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Fire protection — Automatic sprinklers —

Part 13:
Requirements and test methods for extended coverage sprinklers

Protection contre l'incendie — Systèmes d'extinction automatiques du type sprinkler —

Partie 13: Prescriptions et méthodes d'essai des sprinklers couvrant une surface plus étendue que la normale

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6182-13 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Sprinkler and water spray extinguishing systems*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO 6182 consists of the following parts, under the general title *Fire protection — Automatic sprinklers*:

— *Part 1: Requirements and test methods for sprinklers*

— *Part 2: Requirements and test methods for wet alarm valves, retard chambers and water motor alarms*

— *Part 3: Requirements and test methods for dry pipe valves*

— *Part 4: Requirements and test methods for quick-opening devices*

— *Part 5: Requirements and test methods for deluge valves*

— *Part 6: Requirements and test methods for check valves*

— *Part 7: Requirements and test methods for early suppression fast response (ESFR) sprinklers*

— *Part 8: Requirements and test methods for pre-action dry alarm valves*

— *Part 9: Requirements and test methods for water mist nozzles*

— *Part 10: Requirements and test methods for domestic sprinklers*

— *Part 11: Requirements and test methods for pipe hangers*

— *Part 12: Requirements and test methods for couplings for grooved end components for steel pipe systems*

— *Part 13: Requirements and test methods for extended coverage sprinklers*

All pressure data in this ISO Standard are given as gauge pressure in bar[1] (1 bar = 0,1 MPa).

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Fire protection — Automatic sprinklers —

Part 13: Requirements and test methods for extended coverage sprinklers

1 Scope

1.1 This part of ISO 6182 specifies performance requirements, test methods and marking requirements for extended coverage spray sprinklers.

1.2 These sprinklers are intended to provide control of fires in occupancies or portions of occupancies where quantity and/or combustibility of contents is low such as in hotel rooms. Requirements and test methods for extended coverage sprinklers for other occupancy hazards are in preparation.

2 References

The following standards contain provisions which, though referenced in this text, constitute provisions of this part of ISO 6182. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6182 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7-1:1982, Pipe threads where pressure-tight joints are made on the threads, Part 1: Designation, Dimension and Tolerances

ISO 49:1983, Malleable cast iron fittings threaded to ISO 7-1

ISO 65:1981, Carbon steel tubes suitable for screwing in accordance with ISO 7-1

3 Definitions

3.1 General

3.1.1 Assembly load: The force exerted on the sprinkler body at 0 bar hydraulic pressure at the inlet.

3.1.2 Conductivity factor: A measure of the conductance between the sprinkler's heat responsive element and the fitting expressed in units of $(m/s)^{0,5}$.

3.1.3 Design load: The force exerted on the release element at the service load of the sprinkler.

3.1.4 Extended coverage sprinkler: A sprinkler having a specified area of coverage which is larger than that of a conventional, spray, flat spray or sidewall sprinkler.

3.1.5 Response time index: A measure of sprinkler sensitivity expressed as $RTI = tu^{0,5}$, where t is the time constant of the heat responsive element in units of seconds, and u is the gas velocity expressed in meters per second. RTI can be used in combination with the conductivity factor (C) to predict the response of a sprinkler in fire environments defined in terms of gas temperature and velocity versus time. RTI has units of $(m\text{-}s)^{0,5}$.

3.1.6 Service load: The combined force exerted on the sprinkler body by the assembly load of the sprinkler and equivalent force of a 12 bar (1,2 MPa) hydraulic pressure at the inlet.

3.1.7 Sprinkler: A thermosensitive device designed to react at a predetermined temperature by automatically releasing a stream of water and distributing it in a specified pattern and quantity over a designated area.

3.1.8 Standard orientation: In the case of symmetrical heat responsive elements, standard orientation is with the air flow perpendicular to both the axis of the waterway and the plane of the frame arms. In the case of non-symmetrical heat responsive elements, standard orientation is with the air flow perpendicular to both the waterway axis and the plane of the frame arms which produces the shortest response time.

