Table 54.7
Lateral Discharge Test Parameters

Sprinkler Type	Distance Between Sprinkler, ft. (m)	Distance from Top of Pan to Sprinkler Heat Responsive Element, inches (mm)	Distance from Ceiling,[1] inches (mm)
Standard and Extended Coverage, Pendent and Upright ESFR	6 (1.83)	6 (152)	6, 14 and 22 (152, 356 and 559)
Standard and Extended Coverage Spray Sidewall	6 (1.83)	6 (152)	4 and 12 (102 and 305)
Residential Pendent and Upright	8 (2.4) or minimum distance specified by installation instructions	12 (305)	4 (102)[2]
Residential Sidewall	8 (2.4) or minimum distance specified by installation instructions	12 (305)	4 and 12 (102 and 300)
Specific application – horizontal concealed spaces	8 (2.4) or minimum distance specified by installation instructions	6 (152)	4 (102)
Note 1 – See 54.12.2.1 for ceiling sprinklers. Note 2 – Recessed sprinklers can be tested in the recessed condition in lieu of 4 in (102 mm) below ceiling.			

FIRE TESTS

55 Fire Test Requirements

55.1 General

55.1.1 An automatic sprinkler shall comply with the requirements as referenced in Table 55.1 based upon the sprinkler type.

Table 55.1
Fire Test by Sprinkler Type

Sprinkler Type	Requirements
All pendent and upright standard coverage sprinklers, including flush, recessed and concealed that have a nominal K-factor not exceeding 8.0 gpm/(psi)$^{1/2}$ [115 L/min/(bar)$^{1/2}$]. All sidewall standard coverage sprinklers, including flush, recessed and concealed that have a nominal K-factor of 5.6 gpm/(psi)$^{1/2}$ [80 L/min/(bar)$^{1/2}$] or 8.0 gpm/(psi)$^{1/2}$ [115 L/min/(bar)$^{1/2}$] intended for use in ordinary hazard occupancies. All ECOH sprinklers, including flush, recessed and concealed types.	55.2 350 lb. (159 kg) Wood Crib Fire Test
All ECLH sprinklers, including flush, recessed and concealed types	55.3 ECLH Sprinkler Fire Tests
All ECOH sprinklers, including flush, recessed and concealed types	55.4 ECOH Sprinkler Piled Stock Fire Tests
Residential pendent, upright and sidewall including flush, recessed and concealed	55.5 Residential Sprinkler Fire Tests
Flow control type sprinklers	55.6 Flow Control (FC) Sprinkler Piled Stock Fire Test

Table 55.1 Continued on Next Page

Table 55.1 Continued

Sprinkler Type	Requirements
CMDA storage sprinklers	55.7 CMDA Storage Sprinkler Large Scale Fire Tests
CMSA storage sprinklers	55.8 CMSA Storage Sprinkler Large Scale Fire Tests
All pendent ESFR sprinklers	55.9 ESFR Sprinkler Large Scale Fire Tests
Pendent ESFR sprinklers having nominal K-factor of 14.0 gpm/(psi)$^{1/2}$ [200 L/min/(bar)$^{1/2}$] or 16.8 gpm/(psi)$^{1/2}$ [240 L/min/(bar)$^{1/2}$]	55.10 Actual Delivered Density (ADD) Tests for Pendent ESFR Sprinklers Having a Nominal K-factor of 14.0 or 16.8
Specific application – windows	55.11 Fire Tests for Specific Application Sprinklers Intended to Protect Windows
Specific application – horizontal concealed spaces	55.12 Fire Tests for Specific Application Sprinklers Intended for Use in Horizontal Concealed Spaces

55.2 350 Pound (159 kg) Wood Crib Fire Test

55.2.1 General

55.2.1.1 When tested as described in 55.2.2 – 55.2.4 while discharging water at the flow rates as shown in Table 55.2; and for sprinklers having a rated pressure exceeding 175 psig (1.2 MPa), at a flow rate corresponding to a pressure of 75 psig (517 kPa) less than the rated pressure; four open sprinklers shall:

a) Limit the loss in weight of the wood crib to not more than 20 percent; and

b) Result in the ceiling temperature reduced to a value less than 530°F (295°C) above ambient within 5 minutes after start of water discharge. Additionally, from the time the temperature initially falls below 530°F (295°C) above ambient to the end of the test, the ceiling temperature shall not exceed this value for more than three consecutive minutes and the average temperature for this period shall not exceed 530°F (295°C) above ambient.

