

BS 9252:2011



BSI Standards Publication

Components for residential sprinkler systems – Specification and test methods for residential sprinklers

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This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 50, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 25 May 2011. This British Standard was prepared by Subcommittee FSH/18/2, *Sprinkler systems*, under the authority of Technical Committee FSH/18, *Fixed firefighting systems*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes DD 252:2002, which is withdrawn.

Relationship with other publications

This British Standard specifies requirements for the construction and performance, and testing of fire sprinklers for use specifically in residential and domestic occupancies. Requirements for the construction, performance and testing of fire sprinklers for other buildings and industrial plant are specified in BS EN 12259-1.

Information about this document

This document converts DD 252 into a full British Standard. The principal changes are further development of the test methods.

Domestic and residential sprinklers are for use in fire sprinkler systems and are designed to provide an additional degree of protection of life and property, above that already achieved by the building design and the installation of smoke and/or fire detectors and systems. This British Standard presumes that the sprinkler protection will form part of an integrated fire safety system.

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Appropriate conformity attestation arrangements are described in BS EN ISO 9001. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

This British Standard is intended for the use of designers, engineers, architects, surveyors, contractors, installers and authorities having jurisdiction.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall". Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies requirements for the construction and performance of sprinklers which are operated by a change of state of an element or bursting of a glass bulb under the influence of heat, for use in residential and domestic automatic sprinkler systems conforming to BS 9251. Test methods and a recommended test schedule for type approval testing are also given.

NOTE All pressure data in this standard are given as gauge pressures in bar ¹⁾.

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.

BS 9251, *Sprinkler systems for residential and domestic occupancies – Code of practice*

BS EN 12259-1, *Fixed firefighting systems – Components for sprinkler and water spray systems – Part 1: Sprinklers*

BS EN 13238, *Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates*

BS EN 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

ISO 7-1, *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 tube suitable for screwing in accordance with ISO 7-1*

3 Terms, definitions and abbreviations

For the purposes of this British Standard, the terms, definitions and abbreviations in BS EN 12259-1 and the following apply.

- 3.1 automatic sprinkler**
nozzle with a thermally sensitive sealing device which opens to discharge water for firefighting
- 3.2 coated sprinkler**
sprinkler with a coating, applied for the purpose of reducing the effects of corrosive environments, excluding decorative paint or painted finishes
- 3.3 concealed sprinkler**
recessed sprinkler with a cover plate that disengages when heat is applied
- 3.4 conductivity factor (C)**
measure of the conductance between the sprinkler's heat responsive element and the water-filled fitting, expressed in $\text{m/s}^{1/2}$.
- 3.5 design lower tolerance limit (DLTL)**
lowest lower tolerance limit (LTL) for glass bulbs specified and assured by the glass bulb supplier

¹⁾ 1 bar = 10^5 N/m^2 = 100 kPa.

- 3.6 design upper tolerance limit (DUTL)**
highest upper tolerance limit (UTL) for sprinklers specified and assured by the sprinkler supplier
- 3.7 dry sprinkler**
sprinkler and dry drop pipe with a valve, at the head of the pipe, held closed by a device maintained in position by the sprinkler head valve
- 3.8 dry upright sprinkler**
sprinkler and dry rise pipe with a valve, at the base of the pipe, held closed by a device maintained in position by the sprinkler head valve
- 3.9 flush pattern sprinkler**
pendent sprinkler for fitting partly above, but with the temperature sensitive element below, the lower plane of the ceiling
- 3.10 fusible link sprinkler**
sprinkler which opens when an element provided for that purpose melts
- 3.11 glass bulb sprinkler**
sprinkler which opens when a liquid-filled glass bulb bursts
- 3.12 horizontal sprinkler**
sprinkler in which the nozzle directs the water horizontally
- 3.13 lower tolerance limit (LTL)**
lowest strength of a glass bulb determined by testing and statistical analysis of a batch of 55 or more bulbs
- 3.14 mean design bulb strength**
lowest mean bulb strength, specified and assured by the glass bulb supplier, for any batch of 55 or more bulbs
- 3.15 mean design service load**
highest mean service load, specified and assured by the sprinkler supplier, for any batch of 10 or more sprinklers
- 3.16 pendent sprinkler**
sprinkler in which the nozzle directs the water downwards
- 3.17 recessed sprinkler**
sprinkler in which all or part of the thermally sensitive element is above the plane of the ceiling
- 3.18 residential sprinkler**
sprinkler for use in domestic and residential occupancies
- 3.19 response time index (RTI)**
measure of the thermal sensitivity of the fusible or frangible element in the sprinkler
NOTE The response time index is expressed in $m \cdot s^{1/2}$.
- 3.20 sidewall pattern sprinkler**
sprinkler that gives an outward half paraboloid pattern of water discharge
- 3.21 spray pattern sprinkler**
sprinkler which gives a downward paraboloid pattern of water discharge

