

UL 199

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Automatic Sprinklers for Fire-Protection Service

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
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UL Standard for Safety for Automatic Sprinklers for Fire-Protection Service, UL 199

Tenth Edition, Dated April 8, 1997

Revisions: This Standard contains revisions through and including April 7, 2004.

Summary of Topics

These revisions to ANSI/UL 199 are being issued to change the effective date for the glass bulb sprinkler protective cover requirements.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding reference.

Future Effective Dates	References
March 26, 2004	Paragraph 5.1.1 and Sections 14A, 20
September 26, 2004	Section 9A, 27A, 53A and paragraphs 52.1 and 54.20
June 8, 2005	Paragraphs 19.2.1, 19.2.2, 19.2.4, 19.2.5, 19.2.6, 54.2 and 54.19, and Tables 19.1 and 19.2

The revised effective dates are substantially in accordance with UL's Bulletin(s) on this subject dated March 5, 2004. The bulletin(s) is now obsolete and may be discarded.

The revisions dated April 7, 2004 include a reprinted title page (page1) for this Standard.

The revisions dated May 12, 1997 were issued to correct the effective date for paragraph 55.1.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfonet.ul.com/ulforeword.html>

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This ANSI/UL Standard for Safety, which consists of the Tenth edition with revisions through April 7, 2004 is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to UL-RTP Standards Department, 12 Laboratory Dr., P.O. Box 13995, Research Triangle Park, NC 27709-3995.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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INTRODUCTION

1 Scope

1.1 These requirements cover automatic sprinklers intended for installation on sprinkler systems for fire-protection service. Requirements for the installation and use of sprinklers are included in the Standard for the Installation of Sprinkler Systems, NFPA 13.

1.2 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.2 revised September 6, 2000

2 General

2.1 Sprinklers are categorized by operating temperature rating, nominal "K" factor, installation position, type of coating or plating, and other factors that have a bearing on their application.

2.1 revised January 24, 2000

2.2 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2 revised September 6, 2000

2.3 Where these requirements reference "extended coverage sprinklers", the requirements apply to both extended coverage light hazard and extended coverage ordinary hazard sprinklers unless otherwise specified.

3 Glossary

3.1 General

3.1.1 For the purpose of this standard the following definitions apply:

3.2 Basic definitions

3.2.1 DISCHARGE COEFFICIENT "K" – Coefficient of discharge in the formula,

$$Q=K\sqrt{p}$$

in which:

Q is the flow in gallons per minute (L/s x 15.85), and

p is the pressure in pounds per square inch gauge (psig) (MPa x 145).

3.2.2 HEAT RESPONSIVE ELEMENT – That portion of a sprinkler that breaks, melts, or otherwise functions to initiate the automatic operation of the sprinkler when exposed to sufficient heat.

3.2.3 OPERATING TEMPERATURE – The temperature at which the heat responsive element of a sprinkler operates when subjected to a 1°F (0.5°C) per minute temperature rise while immersed in a liquid bath.

3.2.4 ORIFICE – The opening that controls the amount of water discharged from a sprinkler at a given pressure.

3.2.5 AUTOMATIC SPRINKLER – A sprinkler intended to open automatically by operation of a heat-responsive element that maintains the discharge orifice closed by means such as the exertion of pressure on a cap (button or disc). A sprinkler is installed on piping so that a spray of water is discharged in a specific pattern for suppression or control of fires.

3.3 Sprinkler type definitions

3.3.1 EXTENDED COVERAGE SPRINKLER INTENDED FOR LIGHT HAZARD OCCUPANCIES – A sprinkler intended:

- a) For use at greater than standard spacing;
- b) To open automatically by operation of a heat responsive element and releasing mechanism having a response time equal to or less than a standard response sprinkler used on standard spacings;
- c) To discharge water over a specified coverage area at a specified minimum water flow rate; and
- d) For use in light hazard occupancies as described in NFPA 13, Standard for Installation of Sprinklers. The use limitation for this sprinkler specifies the coverage area dimensions, minimum operating water flow rate, "K" factor, the type of ceiling configuration under which the sprinkler is intended to be installed, and installation position from the wall and ceiling, when different from NFPA 13.

3.3.1 revised January 24, 2000

3.3.2 EXTENDED COVERAGE SPRINKLER INTENDED FOR ORDINARY HAZARD OCCUPANCIES – A sprinkler intended:

- a) For use at greater than standard spacing;

- b) To open automatically by operation of a heat responsive element and releasing mechanism having a response time equal to or less than a standard response sprinkler used on standard spacings;
- c) To discharge water over a specified coverage area at a specified minimum water flow rate; and
- d) For use in ordinary hazard occupancies as described in NFPA 13, Standard for Installation of Sprinklers.

