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Second edition
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Fire protection — Automatic sprinkler systems —

Part 10: Requirements and test methods for domestic sprinklers

Protection contre l'incendie — Systèmes d'extinction automatiques du type sprinkler —
Partie 10: Exigences et méthodes d'essai des sprinklers domestiques

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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.

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 fire fighting systems using water*.

This second edition cancels and replaces the first edition (ISO 6182-10:2006), 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*

Introduction

Domestic sprinklers are primarily intended for use in dwelling units. These sprinklers are specifically designed to discharge water in a manner that is expected to prevent flashover within the compartment of fire origin and improve the chance for occupants to escape or be evacuated in dwelling units such as homes, apartments, condominiums, and hotel sleeping rooms. While domestic sprinklers are designed to protect against injury and loss of life, the use of these sprinklers has demonstrated the ability to provide property protection as well. Other types of sprinklers are addressed in the separate parts of the ISO 6182 series.

These sprinklers characteristically have a very flat spray pattern. This allows for the sprinklers to wet the walls of the compartment which reduces the potential for the vertical surfaces to substantially contribute to a flashover condition. These sprinklers also discharge water in a manner that provides a relatively uniform distribution of water on the protected floor area. Obstructions can pose a significant obstacle to domestic sprinklers because of the flat spray pattern. Domestic sprinkler installation guidelines need to account for the flat spray pattern when considering the distances between obstructions and the sprinkler.

Product standards, such as this one, can provide a minimum level of safety in the built environment as well as a level of quality to the products on the market.

Fire protection — Automatic sprinkler systems —

Part 10: Requirements and test methods for domestic sprinklers

1 Scope

This part of ISO 6182 specifies performance requirements, test methods, and marking requirements for domestic sprinklers.

These sprinklers are intended to provide control of fires in domestic occupancies, to prevent flashover (total involvement) in the room of fire origin and to improve the probability for successful escape or evacuation of the occupants.

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

ISO 5660-1, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method)*

ASTM G36-94, *Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution*

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 suppliers' specified and assured lowest average design strength of any batch of 50 bulbs

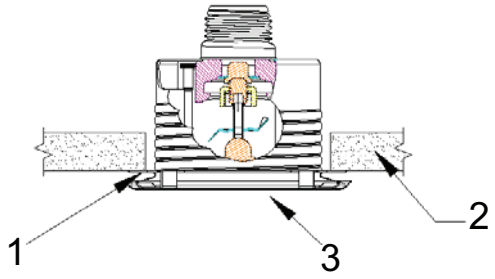
3.1.3
design length
maximum length of the sprinkler coverage area

3.1.4
design load
force exerted on the release element at the service load of the sprinkler

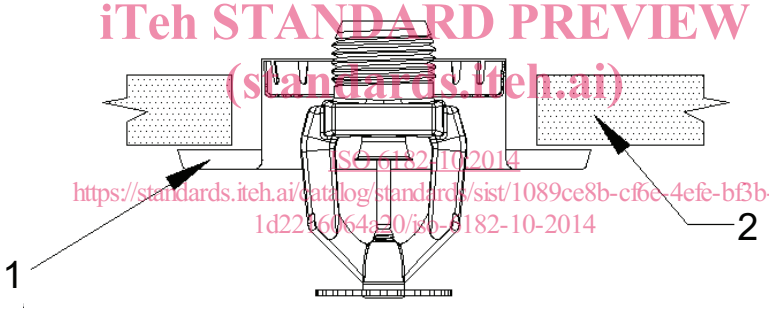
3.1.5
design width
maximum width of the sprinkler coverage area

3.1.6
housing assembly
escutcheon
ornamental or protective component(s) around the hole from which the sprinkler penetrates the plane of the ceiling or the wall

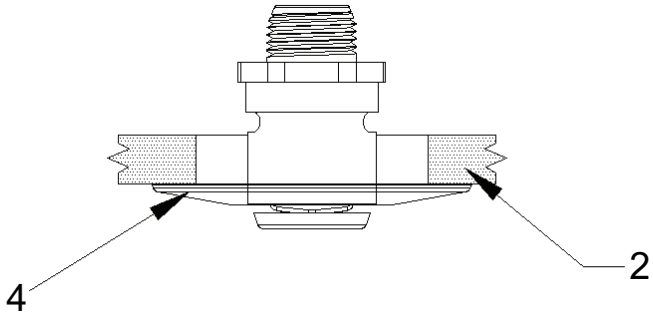
Note 1 to entry: For the purposes of this part of ISO 6182, housing assembly applies to recessed and concealed sprinklers. See Figure 1.



