



BSI Standards Publication

Fixed firefighting systems — Components for sprinkler and water spray systems

Part 15: Spray pattern sprinklers with a k-factor of at least K160, extended coverage sprinklers of at least K80 and control mode special application sprinklers

National foreword

This British Standard is the UK implementation of EN 12259-15:2025.

The UK participation in its preparation was entrusted to Technical Committee FSH/18/2, Sprinkler Systems.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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**Fixed firefighting systems - Components for sprinkler and
water spray systems - Part 15: Spray pattern sprinklers
with a k-factor of at least K160, extended coverage
sprinklers of at least K80 and control mode special
application sprinklers**

Installations fixes de lutte contre l'incendie -
Composants des systèmes d'extinction du type
sprinkleur et à pulvérisation d'eau - Partie 15 :
Sprinkleurs de type spray avec un coefficient K d'au
moins K160, sprinkleurs à couverture étendue d'au
moins K80 et sprinkleurs en mode contrôle pour
applications spécifiques

Ortsfeste Brandbekämpfungsanlagen - Bauteile für
Sprinkler- und Sprühwasseranlagen - Teil 15: Schirm-
Sprinkler mit einem k-Faktor von mindestens K160,
Weitwurf-Sprinkler von mindestens K80 und Sprinkler
für spezielle Anwendungen im Regelbetrieb

This European Standard was approved by CEN on 2 March 2025.

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European foreword

This document (EN 12259-15:2025) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2025, and conflicting national standards shall be withdrawn at the latest by October 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

EN 12259, *Fixed firefighting systems — Components for sprinkler and water spray systems*, consists of the following parts:

- *Part 1: Sprinklers;*
- *Part 2: Wet alarm valve assemblies;*
- *Part 3: Dry alarm valve assemblies;*
- *Part 4: Water motor alarms;*
- *Part 5: Water flow detectors;*
- *Part 9: Deluge alarm valves;*
- *Part 12: Pumps;*
- *Part 13: ESFR sprinklers;*
- *Part 14: Sprinklers for residential applications.*

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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Introduction

The response characteristics of classic sprinklers (EN 12259-1 and EN 12259-15) is based on the measurement of both sensitivity and conductivity (C-factor). For EN 12259-13 sprinkler type (ESFR) their response characteristics are determined without reference to its conductivity.

1 Scope

This document specifies requirements and test methods for spray pattern sprinklers with a k-factor of at least K160, extended coverage (EC) sprinklers of at least K80, extended coverage storage sprinklers of at least K200 and control mode special application (CMSA) sprinklers. This document only covers sprinkler types up to K360.

This document does not apply to concealed, conventional, flat spray, flush and recessed sprinklers.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 12259 (all parts), *Fixed firefighting systems — Components for sprinkler and water spray systems*

EN 12259-1:1999+A1:2001,¹ *Fixed firefighting systems — Components for sprinkler and water spray systems — Part 1: Sprinklers*

EN 12845 (all parts),² *Fixed firefighting systems — Automatic sprinkler systems*

EN IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors (IEC 60751)*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the EN 12845 series and the EN 12259 series apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

extended coverage sprinkler

sprinkler with a k-factor of 80 to 200 intended to be installed in accordance with the EN 12845 series to protect non-storage occupancies

3.2

extended coverage storage sprinkler

sprinkler with a k-factor of 200 and larger and intended to be installed in accordance with EN 12845-2 to protect storage occupancies

¹ As impacted by EN 12259-1:1999+A1:2001/A2:2004 and EN 12259-1:1999+A1:2001/A3:2006.

² This series is under development.

3.3

standard non-plastic commodity

commodity product that consists of three double-wall corrugated paper cartons

Note 1 to entry: Dimensions for the inner, middle and outer box are $[(1\text{ m} \pm 5\%) \times (1\text{ m} \pm 5\%) \times (1\text{ m} \pm 5\%)]$, $[(1\text{ m} \pm 5\%) \times (1\text{ m} \pm 5\%) \times (1\text{ m} \pm 5\%)]$, and $[(1\text{ m} \pm 6\%) \times (1\text{ m} \pm 6\%) \times (1\text{ m} \pm 5\%)]$.

Note 2 to entry: The inside cartons have a five-sided sheet metal liner, representing a non-combustible content.

Note 3 to entry: The cartoned liner is supported on an ordinary, two-way, slatted deck, hardwood pallet, measuring $[(1,07\text{ m} \pm 5\%) \times (1,07\text{ m} \pm 5\%) \times (0,13\text{ m} \pm 5\%)]$.

Note 4 to entry: The total combustible weight of the commodity is approximately 58 kg; the corrugated containerboard weighs approximately 35,5 kg, and the pallet weighs approximately 22,5 kg.

4 Assessment methods and criteria

4.1 Tolerances

If not given differently in the specific clause below, the tolerances of Annex A shall be applied.

4.2 Connections

4.2.1 Assessment method

The sprinkler connection, e.g. the thread size, shall be assessed by measurements.

4.2.2 Criteria

The thread connections of the sprinkler shall be in accordance with ISO 7-1 or shall be grooved connections. Alternative connection methods that have been tested and validated for use in fire sprinkler systems also fulfil 4.2.2.

4.3 Durability of coated sprinklers

4.3.1 Assessment method

12 coated sprinklers shall be exposed for a period of 90 days in an oven at a temperature of 30 °C below the nominal operating temperature. At intervals of 7 days, the sprinklers shall be removed from the oven, allow to cool for 2 h to 4 h and the coating shall be inspected with the unaided eye, corrected for normal vision if necessary. Then the sprinklers shall be returned to the oven. At the end of the exposure period, remove the sprinklers from the oven, cool them again and re-examine the coating.

4.3.2 Criteria

The coating shall show no visible evidence of damage.

4.4 High temperature exposure

4.4.1 Assessment method

The assessment method given in EN 12259-1:1999+A1:2001, Annex O shall be applied for three samples.

4.4.2 Criteria

Sprinklers, less operating mechanisms, shall not show significant deformation, blistering, or fracture following exposure to an elevated temperature as detailed below.

When surfaces of the orifice or frame exhibit significant deformation a discharge coefficient (k-factor), (see 4.16) and/or water distribution tests (see 4.13) on exposed samples to validate compliance with these requirements shall be conducted.

4.5 Conductivity (C-Factor)

4.5.1 Assessment method

The assessment method given in EN 12259-1:1999+A1:2001, N.2 shall be applied.

