INTERNATIONAL STANDARD

ISO 6182-10

First edition
2006-02-15

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

Reference number
ISO 6182-10:2006(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 6182-10 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

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 pipe couplings*

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

Introduction

This part of ISO 6182 is one of a number of ISO Standards prepared by ISO/TC 21 covering components for automatic sprinkler systems.

They are included in a series of ISO Standards planned to cover the following:

a) carbon dioxide systems;

b) explosion suppression systems;

c) foam systems.

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

ISO 5660-1:2002, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method)*

ANSI/UL 723:2003, *Test for surface burning characteristics of building materials*

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 at 0 MPa (0 bar) hydraulic pressure at the inlet

3.1.2
average design strength
⟨axial⟩ glass bulb suppliers' specified and assured lowest average design strength of any batch of 50 bulbs

3.1.3
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 $(m \cdot s)^{1/2}$.

3.1.4
design length
maximum length of the sprinkler coverage area

3.1.5
design load
force exerted on the release element at the service load of the sprinkler

3.1.6
design width
maximum width of the sprinkler coverage area

3.1.7
response time index
RTI
measure of sprinkler sensitivity, equal to $tu^{1/2}$, where t is the time constant of the heat-responsive element and u is the gas velocity

NOTE 1 t is expressed in units of seconds, u is expressed in metres per second, and RTI is expressed in units of $(m \cdot s)^{1/2}$.

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.

3.1.8
service load
combined force exerted on the sprinkler body by the assembly load of the sprinkler and the equivalent force of the maximum rated working 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

3.1.10
standard orientation
⟨symmetrical heat-responsive elements⟩ orientation where the airflow is perpendicular to both the axis of the waterway and the plane of the frame arms

3.1.11
standard orientation
⟨non-symmetrical heat responsive elements⟩ orientation where the airflow is perpendicular to both the waterway axis and the plane of the frame arms that produce the shortest response time

3.1.12
standard orientation
⟨worst-case (response) orientation⟩ orientation that produces the longest response time with the axis of the sprinkler inlet perpendicular to the airflow

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, caused by pressure resulting from expansion of the fluid enclosed therein

3.3 Type of sprinklers according to type of water distribution

3.3.1
domestic sprinkler
⟨residential⟩ sprinkler intended to be installed in domestic (residential) occupancies that opens automatically by operation of a heat-responsive releasing mechanism that maintains the discharge orifice closed

NOTE Upon operating at a specified temperature, water shall be discharged in a specific pattern and quantity over a definite protection area.

3.3.2
domestic sidewall sprinkler
⟨residential⟩ domestic sprinkler intended to be installed on or near the wall and near the ceiling and intended to discharge water onto the wall and outward in a one-sided (half-paraboloid) water distribution over a definite protection area

3.4 Special types of sprinklers

3.4.1
concealed sprinkler
recessed sprinkler that has a cover plate

3.4.2
flush sprinkler
sprinkler all or part of whose 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

3.4.3
recessed sprinkler
sprinkler all or part of whose body, other than the shank thread, is mounted within a recessed housing

4 Product consistency

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 in the same manner as the originally tested samples.

Every domestic 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

5.1 General

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

5.2 Domestic sprinklers

A domestic sprinkler shall be constructed to effect closure of its water seat for extend periods of time without leakage and to open as intended and release all parts from 0,034 MPa (0,34 bar) 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 Dimensions

6.1.1 Orifices

6.1.1.1 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

6.1.1.2 In some countries, sprinklers having orifices of nominal diameters 6 mm, 8 mm, 9 mm and 12 mm are acceptable.

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

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.

6.1.2.2 If International Standards are not applicable, it shall be permitted to use national standards.

6.1.2.3 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.

6.1.2.4 Special sprinklers, such as flush sprinklers, may have larger thread sizes.

6.2 Nominal operating temperatures

NOTE See 7.6.1.

The nominal operating temperature of domestic sprinklers shall be as indicated in Table 2.

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

Table 2 — Nominal operating temperature

Glass bulb sprinklers		Fusible element sprinklers	
Nominal operating temperature °C	Liquid colour code	Nominal operating temperature °C	Yoke arm colour code
57	Orange	57 to 77	Uncoloured
68	Red	79 to 107	White
79	Yellow	—	—
93, 100	Green	—	—

6.3 Operating temperatures

Domestic sprinklers shall operate within the temperature range given by Equation (1):

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

where

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

X is the marked nominal operating temperature.

6.4 Water flow and distribution

6.4.1 Flow constant (see 7.10)

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

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

where

p is the pressure, expressed in 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 7.10. 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 7.11)

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- 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 7.11.1.1 through 7.11.1.4, a domestic 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 centreline) 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 7.11.2.1 through 7.11.2.5, a domestic 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 Equation (3):

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

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 When tested in accordance with 7.5.1 through 7.5.4, domestic sprinklers shall open and, within 5 s after the release of the heat-responsive element, shall operate satisfactorily. Any lodgement of released parts shall be cleared within 10 s of release of the heat-responsive element or the sprinkler shall then comply with the requirement of 6.4.1 and 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 7.5.5 and shall meet the requirements of 6.4.2.

