

Fire extinguishing installations and equipment on premises —

Part 2: Specification for sprinkler systems

ICS 13.220.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Fire Standards Policy Committee (FSM/-) to Technical Committee FSM/13, upon which the following bodies were represented:

- Association of Metropolitan Authorities
- British Automatic Sprinkler Association
- British Fire Protection Systems Association Ltd.
- British Fire Services' Association
- British Nuclear Fuels Ltd.
- Chief and Assistant Chief Fire Officers' Association
- Convention of Scottish Local Authorities
- Department of Health
- Department of the Environment (Property Services Agency)
- Department of the Environment (Building Research Establishment)
- Department of Transport (Marine Directorate)
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Fire Brigades Union
- Fire Extinguishing Trades' Association
- Health and Safety Executive
- Hevac Association
- Home Office
- Incorporated Association of Architects and Surveyors
- Institution of Fire Engineers
- Lloyds Syndicates Survey Department
- London Fire and Civil Defence Authority
- Loss Prevention Council
- Ministry of Defence
- Royal Institute of British Architects
- Society of Fire Protection Engineers
- Society of Motor Manufacturers and Traders Ltd.
- United Kingdom Atomic Energy Authority
- Warrington Fire Research Centre
- Water Research Centre

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The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Copper Development Association
- London District Surveyors Association

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Foreword

This Part of BS 5306 is published under the direction of the Fire Standards Policy Committee. It is a revision of BS 5306-2:1979 which is superseded and withdrawn.

The other Parts of BS 5306 in preparation or published are as follows:

- *Part 0: Guide for the selection of installed systems and other fire equipment;*
- *Part 1: Hydrant systems, hose reels and foam inlets;*
- *Part 3: Code of practice for selection, installation and maintenance of portable fire extinguishers;*
- *Part 4: Specification for carbon dioxide systems;*
- *Part 5: Halon systems;*
- *Section 5.1: Halon 1301 total flooding systems¹⁾;*
- *Section 5.2: Halon 1211 total flooding systems;*
- *Part 6: Foam systems — Section 6.1: Specification for low expansion foam systems;*
- *Section 6.2: Specification for medium and high expansion foam systems;*
- *Part 7: Specification for powder systems.*

The foreword of the previous edition of this Part of this standard pointed out that it should be read in conjunction with the “Rules for automatic sprinkler installations” (29th edition), issued by the Fire Offices Committee (FOC) now incorporated in the Loss Prevention Council (LPC), and used by the majority of insurers in the UK.

With the agreement and active cooperation of the LPC, this revision, initially prepared by a consultant funded by the Department of Trade and Industry under the BSI/DTI consultancy scheme for Initial Draft Standards, includes all matters previously dealt with by reference to the FOC Rules.

Full acknowledgment is given to the LPC for its agreement to incorporate material from the FOC rules, and also texts of amendments to the FOC Rules as yet unpublished, in this new edition of this Part of this British Standard.

It is the intention of the LPC to replace the 29th edition of the FOC Rules by new document “LPC Rules for Automatic Sprinkler Installations”.

That new document will incorporate the full text of this British Standard specification and include additional material not suitable for inclusion in a British Standard, related to the use of sprinkler systems installed primarily to reduce loss of property by fire. It will be available from:

Loss Prevention Council
140 Aldersgate Street
London
EC1A 4HX

Arrangements have been made for the continual review of this specification and the “LPC Rules for Automatic Sprinkler Installations” to ensure that, as far as possible, amendments to the two documents are made simultaneously so that they remain compatible. In consequence this standard will be reviewed on an annual basis, more frequently than is usual for most other standards. In particular it is intended as part of the first review to consider some proposals, made as part of the public comment, related to applications of sprinkler systems in multi-storey buildings which merit issue for public comment. However, some new requirements and recommendations are included covering the installation of sprinkler systems in high-rise buildings.

¹⁾ Under revision.

There is increasing use of sprinkler systems which, in addition to protecting property, may serve for the protection of life, usually as an integral part of measures approved by a fire authority. An example is in covered and enclosed shopping centres, where automatic sprinkler systems can serve to prevent the spread of fire and its products to adjacent exit routes. This revision includes new recommendations together with those previously given in BS 5306-1:1979 in an appendix, to ensure that the reliability of such a sprinkler system is consistent with its function as an essential life safety measure, in such particular circumstances or where sprinkler systems may be called for in BS 5588-10²⁾.