For sprinklers which could damage or cause problems in a plunge tunnel setup shall be allowed to be tested in accordance with 4.6.

4.5.2 Criteria

The criteria given in EN 12259-1:1999+A1:2001, 4.15 shall be applied.

4.6 Sensitivity (Air oven)

4.6.1 Assessment method

This assessment shall only be applied for sprinklers which could damage or cause problems in a plunge tunnel setup (see 4.5).

Ten previously untested sprinklers of each nominal temperature rating shall be individually operated in an air oven with the inlet of the sprinkler pressurized to the minimum operating pressure in accordance with 4.8. The rate-of-temperature-rise within the oven, starting from room temperature $22\text{ °C} \pm 5\text{ °C}$, shall be controlled in accordance with Table 1.

Table 1 — Time vs. temperature points for air oven sprinkler sensitivity test

Time min:sec	Temperature °C	Time min:sec	Temperature °C	Time min:sec	Temperature °C
0:15	135	6:00	327	16:00	399
0:30	210	7:00	332	17:00	407
0:45	246	8:00	341	18:00	414
1:00	263	9:00	349	19:00	421
1:15	274	10:00	354	20:00	429
1:30	282	11:00	363	22:00	443
2:00	290	12:00	368	24:00	457
3:00	302	13:00	377	26:00	471
4:00	310	14:00	385	28:00	485
5:00	318	15:00	391	30:00	499

4.6.2 Criteria

New, uncoated sprinklers which cannot be tested in the plunge tunnel shall operate within a time limit not exceeding the maximum permitted in Table 2 for the respective nominal temperature rating.

New sprinklers having corrosion resistant coatings (decorative, wax, etc.), which cannot be tested in the plunge tunnel, shall operate within a time limit not exceeding the maximum permitted in Table 3 for the respective nominal temperature rating.

Sprinklers having corrosion resistant coatings (decorative, wax, etc.), which cannot be tested in the plunge tunnel, and have been subjected to environmental testing, shall operate within the limits stated in Table 4.

Table 2 — Air oven sprinkler sensitivity for new, uncoated sprinklers utilizing the time vs. temperature data

Sprinkler nominal temperature rating °C	Maximum operating temperature °C	Maximum operating time min:sec
57 to 76	274	1:15
79 to 107	288	1:45
121 to 149	302	3:00
163 to 191	319	5:00
204 to 246	338	7:30
260 to 302	391	15:00

Table 3 — Air oven sprinkler sensitivity for new sprinklers having corrosion resistant coating utilizing the time vs. temperature data

Sprinkler nominal temperature rating °C	Maximum operating temperature °C	Maximum operating time min:sec
57 to 76	275	1:34
79 to 107	293	2:11
121 to 149	308	3:45
163 to 191	328	6:15
204 to 246	351	9:22
260 to 302	419	18:45

Table 4 — Air oven sprinkler sensitivity for aged or elevated temperature exposed sprinklers having corrosion resistant coating utilizing the time vs. temperature data

Sprinkler nominal temperature rating °C	Maximum operating temperature °C	Maximum operating time min:sec
57 to 76	291	2:00
79 to 107	302	3:00
121 to 149	319	5:00
163 to 191	341	8:00
204 to 246	355	10:00
260 and more	To be evaluated on a case-by-case basis.	

4.7 Leak resistance

4.7.1 Assessment method

4 sprinklers shall be subjected to water pressure of (30 ± 1) bar at the inlet. Increase the pressure from 0 to (30 ± 1) bar at a rate not exceeding 1 bar/s, maintain the pressure at (30 ± 1) bar for a period of 3_0^{+1} min and then allow it to fall to 0 bar. After the pressure has dropped to 0 bar, increase it to $(0,5 \pm 0,1)$ bar in not more than 5 s. Maintain this pressure for 15_0^{+5} s, and then increase it to $(10 \pm 0,5)$ bar at a rate not exceeding 1 bar/s and maintain it for 15_0^{+5} s. Examine the sprinkler for evidence of leakage during the test.

4.7.2 Criteria

The sprinklers shall not show any visible hydraulic leakage.

4.8 Release of the sprinkler at minimum operating pressure (for spray pattern, EC and ECS sprinklers)

4.8.1 Assessment method

The assessment method given in EN 12259-1:1999+A1:2001, Annex E shall be applied.

4.8.2 Criteria

When tested in accordance with EN 12259-1:1999+A1:2001, E.1 the sprinkler shall open and within 5 s of release of the thermally sensitive element shall operate satisfactorily. Any lodgement of released parts shall be cleared within 60 s of the release of the thermally sensitive element.

4.9 Nominal operating temperature

4.9.1 Assessment method

4.9.1.1 Apparatus

Laboratory temperature measuring device having an accuracy of $\pm 0,25\%$ of the nominal rating, calibrated to a depth of 40 mm immersion, for determining temperatures of liquids in bath tests and operating temperatures shall be used. The thermally sensitive part of the sensor (e.g. bulb of a

thermometer) shall be held level with the centre of the sprinkler operating parts. To control the temperature in the thermal bath, a PT100 sensor in accordance with EN IEC 60751 shall be used.

For sprinklers with a nominal operating temperature less than or equal to 80 °C a liquid bath of demineralized water shall be used. For sprinklers with higher rated elements a liquid bath of glycerine, vegetable oil or synthetic oil shall be used.

4.9.1.2 Procedure (liquid bath testing)

A total of 30 sprinklers shall be tested. Sprinklers shall be heated in a liquid bath from a temperature of $(20 \pm 5) ^\circ\text{C}$ to an intermediate temperature of $(20 \pm 2) ^\circ\text{C}$ below their nominal operating temperature. The rate of temperature increase shall not exceed $20_0^{+2} ^\circ\text{C}$ per minute. Maintain the intermediate temperature for 10_0^{+1} min. Then increase the temperature at a rate of $(0,5 \pm 0,1) ^\circ\text{C}$ per minute until the sprinklers operate or up to $2,0 ^\circ\text{C}$ above the upper operating limit.

The sprinklers shall be located in the vertical position and totally covered by the liquid to a depth of at least 5 mm. The geometric centre of the sprinkler operating parts shall be located not less than 35 mm below the liquid surface and in alignment with the temperature sensing device. The temperature deviation within the test zone should be within $0,25 ^\circ\text{C}$. The preferred location of the geometric centre of the sprinkler operating parts and temperature measuring device should be (40 ± 5) mm below the liquid surface. If strutting occurs during the test the air bath test (see 4.9.1.3) shall be performed.