The use limitation for this sprinkler specifies the coverage area dimensions, minimum operating water flow rate, "K" factor, the type of ceiling configuration under which the sprinkler is intended to be installed, and installation position from the wall and ceiling, when different from NFPA 13.

3.3.2 revised January 24, 2000

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3.3.3 FLUSH CEILING SPRINKLER – A sprinkler in which only a minimum of the parts project below the ceiling.

3.3.4 COATED, PAINTED, OR PLATED SPRINKLER – A sprinkler that has factory applied coatings, paint, or platings for corrosion protection or decorative purposes.

3.3.5 CONCEALED CEILING SPRINKLER – A recessed sprinkler assembly having a cover plate installed approximately flush with the ceiling material for aesthetic purposes.

3.3.6 DRY-TYPE 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. These sprinklers consist of an upright, pendent, sidewall, flush, or other types.

3.3.6 revised July 9, 2001

3.3.7 CONVENTIONAL (OLD STYLE) SPRINKLER – A sprinkler intended for installation in the upright or pendent position, that directs from 40 to 60 percent of the total water initially discharged in the downward direction. When installed in the upright position, this discharge covers a 10 foot (3.05 m) diameter circle, 10 feet (3.05 m) below the sprinkler, when the sprinkler is discharging water at the rate of 15 gallons per minute (0.95 L/s). See Water Distribution Test – Conventional (Old Style) Sprinklers, Section 32.

3.3.8 FLOW CONTROL (FC) SPRINKLER – A sprinkler that is intended to control water flow by automatically cycling open and closed within a specified temperature range.

3.3.9 A HIGH TEMPERATURE, WAX COATED SPRINKLER – A sprinkler intended to be installed where corrosion resistant, high temperature rated sprinklers are required and where the maximum ambient temperature does not exceed 150°F.

3.3.10 OPEN SPRINKLER – An automatic sprinkler with the heat responsive and activating elements removed. The discharge orifice is open.

3.3.11 PENDENT SPRINKLER – A sprinkler intended to be installed so that its deflector is located below the orifice and the water flows downward through the orifice.

3.3.12 QUICK RESPONSE (QR) SPRINKLER – A sprinkler that complies with the applicable requirements for such sprinklers in the Sensitivity Tests, Section 19, and that is intended to be installed at standard spacings.

3.3.13 QUICK RESPONSE-EXTENDED COVERAGE LIGHT HAZARD OCCUPANCY SPRINKLER – A sprinkler that complies with the applicable requirements for such sprinklers in the Sensitivity Tests, Section 19, when tested and installed in a test room at greater than standard spacings as stated in the installation instructions and complies with the requirements for extended coverage light hazard occupancy sprinklers.

3.3.14 QUICK RESPONSE-EXTENDED COVERAGE ORDINARY HAZARD OCCUPANCY SPRINKLER – A sprinkler that complies with the applicable requirements for such sprinklers in the Sensitivity Tests, Section 19, when tested and installed in a test room at greater than standard spacings as stated in the installation instructions and complies with the requirements for extended coverage ordinary hazard occupancy sprinklers.

3.3.15 RECESSED SPRINKLER – A sprinkler assembly in which all or part of the sprinkler body or frame, other than the shank thread, is mounted within a housing that is recessed within a wall or ceiling.

3.3.16 SIDEWALL SPRAY SPRINKLER – A sprinkler intended for installation on or near the wall and near the ceiling, and intended to discharge water onto the walls and outward in a quarter-spherical pattern.

3.3.17 SPRAY SPRINKLER – A sprinkler intended for installation in either the upright or pendent position respectively, designed to distribute water downward in an umbrella-shaped pattern. The discharge from a spray sprinkler having a nominal 5.6 "K" factor covers a circle 16 feet (4.88 m) in diameter, 4 feet (1.22 m) below the sprinkler, when the sprinkler is discharging water at the rate of 15 gallons per minute (0.95 L/s). See 10 Pan Distribution Test, Section 30.

3.3.17 revised January 24, 2000

3.3.18 UPRIGHT SPRINKLER – A sprinkler intended to be installed so that its deflector is located above the orifice and the water flows upward through the orifice.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component.

