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Fire protection — Automatic sprinkler systems —

Part 1: Requirements and test methods for sprinklers

Protection contre l'incendie — Systèmes d'extinction automatiques du type sprinkler —
Partie 1: Prescriptions et méthodes d'essai des sprinklers

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Contents

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Annexes

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6182-1 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Sub-Committee SC 5, *Fixed fire extinguishing systems*.

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

— *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*

Annexes A and B of this part of ISO 6182 are for information only.

Introduction

ISO 6182 comprises several parts prepared by ISO/TC 21 covering components for automatic sprinkler systems.

ISO 6182 is included in a series of International Standards planned to cover:

— carbon dioxide systems (ISO 6183);

— explosion suppression systems (ISO 6184);

— foam systems (ISO 7076).

Fire protection — Automatic sprinkler systems —

Part 1:
Requirements and test methods for sprinklers

1 Scope

This part of ISO 6182 specifies performance requirements, test methods and marking requirements for fusible element and glass bulb sprinklers.

Special sprinklers as defined in 3.5, are not covered by this part of ISO 6182.

All pressure data in this part of ISO 6182 are given as gauge pressure in bar[1)].

2 Normative references

The following standards contain provisions which, through reference 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, dimensions 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.*

1) 1 bar = 10^5 Pa = 0,1 MPa

3 Definitions, symbols and abbreviations

For the purposes of this part of ISO 6182, the following definitions apply.

3.1 General

3.1.1 sprinkler: 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.

3.1.2 conductivity factor, *C*: Measure of the conductance between the sprinkler's heat responsive element and the fitting, expressed in $(m/s)^{1/2}$.

3.1.3 response time index, RTI: Measure of sprinkler sensitivity expressed as

$$RTI = \tau u^{0,5}$$

where

τ is the time constant of the heat responsive element, expressed in seconds; and

u is the gas velocity, expressed in metres 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 is expressed in $(m·s)^{1/2}$.

3.1.4 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 and which produces the shortest response time.

3.1.5 worst-case orientation: Orientation which produces the longest response time with the axis of the sprinkler waterway perpendicular to the air flow.

3.2 Sprinkler types according to type of heat responsive element

3.2.1 fusible-element sprinkler: Sprinkler that opens under the influence of heat by the melting of a component.

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

3.3 Sprinkler types according to type of water distribution

3.3.1 conventional sprinkler, C: Sprinkler giving spherical water distribution directed downward and at the ceiling for a definite protection area.

A conventional sprinkler directs from 40 % to 60 % of the total water flow initially in a downward direction.

3.3.2 spray sprinkler, S: Sprinkler giving paraboloidal water distribution directed downward for a definite protection area.

A spray sprinkler directs from 80 % to 100 % of the total water flow initially in a downward direction.

3.3.3 flat spray sprinkler, F: Sprinkler giving paraboloidal water distribution directed downward for a definite protection area, while some of the water sprays the ceiling.

A flat spray sprinkler directs from 60 % to 80 % of the total water flow in a downward direction.

3.3.4 sidewall sprinkler, W: Sprinkler giving a one-sided (half-paraboloidal) water distribution directed outward for a definite protection area.

3.4 Sprinkler types according to position

3.4.1 upright sprinkler, U: Sprinkler that is arranged in such a way that the water stream is directed upwards against the distribution plate.

3.4.2 pendent sprinkler, P: Sprinkler that is arranged in such a way that the water stream is directed downwards against the distribution plate.

3.4.3 horizontal sprinkler, H: Sprinkler that is arranged in such a way that the water stream is directed horizontally against the distribution plate.

3.5 Special sprinkler types

NOTE 1 For these sprinklers, special tests, which are in preparation, are necessary.

3.5.1 dry upright sprinkkler, DU: Sprinkler that is installed upright on a special rise pipe which is kept free from water.

3.5.2 dry pendent sprinkler, DP: Sprinkler that is installed pendent on a special drop pipe which is kept free from water.

3.5.3 flush sprinkler, L: Sprinkler of which all or part of the body, including the shank thread, is mounted above the lower plane of the ceiling, but of which part or all of the heat responsive element is below the lower plane of the ceiling.