3.1.9 Worst case (response) orientation: The orientation which produces the longest response time with the axis of the sprinkler inlet perpendicular to the air flow.

3.2 Type of sprinklers according to type of heat responsive element.

3.2.1 Fusible element sprinkler: A sprinkler that opens under the influence of heat by the melting of a component.

3.2.2 Glass bulb sprinkler: A sprinkler that opens under the influence of heat by the bursting of the glass bulb through pressure resulting from expansion of the fluid enclosed therein.

3.3 Types of extended coverage sprinklers

3.3.1 Pendent extended coverage sprinkler: An extended coverage sprinkler that is arranged in such a way that the water stream is directed initially downwards against the distribution plate. This sprinkler has a square area of coverage not exceeding 36 m^2 with sprinkler spacings in 0,5 m increments. The maximum spacing between sprinklers is 6,0 m.

3.3.2 Sidewall extended coverage sprinkler: An extended coverage sprinkler giving a one-sided (half-paraboloid) water distribution over a definite protection area. The axis of the sprinkler waterway may be either horizontal or vertical. This sprinkler has an area of coverage not exceeding 36 m^2, with sprinkler spacings in 0,5 m increments, with no dimension exceeding 7 m.

3.3.3 Upright extended coverage sprinkler: An extended coverage sprinkler that is arranged in such a way that the water stream is directed initially upwards against the distribution plate. This sprinkler has a square area of coverage not exceeding 36 m^2 with sprinkler spacings in 0,5 m increments. The maximum spacing between sprinklers is 6,0 m.

3.4 Special types of extended coverage sprinklers

3.4.1 Concealed extended coverage sprinkler: An extended coverage sprinkler fitted with a ceiling cover plate with the sprinkler body and heat responsive element located above the plane of the ceiling.

3.4.2 Dry extended coverage sprinkler: A unit comprising an extended coverage sprinkler mounted at the outlet of a special riser extension with a seal at the inlet end, which prevents water from entering the riser until it is released by operation of the sprinkler.

3.4.3 Flush extended coverage sprinkler: An extended coverage sprinkler of which all or part of the body, including the shank thread, is mounted above the lower plane of the ceiling, but part of, or all of, the heat responsive element is below the lower plane of the ceiling.

3.4.4 Recessed extended coverage sprinkler: An extended coverage sprinkler of which all or part of the body, other than the shank thread, is mounted within a recessed housing.

3.4.5 Coated extended coverage sprinkler: An extended coverage sprinkler which has a factory applied coating for corrosion protection.

4 Product consistency

It shall be the responsibility of the manufacturer to implement a quality control programme to ensure that production continuously meets the requirements of this part of IS0 6182 in the same manner as the originally tested samples.

Every manufactured sprinkler shall pass a leak resistance test equivalent to a hydrostatic pressure of at least 30 bar (3,0 MPa) for at least 2 seconds.

5 Product assembly

5.1 All extended coverage sprinklers shall be designed and manufactured in such a way that they cannot be readily adjusted, dismantled or reassembled.

5.2 An extended coverage 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 from 0,34 bar (0,034 MPa) up to the rated working 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.

6 Requirements

6.1 General

Sprinklers shall comply with the requirements given in table 1.

Nominal flow constant, K (l/min/bar^{0,5}) (see 6.4.1)	Nominal thread size (inches)
80 ± 4	1/2
115 ± 6	3/4
160 ± 8	3/4
200 ± 10	3/4

Note: In some countries, the use of 1/2 inch threads for sprinklers having nominal flow constants up to 160 l/min/bar^{0,5} is acceptable.

Table 1 — Dimensional requirements

6.1.1 All sprinklers shall be constructed so that a sphere of diameter 8 mm can pass through each water passage in the sprinkler.