55.2.1.2 Sidewall, 1.4, 1.9, 2.8, and 4.2 nominal “K” factor, and extended coverage type sprinklers, intended for use in light hazard occupancies only, are not to be subjected to the 350 Pound (159 kg) Wood Crib Fire Test, 55.2.

Table 55.2
Flows for 350 pound (159 kg) wood crib fire test

Sprinkler description	Spacing		Test flow per sprinkler	
	Feet	(m)	GPM	(l/min)
Spray type, Nominal K = 5.6 (80)	10 x 10	(3.05 x 3.05)	15 and 25	(56.7 and 94.5)
Spray type, Nominal K = 8.0 (115)	10 x 10	(3.05 x 3.05)	21 and 35	(79.4 and 132.3)
Sidewall, Nominal K = 5.6 (80)	10 x 20	(3.05 x 6.1)	15 and 25	(56.7 and 94.5)
Sidewall, Nominal K = 8.0 (115)	10 x 20	(3.05 x 6.1)	21 and 35	(79.4 and 132.3)
Extended coverage sprinklers for ordinary hazard occupancies, upright and pendent	12 x 12	(3.7 x 3.7)	22 and 29	(83.2 and 109.6)
	14 x 14	(4.3 x 4.3)	30 and 39	(113.4 and 147.4)
	16 x 16	(4.9 x 4.9)	39 and 51	(147.4 and 192.8)
	18 x 18	(5.5 by 5.5)	49 and 65	(185.2 and 245.7)
	20 x 20	(6.1 by 6.1)	60 and 80	(226.8 and 302.4)

55.2.2 Test Method – spray upright, spray pendent, ceiling, dry, or recessed or extended coverage for ordinary hazard occupancies types

55.2.2.1 Four open standard coverage sprinklers of the upright, pendent, ceiling, or dry type are to be installed on 10 by 10 foot (3.05 by 3.05 m) spacings. Extended Coverage Sprinklers for Ordinary Hazard Occupancies are to be installed at their rated spacings. Sprinkler frame arms are to be parallel to the piping and the wood crib centered between the four sprinklers. For extended coverage sprinklers, an additional fire test is to be conducted at the maximum rated spacing, using the highest flow indicated in Table 55.2 for the applicable spacing, with the crib positioned in a location yielding the least amount of water collected during the Distribution Tests for Extended Coverage Sprinklers Intended for Ordinary Hazard Occupancies, 54.7. The test room is to be a minimum of 60 by 60 feet (18.3 by 18.3 m) square. The piping grid is to be connected to a water-supply piping system. See Figure 55.2.

55.2.2.2 Dry-type sprinklers are to be tested using the shortest available length produced by the manufacturer and installed into tees rather than elbows in the piping system.

55.2.2.3 The deflectors of upright sprinklers are to be located 7 inches (178 mm) below the ceiling. The deflectors of pendent sprinklers are to be located 12 inches (305 mm) below the ceiling. Each ceiling sprinkler (flush, concealed, or recessed type) is to be mounted in the center of a 4 by 4 foot (1.2 by 1.2 m) ceiling section in accordance with the manufacturer's installation instructions.

55.2.3 Test method – sidewall types for ordinary hazard use

55.2.3.1 Four open sidewall sprinklers are to be installed at the corners of a 10 by 20 foot (3.05 by 6.1 m) piping grid with the deflectors located 7 inches (178 mm) for upright sprinklers, 9-1/2 inches (241 mm) for horizontal sprinklers, and 12 inches (305 mm) for pendent sprinklers from the ceiling. Sprinklers located at the extremities of each 20 foot (6.1 m) dimensional line are to face each other and are to be set to discharge in an opposing pattern with the line forming the axis of the spray.

55.2.4 Test method – all types

55.2.4.1 The test is to be conducted in a vented test room having a 15 feet, 9 inches (4.8 m) high smooth, flat, horizontal ceiling. The piping grid is to be connected to the water supply.