4.9.1.3 Air bath test

Fifty previously untested sprinklers shall be placed on their threaded inlets in a programmable oven circulating air at ambient temperature. The temperature in the oven shall be steadily raised to $11,1 ^\circ\text{C} \pm 1,1 ^\circ\text{C}$ below the nominal temperature rating of the sprinklers over a $20_0^{+0,1}$ minute period. Once this temperature is reached, the oven shall be maintained at constant temperature for a period of $60 \text{ min} \pm 5 \text{ min}$. The temperature shall then be raised at a constant rate of $0,5 ^\circ\text{C} \pm 0,3 ^\circ\text{C}$ per minute until the temperature reaches $22 ^\circ\text{C} \pm 2,8 ^\circ\text{C}$ above the nominal temperature rating of the sprinklers.

4.9.2 Criteria

4.9.2.1 Liquid bath criteria

For sprinklers with a nominal temperature below 204 °C, full rupture of heat responsive element in liquid bath (see 4.9.1.2) within a temperature range of $t \pm (0,035 t + 0,62) ^\circ\text{C}$, where t is the nominal operating temperature, resulting in sprinkler operation.

Sprinklers with nominal temperature ratings of 204 °C or greater shall meet the requirements stated above, or shall have an actual operating temperature of $t + (0,07 t + 0,62) ^\circ\text{C}$ of the marked nominal temperature rating.

4.9.2.2 Air bath criteria

When subjected to the air bath test no partial fracture of a glass bulb or no partial rupture of a fusible link (i.e. strutting) shall occur.

4.10 Function (only for CMSA)

4.10.1 Assessment method

Samples for CMSA sprinklers shall be selected in accordance with Table 5. Samples shall be selected for spray pattern sprinklers with a k-factor of at least K160, extended coverage sprinklers of at least K80 in accordance with EN 12259-1:1999+A1:2001, Annex E. Both shall be individually installed in their intended installation position, on a pipe manifold.

A typical example of the test apparatus is shown in EN 12259-1:1999+A1:2001, Figure E.1. Each sample shall be subjected to an inlet water pressure in accordance with 4.8.2, operated using a suitable heat source, and observed for complete and proper functioning.

Dry sprinklers shall be tested at both the minimum and maximum lengths, and may require a total sample quantity of up to 200 sprinklers. The pipe manifold shall be modified by installing a plugged tee in place of the elbow and may be modified further to accommodate long samples of dry sprinklers.

Table 5 — Lodgement

Pressure ^a	Number of samples
0,5 bar	10
1,7 bar	10
3,4 bar	10
5,2 bar	10
6,9 bar	10
8,6 bar	10
10,3 bar	10
12,1 bar	10
^a A tolerance of ± 5 % applies to all pressures specified in the table.	

4.10.2 Criteria

Upon activation of each sample, the discharge coefficient shall be measured to verify complete operation.

4.11 Size of water passageways

4.11.1 Assessment method

A sphere of diameter 8 mm shall be passed through each water passage in the sprinkler.

4.11.2 Criteria

The sphere passes freely through each water passage or the sprinkler.

4.12 Sprinkler temperature identification

4.12.1 Assessment method

4.12.1.1 Glass bulb sprinklers

Visual inspection shall be performed to determine the colour of the liquid inside the bulb.

4.12.1.2 Fusible link sprinklers

A visual inspection shall be performed to determine colour painted on frame arm surface. In addition, a visual inspection shall be performed to ensure at least 50 % of frame arm surface is painted in the colour, and that paint is visible from all directions. If the percentage of painted colour surface is in doubt, optical measurement shall be applied.

4.12.2 Criteria

Sprinklers shall be in accordance with Table 6. In addition, fusible link sprinklers shall be painted for at least 50 % of each frame arm surface and the paint shall be visible from all directions.

Table 6 — 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	121 to 149	Blue
93	Green	163 to 191	Red
100	green	204 to 246	Green
121	blue	260 to 302	Orange
141	blue	320 to 343	Black
163	mauve	-	-
182	mauve	-	-
204	black	-	-
227	black	-	-
260	black	-	-
286	black	-	-
343	black	-	-

4.13 Water distribution

4.13.1 General

Both test methods given in 4.13.2 and 4.13.3 can be used. It is not necessary to carry out both procedures.

4.13.2 Assessment method 1

4.13.2.1 General

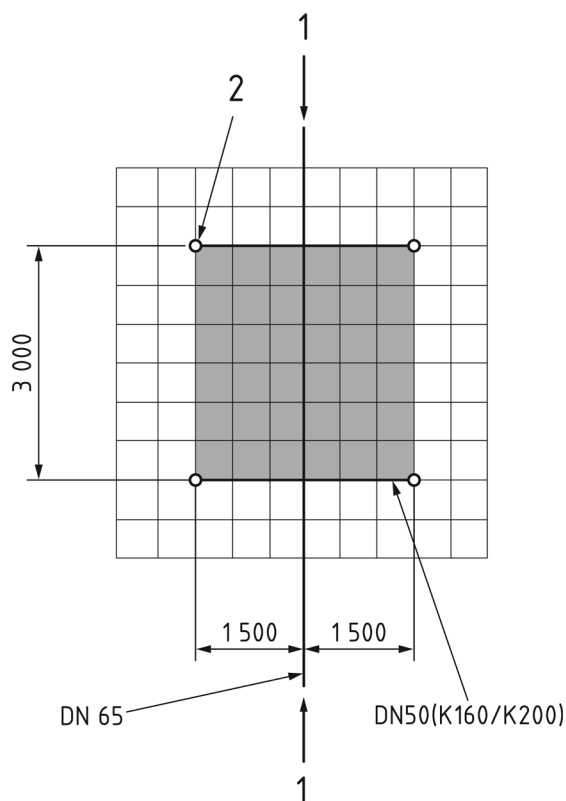
In a test chamber $7^{+1} \text{ m} \times 7^{+1} \text{ m}$, sprinklers of the same type shall be mounted in a square arrangement on a designated pipe. The arms of the sprinkler body shall be aligned parallel to the supply pipes. The distance between the ceiling and the deflector of upright sprinklers shall be $(50 \pm 5) \text{ mm}$ and of pendent sprinklers $(275 \pm 5) \text{ mm}$.