4.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

4.2 revised September 6, 2000

4.3 A component shall be used in accordance with its rating established for the intended conditions of use.

4.3 revised September 6, 2000

4.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4.4 revised September 6, 2000

CONSTRUCTION

5 General

5.1 An automatic sprinkler shall be constructed to effect closure of its water seat for extended periods of time without leakage and to open as intended and release all parts at a pressure of 5 psi (0.034 MPa) up to the rated pressure. The closure of the water seat shall not be achieved by the use of a dynamic O-ring or similar seal (an O-ring or similar seal that moves during operation or is in contact with a component that moves during operation).

5.1 revised March 26, 2003

5.1.1 For dry-type pendent and sidewall sprinklers, the connection of the extension nipple to the seal assembly at the inlet shall be airtight. See Section 14A, Dry Sprinkler Air Tightness Test.

Added 5.1.1 effective March 26, 2004

5.2 Stampings shall show no cracking or splitting and shall be uniformly smooth and clean cut.

5.3 An automatic sprinkler shall be chemically or mechanically staked to maintain the manufacturer's assembly load. The assembly load shall not be able to be changed by the use of common hand tools without causing visible damage to the sprinkler.

5.4 Sprinkler types or materials not anticipated by these requirements require additional evaluation, such as tests to investigate special metallic or nonmetallic materials.

5.5 When installed with the intended fittings specified in the installation instructions (see Section 55, Design Parameters and Installation Instructions), dry sprinklers installed in dry systems shall be constructed to minimize the potential to accumulate water, scale, and sediment on the sprinkler inlet and shall provide an unobstructed flow path upon operation.

5.5 effective October 8, 1998

6 Inlet Threads

6.1 Sprinklers shall be provided with external pipe threads at the inlet end as specified in Table 8.1. Inlet-end pipe threads shall comply with the Standard for Pipe Threads, General Purpose (Inch) (Revision and Redesignation of ASME/ANSI B2.1-1968)(R1992), ASME B1.20.1-1983.

Exception No. 1: Ceiling- and dry-type sprinklers shall be permitted to be provided with 3/4- or 1-inch external NPT pipe threads.

Exception No. 2: Internal taper pipe threads (NPT) of 3/4- or 1-inch size shall be permitted to be used for an 8.0 nominal "K" factor, ceiling type, and dry type sprinklers in lieu of those specified in Table 8.1.

Exception No. 3: Sprinklers intended for use in installations where sprinkler fittings incorporate pipe threads other than NPT type threads shall be permitted to be provided with pipe threads complying with a national pipe thread standard compatible with those fittings.

Exception No. 4: Sprinkler inlets intended for attachment to piping by means other than threads are able to be used when the sprinklers:

- a) Have a nominal "K" factor corresponding to the discharge coefficient as specified in Table 8.1;*

b) Are provided with nominal "K" factor markings as specified in 54.2; and

c) Are intended to be attached in a manner that does not involve welding and that permits sprinkler removal from sprinkler piping without the use of special tools or torch cutting equipment.

6.1 revised January 24, 2000

6.2 Threads shall be clean cut and true and free from burrs, scoring or chatter marks.

7 Temperature Ratings

7.1 The temperature ratings and temperature classifications of automatic sprinklers shall be as specified in Table 7.1. The frame arms of automatic sprinklers or frangible bulb heat responsive elements shall be colored according to the color code specified in Table 7.1. See 54.9.

7.1 revised March 26, 2003

Table 7.1
Temperature classification ratings and color coding

Table 7.1 revised March 26, 2003

Temperature classification	Temperature rating		Color code		Maximum ceiling temperature	
	Degrees F	(Degrees C)	Frame arms	Frangible bulb	Degrees F	(Degrees C)
Ordinary	135 – 170	(57 – 77)	Uncolored or black	Orange or red	100	(38)
Intermediate	175 – 225	(79 – 107)	White	Yellow or green	150	(66)
High	250 – 300	(121 – 149)	Blue	Blue	225	(107)
Extra high	325 – 375	(163 – 191)	Red	Purple	300	(149)
Very extra high	400 – 475	(204 – 246)	Green	Black	375	(191)
Ultra high	500 – 575	(260 – 302)	Orange	Black	475	(246)

7A Pressure Rating

7A.1 Sprinklers shall have a rated pressure of 175 psig (1.2 Mpa), 250 psig (1.7 Mpa), or 300 psig (2.1 Mpa).

7A.1 added October 8, 1997

8 Nominal "K" Factor

8.1 A sprinkler shall have a discharge coefficient complying with one of the nominal "K" factor ranges specified in Table 8.1. The nominal "K" factor is to be determined from the discharge coefficient "K", as specified by the Calibration Test, Section 29.

