
**Fire protection — Automatic sprinkler
systems —**

**Part 1:
Requirements and test methods for
sprinklers**

iTeh STANDARD PREVIEW
(standards.iteh.ai)
*Protection contre l'incendie — Systèmes d'extinction automatiques du
type sprinkler —
Partie 1: Prescriptions et méthodes d'essai des sprinklers*

ISO 6182-1:2021

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>



iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 6182-1:2021

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword	vii
Introduction	ix
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 General.....	1
3.2 Types of sprinklers according to type of responsive element.....	4
3.3 Types of sprinklers according to type of water distribution.....	4
3.4 Types of sprinklers according to position.....	5
3.5 Special types of sprinklers.....	6
3.6 Types of sprinklers according to sprinkler sensitivity.....	7
4 Product consistency	8
4.1 Quality control programme.....	8
4.2 Leak resistance testing.....	8
4.3 Glass bulb integrity test.....	8
5 Product assembly	8
5.1 General.....	8
5.2 Dynamic O-ring seals.....	8
5.3 Rated pressure.....	8
5.4 Dry sprinklers.....	9
5.5 Escutcheons.....	9
6 Requirements	9
6.1 General.....	9
6.1.1 Electrically activated sprinkler and monitoring of activation.....	9
6.1.2 Orifice size.....	9
6.1.3 Nominal thread sizes.....	9
6.2 Maximum coverage areas and spacing.....	10
6.3 Temperature ratings and colour coding.....	10
6.4 Service load and strength of sprinkler body (see 7.4).....	11
6.5 Strength of heat-responsive element (see 7.5).....	11
6.5.1 Glass bulb elements.....	11
6.5.2 Fusible elements.....	12
6.6 Leak resistance and hydrostatic strength (see 7.6).....	12
6.7 Thirty-day leakage resistance (see 7.7).....	12
6.8 Vacuum resistance (see 7.8).....	13
6.9 Water hammer (see 7.9).....	13
6.10 Vibration (see 7.10).....	13
6.11 Deflector strength (see 7.11).....	13
6.12 Water shield rotation (see 7.12).....	13
6.13 Impact (see 7.13).....	13
6.14 Protective covers (see 7.14).....	13
6.15 Rough usage (see 7.15).....	14
6.16 Dry sprinkler air tightness (see 7.16).....	14
6.17 Operating temperature (see 7.17).....	14
6.18 Sensitivity — response time index (RTI) (see 7.18).....	14
6.18.1 Pre-exposure RTI.....	14
6.18.2 Post-exposure RTI.....	15
6.19 Sensitivity test of flush, concealed and recessed sprinklers (see 7.19).....	15
6.19.1 General.....	15
6.19.2 Room response test (see 7.19.2).....	15
6.19.3 Plunge test (see 7.19.3).....	15
6.20 Lodgement (see 7.20).....	16

