, 11.3, and Sections 11.3 and 12.1.

9.5.6.6.1
Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

9.5.6.6.2
Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 11:41:53 EDT 2016

Committee Statement

Committee Statement: The requirements of 8.6.6.2 should be moved to 8.5.6.6 because they are general requirements that also apply to 8.7, 8.8, and 8.9.

This requirements applies to all of the sprinklers listed and believe that it should apply to residential sprinklers.

Text will move to 9.5.6.6 due to the re-organization of NFPA 13.

Response Message:
Public Input No. 362-NFPA 13-2016 [Section No. 8.6.6.2]
Sidewall sprinklers shall not be installed no closer less than 4 ft (1.2 m) from light fixtures or similar obstructions unless the requirements of 10.3.6.1.2.1 or 10.3.6.1.2.2 are met.

10.3.6.1.2.1
For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of three times the greatest dimension.

10.3.6.1.2.2
The bottom of light fixtures and similar obstructions located less than 4 ft (1.2 m) from the sprinkler shall be above the plane of the sprinkler deflector.
10.3.6.1.3

The distance between light fixtures or similar obstructions located more than 4 ft (1.2 m) or greater from the sprinkler shall be in conformity with Table 10.3.6.1.3 and Figure 10.3.6.1.3.

Table 10.3.6.1.3 Positioning of Sprinklers to Avoid Obstructions (Standard Sidewall Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 4 ft (1.2 m)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 5 ft (1.5 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>7 ft 6 in. (2.3 m) to less than 8 ft (2.4 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 8 ft 6 in. (2.6 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>8 ft 6 in. (2.6 m) or greater</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.7.5.1.3.

Figure 10.3.6.1.3 Positioning of Sprinkler to Avoid Obstruction (Standard Sidewall Spray Sprinklers).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 13:34:55 EDT 2016
Committee Statement

Committee Statement: The additions of the 3 times rule and obstructions closer to the sprinkler above the deflector provides consistency between the sidewall sprinkler types. A conflict was also identified in 8.7.5.1.3. The body text indicates "more than" 4 ft when the table references 4 ft (1.2 m) to less than 5 ft (1.5 m). Strike out "less than 4 ft, not allowed" since that is not addressed by 8.7.5.1.3.

Response Message:
10.3.6.3.2*
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as ducts, decks, open grate flooring, cutting tables, and overhead doors.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-686_A.10.3.6.3.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 13:33:29 EDT 2016

Committee Statement

Committee Statement: During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now.

Response Message:

Public Input No. 496-NFPA 13-2016 [Section No. 8.7.5.3.2]
A.10.3.6.3.2
When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1219 mm) wide do not require additional protection underneath. Examples are ducts, stairs, landings, and other similar obstructions.
Sprinklers shall be arranged to comply with one of the following arrangements:

1. Sprinklers shall be in accordance with 9.5.5.2, Table 11.2.5.1.2, and Figure 11.2.5.1.2(a).

2. Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.

3. Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 11.2.5.1.2(b).

4. Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 11.2.5.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

### Table 11.2.5.1.2 Position of Sprinklers to Avoid Obstructions to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 m)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 m) to less than 1 ft 6 in. (450 m)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 m) to less than 2 ft (600 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft (600 m) to less than 2 ft 6 in. (750 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 m) to less than 3 ft (900 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 m) to less than 3 ft 6 in. (1.1 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>6 ft 6 in. (2 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) to less than 7 ft 6 in. (2.3 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>7 ft 6 in. (2.3 m) to less than 8 ft (2.4 m)</td>
<td>14 (350)</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 8 ft 6 in. (2.6 m)</td>
<td>15 (375)</td>
</tr>
<tr>
<td>8 ft 6 in. (2.6 m) to less than 9 ft (2.7 m)</td>
<td>17 (425)</td>
</tr>
<tr>
<td>9 ft (2.7 m) to less than 9 ft 6 in. (2.9 m)</td>
<td>19 (475)</td>
</tr>
<tr>
<td>Distance from Sprinklers to Side of Obstruction (A)</td>
<td>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9 ft 6 (2.9 m) in. to less than 10 ft (3.0 m)</td>
<td>21 (525)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.8.5.1.2(a).

**Figure 11.2.5.1.2(a)** Position of Sprinkler to Avoid Obstruction to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers).

**Figure 11.2.5.1.2(b)** Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).

**Figure 11.2.5.1.2(c)** Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).

\[ A > (D - 8 \text{ in.}) + B \]
\[ A = (D - 200 \text{ mm}) + B \]
where: \( D \leq 30 \text{ in.} (750 \text{ mm}) \)
Committee Statement

This proposal seeks to rectify a discrepancy that was introduced during the Second Draft of the cycle leading up to the 2016 edition of the standard, whereby the figure that was imaged in the First Draft Report was not consistent with the image illustrated in the Second Draft Report (covered in TIA 16-7).
Public Input No. 289 and First Revision No. 105 and 106 sought to correct typographical errors in the Obstructions Against Walls figures, relating to the distance from the wall and to correct the misconception that a sprinkler deflector would need to be at least 18 inches above the bottom of the obstruction/soffit. The revisions were agreed to during the First Revision Meeting and shown correctly in the First Draft Report. During the Second Draft Meeting, the subject was not discussed again, but for some reason, in the Second Draft Report the figures reverted to show the incorrect information. It appears to be a mistake that was made when the figures were edited to show the metric conversions.

Additionally, in its current state Figure 8.8.5.1.2(c) is inconsistent with the similar new Figure 8.9.5.1.4(c) and Figure 8.10.7.1.4(c), which properly indicate the "No maximum" dimensions.

This change was inadvertent. The Technical Committee did not take any action to change the figure after the First Draft. It should therefore be corrected again.

Response
Message:
Public Input No. 534-NFPA 13-2016 [Section No. 8.8.5.1.2]
First Revision No. 688-NFPA 13-2016 [Section No. 8.8.5.2.1.3 [Excluding any Sub-Sections]]
Unless the requirements of 11.2.5.2.1.4 through 11.2.5.2.1.8 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 11.2.5.2.1.3(a) and Figure 11.2.5.2.1.3(b).

Figure 11.2.5.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Extended Coverage Upright and Pendent Spray Sprinkler).

Figure 11.2.5.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Extended Coverage Upright and Pendent Spray Sprinkler).
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 13:39:29 EDT 2016

Committee Statement

Committee Statement: This Figure is for the "4 times rule" for EC but figure states 3x not 4x

The correct wording: is A>=4C or 4D. See uploaded file

This was submitted NFPA as an Erratum. This PI is in case this erratum is not corrected.

Response Message:

Public Input No. 432-NFPA 13-2016 [Section No. 8.8.5.2.1.3 [Excluding any Sub-Sections]]
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide such as ducts, decks, open grate flooring, cutting tables, and overhead doors.
A.11.2.5.3.2
When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1219 mm) wide do not require additional protection underneath. Examples are ducts, stairs, landings, and other similar obstructions.
11.3.6.1.2
Sidewall sprinklers shall **not** be installed **no closer less** than 8 ft (2.4 m) from light fixtures or similar obstructions unless the requirements of 11.3.6.1.2.1 or 11.3.6.1.2.2 are met.

11.3.6.1.2.1
For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of four times the greatest dimension.

11.3.6.1.2.2
For obstructions located 4 in. or greater above the plane of the sprinkler deflector the sprinkler shall be permitted to be located less than 8 ft (2.4 m) from the obstruction.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI_461.docx</td>
<td>For staff use</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc

Committee Statement

The current language is ambiguous on what a "light fixture or similar obstruction" pertains to. As fire testing has shown that EC sidewall sprinklers can be placed per the 4 times rule of section 8.9.5.2.1.4, allowing a column with a maximum dimension of 1 foot be within 3 feet of an EC sidewall, then surely a light fixture can be protected by the same criteria, as it acts as less of an obstruction than a vertical column.

Explicit guidance on the change of philosophy regarding obstructions closer than 8 ft is warranted. Additionally, paragraph 8.9.5.1.3 applies only to obstructions greater than 8 ft from the sprinkler so guidance on the area closer to the sprinkler should be a separate paragraph.

Response Message:

Public Input No. 370-NFPA 13-2016 [New Section after 8.9.5.1.3]
Public Input No. 461-NFPA 13-2016 [Section No. 8.9.5.1.2]
Public Input No. 463-NFPA 13-2016 [New Section after 8.9.5.1.2]
**11.3.6.1.3**

The distance between light fixtures or similar obstructions located more than 8 ft (2.4 m) from or greater from the sprinkler shall be in conformance with Table 11.3.6.1.3 and Figure 11.3.6.1.3.

Table 11.3.6.1.3 Positioning of Sprinklers to Avoid Obstructions (Extended Coverage Sidewall Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 8 ft (2.4 m)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 10 ft (3.0 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>10 ft (3.0 m) to less than 11 ft (3.3 m)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>11 ft (3.3 m) to less than 12 ft (3.7 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>12 ft (3.7 m) to less than 13 ft (4.0 m)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>13 ft (4.0 m) to less than 14 ft (4.3 m)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>14 ft (4.3 m) to less than 15 ft (4.6 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>15 ft (4.6 m) to less than 16 ft (4.9 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>16 ft (4.9 m) to less than 17 ft (5.2 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>17 ft (5.2 m) or greater</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.9.5.1.3.

**Figure 11.3.6.1.3 Positioning of Sprinkler to Avoid Obstruction (Extended Coverage Sidewall Spray Sprinklers).**

---

**Submitter Information Verification**

**Submitter Full Name:** AUT-SSI

**Organization:** National Fire Protection Assoc

**Street Address:**

**City:**

**State:**

**Zip:**

**Submittal Date:** Fri Aug 12 13:25:00 EDT 2016
## Committee Statement

<table>
<thead>
<tr>
<th>Committee Statement:</th>
<th>The first revision of PI's 463 and 370 creates a conflict. The proposed changes address the conflict. The additions of the 3 times rule and obstructions closer to the sprinkler above the deflector provides consistency between the sidewall sprinkler types. A conflict was also identified in 8.7.5.1.3. The body text indicates “more than” 4 ft when the table references 4 ft (1.2 m) to less than 5 ft (1.5 m). Strike out “less than 4ft, not allowed” since that is not addressed by 8.7.5.1.3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Message:</td>
<td></td>
</tr>
</tbody>
</table>
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide, such as ducts, decks, open grate flooring, cutting tables, and overhead doors.

Committee Statement:
During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now.
A.11.3.6.3.2
When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1219 mm) wide do not require additional protection underneath. Examples are ducts, stairs, landings, and other similar obstructions.
11.3.7 Clearance to Storage (Extended Coverage Sidewall Spray Sprinklers).

The clearance between the deflector and the top of storage shall be 18 in. (457 mm) or greater.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 14:04:03 EDT 2016

Committee Statement

Committee Statement: The statement defining maximum clearance between the deflector and top of storage for Standard Spray Sidewalls in section 8.7.6 should be mirrored in 8.9 for Extended Coverage Sidewall Sprinklers

Response Message:

Public Input No. 429-NFPA 13-2016 [New Section after 8.9.5.3.3]
Pendent and upright sprinklers installed under beamed or beamed and sloped ceilings shall be permitted to be installed within 3 in. (75 mm) below beams where all of the following apply:

1. Maximum beam depth of 14 in. (355 mm)
2. Maximum ceiling height of 24 ft. (7.3 m)
3. Maximum ceiling slope of 8 in 12
4. Maximum compartment size of 600 ft$^2$ (56 m$^2$)

The highest sprinkler in the compartment shall be above all openings from the compartment into any communicated spaces.
Sprinklers shall be arranged to comply with one of the following arrangements:

(1) Sprinklers shall be in accordance with 9.5.5.2, Table 12.1.10.1.2, and Figure 12.1.10.1.2(a).

(2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.

(3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 12.1.10.1.2(b).

(4) Obstructions that are located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 8.10.6.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 12.1.10.1.2 Positioning of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sprinklers to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 ft (300 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft (300 mm) to less than 1 ft 6 in. (450 mm)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>1 ft 6 in. (450 mm) to less than 2 ft (600 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft (600 mm) to less than 2 ft 6 in. (750 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>2 ft 6 in. (750 mm) to less than 3 ft (900 mm)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>3 ft (900 mm) to less than 3 ft 6 in. (1.1 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m)</td>
<td>5 (125)</td>
</tr>
<tr>
<td>4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m)</td>
<td>7 (175)</td>
</tr>
<tr>
<td>6 ft (1.8 m) to less than 6 ft 6 in. (2.0 m)</td>
<td>9 (225)</td>
</tr>
<tr>
<td>6 ft 6 in. (2.0 m) to less than 7 ft (2.1 m)</td>
<td>11 (275)</td>
</tr>
<tr>
<td>7 ft (2.1 m) and greater</td>
<td>14 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.10.6.1.2(a).

