

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

ICS 65.060.35

Committees responsible for this Draft for Development

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- Association of Building Engineers
- Association of British Insurers
- British Automatic Sprinkler Association
- British Fire Protection Systems Association
- British Plastics Federation
- British Pump Manufacturers' Association
- BRE/LPC Laboratories
- Chartered Institution of Building Services
- Chief and Assistant Chief Fire Officers' Association
- Copper Development Association
- DETR — Represented by the BRE
- DETR — Construction Directorate
- District Surveyors Association
- Home Office
- Institute of Fire Safety
- London Fire and Emergency Planning Authority
- Powder Actuated Systems Association
- Residential Sprinkler Association

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Foreword

This Draft for Development has been prepared by a Task Group from Technical Committee FSH/18/2. It specifies requirements for the construction and performance, and testing of fire sprinklers for use specifically in residential and domestic occupancies. It is intended for the use of designers, engineers, architects, surveyors, contractors, installers and authorities having jurisdiction. Sprinkler protection for other buildings and industrial plant is specified in BS 5306-2.

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 Draft for Development presumes that the sprinkler protection will form part of an integrated fire safety system.

Product certification/inspection/testing. Users of this Draft for Development are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this Draft for Development. 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.

The requirements contained in this Draft for Development result from the best technical information available to the committee at the time of writing. Firefighting and life protection encompasses a wide field of endeavour and as such it is impracticable to cover every possible factor or circumstance that might affect implementation of this Draft for Development. Therefore, the design and installation of any system should be entrusted to a suitably qualified and experienced sprinkler contractor.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because UK experience needs to be gained. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than 2 years after its publication. Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

Observations which it is felt should receive attention before the official call for comments will be welcomed.

These should be sent to the Secretary of BSI Technical Committee FSH/18/2 at British Standards House, 389 Chiswick High Road, London W4 4AL.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 44, an inside back cover and a back cover.

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1 Scope

This Draft for Development 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 DD 251. Test methods and a recommended test schedule for type approval testing are also given.

NOTE All pressure data in this Draft for Development are given as gauge pressures in bar¹⁾.

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

DD 251, *Sprinkler systems for residential and domestic occupancies — Code of practice*.

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 Draft for Development, 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 fire fighting

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

design lower tolerance limit (DLTL)

lowest lower tolerance limit (LTL) for glass bulbs specified and assured by the glass bulb supplier

3.5

design upper tolerance limit (DUTL)

highest upper tolerance limit (UTL) for sprinklers specified and assured by the sprinkler supplier

3.6

dry sprinkler

sprinkler and dry drop pipe with a valve, at the head of the pipe, held closed by a device maintained in a position by the sprinkler head valve

3.7

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

¹⁾ 1 bar = 10⁵ Pa.

3.8

flush pattern sprinkler

pendent sprinkler for fitting partly above, but with the temperature sensitive element below, the lower plane of the ceiling

3.9

fusible link sprinkler

sprinkler which opens when an element provided for that purpose melts

3.10

glass bulb sprinkler

sprinkler which opens when a liquid-filled glass bulb bursts

3.11

horizontal sprinkler

sprinkler in which the nozzle directs the water horizontally

3.12

lower tolerance limit (LTL)

lowest strength of a glass bulb determined by testing and statistical analysis of a batch of 55 or more bulbs

3.13

mean design bulb strength

lowest mean bulb strength, specified and assured by the glass bulb supplier, for any batch of 55 or more bulbs

3.14

mean design service load

highest mean service load, specified and assured by the sprinkler supplier, for any batch of 10 or more sprinklers

3.15

pendent sprinkler

sprinkler in which the nozzle directs the water downwards

3.16

recessed sprinkler

sprinkler in which all or part of the thermally sensitive element is above the plane of the ceiling

3.17

residential sprinkler

sprinkler for use in domestic and residential occupancies with an appropriate water distribution

3.18

response time index (RTI)

measure of the thermal sensitivity of the sprinkler

NOTE The response time index is expressed in (metres·second)^½.

3.19

sidewall pattern sprinkler

sprinkler that gives an outward half paraboloid pattern of water discharge

3.20

spray pattern sprinkler

sprinkler which gives a downward paraboloid pattern of water discharge

3.21

upright sprinkler

sprinkler in which the nozzle directs the water upwards

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

4 Construction and performance

4.1 Product assembly

Sprinklers shall only 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 $\frac{3}{8}$ inch or $\frac{1}{2}$ inch 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 sphere of $8^{+0.01}_0$ mm diameter to pass through each water passage in the sprinkler; or
- 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

4.4.1 When tested in accordance with Annex A, fusible link 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.

When tested in accordance with Annex A, glass bulbs and glass bulb sprinklers shall operate within the temperature range specified in Table 2.