6.21	Heat exposure (see 7.21)	17
6.21.1	Glass bulb sprinklers	17
6.21.2	All sprinklers	17
6.21.3	Coated sprinklers	17
6.22	Sprinkler coatings (see 7.22)	17
6.22.1	Evaporation of wax and bitumen	17
6.22.2	Resistance to low temperatures	17
6.23	Thermal shock for glass bulb sprinklers (see 7.23)	17
6.24	Resistance to heat (see 7.24)	17
6.25	Freezing test (see 7.25)	17
6.26	Corrosion (see 7.26)	18
6.26.1	Stress corrosion for copper-based alloy components (see 7.26.1)	18
6.26.2	Stress corrosion for stainless steel components (see 7.26.2)	18
6.26.3	Sulphur dioxide/carbon dioxide corrosion (see 7.26.3)	18
6.26.4	Hydrogen sulphide corrosion (see 7.26.4)	18
6.26.5	Salt spray loading (see 7.26.5)	18
6.26.6	Moist air exposure (see 7.26.6)	19
6.26.7	Dry-type sprinkler deposit loading (see 7.26.7)	19
6.26.8	Dezincification of brass parts (see 7.26.8)	19
6.27	Water flow constant (see 7.27)	19
6.28	Water distribution (see 7.28)	20
6.28.1	General	20
6.28.2	Spray, flat spray, conventional and dry sprinkler water distribution (see 7.28.2)	21
6.28.3	Domestic sprinkler water distribution (see 7.28.3)	22
6.28.4	Extended coverage light hazard sprinkler water distribution (see 7.28.4)	22
6.28.5	Extended coverage ordinary hazard sprinkler water distribution (see 7.28.5)	23
6.28.6	K202 and K242 pendent ESFR sprinkler water distribution (see 7.28.6)	23
6.28.7	Thrust force measurements for K202 and K242 pendent ESFR sprinklers (see 7.28.7)	28
6.29	Lateral discharge (see 7.29)	28
6.30	Water shield angle of protection (see 7.30)	28
6.31	Fire performance (see 7.31)	29
6.31.1	General	29
6.31.2	Spray sprinkler fire performance (see 7.31.2)	30
6.31.3	Domestic sprinkler fire performance (see 7.31.3)	30
6.31.4	Extended coverage light hazard sprinkler fire performance (see 7.31.4)	31
6.31.5	Extended coverage ordinary hazard sprinkler fire performance (See 7.31.5)	31
6.31.6	Nominal K-202 and K-242 pendent ESFR fire performance (see 7.31.6)	31
6.31.7	Standard coverage storage, extended coverage storage and ESFR (Other than K202 & K242 Pendent) sprinkler fire test performance (see 7.31.7)	32
6.32	Electrical characteristics	33
7	Test methods	33
7.1	General	33
7.2	Preliminary examination	33
7.3	Visual examination	33
7.4	Service load and strength of sprinkler body test (see 6.4)	34
7.4.1	Test option 1	34
7.4.2	Test option 2	34
7.4.3	Test option 3	35
7.5	Strength of heat-responsive element test (see 6.5)	35
7.5.1	Glass bulbs	35
7.5.2	Fusible elements	35
7.6	Leak resistance and hydrostatic strength tests (see 6.6)	36
7.7	Thirty-day leakage test (see 6.7)	36
7.8	Vacuum test (see 6.8)	36
7.9	Water hammer test (see 6.9)	36
7.10	Vibration test (see 6.10)	37

7.11	Deflector strength test (see 6.11)	37
7.12	Water shield rotation test (see 6.12)	37
7.13	Impact (see 6.13)	37
7.14	Protective cover impact test for glass bulb sprinklers (see 6.14)	38
7.15	Rough usage test (see 6.15)	39
7.16	Dry sprinkler air tightness test (see 6.16)	40
7.17	Operating temperature tests (see 6.17)	41
	7.17.1 Liquid test	41
	7.17.2 Air test	42
7.18	Sensitivity test — response time index (RTI) (see 6.18)	43
	7.18.1 Plunge test	43
	7.18.2 Response time index (RTI) calculation	44
7.19	Sensitivity test for flush, concealed and recessed sprinklers (see 6.19)	44
	7.19.1 General	44
	7.19.2 Room response test	44
	7.19.3 Plunge test	49
7.20	Lodgement test (see 6.20)	52
7.21	Heat exposure test (see 6.21)	55
	7.21.1 Glass bulb sprinklers (see 6.21.1)	55
	7.21.2 All sprinklers (see 6.21.2)	55
	7.21.3 Coated sprinklers (see 6.21.3)	55
7.22	Sprinkler coatings (see 6.22)	56
	7.22.1 Evaporation of wax and bitumen test (see 6.22.1)	56
	7.22.2 Low temperature test (see 6.22.2)	56
7.23	Thermal shock test for glass bulb sprinklers (see 6.23)	56
7.24	Resistance to heat test (see 6.24)	56
7.25	Freezing (see 6.25)	57
7.26	Corrosion tests (see 6.26)	57
	7.26.1 Stress corrosion test for copper-based alloy components (see 6.26.1)	57
	7.26.2 Stress corrosion for stainless steel components (see 6.26.2)	57
	7.26.3 Sulphur dioxide/carbon dioxide corrosion test (see 6.26.3)	58
	7.26.4 Hydrogen sulphide corrosion test (see 6.26.4)	58
	7.26.5 Salt spray loading test (see 6.26.5)	59
	7.26.6 Moist air exposure (see 6.26.6)	59
	7.26.7 Dry-type sprinkler deposit loading test (see 6.26.7)	59
	7.26.8 Dezincification of brass components (see 6.26.8)	60
7.27	Water flow constant (see 6.27)	61
7.28	Water distribution tests (see 6.28)	62
	7.28.1 General	62
	7.28.2 Spray, flat spray, conventional and dry sprinklers (see 6.28.2)	62
	7.28.3 Domestic sprinklers (see 6.28.3)	70
	7.28.4 Extended coverage light hazard sprinklers (see 6.28.4)	74
	7.28.5 Extended coverage ordinary hazard sprinklers (see 6.28.5)	80
	7.28.6 K202 and K242 pendent ESFR sprinklers (see 6.28.6)	80
	7.28.7 Thrust force test (see 6.28.7)	85
7.29	Lateral discharge test (see 6.29)	86
	7.29.1 General	86
	7.29.2 Upright and pendent sprinklers	86
	7.29.3 Sidewall sprinklers	87
	7.29.4 Exposure to heat and flame	87
	7.29.5 Consumption of heptane	87
7.30	Water shield angle of protection (see 6.30)	87
7.31	Fire performance (see 6.31)	88
	7.31.1 General	88
	7.31.2 Spray sprinkler fire performance	88
	7.31.3 Domestic sprinkler fire performance (see 6.31.3)	91
	7.31.4 Extended coverage light hazard sprinkler fire performance (see 6.31.4)	99
	7.31.5 Extended coverage ordinary hazard sprinkler fire performance (see 6.31.5)	102