Figure 12.1.10.1.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (Residential Upright and Pendent Spray Sprinklers).
Figure 12.1.10.1.2(b) Obstructions Against Wall (Residential Upright and Pendent Spray Sprinklers).

Figure 12.1.10.1.2(c) Obstructions Against Wall (Measurements for Residential Upright and Pendent Spray Sprinklers).
Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Committee Statement

This proposal seeks to rectify a discrepancy that was introduced during the Second Draft of the cycle leading up to the 2016 edition of the standard, whereby the figure that was imaged in the First Draft Report was not consistent with the image illustrated in the Second Draft Report (covered in TIA 16-7).

Public Input No. 289 and First Revision No. 105 and 106 sought to correct typographical errors in the Obstructions Against Walls figures, relating to the distance from the wall and to correct the misconception that a sprinkler deflector would need to be at least 18 inches above the bottom of the obstruction/soffit. The revisions were agreed to during the First Revision Meeting and shown correctly in the First Draft Report. During the Second Draft Meeting, the subject was not discussed again, but for some reason, in the Second Draft Report the figures reverted to show the incorrect information. It appears to be a mistake that was made when the figures were edited to show the metric conversions.

Additionally, in its current state Figure 8.10.6.1.2(c) is inconsistent with the similar new Figure 8.9.5.1.4(c) and Figure 8.10.7.1.4(c), which properly indicate the “½ S” and the “No maximum” dimensions.

This change was inadvertent. The Technical Committee did not take any action to change the figure after the First Draft. They should therefore be corrected again.

Response Message:

Public Input No. 535-NFPA 13-2016 [Section No. 8.10.6.1.2]
12.1.11.1.2

Sidewall sprinklers shall not be installed no closer than 8 ft (2.4 m) from light fixtures or similar obstructions, unless the requirements of 12.1.11.1.2.1 or 12.1.11.1.2.2 are met.

12.1.11.1.2.1

For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of four times the greatest dimension.

12.1.11.1.2.2

For obstructions located at least 4 in. (100 mm) above the plane of the sprinkler deflector, the sprinkler shall be permitted to be located less than 8 ft (2.4 m) from the obstruction.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 13:37:18 EDT 2016

Committee Statement

Committee Statement: These changes correlate with changes to extended coverage sprinklers.
Response Message:
12.1.11.1.3

The distance between light fixtures or similar obstructions located more than 8 ft (2.4 m) or greater from the sprinkler shall be in conformance with Table 12.1.11.1.3 and Figure 12.1.11.1.3.

Table 12.1.11.1.3 Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers)

<table>
<thead>
<tr>
<th>Distance from Sidewall Sprinkler to Side of Obstruction (A)</th>
<th>Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 8 ft (2.4 m)</td>
<td>Not allowed</td>
</tr>
<tr>
<td>8 ft (2.4 m) to less than 10 ft (3.0 m)</td>
<td>1 (25)</td>
</tr>
<tr>
<td>10 ft (3.0 m) to less than 11 ft (3.3 m)</td>
<td>2 (50)</td>
</tr>
<tr>
<td>11 ft (3.3 m) to less than 12 ft (3.7 m)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>12 ft (3.7 m) to less than 13 ft (4.0 m)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>13 ft (4.0 m) to less than 14 ft (4.3 m)</td>
<td>5 (150)</td>
</tr>
<tr>
<td>14 ft (4.3 m) to less than 15 ft (4.6 m)</td>
<td>6 (175)</td>
</tr>
<tr>
<td>15 ft (4.6 m) to less than 16 ft (4.9 m)</td>
<td>7 (225)</td>
</tr>
<tr>
<td>16 ft (4.9 m) to less than 17 ft (5.2 m)</td>
<td>9 (275)</td>
</tr>
<tr>
<td>17 ft (5.2 m) or greater</td>
<td>13 (350)</td>
</tr>
</tbody>
</table>

Note: For A and B, refer to Figure 8.10.7.1.3.

Figure 12.1.11.1.3 Positioning of Sprinkler to Avoid Obstruction (Residential Sidewall Sprinklers).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Aug 12 13:38:53 EDT 2016

Committee Statement
Committee Statement: These changes correlate with changes to extended coverage sprinklers.
Response Message:
12.11.2.2* Suspended or Floor-Mounted Vertical Obstructions. 

The distance from sprinklers to privacy curtains, free-standing partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 12.1.11.2.2 and Figure 12.1.11.2.2(a).

Table 12.1.11.2.2 Suspended or Floor-Mounted Obstructions (Residential Sidewall Sprinklers) in Light Hazard Occupancies Only

<table>
<thead>
<tr>
<th>Horizontal Distance (A)</th>
<th>Minimum Allowable Distance Below Deflector (B) [in. (mm)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in. (150 mm) or less</td>
<td>3 (75)</td>
</tr>
<tr>
<td>More than 6 in. (150 mm) to 9 in. (225 mm)</td>
<td>4 (100)</td>
</tr>
<tr>
<td>More than 9 in. (225 mm) to 12 in. (300 mm)</td>
<td>6 (150)</td>
</tr>
<tr>
<td>More than 12 in. (300 mm) to 15 in. (375 mm)</td>
<td>8 (200)</td>
</tr>
<tr>
<td>More than 15 in. (375 mm) to 18 in. (450 mm)</td>
<td>9(\frac{3}{4}) (240)</td>
</tr>
<tr>
<td>More than 18 in. (450 mm) to 24 in. (600 mm)</td>
<td>12(\frac{1}{4}) (315)</td>
</tr>
<tr>
<td>More than 24 in. (600 mm) to 30 in. (750 mm)</td>
<td>15(\frac{3}{4}) (390)</td>
</tr>
<tr>
<td>More than 30 in. (750 mm)</td>
<td>18 (450)</td>
</tr>
</tbody>
</table>

For SI units, 1 in. = 25.4 mm.

Note: For A and B, refer to Figure 8.10.7.2.2.

Figure 12.1.11.2.2(a) Suspended or Floor-Mounted Obstruction (Residential Sidewall Sprinklers) in Light Hazard Occupancy Only.

Figure 12.1.11.2.2(b) Suspended or Floor-Mounted Obstructions (Residential Sprinklers).

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-697_A.12.1.11.2.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>
Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 14:19:14 EDT 2016

Committee Statement

Committee Statement: Currently, Figure 8.10.7.2.2 shows the partition parallel to the wall the sidewall sprinkler is installed upon. A partition wall that is below the level of the sidewall sprinkler could be parallel or perpendicular to the wall where the sprinkler is located. The clearance distances should still be acceptable. The new figure demonstrates where measurements apply for a wall perpendicular to the wall where the sprinkler is located. A statement has also been added to the annex for clarity.

This proposal was developed by the NFSA Engineering and Standards Committee.

Response Message:

Public Input No. 457-NFPA 13-2016 [Section No. 8.10.7.2.2]
A.12.1.11.2.2
Floor-mounted obstructions can be parallel or perpendicular to the wall with the sidewall sprinkler.
12.1.11.3.2*
Sprinklers shall be installed under fixed obstructions over 4 ft (1.2 m) wide, such as ducts, stairs, and landings.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-698_A.12.1.11.3.2.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 14:29:20 EDT 2016

Committee Statement

Committee Statement: During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now.

Response Message:
Public Input No. 503-NFPA 13-2016 [Section No. 8.10.7.3.2]
Public Input No. 504-NFPA 13-2016 [New Section after A.8.10.7.3]
A.12.1.11.3.2
When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1.2 m) wide do not require additional protection underneath. Examples are ducts, stairs, landings, and other similar obstructions.
14.2.8.2.4

Deviations from the maximum sprinkler spacing shall be permitted to eliminate obstructions created by structural elements (such as trusses, bar joists, and wind bracing) by moving a single branch line a maximum of 1 ft (300 mm) from its allowable spacing, provided coverage for the sprinklers on that branch line and the sprinklers on the branch line it is moving away from does not exceed 110 ft² (10.2 m²) per sprinkler where all of the following conditions are met:

1. The average actual floor area protected by the sprinklers on the moved branch line and the sprinklers on the adjacent branch lines shall not exceed 100 ft² (9.3 m²) per sprinkler.
2. In no case shall the distance between sprinklers exceed 12 ft (3.7 m).
3. It shall not be permitted to move a branch line where there are moved sprinklers on a branch line that exceed the maximum sprinkler spacing.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:07:21 EDT 2016

Committee Statement

Committee Statement: The sensitivity of ESFR sprinklers means that they are impacted by structural and nonstructural obstructions. This modification would allow the user flexibility to locate ESFR sprinklers even when other nonstructural obstructions are present.

Response Message:

Public Input No. 447-NFPA 13-2016 [Section No. 8.12.2.2.4]
ESFR sprinklers shall be positioned a minimum of 1 ft (300 mm) horizontally from the nearest edge to any the bottom chord of a bar joist or open truss, where the bottom chord does not exceed 1 ft (300 mm) in width.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:08:20 EDT 2016

Committee Statement

Committee Statement: This proposal will limit the maximum width of the bottom chord of the bar joist to 12 inches. This will be in compliance with section 8.12.5.3.1 (3). Common width of bar joist seldom exceed 6 inches however there are cases where the bottom chord of open web trusses actually exceed 12 inches in width. As this section read write know, an ESFR Sprinkler could be located 1 ft away from a bottom chord that exceeds 12 inches in width and be in compliance with the standard.

Response Message:

Public Input No. 519-NFPA 13-2016 [Section No. 8.12.5.3.2 [Excluding any Sub-Sections]]
9.2.1.1.2

Small openings with both of the following limits shall be permitted where length:

1. A combined total area of not more than 20 percent of the ceiling, construction feature, or plane shall be used to determine the boundaries of the concealed space.

2. Gaps greater than 4 ft (1.2 m) long shall not have a width greater than 8 in. (200 mm) wide.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 14:39:22 EDT 2016

Committee Statement

Committee Statement: Clarity and Manual of Style. Splitting the requirements into two parts makes them much more clear. The Manual of Style does not like two requirements in the same section.
9.2.1.6*
Concealed spaces formed by ceilings attached to composite wood joist construction either directly or onto metal channels not exceeding 1 in. (25 mm) in depth, provided the joist channels are firestopped as measured from the top of the batt insulation are separated into volumes each not exceeding 160 ft$^3$ (4.5 m$^3$) using materials equivalent to the web construction and at least 3½ in. (90 mm) of batt insulation is installed at the bottom of the joist channels when the ceiling is attached utilizing metal channels, shall not require sprinkler protection.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 14:42:37 EDT 2016

Committee Statement

Committee Statement: The use of the term "firestopped" is inappropriate. Reference to a firestop is (or should be) reserved for an assembly that has a fire resistance rating that is applied to the protection of penetrations through fire-rated floors and walls, and that is listed in accordance with UL 1479 or an equivalent standard of performance and testing. Section 8.15.1.2.8 was apparently revised during the previous cycle to include the word "separated" and this section should be so revised as well. If it suits the committee, the term "compartmentalized" or "divided" could also be used instead of "firestopped".

Response Message:

Public Input No. 268-NFPA 13-2016 [Section No. 8.15.1.2.6]
9.2.1.8 Concealed spaces within wood joist construction and composite wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the joist of the roof or floor deck, provided that in composite wood joist construction the joist channels separated into volumes each not exceeding 160 ft$^3$ (4.5 m$^3$) to the full depth of the composite wood joist with material equivalent to the web construction, shall not require sprinkler protection.

9.2.1.9 Concealed spaces within composite wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the composite wood joist of the roof or floor deck and with the joist channels separated into volumes each not exceeding 160 ft$^3$ (4.5 m$^3$) to the full depth of the composite wood joist, with material equivalent to the web construction, shall not require sprinkler protection.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-701_8.15.1.2.8.docx</td>
<td>Showing legislative changes. For staff use.</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 14:49:14 EDT 2016

Committee Statement

Committee Statement: This proposal is to separate the requirements for wood joist construction and for composite wood joist construction into two separate sections for clarity. Because the composite wood joist spaces need to be separated into 160 ft$^3$ volumes, but the wood joist do not require such division, containing the provisions all within one section is somewhat confusing.