55.2.4.2 The fire employed for these tests is to combine the use of a combustible liquid (heptane, see 5.20) torch and a crib of wood weighing approximately 350 pounds (159 kg).

55.2.4.3 The wood crib is to consist of layers of trade size 2- by 4-inch [nominal 1-1/2 by 3-1/2 inch (38.1 by 88.9 mm)], trade size 4- by 4-inch [nominal 3-1/2 by 3-1/2 inch (88.9 by 88.9 mm)] and trade size 4- by 6-inch [nominal 3-1/2 by 5-1/2 inch (88.9 by 138 mm)] kiln-dried spruce or fir lumber (moisture content 6 to 12 percent) having the configuration and support illustrated by Figure 55.1.

55.2.4.4 The alternate layers of lumber are to consist of the sizes specified in 55.2.4.3 of the lengths specified in Figure 55.1, and placed at right angles to the adjacent layers as illustrated in Figure 55.1. The individual wood members in each layer are to be evenly spaced from each other, and form a square crib, 4- by 4-feet (1.22- by 1.22-m) in area and 21-1/2 inches (546 mm) high, supported, in turn, by the two 8 foot (2.44 m) long, 4- by 6-inch (104- by 152-mm) stringers. The total crib weight is to be determined and recorded.

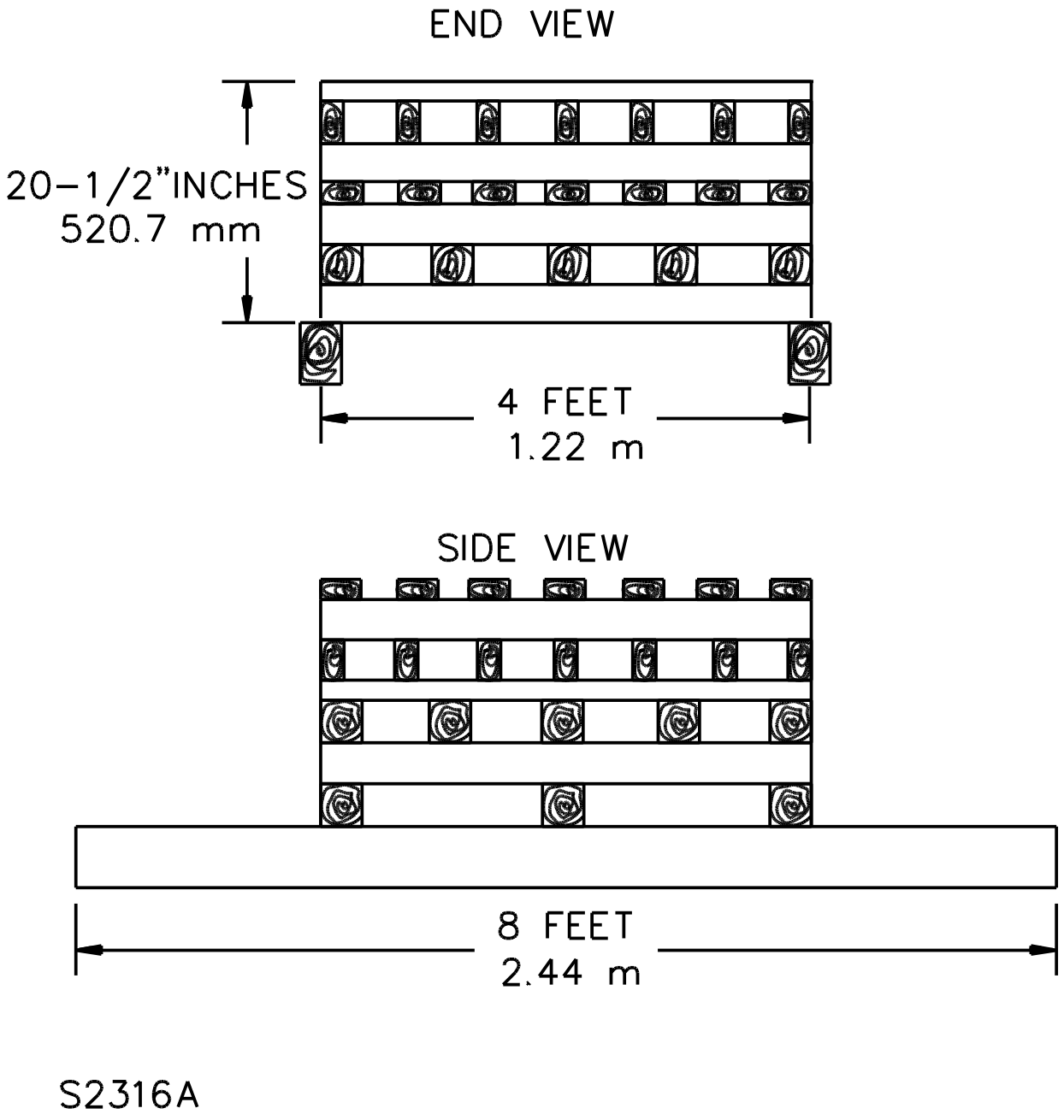
55.2.4.5 The crib is to be supported by a steel framework as illustrated in Figure 55.2, or the equivalent. The crib supports are to be located beyond the edges of a 6- by 8-foot (1.83- by 2.44-m) steel pan.