3.22 upper tolerance limit (UTL)

highest service load of a sprinkler determined by testing and statistical analysis of a batch of 20 or more sprinklers

3.23 upright sprinkler

sprinkler in which the nozzle directs the water upwards

4 Construction and performance**4.1 Product assembly**

Sprinklers shall be assembled in the original equipment supplier's factory, in such a way that any subsequent adjustment or dismantling will result in destruction of an element of construction.

4.2 Dimensions

4.2.1 Nominal thread sizes shall be $\frac{3}{4}$ in or $\frac{1}{2}$ in and suitable for fittings threaded in accordance with ISO 7-1.

NOTE Flush pattern sprinklers may have larger thread sizes.

4.2.2 It shall be possible for:

- a) a sphere of $(8^{+0.01}_0)$ mm diameter to pass through each water passage in the sprinkler; or
- b) a sphere of $(6^{+0.01}_0)$ mm diameter to pass through each water passage in the sprinkler, where the water supply gives a pressure of not less than 3 bar at the sprinkler.

4.3 Nominal operating temperature

4.3.1 The nominal operating temperatures of glass bulb sprinklers shall be in accordance with Table 1.

4.3.2 The nominal operating temperature ranges of fusible link sprinklers shall be in accordance with Table 1.

4.3.3 Glass bulb sprinklers and non-plated and non-coated fusible link sprinklers shall be colour coded according to the nominal operating temperature as given in Table 1.

Table 1 Nominal operating temperatures and colour codes

Glass bulb sprinklers		Fusible link sprinklers	
Nominal operating temperature °C	Liquid colour code	Nominal operating temperature within range °C	Yoke arms colour code
57	Orange	57 to 77	Uncoloured
68	Red	80 to 107	White
79	Yellow	—	—
93	Green	—	—
100	Green	—	—

4.4 Operating temperatures

When tested in accordance with Annex A, sprinklers shall operate at a temperature within the range:

$$[t \pm (0.035 t + 0.62)] \text{ }^{\circ}\text{C}$$

where t is the nominal operating temperature.

4.5 Water flow and distribution

4.5.1 K-factor

When determined in accordance with Annex B, the K -factor, the orifice coefficient of the sprinkler, shall be within the range given in Table 2.

Table 2 K -factor tolerance

Nominal K -factor	K -factor tolerance	
	$\text{l}\cdot\text{min}^{-1}\cdot\text{bar}^{-1/2}$	
<80	± 3	± 5
>80	± 4	± 6

4.5.2 Water distribution

4.5.2.1 Sprinklers other than sidewall sprinklers

When sprinklers are tested in accordance with Annex C (C.1 and C.2), using the parameters given in Table 3 and Table 4, the minimum conditions specified in Table 4 shall be achieved and the minimum operating pressure at any sprinkler shall not be less than 0.5 bar.

Sprinklers shall distribute water over a horizontal surface such that the discharge density collected in not more than four collection pans shall be at least 0.6 mm/min. All other collection pans within the measurement area shall be at least 0.8 mm/min.

