



BSI Standards Publication

Fixed firefighting systems - Automatic sprinkler systems - Design, installation and maintenance

National foreword

This British Standard is the UK implementation of EN 12845:2015+A1:2019, incorporating corrigendum January 2016. It supersedes BS EN 12845:2015, which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CEN corrigendum January 2016 is indicated in the text by AC1 AC1.

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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 secretary.

The revision of EN 12845 took some time in development and, as a result, the UK committee feels it may not reflect current sprinkler technology and practice. National Annex NA identifies some areas of concern and also provides guidance and material related to UK practice.

A sprinkler system designed, installed and maintained in accordance with this standard is capable of providing protection of property and for the safety of people, including firefighters, should a fire occur in sprinklerprotected premises.

It should be noted that this standard no longer uses the term 'life safety'. For the avoidance of doubt and to clarify issues that have frequently arisen, when sprinkler systems are called for to satisfy national regulations, including any references to 'life safety', such requirements are now found in Annex F: Additional measures to improve system reliability and availability.

It is anticipated that this annex will make it clear that additional equipment and facilities are usually only necessary to enhance system response or prevent the periodic closure of protected occupancies when a sprinkler system is impaired.

Attention is drawn to the *LPC Rules for Automatic Sprinkler Installations*, which incorporate the provisions of BS EN 12845.

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

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English Version

Fixed firefighting systems - Automatic sprinkler systems - Design, installation and maintenance

Installations fixes de lutte contre l'incendie - Systèmes
d'extinction automatique du type sprinkleur -
Conception, installation et maintenance

Ortsfeste Brandbekämpfungsanlagen - Automatische
Sprinkleranlagen - Planung, Installation und
Instandhaltung

This European Standard was approved by CEN on 20 December 2014 and includes Amendment 1 approved by CEN on 2 October 2019.

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Contents	Page
European foreword.....	12
Introduction	13
1 Scope	15
2 Normative references	15
3 Terms and definitions	16
4 Contract planning and documentation.....	24
4.1 General.....	24
4.2 Initial considerations.....	24
4.3 Preliminary or estimating stage	24
4.4 Design stage	25
4.4.1 General.....	25
4.4.2 Summary schedule.....	25
4.4.3 Installation layout drawings	25
4.4.4 Water supply.....	28
5 Extent of sprinkler protection.....	31
5.1 Buildings and areas to be protected.....	31
5.1.1 General.....	31
5.1.2 Permitted exceptions within a building.....	31
5.1.3 Necessary exceptions.....	31
5.2 Storage in the open air	31
5.3 Fire resistant separation	31
5.4 Protection of concealed spaces	32
5.5 Height difference between the highest and lowest sprinklers.....	32
6 Classification of occupancies and fire hazards.....	32
6.1 General.....	32
6.2 Hazard classes	32
6.2.1 General.....	32
6.2.2 Light Hazard – LH	32
6.2.3 Ordinary Hazard – OH.....	32
6.2.4 High Hazard – HH	33
6.3 Storage	34
6.3.1 General.....	34
6.3.2 Storage Configuration.....	34
7 Hydraulic design criteria.....	37
7.1 LH, OH and HHP	37
7.2 High Hazard Storage – HHS.....	38
7.2.1 General.....	38
7.2.2 Ceiling or roof protection only	38
7.2.3 Intermediate level in-rack sprinklers	39
7.3 Pressure and flow requirements for pre-calculated systems.....	41
7.3.1 LH and OH systems	41
7.3.2 HHP and HHS systems without in-rack sprinklers.....	42
8 Water supplies	44

8.1	General	44
8.1.1	Duration	44
8.1.2	Continuity	44
8.1.3	Frost protection.....	44
8.2	Maximum water pressure.....	44
8.3	Connections for other services	45
8.4	Housing of equipment for water supplies	46
8.5	Test facility devices.....	46
8.5.1	General	46
8.5.2	At pump house	47
8.5.3	At control valve sets.....	47
8.6	Water supply test.....	47
8.6.1	General	47
8.6.2	Storage tank and pressure tank supplies	47
8.6.3	Town main, booster pump, elevated private reservoir and gravity tank supplies	48
9	Type of water supply	48
9.1	General	48
9.2	Town mains.....	48
9.3	Storage tanks.....	48
9.3.1	General	48
9.3.2	Water volume.....	49
9.3.3	Refill rates for full capacity tanks	50
9.3.4	Reduced capacity tanks	50
9.3.5	Effective capacity of tanks and dimensions of suction chambers	52
9.3.6	Strainers.....	53
9.4	Inexhaustible sources – settling and suction chambers	53
9.5	Pressure tanks	56
9.5.1	General	56
9.5.2	Housing.....	56
9.5.3	Minimum capacity (water).....	56
9.5.4	Air pressure and contents	56
9.5.5	Charging with air and water	57
9.5.6	Control and safety equipment.....	57
9.6	Choice of water supply.....	57
9.6.1	Single water supplies	57
9.6.2	Superior single water supplies	58
9.6.3	Duplicate water supplies	58
9.6.4	Combined water supplies	58
9.7	Isolation of water supply	59
10	Pumps	59
10.1	General	59
10.2	Multiple pump arrangements	59
10.3	Compartments for pumpsets.....	60
10.3.1	General	60
10.3.2	Sprinkler protection.....	60
10.3.3	Temperature	60
10.3.4	Ventilation.....	60
10.4	Maximum temperature of water supply	60
10.5	Valves and accessories.....	60
10.6	Suction conditions.....	61
10.6.1	General	61
10.6.2	Suction pipe	61

10.7	Performance characteristics.....	64
10.7.1	Pre-calculated systems – LH and OH.....	64
10.7.2	Pre-calculated systems – HHP and HHS with no in-rack sprinklers.....	65
10.7.3	Calculated systems	66
10.7.4	Pressure and water capacity of boosted town mains.....	67
10.7.5	Pressure switches	67
10.8	Electrically driven pumpsets	67
10.8.1	General.....	67
10.8.2	Electricity supply.....	67
10.8.3	Main switchboard	68
10.8.4	Installation between the main switchboard and the pump controller.....	68
10.8.5	Pump controller.....	69
10.8.6	Monitoring of pump operation.....	69
10.9	Diesel engine driven pumpsets.....	69
10.9.1	General.....	69
10.9.2	Engines.....	69
10.9.3	Cooling system	70
10.9.4	Air filtration	70
10.9.5	Exhaust system.....	70
10.9.6	Fuel, fuel tank and fuel feed pipes	70
10.9.7	Starting mechanism.....	71
10.9.8	Electric starter motor batteries	72
10.9.9	Battery chargers.....	72
10.9.10	Siting of batteries and chargers.....	72
10.9.11	Starter alarm indication	72
10.9.12	Tools and spare parts.....	73
10.9.13	Engine tests and exercising.....	73
11	Installation type and size	74
11.1	Wet pipe installations.....	74
11.1.1	General.....	74
11.1.2	Protection against freezing	74
11.1.3	Size of installations.....	74
11.2	Dry pipe installations	75
11.2.1	General.....	75
11.2.2	Size of installations.....	75
11.3	Alternate installations.....	75
11.3.1	General.....	75
11.3.2	Size of installations.....	76
11.4	Pre-action installations.....	76
11.4.1	General.....	76
11.4.2	Automatic detection system.....	76
11.4.3	Size of installations.....	77
11.5	Subsidiary dry pipe or alternate extension	77
11.5.1	General.....	77
11.5.2	Size of subsidiary extensions.....	77
11.6	Subsidiary water spray extension.....	77
12	Spacing and location of sprinklers.....	77
12.1	General.....	77
12.2	Maximum area of coverage per sprinkler	78
12.3	Minimum distance between sprinklers	80
12.4	Location of sprinklers in relation to building construction	80
12.5	Intermediate sprinklers in HH occupancies.....	86

12.5.1	General	86
12.5.2	Maximum vertical distance between sprinklers at intermediate levels	86
12.5.3	Horizontal position of sprinklers at intermediate levels.....	86
12.5.4	Numbers of rows of sprinklers at each level	88
12.5.5	HHS intermediate sprinklers in non-shelved racks.....	88
12.5.6	HHS intermediate sprinklers below solid or slatted shelves in racks (ST5 and ST6)	89
13	Pipe sizing and layout	90
13.1	General	90
13.2	Calculation of pressure losses in pipework	90
13.2.1	Pipe friction loss	90
13.2.2	Static pressure difference.....	91
13.2.3	Velocity.....	91
13.2.4	Pressure loss through fittings and valves.....	91
13.2.5	Accuracy of calculations.....	92
13.3	Pre-calculated systems.....	93
13.3.1	General	93
13.3.2	Location of Design Points.....	93
13.3.3	Light Hazard - LH	94
13.3.4	Ordinary Hazard - OH.....	96
13.3.5	High hazard - HHP and HHS (except intermediate level sprinklers)	97
13.4	Fully calculated systems	106
13.4.1	Design density.....	106
13.4.2	Locations of the area of operation.....	107
13.4.3	Shape of the area of operation	107
13.4.4	Minimum sprinkler discharge pressure	110
13.4.5	Minimum pipe diameters	110
14	Sprinkler design characteristics and uses.....	111
14.1	General	111
14.2	Sprinkler types and application.....	111
14.2.1	General	111
14.2.2	Ceiling, flush, recessed and concealed pattern.....	112
14.2.3	Sidewall pattern	112
14.2.4	Flat spray pattern	112
14.3	Flow from sprinklers.....	112
14.4	Sprinkler temperature ratings	113
14.5	Sprinkler thermal sensitivity.....	114
14.5.1	General	114
14.5.2	Interaction with other measures.....	114
14.6	Sprinkler guards	114
14.7	Sprinkler water shields.....	114
14.8	Sprinkler rosettes.....	115
14.9	Corrosion protection of sprinklers	115
15	Valves.....	115
15.1	Control valve set.....	115
15.2	Stop valves.....	115
15.3	Ring main valves	115
15.4	Drain valves.....	115
15.5	Test valves.....	116
15.5.1	Alarm and pump start test valves.....	116
15.5.2	Remote test valves.....	117
15.6	Flushing connections.....	117
15.7	Pressure gauges	117