6.1.2 Nominal thread sizes should be suitable for fittings threaded in accordance with ISO 7-1.

6.1.2.1 In some countries, the use of 1/2 inch threads for sprinklers having nominal flow constants up to 160 l/min/bar^{0,5} is acceptable.

6.1.2.2 Special sprinklers may have larger thread sizes.

6.1.2.3 The dimensions of all threaded connections should conform to International Standards where applied. National Standards may be used if International Standards are not applicable.

6.2 Nominal operating temperatures (see 7.6)

The nominal operating temperature of sprinklers shall be as indicated in table 2. The nominal operating temperatures of all other sprinklers shall be specified in advance by the manufacturer and verified in accordance with 6.3. They shall be determined as a result of the operating temperature test (see 7.6.1). Nominal operating temperatures shall be within the ranges specified in table 2.

The nominal operating temperature that is to be marked on the sprinkler shall be that determined when the sprinkler is tested in accordance with 7.6.1, taking into account the specifications of 6.3.

Values in degrees Celsius

1	2
GLASS BULB SPRINKLERS	
Nominal Operating Temperature	**Liqud Color code**
57	Orange
68	Red
79	yellow
93	green
107	green
121	blue
141	blue
163	mauve
182	mauve
204	black
227	black
260	black
343	black

3	4
FUSIBLE ELEMENT SPRINKLERS	
Nominal Operating Temperature	**Yoke arm color code**
57 to 77	uncolored
80 to 107	white
121 to 149	blue
163 to 191	red
204 to 246	green
260 to 302	orange
320 to 343	orange

Table 2 — Nominal operating temperature

6.3 Operating temperatures (see 7.6.1)

6.3.1 Extended coverage sprinklers, shall open within a temperature range of

$X \pm (0{,}035\ X + 0{,}62)\ ^{\circ}C$

where X is the nominal operating temperature.

6.4 Water flow and distribution

6.4.1 Flow constant (see 7.10)

The flow constant, K, for sprinklers is given by the formula:

$$K = \frac{Q}{P^{0{,}5}}$$

where

P is the pressure in bars;

Q is the flow rate in liters per minute;

K-factor for the sprinklers defined in table 1 shall have the values given in table 1 when determined by the test method of 7.10.

6.4.2 Water distribution (see 7.11)

6.4.2.1 To demonstrate the required coverage of the protected area allotted to it, the sprinkler shall pass the tests specified in 7.11.

6.4.2.2 Upright and pendent sprinklers shall be evaluated using one quadrant of the room as shown in figures 5 through 8. Sidewall sprinkler distributions shall be measured utilizing one half of the floor area as shown in figures 9 through 14. In all cases, a space of 25 mm shall be maintained between all walls and pans.

6.4.2.3 Not more than one pan shall have a collection less than 0,6 mm/minute and it shall not have less than 0,2 mm/minute.

6.4.2.4 The average collection of all the distribution pans for each test shall be a minimum of 1,6 mm/minute.

6.4.2.5 Sprinklers must meet all criteria when tested to the parameters shown in tables 3 and 4. Pendent or upright sprinklers shall meet all criteria as shown in table 3. Sidewall sprinklers shall meet all criteria as shown in table 4.

6.4.2.6 Coated sprinklers shall be subjected to additional distribution tests if the coating is observed to deform or deteriorate during the dynamic heating test of 6.15.

Nominal Flow Constant, K (l/m/[bar]^{0,5})	Nominal Room Dimensions [width x length] (m x m)	Deflector to Ceiling Distance (mm)	Nominal Flow Rate (l/min)
80	5,0 x 5,0	100	101,8
80	5,5 x 5,5	100	123,2
80	6,0 x 6,0	100	146,6
115	5,0 x 5,0	100	101,8
115	5,5 x 5,5	100	123,2
115	6,0 x 6,0	100	146,6
160	5,0 x 5,0	100	111,1
160	5,5 x 5,5	100	123,2
160	6,0 x 6,0	100	146,6
200	5,0 x 5,0	100	138,9
200	5,5 x 5,5	100	138,9
200	6,0 x 6,0	100	146,6