Each wall defining the collection area shall be wetted with water to within 0.7 m of the ceiling and when collected in the containers at the base of the wall shall not be less than the volume defined in the equation for each wall:

$$V = 0.2 \times Q \times \frac{L}{Z}$$

where:

V is the volume of water collected at the base of the wall (dm^3);

Q is the total flow from the sprinkler (dm^3);

L is the wall length (m);

Z is the perimeter of sprinkler coverage area (m).

4.5.2.2 Sidewall sprinkler

When sprinklers are tested in accordance with Annex C (C.2 and C.3), using the parameters given in Table 3 and Table 4, the minimum conditions specified in Table 4 shall be achieved and the minimum operating pressure at any sprinkler shall not be less than 0.5 bar.

Sprinklers shall distribute water over a horizontal surface such that the discharge density collected in any eight collection pans shall be not less than 0.6 mm/min. All other collection pans within the design area shall be at least 0.8 mm/min.

Each wall defining the collection area shall be wetted to within 0.7 m of the ceiling with water from the sprinkler and when collected in the containers at the base of the wall shall not be less than the volume defined in the equation for each wall (see 4.5.2.1).

Table 3 Allowable spacings (S , L_c , W_c)

Sprinkler head selection	Spacing (S) m	Length (L_c) m	Width (W_c) m
Sprinklers other than sidewall	3.7 × 3.7	—	—
	4.3 × 4.3	—	—
	4.9 × 4.9	—	—
	5.5 × 2.5 ^{A)}	—	—
Sidewall	—	3.7	3.7
	—	4.3	4.3
	—	4.9	4.9
	—	5.5 ^{A)}	2.5 ^{A)}

^{A)} Sprinkler spacing permissible in corridors only.

4.6 Function

4.6.1 When tested in accordance with Annex D (D.1), the sprinkler shall open and within 5 s of release of the thermally sensitive element shall operate satisfactorily and shall conform to the requirements specified in 4.5.1. Any lodgement of released parts shall be cleared within 60 s of the release of the thermally sensitive element and the sprinkler shall conform to the requirements specified in 4.5.2.

4.6.2 When tested in accordance with Annex D (D.2), the deflector and its supporting parts shall conform to the requirements specified in 4.5.2.

NOTE In most instances, visual examination of the equipment will be sufficient to establish conformity to 4.5.2.

4.7 Strength of sprinkler body and deflector

4.7.1 When tested in accordance with Annex E (E.1), the sprinkler body shall not show permanent elongation of more than 0.2% between the load-bearing parts when subjected to twice the average service load.

4.7.2 When tested in accordance with Annex E (E.2), the sprinkler deflector and its supporting parts shall withstand an applied force of 70 N without permanent deformation.

Table 4 Water distribution parameters

Column 1 Test condition	Column 2 Nominal water coverage ^{A)} mm/min	Column 3 Flow rate per sprinkler ^{B)} l/min	Column 4 No of sprinklers under test	Column 5 Minimum test duration s	Column 6 Minimum collection value ^{D)} mm/min	Column 7 Not more than 4 pans per plane below mm/min	Column 8 Not more than 8 pans per plane below mm/min	Column 9 Figure reference
Floor (horizontal) collection (non-sidewall)	2.8	$2.8 \times S^2$	1 ^{C)}	360	0.8	0.6	—	C.1
Vertical distribution test (non-sidewall)	2.8	$2.8 \times S^2$	1 ^{C)}	360	See 4.5.2.1	—	—	C.3
Floor (horizontal) collection (sidewall)	2.8	$2.8 \times L_c \times W_c$	1	360	0.8	—	0.6	C.4
Vertical distribution test (sidewall)	2.8	$2.8 \times L_c \times W_c$	1	360	See 4.5.2.2	—	—	C.2

^{A)} Test shall be conducted at either 2.8 mm/min or the value specified by the supplier, whichever is the greater.