15.7.1	General.....	117
15.7.2	Water supply connections.....	117
15.7.3	Control valve set.....	117
15.7.4	Removal.....	118
16	Alarms and alarm devices.....	118
16.1	Water flow alarms.....	118
16.1.1	General.....	118
16.1.2	Water motor and gong.....	118
16.1.3	Piping to water motor.....	118
16.2	Electrical water flow and pressure switches	118
16.2.1	General.....	118
16.2.2	Water flow alarm switches	118
16.2.3	Dry and pre-action systems.....	119
16.3	Fire brigade and remote central station alarm connection.....	119
17	Pipework.....	119
17.1	General.....	119
17.1.1	Underground piping.....	119
17.1.2	Above ground piping.....	119
17.1.3	Welding of steel pipe.....	119
17.1.4	Flexible pipes and joints	120
17.1.5	Concealment.....	120
17.1.6	Protection against fire and mechanical damage.....	120
17.1.7	Painting.....	120
17.1.8	Drainage	120
17.1.9	Copper pipe	121
17.2	Pipe supports.....	121
17.2.1	General.....	121
17.2.2	Spacing and location	121
17.2.3	Design.....	122
17.3	Pipework in concealed spaces.....	122
17.3.1	General.....	122
17.3.2	False ceilings above OH occupancies	122
17.3.3	All other cases	123
18	Signs, notices, and information.....	123
18.1	Block plan	123
18.2	Signs and notices	123
18.2.1	Location plate	123
18.2.2	Signs for stop valves.....	123
18.2.3	Control valve set.....	123
18.2.4	Water supply connections to other services	124
18.2.5	Suction and booster pumps.....	124
18.2.6	Electric switches and control panels.....	124
18.2.7	Testing and operating devices.....	125
19	Commissioning.....	125
19.1	Commissioning tests	125
19.1.1	Pipework.....	125
19.1.2	Equipment	125
19.1.3	Water supplies	126
19.2	Completion certificate and documents	126
20	Maintenance.....	126
20.1	General.....	126

20.1.1	Introduction.....	126
20.1.2	Programmed work.....	126
20.1.3	Precautions while carrying out work.....	126
20.1.4	Replacement sprinklers.....	126
20.2	User's programme of inspection and checking.....	127
20.2.1	General.....	127
20.2.2	Weekly routine.....	127
20.2.3	Monthly routine.....	128
20.3	Service, testing and maintenance schedule.....	128
20.3.1	General.....	128
20.3.2	Quarterly routine.....	128
20.3.3	Half-yearly routine.....	129
20.3.4	Yearly routine.....	130
20.3.5	3 Yearly routine.....	130
20.3.6	10 yearly routine.....	131
21	 Periodic system inspection.....	131
Annex A (normative) Classification of typical hazards.....		132
Annex B (normative) Methodology for categorizing stored goods.....		135
B.1	General.....	135
B.2	Material factor (M).....	135
B.2.1	General.....	135
B.2.2	Material Factor 1.....	135
B.2.3	Material factor 2.....	136
B.2.4	Material factor 3.....	136
B.2.5	Material factor 4.....	137
B.3	Storage configuration.....	137
B.3.1	Effect of storage configuration.....	137
B.3.2	Exposed plastic container with non-combustible content.....	138
B.3.3	Exposed plastic surface – unexpanded.....	138
B.3.4	Exposed plastic surface – expanded.....	138
B.3.5	Open structure.....	138
B.3.6	Solid block materials.....	139
B.3.7	Granular or powdered materials.....	139
B.3.8	No special configuration.....	139
Annex C (normative) Alphabetical listing of stored products and categories.....		140
Annex D (normative) Zoning of sprinkler installations.....		144
D.1	General.....	144
D.2	Zoning of installations.....	144
D.3	Requirements for zoned installations.....	144
D.3.1	Extent of zones.....	144
D.3.2	Zone subsidiary stop valves.....	144

D.3.3	Flushing Valves	144
D.3.4	Monitoring	144
D.3.5	Zone test and drainage facilities.....	145
D.3.6	Installation control valve set	145
D.3.7	Installation monitoring and alarms	145
D.4	Block plan	145
Annex E (normative)	Special requirements for high rise systems.....	147
E.1	General.....	147
E.2	Design criteria.....	147
E.2.1	Hazard group	147
E.2.2	Subdivision of high rise sprinkler systems.....	147
E.2.3	Standing water pressures at non-return and alarm valves	147
E.2.4	Calculation of distribution pipework for pre-calculated systems.....	147
E.2.5	Water pressures	147
E.3	Water supplies	148
E.3.1	Types of water supplies	148
E.3.2	Pressure and flow requirements for pre-calculated installations.....	148
E.3.3	Water supply characteristics for pre-calculated installations	148
E.3.4	Pump performance for pre-calculated installations.....	148
Annex F (normative)	Additional measures to improve system reliability and availability	151
F.1	General.....	151
F.2	Subdivision into zones	151
F.3	Wet pipe installations.....	151
F.4	Sprinkler type and sensitivity	151
F.5	Control valve set.....	151
F.6	Water supplies	151
F.7	Additional measures for theatres	151
F.8	Additional precautions for maintenance	152
Annex G (normative)	Protection of special hazards.....	153
G.1	General.....	153
G.2	Aerosols	153
G.3	Clothes in multiple garment hanging storage.....	153
G.3.1	General.....	153
G.3.2	Categorization	154
G.3.3	Sprinkler protection other than at ceiling.....	154
G.3.4	Sprinklers in operation.....	154

G.3.5	Ceiling sprinklers	154
G.3.6	Automatic shutdown	154
G.3.7	Control valve set.....	155
G.4	Flammable liquid storage.....	155
G.5	Idle pallets.....	157
G.6	Spirit based liquors in wooden barrels	158
G.7	Non-woven synthetic fabric	158
G.7.1	Free standing storage.....	158
G.7.2	Rack storage	159
G.8	Polypropylene or polyethylene storage bins.....	159
G.8.1	General	159
G.8.2	Classification	159
G.8.3	Palletized rack storage (ST4)	159
G.8.4	All other storage.....	159
G.8.5	Foam additive.....	160
Annex H	(normative) Sprinkler systems monitoring.....	161
H.1	General	161
H.2	Functions to be monitored	161
H.2.1	General	161
H.2.2	Stop valves controlling water flow to sprinklers	161
H.2.3	Other stop valves	161
H.2.4	Liquid levels.....	161
H.2.5	Pressures	161
H.2.6	Electrical power	162
H.2.7	Temperature	162
Annex I	(normative) Transmission of alarms	163
I.1	Functions to be monitored	163
I.2	Alarm levels.....	164
Annex J	(informative) Precautions and procedures when a system is not fully operational.....	165
J.1	Minimizing the effects.....	165
J.2	Planned shut-down.....	165
J.3	Unplanned shut-down.....	166
J.4	Action following sprinkler operation.....	166
J.4.1	General	166
J.4.2	Installations protecting cold storage warehouses (air circulation refrigeration)	166
Annex K	(informative) Twenty-five year inspection.....	167

Annex L (informative) Special technology	168
Annex M (informative) Independent certification body	169
Annex N (normative) Control Mode Specific Application Sprinklers: CMSA	170
N.1 Introduction	170
N.1.1 General.....	170
N.1.2 Definitions	170
N.1.3 General.....	170
N.1.4 Sprinkler type and temperature rating	170
N.1.5 Water demand.....	171
N.2 Sprinkler location	171
N.2.1 Sprinkler spacing.....	171
N.2.2 Range pipe sizes.....	171
N.2.3 Minimum clear space below sprinklers.....	171
N.2.4 Excessive clearance	171
N.2.5 Distance of sprinklers below ceiling.....	171
N.2.6 Location of sprinklers in beam and girder, concrete T and panel construction	172
N.2.7 Obstructions to sprinkler distribution.....	172
N.3 Design.....	176
Annex O (informative) Example of P&ID	182
Annex P (normative) ESFR sprinkler protection.....	183
P.1 Introduction	183
P.2 Scope	183
P.3 Definitions	183
P.3.1 Sprinkler, ESFR pattern	183
P.3.2 Suppression mode	183
P.3.3 Classification of goods	183
P.3.4 Ceiling height.....	184
P.3.5 Laced tyre storage.....	184
P.3.6 Paper categories, based on weight	184
P.4 Contract arrangements	184
P.5 General.....	184
P.6 Occupancies and fire hazards	185
P.7 Racked, shelved and post pallet storage.....	185
P.7.1 Longitudinal and transverse flues	185
P.7.2 Shelving.....	186
P.7.3 In-rack sprinklers for ESFR systems.....	186

P.7.4	Design requirements	186
P.8	Building requirements	205
P.8.1	Roof or ceiling slope	205
P.8.2	Measures required to correct excessive roof or ceiling slope	205
P.8.3	Ceiling strength	206
P.8.4	Sky lights	206
P.8.5	Powered ventilation	206
P.8.6	Walkways and conveyors	208
P.8.7	Sprinkler protection beneath mezzanines	208
P.9	ESFR sprinkler installation design	208
P.9.1	Installation type	208
P.9.2	Sprinkler nominal k-factor	208
P.9.3	Temperature ratings thermal sensitivity and colour codings	208
P.9.4	ESFR sprinkler location relative to obstructions at or near the ceiling or roof	209
P.10	Pipe sizing	210
P.10.1	General	210
P.10.2	Minimum pipe sizes	210
P.10.3	Minimum ESFR sprinkler flow pressure	210
P.10.4	The number of sprinklers assumed to be operating	210
P.10.5	Shape of design sprinkler area	211
P.10.6	Sprinklers beneath obstructions	211
P.11	Sprinkler spacing and location	211
P.11.1	ESFR sprinkler area of coverage	211
P.11.2	Obstructions	211
P.11.3	Sprinkler positioning relative to roof and ceilings	212
P.11.4	Sprinkler orientation relative to the floor or pipework	212
P.11.5	Clear space below sprinklers	212
P.11.6	Sprinkler location relative to draught or smoke curtains	212
P.11.7	Positioning of ESFR sprinklers relative to draught or smoke curtains	212
P.11.8	ESFR sprinkler protection adjacent to areas protected by standard sprinklers	212
P.12	Water supplies	213
P.12.1	Pump drive and power arrangements	213
P.12.2	Pump selection	213
P.12.3	Duration	213
Annex Q (informative)	Periodic system inspection	214
Bibliography		215

European foreword

This document (EN 12845:2015+A1:2019) 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 June 2020, and conflicting national standards shall be withdrawn at the latest by June 2020.

