INTERNATIONAL STANDARD

ISO 6182-1

Second edition
2004-02-01

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

Reference number
ISO 6182-1:2004(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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 6182-1 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

This second edition cancels and replaces the first edition (ISO 6182-1:1993), which has been technically revised.

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*

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

— *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*

Fire protection — Automatic sprinkler systems —

Part 1:
Requirements and test methods for sprinklers

1 Scope

This part of ISO 6182 specifies performance and marking requirements and test methods for conventional, spray, flat spray and sidewall sprinklers. It is not applicable to sprinklers having multiple orifices.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7-1:1982, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

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

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

PPP-B-640D:1969, *Federal Specification for Boxes, Fiberboard, Corrugated, Triple-wall*

3 Terms and definitions

For the purposes of this document, the following terms and 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

NOTE The conductivity factor is expressed in units of $(m/s)^{0,5}$.

3.1.3
response time index
RTI
measure of sprinkler sensitivity

$$\text{RTI} = \tau\sqrt{u}$$

where

τ is equal to the time constant, expressed in seconds, of the heat-responsive element;

u is the gas velocity, expressed in metres per second

NOTE 1 The response time index is expressed in units of $(\text{m}\cdot\text{s})^{0,5}$.

NOTE 2 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.

3.1.4
standard orientation
orientation that produces the shortest response time with the axis of the sprinkler inlet perpendicular to the air flow

NOTE 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, it is with the air flow perpendicular to both the waterway axis and the plane of the frame arms which produces the shortest response time.

3.1.5
worst-case orientation
⟨response⟩ orientation that produces the longest response time with the axis of the sprinkler inlet perpendicular to the air flow

3.1.6
assembly load
force exerted on the sprinkler body at 0 MPa (0 bar) hydraulic pressure at the inlet

3.1.7
design load
force exerted on the release element at the service load of the sprinkler

3.1.8
service load
combined force exerted on the sprinkler body by the assembly load of the sprinkler and the equivalent force of a 1,2 MPa (12 bar) hydraulic pressure of the inlet

3.1.9
average design strength
⟨**axial**⟩ glass bulb supplier's specified and assured lowest average design strength of any batch of 50 bulbs

3.2 Types of sprinkler 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 the glass bulb through pressure resulting from expansion of the fluid enclosed therein

3.3 Types of sprinkler 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 such that 40 % to 60 % of the total water flow is initially directed downward

3.3.2
spray sprinkler
S
sprinkler giving paraboloid water distribution directed downward for a definite protection area such that 80 % to 100 % of the total water flow is initially directed downward

3.3.3
flat spray sprinkler
F
sprinkler giving paraboloid water distribution directed downward for a definite protection area, such that 60 % to 80 % of the total water flow is initially directed downward

3.3.4
sidewall sprinkler
W
sprinkler giving a one-sided (half-paraboloid) water distribution over a definite protection area

3.4 Types of sprinkler according to position

3.4.1
upright sprinkler
U
sprinkler arranged such that the water stream is directed upwards against the distribution plate

3.4.2
pendent sprinkler
P
sprinkler arranged such that the water stream is directed downwards against the distribution plate

3.4.3
horizontal sprinkler
H
sprinkler arranged such that the water stream is directed horizontally against the distribution plate

3.5 Special types of sprinkler

3.5.1
dry upright sprinkler
unit comprising an upright installed sprinkler mounted at the outlet of a special riser extension with a seal at the inlet end that prevents water from entering the riser until it is released by operation of the sprinkler

3.5.2
dry pendent sprinkler
unit comprising a pendent installed sprinkler mounted at the outlet of a special drop extension with a seal at the inlet end that prevents water from entering the drop until it is released by operation of the sprinkler

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

3.5.4
recessed sprinkler
sprinkler of which all or part of the body, other than the shank thread, is mounted within recessed housing