^{B)} S (or $L_c \times W_c$ in the case of sidewall sprinklers) is the maximum allowable spacing specified by the supplier and constrained by Table 3. Distribution test to be undertaken at each of the maximum allowable spacings.

^{C)} Repeat test having rotated sprinkler frame arms through 90°.

^{D)} Except the four pans allowed by column 7.

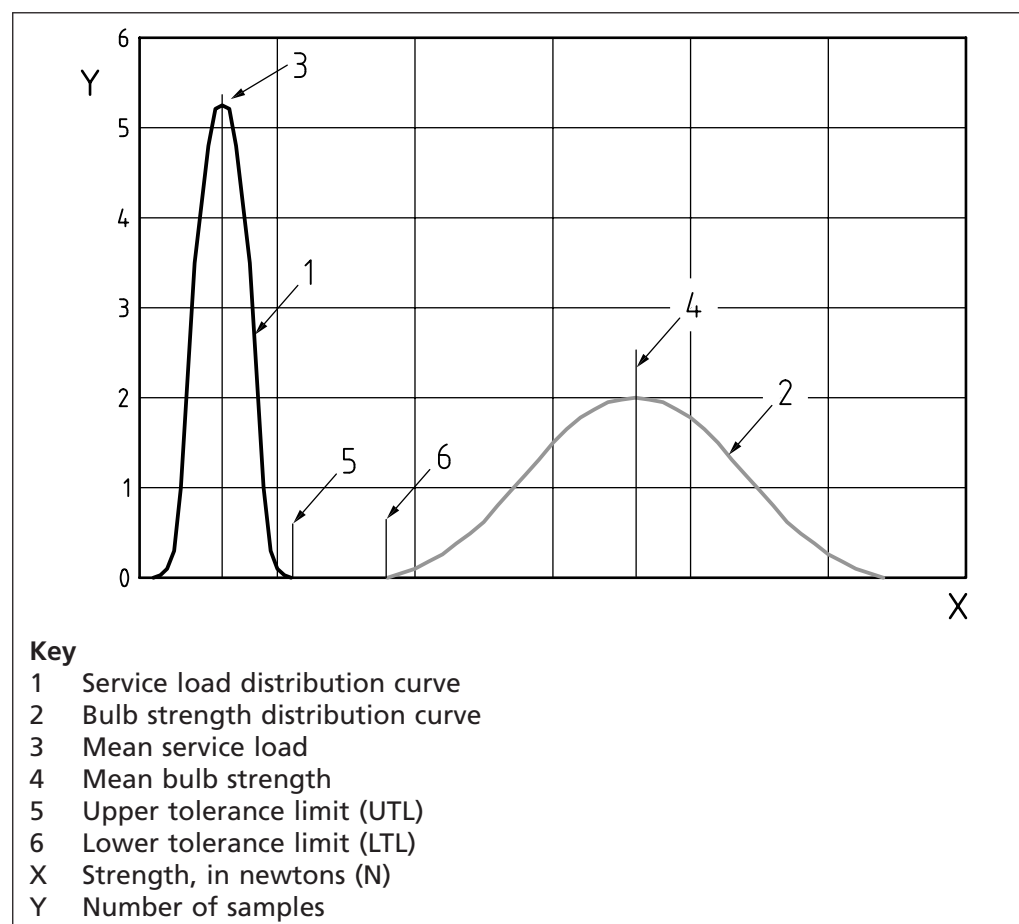
4.8 Strength of release element

4.8.1 Glass bulb sprinklers

When evaluated and tested in accordance with Annex F (F.1), glass bulb sprinklers shall have:

- a) a mean design bulb strength of at least six times the mean design service load;
- b) a mean bulb strength not less than the mean design bulb strength;
- c) a mean service load not more than the mean design service load;
- d) a design lower tolerance limit (DLTL) on the distribution curve of at least two times the design upper tolerance limit (DUTL) of the service load distribution curve;
- e) an upper tolerance limit (UTL) less than or equal to the design upper tolerance limit (DUTL);
- f) a lower tolerance limit (LTL) greater than or equal to the design lower tolerance limit (DLTL) (see Figure 1).