a) Concealed sprinkler



b) Recessed sprinkler



c) Flush sprinkler

Key
1 housing assembly
2 ceiling
3 cover plate
4 escutcheon

Figure 1 — Concealed, recessed, and flush sprinklers

3.1.7
response time index
RTI
measure of sprinkler sensitivity

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

where

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

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

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

3.1.8
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

3.1.9
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

3.1.9.1
domestic sprinkler
sprinkler intended to provide control of fire in domestic occupancies

3.1.10
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 Type of sprinklers 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 Type of sprinklers according to type of water distribution and orientation

3.3.1
horizontal sprinkler
sprinkler, arranged such that the water stream is directed horizontally against the distribution plate

3.3.2
pendent sprinkler
sprinkler, arranged such that the water stream is directed downwards against the distribution plate

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

3.3.4
upright sprinkler
sprinkler, arranged such that the water stream is directed upwards against the distribution plate

3.4 Special types of sprinklers

3.4.1
concealed sprinkler
recessed sprinkler having a cover plate

Note 1 to entry: See Figure 1.

3.4.2
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 might consist of pendent, sidewall, or other types.

3.4.3
flush sprinkler (1)
<pendent sprinkler> sprinkler in which 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

Note 1 to entry: These are not typically frame arm sprinklers.

Note 2 to entry: See Figure 1.

3.4.4
flush sprinkler (2)
<horizontal sprinkler> sprinkler which is within the wall, but the heat-responsive collector projects into the room beyond the plane of the wall

Note 1 to entry: These are not typically frame arm sprinklers.

3.4.5
recessed sprinkler
sprinkler of which all or part of the body, other than the thread, is mounted within recessed housing

Note 1 to entry: See Figure 1.

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 for at least 2 s.

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.

EXAMPLE 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 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 the bubble returned to the original size within the tolerance allowed by the glass bulb manufacturer.

5 Product assembly

5.1 General

All domestic 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 water way 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).

5.3 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 installed 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 Coverage area

This sprinkler shall have an area of coverage not exceeding 37,2 m^2.

6.1.2 Orifices

All sprinklers shall be constructed so that a sphere of diameter 5 mm can pass through the sprinkler.

6.1.3 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 rating and colour coding (see 7.2)

The marked nominal temperature rating and colour coding of 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
57	Orange	57 to 77
68	Red	79 to 107
79	Yellow	—
93, 107	Green	—

6.3 Operating temperatures (see 7.2)

Sprinklers shall be verified to operate within the temperature range of:

$$t = x \pm (0{,}035x + 0{,}62)°C \quad (1)$$

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 (see 7.3 and 7.4)

6.4.1 Water flow constant (see 7.3)

6.4.1.1 The flow constant, K, for sprinklers is given by Formula (2):

$$K = \frac{q}{\sqrt{10p}} \quad (2)$$

where

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

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

6.4.1.2 The value of the nominal flow constant, K, published in the manufacturer's design and installation instructions shall be verified using the test method of 7.3. Each flow constant, K, (calculated) shall be within ±5 % or ±3 units of the manufacturer's value, whichever is greater.

6.4.2 Water distribution (see 7.4)

6.4.2.1 General

To demonstrate the required coverage of the protected area allotted to it, a domestic sprinkler shall comply with the horizontal surface water distribution and vertical surface water distribution requirements described in 6.4.2.2 and 6.4.2.3.

6.4.2.2 Horizontal surfaces

When installed in accordance with the manufacturer's design and installation instructions and tested as described in 7.4.1.1 to 7.4.1.4, a sprinkler shall distribute water over a horizontal surface, such that, the discharge density collected in any single 300 mm × 300 mm collection pan within the design area shall be at least 0,8 mm/min, except that

a) no more than four collection pans in each quadrant shall be allowed to be at least 0,6 mm/min for upright and pendent sprinklers, and

b) no more than eight collection pans shall be allowed to be at least 0,6 mm/min for each half (split along the sprinkler centerline) of the design area for sidewall sprinklers.