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.

This document supersedes A1 EN 12845:2015 and EN 12845:2015/AC:2016 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags AC AC and A1 A1.

It is included in a series of European Standards planned to cover:

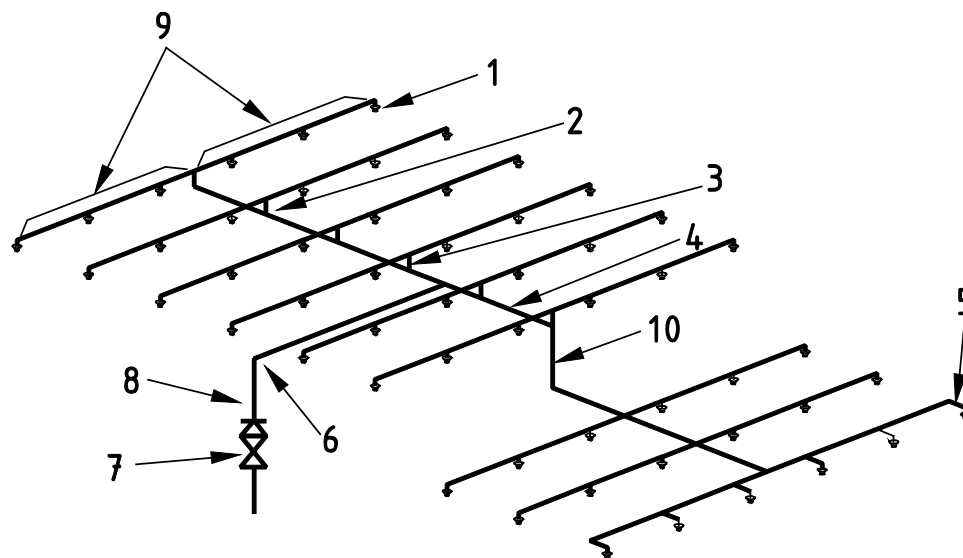
- automatic sprinkler systems (EN 12259);
- gas extinguishing systems (EN 12094);
- powder systems (EN 12416);
- explosion protection systems (ISO 6184);
- foam systems (EN 13565);
- gas systems (EN 12094);
- hydrant and hose reel systems (EN 671);
- smoke and heat control systems (EN 12101).

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Introduction

An automatic sprinkler system is designed to detect a fire and extinguish it with water in its early stages or hold the fire in check so that extinguishment can be completed by other means.

A sprinkler system consists of a water supply (or supplies) and one or more sprinkler installations; each installation consists of a set of installation main control valves and a pipe array fitted with sprinkler heads. The sprinkler heads are fitted at specified locations at the roof or ceiling, and where necessary between racks, below shelves, and in ovens or stoves. The main elements of a typical installation are shown in Figure 1.



Key

1	sprinkler head	6	main distribution pipe
2	riser	7	control valve set
3	design point	8	riser
4	distribution pipe spur	9	range pipes
5	arm pipe	10	drop

Figure 1 — Main elements of a sprinkler installation

The sprinklers operate at predetermined temperatures to discharge water over the affected part of the area below. The flow of water through the alarm valve initiates a fire alarm. The operating temperature is generally selected to suit ambient temperature conditions.

Only sprinklers in the vicinity of the fire, i.e. those which become sufficiently heated, operate.

The sprinkler system is intended to extend throughout the premises with only limited exceptions.

It should not be assumed that the provision of a sprinkler system entirely obviates the need for other means of fighting fires and it is important to consider the fire precautions in the premises as a whole.

Structural fire resistance, escape routes, fire alarm systems, particular hazards needing other fire protection methods, provision of hose reels and fire hydrants and portable fire extinguishers, etc., safe working and goods handling methods, management supervision and good housekeeping all need consideration.

It is essential that sprinkler systems should be properly maintained to ensure operation when required. This routine is liable to be overlooked or given insufficient attention by supervisors. It is, however,

neglected at peril to the lives of occupants of the premises and at the risk of crippling financial loss. The importance of proper maintenance cannot be too highly emphasized.

When sprinkler systems are out of service extra attention should be paid to fire precautions and the appropriate authorities informed.

It is a basic assumption that this standard is for the use of companies employing personnel competent in the field of application with which it deals. Only trained and experienced personnel should undertake the design, installation and maintenance of sprinkler systems. Similarly, competent technicians should be used in the installation and testing of the equipment (see Annex M).

1 Scope

This European Standard specifies requirements and gives recommendations for the design, installation and maintenance of fixed fire sprinkler systems in buildings and industrial plants, and particular requirements for sprinkler systems that are integral to measures for the protection of life.

This European Standard covers only the types of sprinkler specified in EN 12259-1 (see Annex L).

The requirements and recommendations of this European Standard are also applicable to any addition, extension, repair or other modification to a sprinkler system. They are not applicable to water spray or deluge systems.

It covers the classification of hazards, provision of water supplies, components to be used, installation and testing of the system, maintenance, and the extension of existing systems, and identifies construction details of buildings which are the minimum necessary for satisfactory performance of sprinkler systems complying with this European Standard.

This European Standard does not cover water supplies to systems other than sprinklers. Its requirements can be used as guidance for other fixed firefighting extinguishing systems, provided that any specific requirements for other firefighting extinguishing supplies are taken into account.

This European Standard is intended for use by those concerned with purchasing, designing, installing, testing, inspecting, approving, operating and maintaining automatic sprinkler systems, in order that such equipment will function as intended throughout its life.

This European Standard is intended only for fixed fire sprinkler systems in buildings and other premises on land. Although the general principles might well apply to other uses (e.g. maritime use). For these other uses additional considerations should be taken into account.

The requirements are not valid for automatic sprinkler systems on ships, in aircraft, on vehicles and mobile fire appliances or for below ground systems in the mining industry.

Sprinkler system design deviations might be allowed when such deviations have been shown to provide a level of protection at least equivalent to this European Standard, for example by means of full-scale fire testing where appropriate, and where the design criteria have been fully documented.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 54 (all parts), *Fire detection and fire alarm systems*

EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1254 (all parts), *Copper and copper alloys — Plumbing fittings*

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

EN 12259-2, *Fixed firefighting systems — Components for sprinkler and water spray systems — Part 2: Wet alarm valve assemblies*

EN 12259-3, *Fixed firefighting systems — Components for automatic sprinkler and water spray systems — Part 3: Dry alarm valve assemblies*

EN 12259-4, *Fixed firefighting systems — Components for sprinkler and water spray systems — Part 4: Water motor alarms*

EN 12259-5, *Fixed firefighting systems — Components for sprinkler and water spray systems — Part 5: Water flow detectors*

EN 50342-1, *Lead-acid starter batteries — Part 1: General requirements and methods of test*

EN 50342-2, *Lead-acid starter batteries — Part 2: Dimensions of batteries and marking of terminals*

EN 60332 (all parts), *Tests on electric and optical fibre cables under fire conditions (IEC 60332)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

EN 60623, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Vented nickel-cadmium prismatic rechargeable single cells (IEC 60623)*

EN 60947-1, *Low-voltage switchgear and controlgear — Part 1: General rules (IEC 60947-1)*

EN 60947-4, *Low-voltage switchgear and control gear — Part 4: Contactors and motor-starters — Electromechanical contactors and motor-starters (IEC 60947-4)*

EN ISO 3677, *Filler metal for soft soldering, brazing and braze welding — Designation (ISO 3677)*

EN ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1)*

ISO 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1*

ISO 3046 (all parts), *Reciprocating internal combustion engines — Performance*

3 Terms and definitions

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

3.1

'A' gauge

pressure gauge connected to a town main connection, between the supply pipe stop valve and the non-return valve

3.2

accelerator

device that reduces the delay in operation of a dry alarm valve, or composite alarm valve in dry mode, by early detection of the drop in air or inert gas pressure on sprinkler operation

3.3

alarm test valve

valve through which water might be drawn to test the operation of the water motor fire alarm and/or of any associated electric fire alarm

3.4

alarm valve

non-return valve, of the wet, dry or composite type that also initiates the water motor fire alarm when the sprinkler installation operates

3.5**alarm valve, alternate**

alarm valve suitable for a wet, dry or alternate installation

3.6**alarm valve, dry**

alarm valve suitable for a dry installation; and/or in association with a wet alarm valve for an alternate installation

3.7**alarm valve, pre-action**

alarm valve suitable for a pre-action installation

3.8**alarm valve, wet**

alarm valve suitable for a wet installation

3.9**area of operation**

maximum area, over which it is assumed, for design purposes, that sprinklers will operate in a fire

3.10**area of operation, hydraulically most favourable**

location in a sprinkler array of an area of operation of specified shape at which the water flow is the maximum for a specific pressure measured at the control valve set

3.11**area of operation, hydraulically most unfavourable**

location in a sprinkler array of an area of operation of specified shape at which the water supply pressure measured at the control valve set is the maximum needed to give the specified design density

3.12**arm pipe**

pipe less than 0,3 m long, other than the last section of a range pipe, feeding a single sprinkler

3.13**authorities**

organizations responsible for approving sprinkler systems, equipment and procedures, e.g. the fire and building control authorities, the fire insurers, the local water authority or other appropriate public authorities

3.14**'B' gauge**

pressure gauge connected to and on the same level as an alarm valve, indicating the pressure on the upstream side of the valve

3.15**booster pump set**

automatic pump supplying water to a sprinkler system from a gravity tank or town main

3.16**'C' gauge**

pressure gauge connected to and on the same level as an alarm valve, indicating the pressure on the downstream side of the valve

3.17

control valve set

assembly comprising an alarm valve, a stop valve and all the associated valves and accessories for the control of one sprinkler installation

3.18

cut-off sprinkler

sprinkler protecting a door or window between two areas only one of which is protected by sprinklers

3.19

design density

minimum density of discharge, in millimetres per minute of water, for which a sprinkler installation is designed, determined from the discharge of a specified group of sprinklers, in litres per minute, divided by the area covered, in square metres

3.20

design point

point on a distribution pipe of a pre-calculated installation, downstream of which pipework is sized from tables and upstream of which pipework is sized by hydraulic calculation

3.21

distribution pipe

pipe feeding either a range pipe directly or a single sprinkler on a non-terminal range pipe more than 300 mm long

3.22

distribution pipe spur

distribution pipe from a main distribution pipe, to a terminal branched pipe array

3.23

drencher

sprayer used to distribute water over a surface to provide protection against fire exposure

3.24

drop

vertical distribution pipe feeding a distribution or range pipe below

3.25

end-centre array

pipe array with range pipes on both sides of a distribution pipe

3.26

end-side array

pipe array with range pipes on one side only of a distribution pipe

3.27

exhauster

device to exhaust the air or inert gas from a dry or alternate installation to atmosphere on sprinkler operation to give more rapid operation of the alarm valve

3.28

fire resistant compartment

enclosed volume capable of maintaining its fire integrity for a minimum specified time

3.29**fully calculated**

term applied to an installation in which all the pipework is sized by hydraulic calculation

3.30**gridded configuration**

pipe array in which water flows to each sprinkler by more than one route

3.31**hanger**

assembly for suspending pipework from elements of building structure

3.32**high rise system**

sprinkler system in which the highest sprinkler is more than 45 m above the lowest sprinkler or above the sprinkler pumps, whichever is the lower

3.33**inexhaustible sources**

natural and artificial water sources such as rivers, canals and lakes which are virtually inexhaustible for reasons of capacity and climate, etc.