8.1 revised January 24, 2000

Table 8.1
Nominal "K" factor and Thread Size

Table 8.1 revised January 24, 2000

Nominal K	Discharge coefficient "K"	External thread-type
1.4	1.3 – 1.5	1/2 inch NPT
1.9	1.8 – 2.0	1/2 inch NPT
2.8	2.6 – 2.9	1/2 inch NPT
4.2	4.0 – 4.4	1/2 inch NPT
5.6	5.3 – 5.8	1/2 inch NPT
8.0	7.4 – 8.2	3/4 inch NPT
		or 1/2 inch NPT
11.2	11.0 – 11.5	3/4 inch NPT
		or 1/2 inch NPT
14.0	13.5 – 14.5	3/4 inch NPT

8.2 Sprinkler orifices shall have individual "K" factor values that are within ± 5 percent of the average "K" factor determined at a specific pressure for the dimensional tolerance specified by the manufacturer.

8.2 revised January 24, 2000

8.3 The diameter of a discharge orifice or any internal passage of a sprinkler shall be at least 0.21 inch (5.3 mm).

9 Coatings And Platings

9.1 The operation and distribution characteristics of a sprinkler shall not be impaired by the application of any factory applied coating, paint, or plating when the sprinkler is tested in accordance with these requirements.

9.2 A corrosion resistant coating or plating shall be uniformly applied.

9.3 A wax coating shall not be brittle when new nor become brittle with age.

9A Protective Covers

9A.1 Sprinklers with frangible bulb type heat responsive elements shall be equipped with protective covers that are designed to remain in place during installation and be removed before the sprinkler system is placed in service.

Exception: Certain sprinkler designs, such as concealed sprinklers and sprinklers with guards, may not be required to have protective covers.

9A.1 effective September 26, 2004 for sprinklers with a glass bulb having a diameter of greater than 4 mm

9A.2 Sprinklers required to be equipped with sprinkler covers shall comply with Section 27A, Impact Test for Protective Covers, and 54.20.

9A.2 effective September 26, 2004 for sprinklers with a glass bulb having a diameter of greater than 4 mm

PERFORMANCE

10 General

10.1 To determine compliance with these requirements, the various types and patterns of a sprinkler shall be subjected to the performance tests described in Sections 12 – 51, and specified in Table 10.1.

10.2 When a recessed or concealed sprinkler is tested with an escutcheon during the performance tests, the sprinkler is to be recessed to the maximum depth allowed by the sprinkler/escutcheon combination.

Table 10.1
Sprinkler test requirements
Table 10.1 revised March 26, 2003

Section number and test	Basic sprinkler types, lowest temperature rating			Variations to basic sprinkler types				Other sprinkler types ^a					
	Spray upright/pendent	Old style	Flow control	Each additional temperature rating	Each additional orifice size	Decorative coatings or platings	Corrosion resistant coatings or platings	Dry	Ceiling	Side-wall	EC light hazard	EC ordinary hazard response	Other ^b
12. Load on heat responsive element	X	X	X	-	X	-	-	X	-	-	-	X	-
13. Strength of heat responsive element	X	X	X	-	X	-	-	X	-	-	-	X	-
14. Leakage	X	X	X	-	X	X	X	X	-	-	-	X	-
14A. Dry sprinkler air tightness	-	-	-	-	-	-	-	X	-	-	-	-	-
15. Hydrostatic strength	X	X	X	-	X	-	-	X	-	-	-	X	-
16. 30-day leakage	X	X	X	-	X	-	-	X	-	-	-	X	-
17. Water hammer	X	X	X	-	X	-	-	X	-	-	-	X	-
18. Operating temperature (bath)	X	X	X	X	-	X	X	-	-	-	-	X	-
19. Sensitivity	X	X	X	X	-	X	X	-	-	-	-	X	-
20. Operation – lodgement	X	X	X	-	X	-	X	X	X	X	X	X	-
21. Flow endurance	X	X	X	-	X	-	-	-	-	X	X	-	-
22. Operation – cold soldering	X	-	X	-	X	-	-	-	-	X	X	X	-
23. High temperature– test for uncoated sprinklers	X	X	X	X	-	X	-	X	X	-	-	X	-
24. High temperature – test for coated sprinklers	-	-	-	-	-	-	X	-	-	-	-	-	-
25. Strength of frame	X	X	X	-	X	-	-	X	-	-	-	X	-
26. Impact resistance	X	X	X	-	-	-	-	-	-	-	-	X	-
27. Rough usage	X	X	X	-	-	-	-	-	-	-	-	X	-