55.2.4.6 The top of the wood crib is to be 7-1/2 feet (2.29 m) below the deflectors of the test sprinklers.

55.2.4.7 The steel pan is to be 6 by 8 feet (1.83 by 2.44 m) by 12 inches (305 mm) deep, constructed of steel not less than 3/16 inch (5.4 mm) thick. The top edges are to be reinforced by a continuous steel angle section. The pan is to be liquid-tight and is to be filled prior to test with water to a depth of approximately 4 inches (102 mm). The pan is to be provided with a means for draining to maintain the 4 inch (102 mm) water level.

Figure 55.1

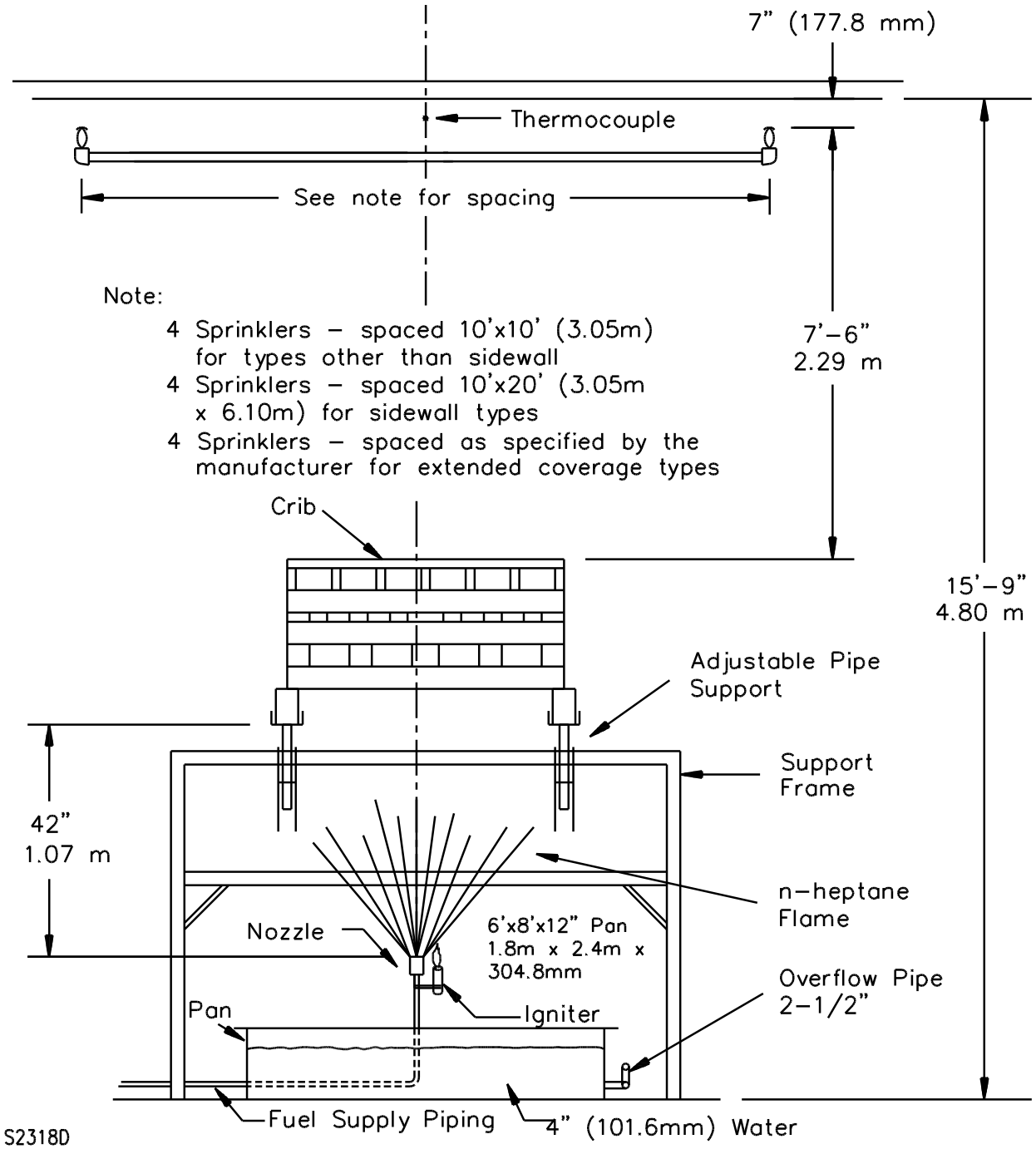
350 pound (159 kg) fire test crib



Quantity	Description of material
2	4- by 6-inch trade size lumber, 8 feet (2.44 m) long
13	4- by 4-inch trade size lumber, 4 feet (1.22 m) long
28	2- by 4-inch trade size lumber, 4 feet (1.22 m) long
Note: 1 inch = 25.4 mm 1 foot = 0.305 m	

Figure 55.2

Typical fire test arrangement



55.2.4.8 At a location in the pan and directly under the vertical axis of the wood crib, an atomizing nozzle is to be placed and arranged to spray heptane vertically upward. The nozzle and its supply piping are to be arranged as shown by Figure 55.2. To prevent flameout, an igniter is to be located near the nozzle. The igniter shall be any convenient device that prevents flameout, such as a container partially filled with heptane.

55.2.4.9 The atomizing nozzle[a] is to form a hollow-spray pattern having an included angle of 75 degrees when atomizing heptane at the rate of 0.9 gallons per minute (3.4 L/min).