3.34**installation (sprinkler installation)**

part of sprinkler system comprising a control valve set, the associated downstream pipes and sprinklers

3.35**installation, alternate**

installation in which the pipework is selectively charged with either water or air/inert gas according to ambient temperature conditions

3.36**installation, dry (pipe)**

installation in which the pipework is charged with air or inert gas under pressure

3.37**installation, pre-action**

one of two types of dry, or alternate in dry mode, installation in which the alarm valve can be opened by an independent fire detection system in the protected area

3.38**installation, wet (pipe)**

installation in which the pipework is always charged with water

3.39**discharge coefficient “K”**

coefficient of discharge in the formula $Q = K\sqrt{p}$

where:

Q is the flow in litres per minute, and p is the pressure in bar

3.40

looped configuration

pipe array in which there is more than one distribution pipe route along which water might flow to a range pipe

3.41

main distribution pipe

pipe feeding a distribution pipe

3.42

maximum flow demand (Q_{max})

flow at the point of intersection of the pressure-flow demand characteristic, of the most favourable area of operation of the sprinkler system, and the water supply pressure-flow characteristic, with the suction source at its normal level

3.43

mechanical pipe joint

pipe fitting other than threaded tubulars, screwed fittings, spigots and socket and flanged joint, used to connect pipes and components

3.44

multi-storey building

building comprising two or more storeys, above or below ground

3.45

node

point in pipework at which pressure and flow(s) are calculated; each node is a datum point for the purpose of hydraulic calculations in the installation

3.46

normal water level

water level at the water supply needed to give the required effect capacity in relation to the low water level, including any necessary margins

EXAMPLE For ice.

3.47

pipe array

pipes feeding a group of sprinklers

EXAMPLE Pipe arrays can be looped, gridded or branched.

3.48

pre-calculated

installation in which the pipes downstream of the design point(s) have been previously sized by hydraulic calculation

Note 1 to entry: Tables of diameters are given.

3.49

pressure maintenance pump (jockey pump)

small automatic pumpset used to replenish minor water loss and maintain system pressure

3.50**pressure tank**

tank containing water under air pressure sufficient to ensure that all the water can be discharged at the necessary pressure

3.51**range pipe**

pipe feeding sprinklers either directly or via arm pipes

3.52**riser**

vertical distribution pipe feeding a distribution or range pipe above

3.53**sprayer**

water spray nozzle that gives a downward conical pattern discharge

3.54**sprinkler (automatic)**

nozzle with a thermally sensitive sealing device which opens to discharge water for fire fighting

3.55**sprinkler, ceiling or flush**

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

3.56**sprinkler, concealed**

recessed sprinkler with a cover plate that disengages when heat is applied

3.57**sprinkler, conventional pattern**

sprinkler that gives a spherical pattern of water discharge

3.58**sprinkler, dry pendent pattern**

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

3.59**sprinkler, dry upright pattern**

unit comprising a sprinkler and dry rise pipe unit with a valve, at the base of the pipe, held closed by a device maintained in position by the sprinkler head valve

3.60**sprinkler, spray flat**

sprinkler that gives a pattern of water discharge with a proportion of the discharge directed above the level of the deflector

3.61**sprinkler, fusible link**

sprinkler which opens when a component provided for this purpose melts

3.62

sprinkler, glass bulb

sprinkler which opens when a liquid-filled glass bulb bursts

3.63

sprinkler, horizontal

sprinkler in which the nozzle directs water horizontally

3.64

sprinkler, open

sprinkler not sealed by a temperature sensitive element

3.65

sprinkler, pendant

sprinkler in which the nozzle directs water downwards

3.66

sprinkler, recessed

sprinkler in which all or part of the heat sensing element is above the lower plane of the ceiling

3.67

sprinkler rosette

plate covering the gap between the shank or body of a sprinkler projecting through a suspended ceiling, and the ceiling

3.68

sprinkler, sidewall pattern

sprinkler that gives an outward half-paraboloid pattern discharge

3.69

sprinkler, spray pattern

sprinkler that gives a downward paraboloid pattern discharge

3.70

sprinkler, upright

sprinkler in which the nozzle directs water upwards

3.71

sprinkler system

entire means of providing sprinkler protection in the premises comprising one or more sprinkler installations, the pipework to the installations and the water supply/supplies

3.72

sprinkler yoke (arms)

part of a sprinkler that retains the heat sensitive element in load bearing contact with the sprinkler head valve

3.73

staggered (sprinkler) layout

off-set layout with the sprinklers displaced one-half pitch along the range pipe relative to the next range or ranges

3.74**standard (sprinkler) layout**

rectilinear layout with the sprinklers aligned perpendicular to the run of the ranges

3.75**subsidiary alternate (wet and dry pipe) extension**

part of a wet installation that is selectively charged with water or air/inert gas according to ambient temperature conditions and that is controlled by a subsidiary dry or alternate alarm valve

3.76**subsidiary dry extension**

part of a wet or alternate installation that is charged permanently with air or inert gas under pressure

3.77**suitable for sprinkler use**

term applied to equipment or components accepted by the authorities as suitable for a particular application in a sprinkler system, either by conforming to EN product standards where available or if not by compliance with specified criteria

3.78**supply pipe**

pipe connecting a water supply to a trunk main or the installation control valve set(s); or a pipe supplying water to a private reservoir or storage tank

3.79**suspended open cell ceiling**

ceiling of regular open cell construction through which water from sprinklers can be discharged freely

3.80**terminal main configuration**

pipe array with only one water supply route to each range pipe

3.81**terminal range configuration**

pipe array with only one water supply route from a distribution pipe

3.82**trunk main**

pipe connecting two or more water supply pipes to the installation control valve set(s)

3.83**water supply datum point**

point on the installation pipework at which the water supply pressure and flow characteristics are specified and measured

3.84**zone**

sub-division of an installation with a specific flow alarm and fitted with a monitored subsidiary stop

4 Contract planning and documentation

4.1 General

The information specified in 4.3 and 4.4 shall be provided to the user or owner as appropriate. All drawings and information documents shall carry the following information:

- a) the name of the user and the owner, where known;
- b) the address and location of premises;
- c) the occupancy of each building;
- d) the name of the designer;
- e) the name of the person responsible for checking the design, who shall not be the designer;
- f) date and number of issue.

4.2 Initial considerations

When preparing the outline design, consideration shall be given to aspects of building design, building systems and work procedures that might affect the performance of the sprinkler system.

Although an automatic sprinkler system usually extends throughout a building or plant, it should not be assumed that this entirely obviates the need for other means of fire protection and it is important to consider the fire precautions of the premises as a whole. Account shall be taken of possible interaction between sprinkler systems and other fire protection measures.

Where a sprinkler system or an extension or alteration to a sprinkler system is being considered for new or existing buildings and industrial plant the relevant authorities shall be consulted at an early stage.

The authorities should be consulted when the hazard classification is being determined.

4.3 Preliminary or estimating stage

At least the following information shall be provided:

- a) a general specification of the system; and
- b) a block plan of the premises showing:
 - 1) the type(s) of installation(s) and the hazard class(es) and storage categories in the various buildings;
 - 2) the extent of the system with details of any unprotected areas;
 - 3) the construction and occupancy of the main building and any communicating and/or neighbouring buildings;
 - 4) a cross-section of the full height of the building(s) showing the height of the highest sprinkler above a stated datum level;
- c) general details of the water supplies, which if town main shall include pressure flow data, with the date and time of test, and a plan of the test site; and

- d) a statement that the estimate is based on the provision of a sprinkler system to this European Standard, based on available information.

4.4 Design stage

4.4.1 General

The information provided shall include a summary schedule (see 4.4.2), complete working drawings of the sprinkler installation(s) (see 4.4.3) and details of the water supplies (see 4.4.4).

4.4.2 Summary schedule

The summary schedule shall give the following information:

- a) the name of project;
- b) all drawings or document reference numbers;
- c) all drawings or document issue numbers;
- d) all dates of issue of drawing or documents;
- e) all drawing or document titles;
- f) the type(s) of installation(s) and the nominal diameter(s) of each control valve set;
- g) the number or references of each control valve set in the system;
- h) the number of sprinklers on each control valve set;
- i) a list of the components suitable for sprinkler use included in the system, each identified by supplier's name and model/reference number. If required by the authorities, a Piping and Instrumentation Diagram (P&ID) with a list of all components included in the system, each identified by supplier's name, model, diameter, total number and reference number should be added. For an example of a P&ID, see figure in Annex O.
- j) the height of the highest sprinkler on each control valve set;
- k) a statement that the installation has been designed and will be installed in accordance with this European Standard or giving details of any deviations from its requirements and the reasons why, based on available information.