Response Message:

Public Input No. 505-NFPA 13-2016 [Section No. 8.15.1.2.8]
9.2.1.11

Concealed spaces where rigid materials are used and the exposed surfaces, in the form in which they are installed, comply with one of the following, shall not require sprinkler protection:

(1) The surface materials have a flame spread index of 25 or less, and the materials have been demonstrated not to propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E84, Standard Test Method of Surface Burning Characteristics of Building Materials, or ANSI/UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes.

(2) The surface materials comply with the requirements of ASTM E2768, Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 18 13:32:12 EDT 2016

Committee Statement

Committee Statement: ASTM E2768 was developed specifically as the test that includes all requirements of the "30 minute test" for ASTM E84. ASTM E84 is a 10 minute test and, when extended for 20 additional minutes, it becomes a 30 minute test. Testing to ASTM E2768 and complying with the requirements means that it complies with all the requirements in the existing section.

Response Message:

Public Input No. 22-NFPA 13-2016 [Section No. 8.15.1.2.10]
9.2.1.15

Vertical pipe chases under 10 ft² (0.9 m²) where provided in multifloor buildings where the chases that are firestopped at each floor using materials equivalent to the floor construction, and where such pipe chases shall contain no sources of ignition, piping shall be water-filled or, limited combustible or noncombustible, and pipe penetrations at each floor shall be properly sealed and shall not require sprinkler protection.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 14:54:42 EDT 2016

Committee Statement

Committee Statement: A pipe chase in a single story building less than 10 square feet should not be required to be have sprinkler protection. Currently this section applies to 2 story or taller buildings (multifloor). In addition, the committee should seriously look at the requirement to only allow non combustible piping when non water filled. This contradicts section 8.15.1.2.1 which allows minimal combustible loading. Once could infer that a space above an acoustical ceiling containing PVC piping for Drain and Waste should be protected.

Response Message:

Public Input No. 18-NFPA 13-2016 [Section No. 8.15.1.2.14]
Sprinklers: Unless the requirements of 9.2.1.18 are met, sprinklers used in horizontal combustible concealed spaces (with a slope not exceeding 2 in 12) with combustible wood truss, wood joist construction, or bar joist construction having a combustible upper surface and where the depth of the space is less than 36 in. (900 mm) from deck to deck, from deck to ceiling, or with double wood joist construction with a maximum of 36 in. (900 mm) between the top of the bottom joist and the bottom of the upper joist shall be listed for such use.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 16:47:20 EDT 2016

Committee Statement

Committee Statement: Shows that this requirement would not apply if sprinklers were omitted per 8.15.1.2.17.
Response Message:

Public Input No. 377-NFPA 13-2016 [Section No. 8.15.1.6 [Excluding any Sub-Sections]]
9.3.2.3
Sprinklers specifically listed to provide protection of combustible concealed spaces described in 9.3.2 shall be permitted to be used in accordance with 9.4.1.2 to protect composite wood joist construction with a maximum of 36 in. (900 mm) from deck to deck, from deck to ceiling, or with double composite wood joist construction with a maximum of 36 in. (900 mm) between the top of the bottom joist and the bottom of the upper joist.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 16:49:50 EDT 2016

Committee Statement

Committee Statement: This text is redundant and is covered by 8.15.1.6 and is referenced by this paragraph. More importantly, deleting this text avoids having to repeat the criteria from 8.15.1.6.2 on when the space also exceeds 36 inches.

Text is redundant and this eliminates the redundancy.

Response Message:

Public Input No. 483-NFPA 13-2016 [Section No. 8.15.1.7]
First Revision No. 709-NFPA 13-2016 [Section No. 8.15.5.1]

8.15.5.1
Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft (600 mm) above the floor of the pit.

Submitter Information Verification
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 17:42:55 EDT 2016

Committee Statement
Committee Statement: See rational for PI # 210
The difference is that this proposal proposes to delete Sections 8.15.5.1 and 8.15.5.2 completely and the associated annex to section 18.15.5.1

Response Message:
Public Input No. 211-NFPA 13-2016 [Section No. 8.15.5.1]
8.15.5.2
The sprinkler required at the bottom of the elevator hoistway by 8.15.5.1 shall not be required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 17:43:16 EDT 2016

Committee Statement

Committee Statement: See rational for PI # 210
The difference is that this proposal proposes to delete Sections 8.15.5.1 and 8.15.5.2 completely and the associated annex to section 18.15.5.1

Response Message: 
Public Input No. 212-NFPA 13-2016 [Section No. 8.15.5.2]
9.3.6.1

Automatic fire sprinklers shall not be required in elevator machine rooms, elevator machinery spaces, control spaces, or hoistways of traction elevators installed in accordance with the applicable provisions in NFPA 101, or the applicable building code, where all of the following conditions are met:

1. The elevator machine room, machinery space, control room, control space, or hoistway of traction elevator is dedicated to elevator equipment only.

2. The elevator machine room, machinery space, control room, or control space, or hoistway of traction elevators are is protected by smoke detectors, or other automatic fire detection, installed in accordance with NFPA 72.

3. The elevator machinery space, control room, control space, or hoistway of traction elevators is separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire resistance rating of not less than that specified by the applicable building code.

4. No materials unrelated to elevator equipment are permitted to be stored in elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways of traction elevators.

5. The elevator machinery is not of the hydraulic type.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 17:41:50 EDT 2016

Committee Statement

Committee Statement: NFPA 72 specifically prohibits the installation of smoke detectors in elevator shafts that are not sprinkler protected unless the smoke detector is installed to operate a smoke vent. The current code language is in conflict with NFPA 72. This code change removes the requirement for the smoke detector in an elevator shaft.

Response Message:

Public Input No. 207-NFPA 13-2016 [Section No. 8.15.5.3]
9.3.6.2*
Automatic sprinklers in elevator machine rooms or elevator machinery spaces, or at the tops of hoistways shall be of ordinary- or intermediate-temperature rating.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 17:41:23 EDT 2016

Committee Statement

Committee Statement: The intent of this proposal is to expand this requirement to include potential elevator machinery spaces which are not "rooms"
Response Message:

Public Input No. 217-NFPA 13-2016 [Section No. 8.15.5.4]
9.3.6.5.2
The sprinklers in the elevator hoistway shall not be required when the suspension means provide not less than an FT-1 rating when tested to the vertical burn test requirements of UL 62, Flexible Cords and Cables, and UL 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords, 2556, Wire and Cable Test Methods (Tri-national standard, with NMX-J-556-ANCE and CSA 22.2 No. 2556).

9.3.6.5.3
The suspension means shall not continue to burn for more than 60 seconds nor shall the indicator flag be burned more than 25 percent.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 17:44:55 EDT 2016

Committee Statement

Committee Statement: The current requirements make reference to the FT-1 rating when tested to the vertical burn test requirements of UL 62 and UL 1581 standards. Since UL 62 and UL 1581 standards are more applicable to Flexible Electrical Wire & Cables and there are no design criteria for noncircular elastomeric-coated or polyurethane-coated steel belts addressed by ASME A17.1, a reference to UL 2556 is more appropriate for the FT-1 rating.

RATIONALE: The current requirements make reference to the FT-1 rating when tested to vertical burn test requirements of UL 62 and UL 1581 standards. Since UL 62 and UL 1581 standards are more applicable to Flexible Electrical Wire & Cables and there are no design criteria for noncircular elastomeric-coated or polyurethane-coated steel belts addressed by ASME A17.1, a reference to UL 2556 is more appropriate for the FT-1 rating.

Response Message:

Public Input No. 5-NFPA 13-2015 [Section No. 8.15.5.7.2]
**First Revision No. 712-NFPA 13-2016 [Section No. 8.15.7.1]**

**9.3.20.1**

Unless the requirements of 9.2.3.1, 9.2.3.2, or 9.2.3.3 are met, sprinklers shall be installed under exterior projections exceeding 4 ft (1.2 m) in width.

**Supplemental Information**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-712_A.9.3.20.1.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

**Submitter Information Verification**

- **Submitter Full Name:** AUT-SSI
- **Organization:** National Fire Protection Assoc
- **Street Address:**
- **City:**
- **State:**
- **Zip:**
- **Submittal Date:** Thu Aug 11 17:57:28 EDT 2016

**Committee Statement**

- **Committee Statement:** Quite often, an additional line of sprinklers is required beyond the support beam of a canopy. The sprinklers are located where the obstruction rules cannot be met for the support beam where the standard requires an additional line of sprinklers. A fire involving the exterior edge of the canopy is not likely to progress into the structure since sprinklers are present.

**Response Message:**

Public Input No. 382-NFPA 13-2016 [Section No. 8.15.7.1]
A.9.3.20.1
Sprinkler protection under exterior projections should not be required to spray beyond the support beam on the exterior edge of the exterior projection. An additional line of sprinklers on the exterior edge is not required due to obstruction rules. This is considered a reasonable level of protection since sprinklers are located between the structure and the exterior edge.
9.2.3.3
Sprinklers shall be permitted to be omitted from an exterior exit corridor when the exterior walls of the corridor are at least 50 percent open and the corridor is entirely of noncombustible construction.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 18:22:44 EDT 2016

Committee Statement

Committee Statement: Clarifies that this section applies to the exterior wall of the corridor
Response Message:
9.3.20.2*
Sprinklers shall be installed under all exterior projections greater than 2 ft (600 mm) wide over areas 4 ft (1.2 m) where combustibles are stored.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 18:56:13 EDT 2016

Committee Statement

Committee Statement: This is the result of a task group in regards to protection of overhangs.
Response Message:

Public Input No. 464-NFPA 13-2016 [Section No. 8.15.7.5]
9.2.6 Sprinklers shall not be required in electrical equipment rooms where all of the following conditions are met:

(1) The room is dedicated to electrical equipment only.
(2) Only dry-type electrical equipment is used.
(3) Equipment is installed in a 2-hour fire-rated enclosure including protection for penetrations.
(4) No combustible storage is permitted to be stored in the room.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 14:13:56 EDT 2016

Committee Statement

Committee Statement: This Public Input appeared as "Reject but Hold" in Public Comment No. 120 of the (A2015 cycle) Second Draft Report.

Obviously non combustible storage will not burn. However, any storage should not be allowed as it may lead to storage of combustibles.

Response Message:

Public Input No. 115-NFPA 13-2016 [Section No. 8.15.11.2]
First Revision No. 657-NFPA 13-2016 [Section No. 8.15.23.3 [Excluding any Sub-Sections]]

Where there is a noncombustible space above a noncombustible or limited-combustible drop ceiling that is sprinklered because it is open to an adjacent sprinklered space on only one side, and where there is no possibility for storage above the drop ceiling, the sprinkler system shall be permitted to extend only as far into the space as 0.6 times the square root of the design area of the sprinkler system in the adjacent space.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 10 23:00:45 EDT 2016

Committee Statement

Committee Statement: There is no reason to limit the presence of an opening over an unprotected ceiling space to only one side. As long as all open sides are protected using the same criteria of extending the sprinkler protection 0.6 x the square root of the design above the space, this would adequately cool the ceiling jet from an adjacent fire and protect the space above the ceiling. Example: A noncombustible office building with a mechanical room that does not have a ceiling and walls in the mechanical room do not go all the way to the underside of the roof deck. The current language in the standard would require the entire area above the ceiling to be provided with sprinkler protection until full height walls were encountered. The requirement is excessive and unnecessary.

Response Message:

Public Input No. 363-NFPA 13-2016 [Section No. 8.15.23.3 [Excluding any Sub-Sections]]
9.2.7.1*
Sprinklers shall be permitted to be omitted above cloud ceilings where both all of the following apply:

(1)* The openings around the cloud and the maximum sprinkler protection area meet the requirements of 8.15.1.2.1.2, and Table 8.15.24.1 combined total area of the openings around the cloud are less than or equal to 20 percent of the area of the ceiling, construction feature, or plane used to determine the boundaries of the compartment.

(2) The width of the gap and the maximum sprinkler protection area shall meet Table 9.2.7.1.

(3) The requirements of 9.2.7.2 are met.