7.31.6	Actual delivered density (nominal K-202 and K-242 pendent ESFR fire performance) (see 6.31.6).....	103
7.31.7	Standard coverage storage, extended coverage storage and ESFR (other than K202 & K242 pendent) sprinkler fire test performance (see 6.31.7).....	104
7.32	Electrical characteristics.....	106
7.32.1	Starting current and response time (see 6.32.1).....	106
7.32.2	Monitoring current (see 6.32.2).....	106
7.32.3	Wires (6.32.3).....	106
8	Marking	106
8.1	Sprinklers.....	106
8.2	Sprinkler housings and concealed-sprinkler cover plates.....	108
8.3	Protective covers.....	108
9	Manufacturer's installation instructions	108
Annex A (normative) Tolerance limit calculation methods		111
Annex B (informative) Analysis of the strength test for fusible element		113
Annex C (normative) Tolerances		114
Annex D (informative) Standard test commodities and fire test configurations		115
Annex E (informative) Fire test arrangements for extended coverage ordinary hazard		119
Annex F (informative) Statistical tolerance limits		122
Bibliography		125

ITeH STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 6182-1:2014) which has been technically revised.

The main changes compared to the previous edition are as follows:

- Consolidation of the requirements for early suppression fast response (ESFR) sprinklers (ISO 6182-7:2020), domestic sprinklers (ISO 6182-10:2014) and extended coverage sprinklers (ISO 6182-13:2017) into a single document.
- Increased harmonization of test methods and requirements for the different types of sprinklers.
- Expanded scope to include extended coverage sprinklers for ordinary hazard occupancies and large flow constant, *K*, storage type sprinklers.
- New water distribution and fire test methods as well as requirements for the additional sprinkler technologies.
- New requirements for electrically operated style sprinklers.

A list of all parts in the ISO 6182 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This corrected version of ISO 6182-1:2021 incorporates the following corrections:

- Correction of error in column 1, second row of [Table 11](#) and column 1, final row of [Table 12](#).
- First column heading in [Table 22](#) and [Table 23](#) changed from "Flow constant, *K*" to "Nominal flow constant, *K*".

- Corrections to key elements ^a and ^b in [Figure 27](#) (addition of the phrase "divided by 2").
- Correction to key element ^a in [Figure 28](#) (addition of the phrase "divided by 2").
- [Figure 32](#) and [Figure 42](#) reduced in size for formatting purposes.
- Two subfigures added to [Figure 46](#) and key corrected.
- Corrections to whole key of [Figure D.1](#).
- The term "K-factor" replaced by "flow constant, *K*," throughout.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 6182-1:2021](#)

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>

Introduction

This document includes requirements for conventional, spray, flat spray, sidewall, extended coverage, domestic and storage sprinklers, including early suppression fast response (ESFR) sprinklers, electrically activated sprinklers (EAS) and sprinklers with monitoring of activation (SMA).

Conventional sprinklers are the oldest of the fire sprinkler technologies. These sprinklers discharge water in a spherical discharge pattern such that 40 % to 60 % of the total water flow is initially discharged in the downward direction. In general, the use of this sprinkler technology is limited to applications where this discharge characteristic has been determined to be more effective than the spray sprinkler.

Spray sprinklers were developed in the 1950s and are used to provide fire protection for a wide range of fire risks, including those found in light hazard, ordinary hazard and extra hazard occupancies, as well as storage facilities.

Flat spray sprinklers have a wider spray angle than spray sprinklers and are generally limited to use in spaces with low clearances and storage racks in specific geographic regions.

Domestic 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.

Extended coverage light hazard sprinklers are intended to provide control of fires in occupancies or portions of occupancies where quantity and/or combustibility of contents is low, such as office spaces.