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 accordance with 7.3.

6.7 Strength of heat-responsive element (see 7.9)

6.7.1 When tested in accordance with 7.9, 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 % 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 of design factors. (See Annex A).

6.7.2 Fusible heat-responsive elements shall

a) sustain a load of 15 times its design load, corresponding to the maximum service load measured in accordance with 7.3, for a period of 100 h 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 resistance and hydrostatic strength (see 7.4)

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

6.8.2 A domestic 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 There shall be no damage to the glass bulb element when glass bulb domestic sprinklers are tested by the method specified in 7.7.1.

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

6.10 Thermal shock (see 7.8)

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

6.11 Corrosion

6.11.1 Stress corrosion

NOTE See 7.12.1.

When tested in accordance with 7.12.1, each domestic sprinkler shall show no cracks, delaminations or failures that can affect its ability to function as intended.

6.11.2 Sulfur dioxide corrosion

NOTE See 7.12.2.

Domestic sprinklers shall be resistant to sulfur dioxide saturated with water vapour when conditioned in accordance with 7.12.2. Following exposure, the sprinklers shall be functionally tested at 0,035 MPa (0,35 bar) only in accordance with 6.5.1, and shall meet the requirements of 6.22 for concealed, flush or recessed sprinklers or the requirements of 6.14.2 for other types of sprinklers.

6.11.3 Salt spray corrosion

NOTE See 7.12.3.

Domestic sprinklers shall be resistant to salt spray when conditioned in accordance with 7.12.3. Following exposure, the sprinklers shall be functionally tested at 0,035 MPa (0,35 bar) only in accordance with 6.5.1, and shall meet the requirements of 6.22 for concealed, flush or recessed sprinklers or the requirements of 6.14.2 for other types of sprinklers.

6.11.4 Moist air exposure

NOTE See 7.12.4.

Domestic 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 0,035 MPa (0,35 bar) only in accordance with 6.5.1, and shall meet the requirements of 6.22 for concealed, flush or recessed sprinklers or the requirements of 6.14.2 for other types of sprinklers.

6.12 Rough usage test (see 7.13)

A domestic sprinkler shall withstand the effects of rough usage without deterioration of its performance characteristics. Following 3 min of tumbling as described in 7.13, the sprinkler shall comply with the leak

requirement of 6.8.1 and the RTI requirement of 6.14.1 in standard orientation only, or in accordance with 6.22 b), the requirement for recessed, flush and concealed sprinklers.

6.13 Water hammer (see 7.15)

Sprinklers shall not leak during or after the pressure surges of 7.15. After being subjected to the test of 7.15, they shall show no signs of mechanical damage and shall meet the requirements of 6.8.1 and shall operate when functionally tested to the requirements of 6.5.1 at a pressure of 0,035 MPa (0,35 bar) only.

6.14 Dynamic heating (see 7.6.2)

6.14.1 When tested in accordance with 7.6.2 in their standard orientation, domestic sprinklers shall have a RTI not exceeding 50 $(m \cdot s)^{1/2}$ and a conductivity factor, C, less than 1 $(m \cdot s)^{1/2}$. When tested at an angular offset of 25° to the worst case orientation, the RTI shall not exceed 250 % of the value of RTI in the standard orientation.

6.14.2 After exposure to the corrosion test described in 6.11.2, 6.11.3 and 6.11.4, domestic sprinklers shall be tested in the standard orientation as described in 7.6.2.1 to determine the post-exposure RTI. The post-exposure RTI values 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.

6.15 Resistance to heat (see 7.14)

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

6.16 Resistance to vibration (see 7.16)

Domestic sprinklers shall be able to withstand the effects of vibration without deterioration when tested in accordance with 7.16. After the performance of the vibration test described in 7.16, sprinklers shall show no visible deterioration, shall meet the requirements of 6.8.1 and shall operate when functionally tested to the requirements of 6.5.1 at a pressure of 0,035 MPa (0,35 bar) only.

6.17 Resistance to impact (see 7.17)

Domestic sprinklers shall have adequate strength to withstand impacts associated with handling, transport and installation without deterioration of performance or reliability. After the performance of the impact test described in 7.17, these sprinklers shall show no fracture or deformation, shall meet the leak resistance requirement of 6.8.1, and the requirements of 6.8.1 and shall operate when functionally tested to the requirements of 6.5.1 at a pressure of 0,035 MPa (0,35 bar) only.

6.18 Fire performance (see 7.18)

6.18.1 General

When fire tested as described in 7.18.1 through 17.18.22, domestic sprinklers shall limit temperatures as specified in items a) through d). Additionally, a maximum of two domestic sprinklers shall operate. The third sprinkler at the doorway shall not operate. The total discharge rate for two domestic sprinklers shall be twice the minimum discharge rate for a single sprinkler. The sprinklers shall limit temperatures as follows.

a) Maximum temperature 76 mm below the ceiling shall not exceed 315 °C.

