**Chapter 14 Installation Requirements for Early Suppression Fast-Response Sprinklers**

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 9.5.

14.2 Early Suppression Fast-Response Sprinklers

14.2.1 General

All requirements of Section 9.5 shall apply except as modified in Section 14.2.

14.2.2

ESFR sprinklers shall be used only in wet pipe systems unless specifically listed for use in dry systems or preaction systems.

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).

14.2.4\*

ESFR sprinklers shall be permitted for use in buildings with unobstructed or obstructed construction.

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.

14.2.4.2

Minimum sprinkler spacing and area of coverage shall comply with the requirements of 14.2.8 and 14.2.9.

14.2.5 Draft Curtains

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.

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.

14.2.6 Temperature Ratings

Sprinkler temperature ratings for ESFR sprinklers shall be ordinary unless 9.4.2 requires intermediate- or high-temperature ratings.

14.2.7 Occupancy and Hazard

ESFR sprinklers designed to meet any criteria in Chapter 23 or 24 shall be permitted to protect light and ordinary hazard occupancies.

14.2.8 Protection Areas Per Sprinkler (Early Suppression Fast-Response Sprinklers)

14.2.8.1 Determination of Protection Area of Coverage

The protection area of coverage per sprinkler (As) shall be determined in accordance with 9.5.2.1.

14.2.8.2 Maximum Protection Area of Coverage

14.2.8.2.1

The maximum allowable protection area of coverage for a sprinkler (As) shall be in accordance with the value indicated in Table 14.2.8.2.1.

Table 14.2.8.2.1 Protection Areas and Maximum Spacing of ESFR Sprinklers

Construction Type Ceiling/Roof Heights Up to 30 ft (9.1 m) Ceiling/Roof Heights Over 30 ft (9.1 m)

Protection Area Spacing Protection Area Spacing

ft2 m2 ft m ft2 m2 ft m

Noncombustible unobstructed 100 9 12 3.7 100 9 10 3.0

Noncombustible obstructed 100 9 12 3.7 100 9 10 3.0

Combustible unobstructed 100 9 12 3.7 100 9 10 3.0

Combustible obstructed N/A N/A N/A N/A

14.2.8.2.2

Unless the requirements of 14.2.8.2.3 are met, the maximum area of coverage of any sprinkler shall not exceed 100 ft2 (9.3 m2).

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 m2) per sprinkler where all of the following conditions are met:

The average actual floor area protected by the moved sprinkler and the adjacent sprinklers shall not exceed 100 ft2 (9 m2).

Adjacent branch lines shall maintain the same pattern.

In no case shall the distance between sprinklers exceed 12 ft (3.7 m).

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 m2) per sprinkler where all of the following conditions are met:

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 m2) per sprinkler.

In no case shall the distance between sprinklers exceed 12 ft (3.7 m).

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.

14.2.8.3

Minimum Protection Area of Coverage. The minimum allowable protection area of coverage for a sprinkler (As) shall not be less than 64 ft2 (5.9 m2).

14.2.9 Sprinkler Spacing (Early Suppression Fast-Response Sprinklers)

14.2.9.1 Maximum Distance Between Sprinklers

The maximum distance between sprinklers shall be in accordance with the following:

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 14.2.8.2.1.

Unless the requirements of 14.2.9.1(3) or 14.2.9.1(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.

\* 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 m2) where all of the following conditions are met:

The average actual floor area protected by the moved sprinkler and the adjacent sprinklers shall not exceed 100 ft2 (9 m2).

Adjacent branch lines shall maintain the same pattern.

In no case shall the distance between sprinklers exceed 12 ft (3.7 m).

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 m2) per sprinkler where all of the following conditions are met:

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 m2) per sprinkler.

In no case shall the distance between sprinklers exceed 12 ft (3.7 m).

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.

14.2.9.2 Maximum Distance From Walls

The distance from sprinklers to walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 14.2.8.2.1.

14.2.9.3 Minimum Distance From Walls

Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall.

14.2.9.4 Minimum Distance Between Sprinklers

Sprinklers shall be spaced not less than 8 ft (2.4 m) on center.