Table 10.1 Continued on Next Page

Table 10.1 Continued

Section number and test	Basic sprinkler types, lowest temperature rating			Variations to basic sprinkler types				Other sprinkler types ^a						
	Spray upright/pendent	Old style	Flow control	Each additional temperature rating	Each additional orifice size	Decorative coatings or platings	Corrosion resistant coatings or platings	Dry	Ceiling	Side-wall	EC light hazard	EC ordinary hazard response	Quick response	Other ^b
27A. Impact test for protective covers	–	–	–	–	–	–	–	–	–	–	–	–	–	X
28. Vibration	X	X	X	–	–	–	–	X	X	–	–	–	X	–
29. Calibration	X	X	X	–	X	–	–	X	–	–	–	–	–	–
30. 10 pan distribution	X	–	X	–	X	–	–	X	X	–	–	–	–	–
31. 16 pan distribution	X	–	X	–	X	–	–	X	X	–	–	–	–	–
32. Water Distribution – conventional (old style) sprinklers	–	X	–	–	–	–	–	–	–	–	–	–	–	–
33. 100 pan distribution – sidewall sprinklers	–	–	–	–	–	–	–	–	–	X	–	–	–	–
34. 350 Pound wood crib fire	X	–	X	–	X	–	–	X	X	X ^c	–	–	–	–
35. 10 day corrosion	X	X	X	–	–	–	–	X	X	–	–	–	X	–
36. 30 day corrosion	–	–	–	–	–	–	X	–	–	–	–	–	–	X
37. 90 day moist air corrosion	X	X	X	–	–	X	–	X	–	–	–	–	X	X
38. Stress-corrosion cracking of brass parts	X	X	X	–	–	–	–	–	–	X	X	–	X	–
39. Stress-corrosion cracking of stainless steel parts	X	X	X	–	–	–	X	–	–	–	–	–	X	X
40. Operational tests on sprinklers incorporating gaskets or “O” ring seals	–	–	X	–	–	–	–	–	–	–	–	–	–	X

Table 10.1 Continued on Next Page

Table 10.1 Continued

Section number and test	Basic sprinkler types, lowest temperature rating			Variations to basic sprinkler types				Other sprinkler types ^a						
	Spray upright/pendent	Old style	Flow control	Each additional temperature rating	Each additional orifice size	Decorative coatings or platings	Corrosion resistant coatings or platings	Dry	Ceiling	Side-wall	EC light hazard	EC ordinary hazard response	Quick response	Other ^b
40A. Dry-type sprinkler deposit loading	–	–	–	–	–	–	–	X	–	–	–	–	–	–
40B. Dezincification test of brass parts	X	X	X	–	–	–	–	–	–	–	–	–	–	–
41. Vacuum test	X	X	X	–	X	–	–	–	–	–	–	–	–	–
42. Elastomeric parts test	X	X	X	–	–	–	–	–	–	–	–	–	–	X
43. Freezing test	X	X	X	–	X	–	–	–	–	–	–	–	–	–
44. Fire test for EC sprinklers	–	–	–	–	–	–	–	–	–	–	X	–	–	–
45. Wall wetting test for EC sprinklers	–	–	–	–	–	–	–	–	–	–	X	–	–	–
46. Evaporation test for sprinkler coatings	–	–	–	–	–	–	X	–	–	–	–	–	–	–
47. Cycling tests for FC sprinklers	–	–	X	–	–	–	–	–	–	–	–	–	–	–
48. Piled stock fire test for FC sprinklers	–	–	X	–	–	–	–	–	–	–	–	–	–	–
49. Piled stock fire test for ECOH sprinklers	–	–	–	–	–	–	–	–	–	–	–	X	–	–
50. Distribution test for ECOH sprinklers	–	–	–	–	–	–	–	–	–	–	–	X	–	–
51. High temperature exposure test for FC sprinklers	–	–	X	–	–	–	–	–	–	–	–	–	–	–
53A. Frangible bulb integrity	–	–	–	–	–	–	–	–	–	–	–	–	–	X ^{d,e}
NOTE – This table is intended only as a guide to determining which tests are applicable to sprinkler types, and variations of sprinkler types. Other sprinkler types or materials not anticipated by these requirements may require additional tests, such as tests to evaluate and identify special metallic or nonmetallic materials. An “X” indicates a required test.														