4.4.3 Installation layout drawings

4.4.3.1 General

Layout drawings shall include the following information:

- a) north point indication;
- b) the class or classes of installation according to hazard class, including storage category and design storage height;
- c) construction details of floors, ceilings, roofs, exterior walls and walls separating sprinklered and non-sprinklered areas;

- d) sectional elevations of each floor of each building showing the distance of sprinklers from ceilings, structural features, etc. which affect the sprinkler layout or the water distribution from the sprinklers;
- e) the location and size of concealed roof or ceiling voids, offices and other enclosures sealed at a level lower than the roof or ceiling proper;
- f) indication of trunking, stagings, platforms, machinery, light fittings, heaters, suspended open cell ceilings, etc. which might adversely affect the sprinkler distribution;
- g) the sprinkler type(s) and temperature rating(s);
- h) the type and approximate location of pipe supports;
- i) the location and type of control valve sets and location of water motor alarms;
- j) the location and details of any water flow, and air or water pressure alarm switches;
- k) the location and size of any subsidiary valves, subsidiary stop valves and drain valves;
- l) the drainage slope of the pipework;
- m) a schedule listing the numbers of sprinklers, sprayers etc., and the area of protection;
- n) the location of all test valves;
- o) the location and details of any alarm panel;
- p) the location and details of any fire department inlet connections;
- q) a key to the symbols used.

4.4.3.2 Pre-calculated pipework

For pre-calculated pipework the following details shall be given on, or with, the drawings:

- a) identification of the design point of each array on the layout drawing (for example, as in Figure 18);
- b) a summary of the pressure losses between the control valve set and the design points at the following design rates of flow:
 - 1) in an Light Hazard — 225 l/min;
(LH) installation
 - 2) in an Ordinary — the flow corresponding to the appropriate design (OH) as given in
Hazard Table 6;
(OH) installation
 - 3) in a High Hazard — the flow corresponding to the appropriate design density given in
(HH) installation Table 7 or in 7.3.2.2.

NOTE See 6.2 for hazard classification.

c) The calculation as specified in 13.3, showing that:

1) in LH and OH installations, for each run of distribution pipework,

$$p_f + p_h$$

is no more than the appropriate value specified in 13.3.3 or 13.3.4; and/or

2) in HHP and HHS installations designed using Tables 32 to 35,

$$p_f + p_d + p_s$$

is no more than the residual pressure available at the control valve set from the water supply when it is tested at the appropriate flow rate,

where

p_d is the pressure at the design point specified in Table 7 or as appropriate, in bar;

p_f is the frictional pressure loss in the distribution pipework between the design point and the control valve 'C' gauge, in bar;

p_h is the static pressure between the level of the highest design point on the floor concerned and the level of the highest design point in the top storey, in bar;

p_s is the static head loss owing to the height of the highest sprinkler in the array concerned above the control valve 'C' gauge, in bar.

4.4.3.3 Fully calculated pipework

For fully calculated pipework, the following shall be given, with detailed calculations, either on purpose designed work-sheets or as a computer printout:

- a) the program name and version number;
- b) the date of the worksheet or print-out;
- c) the actual internal diameters of all pipes used in the calculation;
- d) for each design area of operation:
 - 1) the area identification;
 - 2) the hazard class;
 - 3) the specified design density in millimetres per minute;
 - 4) the assumed maximum area of operation (area of operation) in square metres;
 - 5) the number of sprinklers in the area of operation;
 - 6) the sprinkler nominal orifice size in millimetres;
 - 7) the maximum area covered per sprinkler in square metres;
 - 8) detailed and dimensioned working drawings showing the following:

- i) the node or pipe reference scheme used to identify pipes, junctions, sprinkler heads and fittings which need hydraulic consideration;
 - ii) the position of the hydraulically most unfavourable area of operation;
 - iii) the position of the hydraulically most favourable area of operation;
 - iv) the four sprinklers upon which the design density is based;
 - v) the height above datum (e.g. pump axis) of each point of identified pressure value.
- e) for each operating sprinkler:
- 1) the sprinkler node or reference number;
 - 2) the nominal K-factor (see EN 12259-1);
 - 3) the flow through the sprinkler in litres per minute;
 - 4) the inlet pressure to the sprinkler or sprinkler assembly in bar.
- f) for each hydraulically significant pipe:
- 1) pipe node or other reference number;
 - 2) nominal bore in millimetres;
 - 3) the Hazen-Williams constant;
 - 4) flow in litres per minute;
 - 5) velocity in metres per second;
 - 6) length in metres;
 - 7) numbers, types and equivalent length in metres of fittings and components;
 - 8) static head change in metres;
 - 9) pressures at inlet and outlet in bar;
 - 10) friction loss in bar;
 - 11) indication of flow direction.

4.4.4 Water supply

4.4.4.1 Water supply drawings

The drawings shall show water supplies and pipework up to the control valve set. A key to the symbols shall be included. The position and type of stop and non-return valves and any pressure reducing valves, water meters, back flow preventers and any connections supplying water for other services, shall be indicated.

4.4.4.2 Hydraulic calculation

A hydraulic calculation shall show that the minimum water supply characteristics are capable of providing the required pressure and flow at the control valve set.

4.4.4.3 Town main

Where a town main forms one or both of the supplies or provides infill to a reduced capacity storage tank, the following details shall be given:

- a) the nominal diameter of the main;
- b) whether the main is double-end fed or dead-end; if dead-end, the location of the nearest double-end fed main connected to it;
- c) the pressure/flow characteristic graph of the town main determined by a test at a period of peak demand. At least three pressure/flow points shall be obtained. The graph shall be corrected for friction losses and static head difference between the test location and either the control valve 'C' gauge or the suction tank infill valve, as appropriate;
- d) the date and time of the town main test;
- e) the location of the town main test point relative to the control valve set.

Where the pipework is fully calculated the following additional details shall be given:

- f) a pressure/flow characteristic graph indicating the available pressure at any flow up to the maximum flow demand;
- g) the demand pressure/flow characteristic graph for each installation for the hydraulically most unfavourable (and if required the most favourable) area of operation with pressure taken as at the control valve 'C' pressure gauge.

4.4.4.4 Automatic pump set

The following details of each automatic pump set shall be provided:

- a) a pump characteristic curve for low water level 'X' (see Figures 4 and 5), showing the estimated performance of the pump or pumps under installed conditions at the control valve 'C' gauge.
- b) the pump supplier's data sheet showing the following:
 - 1) the generated head graph;
 - 2) the power absorption graph;
 - 3) the net positive suction head (NPSH) graph showing requirements according to 10.1.a and 10.1.b;
 - 4) a statement of the power output of each prime mover.
- c) the installer's data sheet showing the pumpset installed performance pressure/flow characteristics, at the control valve 'C' gauge for normal water level and for low water level 'X' (see Figures 4 and 5), and at the pump outlet pressure gauge for normal water level;
- d) the height difference between the control valve 'C' gauge and the pump delivery pressure gauge;

- e) the installation number and the hazard classification(s);
- f) the available and the specified NPSH at maximum required flow;
- g) the minimum depth of water cover of submersible pumps.

Where the pipework is fully calculated the following additional details shall be provided:

- h) the demand pressure/flow characteristic for the hydraulically most unfavourable and most favourable area of operation calculated at the control valve 'C' gauge.

4.4.4.5 Storage tank

The following details shall be provided:

- a) the location;
- b) the total volume of the tank;
- c) the effective capacity of the tank and duration;
- d) the inflow for reduced capacity tanks;
- e) the vertical distance between the pump centre line and the tank low water level 'X' (see Figure 4);
- f) structural details of the tank and roof;
- g) the recommended frequency of scheduled repairs requiring emptying of the tank;
- h) protection against freezing;
- i) low and normal water levels X and N (see Figure 4);
- j) height of gravity tank above the highest sprinkler.

4.4.4.6 Pressure tank

The following details shall be provided:

- a) the location;
- b) the total volume of the tank;
- c) the volume of stored water;
- d) the air pressure;
- e) the height of the highest and/or hydraulically most remote sprinkler above the bottom of the tank;
- f) the vertical distance of the lowest sprinklers below the bottom of the tank;
- g) details of the means of refilling.

5 Extent of sprinkler protection

5.1 Buildings and areas to be protected

5.1.1 General

Where a building is to be sprinkler protected, all areas of that building or of a communicating building shall be sprinkler protected, except in the cases indicated in 5.1.2 and 5.1.3 and 5.3.

Consideration should be given to the protection of load bearing steel.

5.1.2 Permitted exceptions within a building

Sprinkler protection shall be considered in the following cases, but might be omitted after due consideration of the fire load in each case:

- a) washrooms and toilets (but not cloakrooms) of non-combustible materials and which are not used to store combustible materials;
- b) enclosed staircases and enclosed vertical shafts (e.g. lifts or service shafts) containing no combustible material and constructed as a fire resistant separation (see 5.3).
- c) rooms protected by other automatic extinguishing systems (e.g. gas, powder and water spray);
- d) wet processes such as the wet end of paper making machines.

5.1.3 Necessary exceptions

Sprinkler protection shall not be provided in the following areas of a building or plant:

- a) silos or bins containing substances which expand on contact with water;
- b) in the vicinity of industrial furnaces or kilns, salt baths, smelting ladles or similar equipment if the hazard would be increased by the use of water in extinguishing a fire;
- c) areas, rooms or places where water discharge might present a hazard.

In these cases, other automatic extinguishing systems should be considered (e.g. gas or powder).

5.2 Storage in the open air

The distance between combustible materials stored in the open air and the sprinklered building shall correspond to regulatory provisions in the place of use.

Where it is not regulated, the distance between combustible materials stored in the open air and the sprinklered building shall be no less than 10 m or 1,5 times the height of the stored material.

NOTE Such a fire resistant separation can be achieved by a firewall or by a suitable exposure protection system.

5.3 Fire resistant separation

The separation between a sprinkler protected area and a non-protected area shall have a fire resistance specified by the authority but in no case less than 60 min. Doors shall be self-closing or be closed automatically in the event of fire.

No part of an unsprinklered building or section should be located vertically below a sprinklered building or section except as indicated in 5.1.2 and 5.1.3.

5.4 Protection of concealed spaces

If the height of the concealed space at roof and floor exceeds 0,8 m, measured between the underside of the roof and the top of the suspended ceiling or between the floor and the underside of the raised floor, these spaces shall be sprinkler protected.

If the height of the concealed space at roof and floor is no greater than 0,8 m, the spaces shall be sprinkler protected only if they contain combustible materials or are constructed with combustible materials. Electrical cables with voltage less than 250V, single phase, with a maximum of 15 cables per tray, are allowed.

The protection in the concealed space shall be to LH when the main hazard class is LH, and OH1 in all other cases. See 17.3 for the pipework arrangement.