Table 9.2.7.1 Maximum Sprinkler Protection Area Based on Ceiling Cloud Width and Opening Width

<table>
<thead>
<tr>
<th>Ceiling Cloud Minimum Width Dimension (ft)</th>
<th>Maximum Area (ft²) — Opening Width ≤0.5 in./ft of Ceiling Height</th>
<th>Maximum Area (ft²) — Opening Width ≤0.75 in./ft of Ceiling Height</th>
<th>Maximum Area (ft²) — Opening Width ≤1 in./ft of Ceiling Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>2—&lt;2.5</td>
<td>175</td>
<td>70</td>
<td>NP</td>
</tr>
<tr>
<td>2.5–4</td>
<td>225</td>
<td>120</td>
<td>70</td>
</tr>
<tr>
<td>&gt;4</td>
<td>225</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Thu Aug 11 19:20:53 EDT 2016

Committee Statement

Committee Statement: Sending the user back to the concealed space rules is inappropriate. The space above drop ceilings are not concealed spaces and to send the user back there creates confusion. All of the information necessary to deal with cloud ceilings should be in section 8.15.24. My intent was to consolidate it all here. Hopefully, I correctly did that. There was no intent to change any of the rules.

Response Message: There are no technical changes but this consolidates and makes this section more user friendly.

Public Input No. 164-NFPA 13-2016 [Section No. 8.15.24.1]
9.10.2.1.1

Where extended coverage sprinklers are used, the maximum distance between sprinklers shall not exceed 16 ft (4.9 m).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 11 19:29:46 EDT 2016

Committee Statement

Committee Statement:
Section 8.15.24.2.3 contradicts section 8.15.24.1.1. We are concerned with the area of protection as well as spacing in this section (specifically where the table allows for larger design areas than are permitted for OH occupancies). This change will address this oversight.

See uploaded document

Response Message:
Public Input No. 516-NFPA 13-2016 [Section No. 8.15.24.2.1.1]
First Revision No. 718-NFPA 13-2016 [Section No. 8.15.24.2.3]

9.2.7.2.3
Maximum spacing and area of protection shall not exceed the maximum requirements of Table 10.2.4.2.1(a) for light hazard and Table 10.2.4.2.1(b) for ordinary hazard.

9.2.7.2.3.1
Where extended coverage sprinklers are used, the maximum distance between sprinklers shall not exceed 16 ft (4.9 m).

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Thu Aug 11 19:32:03 EDT 2016

Committee Statement

Committee Statement: Section 8.15.24.2.3 contradicts section 8.15.24.1.1. We are concerned with the area of protection as well as spacing in this section (specifically where the table allows for larger design areas than are permitted for OH occupancies). This change will address this oversight.

See uploaded document

Response Message:

Public Input No. 517-NFPA 13-2016 [Section No. 8.15.24.2.3]
Public Input No. 518-NFPA 13-2016 [New Section after 8.15.24.2.3]
**First Revision No. 658-NFPA 13-2016 [New Section after 8.15.26]**

**9.3.16 Vestibules.**
Sprinkler protection shall not be required within entrance vestibules of noncombustible construction that do not contain combustibles and are 150 ft² (13.9 m²) or less in area.

**Submitter Information Verification**

Submitter Full Name: AUT-SSI  
Organization: National Fire Protection Assoc  
Street Address: 
City: 
State: 
Zip: 
Submital Date: Wed Aug 10 23:01:58 EDT 2016

**Committee Statement**

Committee Statement: It is often very challenging to route piping to a vestibule, especially when the vestibule is located partially or wholly on the interior side of the exterior wall in a high space such as an atrium. Additionally, when the vestibule is located entirely on the exterior side of the facade it can be difficult to route piping within the heated envelope of the building. With concerns about freeze protection, required testing of dry sprinklers, antifreeze systems, and the impact of penetrations through the building envelope on energy consumption, there are maintenance and operational benefits in not sprinklering these relatively small spaces.

The normal flow of pedestrian traffic naturally limits the presence of combustibles, and this proposal goes further by explicitly stating the provision is not applicable if there are combustibles present. Therefore, the proposal contemplates virtually no fuel load. Furthermore, the likelihood of an occupant becoming trapped within the vestibule is remote. Accordingly, this proposal does not have a significant impact on property protection or life safety.

**Response Message:**
Public Input No. 171-NFPA 13-2016 [New Section after 8.15.26]
16.9.8.6
Such means shall consist of a tee outlet downstream of the pressure-reducing valve identical in size to
the sprinkler system feed, available for connection to field testing devices, or other method approved by
the authority having jurisdiction.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 10 23:05:13 EDT 2016

Committee Statement

Committee Statement: The purpose of this amendment is to prescribe a method for testing PRV control valves in fire
sprinkler systems. This is a low-cost option that will allow for testing during construction and during
maintenance testing. The designer is permitted to submit alternate methods for providing means to
test the PRV, which can be approved by the AHJ if the alternate means provides the same ability to
test both during construction and during maintenance.

Response Message:
Public Input No. 568-NFPA 13-2016 [Section No. 8.16.1.2.5]
16.10.4.6.3
Main drain connections shall be sized in accordance with 8.12.4.2 16.10.4.2.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 10 23:05:47 EDT 2016

Committee Statement

Committee Statement: Editorial correction.
Response Message:

Public Input No. 506-NFPA 13-2016 [Section No. 8.16.2.4.6.3]
16.10.5.3.4
Auxiliary drains **shall not be required** for pipe drops supplying dry pendent sprinklers installed in accordance with 8.2.2, 7.3.25, and 7.7.3.4.

Submitter Information Verification

**Submitter Full Name:** AUT-SSI  
**Organization:** National Fire Protection Assoc  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Aug 10 23:07:02 EDT 2016

Committee Statement

**Committee Statement:** This proposal is offered because Section 8.16.2.5.3 also covers auxiliary drains on preaction systems as well as dry pipe systems.

Additionally, the word “required” is proposed to be inserted, for editorial correction.

**Response Message:**

Public Input No. 507-NFPA 13-2016 [Section No. 8.16.2.5.3.4]
First Revision No. 662-NFPA 13-2016 [Section No. 8.16.6]

16.7* Air Venting.

The vent required by 8.1.5 shall be located near a high point in the system to allow air to be removed from that portion of the system by one of the following methods:

1. Manual valve, minimum ½ in. (15 mm) size
2. Automatic air vent
3. Remote inspector’s test valve
4. Other approved means

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Aug 10 23:08:52 EDT 2016

Committee Statement

Committee Statement: Spell out the option of moving the inspectors test valve to the remote part of the system to provide dual functionality.

Remote ITC’s can be an effective means of venting air.

Response Message:

Public Input No. 276-NFPA 13-2016 [Section No. 8.16.6]
16.12.5 Arrangement.

See Figure 16.12.1.

16.12.5.1*
The fire department connection shall be on the system side of the water supply check valve.

16.12.5.1.1
The fire department connection shall not be attached to branch line piping.

16.12.5.1.2
The fire department connection shall be permitted to be connected to main piping on the system it serves. The fire department connection shall be located not less than 18 in. (457 mm) and not more than 4 ft (1.2 m) above the level of the adjacent grade or access level.

16.12.5.2
For single systems, the fire department connection shall be installed as follows:

1. Wet system — on the system side of system control, check, and alarm valves (see Figure A.16.9.3)
2. Dry system — between the system control valve and the dry pipe valve
3. Preaction system — between the preaction valve and the check valve on the system side of the preaction valve
4. Deluge system — on the system side of the deluge valve

16.12.5.3
The fire department connection shall be permitted to be connected to main piping on the wet pipe or deluge system it serves.

16.12.5.4
For multiple systems, the fire department connection shall be connected between the supply control valves and the system control valves.

16.12.5.5
The requirements of 16.12.5.2 and 16.12.5.4 shall not apply where the fire department connection is connected to the underground piping.

16.12.5.6
Where a fire department connection services only a portion of a building, a sign shall be attached indicating the portions of the building served.

16.12.5.7*
Fire department connections shall be located at the nearest point of fire department apparatus accessibility or at a location approved by the authority having jurisdiction.

16.12.5.8 Signs.

16.12.5.8.1
Each fire department connection to sprinkler systems shall be designated by a sign having raised or engraved letters at least 1 in. (25 mm) in height on plate or fitting reading service design — for example, AUTOSPKR., OPEN SPKR., AND STANDPIPE.

16.12.5.8.2
A sign shall also indicate the pressure required at the inlets to deliver the greatest system demand.
The sign required in 16.12.5.8.2 shall not be required where the system demand pressure is less than 150 psi (10.3 bar).

Fire department connections shall not be connected on the suction side of fire pumps.

Fire department connections shall be properly supported.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR_663.docx</td>
<td>Revise 8.17.2.4 as per the attached word doc. For staff use.</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI  
Organization: National Fire Protection Assoc  
Street Address:  
City:  
State:  
Zip:  

Committee Statement

Committee Statement: As per Section 8.17.2.4.3, for multiple systems, the fire department connection shall be connected between the supply control valves and the system control valves. Therefore the current 8.17.2.4.1.2 deals with single systems and should therefore be part of Section 8.17.2.4.2, which deals with single systems.

Further, the current text of 8.17.2.4.1.2 implies that the FDC is permitted to be connected to the mains of any system, when in fact, that should only be done on wet or deluge systems, because for dry and preaction systems, it should be connected at the system riser as per 8.17.2.4.2 (2) and (3).

NFPA 14 uses the same language for FDC's.
16.14.5.1.1
The arrangement required in 8.17.4.5.1 shall be serviceable, without requiring the owner to modify the system to perform the test.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Aug 10 23:30:36 EDT 2016

Committee Statement

Committee Statement: Substantiation: The proposed new section 8.17.4.5.1.1 is intended to clarify the intent of section 8.17.4.5.1. The commentary in the NFPA 13 Handbook describes that, ‘Reversing the check valve orientation is unacceptable for new systems because it is unlikely that property owners will undertake such effort and expense to conduct this important test.’ If the intent is to have a serviceable arrangement, then the standard should clarify that.

Response Message:

Public Input No. 587-NFPA 13-2016 [New Section after 8.17.4.5.1]
27.1 Approval of Sprinkler Systems and Private Fire Service Mains.
The installing contractor shall do the following:

1. Notify the authority having jurisdiction and the property owner or the property owner’s authorized representative of the time and date testing will be performed.

2. Perform all required acceptance tests (see Section 27.2).

3. Complete and sign the appropriate contractor’s material and test certificate(s) (see Figure 27.1).

4. Remove all caps and straps prior to placing the sprinkler system in service.

**Figure 27.1 Contractor’s Material and Test Certificate for Aboveground Piping.**
### Contractor's Material and Test Certificate for Aboveground Piping

**PROCEDURE:** Upon conclusion of work, inspection and tests shall be made by the contractor's representatives and witnessed by the property owner or authorized representative. Tests shall be conducted and signed off by contractor and owner. Upon approval, the certificate of completion will be signed by both parties.

A certificate shall be filled out and signed by both representatives. Expired shall be for the purpose of ensuring that the certificate is signed by all parties involved in the installation of the equipment. The certificate shall be signed by both parties involved in the installation of the equipment. The certificate shall be signed by both parties involved in the installation of the equipment. The certificate shall be signed by both parties involved in the installation of the equipment.

**Insurance:** To be completed by agreeing authority (if necessary).

**Property Address:** [Details not visible]

**Installation: Is the system compliance with the National Fire Protection Association (NFPA)?**

**Is the system compliance with the National Fire Protection Association (NFPA)?**

**Is the system compliance with the National Fire Protection Association (NFPA)?**

**Is the system compliance with the National Fire Protection Association (NFPA)?**

<table>
<thead>
<tr>
<th>Location of System</th>
<th>Type of Pipe</th>
<th>Type of Flow Control</th>
<th>Minimum Time to Operate Prior to Commissioning</th>
<th>Minimum Time to Operate After Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>Male</td>
<td>Model</td>
<td>Series</td>
<td>Quantity</td>
</tr>
<tr>
<td>Sprinklers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pipes and Manifolds:**

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Type of Flow Control</th>
<th>Minimum Time to Operate Prior to Commissioning</th>
<th>Minimum Time to Operate After Commissioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Model</td>
<td>Series</td>
<td>Quantity</td>
</tr>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
</tr>
</tbody>
</table>

**Pressure Rating:**

<table>
<thead>
<tr>
<th>Location and Use</th>
<th>Pressure Rating</th>
<th>Relief Valve</th>
<th>Shut-Off Valve</th>
<th>Check Valve</th>
<th>Blowoff Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of System</td>
<td>Male</td>
<td>Model</td>
<td>Series</td>
<td>Quantity</td>
<td>Temperature (F)</td>
</tr>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
<td>Time water test conducted</td>
<td>Hours</td>
</tr>
</tbody>
</table>

**Design and Installation:**

<table>
<thead>
<tr>
<th>Design and Installation</th>
<th>Male</th>
<th>Model</th>
<th>Series</th>
<th>Quantity</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
<td>Time water test conducted</td>
<td>Hours</td>
</tr>
</tbody>
</table>

**Operation:**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Male</th>
<th>Model</th>
<th>Series</th>
<th>Quantity</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
<td>Time water test conducted</td>
<td>Hours</td>
</tr>
</tbody>
</table>

**Testing:**

<table>
<thead>
<tr>
<th>Testing</th>
<th>Male</th>
<th>Model</th>
<th>Series</th>
<th>Quantity</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
<td>Time water test conducted</td>
<td>Hours</td>
</tr>
</tbody>
</table>

**Wiring:**

<table>
<thead>
<tr>
<th>Wiring</th>
<th>Male</th>
<th>Model</th>
<th>Series</th>
<th>Quantity</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Fire pressure</td>
<td>No pressure</td>
<td>Tag point air pressure</td>
<td>Time water test conducted</td>
<td>Hours</td>
</tr>
</tbody>
</table>

© 2018 National Fire Protection Association

NFPA 13 (p. 14 of 2)

Field and Test Data form the basis for which results are shown in the certificate.