Although sprinkler systems are likely to provide some life safety protection to occupants of the areas of buildings in which sprinklers are installed, additional requirements may be necessary for systems specifically intended for life safety protection, e.g. where smoke could accumulate so rapidly that the lives of some of the occupants might be endangered before they could escape. It is intended to cover this subject, which may include additional recommendations for sprinkler sensitivity for life safety purposes, in a future revision of this specification.

Emphasis is given to the importance of ensuring that components of sprinkler systems are of established reliability and durability and suitable for the particular application and circumstances.

The requirements and recommendations are made in the light of the best technical data known to the committee at the time of writing, but since a wide field is covered it has been impracticable to consider every possible factor or circumstance that might affect implementation of the recommendations.

The previous edition of this standard was written in the form of a code of practice, but this revision is written as a specification to make it more suitable for reference in designs and specifications for actual projects. To comply with this specification, the user has to comply with all its requirements. He may depart from recommendations, but this would be on his own responsibility and he would be expected to have good reasons for doing so. It is a requirement of this specification to have consulted the various authorities concerned with the system, a procedure which allows for discussion and agreement of which recommendations may be appropriate in any particular case.

It has been assumed in the preparation of this standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, attention is drawn to:

Health & Safety at Work etc. Act 1974

Water Acts 1989

Water (Scotland) Acts 1946/67

Water Supplies and Sewerage Act (Northern Ireland) 1945

Public Health Acts (Northern Ireland) 1878–1955

²⁾ Under revision.

Product Certification. Users of this British Standard are advised to consider the desirability of independent certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to x, pages 1 to 156, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

0 Introduction

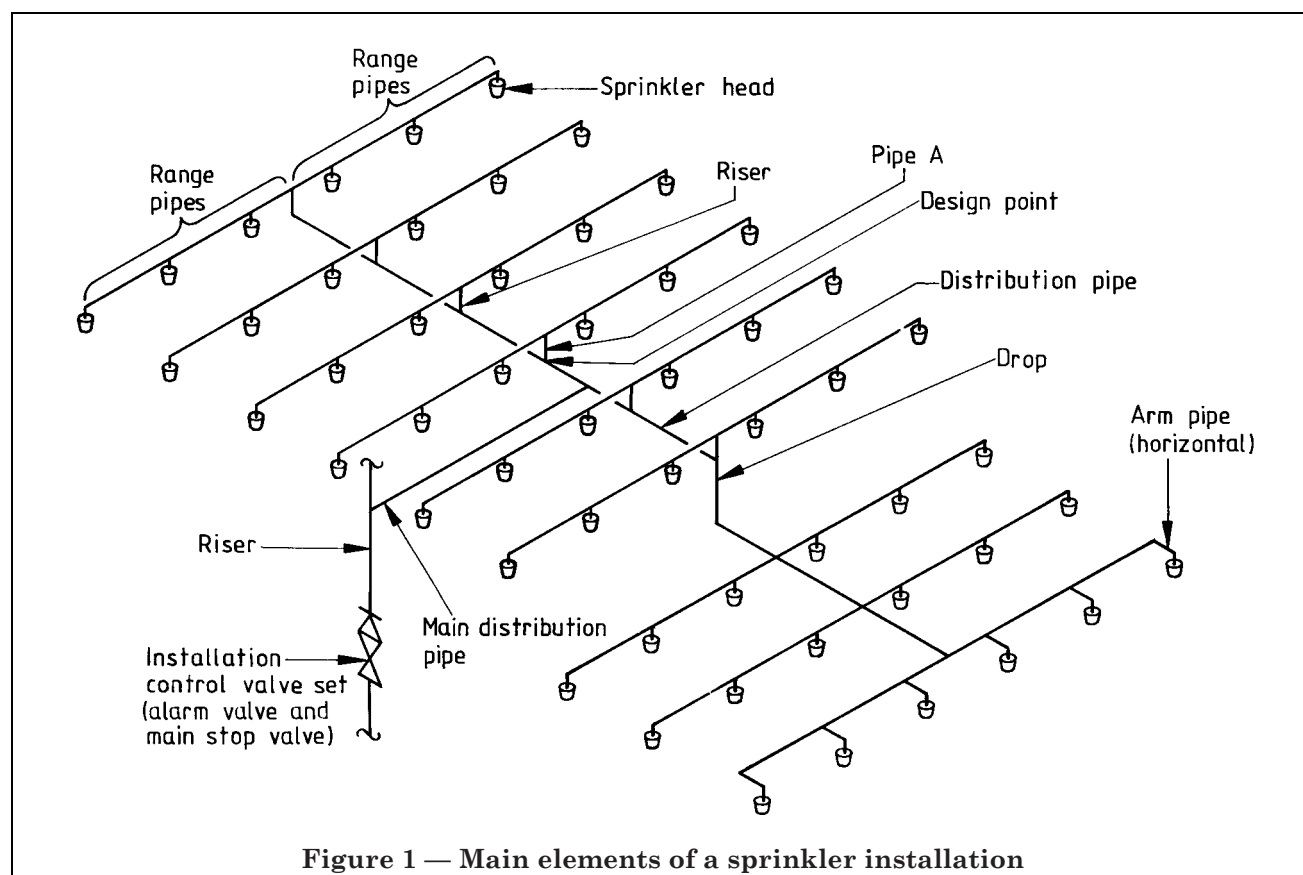
A sprinkler system consists of a water supply (or supplies) and one or more sprinkler installations; each installation consists of a set of installation main control valves and a pipe array fitted with sprinkler heads. The sprinkler heads are fitted at specified locations at the roof or ceiling, and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