NOTE – This table is intended only as a guide to determining which tests are applicable to sprinkler types, and variations of sprinkler types. Other sprinkler types or materials not anticipated by these requirements may require additional tests, such as tests to evaluate and identify special metallic or nonmetallic materials. An "X" indicates a required test.

Table 10.1 Continued on Next Page

Table 10.1 Continued

Section number and test	Basic sprinkler types, lowest temperature rating			Variations to basic sprinkler types				Other sprinkler types ^a						
	Spray upright/pendent	Old style	Flow control	Each additional temperature rating	Each additional orifice size	Decorative coatings or platings	Corrosion resistant coatings or platings	Dry	Ceiling	Side-wall	EC light hazard	EC ordinary hazard	Quick response	Other ^b
^a An other sprinkler type is also identified as a basic sprinkler type when the sprinkler meets the definition of a standard, conventional (old style), or flow control sprinkler. In such cases, the sprinkler shall also comply with the tests specified in the "Basic Sprinkler Types, Lowest Temperature Rating" column of this table. The "additional" tests specified under the "Other Sprinkler Types", column apply to sprinklers that have components or installation techniques not evaluated during "basic sprinkler type" testing.														
^b Sprinklers having components of stainless steel or nonmetallic sealing materials.														
^c Not required for light and ordinary hazards occupancies.														
^d Sprinklers with frangible bulbs.														
^e Any sprinkler equipped with a protective cover.														

11 Samples

11.1 The number of samples required for investigation varies for different sprinkler types. The number of samples required for examination and test are to be determined following a review of detailed drawings, examination of a preliminary sample, or both.

12 Load On Heat Responsive Element Test

12.1 The average and maximum design loads exerted on the heat responsive element, and the overall load tolerance based on the design load for the assembly, is to be determined. When the application of the rated working pressure to the inlet end of the sprinkler increases the assembly load by more than 10 percent, the additional load is to be added to the measured load on the heat responsive element. The information developed is to be used for Strength of Heat Responsive Element Test, Section 13.

12.2 At least 25 sprinklers are to be tested to determine the average load. An arrangement for measuring the load on the heat responsive element is to be developed for each specific design.

13 Strength Of Heat Responsive Element Test

13.1 Fusible-alloy types

13.1.1 A heat responsive element in the ordinary temperature rating shall either:

- a) Sustain a load of 15 times its maximum design load for a period of 100 hours; or
- b) Demonstrate the ability to sustain the maximum design load when tested in accordance with 13.1.2 and 13.1.3.

13.1.2 Compliance with 13.1.1(b) is to be determined by subjecting sample heat-responsive elements to loads in excess of the maximum design load. A minimum of ten samples are to be loaded at various values as required up to 15 times the design load. At least one heat responsive element shall sustain a load for a time greater than 1000 hours. These load and time values shall then be used to derive a least-square, full logarithmic regression curve of time as a function of load, from which the loads at 1 hour and 1000 hours are to be determined. The design load shall comply with the following equation:

$$L_d \leq 1.02 L_m^2 / L_o$$

in which:

L_d is the maximum design load,

L_m is the load at 1000 hours, and

L_o is the load at 1 hour.

13.1.3 The test samples are to be loaded at a conditioned temperature of $70 \pm 5^{\circ}\text{F}$ ($21 \pm 3^{\circ}\text{C}$).

13.2 Frangible-bulb types

13.2.1 The lower tolerance limit for bulb strength, based on calculations with a degree of confidence of 0.99 for 99 percent of samples, shall exceed two times the upper tolerance limit for sprinkler assembly load based on calculations with the same degree of precision as for bulb strength. Calculations are to be based on the Normal or Gaussian Distribution except where another distribution is shown to be more applicable due to manufacturing or design factors. The bulb strength is to be measured by applying a steadily increasing load, utilizing a compression testing machine, until the bulb breaks. This test is to be conducted with the bulb mounted in the seating parts, with the same dimensions used in the sprinkler and a material hardness within the range of 38 – 50 Rockwell C. The rate of loading shall not exceed 55 pounds-force load per second (25 kg/s), or at a rate that deflects the bulb 0.02 inch (0.51 mm) per minute, whichever measurement is convenient for the test apparatus being used. Bulb seatings shall be permitted to be reinforced circumferentially so as not to interfere with the bulb breakage. A minimum of 15 samples of each temperature rating and each bulb type are to be tested. See Appendix A.