[a] A nozzle having these characteristics is the Catalog Number WS-15 Industrial Nozzle as produced by the Delavan Manufacturing Co., West Des Moines, Iowa 50265.

55.2.4.10 A means for supplying and metering the fuel is to be furnished.

55.2.4.11 The temperatures at the ceiling level are to be continuously recorded during the test, utilizing an unprotected 20 AWG (0.52 mm^2) chromel-alumel thermocouple centrally located above the test crib 2 inches (50.8 mm) from the ceiling. The relation of the thermocouple to the ceiling and the crib is to be as illustrated in Figure 55.2.

55.2.4.12 The fuel flow is to be started and the torch ignited immediately. The 30-minute test period is to begin when the torch is ignited. Water application is to be started after a minimum free-burning time of 1 minute or after a ceiling temperature of 1400°F (760°C) is attained, whichever occurs last. Thirty minutes after ignition, the fuel flow to the torch is to be stopped, and after any residual fire in the crib is extinguished, the water is to be turned off.

55.2.4.13 The crib is then to be dried and weighed. The drying is to be accomplished either by using an oven or by storing the crib for 7 days after the test in a sheltered area. The values of the crib weight measured before the test (6 to 12 percent moisture content) and after drying are to be corrected to the value at 0 percent moisture before calculations are performed to determine compliance with the 20 percent weight loss requirement specified in 55.2.1.1.