3.5.5
concealed sprinkler
recessed sprinkler having a cover plate

3.5.6
on/off sprinkler
O/O
sprinkler that repeatedly opens under the influence of heat and closes if a heat-sensitive element cools to 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 that has a factory-applied coating for corrosion protection

3.5.9
sprinkler with water shield
sprinkler, intended for use in racks or beneath open grating, which is provided with a water shield mounted above the heat-responsive element to protect it from water discharged by sprinklers at higher elevations

3.5.10
extended-coverage sprinkler
EC
sprinkler having a specified area of coverage larger than that of a conventional, spray, flat spray or sidewall sprinkler

3.6 Types of sprinkler according to sprinkler sensitivity

3.6.1
fast-response sprinkler
sprinkler having a response time index (RTI) $\leqslant$ 50 $(\text{m}\cdot\text{s})^{0,5}$ and a conductivity factor (C) of $\leqslant$ 1,0 $(\text{m/s})^{0,5}$

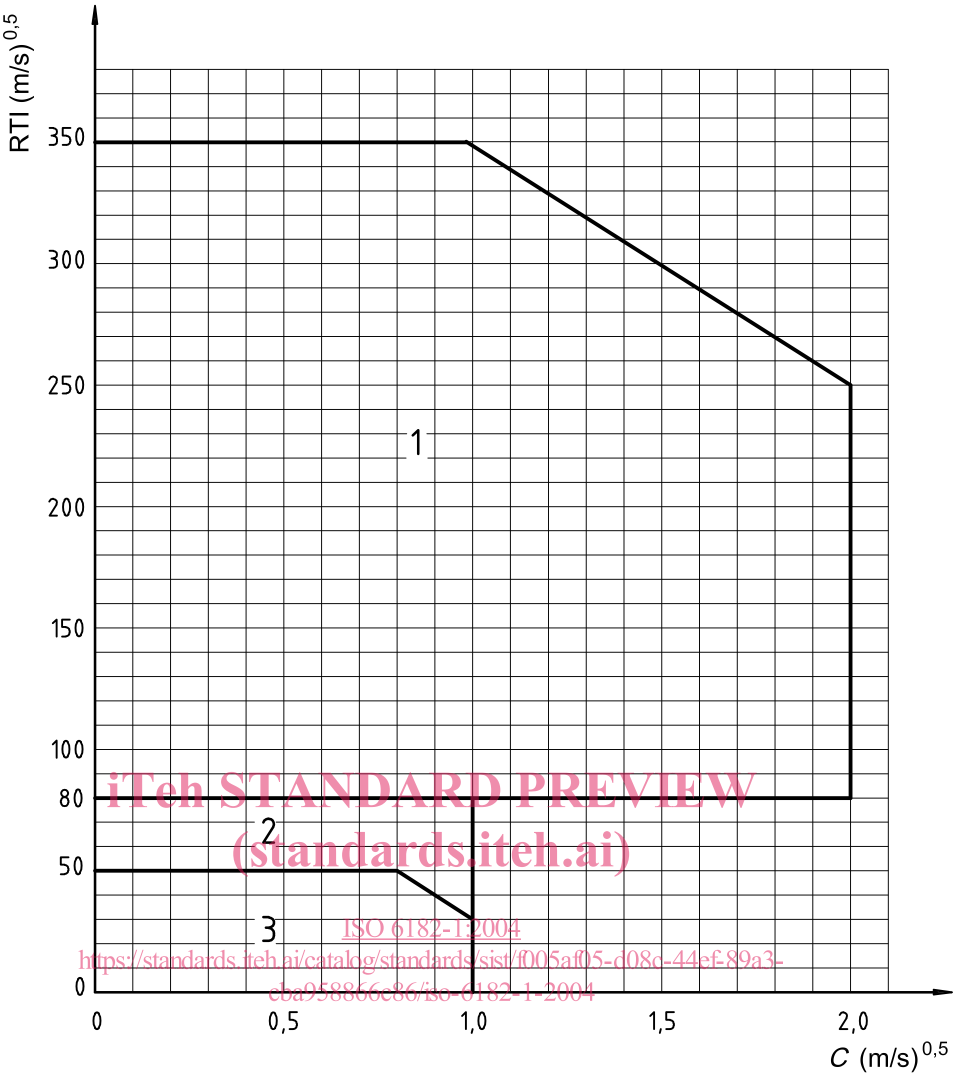
See Figure 1.

