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Third edition
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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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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

This third edition cancels and replaces the second edition (ISO 6182-1:2004), of which it constitutes a minor revision.

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 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 grooved-end components for steel pipe systems*

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.

NOTE The requirements for early suppression fast response (ESFR) sprinklers are in ISO 6182-7; the requirements for domestic sprinklers are in ISO 6182-10; and the requirements for extended coverage (EC) sprinklers are under development.

2 Normative references

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

ISO 7-1:1994, *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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General

3.1.1
assembly load
force exerted on the sprinkler body excluding hydrostatic pressure

3.1.2
average design strength
glass bulb supplier's specified and assured lowest average axial design strength of any batch of 50 bulbs

3.1.3
design load
force exerted on the release element at the service load of the sprinkler

3.1.4
housing assembly/escutcheon
ornamental or protective component(s) around the hole from which the sprinkler penetrates the plane of the ceiling or the wall

Note 1 to entry: See Figure 1.

Note 2 to entry: For the purposes of this part of ISO 6182, housing applies to recessed and concealed sprinklers.

3.1.5
response time index
RTI
measure of sprinkler sensitivity

$$RTI = t\sqrt{u}$$

where

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

u is the gas velocity, expressed in meters per second.

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

3.1.6
service load
combined force exerted on the sprinkler body by the assembly load of the sprinkler and the equivalent force of the rated pressure on the inlet

3.1.7
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

3.1.8
standard orientation
orientation that produces the shortest response time with the axis of the sprinkler inlet perpendicular to the airflow

Note 1 to entry: In the case of symmetrical heat-responsive elements, standard orientation is with the airflow 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 airflow perpendicular to both the waterway axis and the plane of the frame arms which produces the shortest response time.

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
flat spray sprinkler
F
sprinkler giving water distribution directed downward for a definite protection area, such that 85 % to 100 % of the total water flow is initially directed downward with a wider spray angle than expected with a spray sprinkler

Note 1 to entry: This type of sprinkler is used in storage racks and other shallow areas in some countries.

3.3.3
sidewall sprinkler
W
sprinkler giving a one-sided water distribution over a definite protection area

3.3.4
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

3.4 Types of sprinkler according to position

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

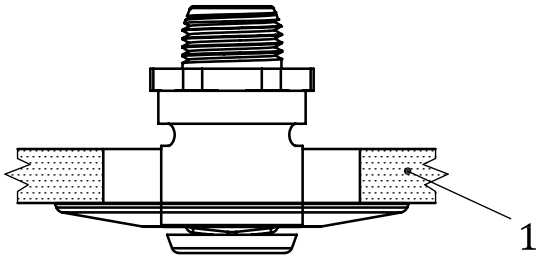
3.5 Special types of sprinkler

3.5.1
coated sprinkler
sprinkler that has a factory-applied coating for corrosion protection

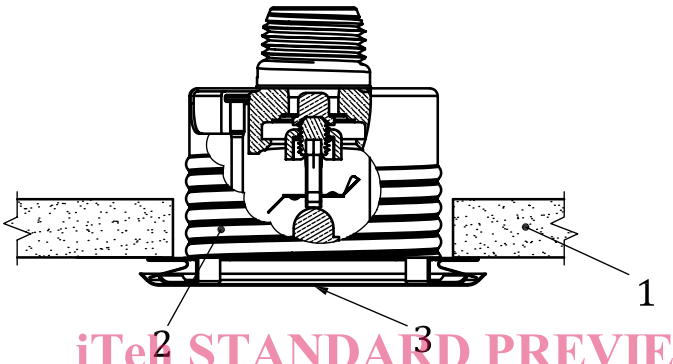
Note 1 to entry: For this part of ISO 6182, coated sprinkler does not include coatings intended for aesthetic purposes.

3.5.2
concealed sprinkler
recessed sprinkler having a cover plate

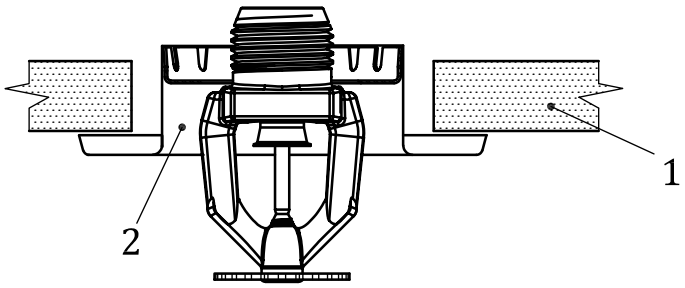
Note 1 to entry: See Figure 1.



a) Flush



b) Concealed



c) Recessed

Key

1 ceiling
2 housing assembly
3 cover plate

Figure 1 — Flushed, concealed, and recessed sprinklers

3.5.3
dry sprinkler
assembly comprising of a sprinkler mounted at the outlet of a special extension with a seal at the inlet that prevents water from entering the extension until it is released by operation of the sprinkler

Note 1 to entry: These sprinklers may consist of pendent, sidewall, or other types.