Extended coverage ordinary hazard sprinklers are intended to provide control of fires in occupancies or portions of occupancies where quantity and/or combustibility of contents is moderate to high, such as mercantile areas.

Storage sprinklers, including ESFR sprinklers, are primarily intended to be used to provide fire protection for storage facilities.

Electrically activated sprinklers make it possible to activate more than one sprinkler simultaneously.

Sprinklers with monitoring of activation make it possible to detect the location of an actuated sprinkler.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 6182-1:2021

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>

Fire protection — Automatic sprinkler systems —

Part 1: Requirements and test methods for sprinklers

1 Scope

This document specifies performance and marking requirements and test methods for conventional, spray, flat spray, sidewall, extended coverage, domestic and storage sprinklers, including early suppression fast response (ESFR), electrically activated sprinklers (EAS) and sprinklers with monitoring of activation (SMA) for use in water-based fire protection systems. This document is not applicable to sprinklers with multiple orifices.

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.

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

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

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1 General

3.1.1

actual delivered density

ADD

rate at which water is deposited from an operating *sprinkler* (3.1.13) onto the top horizontal surface of a simulated burning combustible array

3.1.2

assembly load

force exerted on the sprinkler body excluding hydrostatic pressure

3.1.3

average design strength

glass bulb supplier's specified and assured lowest average axial design strength of any batch of 50 bulbs

3.1.4 coverage length

maximum length of the sprinkler coverage area

3.1.5 coverage width

maximum width of the sprinkler coverage area

3.1.6 design load

force exerted on the release element at the *service load* (3.1.12) of the *sprinkler* (3.1.13)

**3.1.7 housing assembly
escutcheon**

ornamental or protective component(s) around the hole from which the *sprinkler* (3.1.13) penetrates the plane of the ceiling or the wall

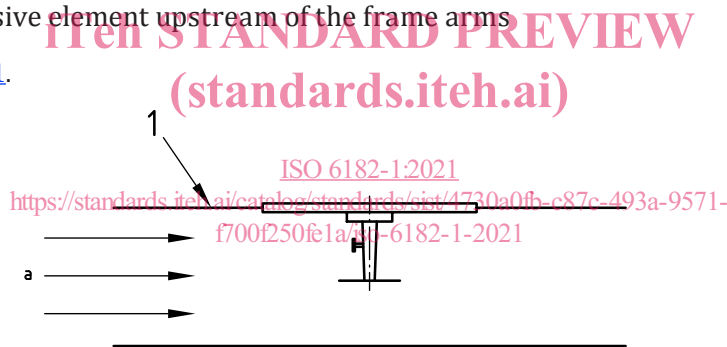
Note 1 to entry: See [Figure 3](#).

Note 2 to entry: For the purposes of this document, housing applies to recessed and *concealed sprinklers* (3.5.2).

3.1.8 orientation A

orientation with the airflow perpendicular to both the waterway axis and the plane of the frame arms and with the heat responsive element upstream of the frame arms

Note 1 to entry: See [Figure 1](#).



Key

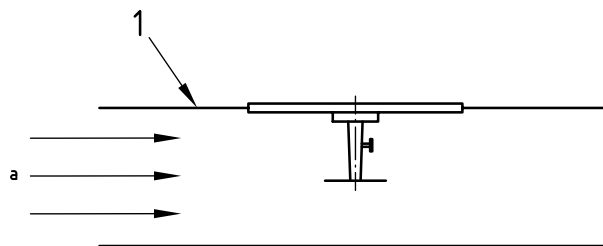
- 1 tunnel test section (elevation view)
- a Airflow.

Figure 1 — Orientation A

3.1.9 orientation B

orientation with the airflow perpendicular to both the waterway axis and the plane of the frame arms and with the heat responsive element downstream of the frame arms

Note 1 to entry: See [Figure 2](#).

**Key**

- 1 tunnel test section (elevation view)
 a Airflow.

Figure 2 — Orientation B**3.1.10****protective covers**

protective caps or straps intended to provide temporary protection for *sprinklers* (3.1.13) during shipping, handling and installation

3.1.11**response time index****RTI**

measure of sprinkler sensitivity determined by [Formula \(1\)](#)

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

(1)

where

- t is equal to the time constant, in seconds, of the heat-responsive element;
 u is the gas velocity, in meters per second.

Note 1 to entry: The response time index is expressed in units of (m·s)^{0.5}.