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 initiating 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.

In some life safety applications an authority may require sprinkler protection only in certain designated areas and solely to maintain safe conditions for the evacuation of persons from the sprinklers protected areas. Such a system may not provide protection against a fire which starts in a non-sprinklered part of the premises and develops to some size before spreading to the sprinkled parts, and for more complete protection the sprinkler system is extended 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. Advice on these matters may be obtained from the fire authority, the Health and Safety Executive or other enforcing authority under the Health and Safety at Work etc. Act 1974, and the fire insurers. In addition, reference should be made to BS 5306-0 and as necessary to other Parts of this standard.

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 disabled, extra attention should be paid to fire precautions and the appropriate authorities informed. Advice on fire precautions is given in Appendix C, and is particularly appropriate when hot work is being carried out on a sprinkler system which in consequence is not operational.

1 Scope

This Part of BS 5306 specifies requirements and gives recommendations for the design, installation and maintenance of fire sprinkler systems in buildings and industrial plant. It includes particular requirements for sprinkler systems which are integral to measures for the protection of life.

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 necessary for satisfactory performance of sprinkler systems complying with this specification.

NOTE 1 This standard does not deal with water spray deluge systems in detail.

NOTE 2 Unless otherwise stated in this standard all pressures are gauge pressures and are expressed in bars.

1 bar = 10^5 N/m² = 10² kPa.

NOTE 3 The titles of publications referred to in this standard are listed on page 155.

2 Definitions

For the purposes of this Part of BS 5306 the following definitions apply.

2.1

accelerator

a 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 pressure when a sprinkler operates

2.2

alarm test valve

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

2.3

alarm valve

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

2.4

alarm valve, composite

an alarm valve suitable for a wet, dry or alternate installation

2.5

alarm valve, dry

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

2.6

alarm valve, pre-action

an alarm valve suitable for a pre-action installation

2.7

alarm valve, recycling

an alarm valve suitable for a recycling installation

2.8

alarm valve, wet

an alarm valve suitable for a wet installation

2.9

arm pipe

a pipe, other than the last section of a range pipe, feeding a single sprinkler

2.10

assumed maximum area of operation (AMAO)

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

2.11**assumed maximum area of operation, hydraulically most favourable location**

the location in a sprinkler array of an AMAO of specified shape at which the water flow is the maximum for a specific pressure

2.12**assumed maximum area of operation, hydraulically most unfavourable location**

the location in a sprinkler array of an AMAO of specified shape at which the water supply pressure is the maximum needed to give the specified design density

2.13**authority**

an organization, officer or individual responsible for approving sprinkler systems, equipment and procedures (see 3.1)