[Note: The certificate contains additional information and details about the installation and testing of aboveground piping systems.]
<table>
<thead>
<tr>
<th>Operation</th>
<th>Diesel, Electrical, Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piping supervised</td>
<td>Yes, No</td>
</tr>
<tr>
<td>No, Yes</td>
<td></td>
</tr>
<tr>
<td>Defining media supervised</td>
<td>Yes, No</td>
</tr>
<tr>
<td>Yes, No</td>
<td></td>
</tr>
<tr>
<td>Does value operate from the manual 15, 16, or both control station?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>Yes, No</td>
<td></td>
</tr>
<tr>
<td>Is there an accessible flammable in each circuit for testing?</td>
<td>No, Yes</td>
</tr>
<tr>
<td>No, Yes</td>
<td></td>
</tr>
<tr>
<td>Make Meter</td>
<td>Yes, No</td>
</tr>
<tr>
<td>No, Yes</td>
<td></td>
</tr>
<tr>
<td>Does each circuit operate at the same speed?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>Yes, No</td>
<td></td>
</tr>
<tr>
<td>Maximum time to inject outside pump</td>
<td>Minutes, Seconds</td>
</tr>
<tr>
<td>Minutes, Seconds</td>
<td></td>
</tr>
</tbody>
</table>

### Pressure-Relating Data

<table>
<thead>
<tr>
<th>Location and Test</th>
<th>Make Meter</th>
<th>Setting</th>
<th>Static Pressure</th>
<th>Residual Pressure (Test)</th>
<th>Flow (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrostatic: Hydrostatic tests shall be made at not less than 200 psi (1375 kPa) for 2 hours or 80 psi (52 kPa) for 8 hours. All tests shall be made at ambient temperature using fresh water and full pressure.</td>
<td>Yes, No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propagated: Test for 2 hours at 10 psi (68.9 kPa) air pressure and maximum drop, which shall not exceed 1 psi (6.8 kPa) in 30 minutes. Transmission lines in normal water level and air pressures shall measure 5 psi air pressure drop, which shall not exceed 1 psi (6.8 kPa) in 30 minutes.</td>
<td>Yes, No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Stack Testing

<table>
<thead>
<tr>
<th>Name of those tests</th>
<th>Location</th>
<th>Number recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding test</td>
<td>Yes, No</td>
<td></td>
</tr>
<tr>
<td>Number tested</td>
<td>Yes, No</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Explanations and Notes

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Wed Aug 24 09:02:44 EDT 2016

Committee Statement

Committee Statement:
There is no indication on the form for system modifications or additions. The subsequent forms will cause confusion and will not indicated the scope of work completed.

Response Message:
Public Input No. 386-NFPA 13-2016 [Section No. 25.1]
Public Input No. 45-NFPA 13-2016 [Section No. 25.1]
### 27.2.2.3
Pipe or tube specifically investigated for suitability in dry pipe and double interlock preaction system(s) and listed for this service, shall be permitted to be tested in accordance with their listing limitations.

---

## Submitter Information Verification

<table>
<thead>
<tr>
<th>Submitter Full Name:</th>
<th>AUT-SSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization:</td>
<td>National Fire Protection Assoc</td>
</tr>
<tr>
<td>Street Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>State:</td>
<td></td>
</tr>
<tr>
<td>Zip:</td>
<td></td>
</tr>
<tr>
<td>Submittal Date:</td>
<td>Wed Aug 24 09:04:46 EDT 2016</td>
</tr>
</tbody>
</table>

---

## Committee Statement

Committee Statement: CPVC is currently listed for use in Dry Pipe Systems, but cannot be used when pressures exceed 15 psi. This changes provides a listed alternative to the 40 psi leakage test.

Response Message:

- Public Input No. 418-NFPA 13-2016 [Section No. 25.2.2.2]
- Public Input No. 265-NFPA 13-2016 [New Section after 25.2.2]
28.7.2

Modifications to existing **dry pipe or double interlock preaction** systems shall be tested for air leakage using one of the following test methods:

1. An air pressure test at 40 psi (2.7 bar) shall be performed for 2 hours as follows:
   
   a. The system shall be permitted to lose up to 3 psi (0.2 bar) during the duration of the test.
   
   b. Air leaks shall be addressed if the system loses more than 3 psi (0.2 bar) during this test.

2. With the system at normal system air pressure, the air source shall be shut off for 4 hours. If the low pressure alarm goes off within this period, the leaks shall be addressed.

**Supplemental Information**

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter_28_New_Text.docx</td>
<td>Adds new text due to reformat</td>
</tr>
</tbody>
</table>

**Submitter Information Verification**

<table>
<thead>
<tr>
<th>Submitter Full Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUT-SSI</td>
<td>National Fire Protection Assoc</td>
</tr>
</tbody>
</table>

**Committee Statement**

Chapter 28 This chapter is a new concept for the 2019 edition of NFPA 13. The task group felt that it would be an added benefit to locate all the rules that apply to system modifications in one location. Previously, system modification language was scattered throughout the document.
Chapter 28 Existing System Modifications

28.1 General

28.1.1 In addition to the applicable requirements of this standard, the requirements of Chapter 28 shall apply when modifications or additions are made to existing systems.

28.1.2 Torch cutting and welding shall not be permitted as a means of modifying or repairing sprinkler systems.

28.1.3 Additives to existing systems intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

28.2 Reconditioned Components

28.2.1 The use of reconditioned valves and devices as replacement equipment in existing systems shall be permitted.

28.2.5 8.15.20.3 When pipe schedule or hydraulically designed systems are revamped to accommodate added ceilings, sprinkler outlets utilized for new armover or drop nipples shall have hexagonal bushings removed when present.

28.3 Sprinklers

28.3.1 Reconditioned sprinklers shall not be permitted on any new or existing system.

28.3.2 When a sprinkler is removed from a fitting or welded outlet, it shall not be reinstalled except as permitted by 28.3.2.1 6.2.1.1.1

28.3.2.1 Dry sprinklers shall be permitted to be reinstalled when removed in accordance with the manufacturer’s installation and maintenance instructions.

28.3.3 Where modifications or additions are made to existing light hazard systems equipped with standard response sprinklers, new standard response sprinklers shall be permitted to be used.

28.3.4 Where individual standard response sprinklers are replaced in existing light hazard systems, new standard response sprinklers shall be permitted to be used.

28.3.5 8.3.3.6 When existing light hazard systems are converted to use quick-response or residential sprinklers, all sprinklers in a compartment shall be changed.

28.3.6 Where replacing residential sprinklers manufactured prior to 2003 that are no longer available from the manufacturer and that are installed using a design density less than 0.05 gpm/ft² (2.04mm/min), a residential sprinkler with an equivalent K-factor (± 5 percent) shall be permitted to be used provided the currently listed coverage area for the replacement sprinkler is not exceeded.

28.3.7 Where cover plates on concealed sprinklers have been painted by other than the sprinkler manufacturer, the cover plate shall be replaced.

28.4.3 8.15.20.4.3 When it is necessary to pipe two new sprinklers from an existing outlet in an overhead system, the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted in accordance with Figure 28.4.3, provided that a
hydraulic calculation verifies that the design flow rate will be achieved, in accordance with Figure 8.15.20.4.3.

28.6 System Design

28.6.1 Where the equipment is to be installed as an addition or modifications are made to an existing system, enough of the existing system shall be indicated on the plans to make all conditions clear.

28.6.2 The pipe schedule method shall be permitted as follows:

28.6.3 For modifications or additions to existing systems equipped with residential sprinklers, the listed discharge criteria less than 0.1 gpm/ft² (4.1mm/min) shall be permitted to be used.

28.6.5 A hydraulically calculated system for a building, or a hydraulically calculated addition to a system in an existing sprinklered building using the pipe schedule method, shall supersede the rules in this standard governing pipe schedules, except that all systems shall continue to be limited by area.

28.6.6 Unless permitted by 28.6.6.1 Unless the requirements of 12.6.5 are met, when modifying existing systems protecting general storage, rack storage, rubber tire storage, roll paper storage, and baled cotton storage, using sprinklers with K-factors K-8.0 (115) or less, the requirements of 12.6.2 and 12.6.3 shall not apply to modifications to existing storage application systems, using sprinklers with K-factors K-8.0 (115) or less.

28.6.6.1 Where applying the requirements of Figure 17.2.1.2.1(b) and Figure 17.2.1.2.1(c) utilizing the design criteria of 0.6 gpm/ft² per 2000 ft² (24.4 mm/min per 186 m²) to existing storage applications, standard-response spray sprinklers with a K-factor of K-11.2 (161) or larger that are listed for storage applications shall be used. The requirements of 12.6.3 shall apply.

28.7 Testing

28.7.1 Modifications to existing dry pipe or double interlock preaction systems shall be tested for air leakage using one of the following test methods:

(1) An air pressure test at 40 psi (3.2 bar) shall be performed for 2 hours.

(a) The system shall be permitted to lose up to 3 psi (0.2 bar) during the duration of the test.

(b) Air leaks shall be addressed if the system loses more than 3 psi (0.2 bar) during this test.

(2) With the system at normal system air pressure, the air source shall be shut off for 4 hours. If the low pressure alarm goes off within this period, the leaks shall be addressed.
27.2.4.1

Each pressure-reducing valve shall be tested upon completion of installation to ensure proper operation under full flow and no-flow conditions.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 24 09:06:18 EDT 2016

Committee Statement

Committee Statement: NFPA 25 - 13.5.1.2 states a full flow test shall be conducted on each valve at the 5 year interval mark. This proposal would have the NFPA 13 language line up with the NFPA 25 language.

Response Message: 

Public Input No. 353-NFPA 13-2016 [Section No. 25.2.4.1]
### 27.3 - Automated Inspection and Testing Devices and Equipment

**27.3.1**
Automated inspection and testing devices and equipment installed on the sprinkler system shall be tested to ensure the desired result of the automated inspection or test is realized.

**27.3.1.1**
Automated inspection devices and equipment shall be shown to be as effective as a visual examination.

**27.3.1.2**
Automated testing devices and equipment shall produce the same action required by this standard to test a device.

**27.3.1.2.1**
The testing shall discharge water where required by this standard and NFPA 25.

**27.3.2**
Failure of automated inspection and testing devices and equipment shall not impair the operation of the system unless indicated by an audible and visual trouble signal in accordance with NFPA 72.

**27.3.3**
Failure of a system or component to pass automated inspection and testing devices and equipment shall result in an audible and visual trouble signal in accordance with NFPA 72.

**27.3.4**
Failure of automated inspection and testing devices and equipment shall result in an audible and visual trouble signal in accordance with NFPA 72.

### Committee Statement

**Committee Statement:** Technology now allows for automated inspection and testing of systems and components. When the devices and equipment are installed for that purpose, they need to be tested to make sure they provide the desired result for future inspections and tests. NFPA 25 has language describing how the device or equipment can be used and their limitations as they apply to the periodic testing of systems and components. NFPA 13 needs to provide the original acceptance test criteria for these devices and equipment.
First Revision No. 853-NFPA 13-2016 [ Section No. 25.3 ]

27.4 Circulating Closed Loop Systems.

27.4.1 For sprinkler systems with non–fire protection connections, additional information shall be appended to the contractor's material and test certificate for aboveground piping shown in Figure 27.1 as follows:

(1) Certification that all auxiliary devices, such as heat pumps, circulating pumps, heat exchangers, radiators, and luminaires, if a part of the system, have a pressure rating of at least 175 psi or 300 psi (12.1 bar or 20.7 bar) if exposed to pressures greater than 175 psi (12.1 bar).