3.5.4 recessed sprinkler, R: Sprinkler of which all or part of the body, other than the shank thread, is mounted within a recessed housing.

3.5.5 concealed sprinkler, CC: Recessed sprinkler having a cover plate.

3.5.6 on/off sprinkler, OO: Sprinkler which combines the performance characteristics of a standard sprinkler with the additional feature of automatic closure at a predetermined temperature.

3.5.7 multiple-orifice pendent sprinkler, MO: Sprinkler having two or more outlet orifices arranged to distribute the water discharge downward in a specified pattern and quantity for a definite protection area.

3.5.8 coated sprinkler: Sprinkler which has a factory applied coating for corrosion protection.

3.6 Sprinkler types according to sprinkler sensitivity

3.6.1 fast-response sprinkler: Sprinkler having a response time index (RTI) less than 50 $(m \cdot s)^{1/2}$ and a conductivity factor (C) less than 1,0 $(m \cdot s)^{1/2}$ as shown in figure 1.

3.6.2 special-response sprinkler: Sprinkler having an average response time index (RTI) between 50 $(m \cdot s)^{1/2}$ and 80 $(m \cdot s)^{1/2}$ and a conductivity factor (C) less than 1,0 $(m \cdot s)^{1/2}$ as shown in figure 1.

3.6.3 standard response sprinkler: Sprinkler having a response time index (RTI) between 80 $(m \cdot s)^{1/2}$ and 350 $(m \cdot s)^{1/2}$ and a conductivity (C) factor not exceeding 2,0 $(m \cdot s)^{1/2}$ as shown in figure 1.

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 ISO 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 MPa) for a duration of at least 2 s.

5 Product assembly

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

6 Requirements

6.1 Dimensions

Sprinklers shall comply with the dimensional requirements given in table 1.

Table 1 — Dimensional requirements

Nominal diameter of orifice mm	Nominal thread size in
10	3/8
15	1/2
20	3/4

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

NOTES

2 Requirements for water passages used for control of sprinkler function are in preparation.

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

4 In some countries, sprinklers having orifices of nominal diameters 6 mm, 8 mm and 9 mm are acceptable at the present time.

5 In some countries, the use of 1/2 in threads for sprinklers having orifices of nominal diameters 6 mm, 8 mm 9 mm, 10 mm and 20 mm is acceptable at the present time.

6 In countries where 6 mm, 8 mm and 9 mm orifice automatic sprinklers are presently acceptable, if the sprinklers are used together with a strainer in the system or in each sprinkler, a 5 mm sphere may be used for checking the size of each water passage.

7 Certain special sprinklers may have larger thread sizes.

8 In countries where sprinklers having multiple water passages are acceptable on the bases of national regulation, if the sprinklers are used together with a strainer in the system or in each sprinkler, a 3 mm sphere may be used for checking the size of each water passage.

Sprinklers having 1/2 in threads with a nominal orifice size other than 15 mm shall be fitted with a metal rod extension, (10 ± 2) mm long and having a diameter of (5 ± 2) mm, above the deflector.

6.2 Nominal release temperatures

The nominal release temperatures of glass bulb sprinklers shall be as indicated in table 2 and the operating temperatures shall be within the ranges specified in table 3.

The nominal release temperatures of fusible-element 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 nominal release temperature test (see 7.6). Nominal release temperatures shall be within the ranges specified in table 2.

Table 2 — Nominal release temperatures

Temperatures in degrees Celsius

Glass bulb sprinkler		Fusible element sprinkler	
Nominal release temperature	Liquid colour code	Nominal release temperature	Yoke arm colour code
57	Orange	57 to 77	Uncoloured
68	Red	80 to 107	White
79	Yellow	121 to 149	Blue
93	Green	163 to 191	Red
100	Green	204 to 246	Green
121	Blue	260 to 302	Orange
141	Blue	320 to 343	Black
163	Mauve		
182	Mauve		
204	Black		
227	Black		
260	Black		
343	Black		

The nominal release temperature that is to be marked on the sprinkler shall be that determined when the sprinkler is tested in accordance with 7.6, taking into account the specifications of 6.3.