The arrangement of the pipe network and the measuring containers for collecting the water can be seen in Figure 1 to Figure 3. The water distribution is measured using measuring containers with an opening area of $(500 \pm 10) \text{ mm} \times (500 \pm 10) \text{ mm}$. The distance between the ceiling and the upper edge of the containers shall be $(2\,700 \pm 25) \text{ mm}$. The test is carried out according to the conditions met in the following clauses and the water flowing from the sprinklers is collected until a complete measurement result is obtained for the measurement area under consideration.

4.13.2.2 Assessment method for spray pattern sprinkler with at least K160

The test shall be carried out in accordance with the test procedure described 4.13.2.1 but in accordance with the test arrangement shown in Figure 1.

Dimensions in mm



Key

- 1 waterflow
- 2 sprinkler

Figure 1 — Arrangement of the K160 / K200 sprinklers at the water distribution (9 m²)

The parameters in Table 7 shall be applied for the assessment.

Table 7 — Assessment parameters for spray pattern sprinkler

k-factor	Flow rate l/min	Measuring area m ²	Sprinkler spacing m
160	112,5	9,00	3,0
160	270,0	9,00	3,0
200	270,0	9,00	3,0

4.13.2.3 Assessment method for extended coverage sidewall sprinklers with at least K80

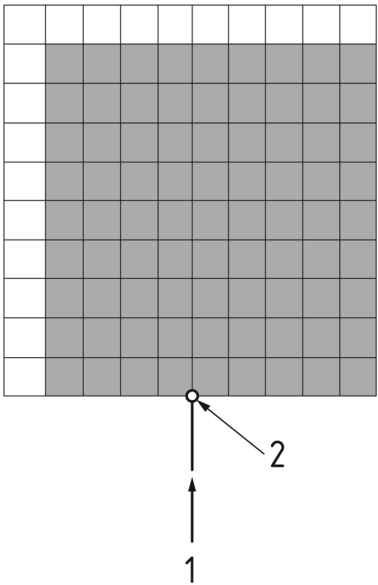
In addition to the test procedure described in 4.13.2.1, extended coverage sidewall sprinklers shall be tested according to Figure 2 with the following adjustments:

- the distance between the ceiling and the deflector shall be (150 ± 5) mm;
- the measurement with a measuring area of $19,5\text{ m}^2$ ($3\text{ m} \times 6,5\text{ m}$) shall be carried out in two steps (see Figure 3).

The parameters given in Table 8 shall be applied.

Table 8 — Water distribution requirements for individual extended coverage sidewall sprinklers

Distance ceiling / measuring surface mm	Flow rate l/min	Measuring area m^2
1 500	126,5	20,25 ($4,5\text{ m} \times 4,5\text{ m}$)
2 700	126,5	20,25 ($4,5\text{ m} \times 4,5\text{ m}$)
4 100	138,6	20,25 ($4,5\text{ m} \times 4,5\text{ m}$)
1 500	126,5	19,5 ($3,0\text{ m} \times 6,5\text{ m}$)
2 700	126,5	19,5 ($3,0\text{ m} \times 6,5\text{ m}$)
4 100	138,6	19,5 ($3,0\text{ m} \times 6,5\text{ m}$)

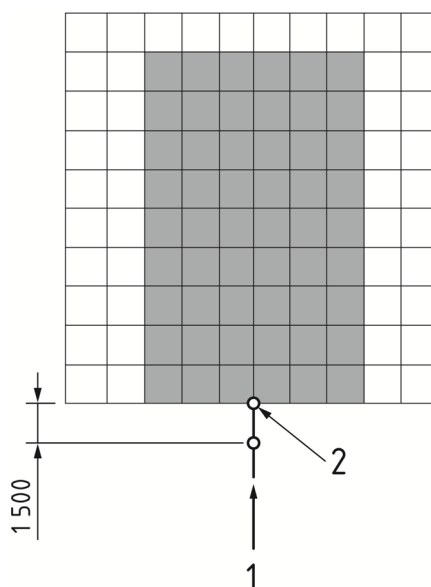


Key

- 1 waterflow
- 2 sprinkler

Figure 2 — Layout of the test room for determining the water distribution of extended coverage sidewall sprinklers ($20,25\text{ m}^2$)

Dimensions in mm

**Key**

- 1 waterflow
- 2 sprinkler

Figure 3 — Layout of the test room for determining the water distribution of extended coverage sidewall sprinklers (19,5 m²)

4.13.2.4 Criteria for test method 1

4.13.2.4.1 Spray pattern sprinkler with at least K160

For sprinklers tested in accordance with 4.13.2.2 the number of containers in which the water volume is less than 50 % of the water coverage specified in Table 9 shall not exceed the maximum number of containers specified in Table 9.

Table 9 — Spray pattern sprinkler with at least K160 test criteria

k-factor	Water coverage mm/min	Maximum number of containers with low water coverage
160	12,5	3
160	30,0	3
200	30,0	3

4.13.2.4.2 Extended coverage sidewall sprinklers with at least K80

The nominal k-factor of extended coverage sidewall sprinklers shall be at least K80.

When tested in accordance with 4.13.2.3, a single extended coverage sidewall sprinkler shall meet the water distribution requirements of Table 10.

With the exception of the measurements at the distance ceiling/measuring surface of 4 100 mm are not necessary, if the manufacturer has specified the use of the extended coverage sidewall sprinklers in rooms with a height up to maximum 2,8 m only.

Table 10 — Extended coverage sidewall sprinklers with at least K80 test criteria

Minimum number of containers with water coverage $\geq 2,5$ mm/min	Minimum number of containers with water coverage $\geq 1,25$ mm/min	Minimum number of containers with water coverage $\geq 0,6$ mm/min	Measuring area in m ²
41	65	73	20,25 (4,5 m $\times$ 4,5 m)
39	62	70	19,5 (3,0 m $\times$ 6,5 m)

4.13.3 Assessment method 2

4.13.3.1 Spray pattern sprinklers with at least K160

The appropriate number of previously untested samples shall be subjected to the distribution test conditions detailed in Table 11 for the type of sprinkler under examination. All samples shall be provided completely assembled. Prior to distribution testing, the sprinklers shall be operated, using a suitable heat source, to remove the heat responsive assembly. In cases where adjustment of the distance between the deflector and the ceiling or wall is possible (e.g. recessed type), the distribution tests shall be conducted at both extremes of deflector position.

For upright and pendent sprinklers, the water discharge from four and six sprinklers shall be collected in sixteen pans. They shall be placed in a 4 by 4 array with a pan size of (305 mm $\pm$ 10 mm) $\times$ (305 mm $\pm$ 10 mm). Water shall be collected for a period of not less than three minutes in accordance with the conditions detailed in Table 11.