55.2.4.14 The average temperature for the time interval between the time at which the ceiling temperature first falls below a temperature of 530°F (295°C) above initial ambient and the time at the end of the test is to be computed by comparing the area under the curve determined by the recorded ceiling temperatures with the area beneath a straight line drawn at the temperature point 530°F (295°C) above initial ambient. The area beneath the curve of the recorded ceiling temperatures shall be the lesser of the two areas.

55.3 ECLH Sprinkler Fire Tests

55.3.1 General

55.3.1.1 When tested as described in 55.3.2 – 55.3.4, an extended coverage sprinkler for light-hazard occupancies shall limit the average loss of weight of three wood cribs to not more than 35 percent.

55.3.1.2 The fire test is to be conducted in a room having the maximum dimensions intended for the sprinkler as specified by the manufacturer for each flow rating.

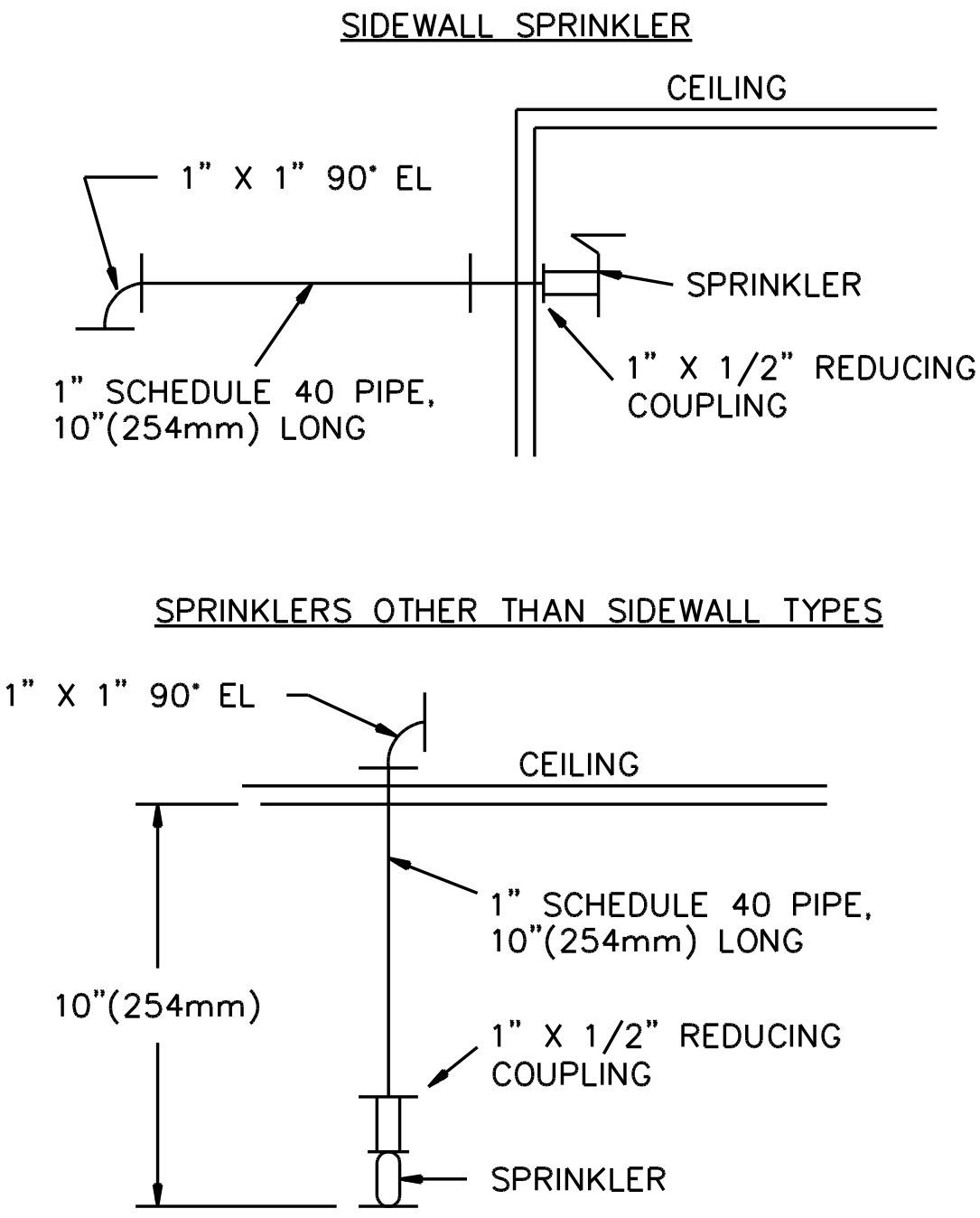
55.3.1.3 Recessed or concealed sprinklers with vented escutcheons are to be installed in a manner that does not inhibit air flow through the escutcheon (unblocked).