13.2.1 revised January 24, 2000

13.2.2 A sprinkler having a frangible bulb shall withstand the thermal shock of rapid temperature changes 20°F (11°C) below its marked operating temperature or 20°F below the lowest allowable value of the operating temperature range determined in the Operating Temperature (Bath) Test, Section 18, whichever is lower. At least five samples of the sprinkler are to be conditioned for 5 minutes in a liquid bath at 20°F less than their rated operating temperature or minimum permitted operating temperature. The samples then are to be removed and immediately submerged in another liquid bath at 50°F (10°C). There shall be no breakage or fracture of the frangible bulb.

13.2.2 revised March 26, 2003

14 Leakage Test

14.1 When tested as described in 14.2 and 14.3, an automatic sprinkler shall not exhibit leakage at any pressure from 0 to the applicable leakage test pressure shown in Table 14.1.

14.1 revised October 8, 1997

Table 14.1
Test pressures for the leakage and hydrostatic tests

Table 14.1 added October 8, 1997

Rated pressure		Leakage test pressure		Hydrostatic test pressure	
psig	(MPa)	psig	(MPa)	psig	(MPa)
175	(1.2)	500	(3.4)	700	(4.8)
250	(1.7)	500	(3.4)	1000	(6.9)
300	(2.1)	600	(4.1)	1200	(8.3)

14.2 At least 20 samples are to be individually tested. The sprinkler inlets are to be filled with water and vented of air.

14.3 The pressure is to be increased from 0 to the test pressure at a rate not exceeding 300 psig (2.07 MPa) per minute and then held for 1 minute. There shall be no visible leakage in any sample.

14.3 revised October 8, 1997

14A Dry Sprinkler Air Tightness Test

14A.1 When tested as described in 14A.2 and 14A.3, the connection of the extension nipple to the inlet seal assembly for a dry-type pendent or sidewall sprinkler shall not exhibit leakage at any air pressure from 0 to 15 psig (0 to 103 kPa) when the pressure is applied externally to this connection.