6.3 Operating temperatures

6.3.1 Fusible-element sprinklers shall open within a temperature range of

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

where χ is the nominal release temperature.

6.3.2 All glass bulb sprinklers shall open within the temperature range specified in table 3 (according to the nominal release temperature).

6.4 Water flow and distribution

6.4.1 Flow constant

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

$$K = \frac{q_V}{\sqrt{p}}$$

where

p is the pressure, in bar;

q_V is the flow rate, in litres per minute.

K shall have the values given in table 4 when determined by the test method of 7.10.

6.4.2 Water distribution

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

6.5 Function

6.5.1 When tested in accordance with 7.5, the sprinkler shall open and, not more than 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 either be cleared within 60 s of the release of the heat responsive element or the sprinkler shall then comply with the requirement of 6.4.2.

6.5.2 The deflector and its supporting parts shall not sustain significant damage as a result of the functional test specified in 7.5.6 and shall meet the requirements of 6.4.2.

NOTE 9 In most instances, visual examination of the equipment will be sufficient to establish conformity with the requirements of 6.5.1 and 6.5.2.

Table 3 — Glass bulb temperature ranges

Temperatures in degrees Celsius

Glass bulb nominal release temperature	Lowest operating temperature	Temperature at, or below, which 25 of the 50 specimens operate	40 of the 50 specimens operate	50 of the 50 specimens operate
57	54	63	68	74
68	65	74	79	86
79	76	87	92	99
93	90	101	106	113
100	97	108	113	120
121	118	129	134	141
141	138	149	155	163
163	160	171	177	186
182	179	190	196	206
204	201	212	218	228
227	224	235	242	252
260	257	268	275	286
343	340	351	359	372

Table 4 — Flow constant

Nominal diameter of orifice mm	*K*	*K* for dry sprinklers
10	57 ± 3	57 ± 5
15	80 ± 4	80 ± 6
20	115 ± 6	115 ± 9

6.6 Strength of sprinkler body

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

6.7 Strength of release element

6.7.1 The average strength of glass bulb elements shall be at least six times the average service load of the sprinkler when tested in accordance with 7.9.1.

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

— sustain a load of 15 times its design load corresponding to the maximum service load measured in 7.3 for a period of 100 h; or

— demonstrate the ability to sustain the design load when tested in accordance with 7.9.2.

6.8 Leak resistance

A sprinkler shall not show any sign of leakage when tested in accordance with 7.4.

6.9 Heat exposure

6.9.1 Glass bulb sprinklers

There shall be no damage to the glass bulb element when sprinklers are tested in accordance with 7.7.1.

6.9.2 Uncoated sprinklers

Sprinklers shall withstand exposure to increased ambient temperature without evidence of weakness or failure, when tested in accordance with 7.7.2.

6.9.3 Coated sprinklers

In addition to meeting the requirement of 6.9.2 in an uncoated version, coated sprinklers shall withstand exposure to increased ambient temperatures without evidence of weakness or failure of the coating, when tested in accordance with 7.7.3.

6.10 Thermal shock

Glass bulb sprinklers shall not be damaged when tested in accordance with 7.8. Proper operation is not considered as damage.

6.11 Corrosion

6.11.1 Stress corrosion

When tested in accordance with 7.12.1, sprinklers shall not show fractures which could affect their ability to satisfy other requirements.

6.11.2 Sulfur dioxide corrosion

Sprinklers shall be sufficiently resistant to sulfur dioxide saturated with water vapour when conditioned in accordance with 7.12.2. Following exposure, the sprinklers shall operate when functionally tested at 0,35 bar (0,035 MPa) (see 6.5.1 and 7.5.2).

6.11.3 Salt spray corrosion

Sprinklers shall be sufficiently resistant to salt spray and shall satisfy the requirements of 7.12.3.

6.11.4 Moist air exposure

Sprinklers shall be sufficiently resistant to moist air exposure and shall satisfy the requirements of 6.14.2 after being tested in accordance with 7.12.4.