5.5 Height difference between the highest and lowest sprinklers

Where the height difference between the highest and lowest sprinklers in a system or building exceeds 45 m the requirements of Annex E shall be applied.

The height difference between the highest and lowest sprinkler on an installation (i.e. connected to a single control valve set) shall not exceed 45 m.

6 Classification of occupancies and fire hazards

6.1 General

The hazard class to which the sprinkler system is to be designed shall be determined before the design work is begun.

The buildings and areas to be protected by the automatic sprinkler system shall be classified as Light Hazard, Ordinary Hazard or High Hazard.

This classification depends on the occupancy and the fire load. Examples of occupancies are given in Annex A.

Where there are areas in open communication having different hazard classification, the higher design criteria shall be extended at least two rows of sprinklers into the area with the lower classification.

6.2 Hazard classes

6.2.1 General

Buildings or areas to be protected which contain one or more of the following occupancies and fire hazards shall be classified as belonging to the appropriate hazard class, as follows:

6.2.2 Light Hazard – LH

LH includes occupancies with low fire loads and low combustibility and with no single compartment greater than 126 m² with a fire resistance of at least 30 min. See Annex A for examples.

6.2.3 Ordinary Hazard – OH

OH includes occupancies where combustible materials with a medium fire load and medium combustibility are processed or manufactured, See Annex A for examples.

Ordinary Hazard is sub-divided into 4 groups:

- OH1, Ordinary Hazard Group 1
- OH2, Ordinary Hazard Group 2

- OH3, Ordinary Hazard Group 3
- OH4, Ordinary Hazard Group 4

Materials might be stored in occupancies classified as OH provided the following conditions are met:

- a) The protection throughout the room shall be designed to at least OH3;
- b) The maximum storage heights shown in Table 1 shall not be exceeded;
- c) The maximum storage area of a single block shall not exceed 50 m², with a clearance around the block of not less than 2,4 m.

When the area is classified as OH4 or where the requirements of b) or c) cannot be met, storage within the area shall be treated as HHS (see 6.2.4.2).

Table 1 — Maximum storage heights for OH3 protection

Storage Category	Maximum storage height ^a	
	m	
	Free standing or block storage (ST1 – see 6.3.2)	Storage configurations (ST2 to ST6 ^b see 6.3.2)
Category I	4,0	3,5
Category II	3,0	2,6
Category III	2,1	1,7
Category IV	1,2	1,2
^a where storage heights exceed the values in the table use HHS protection, see 6.2.4.2 and 7.2 ^b ST6 storage shall be limited to gondola shelving 1,2 m total width with a solid central barrier extending from the base to the top of the gondola shelving. All other ST6 storage requires protection in accordance with HHS protection, see 7.2.		

6.2.4 High Hazard – HH

6.2.4.1 High Hazard, Process – HHP

High Hazard, Process, covers occupancies where the materials concerned have a high fire load and high combustibility and are capable of developing a quickly spreading or intense fire.

HHP is sub-divided into four groups:

- HHP1, High Hazard Process Group 1;
- HHP2, High Hazard Process Group 2;
- HHP3, High Hazard Process Group 3;
- HHP4, High Hazard Process Group 4.

NOTE HHP4 hazards are usually protected by deluge systems, which are not within the scope of this standard.

6.2.4.2 High Hazard, Storage – HHS

High Hazard, Storage, covers the storage of goods where the height of storage exceeds the limits given in 6.2.3.

High Hazard, Storage – HHS, is sub-divided into four categories:

- HHS1, High Hazard Storage Category I;
- HHS2, High Hazard Storage Category II;
- HHS3, High Hazard Storage Category III;
- HHS4, High Hazard Storage Category IV.

NOTE Examples are given in Annex B and Annex C.

6.3 Storage

6.3.1 General

The overall fire hazard of stored goods is a function of the combustibility of the materials being stored, including their packaging, and of the storage configuration.

To determine the required design criteria when stored goods are involved, the procedure shown in Figure 2 shall be followed.

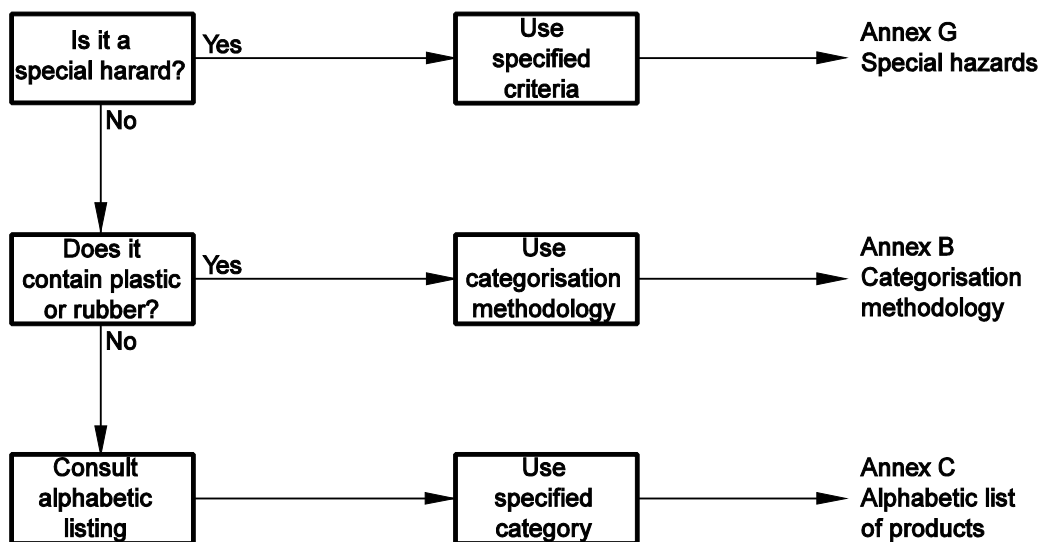


Figure 2 — Flow chart for determining the class required for storage

NOTE Where none of these annexes is fully applicable, and large scale fire test data are available, it can be appropriate to use such data to establish design criteria.

6.3.2 Storage Configuration

The storage configuration shall be classified as follows:

- ST1: free standing or block stacking;
- ST2: post pallets in single rows, with aisles not less than 2,4 m wide;

- ST3: post pallets in multiple (including double) rows;
- ST4: palletized rack (beam pallet racking);
- ST5: solid or slatted shelves 1 m or less wide;
- ST6: solid or slatted shelves over 1 m and no more than 6 m wide;

Typical examples of storage configurations are given in Figure 3.

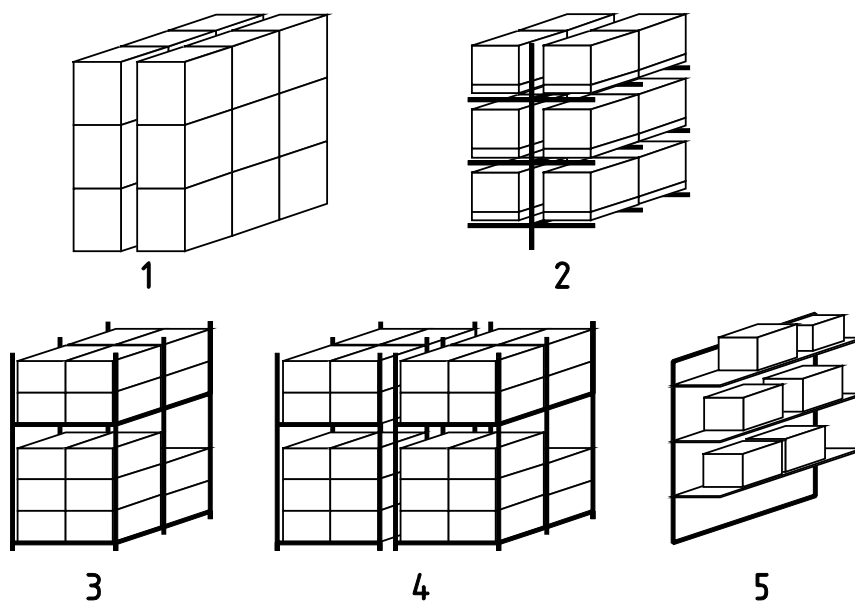
NOTE For each storage method, there are specific limitations to storage heights depending on the type and design of sprinkler systems (see 7.2).

In order for sprinkler protection to be effective, the limitations and protection requirements of Table 2 shall be met.

Table 2 — Protection requirements and limitations for storage configurations ST1 to ST6

Storage configuration	Hazard	Applicable conditions	Maximum storage block area m ²	Width of aisles separating rows of storage m	Minimum separation clearance around storage block area m
ST1	OH		50	^a	2,4
	HH		150	^a	2,4
ST2	OH		50	2,4 or greater	2,4
	HH		unlimited	2,4 or greater	^a
ST3	OH		50	^a	2,4
	HH		150	^a	2,4
ST4	OH		50	1,2 or greater	2,4
	HH	without intermediate level in-rack sprinkler protection ^{b, c}	unlimited	1,2 or greater	^a
		with intermediate level in-rack sprinkler protection ^d		Less than 1,2	^a
		with intermediate level in-rack sprinkler protection ^e		greater than 1,2 but less than 2,4	^a
		with intermediate level in-rack sprinkler protection ^f		2,4 or greater	^a
ST5	OH		50	1,2 or greater	2,4
	HH	without intermediate level in-rack sprinkler protection ^{b, c}	150	less than 1,2	2,4
		with intermediate level in-rack sprinkler protection ^d	150	less than 1,2	2,4
		with intermediate level in-rack sprinkler protection ^g	Unlimited	1,2 or greater	^a
A1 ST6	OH	use HH protection			
	HH	with intermediate level in-rack sprinkler protection ^{c, h}	150	1,2	2,4 A1

^a Not applicable.^b intermediate level in-rack sprinkler protection is recommended.^c Protection method limited to risks where the ceiling sprinklers are less than 4 m above the highest level of stored goods. Where the ceiling sprinklers are more than 4 m above the highest level of stored goods, intermediate level in-rack sprinklers shall be used.^d Assume intermediate level in-rack sprinkler protection in three racks is hydraulically involved, see 7.2.3.3.^e Assume intermediate level in-rack sprinkler protection in two racks is hydraulically involved, see 7.2.3.3.^f Assume intermediate level in-rack sprinkler protection in one rack is hydraulically involved, see 7.2.3.3.^g Assume intermediate level in-rack sprinkler protection in one or two racks is hydraulically involved, see 7.2.3.3.^h If it is not possible to install intermediate sprinklers in ST6 storage longitudinal and transverse full height bulkheads shall be fitted longitudinally within each shelf. The full height bulkheads shall be constructed to EN 13501-1, Euroclass A1, A2 or national equivalent.