Table 3 — Distribution testing parameters for upright and pendent sprinklers

Nominal Flow Constant, K ($l/m/[bar]^{0,5}$)	Nominal Room Dimensions [width x length] (m x m)	Deflector to Ceiling Distance (mm)	Nominal Flow Rate (l/min)
80	5,0 x 5,0	100	101,8
80	5,0 x 5,0	300	101,8
80	5,0 x 5,5	100	112,0
80	5,0 x 5,5	300	112,0
80	5,0 x 6,0	100	122,2
80	5,0 x 6,0	300	122,2
115	5,0 x 5,0	100	127,3
115	5,0 x 5,0	300	127,3
115	5,0 x 5,5	100	140,0
115	5,0 x 5,5	300	140,0
115	5,0 x 6,0	100	152,7
115	5,0 x 6,0	300	152,7
115	5,0 x 6,5	100	165,4
115	5,0 x 6,5	300	165,4
115	5,0 x 7,0	100	178,2
115	5,0 x 7,0	300	178,2
160	In Preparation	In Preparation	In Preparation
200	In Preparation	In Preparation	In Preparation

Table 4 - Distribution testing parameters for sidewall sprinklers

6.5 Function (see 7.5)

6.5.1 When tested in accordance with 7.5.1 to 7.5.4, the sprinkler shall open and, within 5 s after the release of the heat responsive element, shall operate satisfactorily by complying with the requirements of 6.4.1. Any lodgement of released parts shall be cleared within 10 s or the sprinkler shall then comply with the requirement of 6.4.2. No lodgements are permitted in the 80 sprinklers tested. Lodgement is considered to have occurred when one or more of the released parts lodge in the deflector frame assembly in such a way as to cause failure to meet the water distribution requirement of 6.4.2 after 10 s.

6.5.2 The deflector and its supporting parts shall not sustain significant damage as a result of the functional test specified in 7.5.4 and shall meet the requirements of 6.4.2.

6.5.3 In most instances, visual examination of the sprinkler will be sufficient to establish conformity with the requirements of 6.5.1 and 6.5.2.

6.6 Strength of sprinkler body (see 7.3)

The sprinkler body shall not show permanent elongation of more than 0,2% between the load-bearing points of the sprinkler body after being subjected to twice the service load as measured in 7.3.

The manufacturer shall specify the average and upper limit of the service load.

6.7 Strength of release element (see 7.9)

6.7.1 When tested in accordance with 7.9.1 glass bulb elements shall

a) have an average strength of at least six times the average service; load; and

b) have a design strength lower tolerance limit (LTL) on the strength distribution curve of at least two times the upper tolerance limit (UTL) of the service load distribution curve based on calculations with a degree of confidence (*y*) of 0,99 for 99 percent of samples (P). Calculations will be based on Normal or Gaussian Distribution except where other distribution can be shown to be more applicable due to manufacturing of design factors. See Figure 21.

6.7.2 Fusible heat-responsive elements in the ordinary temperature range shall be designed to

a) sustain a load of 15 times its design load corresponding to the maximum service load measured in 7.3; for a period of 100h when tested in accordance with 7.9.2.1; or

b) demonstrate the ability to sustain the design load when tested in accordance with 7.9.2.2.

6.8 Leak and hydrostatic strength (see 7.4.1)

6.8.1 A sprinkler shall not show any sign of leakage when tested by the method specified in 7.4.1.

6.8.2 A sprinkler shall not rupture, operate or release any parts when tested by the method specified in 7.4.2.

6.9 Heat exposure (see 7.7)

6.9.1 Glass bulb sprinklers There shall be no damage to the glass bulb element when the sprinkler is tested by the method specified in 7.7.1.