6.12 Integrity of sprinkler coating

6.12.1 Evaporation of wax and bitumen

Waxes and bitumens used for coated 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 in accordance with 7.13.1.

6.12.2 Resistance to low temperatures

Coatings used for sprinklers shall not crack or flake when subjected to low temperatures in accordance with 7.13.2.

6.12.3 Resistance to high temperatures

Coated sprinklers shall meet the requirements of 6.9.3.

6.13 Water hammer

Sprinklers shall not leak when subjected to pressure surges from 4 bar to 25 bar. They shall not show signs of mechanical damage when tested in accordance with 7.15 and shall operate within the parameters of the functional test at a pressure of 0,35 bar (0,035 MPa) (see 6.5.1).

6.14 Dynamic heating

See also the references in annex B.

6.14.1 Standard, special and fast response sprinklers shall meet the RTI and C limits shown in figure 1, when tested in the standard orientation in accordance with 7.6.2. Maximum and minimum RTI values for all data points calculated using C for the fast and standard response sprinklers shall fall within the appropriate category shown in figure 1. Special response sprinklers shall have a mean RTI value, calculated using C, of between 50 and 80 with no individual value less than 40 or more than 100. When tested in the worst case orientation in accordance with 7.6.2, the RTI shall not exceed 600 $(m \cdot s)^{1/2}$ or 250 % of the value of RTI in the standard orientation, whichever of the two values is less.

6.14.2 After exposure to the corrosion test specified in 6.11.2 to 6.11.4, sprinklers shall be tested in the standard orientation in accordance with 7.6.2.1 to determine the post-exposure RTI.

Post-exposure RTI values shall not exceed the limits shown in figure 1 for the appropriate category. In addition, the mean RTI value shall not exceed 130 % of the pre-exposure average value. Post-exposure RTI values shall be calculated in accordance with 7.6.2.3 using the pre-exposure conductivity factor (C).

6.15 Resistance to heat

Open sprinklers shall be sufficiently resistant to high temperatures when tested in accordance with 7.14. After exposure, the sprinkler shall not show significant deformation or breakage.