Figure 1 Graph of service load and bulb strength distribution curves



4.8.2 Fusible link sprinklers

When tested in accordance with Annex F (F.2), fusible link sprinklers shall meet one of the following requirements:

- a) the temperature sensitive elements shall withstand a load of 15 times the maximum design load for a period of 100 h, without failure; or

- b) the estimated time to failure of temperature sensitive elements shall be not less than 876 600 h at the design load.

NOTE For further information on the strength test for fusible link elements, see Annex G.

4.9 Leak resistance

When tested in accordance with Annex H, sprinklers shall not show any sign of leakage.

4.10 Heat exposure

4.10.1 Sprinklers

When tested in accordance with Annex I (see I.1), the sprinklers shall not operate during the exposure period. When subjected to the additional tests specified in I.1, the sprinklers shall meet the following requirements:

- a) when tested in accordance with D.3, the sprinklers shall operate such that the waterway is cleared; any lodgements shall be disregarded;
- b) when tested in accordance with Annex H, the sprinklers shall conform to the requirements specified in 4.9;
- c) when tested in accordance with Annex A, the sprinklers shall conform to the requirements specified in 4.4.

4.10.2 Glass bulb sprinklers

When glass bulb sprinklers are tested in accordance with Annex I (I.2), there shall be no damage to the glass bulb.

4.11 Thermal shock

When glass bulb sprinklers are tested in accordance with Annex J, the glass bulbs shall either:

- a) break correctly on cooling such that the waterway is cleared; or
- b) remain intact, i.e. after immersion, when subjected to a function test in accordance with D.3, they shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12 Corrosion

4.12.1 Stress corrosion

Concealed sprinklers shall be tested with and without their cover plates assembled. When sprinklers are subjected to a stress corrosion test in accordance with Annex K, then those sprinklers in which cracks, delamination or failure of an operating part is observed, other than the cover plate, shall show no evidence of leakage in the leak resistance test described in Annex H.

After exposure all sprinklers shall be subjected to a function test in accordance with D.3. The sprinklers shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded. In the case of concealed sprinklers, the three complete assemblies and the three sprinklers without cover plates shall be tested.

Those sprinklers which show evidence of cracking, delamination or failure of a non-operating part shall show no visible evidence of separation of permanently attached parts when subjected to the flowing test described in K.1.3.

4.12.2 Sulphur dioxide corrosion

Concealed sprinklers shall be tested with and without their cover plates assembled. When sprinklers are subjected to a sulphur dioxide corrosion test in accordance with **K.2**, then after exposure, when subjected to a function test in accordance with **D.3**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12.3 Salt mist corrosion

Concealed sprinklers shall be tested with and without their cover plates assembled. When sprinklers are subjected to a salt mist corrosion test in accordance with **K.3**, then after exposure, when subjected to a function test in accordance with **D.3**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12.4 Moist air exposure

When sprinklers are subjected to moist air exposure in accordance with **K.4**, then after exposure, when subjected to a function test in accordance with **D.3**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.13 Integrity of sprinkler coatings (coating resistance to low temperature)

When coated sprinklers are tested in accordance with Annex L, any coating (other than decorative coatings) on the sprinkler shall not crack or flake.

4.14 Water hammer

When subjected to pressure surges in accordance with Annex M, sprinklers shall not leak. After the test, when subjected to a function test in accordance with **D.3**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.15 Thermal response – wind tunnel

4.15.1 Response in the standard orientation

When tested in accordance with Annex N (**N.1** to **N.4**), in the standard orientation [see Figure N.1a)], sprinklers shall fall within the response time index (RTI) and conductivity factor (C) limits as shown in Figure 2.