Upright sprinklers shall be tested utilizing the branch lines and located below a suspended ceiling. All pendent sprinklers shall be installed in their intended installation position utilizing a suspended ceiling and supplied with water from branch lines located above the ceiling. In cases where adjustment of the distance between the deflector and the ceiling is possible (e.g. recessed type), the distribution tests shall be conducted at both extremes of deflector position. Sprinklers shall be installed such that their deflectors are positioned 2,3 m from the top plane of the pan array. Sprinklers shall be randomly selected and installed with the frame arms parallel to the branch line pipe. Repositioning of sprinklers, or placing specific sprinklers in specific locations, is not permitted.

See Figures 4 to 7 for more details.

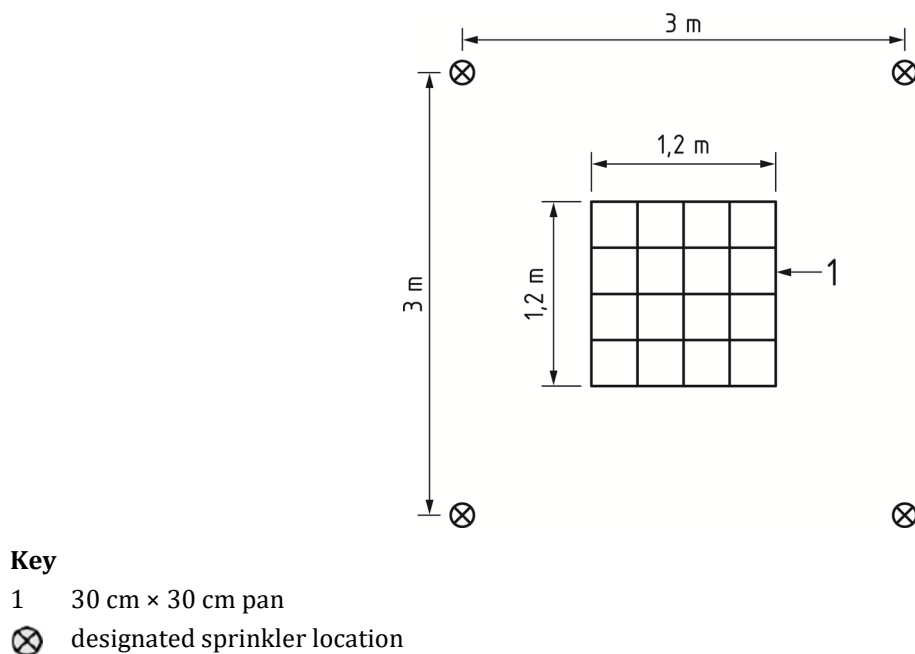


Figure 4 — Standard coverage sprinkler water distribution test layout of the four-sprinkler test

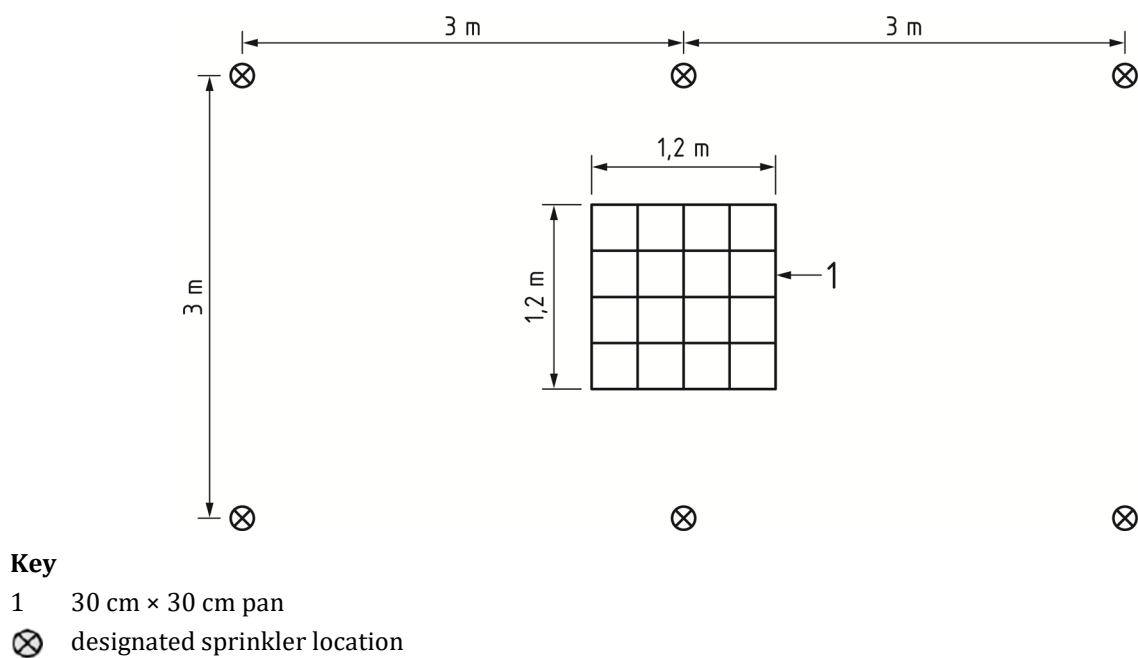
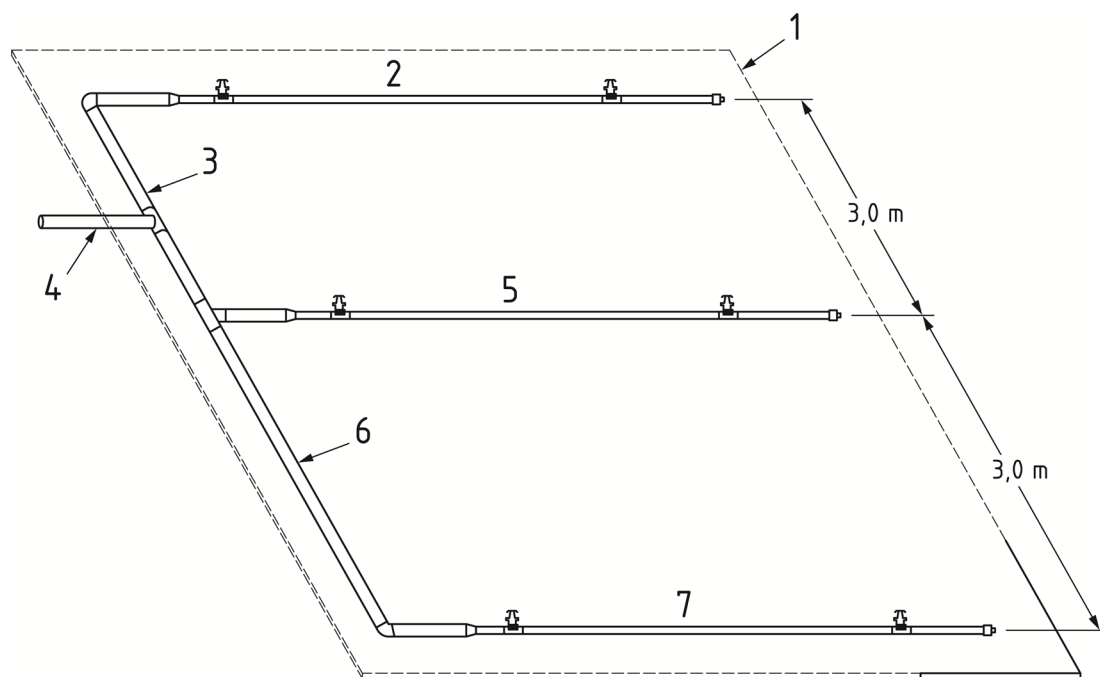
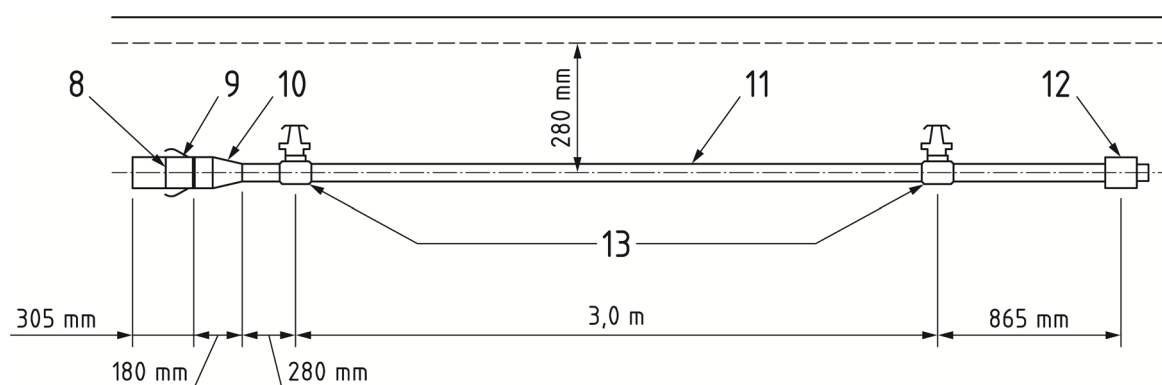