(2) All components of sprinkler system and auxiliary system have been pressure tested as a composite system in accordance with 27.2.2.

(3) Waterflow tests have been conducted and waterflow alarms have operated while auxiliary equipment is in each of the possible modes of operation.

(4) With auxiliary equipment tested in each possible mode of operation and with no flow from sprinklers or test connection, waterflow alarm signals did not operate.

(5) Excess temperature controls for shutting down the auxiliary system have been properly field tested.

27.4.2 Discharge tests of sprinkler systems with non–fire protection connections shall be conducted using system test connections described in 6.8.1.

27.4.3 Pressure gauges shall be installed at critical points and readings shall be taken under various modes of auxiliary equipment operation.

27.4.4 Waterflow alarm signals shall be responsive to discharge of water through system test pipes while auxiliary equipment is in each of the possible modes of operation.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI_48.docx</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI

Organization: National Fire Protection Assoc

Street Address:

City:

State:

Zip:


Committee Statement

Committee Statement: Circulating Closed loops have been removed from NFPA 13. This language no longer applies to new installations.
Response
Message:

Public Input No. 48-NFPA 13-2016 [Section No. 25.3]
8.16.1.1.2.2 Floor control valves in high-rise buildings and valves controlling flow to sprinklers in circulating closed loop systems shall comply with 8.16.1.1.2.1(1) or 8.16.1.1.2.1(2).
27.5 Instructions.
The installing contractor shall provide the property owner or the property owner's authorized representative with the following:

(1) All literature and instructions provided by the manufacturer describing proper operation and maintenance of any equipment and devices installed.

(2)* NFPA 25

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR-850_A.27.5_2_.docx</td>
<td>New annex</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: City: State: Zip:
Submittal Date: Wed Aug 24 09:07:28 EDT 2016

Committee Statement

Committee Statement: The standard does not differentiate between a new installation and a system alteration. Per the standard, a copy of NFPA 25 would have to be supplied each time the system is modified.

Response Message:

Public Input No. 384-NFPA 13-2016 [Section No. 25.4]
A.27.5(2)
A copy of NFPA 25 is not required for system alterations or additions.
27.6* Hydraulic Design Information Sign (Hydraulic Data Nameplate).

27.6.1 The installing contractor shall identify a hydraulically designed sprinkler system with a permanently marked weatherproof metal or rigid plastic sign secured with corrosion-resistant wire, chain, or other approved means.

27.6.2 Such signs shall be placed at the alarm valve, dry pipe valve, preaction valve, or deluge valve supplying the corresponding hydraulically designed area.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 24 09:07:51 EDT 2016

Committee Statement

Committee Statement: In chapter 25 this is referred to as the Hydraulic Design Information Sign. In other parts of the document it is referred to as a hydraulic data nameplate. The standard needs to be consistent.
Response Message:

Public Input No. 476-NFPA 13-2016 [Section No. 25.5]
Public Input No. 53-NFPA 13-2016 [Section No. 25.5.2]
First Revision No. 852-NFPA 13-2016 [New Section after 25.6]

27.7.3
Combination hydraulic design information and general information are permitted.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 24 09:14:21 EDT 2016

Committee Statement

Committee Statement: There should be allowance to combine both data signs into one.
Response Message:

Public Input No. 365-NFPA 13-2016 [New Section after 25.6]
29.1.3 The following definitions shall be applicable to this chapter (see Section 3.3.120):


(3) **Central Safety Station** — A continuously manned control station from which all of the fire control equipment is monitored. If this station is not the bridge, direct communication with the bridge must be provided by means other than the ship's service telephone.

(4) * **Heat-Sensitive Material** — A material whose melting point is below 1700°F (925°C).

(5) **Heel** — The inclination of a ship to one side.

(6) **Heel Angle** — The angle defined by the intersection of a vertical line through the center of a vessel and a line perpendicular to the surface of the water.

(7) **International Shore Connection** — A universal connection to the vessel's fire main to which a shoreside fire-fighting water supply can be connected.

(8) * **Marine System** — A sprinkler system installed on a ship, boat, or other floating structure that takes its supply from the water on which the vessel floats.

(9) * **Marine Thermal Barrier** — An assembly that is constructed of noncombustible materials and made intact with the main structure of the vessel, such as shell, structural bulkheads, and decks; and meets the requirements of a B-Class boundary. In addition, a marine thermal barrier shall be insulated such that, if tested in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or ANSI/UL 263, *Standard for Fire Tests of Building Construction and Materials*, for 15 minutes, the average temperature of the unexposed side does not rise more than 250°F (120°C) above the original temperature, nor does the temperature at any one point, including any joint, rise more than 405°F (225°C) above the original temperature.

(10) **Marine Water Supply** — The supply portion of the sprinkler system from the water pressure tank or the sea suction of the designated sprinkler system pump up to and including the valve that isolates the sprinkler system from these two water sources.

(11) **Supervision** — A visual and audible alarm signal given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists. Supervisory alarms shall give a distinct indication for each individual system component that is monitored.

(12) **Survival Angle** — The maximum angle to which a vessel is permitted to heel after the assumed damage required by stability regulations is imposed.

(13) **Type 1 Stair** — A fully enclosed stair that serves all levels of a vessel in which persons can be employed.

* **Marine Water Supply** — The supply portion of the sprinkler system from the water pressure tank or the sea suction of the designated sprinkler system pump up to and including the valve that isolates the sprinkler system from these two water sources.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Committee Statement

<table>
<thead>
<tr>
<th>Committee Statement:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.</td>
</tr>
</tbody>
</table>

Response Message:

Public Input No. 545-NFPA 13-2016 [Section No. 26.1.3]
A.3.3.120.4 Heat-Sensitive Material.


Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 23 13:19:42 EDT 2016

Committee Statement

Committee Statement: Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.

Response Message:

Public Input No. 546-NFPA 13-2016 [Section No. A.3.10.4]
Included among items requiring listing are sprinklers, some pipe and some fittings, hangers, alarm devices, valves controlling flow of water to sprinklers, supervisory switches, and electrically operated solenoid valves. Products are typically investigated in accordance with published standards. Examples of standards used to investigate several products installed in sprinkler systems are referenced in Table A.7.1.1. This table does not include a comprehensive list of all product standards used to investigate products installed in sprinkler systems.

**Table A.7.1.1 Examples of Standards for Sprinkler System Products**

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinklers</td>
<td>ANSI/UL 199, <em>Automatic Sprinklers for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 2000, <em>Automatic Control Mode Sprinklers for Fire Protection</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1626, <em>Residential Sprinklers for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 2030, <em>Residential Automatic Sprinklers</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1767, <em>Early-Suppression Fast-Response Sprinklers</em></td>
</tr>
<tr>
<td></td>
<td>FM 2008, <em>Suppression Mode ESFR Automatic Sprinklers</em></td>
</tr>
<tr>
<td></td>
<td>FM 1632, <em>Telescoping Sprinkler Assemblies for Use in Fire Protection Systems for Anechoic Chambers</em></td>
</tr>
<tr>
<td>Valves</td>
<td>ANSI/UL 193, <em>Alarm Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1041, <em>Alarm Check Valves</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 260, <em>Dry Pipe and Deluge Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1021, <em>Dry Pipe Valves</em></td>
</tr>
<tr>
<td></td>
<td>FM 1020, <em>Automatic Water Control Valves</em></td>
</tr>
<tr>
<td></td>
<td>UL 262, <em>Gate Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1120, 1130, <em>Fire Service Water Control Valves (OS &amp; Y and NRS Type Gate Valves)</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 312, <em>Check Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1210, <em>Swing Check Valves</em></td>
</tr>
<tr>
<td></td>
<td>UL 1091, <em>Butterfly Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1112, <em>Indicating Valves (Butterfly or Ball Type)</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1468, <em>Direct Acting Pressure Reducing and Pressure Restricting Valves</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1739, <em>Pilot-Operated Pressure-Control Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1362, <em>Pressure Reducing Valves</em></td>
</tr>
<tr>
<td></td>
<td>FM 1011/1012/1013, <em>Deluge and Preaction Sprinkler Systems</em></td>
</tr>
<tr>
<td></td>
<td>FM 1031, <em>Quick Opening Devices (Accelerators and Exhausters) for Dry Pipe Valves</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1486, <em>Quick Opening Devices for Dry Pipe Valves for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 346, <em>Waterflow Indicators for Fire Protective Signaling Systems</em></td>
</tr>
<tr>
<td></td>
<td>FM 1042, <em>Waterflow Alarm Indicators (Vane Type)</em></td>
</tr>
<tr>
<td></td>
<td>FM 1045, <em>Waterflow Detector Check Valves</em></td>
</tr>
<tr>
<td></td>
<td>FM 1140, <em>Quick Opening Valves 1/4 Inch Through 2 Inch Nominal Size</em></td>
</tr>
<tr>
<td>Hangers</td>
<td>ANSI/UL 203, <em>Pipe Hanger Equipment for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1950, <em>Seismic Sway Brace Components for Automatic Sprinkler Systems</em></td>
</tr>
<tr>
<td></td>
<td>UL 203A, <em>Sway Brace Devices for Sprinkler System Piping</em></td>
</tr>
<tr>
<td>Fittings</td>
<td>ANSI/UL 213, <em>Rubber Gasketed Fittings for Fire Protection Service</em></td>
</tr>
<tr>
<td></td>
<td>FM 1920, <em>Pipe Couplings and Fittings for Fire Protection Systems</em></td>
</tr>
<tr>
<td></td>
<td>UL 1474, <em>Adjustable Drop Nipples for Sprinkler Systems</em></td>
</tr>
<tr>
<td>Category</td>
<td>Standard</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Adjustable and</td>
<td>FM 1631, Adjustable and Fixed Sprinkler Fittings ⅛ Inch through 1 Inch</td>
</tr>
<tr>
<td>Fixed Sprinkler</td>
<td>Nominal Size</td>
</tr>
<tr>
<td>Fittings</td>
<td>ANSI/UL 2443, Flexible Sprinkler Hose with Fittings for Fire Protection</td>
</tr>
<tr>
<td></td>
<td>Service</td>
</tr>
<tr>
<td></td>
<td>FM 1637, Flexible Sprinkler Hose with Fittings</td>
</tr>
<tr>
<td>Aboveground</td>
<td>ANS/UL 852, Metallic Sprinkler Pipe for Fire Protection Service</td>
</tr>
<tr>
<td></td>
<td>FM 1630, Steel Pipe for Automatic Fire Sprinkler Systems</td>
</tr>
<tr>
<td></td>
<td>ANSI/UL 1821, Thermoplastic Sprinkler Pipe and Fittings for Fire</td>
</tr>
<tr>
<td></td>
<td>Protection Service</td>
</tr>
<tr>
<td></td>
<td>FM 1635, Plastic Pipe &amp; Fittings for Automatic Sprinkler Systems</td>
</tr>
<tr>
<td></td>
<td>FM 1636, Fire Resistant Barriers for Use with CPVC Pipe and Fittings in</td>
</tr>
<tr>
<td></td>
<td>Light Hazard Occupancies</td>
</tr>
<tr>
<td>Underground</td>
<td>UL 1285, Polyvinyl Chloride (PVC) Pipe and Couplings for Underground Fire</td>
</tr>
<tr>
<td></td>
<td>Service</td>
</tr>
<tr>
<td></td>
<td>FM 1612, Polyvinyl Chloride (PVC) Pipe and Fittings for Underground Fire</td>
</tr>
<tr>
<td></td>
<td>Protection Service</td>
</tr>
<tr>
<td></td>
<td>FM 1613, Polyethylene (PE) Pipe and Fittings for Underground Fire</td>
</tr>
<tr>
<td></td>
<td>Protection Service</td>
</tr>
<tr>
<td></td>
<td>FM 1610, Ductile Iron Pipe and Fittings, Flexible Fittings and Couplings</td>
</tr>
<tr>
<td></td>
<td>UL 194, Gasketed Joints for Ductile-Iron Pipe and Fittings for Fire</td>
</tr>
<tr>
<td></td>
<td>Protection Service</td>
</tr>
<tr>
<td></td>
<td>FM 1620, Pipe Joints and Anchor Fittings for Underground Fire Service</td>
</tr>
<tr>
<td></td>
<td>Mains</td>
</tr>
</tbody>
</table>

**Submitter Information Verification**

**Submitter Full Name:** AUT-SSI  
**Organization:** National Fire Protection Assoc  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Tue Aug 23 13:20:15 EDT 2016

**Committee Statement**

**Committee Statement:**  
**Reason Statement:** The proposed revisions provide updates to the list of standards in the Annex that are commonly used for Listing and are similar to some of the FM standards that are referenced.