For sprinklers which are not conducive to testing in the wind tunnel, equivalence of sensitivity shall be determined by the fire test (**4.21**) and a room test (**4.16**).

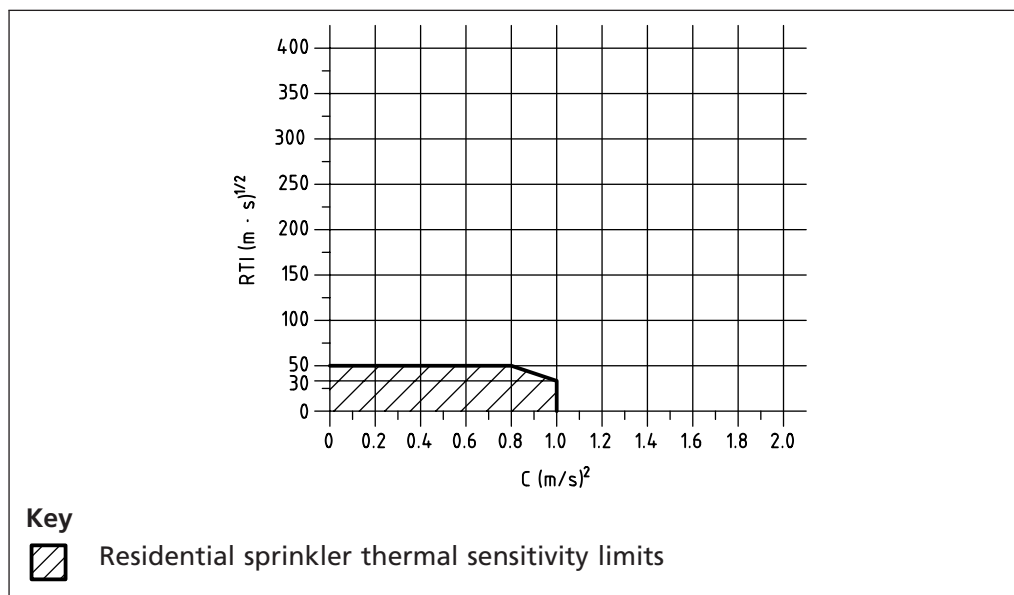
NOTE 1 A test for sprinklers that are not conducive to testing in the existing wind tunnel is in the course of preparation.

NOTE 2 Typical examples of sprinklers which are not conducive for testing in a wind tunnel are concealed, recessed and sidewall sprinklers.

4.15.2 Response in the unfavourable orientation

In the unfavourable orientation, the influence of any yoke arm shadow effect shall be limited to a nominal angle of 25° each side of the yoke arm (e.g. maximum 104° of the 360°) as shown in Figure N.1b). When tested in accordance with Annex N (**N.1** to **N.4**) in the unfavourable orientation, the average RTI values shall not exceed 110% of the relevant limits given in Figure 2. When calculating the RTI in the unfavourable orientation, the C factor from the standard orientation test shall be used.

Figure 2 Standard orientation RTI and C factor limits



4.16 Thermal response – room test

When tested in accordance with Annex N (N.5), sprinklers which are not conducive to testing in a wind tunnel (see Note 2 to 4.15.1) shall operate within 75 s.

4.17 Resistance to heat

When tested in accordance with Annex O, the sprinkler body, deflector and its supporting parts shall show no significant deformation or breakage.

4.18 Resistance to vibration

After being subjected to a vibration test in accordance with Annex P, the sprinkler shall show no visible evidence of damage, and shall conform to 4.8 and 4.9, and when tested in accordance with D.3 shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.19 Resistance to impact

After being subjected to the impact test in accordance with Annex Q, the sprinkler shall conform to 4.9 and shall function satisfactorily when tested in accordance with D.3.