Table 2 — Operating temperatures for glass bulbs and glass bulb sprinklers

Nominal operating temperature °C	Lowest operating temperature °C	Temperature at or below which at least 25 of the 50 specimens operate °C	Temperature at or below which at least 40 of the 50 specimens operate °C	Highest operating temperature °C
57	54	63	68	74
68	65	74	79	86
79	76	87	92	99
93	90	101	106	113
100	97	108	113	120

4.5 Water flow and distribution

4.5.1 *K*-factor

The *K*-factor, the orifice coefficient of the sprinkler, calculated as:

$$K = \frac{Q}{\sqrt{P}}$$

where

Q = flow;

P = pressure;

shall be within the range given in Table 3, when determined in accordance with Annex B.

Table 3 — *K*-factors

Nominal <i>K</i> -factor	<i>K</i> -factor tolerance	
	l·min ⁻¹ ·bar ^{-½}	
<80	±3	±5
>80	±4	±6

4.5.2 *Water distribution*

When sprinklers are tested in accordance with Annex C (see C.1) using the parameters given in Table 4, the minimum conditions specified in Table 4 shall be achieved.

Table 4 — Water distribution parameters

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Test condition	Nominal water coverage mm/min	Flow rate per sprinkler ^a l/min	No. of sprinklers under test	Minimum test duration s	Pan height from floor m	Minimum collection value mm/min	Not more than 4 pans per plane below mm/min	Figure reference
Floor (horizontal) collection	4.0	$4 \times S^2$	1 ^b	360	—	1.22	—	C.1, C.2
	2.8	$2.8 \times S^2$	1 ^b	360	—	1.22	—	C.1, C.2
Wall (vertical) collection	2.8	$2.8 \times S^2$	1 ^{b c}	900	0.08 to 0.75 0.23 to 1.75 1.75 to 1.90 1.90 to 2.44	Unspecified 0.244 0.82 Unspecified	Unspecified 0.408 Unspecified Unspecified	C.3, C.4
^a S is the maximum allowable spacing specified by the supplier. ^b Repeat each test using a second sprinkler system. ^c Repeat tests after elevating the collection container arrays by 150 mm.								

4.6 Function

When tested in accordance with Annex D (see **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 of **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 of **4.5.2**.

4.7 Strength of sprinkler body and deflector

4.7.1 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 when tested in accordance with Annex E (see **E.1**).

4.7.2 The sprinkler deflector and its supporting parts shall withstand an applied force of 70 N without permanent deformation when tested in accordance with **E.2**.

4.7.3 When tested in accordance with **E.2** the deflector and its supporting parts shall conform to the requirements of **4.5.2**.

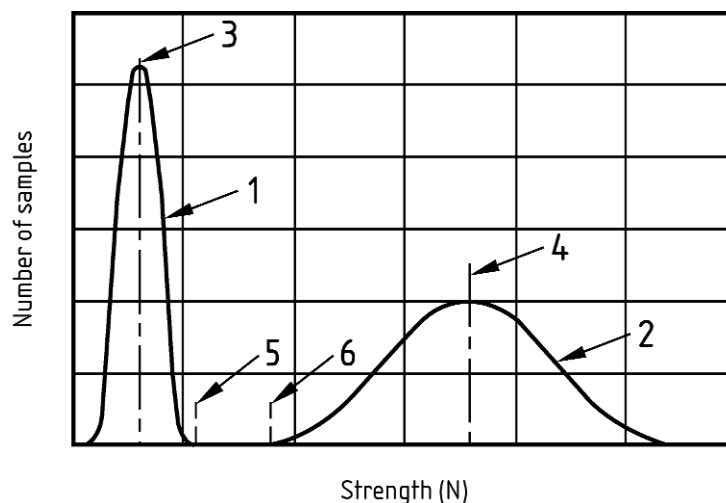
NOTE In most instances visual examination of the equipment will be sufficient to establish conformity to the requirements of **4.5.2**.

4.8 Strength of release element

4.8.1 *Glass bulb sprinklers*

When evaluated and tested in accordance with Annex F (see **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).



- 1 Service load distribution curve
- 2 Bulb strength distribution curve
- 3 Mean service load
- 4 Mean bulb strength
- 5 Upper tolerance limit (UTL)
- 6 Lower tolerance limit (LTL)

Figure 1 — Graph of service load and bulb strength distribution curves

4.8.2 Fusible link sprinklers

For fusible link sprinklers it shall be determined that:

- a) the temperature sensitive elements 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 is not less than 876 600 h at the design load, when tested in accordance with **F.2**.

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

4.9 Leak resistance

The sprinklers shall not show any sign of leakage when hydraulically pressure-tested in accordance with Annex H.

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. After the exposure period four sprinklers shall be tested in accordance with **D.2**; the sprinklers shall operate such that the waterway is cleared. Any lodgements shall be disregarded. Four sprinklers shall be tested in accordance with Annex H and shall conform to **4.9**. Four sprinklers shall be tested in accordance with Annex A and shall conform to **4.4**.

4.10.2 Glass bulb sprinklers

There shall be no damage to the glass bulb when sprinklers are tested in accordance with **I.2**.