6.9.2 Uncoated sprinklers Sprinklers shall withstand exposure to increased ambient temperature without evidence of weakness or failure, when tested by the method specified in 7.7.2.

6.9.3 Coated sprinklers In addition to meeting the requirement of 6.10.2 in an uncoated version, coated sprinklers shall withstand exposure to increased ambient temperatures without evidence of weakness or failure of the coating, when tested by the method specified in 7.7.3.

6.10 Thermal shock (see 7.8)

Glass bulb sprinklers shall not be damaged when tested by the method specified in 7.8. Proper operation shall not be considered damage.

6.11 Corrosion (see 7.12)

6.11.1 Stress corrosion (see 7.12.1) When tested in accordance with 7.12.1, each sprinkler shall show no cracks, delaminations or failures which could affect its ability to satisfy other requirements.

6.11.2 Sulfur dioxide corrosion (See 7.12.2) Coated and uncoated sprinklers shall be resistant to sulfur dioxide saturated with water vapor when conditioned in accordance with 7.12.2. Following exposure, the sprinklers shall be functionally tested at 0,35 bar (0,035 MPa) only in accordance with 6.5.1 and meet the dynamic heating requirements of 6.15.2.

6.11.3 Salt spray corrosion (see 7.12.3) Coated and uncoated sprinklers shall be resistant to salt spray when conditioned in accordance with 7.12.3. Following exposure, the sprinklers shall be functionally tested at 0,35 bar (0,035 MPa) only in accordance with 6.5.1 and meet the dynamic heating requirements of 6.15.2.

6.11.4 Moist air exposure (see 7.12.4) Sprinklers shall be resistant to moist air exposure when tested in accordance with 7.12.4. Following exposure, the sprinklers shall be functionally tested at 0,35 bar (0,035 MPa) only in accordance with 6.5.1 and meet the dynamic heating requirements of 6.15.2.

6.12 Coated sprinklers (see 7.13)

6.12.1 Evaporation of wax and bitumen (see 7.13.1) Waxes and bitumens used for coating sprinklers shall not contain volatile matter in sufficient quantities to cause shrinkage, hardening, cracking or flaking of the applied coating. The loss in mass shall not exceed 5% of that of the original sample when tested by the method in 7.13.1.

6.12.2 Resistance to low temperatures (see 7.13.2) All coatings used for sprinklers shall not crack or flake when subjected to low temperatures by the method in 7.13.2.

6.12.3 Resistance to high temperature Coated sprinklers shall meet the requirements of 6.10.3.

6.13 Water hammer (see 7.15)

Sprinklers shall not leak when subjected to pressure surges from 4 bar to 34 bar (0,4 to 3,4 MPa). They shall show no signs of mechanical damage when tested in accordance with 7.15 and shall operate when functionally tested to the requirements of 6.14.1.

6.14 Dynamic heating (see 7.6.2)

6.14.1 Extended coverage sprinklers shall meet the RTI and C limits for fast response sensitivity sprinklers as shown in figure 1 when tested in the standard orientation. For concealed, flush, and recessed sprinklers see 6.22. Sprinklers with C values below 0,5 $(m/s)^{1/2}$ should be evaluated using C equal to 0,5 $(m/s)^{0,5}$. All RTI values shall be calculated as in 7.6.2.3.

6.14.2 Extended coverage sprinklers, when tested in the worst case orientation, shall have RTI values not exceeding 125 $(m \cdot s)^{0,5}$ or 250 percent of the average RTI in the standard orientation.

6.14.3 After exposure to the corrosion test described in 6.12.2, 6.12.3, and 6.12.4 sprinklers shall be tested in the standard orientation as described in 7.6.2.1 to determine the post-exposure RTI. Each post-exposure RTI value shall not exceed the limits shown in figure 1. In addition, the average RTI value shall not exceed 130% of the pre-exposure average value. All post-exposure RTI values shall be calculated as in 7.6.2.3 using the pre-exposure conductivity factor (C).