4.20 Resistance to low temperature

The sprinkler shall not operate before the function test, when tested in accordance with Annex R. After the test the sprinkler shall show no visible evidence of damage. Following examination, when subjected to a function test in accordance with D.3, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.21 Fire test

When tested in accordance with Annex S, sprinklers shall be capable of controlling the test fires for a period of 10 min, measured from sprinkler operation. Temperatures shall be limited to the values indicated in Table 5. The third sprinkler shall not operate.

Table 5 Fire test maximum temperatures

Thermocouple location	Maximum allowable temperature °C
75 mm below the underside of the ceiling, above centre of crib	320
Ceiling temperature (6.5 mm above the underside of the ceiling), above centre of crib	260
1.6 m above the floor, directly beneath sprinklers ^{A)}	95
1.6 m above the floor, directly beneath sprinklers ^{A)}	55 (for not more than any 120 s interval)

^{A)} For sidewall sprinklers the thermocouple locations remain as if standard sprinkler heads were used (see Figures S.7 and S.8).

5 Marking

5.1 General

Sprinklers shall be marked with the following:

- a) A four- to six-character identification number. The number shall be cast or stamped on the sprinkler deflector or on a visible non-operating part, which is not used to install the sprinkler.

NOTE 1 The identification number for decorative ceiling sprinklers is permitted to be located behind the cover plate which is removable with common tools, provided the number will be visible after the sprinkler is installed and the cover plate is removed.

The identification number shall consist of one or two characters which identify the manufacturer, followed by three or four digits to identify the sprinkler orifice size, type, pressure rating and thermal sensitivity classification.

- b) Nominal operating temperature. The nominal operating temperature shall be stamped, cast, engraved or colour-coded in such a way that it is recognizable after sprinkler operation.
- c) The letters "RES".
- d) Year of manufacture of the full form "2000", or short form "00".

NOTE 2 A sprinkler produced in the last 3 months of a calendar year may be marked with the following year as the date of manufacture, and one produced in the first 6 months of a calendar year may be marked with the preceding year as the date of manufacture.

- e) Factory of origin, if manufacture is at two or more factories.

An escutcheon intended for installation with recessed and concealed type sprinkler assemblies and not attached by the manufacturer shall be marked as follows: "FOR USE WITH [SPRINKLER IDENTIFICATION NUMBER(S)] AND [SPRINKLER TEMPERATURE RATING(S)]."

5.2 Sidewall sprinklers

5.2.1 General

The deflectors of sidewall sprinklers shall be marked with a clear indication of their intended orientation, relative to the direction of flow. If an arrow is employed, it shall be accompanied by the word "flow".

5.2.2 Horizontal sidewall sprinklers

Horizontal sidewall sprinklers shall have the word “top” marked on the deflector to indicate their orientation.

5.3 Concealed sprinklers

The cover plate of a concealed sprinkler shall be impressed with the words “Do not paint”.

5.4 Removable recessed housing

Recessed housings shall be marked to indicate the sprinkler with which they are to be used unless the housing is a non-removable part of the sprinkler.

6 Instruction charts

An instruction chart, giving the recommended method of installation and instructions on care and replacement, shall be available with each type of sprinkler.

7 Conditions for testing and type approval testing

Except where specified, tests shall be carried out at $(20 \pm 10) ^\circ\text{C}$.

Sprinklers shall be examined for obvious defects before testing.

8 Evaluation of conformity

8.1 General

The conformity of a sprinkler to the requirements of this British Standard shall be demonstrated by:

- a) initial type testing;
- b) factory production control by the manufacturer;
- c) audit testing.

8.2 Initial type testing

Initial type testing shall be performed on the first application of this British Standard.

NOTE Tests previously performed in accordance with the provisions of this British Standard may be taken into account.

In addition, initial type testing shall be performed at the beginning of the production of a product type or at the beginning of a new method of production (where these might affect the stated properties).

All characteristics given in Clause 4 shall be subject to initial type testing.

8.3 Factory production control (FPC)

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform with the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product, and shall be sufficiently detailed to ensure that the conformity of the product is apparent.