Figure 5 — Standard coverage sprinkler water distribution test layout of the six-sprinkler test



a) Piping configuration for upright standard coverage sprinkler water distribution test

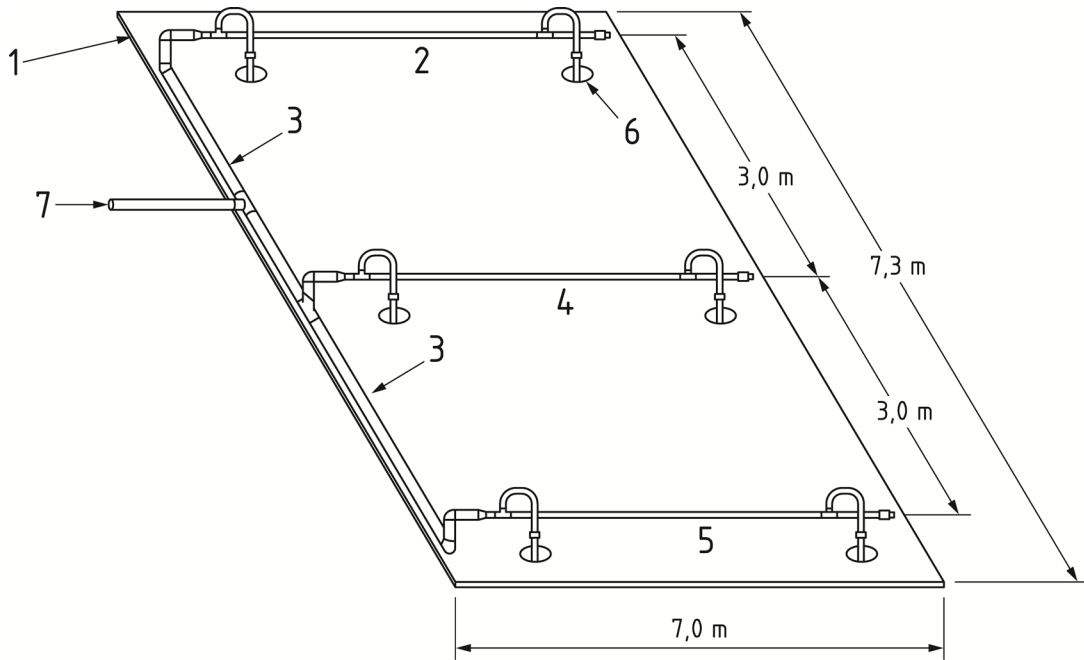


b) Typical branch line for upright standard coverage sprinkler water distribution test

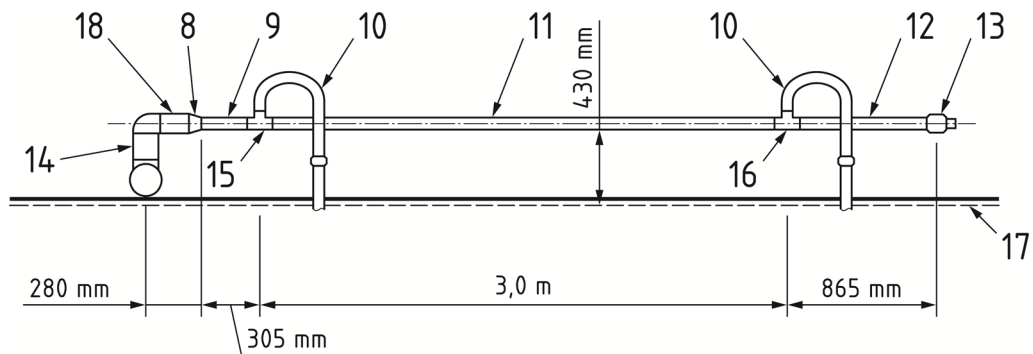
Key

1	suspended plywood ceiling	8	DN32 pipe
2	branch line number 3	9	DN32 quick connect
3	DN50 pipe	10	DN32 × DN25 reducing coupling
4	DN50 to supply	11	DN25 pipe
5	branch line number 2	12	DN25 coupling with plug
6	DN50 pipe	13	DN25 × DN15 or DN25 × DN20 tee
7	branch line number 1		