3.5.4
flush sprinkler
for pendent sprinklers, all or part of the body is mounted above the lower plane of the ceiling, but all of the heat-responsive collector is below the lower plane of the ceiling; for sidewall sprinklers, the sprinkler is within the wall, but the heat-responsive collector projects into the room beyond the plane of the wall

Note 1 to entry: See Figure 1.

Note 2 to entry: These are not typically frame arm sprinklers.

3.5.5
multiple orifice sprinkler
MO
sprinkler having two or more outlet orifices arranged to distribute the water discharge in a specified pattern and quantity for a definite protection area

Note 1 to entry: Multiple orifice sprinklers are excluded from this part of ISO 6182 in the scope.

3.5.6
recessed sprinkler
sprinkler of which all or part of the body, other than the thread, is mounted within a recessed housing

Note 1 to entry: See Figure 1.

3.5.7
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

Note 1 to entry: Sprinklers with water shields may be a single unit that is assembled by the manufacturer or a combination of sprinkler and water shield (which in some countries are evaluated separately from the sprinkler approval) assembled on site.

3.6 Types of sprinkler according to sprinkler sensitivity

3.6.1
fast-response sprinkler
sprinkler having a response time index (RTI) ≤50 $(m \cdot s)^{0,5}$ as determined in 6.14 or for concealed and recessed sprinklers, a maximum response time of 75 s as determined in 6.25

3.6.2
special-response sprinkler
sprinkler having an average response time index (RTI) of between 50 $(m \cdot s)^{0,5}$ and 80 $(m \cdot s)^{0,5}$

3.6.3
standard-response sprinkler
sprinkler having a response time index (RTI) of between 80 $(m \cdot s)^{0,5}$ and 350 $(m \cdot s)^{0,5}$ or for concealed and recessed sprinklers, a maximum response time as determined in 6.25

4 Product consistency

4.1 Quality control program

It shall be the responsibility of the manufacturer to implement a quality control program to ensure that production continuously meets the requirements of this part of ISO 6182.

4.2 Leak resistance testing

Every manufactured sprinkler shall pass a leak resistance test equivalent to a hydrostatic pressure of at least twice the rated pressure.

4.3 Glass bulb integrity test

Each glass bulb sprinkler assembly shall be evaluated for glass bulb cracking, breaking, or other damage as indicated by the loss of fluid. The test shall be conducted after the leakage test.

The bubble in each glass bulb shall be examined at room ambient temperature. The sprinkler shall then be heated in a circulating air oven or liquid bath to 5 °C below the minimum operating temperature range of the sprinkler. The bubble shall then be examined to determine if the bubble size has been reduced in accordance with the glass bulb manufacturer's specifications. After cooling, the bubble size shall again be examined to determine if the bubble returned to the original size within the tolerance allowed by the glass bulb manufacturer.

5 Product assembly

5.1 General

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

NOTE This requirement does not apply to units intended for assembly/adjustment on site, e.g. combinations of sprinkler and housing assemblies/escutcheons or the assembly of the cover plate to concealed sprinklers.

5.2 Dynamic O-ring seals

The closure of the waterway shall not be achieved by the use of a dynamic O-ring or similar seal. (An O-ring or similar seal moves during operation or is in contact with a component that moves during operation.)

5.3 Rated pressure

Sprinklers shall have a rated pressure of not less than 1,2 MPa (12 bar).

5.4 Dry sprinklers

When installed with the intended fittings specified in the manufacturer's installation instructions, dry sprinklers in dry systems shall be constructed to minimize the potential to accumulate water, scale, and sediment on the sprinkler inlet. The sprinkler inlet shall also be constructed not to substantially impact the sprinkler *K*-factor or pressure loss through the fitting.

6 Requirements

6.1 Dimensions

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 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

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.

6.2 Temperature ratings and colour coding

The marked nominal temperature rating and colour coding of the sprinkler shall be in accordance with Table 1.