3.6.2
special-response sprinkler
sprinkler having an average response time index (RTI) of between 50 $(\text{m}\cdot\text{s})^{0,5}$ and 80 $(\text{m}\cdot\text{s})^{0,5}$ and a conductivity (C) factor of $\leqslant$ 1,0 $(\text{m/s})^{0,5}$

See Figure 1.

3.6.3
standard-response sprinkler
sprinkler having a response time index (RTI) of between 80 $(\text{m}\cdot\text{s})^{0,5}$ and 350 $(\text{m}\cdot\text{s})^{0,5}$ and a conductivity (C) factor not exceeding 2,0 $(\text{m/s})^{0,5}$

See Figure 1.



Key

1 standard-response sprinklers

2 special-response sprinklers

3 fast-response sprinklers

Figure 1 — RTI and C limits for standard orientation

4 Product consistency

4.1 Quality control programme

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.

4.2 Leak resistance testing

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

5 Product assembly

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

6 Requirements

6.1 Dimensions

Sprinkler dimensions shall be in accordance with Table 1.

Table 1 — Dimensional requirements

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

6.1.1 Orifice size

6.1.1.1 All sprinklers shall be constructed so that a sphere of diameter 8 mm can pass through each water passage in the sprinkler, with the exceptions specified in 6.1.1.2.

6.1.1.2 In some countries, sprinklers having orifices of nominal diameters 6 mm, 8 mm or 9 mm, or sprinklers having multiple water passages, are acceptable.

In those countries where 6 mm or 8 mm orifice automatic sprinklers are acceptable, and 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.

In those countries where sprinklers having multiple water passages are acceptable, and 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.

6.1.2 Nominal thread sizes

6.1.2.1 Nominal thread sizes shall be suitable for fittings threaded in accordance with ISO 7-1. The dimensions of all threaded connections should conform to International Standards where applied or shall conform to national standards where International Standards are not applicable

6.1.2.2 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.

6.1.2.3 Special sprinklers such as dry and flush sprinklers may have larger thread sizes.

6.2 Nominal operating temperature (see 7.7.1)

6.2.1 The nominal operating temperature of glass bulb sprinklers shall be in accordance with Table 2.

6.2.2 The nominal operating temperatures of all other sprinklers shall be specified in advance by the manufacturer and verified in accordance with 6.3, and shall be determined according to 7.7.1. Nominal operating temperature ranges for these sprinklers shall be in accordance with Table 2.

6.2.3 The nominal operating temperature to be marked on the sprinkler shall be that determined when the sprinkler is tested according to 7.7.1, taking into account the requirement of 6.3.

Table 2 — Nominal operating temperatures

Glass bulb sprinklers	
Nom. operating temperature I °C	**Liquid colour 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
Fusible element sprinklers	
Nom. operating temperature range I °C	**Yoke arm colour code**
57 to 77	uncoloured
80 to 107	white
121 to 149	blue
163 to 191	red
204 to 246	green
260 to 302	orange
320 to 343	orange

6.3 Operating temperature (see 7.7.1)

Sprinklers shall operate within a temperature range of

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

where I is the nominal operating temperature.

6.4 Water flow and distribution

6.4.1 Flow constant (see 7.11)

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

$$K = \frac{q}{\sqrt{10p}}$$

where

p is the pressure, expressed in megapascals;

q is the flow rate, expressed in litres per minute;

K-factor for sprinklers according to this part of ISO 6182 shall be in accordance with Table 3 when determined by the test method given in 7.11.

