

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	[A₁] 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

POLSKI KOMITET NORMALIZACYJNY 2022

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

POLSKI KOMITET NORMALIZACYJNY 2022

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