2.14**booster pump**

an automatic pump supplying water to a sprinkler system from an elevated private reservoir or a town main

2.15**competent person**

a person with the necessary training and experience, and with access to the requisite tools, equipment and information, accepted by the authorities as capable of carrying out installation, inspection and maintenance procedures

2.16**cut-off sprinkler**

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

2.17**deluge installation**

an installation or tail-end extension fitted with open sprayers and either a deluge valve or a multiple control arrangement so that an entire area is sprayed with water on operation of the installation

2.18**deluge valve**

a valve suitable for use in a deluge installation

NOTE The valve is operated manually and usually also automatically by a fire detection system.

2.19 design density

the minimum density of discharge, in mm/min of water, for which a sprinkler installation is designed, determined from the discharge of a specified group of sprinklers, in L/min, divided by the area covered, in m²

2.20**design point**

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

2.21**detector sprinkler**

a sealed sprinkler mounted on a pressurized pipeline used to control a deluge valve. Operation of the detector sprinkler causes loss of air pressure to open the valve

2.22**distribution pipe**

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

2.23**distribution pipe spur**

a distribution pipe from a main distribution pipe, to a terminal branched pipe array (see Figure 30)

2.24**drencher**

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

2.25**drop**

a vertical pipe feeding a distribution or range pipe

2.26**end-centre array**

a pipe array with range pipes on both sides of a distribution pipe (see Figure 2)

2.27**end-side array**

a pipe array with range pipes on one side only of a distribution pipe (see Figure 2)