**Key**

- | | | | |
|---|-----------------------------|---|-----------------------------------|
| 1 | free-standing storage (ST1) | 4 | post-pallet storage (ST3) |
| 2 | palletized rack (ST4) | 5 | solid or slatted shelves (ST 5/6) |
| 3 | post-pallet storage (ST2) | | |

Figure 3 — Storage configuration**7 Hydraulic design criteria****7.1 LH, OH and HHP**

The design density shall be no less than the appropriate value given in this clause when all the ceiling or roof sprinklers in the room concerned, or in the area of operation, whichever is the fewer, plus any in-rack sprinklers and supplementary sprinklers, are in operation. The minimum requirements for design density and area of operation for LH, OH and HHP classes are given in Table 3. For HHS systems, the requirement given in 7.2 shall be applied.

NOTE For pre-calculated systems, the design criteria are achieved by the application of water supply and piping requirements stated elsewhere in this standard (see 7.3, 9.3.2.2 and 10.7).

Table 3 — Design criteria for LH, OH and HHP

Hazard Class	Design Density mm/min	Area of Operation m²	
		Wet or pre-action	Dry or alternate
LH	2,25	84	Not allowed Use OH1
OH1	5,0	72	90
OH2	5,0	144	180
OH3	5,0	216	270
OH4	5,0	360	Not allowed Use HHP1
HHP1	7,5	260	325
HHP2	10,0	260	325
HHP3	12,5	260	325
HHP4	deluge (see NOTE)		
NOTE	Needs special consideration. Deluge systems are not covered by this standard.		

7.2 High Hazard Storage – HHS

7.2.1 General

The type of protection and determination of the design density and area of operation are dependent on the combustibility of the product (or mix of products) and its packaging (including the pallet) and the method and height of storage.

Specific limitations apply to the various types of storage methods as detailed in Clause 6.

7.2.2 Ceiling or roof protection only

7.2.2.1 General

Authorities shall be consulted for buildings exceeding 12 m ^{AC} *deleted text* ^{AC}.

7.2.2.2 Storage height limits

Table 4 specifies the appropriate design density and area of operation according to the category and maximum permitted storage height for the various types of storage with roof or ceiling protection only. More specifically, the storage heights indicated in the table are considered the maximum for efficient sprinkler protection where sprinklers are only provided at the roof or ceiling.

Where storage heights exceed the limit intermediate levels of in-rack sprinklers shall be provided as per 7.2.3 (see Table 4).

7.2.2.3 Excessive clearance

The values from Table 4 shall be used to determine the clearance. Where the clearance, distance between the storage height and ceiling sprinkler deflector, exceeds 4 m one of the following options shall be applied:

Option 1: increase the density for the first excessive meter by 2,5 mm/min. For each additional meter increase the water density by 1 mm/min. A K-Factor of minimum K115 shall be used.

Option 2: intermediate levels of in-rack sprinklers shall be provided as per 7.2.3.

7.2.3 Intermediate level in-rack sprinklers

7.2.3.1 Where more than 50 intermediate level sprinklers are installed in the racks, they shall not be fed from the same control valve set as the roof or ceiling sprinklers.

7.2.3.2 The design density for the roof or ceiling sprinklers shall be a minimum of 7,5 mm/min over an area of operation of 260 m². If goods are stored above the highest level of intermediate protection, the design criteria for the roof or ceiling sprinklers shall be taken from Table 5.

7.2.3.3 For the purposes of hydraulic calculation it shall be assumed that 3 sprinklers are operating simultaneously at the most hydraulically remote position on each level of in-rack sprinklers, up to a maximum of three levels. Where rack aisles are 2,4 m or more in width only one rack need be assumed to be involved. Where rack aisles are less than 2,4 m but greater than or equal to 1,2 m in width, two racks shall be assumed to be involved. Where rack aisles are less than 1,2 m in width, three racks shall be assumed to be involved.

NOTE It is not necessary to assume simultaneous operation of more than three rows of sprinklers in the vertical plane nor more than three rows of sprinklers in the horizontal plane.

7.2.3.4 In-rack sprinklers and the associated ceiling sprinklers shall always be fully calculated (see 13.1).

NOTE The minimum pressure at any operating sprinkler is 2,0 bar (see 13.4.4).

Table 4 — Design criteria for HHS with roof or ceiling protection only

Storage Configuration	Maximum permitted storage height				Design density	Area of operation (wet or pre-action system (see NOTE))
	m				mm/min	m ²
	Category I	Category II	Category III	Category IV		
ST1 Free standing or block stacking	5,3	4,1	2,9	1,6	7,5	260
	6,5	5,0	3,5	2,0	10,0	
	7,6	5,9	4,1	2,3	12,5	
		6,7	4,7	2,7	15,0	
		7,5	5,2	3,0	17,5	
			5,7	3,3	20,0	300
			6,3	3,6	22,5	
			6,7	3,8	25,0	
			7,2	4,1	27,5	
			4,4	3,0	30,0	
ST2 Post pallets in single rows ST4 Palletized racks	4,7	3,4	2,2	1,6	7,5	260
	5,7	4,2	2,6	2,0	10,0	
	6,8	5,0	3,2	2,3	12,5	
		5,6	3,7	2,7	15,0	
		6,0	4,1	3,0	17,5	
			4,4	3,3	20,0	300
			4,8	3,6	22,5	
			5,3	3,8	25,0	
			5,6	4,1	27,5	
			6,0	4,4	30,0	
ST3 Post pallets in multiple rows ST5 and ST6 Solid or slatted shelves	4,7	3,4	2,2	1,6	7,5	260
	5,7	4,2	2,6	2,0	10,0	
		5,0	3,2	2,3	12,5	
				2,7	15,0	
				3,0	17,5	

NOTE Dry and alternate systems should be avoided on High Hazard storage especially with the more combustible products (the higher categories) and the higher storage. Should it nonetheless be necessary to install a dry or alternate system, the area of operation should be increased by 25 %.

Table 5 — Design criteria for roof or ceiling sprinklers with in-rack sprinklers

Storage Configuration	Maximum permitted storage height above the top level of in-rack protection (see NOTE 1)				Design density mm/min	Area of operation (wet or pre-action system (see NOTE 2)) m ²
	Category I	Category II	Category II I	Category I V		
ST4 Palletized racks	3,5	3,4	2,2 2,6 3,2 3,5	1,6 2,0 2,3 2,7	7,5 10,0 12,5 15,0	260
ST5 and ST6 Solid or slatted shelves	3,5	3,4	2,2 2,6 3,2 2,7	1,6 2,0 2,3 2,7	7,5 10,0 12,5 15,0	260

NOTE 1 The vertical distance from the highest level of in-rack sprinklers to the top of the storage.

NOTE 2 Dry and alternate systems should be avoided on High Hazard storage especially with the more combustible products (the higher categories) and the higher storage. If it is, nonetheless, necessary to install a dry or alternate system, the area of operation should be increased by 25 %.

7.3 Pressure and flow requirements for pre-calculated systems

7.3.1 LH and OH systems

The water supply shall be capable of providing not less than the appropriate flows and pressures specified in Table 6 at each control valve set. The pressure loss due to friction and static head between the water supply and each control valve set shall be calculated separately.

Table 6 — Pressure and flow requirements for pre-calculated LH and OH systems

Hazard Class	Flow l/min	Pressure at the control valve set bar	Maximum demand flow l/min	Pressure at the control valve set bar
LH (Wet and pre-action)	225	$2,2+p_s$	—	—
OH1 Wet and pre-action	375	$1,0+p_s$	540	$0,7+ p_s$
OH1 Dry and alternate OH2 Wet and pre-action	725	$1,4+p_s$	1 000	$1,0+p_s$
OH2 Dry and alternate OH3 Wet and pre-action	1 100	$1,7+p_s$	1 350	$1,4+p_s$
OH3 Dry and alternate OH4 Wet and pre-action	1 800	$2,0+p_s$	2 100	$1,5+p_s$

NOTE p_s is the static head loss due to the height of the highest sprinkler in the array concerned above the control valve set 'C' gauge, in bar.

7.3.2 HHP and HHS systems without in-rack sprinklers

7.3.2.1 The water supply shall be capable of delivering at the highest design point not less than the appropriate flow and pressure specified in Table 7, or as modified in 7.3.2.2 to 7.3.2.5. The total requirement for the running pressure at the control valve set shall be the sum of the pressure at the design point, the pressure equivalent of the difference in height between the control valve set and the highest sprinkler downstream of the design point and the pressure loss for the flow in the piping from the control valve set to the design point.

Table 7 — Pressure and flow requirements for pre-calculated installations designed using Tables 32 to 35

Design density mm/min	Maximum demand flow l/min		Pressure at the highest design point (pd) bar			
			Area of operation per sprinkler m ²			
	Wet or pre-action	Dry or alternate	6	7	8	9
(1) With pipe diameters in accordance with Tables 32 and 33 and sprinklers having a K-factor of 80						
7,5	2 300	2 900	—	—	1,80	2,25
10,0	3 050	3 800	1,80	2,40	3,15	3,90
(2) With pipe diameters in accordance with Tables 32 and 34 and sprinklers having a K-factor of 80						
7,5	2 300	2 900	—	—	1,35	1,75
10,0	3 050	3 800	1,30	1,80	2,35	3,00
(3) With pipe diameters in accordance with Tables 35 and 34 and sprinklers having a K-factor of 80						
7,5	2 300	2 900	—	—	0,70	0,90
10,0	3 050	3 800	0,70	0,95	1,25	1,60
(4) With pipe diameters in accordance with Tables 35 and 34 and sprinklers having a K-factor of 115						
10,0	3 050	3 800	—	—	—	0,95
12,5	3 800	4 800	—	0,90	1,15	1,45
15,0	4 550	5 700	0,95	1,25	1,65	2,10
17,5	4 850	6 000	1,25	1,70	2,25	2,80
20,0	6 400	8 000	1,65	2,25	2,95	3,70
22,5	7 200	9 000	2,05	2,85	3,70	4,70
25,0	8 000	10 000	2,55	3,50	4,55	5,75
27,5	8 800	11 000	3,05	4,20	5,50	6,90
30,0	9 650	12 000	3,60	4,95	6,50	—
NOTE If there are sprinklers in the array which are higher than the design point, the static head from the design point to the highest sprinklers should be added to pd.						