3.1.12**service load**

combined force exerted on the sprinkler body by the *assembly load* (3.1.2) of the *sprinkler* (3.1.13) and the equivalent force of the rated pressure on the inlet

3.1.13**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

Note 1 to entry: These devices may sometimes be referred to as a sprinkler head.

3.1.14**standard orientation**

orientation that produces the shortest response time with the axis of the sprinkler inlet perpendicular to the airflow

Note 1 to entry: In the case of symmetrical heat-responsive elements, standard orientation is with the airflow perpendicular to both the axis of the waterway and the plane of the frame arms; in the case of non-symmetrical heat-responsive elements, it is with the airflow perpendicular to both the waterway axis and the plane of the frame arms which produces the shortest response time.

3.2 Types of sprinklers according to type of responsive element

3.2.1

electrically activated sprinkler

EAS

sprinkler (3.1.13) that is equipped with an integral means of activation using electricity

3.2.2

sprinklers with monitoring of activation

SMA

sprinkler (3.1.13) that is equipped with an integral means of monitoring of activation using electricity

3.2.3

electrically activated sprinkler with monitoring of activation

EAS-M

sprinkler (3.1.13) that is equipped with an integral means of activation using electricity and monitoring of activation

3.2.4

fusible element sprinkler

sprinkler (3.1.13) that opens under the influence of heat by the melting of a component

3.2.5

glass bulb sprinkler

sprinkler (3.1.13) that opens under the influence of heat by the bursting of the glass bulb through pressure resulting from expansion of the fluid enclosed therein

3.3 Types of sprinklers according to type of water distribution

3.3.1

conventional sprinkler

<https://standards.iteh.ai/catalog/standards/sist/4730a0fb-c87c-493a-9571-f700f250fe1a/iso-6182-1-2021>

sprinkler (3.1.13) giving spherical water distribution directed downward and at the ceiling for a definite protection area such that 40 % to 60 % of the total water flow is initially directed downward

3.3.2

flat spray sprinkler

F

sprinkler (3.1.13) giving water distribution directed downward for a definite protection area such that 85 % to 100 % of the total water flow is initially directed downward with a wider spray angle than expected with a *spray sprinkler* (3.3.3)

Note 1 to entry: This type of sprinkler is used in storage racks and other shallow areas in some countries.

3.3.3

spray sprinkler

S

sprinkler (3.1.13) giving paraboloid water distribution directed downward for a definite protection area such that 80 % to 100 % of the total water flow is initially directed downward

3.3.4

domestic sprinkler

D

sprinkler (3.1.13) intended to provide control of fire in domestic occupancies

3.3.5

extended coverage sprinkler

EC

sprinkler (3.1.13) with a specified area of coverage which is larger than the standard sprinkler coverage areas

3.3.5.1**extended coverage light hazard sprinkler****ECLH**

sprinkler (3.1.13) having a specified area of coverage which is larger than the standard sprinkler coverage areas and intended for use in occupancies or portions of occupancies where the quantity and/or combustibility of contents is low, such as office spaces

3.3.5.2**extended coverage ordinary hazard sprinkler****ECOH**

sprinkler (3.1.13) having a specified area of coverage which is larger than the standard sprinkler coverage areas and intended for use in occupancies or portions of occupancies where the quantity and/or combustibility of contents is moderate to high

3.3.5.3**extended coverage storage sprinkler****ECSS**

sprinkler (3.1.13) having a specified area of coverage which is larger than the standard sprinkler coverage areas and intended to protect stockpiles of commodities in building structures, such as storage facilities

3.3.6**standard coverage storage sprinkler****SCSS**

sprinkler (3.1.13) having a standard area of coverage (typically 9 m² maximum) and intended to protect stockpiles of commodities in building structures, such as storage facilities

3.3.7**early suppression fast response automatic sprinkler****ESFR**

sprinkler (3.1.13) that is intended to provide early suppression of a fire when protecting stockpiles of commodities in building structures such as storage facilities

3.4 Types of sprinklers according to position**3.4.1****horizontal sidewall sprinkler****H**

sprinkler (3.1.13) arranged such that the orifice directs the water stream horizontally towards the deflector giving a one-sided distribution pattern

3.4.2**pendent sprinkler****P**

sprinkler (3.1.13) arranged such that the orifice directs the water stream downwards towards the deflector

3.4.3**vertical sidewall sprinkler****W**

sprinkler (3.1.13) arranged such that the orifice directs the water stream upwards or downwards towards the deflector giving a one-sided water distribution

3.4.4**upright sprinkler****U**

sprinkler (3.1.13) arranged such that the orifice directs the water stream upwards towards the deflector