2.28**exhauster**

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

2.29**fastener**

a device for attaching pipe hanger components to a building structure or racking

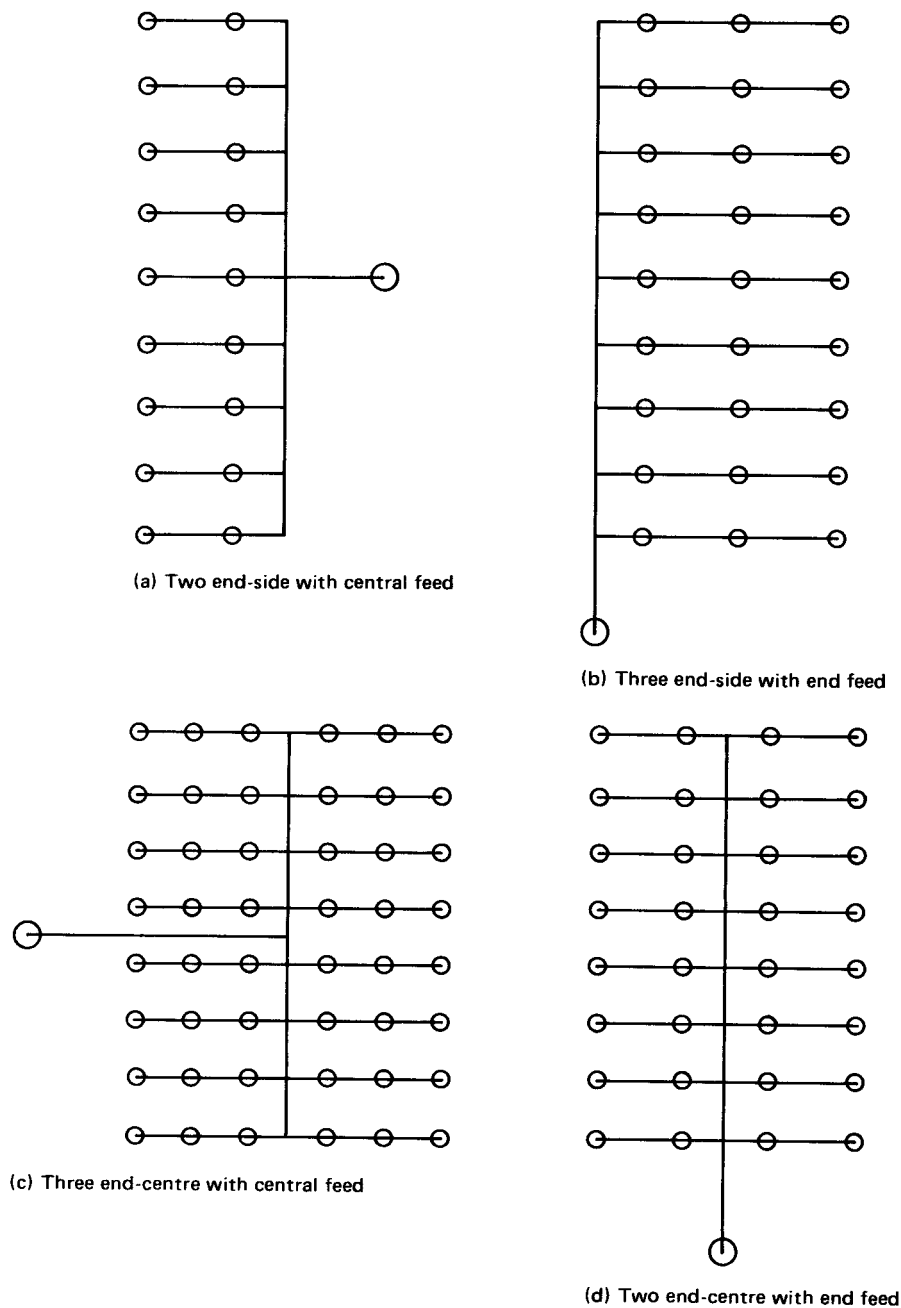


Figure 2 — Examples of range pipe arrays

2.30 fire door

a door and frame of specified fire resistance complying with either:

- a) BS 476-8:1972; or
- b) BS 476-22:1987

with respect to integrity

2.31 fire resistance

the ability of a component or the construction of a building to satisfy for a stated period of time the appropriate criteria specified in the relevant part of BS 476

2.32**fire shutter**

a shutter and frame of specified fire resistance complying with either:

- a) BS 476-8:1972; or
- b) BS 476-22:1987;

with respect to integrity

2.33**(fully) hydraulically calculated**

a term applied to pipework sized as specified in 18.1 a) or an installation in which all the pipework downstream of the main installation control valve set is sized as specified in 18.1 a)

2.34**gridded configuration pipe array**

a pipe array in which water flows to each sprinkler by more than one route (see Figure 37)

2.35**hanger**

an assembly for suspending pipework from elements of building structure

2.36**high-rise system**

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

2.37**hydraulic alarm, intermittent**

sounding of an hydraulic water motor alarm gong for intervals totalling less than the alarm period

2.38**installation (sprinkler installation)**

part of a sprinkler system comprising a set of installation main control valves, the associated downstream pipes and sprinklers

2.39**installation, alternate**

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

2.40**installation, dry (pipe)**

an installation in which the pipework is charged with air under pressure

2.41**installation, pre-action**

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

2.42**installation, recycling**

a pre-action installation in which the alarm valve can be opened and closed repeatedly by a heat detection system

2.43**installation, wet (pipe)**

an installation in which the pipework is always charged with water

2.44**jockey pump**

a small pump used to replenish minor water loss, to avoid starting an automatic suction or booster pump unnecessarily

2.45**life safety**

a term applied to sprinkler systems forming an integral part of measures required for the protection of life

2.46**looped configuration**

a pipe array in which there is more than one distribution pipe route along which water may flow to a range pipe (see Figure 36)

2.47**low-rise system**

sprinkler system in which the highest sprinkler is not more than 45 m above the lowest sprinkler or the sprinkler pumps whichever is the lower

2.48**main distribution pipe**

a pipe feeding a distribution pipe (see Figure 1)

2.49**mechanical pipe joint**

a component part of pipework other than threaded tubulars, screwed fittings, lead or compound sealed spigots and socket and flanged joint, used to connect pipes and to produce a seal both against pressure and vacuum

2.50**multiple control**

a valve, normally held closed by a temperature-sensitive element, suitable for use in a deluge system or for the operation of a pressure switch

2.51**node**

a 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

2.52**pipe array**

the pipes feeding a group of sprinklers

NOTE Pipe arrays may be looped (see 2.46), gridded (see 2.34) or branched (see Figure 35).