**Response Message:**  
**Public Input No. 547-NFPA 13-2016 [Section No. A.6.1.1]**
The minimum information in the list contained in the spare sprinkler cabinet should be marked with the sprinkler identification described in 7.2.1; a general description of the sprinkler, including upright, pendent, residential, ESFR, and so forth; and the quantity of sprinklers that is to be maintained in the spare sprinkler cabinet.

An example of the list is shown in Figure A.16.2.7.1.

Figure A.16.2.7.1 Sample List.

<table>
<thead>
<tr>
<th>Sprinkler Identification, SIN</th>
<th>General Description</th>
<th>Temperature Rating, °F</th>
<th>Sprinkler Quantity Maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td>TY9128</td>
<td>Extended Coverage, K-25, upright</td>
<td>165</td>
<td>6</td>
</tr>
<tr>
<td>VK425</td>
<td>Concealed pendent residential</td>
<td>145</td>
<td>6</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 

Committee Statement

Committee Statement: The Figure is outdated and needs to be updated.
Response Message:

Public Input No. 604-NFPA 13-2016 [Section No. A.6.2.9.7.1]
Table A.16.17 is a summary of the requirements for signs in NFPA 13.

Table A.16.17 Sprinkler System Signage Summary

<table>
<thead>
<tr>
<th>Section</th>
<th>Sign Location</th>
<th>Sign Information/Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7.4</td>
<td>Control valves</td>
<td>Identification sign</td>
</tr>
<tr>
<td></td>
<td>Drain valves</td>
<td>Sign must be made of weatherproof metal or rigid plastic and attached with corrosion-resistant wire or chain</td>
</tr>
<tr>
<td></td>
<td>Test connection valves</td>
<td></td>
</tr>
<tr>
<td>7.6.1.4 and 7.6.1.5</td>
<td>Antifreeze system main valve</td>
<td>Indicate the following:</td>
</tr>
<tr>
<td></td>
<td>Circulating closed loop systems</td>
<td>Antifreeze manufacturer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Antifreeze type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Antifreeze concentration</td>
</tr>
<tr>
<td>7.7.1.5</td>
<td>All valves controlling sprinklers</td>
<td>Sign worded as follows:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“This valve controls fire protection equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not close until after fire has been extinguished.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use auxiliary valves when necessary to shut off supply to auxiliary equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Caution: Automatic alarm may be sounded if this valve is closed.</td>
</tr>
<tr>
<td>8.16.1.1.8</td>
<td>Control valves</td>
<td>Indicate valve function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indicate system being controlled</td>
</tr>
<tr>
<td>8.16.2.5.3.7</td>
<td>Dry valve</td>
<td>Number of low point drains</td>
</tr>
<tr>
<td></td>
<td>Preaction valve</td>
<td>Location of each drain</td>
</tr>
<tr>
<td>8.17.2.4.5</td>
<td>Fire department connections not serving the whole building</td>
<td>Indicate portion of the building served by the fire department connection</td>
</tr>
<tr>
<td>8.17.2.4.7</td>
<td>All fire department connections</td>
<td>Indicate systems served by the fire department connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indicate system pressure demand [for systems requiring more than 150 psi (10 bar)]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Letters must be 1 in. (25 mm) in height</td>
</tr>
<tr>
<td>25.5</td>
<td>Alarm valve</td>
<td>Indicate the following:</td>
</tr>
<tr>
<td></td>
<td>Dry pipe valve</td>
<td>Location of the design area or areas</td>
</tr>
<tr>
<td></td>
<td>Preaction valve</td>
<td>Discharge densities over the design area or areas</td>
</tr>
<tr>
<td></td>
<td>Deluge valve</td>
<td>Required flow and residual pressure demand at the base of the riser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Occupancy classification or commodity classification and maximum permitted storage height and configuration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hose stream allowance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The installing contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sign must be made of weatherproof metal or rigid plastic and attached with corrosion-resistant wire or chain</td>
</tr>
<tr>
<td>25.6</td>
<td>System control riser</td>
<td>Indicate the following:</td>
</tr>
<tr>
<td></td>
<td>Antifreeze loops</td>
<td>Name and location of the facility</td>
</tr>
<tr>
<td></td>
<td>Auxiliary systems</td>
<td>Occupancy and commodity classification</td>
</tr>
<tr>
<td></td>
<td>Control valves</td>
<td>Flow test data</td>
</tr>
<tr>
<td>Section</td>
<td>Sign Location</td>
<td>Sign Information/Requirements</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Original main drain flow test results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of encapsulated pallet loads</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of solid shelving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of flammable/combustible liquids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of hazardous materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of other special storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of antifreeze or other auxiliary systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum storage height</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aisle width</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Location of auxiliary drains and low point drains on dry pipe and preaction systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installing contractor or designer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sign must be made of weatherproof metal or rigid plastic and attached with corrosion-resistant wire or chain</td>
</tr>
<tr>
<td>26.2.7.5</td>
<td>Fire department connection (FDC)</td>
<td>18 in. × 18 in. (450 mm × 450 mm) sign</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FDC symbol from NFPA 170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Located at connection in plain sight from shore access point</td>
</tr>
<tr>
<td>A.8.17.1</td>
<td>Central station, auxiliary, remote station, or proprietary protective signaling systems</td>
<td>Recommended:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Located near the device</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Direct people to call police or fire department when bell rings</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI  
Organization: National Fire Protection Assoc  
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Fri Aug 12 15:04:47 EDT 2016

Committee Statement

Committee Statement: Removed Circulating Closed Loop from the 2nd box under sign location.  
Response Message:  
Public Input No. 49-NFPA 13-2016 [Section No. A.6.9]
A.8.6.3.6
Systems larger than 40 gal (150 L) are required by NFPA 25 to check have the concentration levels checked at the supply inlet to the antifreeze system and at a remote point of the system.

Submitter Information Verification
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:22:29 EDT 2016

Committee Statement
Committee Statement: The current wording is erroneous. All systems are required to have a test connection at the inlet and one at the most remote portion of the system, at a minimum. There is no requirement for the number of test connections based on 40 gallon threshold.
Response Message:

Public Input No. 367-NFPA 13-2016 [Section No. A.7.6.3.6]
A.8.8.2.5
A major factor contributing to the introduction of moisture into the system piping is excessive air compressor operation caused by system leakage. Where excessive compressor operation is noted or ice accumulates in the air supply piping, the system should be checked for leakage and appropriate corrective action should be taken.

Submitter Information Verification
Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:23:25 EDT 2016

Committee Statement
Committee Statement: Section 7.8.2.5 talks about a valve. This annex section does not apply to a valve. It applies to the air lines, which are in section 7.8.2.7, so this should be an annex note to 7.8.2.7. Note that the asterisk after section 7.8.2.5 should be removed if you renumber this text.

Response Message:
Public Input No. 155-NFPA 13-2016 [Section No. A.7.8.2.5]
A.8.8.2.6
The purpose of the check valve is to prevent evaporation of priming water into the system piping.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:23:59 EDT 2016

Committee Statement

Committee Statement: There is no such term as "prime water"
Response Message:

Public Input No. 156-NFPA 13-2016 [Section No. A.7.8.2.6]
A.8.8.2.7.1

The dual lines feeding the system air entering the cold area are intended to facilitate continued service of the system when one line is removed for inspection. It should be noted that, when using a system as described in Figure A.8.8.2.4, differences in the pressures at gauge P1 and gauge P2 indicate blockage in the air supply line or other malfunctions.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 23 13:24:43 EDT 2016

Committee Statement

Committee Statement: This annex note specifically refers to the two air lines, which are required by section 7.8.2.7.1, not section 7.8.2.7.
Response Message: Public Input No. 157-NFPA 13-2016 [Section No. A.7.8.2.7]
A diffuser in ceiling sheathing labeled by the manufacturer as “horizontal discharge” has directional vanes to move air further along the ceiling, and sprinklers located within the 2 ft 6 in. (750 mm) radius should have an intermediate-temperature rating. See Figure A.9.4.2.5(a) and Figure A.9.4.2.5(b).

Figure A.9.4.2.5(a) Recessed Fireplace.

Figure A.9.4.2.5(b) Open Fireplace.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireplace2.pdf</td>
<td></td>
</tr>
</tbody>
</table>

Submitter Information Verification

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

The language provided in the table provides ambiguous information about spacing sprinklers with regard to fireplaces. These diagrams provide additional clarification. Alternatively, the Annex comment could be attached to 8.3.2.5(8).

Add figures A.8.3.2.5(a) & (b) to the annex to illustrate clear space around fireplaces.

Response Message:

Public Input No. 553-NFPA 13-2016 [New Section after A.8.3.2.5(1)]
Dry sprinklers must be of sufficient length to avoid freezing of the water-filled pipes due to conduction along the barrel. The values of exposed barrel length in Table 15.3.1(a) and Table 15.3.1(b) have been developed using an assumption of a properly sealed penetration and an assumed maximum wind velocity on the exposed sprinkler of 30 mph (48 km/h). Where higher wind velocity is expected, longer exposed barrel lengths will help avoid freezing of the wet piping. The total length of the barrel of the dry sprinkler must be longer than the values shown in Table 15.3.1(a) and Table 15.3.1(b) because the length shown in the tables is the minimum length of the barrel that needs to be exposed to the warmer ambient temperature in the heated space. See Figure A.15.3.1(a) for an example of where to measure the exposed barrel length for a sidewall sprinkler penetrating an exterior wall and Figure A.15.3.1(b) for an example of where to measure the exposed barrel length for a pendent sprinkler penetrating a ceiling or top of a freezer.

Figure A.15.3.1(a) Dry Sidewall Sprinkler Through Wall.

![Dry Sidewall Sprinkler Through Wall](image1)

Figure A.15.3.1(b) Dry Pendent Sprinkler Through Ceiling or Top of Freezer.

![Dry Pendent Sprinkler Through Ceiling](image2)

Figure A.15.3.1(c) Dry Sidewall Sprinkler Through Wall

![Dry Sidewall Sprinkler Through Wall](image3)

Figure A.15.3.1(d) Dry Pendent Sprinkler Through Ceiling

![Dry Pendent Sprinkler Through Ceiling](image4)
Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 12:05:00 EDT 2016

Committee Statement

Committee Statement: These figures illustrate how to measure along the length of dry sidewall sprinkler. More accurately reflect the measurement.
Response Message:

Public Input No. 281-NFPA 13-2016 [New Section after A.8.4.9.1]
Public Input No. 282-NFPA 13-2016 [New Section after A.8.4.9.1]
First Revision No. 735-NFPA 13-2016 [Section No. A.8.6.3.2.3]

A.10.2.5.2.2
See Figure A.10.2.5.2.2.

Figure A.10.2.5.2.2 Maximum Distance from Walls.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Fri Aug 12 13:43:50 EDT 2016

Committee Statement

Committee Statement: The actual text in 8.6.3.2.3 is applicable to all occupancy classifications. This was confirmed with the staff liaison. However, we have had a few AHJs state that since the annex only indicates a light hazard occupancy example, this allowance only applies to a light hazard occupancy.

Response Message:

Public Input No. 415-NFPA 13-2016 [Section No. A.8.6.3.2.3]
First Revision No. 908-NFPA 13-2016 [Section No. A.8.9.5.3]

A.11.3.6.3

See A.8.5.5.3. When obstructions are located more than 18 in. (450 mm) below the sprinkler deflector, an adequate spray pattern develops and obstructions up to and including 4 ft (1.2 m) wide do not require additional protection underneath. Examples are ducts, decks, open grate flooring, catwalks, cutting tables, overhead doors, soffits, ceiling panels, and other similar obstructions.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Fri Sep 09 12:00:29 EDT 2016

Committee Statement

Committee Statement: During the cycle leading up to the 2013 edition of the standard, Proposal 13-188 and Proposal 13-203 were accepted to revise Section 8.5.3.1 and Section 8.6.5.3.3 to delete the list of examples from the body of the standard and provide them in the annex instead, to conform with the Manual of style. However, the similar text in other sections such as 8.7.5.3.2, 8.8.5.3.2, 8.9.5.3.2 and 8.10.7.3.2 were not similarly revised. To accord with the other obstruction requirements within NFPA 13, those omissions should be rectified now.