Table 1 — Nominal temperature rating and colour coding

Glass bulb sprinklers		Fusible element sprinklers	
Marked nominal temperature rating °C	Liquid colour code	Marked nominal temperature rating °C	Yoke arm colour code
57	orange	57 to 77	uncoloured
68	red		
79	yellow	80 to 107	white
93, 107	green		
121, 141	blue	121 to 149	blue
163, 182	mauve	163 to 191	red
204, 227, 260, 343	black	204 to 246	green
		260 to 302, 320 to 343	orange

NOTE See 8.1 for concealed, flush, coated, and plated sprinklers.

6.3 Operating temperature (see 7.4)

Sprinklers shall be verified to operate within a temperature range of

$$t = x \pm (0{,}035x + 0{,}62)\ °C$$

where

t is the temperature range, rounded to the nearest 0,1 °C;

x is the marked nominal temperature rating (see Table 1).

6.4 Water flow and distribution

6.4.1 Water flow constant (see 7.5)

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

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

where

p is the pressure, expressed in megapascals (MPa);

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

The *K*-factor for sprinklers, according to this part of ISO 6182, shall be in accordance with Table 2 when determined by the test method given in 7.5.

6.4.2 Water distribution (see 7.6)

6.4.2.1 When tested in accordance with 7.6, the sprinkler shall meet the following applicable requirements.

For other than sidewall types, the number of containers having less than 50 % of the water coverage, as specified in Column 2 of Table 5, shall not exceed the permitted number of containers with a lower content of water, as specified in Column 6 of Table 5.

6.4.2.2 Sidewall sprinklers must meet the following requirements.

In the area between the sidewall sprinklers, the back wall shall be completely wetted from the floor up to 1,2 m below the deflector (see Figure 11).

The total quantity of water collected along the back wall shall be a minimum of 3,5 % of the total water discharged from the sprinklers during the test.

For sidewall sprinklers having a nominal *K*-factor of 80 (l/min)/(bar½) or less, the water flow rate shall be 57 l/min for each sprinkler. The average water collection rate in the containers shall be not less than 2 mm/min and the minimum water collection rate in any individual pan shall be 1,2 mm/min.

For sidewall sprinklers having a nominal *K*-factor of 115 (l/min)/(bar½), the water flow rate shall be 78 l/min for each sprinkler. The average water collection rate in the containers shall be not less than 2,8 mm/min and the minimum water collection rate in any individual pan shall be 1,2 mm/min.

6.4.2.3 The water discharge of sprinklers downward from the deflectors shall be

— 40 % to 60 % for conventional sprinklers,

— 85 % to 100 % for flat spray sprinklers, and

— 80 % to 100 % for spray sprinklers.

Exception: this requirement does not apply to recessed, flush, concealed, and sidewall sprinklers.

Table 2 — Flow constant requirements

Flow constant *K* (l/min)/(bar½)	Flow constant *K* for dry sprinklers (l/min)/(bar½)
57 ± 3	57 ± 5
80 ± 4	80 ± 6
115 ± 6	115 ± 9

NOTE 1 (l/min)/(bar½) = 0,003 2 (m³/min)/(MPa½).

6.5 Function (see 7.7)

6.5.1 Lodgement (see 7.7.1)

When tested in accordance with 7.7.1, the sprinkler shall open and any lodgement of released parts shall be cleared within 60 s of release of the heat-responsive element.

If lodgement occurs at any pressure level and test arrangement, 25 additional sprinklers shall be tested in that arrangement and at that pressure. The total number of sprinklers in which lodgement occurs shall not exceed one out of the 30 sprinklers tested at that pressure and in that arrangement.

6.5.2 Deflector strength (see 7.7.2)

The deflector and its supporting parts shall not sustain significant damage as a result of the deflector strength test specified in 7.7.2.

If minor damage is noted, testing in accordance with 6.4.2 can be done to demonstrate compliance.

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

6.6 Service load and strength of sprinkler body (see 7.8)

6.6.1 The sprinkler body shall comply with the requirements of 6.6.1.1 or 6.6.1.2.

6.6.1.1 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 7.8.1 or 7.8.2.

6.6.1.2 The sprinkler body shall not show permanent elongation of more than 50 % of the sprinkler body with the design load being applied after being subjected to twice the assembly load as measured according to 7.8.3.

6.6.2 The manufacturer shall specify the average and upper limits of the service or assembly load.

6.7 Strength of heat-responsive element (see 7.9)

6.7.1 When tested in accordance with 7.9.1, 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 (γ) of 0,99 for 99 % of samples (P), based on normal or Gaussian distribution,