55.3.2 Test method – sidewall type

55.3.2.1 For a sidewall type sprinkler intended for installation at distances from a smooth (unobstructed) ceiling between 4 and 6 inches (102 and 152 mm), one sprinkler is to be installed on a wall with the deflector located 4 inches (102 mm) below a smooth (unobstructed), horizontal ceiling, as illustrated in Figure 55.3. For a sidewall type sprinkler intended for installation at distances below the ceiling exceeding 6 inches (152 mm), two series of tests are to be conducted, one with the sprinkler installed 4 inches (102 mm) below the ceiling and a second test series with the sprinkler installed at the maximum distance below the ceiling specified by the manufacturer. A sidewall type sprinkler intended for use with obstructed ceilings, such as those ceilings having beams, is to be similarly installed, except that the obstructions specified by the manufacturer are to be incorporated into the ceiling. The base of a horizontal type sprinkler is to be installed adjacent to the wall. The deflector of an upright or pendent type sidewall sprinkler is to be mounted at the minimum clearance from the wall specified by the manufacturer. A sidewall type sprinkler is to be installed using a 10-inch (254-mm) long, 1-inch (25.4-mm) diameter nipple with reducing coupling installed with axis perpendicular to the wall. See Figure 55.3.

Figure 55.3

Piping arrangements for ECLH sprinkler fire tests



55.3.3 Test method – ceiling, pendent, or upright types

55.3.3.1 A sprinkler of the ceiling, pendent, or upright type is to be installed in its intended installation position with the deflector 10 inches (254 mm) below the ceiling, unless specifically designed for other positions (such as ceiling sprinkler installations). See Figure 55.3.

55.3.4 Test method – all types

55.3.4.1 Water distribution measurements are to be conducted in an enclosed room with an open sprinkler discharging water at the minimum flow rate and maximum area of coverage specified by the manufacturer. The minimum flow rate is to be not less than a minimum water density of 0.1 gallon per minute per square foot (4.0 mm/min) for the specified coverage area. For sprinklers rated at a pressure exceeding 175 psig (1.2 MPa), tests are also to be conducted using a flow rate corresponding to a pressure of 75 psig (517 kPa) less than the rated pressure for the largest rated spacing. Water collection pans that are 12 inches (305 mm) square, and 12 inches (305 mm) deep with a lip on one edge, are to be located on the floor of the enclosed room in the areas of the 11 crib locations as shown in Figure 55.4. The distribution data are to be recorded and used in determining the specific positions of the wood cribs as required for the second and third fire tests specified in 55.3.4.2.