14.2.10 Deflector Position (Early Suppression Fast-Response Sprinklers)

14.2.10.1 Distance Below Ceilings

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.

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.

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.

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.

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.

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.

14.2.10.2 Deflector Orientation

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

14.2.11\* Obstructions to Sprinkler Discharge (Early Suppression Fast-Response Sprinklers)

14.2.11.1 Obstructions at or Near Ceiling

14.2.11.1.1

Sprinklers shall be arranged to comply with Table 14.2.11.1.1 and Figure 14.2.11.1.1 for obstructions at the ceiling, such as beams, ducts, lights, and top chords of trusses and bar joists.

Table 14.2.11.1.1 Positioning of Sprinklers to Avoid Obstructions to Discharge (ESFR Sprinklers)

Distance from Sprinkler to Side of Obstruction (A) Maximum Allowable Distance of Deflector Above Bottom of Obstruction (B)

[in. (mm)]

Less than 1 ft (300 mm) 0 (0)

1 ft (300 mm) to less than 1 ft 6 in. (450 mm) 11/2 (40)

1 ft 6 in. (450 mm) to less than 2 ft (600 mm) 3 (75)

2 ft (600 mm) to less than 2 ft 6 in. (750 mm) 51/2 (140)

2 ft 6 in. (750 mm) to less than 3 ft (900 mm) 8 (200)

3 ft (900 mm) to less than 3 ft 6 in. (1.1 m) 10 (250)

3 ft 6 in. (1.1 m) to less than 4 ft (1.2 m) 12 (300)

4 ft (1.2 m) to less than 4 ft 6 in. (1.4 m) 15 (375)

4 ft 6 in. (1.4 m) to less than 5 ft (1.5 m) 18 (450)

5 ft (1.5 m) to less than 5 ft 6 in. (1.7 m) 22 (550)

5 ft 6 in. (1.7 m) to less than 6 ft (1.8 m) 26 (650)

6 ft (1.8 m) 31 (775)

Note: For A and B, refer to Figure 14.2.11.1.1.

FIGURE 14.2.11.1.1 Positioning of Sprinkler to Avoid Obstruction to Discharge (ESFR Sprinklers).

14.2.11.1.2

The requirements of 14.2.11.1.1 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.

14.2.11.1.3

Sprinklers with a special obstruction allowance shall be installed according to their listing.

14.2.11.2\* Isolated Obstructions Below Elevation of Sprinklers

Sprinklers shall be arranged with respect to obstructions in accordance with one of the following:

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.

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.

Additional sprinklers shall not be required where sprinklers are positioned with respect to the bottom of obstructions in accordance with 14.2.11.1.

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.

Sprinklers with a special obstruction allowance shall be installed according to their listing.

14.2.11.3 Continuous Obstructions Below Sprinklers

14.2.11.3.1 General Continuous Obstructions

Sprinklers shall be arranged with respect to obstructions in accordance with one of the following:

Sprinklers shall be installed below continuous obstructions, or they shall be arranged to comply with Table 14.2.11.1.1 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.

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.

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.

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.

Ceiling sprinklers shall not be required to comply with Table 14.2.11.1.1 where a row of sprinklers is installed under the obstruction.

14.2.11.3.2 Bottom Chords of Bar Joists or Open Trusses

ESFR sprinklers shall be positioned a minimum of 1 ft (300 mm) horizontally from the nearest edge to the bottom chord of a bar joist or open truss where the bottom chord does not exceed 1 ft (300 mm) in width.

14.2.11.3.2.1

The requirements of 14.2.11.3.2 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.

14.2.11.3.3\*

For pipes, conduits, or groups of pipes and conduit to be considered individual, they shall 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.

14.2.11.3.4 Open Gratings

Sprinklers installed under open gratings shall be of the intermediate level/rack storage type or otherwise shielded from the discharge of overhead sprinklers.

14.2.11.3.5 Overhead Doors

Quick-response spray sprinklers shall be permitted to be utilized under overhead doors.

Sprinklers with a special obstruction allowance shall be installed according to their listing.

14.2.12 Clearance to Storage (Early Suppression Fast-Response Sprinklers)

The clearance between the deflector and the top of storage shall be 36 in. (900 mm) or greater.