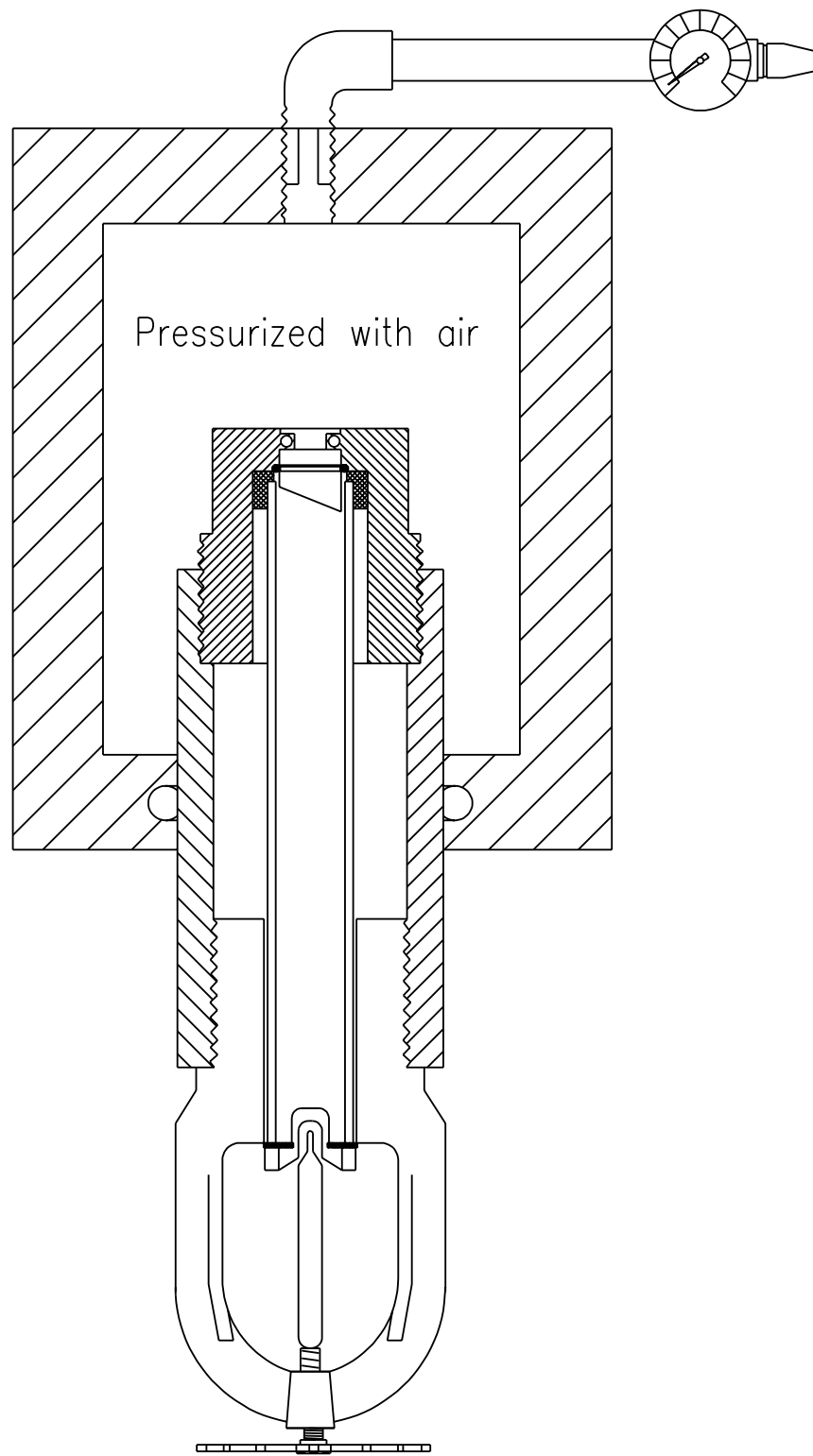
Added 14A.1 effective March 26, 2004

14A.2 At least five samples are to be individually tested. The assembly is to be installed in an air leakage test fixture in such a manner that the extension nipple connection to the inlet seal assembly can be fully pressurized with air. See Figure 14A.1.

Added 14A.2 effective March 26, 2004

Figure 14A.1
Dry sprinkler air tightness test apparatus (typical)

Added Figure 14A.1 effective March 26, 2004



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14A.3 The assembly is to be immersed in water and orientated so that air bubbles indicating leakage past the extension nipple and inlet seal assembly connection point are allowed to freely escape from internal waterway of the dry sprinkler assembly. The air pressure applied to the connection point is then to be increased from 0 to 15 psig (0 to 103 kPa) within 30 seconds and then held for 30 seconds. Observations shall be made for leakage as evidenced by any air bubbles escaping from the internal portion of the dry sprinkler assembly.

Added 14A.3 effective March 26, 2004

15 Hydrostatic Strength Test

15.1 An automatic sprinkler shall withstand, for 1 minute, without rupture, an internal hydrostatic pressure equal to the hydrostatic test pressure shown in Table 14.1.

15.1 revised October 8, 1997

15.2 At least 20 samples are to be individually tested. The sprinkler inlets are to be filled with water and vented of air. The pressure is to be increased from 0 to the hydrostatic test pressure shown in Table 14.1 at a rate not exceeding 300 psig (2.07 MPa) per minute. The pressure is to be maintained at the test pressure and held for 1 minute. The sample shall not rupture, operate, or release any of its operating parts during the pressure increase nor while being maintained at the test pressure for 1 minute.

15.2 revised October 8, 1997

No Text on This Page

16 30-Day Leakage Test

16.1 When tested as described in 16.2 – 16.4, an automatic sprinkler shall:

- a) Experience no leakage when subjected to the 30 day test pressure specified in Table 16.1 for 30 days;
- b) Not leak when subjected to the leakage test pressure specified in Table 14.1 or less for 1 minute following the 30 days; and
- c) Show no distortion or other mechanical damage following the leakage testing, as determined by visual examination.

16.1 revised October 8, 1997

Table 16.1
Test pressures for the 30-day leakage test

Table 16.1 added October 8, 1997

Rated pressure		30-day test pressure	
psig	(MPa)	psig	(MPa)
175	(1.2)	300	(2.1)
250	(1.7)	450	(3.1)
300	(2.1)	500	(3.4)

16.2 Five samples are to be installed on a water-filled test line maintained under a constant test pressure as specified in Table 16.1 for 30 days. The samples are to be examined weekly during the test period for evidence of leakage of water at the closure cap.

16.2 revised October 8, 1997

16.3 Following completion of this 30-day test period, the samples are to be tested to verify that they do not leak at the leakage test pressure specified in Table 14.1 or at any lower pressure. The pressure is to be increased from 0 to the test pressure a rate not exceeding 300 psig (2.07 MPa) per minute. The pressure is to be maintained at the leakage test pressure specified in Table 14.1 for 1 minute, and is then to be decreased to 0 psig at a rate not exceeding 300 psig per minute.

16.3 revised October 8, 1997

16.4 The samples then are to be visually examined to verify there is no evidence of distortion or other mechanical damage.