6.4.2.3 Vertical surfaces

When installed in accordance with the design and installation instructions and tested as described in 7.4.2, a sprinkler shall distribute water over vertical surfaces as follows:

a) Walls within the coverage area shall be wetted to at least 700 mm of the ceiling with one sprinkler operating at the specified design flow rate.

b) For square coverage areas, each wall within the coverage area shall be wetted with at least 5 % of the sprinkler flow; for rectangular coverage areas, each wall within the coverage area shall be wetted with a proportional water amount based on 20 % of the total sprinkler discharge in accordance with Formula (3):

$$A_{\mathrm{col}} = 0{,}2\frac{l_{\mathrm{W}}}{l_{\mathrm{P}}} \tag{3}$$

where

A_{col} is the required amount of water collected on a wall, expressed in percent;

l_{W} is the wall length, expressed in metres;

l_{P} is the total perimeter of coverage area e.g. the length of all walls combined, expressed in metres.

6.5 Function (see 7.5)

6.5.1 Lodgement

When tested in accordance with 7.5.1, the sprinkler shall open and, any lodgement of released parts shall be cleared within 10 s of release of the heat-responsive element.

6.5.2 Deflector strength

The deflector and its supporting parts shall not sustain significant damage as a result of the deflector strength test specified in 7.5.2.

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 7.6)

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 7.6.1 or 7.6.2.

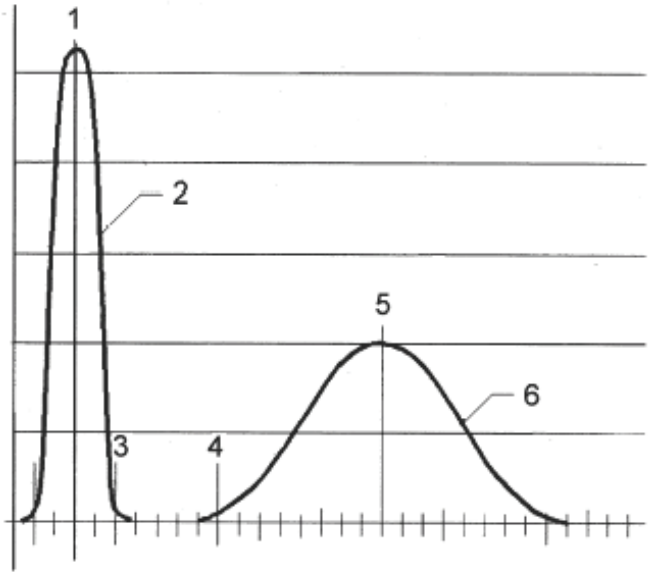
6.6.1.2 The sprinkler body shall not show permanent elongation of more than 50 % of the sprinkler body with the design load being applied after being subjected to twice the assembly load as measured according to 7.6.3.

6.6.2 The manufacturer shall specify the average and upper limit of the service or assembly load. These values shall not be exceeded when tested in accordance with 7.6.1, 7.6.2, or 7.6.3 as applicable

6.7 Strength of heat-responsive element (see 7.7)

6.7.1 Glass bulb elements

When tested in accordance with 7.7, glass bulb elements shall 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 the samples (P). Calculations will be based on normal or Gaussian distribution, except where another distribution can be shown to be more applicable due to manufacturing or design factors (see Figure 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

6.7.2 Fusible elements

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 7.7, for a period of 100 h when tested in accordance with 7.7.2.1, or

b) demonstrate the ability to sustain the design load when tested in accordance with 7.7.2.2 (see Annex B).

6.8 Leak resistance and hydrostatic strength (see 7.8)

6.8.1 A sprinkler shall not show any sign of leakage when tested according to 7.8.1.

6.8.2 A sprinkler shall not rupture, operate, or release any parts when tested according to 7.8.2.

6.9 Heat exposure (see 7.9)

6.9.1 There shall be no damage to the glass bulb element when the sprinkler is tested by the method specified in 7.9.1.

6.9.2 Sprinklers shall withstand exposure to increased ambient temperature without evidence of weakness or failure when tested by the method specified in 7.9.2.