Table 3 — 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

6.4.2 Water distribution (see 7.12)

To demonstrate the required coverage of the protected area allotted to it, the sprinkler shall pass the test according to 7.12.

6.5 Function (see 7.6)

6.5.1 When tested in accordance with 7.6.1 to 7.6.5, the sprinkler shall open and, within 5 s of the release of the heat-responsive element, shall operate satisfactorily in accordance with 6.4.1. Any lodgement of released parts shall be cleared within 60 s of release of the heat-responsive element for standard response sprinklers and within 10 s for special- and fast-response sprinklers; otherwise, the sprinkler shall then comply with 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 7.6.6 and shall be in accordance with 6.4.2.

NOTE In most instances, visual examination of the sprinkler will be sufficient to establish conformance with 6.5.1 and 6.5.2.

6.5.3 An on/off sprinkler shall switch between the fully off and fully on positions. No intermediate, partially on, position is acceptable. After initial operation, leakage not exceeding 20 ml/min is acceptable in the off position (see 7.27.10).

6.6 Service load and strength of sprinkler body (see 7.4)

6.6.1 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 according to 7.4.

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

6.7 Strength of heat-responsive element (see 7.10)

6.7.1 When tested in accordance with 7.10.1, glass bulb elements shall

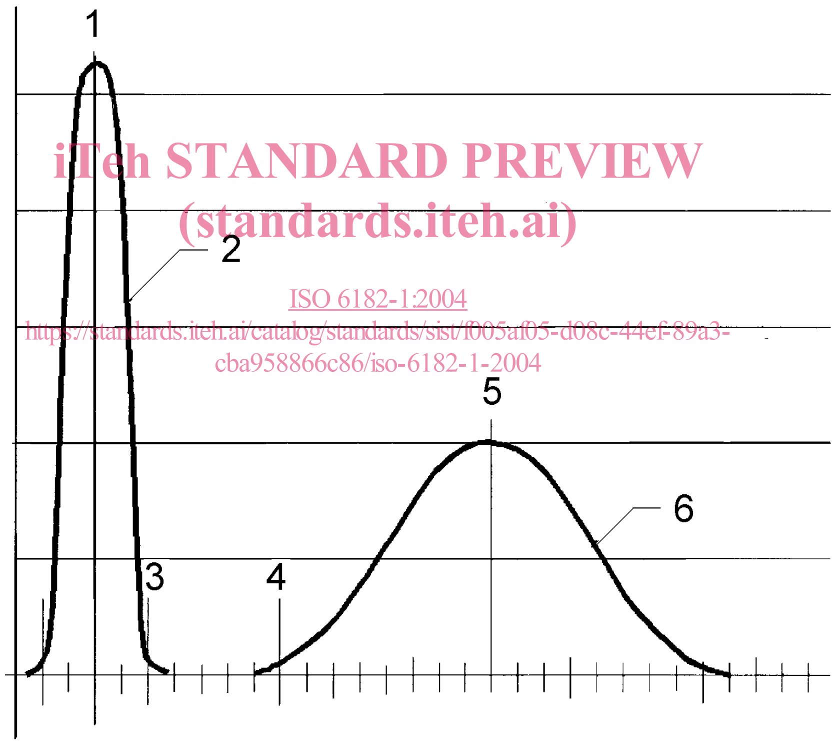
a) have an average design strength of at least six times the average service load, and

b) have a design strength lower tolerance limit (LTL) on the strength distribution curve of at least twice 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 % of samples (P), based on normal or Gaussian distribution except where other distribution can be shown to be more applicable owing to manufacturing of design factors (see Figure 2).

6.7.2 A fusible heat-responsive element 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 according to 7.4 for a period of 100 h when tested in accordance with 7.10.2.1, or

b) demonstrate the ability to sustain the design load when tested in accordance with 7.10.2.2.



Key

1 average service load
2 service load curve
3 UTL
4 LTL
5 average design strength
6 design strength curve

Figure 2 — Strength curve