Response Message:

Public Input No. 502-NFPA 13-2016 [New Section after A.8.9.5.3]
A.9.2.1.1

Minor quantities of combustible materials such as, but not limited to, cabling, nonmetallic plumbing piping, nonstructural wood, and so forth can be present in concealed spaces constructed of limited or noncombustible materials but should not typically be viewed as requiring sprinklers (see 9.3.18.1). For example, it is not the intent of this section to require sprinklers, which would not otherwise be required, in the interstitial space of a typical office building solely due to the presence of the usual amount of cabling within the space. The use of acoustical tile ceilings does not negate that the space above the tile is a concealed space because a tile could be removed. The threshold value at which sprinklers become necessary in the concealed space is not defined.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:

Committee Statement

Committee Statement: Some AHJ's have considered the space above an acoustical ceiling to be accessible and therefore have required sprinkler protection in that space. As long as the space is not intended for storage or occupancy, it should not require sprinkler protection.

Most acoustic tile ceilings meet ASTM A635 rating for construction materials

Response Message:

Public Input No. 19-NFPA 13-2016 [Section No. A.8.15.1.2.1]
A.9.2.1.6

The 3 ½ in. (90 mm) of insulation is only required when the ceiling is not directly attached to the joist. The 160 ft³ (4.5 m³) is the volume of the individual channel excluding the portion occupied by insulation. (See Figure A.9.2.1.6.)

Figure A.9.2.1.6 Combustible Concealed Space Cross Section.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 12 13:51:52 EDT 2016

Committee Statement

Committee Statement: Clarification on these nuances are needed.
Response Message:

Public Input No. 486-NFPA 13-2016 [Section No. A.8.15.1.2.6]
The sprinklers in the pit are intended to protect against fires caused by debris, which can accumulate over time. Ideally, the sprinklers should be located near the side of the pit below the elevator doors, where most debris accumulates. However, care should be taken that the sprinkler location does not interfere with the elevator toe guard, which extends below the face of the door opening.

Committee Statement:

Committee Statement: See rational for PI # 210

The is a conflict in this annex and its associated code section

Resolve based upon action taken on PI 211

Response Message:

Public Input No. 213-NFPA 13-2016 [Section No. A.8.15.5.1]
A.8.15.7

Small loading docks, covered platforms, ducts, or similar small unheated areas can be protected by dry pendent sprinklers extending through the wall from wet sprinkler piping in an adjacent heated area. Where protecting covered platforms, loading docks, and similar areas, a dry pendent sprinkler should extend down at a 45 degree angle. The width of the area to be protected should not exceed 7.12 ft (2.3 m). Sprinklers should be spaced not over 12 ft (3.7 m) apart. Exterior projections include, but are not limited to, exterior roofs, canopies, porte-cocheres, balconies, decks, or similar projections. (See Figure A.8.15.7.)

Figure A.8.15.7 Dry Pendent Sprinklers for Protection of Covered Platforms, Loading Docks, and Similar Areas.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI_456.docx</td>
<td>For staff use</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:  
City:  
State:  
Zip:  
Submittal Date: Fri Aug 12 13:56:32 EDT 2016

Committee Statement

Committee Statement: This language needs to be deleted. This is in the annex and there are dimensions and code language that belongs in the body. In addition, installing a dry pendent in a 45 degree angle is not in accordance with its listing.

This type of installation is no longer considered viable as it uses the sprinkler outside it's listing.

Response Message:
A.9.2.3.1

Vehicles that are temporarily parked are not considered storage. Areas located at drive-in bank windows or porte-cocheres at hotels and motels normally do not require sprinklers where there is no occupancy above, where the area is entirely constructed of noncombustible or limited-combustible materials or fire retardant–treated lumber, and where the area is not the only means of egress. However, areas under exterior ceilings where the building is sprinklered should be protected due to the occupancy above.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc

Committee Statement

Committee Statement: Move this language to the body of the standard.

The annex should not suggest that sprinklers are under projection where there is a floor above. This is an issue dealt with by the building code. The other concepts addressed in PI 470 have merit but the need work.

Response Message:

Public Input No. 470-NFPA 13-2016 [Section No. A.8.15.7.2]
A.12.7.2
When a light hazard occupancy, such as a school, contains separate ordinary hazard storage rooms no
more than 400 ft$^2$ (37 m$^2$), the hose stream demand would be that required for a light hazard
occupancy.

Supplemental Information

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR_779.docx</td>
<td>For staff use</td>
</tr>
</tbody>
</table>

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 16 13:14:06 EDT 2016

Committee Statement

Committee Statement: Examples were not related to storage.
Response Message:
A.16.3.1.3.1.2
In single-row racks with more than 10 ft (3.0 m) between the top of storage and the ceiling, a horizontal barrier should be installed above storage with one line of sprinklers under the barrier.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address: 
City: 
State: 
Zip: 
Submittal Date: Tue Aug 16 16:17:33 EDT 2016

Committee Statement

Committee Statement: does not correlate with section 12.1.3.4
Delete the entire section.
This section no longer correlates to section 12.1.3.4

Response Message:

Public Input No. 462-NFPA 13-2016 [Section No. A.16.3.1.3.1.2]
A.16.3.1.3.1.3

In multiple-row racks with more than 10 ft (3.0 m) between the maximum height of storage and ceiling, a horizontal barrier should be installed above storage with a level of sprinklers, spaced as stipulated for in-rack sprinklers, installed directly beneath the barrier. In-rack sprinklers should be installed as indicated in Figure 16.3.1.3.1.3(A)(a) through Figure 16.3.1.3.1.3(A)(c).

Data indicate that the sprinkler protection criteria in 16.3.1.3.1.3 are ineffective, by themselves, for rack storage with solid shelves if the required flue spaces are not maintained. Use of Table 16.3.1.2, along with the additional provisions that are required by this standard, can provide acceptable protection.

Submitter Information Verification

Submitter Full Name: AUT-SSI
Organization: National Fire Protection Assoc
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 16 16:19:21 EDT 2016

Committee Statement

Committee Statement: does not correlated to section 12.1.3.4
Delete the entire section
This section does not correlate to section 12.1.3.4

Response Message:

Public Input No. 465-NFPA 13-2016 [Section No. A.16.3.1.3.1.3]
A.29.1.3(4)

The backbone of the fire protection philosophy for U.S. flagged vessels and passenger vessels that trade internationally is limiting a fire to the compartment of origin by passive means. Materials that do not withstand a 1-hour fire exposure when tested in accordance with ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or ANSI/UL 263, *Fire Tests of Building Construction Materials*, are considered “heat sensitive.” [See Figure A.29.1.3(4).]

**Figure A.29.1.3(4) International Shore Fire Connection.**

---

**Submitter Information Verification**

**Submitter Full Name:** AUT-SSI  
**Organization:** National Fire Protection Assoc  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Aug 24 10:43:59 EDT 2016

**Committee Statement**

**Committee Statement:** Reason Statement: ASTM E 119 is a listed test referenced in Chapter 2. ANSI/UL 263 is a comparable test available for establishing fire resistance in building and construction materials and should also be listed as an acceptable test.

**Response Message:**
Annex F  Informational References

F.1  Referenced Publications.

The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.
F.1.1 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.


NFPA Fire Protection Handbook

F.1.2 Other Publications.

NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.


NFPA Fire Protection Handbook

F.1.2 Other Publications.
F.1.2.1 ACI Publications.
American Concrete Institute, P.O. Box 9094, 38800 Country Club Drive, Farmington Hills, MI 48333-3439.


F.1.2.2 ACPA Publications.
American Concrete Pipe Association, 222 W. Las Colinas Boulevard, Suite 641, Irving, TX 75039, 8445 Freeport Pkwy, Suite 350, Irving, TX 75063.

Concrete Pipe Handbook.

F.1.2.3 AISC Publications.
American Institute of Steel Construction, One East Wacker Drive, Suite 700, Chicago, IL 60601-1802.


F.1.2.4 ASCE Publications.
American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.


F.1.2.5 ASME Publications.

F.1.2.6  ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.


ASTM B31, Standards of Pressure Piping, collection with various dates.


F.1.2.7 AWWA Publications.
American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.
AWWA C300, Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, 2004 2011.
AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, 2007 2014.
AWWA C302, Reinforced Concrete Pressure Pipe, Non-Cylinder Type, 2004 2011.
AWWA C303, Reinforced Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type, Pretensioned, 2002 2008.
AWWA M9, Concrete Pressure Pipe, 2008, Errata, 2013.
F.1.2.8 DIPRA Publications.
Ductile Iron Pipe Research Association, 245 Riverchase Parkway, East, Suite 0, Birmingham, AL 35244, P.O. Box 19206, Golden, CO 80402.
F.1.2.9 EPRI Publications.

EPRI, 3412 Hillview Avenue, Palo Alto, CA 94304.

F.1.2.10 FM Publications.

FM Global, 4301 Atwood 270 Central Avenue, P.O. Box 7500, Johnston, RI 02919-4923.
FM Approval 1031, Quick Opening Devices (Accelerators and Exhausters) for Dry Pipe Valves, 1977.
FM Approval 1042, Waterflow Alarm Indicators (Vane Type), 1970.
FM Approval 1045, Waterflow Detector Check Valves, 2005.
FM Approval 1112, Indicating Valves (Butterfly or Ball Type), 2006.
FM Approval 1120-1130, Fire Service Water Control Valves (OS & Y and NRS Type Gate Valves), 1997.
FM Approval 1631, Adjustable and Fixed Sprinkler Fittings ½ inch through 1 inch Nominal Size, 2006.
FM Approval 1637, Flexible Sprinkler Hose with Fittings, 2010.

F.1.2.11 FMRC Publications.

FM Global Research, FM Global, 1301 Atwood 270 Central Avenue, P.O. Box 7500, Johnston, RI 02919-4923.

FMRC J. I. 0X1R0.RR, “Large-Scale Fire Tests of Rack Storage Group A Plastics in Retail Operation Scenarios Protected by Extra Large Orifice (ELO) Sprinklers.”
F.1.2.12 FPRF Publications.
Fire Protection Research Foundation, 1 Batterymarch Park, Quincy, MA 02169.

F.1.2.13 IMO Publications.
International Maritime Organization, 4 Albert Embankment, London, SE1 7SR, United Kingdom.

F.1.2.14 ISO Publications.
International Organization for Standardization, 4 ch. de la Voie-Creuse, Case postale 56, CH-1214 Geneva 20, Switzerland. ISO Central Secretariat, BIBC II, Chemin de Blandonnet, 8, CP 401, 1214 Vernier, Geneva Switzerland.

F.1.2.15 NFSA Publications.
National Fire Sprinkler Association, P.O. Box 1000 40 Jon Barrett Road, Patterson, NY 12563.

F.1.2.16 SAE Publications.
SAE International, 400 Commonwealth Dr., Warrendale, PA 15096.
SAE AIR 4127, Steel: Chemical Composition and Hardenability (Stabilized Type), Revision A, Stabilized, December 2015.

F.1.2.17 SNAME Publications.
Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Suite 400, Jersey City, NJ 07306.
99 Canal Center Plaza, Suite 310, Alexandria, VA 22314.
F.1.2.18 UL Publications.
Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.


F.1.2.19 Uni-Bell PVC Pipe Publications.

Uni-Bell PVC Pipe Association, 2655 Villa Creek Drive, Suite 155, Lyndon B Johnson Fwy., Suite 1000, Dallas, TX 75234.


F.1.2.20 U.S. Government Publications.


Title 46, Code of Federal Regulations, Part 72.05-5.

U.S. Federal Standard No. 66C, Standard for Steel Chemical Composition and Harden Ability, April 18, 1967, change notice No. 2, April 16, 1970. (Superseded by SAE AIR4127)

F.1.2.21 Other Publications.

High Volume/Low Speed Fan and Sprinkler Operation — Ph. 2 Final Report, Fire Research Foundation, 2011.


F.2 Informational References. (Reserved)
**F.3 References for Extracts in Informational Sections.**


---

**Submitter Information Verification**

**Submitter Full Name:** AUT-SSI  
**Organization:** National Fire Protection Assoc  
**Street Address:**  
**City:**  
**State:**  
**Zip:**  
**Submittal Date:** Wed Aug 24 11:47:40 EDT 2016

---

**Committee Statement**

**Committee Statement:** Referenced current SDO names, addresses, standard names, numbers, and editions.  
**Response Message:**
Public Input No. 2-NFPA 13-2015 [Chapter F]
Public Input No. 16-NFPA 13-2016 [Section No. F.1.2.6]
Public Input No. 11-NFPA 13-2016 [Section No. F.1.2.6]
Public Input No. 548-NFPA 13-2016 [Section No. F.1.2.17]