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.2**, operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12 Corrosion

4.12.1 Stress corrosion

Sprinklers shall be subjected to a stress corrosion test in accordance with Annex K. Those sprinklers in which cracks, delamination or failure of an operating part is observed shall show no evidence of leakage in the leak resistance test described in Annex H. 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.

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 Sulfur dioxide corrosion

Sprinklers shall be subjected to a sulfur dioxide corrosion test in accordance with **K.2**. After exposure, when subjected to a function test in accordance with **D.2**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12.3 Salt mist corrosion

Sprinklers shall be subjected to a salt mist corrosion test in accordance with **K.3**. After exposure, when subjected to a function test in accordance with **D.2**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.12.4 Moist air exposure

Sprinklers shall be subjected to moist air exposure in accordance with **K.4**. After exposure, when subjected to a function test in accordance with **D.2**, 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)

Any coating (paint or metallic) on the sprinkler shall not crack or flake when the coated sprinkler is tested in accordance with Annex L.

4.14 Water hammer

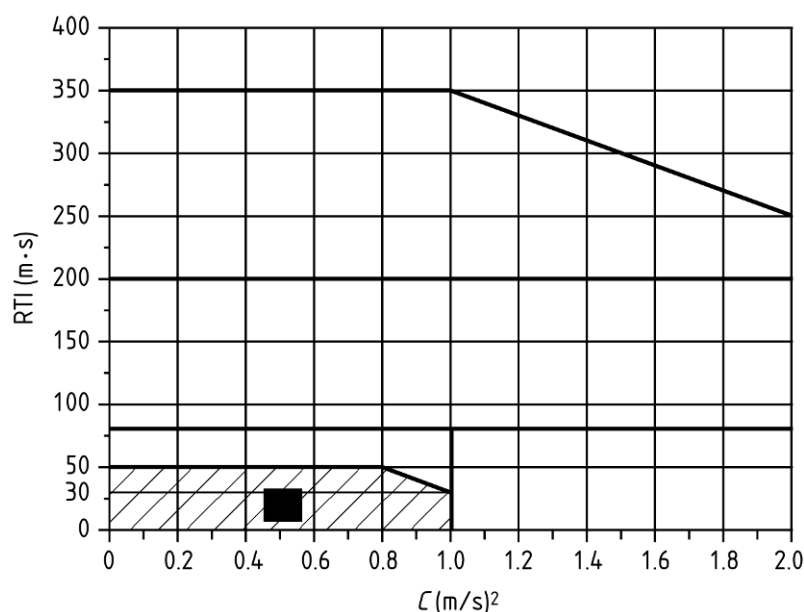
Sprinklers shall not leak when subjected to pressure surges in accordance with Annex M. After the test, when subjected to a function test in accordance with **D.2**, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.15 Thermal response

4.15.1 Response in the standard orientation

When tested in accordance with Annex N, in the standard orientation [see Figure N.1a)], residential and domestic sprinklers shall fall within the “quick response” categories with regard to their response time index (RTI) and conductivity factor (C) as shown in Figure 2.

NOTE For sprinklers which do not fit into the wind tunnel, equivalence of sensitivity is determined by a fire test (not yet standardized).



- 1 $C \text{ (m/s)}^2$
- 2 $RTI \text{ (m·s)}^{1/2}$
- 3 Quick response

Figure 2 — Standard orientation RTI and C factor limits

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 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.

4.16 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.

4.17 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.2 shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.18 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.2.

4.19 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.2, the sprinkler shall operate in such a way that the waterway is cleared; any lodgements shall be disregarded.

4.20 Fire test for residential and domestic sprinklers

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

Table 5 — Fire test maximum temperatures

Thermocouple location	Maximum allowable temperature °C
75 mm below the underside of the ceiling	320
1.6 m above the floor	95
1.6 m above the floor	55 (for not more than any 120 s interval)
Ceiling temperature – 6.5 mm above the underside of the ceiling	260

5 Marking

5.1 General

Sprinklers shall be marked with the following:

- a) name or trade mark of supplier;
- b) model number, catalogue designation or equivalent marking;
- c) factory of origin, if manufacture is at two or more factories;
- d) letters “RES” and letters indicating the type of sprinkler and the mounting position in accordance with Table 6;
- e) nominal operating temperature;

NOTE 1 In addition to any colour coding indicating the nominal operating temperature (see 4.3 and Table 2) the nominal operating temperature should be stamped or cast on the fusible element of the fusible link sprinklers. All sprinklers should be stamped, cast, engraved or colour coded in such a way that the nominal operating temperature is recognizable even if the sprinkler has operated.

Where colour coding of yoke arms of glass bulb sprinklers is used, the colour code given in Table 2 for fusible link sprinklers should be used.

- f) year of manufacture;

NOTE 2 The year of manufacture should be given in a full form, “2000”, or a short form, “00”, and may include the last 3 months of the preceding year and the first 6 months of the following year.