7.3.2.2 Where the area of the HHP or HHS portion of an occupancy is less than the area of operation, the flow rate in Table 7 might be proportionately reduced (see 7.3.2.6), but the pressure at the highest design point for the area shall be equal to that shown in the table, or be determined by hydraulic calculation.

7.3.2.3 When the HHP or HHS portion of an occupancy involves less than 48 sprinklers, the flow rate and appropriate pressure shown in Table 7 shall be available at the level of the highest sprinklers at the point of entry to the HHP or HHS area of sprinklers.

7.3.2.4 Where the area of operation is greater than the area of HHP or HHS protection and this area is adjacent to the OH protection, the total flow rate shall be calculated as the sum of the HHP or HHS portion when reduced proportionately as in 7.3.2.2 plus the flow rate for the OH section calculated on the basis of a design density of 5 mm/min. The pressure at the design point of the highest sprinklers in the HHP or HHS portion of the risk shall be either that shown in Table 7, or be determined by hydraulic calculation.

NOTE If the OH portion is upstream of the HH area, the hydraulic gradient will mean that the greater flow to the OH portion will be taken than for purely OH systems. Therefore, in a fire involving the complete design area the HH portion will have a reduced flow rate.

7.3.2.5 When the area of operation is fed by more than one distribution pipe, the pressure at the level of the highest sprinklers of the design points shall either be as shown in Table 7 for the appropriate design density, or be determined by hydraulic calculation. The flow rate for each distribution pipe shall be determined proportionately (see 7.3.2.6).

7.3.2.6 Where the basic area of operation for a given design density is increased or decreased as described in 7.3.2.2 to 7.3.2.7, the flow rate shall be proportionately increased or decreased (see 7.3.2.7), but the pressure at the design point shall remain unchanged.

7.3.2.7 The increased or decreased flow rates shall be determined proportionately as follows:

$$Q_2 = Q_1 \times \frac{a_2}{a_1} \quad (1)$$

where:

- Q_2 is the flow rate required or in the case of the circumstances described in 7.3.2.2 to 7.3.2.5 the flow rate in each distribution pipe, in litres per minute;
- Q_1 is the flow rate required as given in Table 7, in litres per minute;
- a_1 is the area of operation for design density, in square metres (see Table 4);
- a_2 is the area of operation required, or in the case of the circumstances described in 7.3.2.2 to 7.3.2.5 the area served by each distribution pipe, in square metres.

8 Water supplies

8.1 General

8.1.1 Duration

Water supplies shall be capable of automatically furnishing at least the required pressure/flow conditions of the system. If the water supply is used for other firefighting systems, see 9.6.4, except as specified in the case of pressure tanks, each water supply shall have sufficient capacity for the following minimum durations:

- LH 30 min
- OH 60 min
- HHP 90 min
- HHS 90 min

NOTE In the case of town mains, inexhaustible sources and all pre-calculated systems, the duration is implicit in the requirements given in this standard.

8.1.2 Continuity

A water supply shall not be liable to be affected by possible frost conditions or drought or flooding or any other conditions that could reduce the flow or effective capacity or render the supply inoperative.

All practical steps shall be taken to ensure the continuity and reliability of water supplies.

Water supplies should preferably be under the control of the user, or else the reliability and right of use should be guaranteed by the organization having control.

The water shall be free from fibrous or other matter in suspension liable to cause accumulations in the system piping. Salt or brackish water shall not be retained in sprinkler installation pipework.

Where there is no suitable fresh water source available, a salt or brackish water supply might be used provided the installation is normally charged with fresh water.

8.1.3 Frost protection

The feed pipe and the control valve set shall be maintained at a minimum temperature of 4 °C.

8.2 Maximum water pressure

8.2.1 Except during testing, water pressure shall not exceed 12 bar at equipment connections or locations identified in 8.2.1.1 and 8.2.1.2. The pressure in pumped systems shall take into account any increase in driver speed and pressure due to closed valve condition.

8.2.1.1 All types of sprinklers system

- a) sprinklers;
- b) multiple jet controls;
- c) water flow detectors;
- d) dry pipe and pre-action alarm valves;

- e) accelerators and exhausters;
- f) water motor alarms;
- g) zone control valves.

8.2.1.2 Sprinkler systems where the height difference between the highest and lowest sprinkler heads does not exceed 45 m:

- a) pump outlets, taking into account any increases in driver speed under closed valve conditions;
- b) wet alarm valves;
- c) stop valves;
- d) mechanical pipe joints

8.2.2 In high rise sprinkler systems, where the height difference between the highest and lowest sprinkler exceeds 45 m, water pressures might exceed 12 bar at the following locations (providing all equipment subject to pressures greater than 12 bar is fit for the purpose):

- a) pump outlets;
- b) riser and distribution pipes.

8.3 Connections for other services

Water for other services might be taken from a sprinkler system only when all the following conditions are met:

- a) the connections shall be as specified in Table 8;
- b) the connections shall be made through a stop valve fitted upstream of the control valve set(s), as close as is practical to the point of connection to the sprinkler system supply pipe;
- c) the sprinkler system shall not be a high rise system;
- d) the sprinkler system shall not be protecting a multi-storey building.

The sprinkler system pumps shall be separate from any hydrant system pumps unless a combined water supply in accordance with 9.6.4 is used.

Table 8 — Connections for water for other services in low rise systems

Water supply type	Acceptable number, size and purpose of connection(s)
Town main. Main and supply pipe greater than or equal to 100 mm	one, no more than 25 mm diameter, for non-industrial use
Town main. Main and supply greater than or equal to 150 mm	one, no more than 40 mm diameter, for non-industrial use or: one, no more than 50 mm diameter, for fire hose reels, to which might be made a further connection (close to the first connection, and fitted with a stop valve close to the feed end), no more than 40 mm, for non-industrial use.
Elevated private reservoir, gravity tank or automatic pump	one, no more than 50 mm diameter, for fire hose reels.

NOTE An additional feed arrangement with check valve can be provided for the fire brigade.

8.4 Housing of equipment for water supplies

Water supply equipment, such as pumps, pressure tanks and gravity tanks, shall not be housed in buildings or sections of premises in which there are hazardous processes or explosion hazards. The water supplies, stop valves and control valve sets shall be installed so that they are safely accessible even in a fire situation. All components of the water supplies and control valve sets shall be installed so that they are secured against tampering and are adequately protected against freezing.

8.5 Test facility devices

8.5.1 General

Sprinkler systems shall be permanently provided with devices for measuring pressure and flow for checking compliance with 7.3 and Clause 10 and comply with the following:

- All devices included in a test unit shall be suitable for their purpose and be installed in accordance with the manufacturer's instructions. Manufacturer's instructions shall include requirements for the minimum lengths of straight pieces of pipe up and downstream of the flow measuring device and maximum flow velocity.
- The flow measuring device shall be installed at a suitable location for easy access and readings in a frost-proof area.
- All flow measuring devices shall have an error to within $\pm 5\%$ of its maximum flow. If the device could be influenced during transportation, installation or continuous use, it shall be re-checked before any test results are used to evaluate the available flow.
- In case the calculated system is used, the capacity of the flow measuring device shall be chosen so that both the system demand for both the most unfavourable and most favourable area can be measured. The flow measuring device shall in addition have a measuring capacity of at least 140 % of the maximum flow demand (see 7.3). Where the system demand is provided by more than one pump running in parallel, the capacity of the flow measuring device can be chosen according to the capacity of the largest pump. In this case the individual readings might be added if the suction and discharge layout will not affect the result.

- e) Pressure readings to be used for the pressure/flow test curve shall only be made by an accurate test gauge ($\pm 1,6\%$).
- f) A minimum of three (3) pressure/flow readings shall be carried out to create a test curve. In addition to this, a pressure reading shall be made with no flow, i.e. the static pressure.

Where the water supply is by an automatic pump or pumps, the flow measuring device shall be installed at the pump house (see 8.5.2 below). In this case, 8.5.1 is not applicable.

Where the water supply is not by an automatic pump or pumps, the flow measuring device shall be installed at the control valve sets (see 8.5.3 below).

8.5.2 At pump house

A flow measuring device shall be permanently installed and shall be capable of checking each water supply. If the testing apparatus is not permanently fitted, it shall be available on site at all times. Pressure gauges shall be located upstream and downstream of the pump on a straight piece of pipe. Where the system demand is provided by more than one pump running in parallel, the capacity of the flow measuring device can be chosen according to the capacity of the largest pump. In this case the individual readings might be added if the suction and discharge layout will not affect the result.

8.5.3 At control valve sets

Where the water supply is not by an automatic pump or pumps, a flow measuring device shall be permanently available on site (fixed or mobile) and shall be capable of checking each water supply. Where two or more control valve sets are installed together, the device needs to be installed only at the hydraulically most remote set, or, when the installations belong to different hazard classes, at the control valve set which requires the highest water flow.

In all cases, the appropriate allowance shall be made for the pressure losses between the water source and the control valve set(s) using the calculation methods specified in 13.2.

Facilities shall be provided for the disposal of test water.

Dry or alternate control valve sets (main or subsidiary) might have an additional flow test valve arrangement of unspecified flow loss characteristic fitted below the control valve set, downstream of the main stop valve, to facilitate informal supply pressure testing. Such flow test valves and pipework shall have a nominal diameter of 40 mm for LH installations and of 50 mm for other installations.

8.6 Water supply test

8.6.1 General

The test facility specified in 8.5.2 shall be used. Each supply to the installation shall be tested independently with all other supplies isolated.

For both pre-calculated and fully calculated installations, the water supply shall be tested at least at the installation maximum demand flow.

8.6.2 Storage tank and pressure tank supplies

The stop valves controlling the flow from the water supply to the installation shall be fully opened. Automatic pump starting shall be checked by fully opening the installation drain and test valve. The flow shall be verified in accordance with Clause 7. The supply pressure measured on the 'C' gauge shall be verified as being at least the appropriate value specified in Clause 7.