Figure 6 — Typical branch line for piping configuration for upright sprinklers



a) Piping configuration for pendent standard coverage sprinkler water distribution test



b) Typical branch line for pendent standard coverage sprinkler water distribution test

Key

1	suspended plywood ceiling	10	flex hose to adjustable drops
2	branchline number 3	11	DN25 pipe
3	DN50 pipe	12	DN25 pipe
4	branchline number 2	13	DN25 coupling with plug
5	branchline number 1	14	DN50
6	DN100 typical pipe	15	DN25 tee
7	DN50 to supply	16	DN25 tee
8	DN32 × DN25 reducing coupling	17	ceiling (bottom)
9	DN25 pipe		

Figure 7 — Typical branch line for piping configuration for pendent sprinklers

Table 11 — Distribution requirements

Nominal k-factor	Number of sprinklers	Average water flow per sprinkler l/min	Minimum average collection mm/min	Minimum individual pan mm/min
160	4	134,4	14,7	11,0
	4	189,3	20,4	15,3
	6	136,3	14,7	11,0
	6	189,3	20,4	15,3
200	4	142,0	15,3	11,4
	4	228,3	24,6	18,3
	6	142,0	15,3	11,4
	6	228,3	24,6	18,3

For upright sprinklers in the 6-sprinkler test, the requirements shall only apply to the two rows of pans furthest from the pipe. The two middle rows shall be omitted from the collection results and are exempted due to the unavoidable pipe shadow.

For sidewall sprinklers the floor collection shall be one hundred pans, each with a collection area measuring 305 mm × 305 mm shall be arranged in a 3,05 m × 3,05 m square, centred between two sidewall sprinklers installed 3,05 m apart. The pans shall cover an area 0,6 m to 3,7 m outward from the wall. For vertical type sidewall sprinklers, the tops of the pans shall be located 2,03 m below the deflectors. For horizontal type sidewall sprinklers, the tops of the pans shall be located 2,03 m below the projected axial centreline of the orifice. For either type, the deflector shall be located 153 mm from the wall and 100 mm from the ceiling. Each sprinkler shall flow water at a rate of 56,8 l/min and water shall be collected for a period of not less than three minutes.

For back-wall collection and wetting during the floor collection test, a measurement of the quantity of water being discharged onto the wall behind the sprinkler shall be made. Water shall be collected from the area of the back wall between the two sprinklers by means of a single row of 51 mm wide collecting pans, or other collection apparatus, such as a channel abutting the back wall. The opening in the top of the collection apparatus shall be located not more than 457 mm above the floor. The back wall shall be visually inspected for complete wetting in accordance with the criteria below.

4.13.3.2 Extended coverage sidewall sprinklers with at least K80

The collection pan array consists of water collection pans measuring 0,5 m × 0,5 m. For upright and pendent sprinklers, water distribution shall be measured and recorded for one quadrant of the coverage area. For sidewall sprinklers, water distribution shall be measured and recorded for one half of the coverage area. If visual observation indicates a non-symmetrical distribution pattern, water distribution shall be measured and recorded for the entire coverage area. Wall wetting shall be verified using a 1,2 m high wall enclosing the coverage area and covered with paper as needed for visual verification. Water shall be collected for a period of not less than 6 min.

In cases where adjustment of the distance between the deflector and the ceiling is possible, (i.e. recessed type), distribution tests shall be conducted at both extremes of deflector position. The distribution test conditions given in Table 12 and 13 shall be applied.

Table 12 — Distribution test conditions for upright and pendent extended coverage sprinklers

Nominal k-factor	Coverage area m × m	Deflector to ceiling distance m	Flow rate l/min	End head pressure bar
80	4,9 × 4,9	0,10	100	1,5
	5,5 × 5,5	0,10	125	2,4
	6,1 × 6,1	0,10	150	3,5
115	4,9 × 4,9	0,10	100	0,8
	5,5 × 5,5	0,10	125	1,2
	6,1 × 6,1	0,10	150	1,7
160	4,9 × 4,9	0,10	115	0,5
	5,5 × 5,5	0,10	125	0,6
	6,1 × 6,1	0,10	150	0,9
200	4,9 × 4,9	0,10	139	0,5
	5,5 × 5,5	0,10	139	0,5
	6,1 × 6,1	0,10	150	0,5

Table 13 — Distribution test conditions for sidewall extended coverage sprinklers

Nominal k-factor	Coverage area m × m	Deflector to ceiling distance m	Flow rate l/min	End head pressure bar
80	4,9 × 4,9	0,10 and 0,30	100	1,5
	4,9 × 5,5	0,10 and 0,30	115	2,0
	4,9 × 6,1	0,10 and 0,30	125	2,4
115	4,9 × 4,9	0,10 and 0,30	120	1,1
	4,9 × 5,5	0,10 and 0,30	135	1,4
	4,9 × 6,1	0,10 and 0,30	150	1,7
	4,9 × 6,7	0,10 and 0,30	165	2,0
	4,9 × 7,3	0,10 and 0,30	180	2,5

4.13.3.3 Criteria for test method 2

4.13.3.3.1 Spray pattern sprinklers with at least K160

Upright and pendent standard coverage sprinklers shall be capable of distributing water in a uniform manner. Samples shall be tested as detailed in 4.13.3.1. and shall meet the requirements in Table 11 for the appropriate nominal k-factor. For each test condition, not more than one individual pan shall have a collection less than the minimum required. Dry pans (i.e. zero water collection) are not permitted.

For standard sidewall sprinklers (horizontal and vertical) the amount of water collected in any individual pan shall not be less than 1,22 mm/min and the average collection shall not be less than 2,04 mm/min for the area covered. With the exception of up to two non-adjacent pans which may have a collection less than 1,22 mm/min. Dry pans (i.e. zero water collection) are not permitted. Sidewall sprinklers shall provide a minimum of 3,5 % of the total discharge (i.e. at least 1,99 l/min in the 3,05 m span between sprinklers) against the back wall and shall wet the back wall completely from the floor up to 1,2 m below the deflector. No dry areas are allowed within that region.