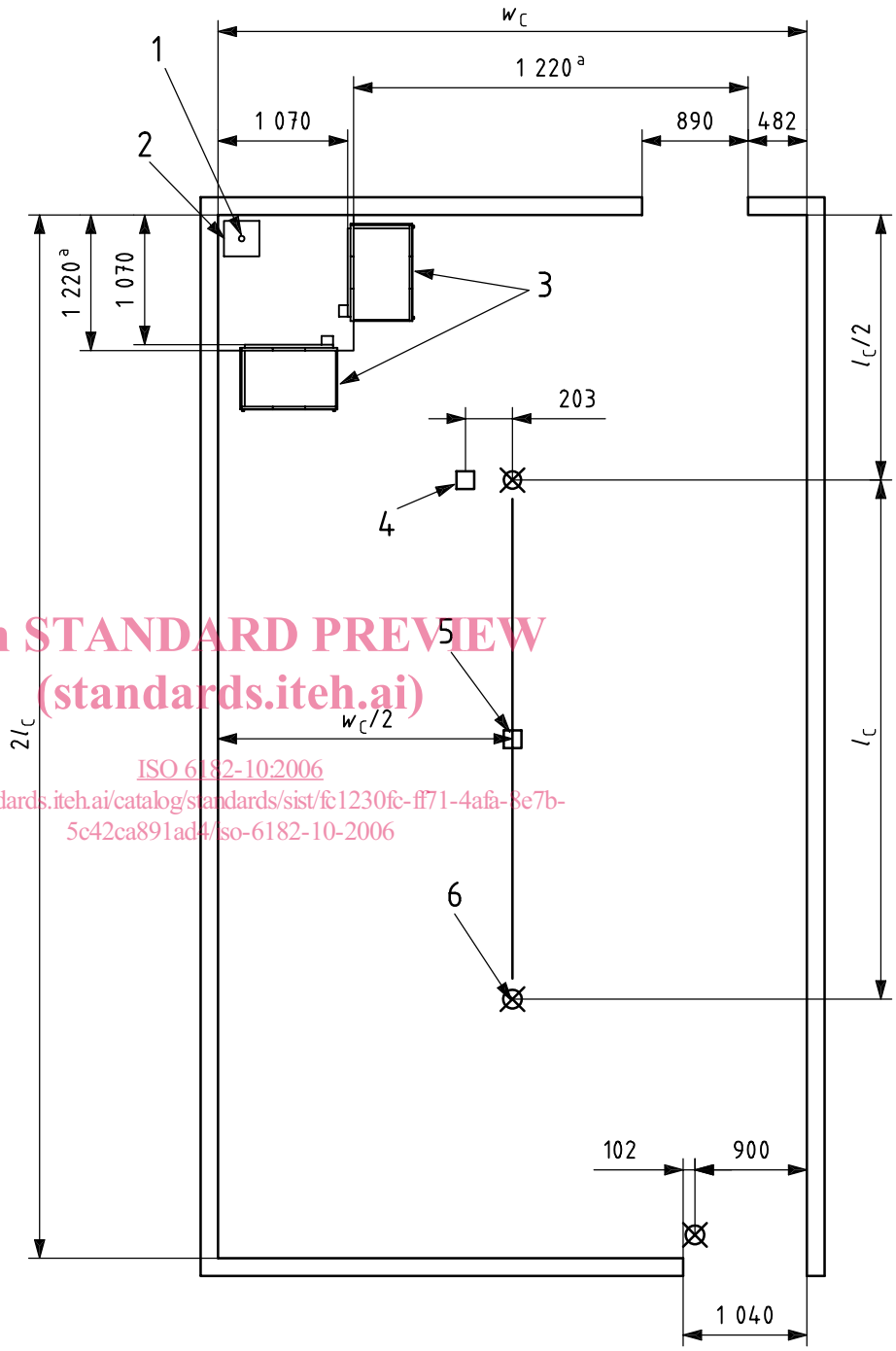
b) Maximum temperature 1,6 m above the floor shall not exceed 93 °C.

c) Temperature at the location described in item b) shall not exceed 54 °C for more than any continuous 2-min period.

d) Maximum ceiling material temperature 6,0 mm behind the finished ceiling surface shall not exceed 260 °C.

See Figure 1 (pendent or upright sprinklers) or Figures 2 and 3 (sidewall sprinklers) for temperature measuring locations.

Dimensions in millimetres



Key

1 thermocouple, 6,3 mm above ceiling and 254 mm diagonally from the corner
2 wood crib
3 simulated furniture
4 thermocouple, 76,2 mm below ceiling and 1 600 mm above the floor
5 thermocouple, 76,2 mm below ceiling (room centre)
6 sprinkler (typical)

a Plywood.

w_C coverage width

l_C coverage length

Figure 1 — Fire test arrangement — Pendent and upright