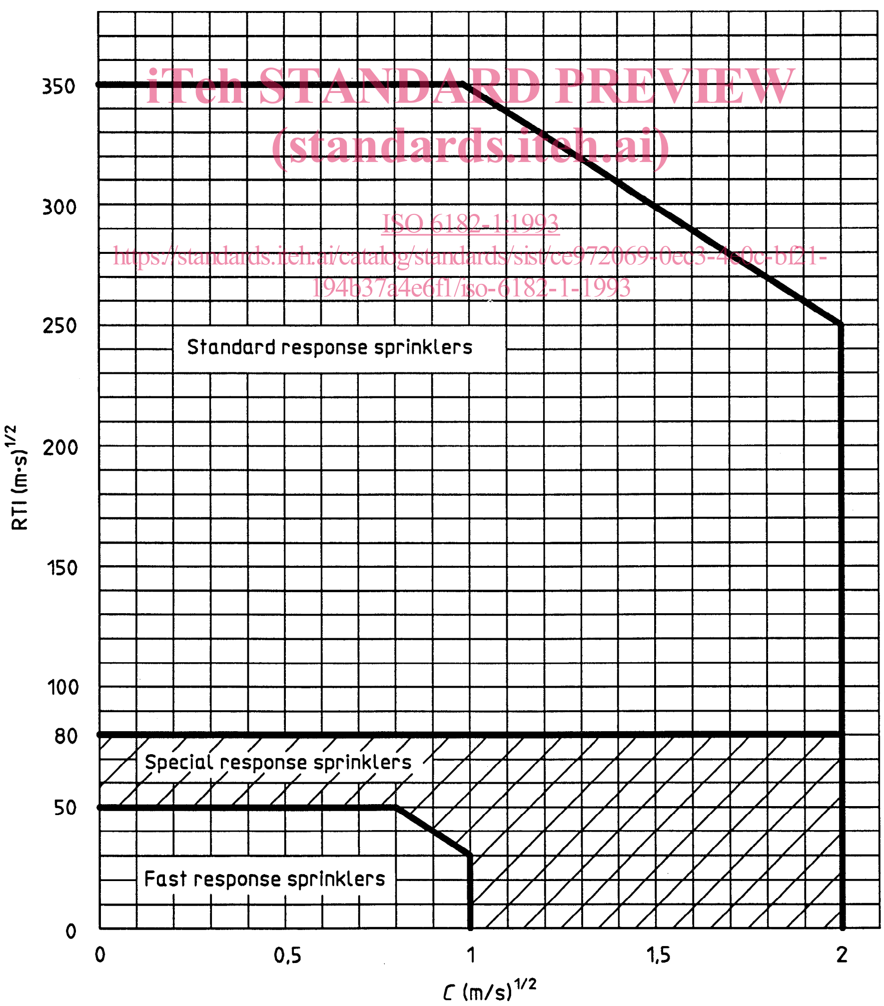

Figure 1 — Standard orientation RTI and C limits

6.16 Resistance to vibration

Assembled sprinklers shall be able to withstand the effects of vibration without deterioration of their performance characteristics when tested in accordance with 7.16. After the vibration test of 7.16, assembled sprinklers shall not show visible deterioration and shall meet the requirements of 6.5 and 6.8.

6.17 Resistance to impact

Conventional and spray sprinklers shall have adequate strength to withstand impacts associated with handling, transport and installation without deterioration of their performance or reliability. Resistance to impact shall be determined in accordance with 7.17.

NOTE 10 Requirements for other sprinklers are in preparation.

6.18 Crib fire performance

Pendent and upright sprinklers having nominal orifice diameters of 15 mm shall control crib fires when tested in accordance with 7.18.

NOTE 11 Requirements and test methods for other sprinklers are in the course of preparation.

6.19 Lateral discharge

Sprinklers shall not prevent the operation of adjacent sprinklers when tested in accordance with 7.19.

6.20 30 day leakage resistance

Sprinklers shall not leak, sustain distortion or other mechanical damage when subjected to 20 bar (2 MPa) water pressure for 30 d. Following exposure, the sprinklers shall satisfy the test requirements of 7.20.

6.21 Vacuum resistance

Sprinklers shall not exhibit distortion, mechanical damage or leakage after testing in accordance with 7.21.

7 Test methods

The following tests shall be carried out for each type of sprinkler. Before testing, precise drawings of parts and the assembly shall be submitted together with the appropriate specifications (using SI units). Tests shall be carried out at an ambient temperature of $(20 \,^{+5}_{0})$ °C, unless other temperatures are indicated. A suggested test programme is illustrated in figure 2 for guidance.

Sprinklers shall be tested with all the components required by their design and installation.

7.1 Preliminary examination

Examine the construction to ensure that it complies with the requirements of clauses 4 and 5.

7.2 Visual examination

Before testing, examine the sprinklers visually with respect to the following points:

a) marking;

b) conformity of the sprinklers with the manufacturer's drawings and specifications;

c) obvious defects.

7.3 Determination of service load

See 6.7.

7.3.1 Measure the service load by securely installing the sprinkler, at room temperature, in a tensile/compression test machine and applying an equivalent of a hydraulic pressure of 12 bar (1,2 MPa) at the inlet.

Use an indicator capable of reading deflection to an accuracy of 0,01 mm to measure any change in length of the sprinkler between its load bearing points. Movement of the sprinkler shank thread in the threaded bush of the test machine shall be avoided or taken into account.

Release hydraulic pressure and remove the heat responsive element of the sprinkler by a suitable method. When the sprinkler is at room temperature, make a second measurement using the indicator.

Apply an increasing mechanical load to the sprinkler, at a rate not exceeding 500 N/min, until the indicator reading at the deflector end of the sprinkler returns to the initial value achieved under hydrostatic load. Record the mechanical load necessary to achieve this which is defined as the service load.

Repeat the test on another four specimens and take the mean of the results which is defined as the average service load

7.3.2 Increase the applied load progressively at a rate not exceeding 500 N/min on each of the five specimens until twice the average service load has been applied. Maintain this load for (15 ± 5) s.

Remove the load and record any permanent elongation as defined in 6.6.