Sprinklers with factory painted or decorative finishes, such as plating, shall comply with the same performance criteria as those without such finishes.

When sprinklers are fitted with protective guards, such guards shall not degrade the average collection by more than 20 %. Minimum average and individual pan requirements shall be ignored. However, dry pans are not permitted.

For sprinklers with corrosion resistant coatings such as wax, prior to the distribution tests, the coated samples shall be operated in the air oven (see 4.6.1) and exposed for the maximum operating time for the appropriate temperature rating as stated in Table 3. The presence of a corrosion resistant coating shall not degrade the average collection by more than 10 %. Minimum individual pan requirements shall be ignored. However, dry pans are not permitted.

4.13.3.3.2 Extended coverage sidewall sprinklers with at least K80

When tested as detailed in 4.13.3.2 extended coverage sprinklers shall perform satisfactorily in all coverage areas indicated. The distribution collection shall exhibit the following:

- no dry pans (i.e. zero water collection);
- not more than one pan with water collection less than 0,61 mm/min;
- average collection of all pans not less than 1,63 mm/min; and
- complete wall wetting up to 0,9 m from the floor on all walls. No dry areas shall be permitted within this region.

4.14 Actual Delivered Density

The ADD assessment shall be performed for the following EC or CMSA sprinklers:

- CMSA sprinklers with a k-factor of K280 and K360;
- EC sprinklers with a k-factor of K160, K200, K280 and K360.

Actual delivered density (ADD) and pre-wetting density (PWD) measurements shall be taken using the test apparatus shown in Figures C.1 and C.2

Except for EC sprinklers with a k-factor of K160, the ADD assessment is only to determine the least favourable ignition location for extinguishing performance testing (full-scale fire testing). Minimum collection requirements are not specified. The least favourable ignition scenario will be identified first by the lowest average density collected in the centre area. If this does not differentiate the scenarios significantly (by at least 5 %), consideration shall be given to the average density collected in the pre-wetting area as well.

The ADD apparatus shall consist of two major components:

- a fire source; and
- a simulated commodity.

The fire source shall consist of a number of spray nozzles equally spaced on the circumference of a circle. Heptane shall be used as the fuel for the fire. Below the fire source shall be an array of collection pans representing a simulated commodity.

The centre section of the array shall approximate the geometry and size of a single tier rack-storage commodity of two pallet loads deep by two pallet loads wide, with a $15\text{ cm} \pm 2\%$ flue space between each pallet. Sixteen square water collection pans, representing the top surface of the commodity within the ignition area, shall collect water that would normally reach the commodity's top surface. Four additional pans, representing the flue spaces between pallet loads of commodity, shall collect water that would normally be delivered to the flue spaces.

At each end of the centre section of the array, a set of pre-wetting density (PWD) pans shall be positioned. Each set of pans shall approximate the geometry and size of one-half of one tier of rack-storage commodity (two pallet loads deep by one pallet load wide), with a $15\text{ cm} \pm 2\%$ flue space between adjacent pallets. At each end of the centre section, eight square collection pans, representing the commodity just beyond the area of ignition, shall collect water that would normally reach the top surface of the adjacent commodity. Three rectangular pans at each end, representing the flue spaces between pallet loads, shall collect water that would normally be delivered to the adjacent flue spaces.

A flat horizontal ceiling with minimum dimensions of 11 m x 10 m shall be suspended above the apparatus. The test apparatus shall be located in a room of sufficient volume to minimize the entrainment of additional water spray.

Open sprinklers shall be connected to DN50 sprinkler pipes under the suspended ceiling via DN50 x DN50 x DN20 threaded tees, mechanical tee fittings with bushings, or a suitable alternative.

The frame arms of each sprinkler shall be aligned parallel with the sprinkler pipe. The distance from the pipe centreline to ceiling shall be 30 cm for upright sprinklers. For pendent sprinklers tested at a clearance from the ceiling to the top of the water collection pans of 1,1 m. For pendent sprinklers tested at a clearance from the ceiling to the top of the water collection pans of 3 m, the distance from the pipe centreline to ceiling shall be 30 cm. For all tests, the pipes shall be fed with water flowing from a single direction.

Tests in which the clearance from the ceiling to the top of the water collection pans is 1,1 m shall be conducted without a fire. For other tests, prior to each measurement, the heptane spray shall be ignited, and the flow stabilized at a flow rate corresponding to the required heat release. Once the fuel flow rate has been stabilized, water shall be discharged from the sprinklers. Water collected by all pans is to be channelled to the collectors of the apparatus. Water shall be collected until one or more collection buckets are filled, or for a minimum of 10 min, whichever occurs first.

For all tests, measurements shall be recorded for up to five different sets of samples.

The distribution test conditions given in Tables 14 to 22 shall be applied.

Table 14 — ADD measurements for K160 EC upright sprinklers

Number of sprinklers centred over the ADD apparatus	Sprinkler Spacing	Pipe spacing	Ceiling clearance to water collection	Freeburn conv. heat release	Pressure	Min. centre pan area average density	Min. pre-wetting area average density
	m	m	m	MW	bar	mm/min	mm/min
1	0,0	-	1,1	0,0	0,8	5,3	4,9
1	0,0	-	3,1	0,5	0,8	2,0	1,2
2	4,9	-	1,1	0,0	0,8	4,1	4,1
2	4,9	-	3,1	1,1	0,8	3,3	2,0
4	4,9	4,9	1,1	0,0	0,8	5,3	4,5
4	4,9	4,9	3,1	1,5	0,8	4,5	5,3

Table 15 — ADD measurements for K160 EC pendent sprinklers

Number of sprinklers centred over the ADD apparatus	Sprinkler Spacing	Pipe spacing	Ceiling clearance to water collection	Freeburn conv. heat release	Pressure	Min. centre pan area average density	Min. pre-wetting area average density
	m	m	m	MW	bar	mm/min	mm/min
1	0,0	-	1,1	0,0	0,8	4,5	2,0
1	0,0	-	3,1	0,5	0,8	0,8	0,8
2	4,9	-	1,1	0,0	0,8	4,9	4,9
2	4,9	-	3,1	1,1	0,8	2,4	3,3
4	4,9	4,9	1,1	0,0	0,8	6,5	4,9
4	4,9	4,9	3,1	1,5	0,8	5,3	5,7