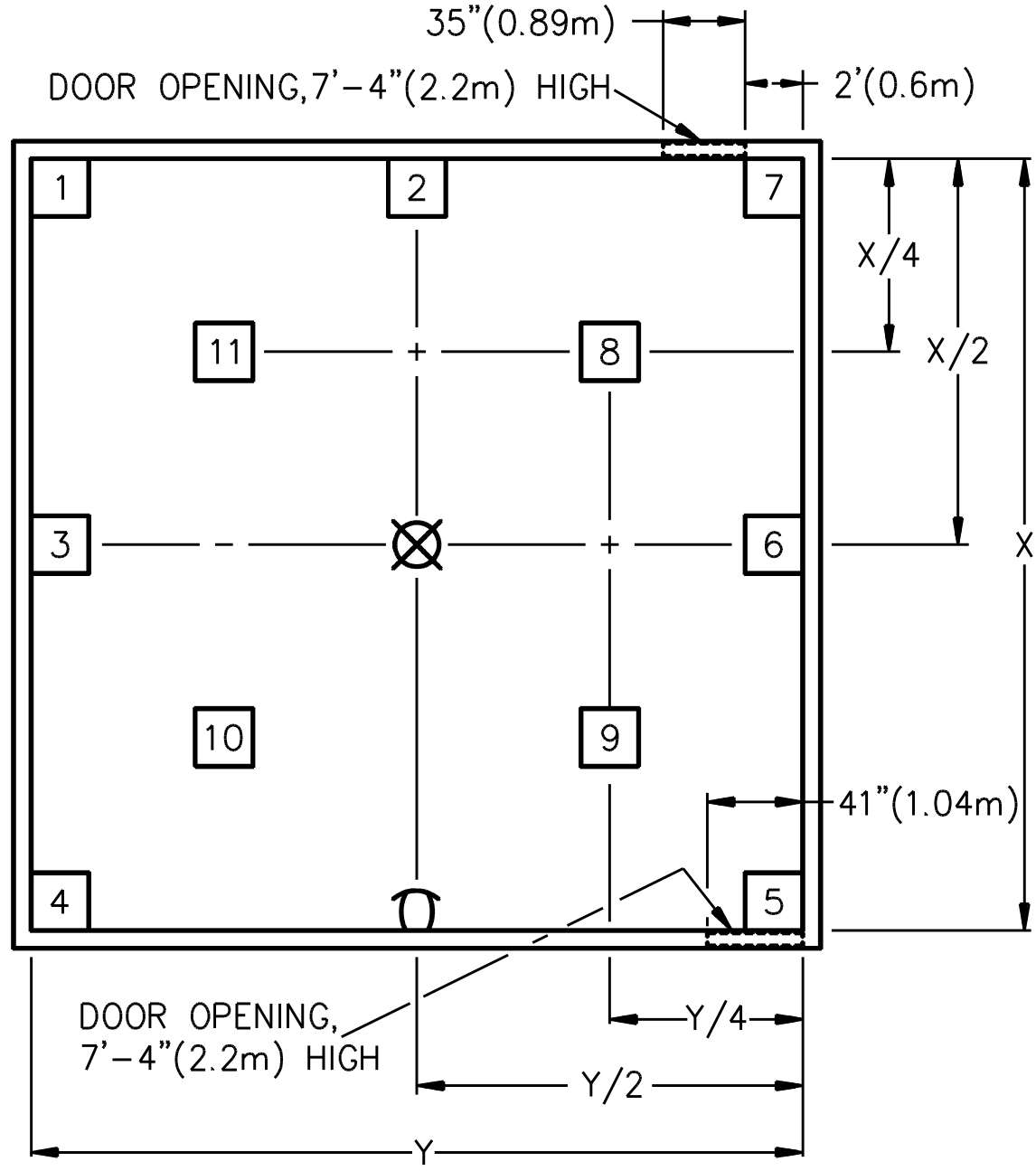
55.3.4.2 A series of three fire tests are to be conducted at each flow rate using automatic sprinklers in the maximum temperature rating. For the first fire test, a wood crib as specified in 55.3.4.4 – 55.3.4.6 is to be located at Crib Location 1 of the test enclosure, see Figure 55.4. For the second fire test, the wood crib is to be located at Crib Location 2, 3, 4, 5, 6, or 7, see Figure 55.4, whichever location had the least amount of water collected during the distribution determinations. However, when Crib Location 5, 6, or 7 had the least amount of water collected then:

a) A sprinkler other than a sidewall type is to be rotated 180 degrees and the crib placed in Crib Location 1, 3, or 4, whichever is opposite the crib location that had the least amount of water collected; and

b) A sidewall type sprinkler is to be installed on the wall near Crib Location 2.

Figure 55.4

Location of fire test cribs for ECLH sprinklers



⊗ – SPRINKLER OTHER THAN SIDEWALL TYPE (WHEN OTHER THAN SIDEWALL TYPE IS BEING TESTED)

∩ – SIDEWALL TYPE SPRINKLER (WHEN SIDEWALL TYPE IS BEING TESTED)

□ – POSSIBLE CRIB LOCATION (SEE TEXT FOR SPECIFIC LOCATION DETERMINATIONS)

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