2.53**precalculated**

a term applied to pipework sized as specified in 18.1 b) or an installation in which pipes downstream of the design point are sized as specified in 18.1 b)

2.54**range pipe**

a pipe feeding sprinklers directly or via arm pipes of restricted length

2.55**riser**

a vertical pipe feeding a distribution or range pipe above

2.56**rosette (sprinkler rosette)**

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

2.57**section**

that part (which may be one or more zones) of an installation on a particular floor fed by a particular riser

2.58**sling rod**

a rod with a sling eye or screwed ends for supporting pipe clips, rings, band hanger etc.

2.59**sprayer**

a sprinkler that gives a downward conical pattern discharge

2.60**sprayer, high velocity**

an open nozzle used to extinguish fires of high flashpoint liquids

2.61**sprayer, medium velocity**

a sprayer of sealed or open type used to control fires of lower flashpoint liquids and gases or to cool surfaces

2.62**sprinkler, (automatic)**

a temperature-sensitive sealing device which opens to discharge water for fire extinguishing

NOTE The term “automatic sprinkler” is now rarely used. The term “sprinkler” does not include “open sprinkler” (see 2.72).

2.63**sprinkler, ceiling or flush pattern**

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

2.64**sprinkler, concealed**

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

2.65**sprinkler, conventional pattern**

a sprinkler that gives a spherical pattern of water discharge

See also:

cut-off sprinkler (2.16);

detector sprinkler (2.21).

2.66**sprinkler, dry pendent pattern**

a 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

2.67**sprinkler, dry upright pattern**

a 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

2.68**sprinkler, fusible link**

a sprinkler which opens when a component provided for the purpose melts

2.69**sprinkler, glass bulb**

a sprinkler which opens when a liquid-filled glass bulb bursts

2.70**sprinkler, horizontal**

a sprinkler in which the nozzle directs water horizontally

2.71**sprinkler, intermediate**

a sprinkler installed below, and additional to the roof or ceiling sprinklers

2.72**sprinkler, open**

a device, otherwise like a sprinkler (automatic sprinkler), not sealed by a temperature-sensitive element

2.73**sprinkler, pendent**

a sprinkler in which the nozzle directs water downwards

2.74**sprinkler, recessed**

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

2.75**sprinkler, roof or ceiling**

a sprinkler protecting the roof or ceiling

2.76**sprinkler, sidewall pattern**

a sprinkler that gives an outward half-paraboloid discharge

2.77**sprinkler, spray pattern**

a sprinkler that gives a downward paraboloid pattern discharge

2.78**sprinkler, upright**

a sprinkler in which the nozzle directs water upwards

2.79**sprinkler system**

the 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 except town mains and bodies of water such as lakes or canals

2.80**sprinkler yoke (arms)**

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

2.81**staggered (sprinkler) layout**

an off-set layout with the sprinklers displaced one-half pitch along the range pipe relative to the next range or ranges [see Figure 38(b)]

2.82**standard (sprinkler) layout**

a rectilinear layout with the sprinklers aligned perpendicular to the run of the ranges (see Figure 38(a))

2.83**suction pump**

an automatic pump supplying water to a sprinkler system from a suction tank, river, lake, or canal

2.84**suitable for sprinkler use**

a term applied to equipment or components accepted by the authorities as suitable for a particular application in a sprinkler system, either by particular test or by compliance with specified general criteria

NOTE The LPC publishes a list of components suitable for use in sprinkler systems.

2.85**supply pipe**

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

2.86**suspended open cell ceiling**

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

2.87**tail-end alternate (wet and dry pipe) extension**

a part of a wet installation that is selectively charged with water or air according to ambient temperature conditions

2.88**tail-end dry extension**

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

2.89**terminal main configuration**

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

2.90**terminal range configuration**

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

2.91**toggle support**

a swivel device for securing hangers to hollow section ceilings or roofs

2.92

trunk main

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

2.93

user

the person responsible for or having effective control over the fire safety provision adopted in or appropriate to the premises or the building

2.94

zone

a subdivision of an installation fitted with a subsidiary stop valve or multiple control

Section 2. Planning

3 Initial considerations

3.1 Consultation

Where a sprinkler system or an extension or alteration to a sprinkler system is being considered for new or existing buildings the following shall be consulted at an early stage:

- a) the fire authority;
- b) the local water authority or local water undertaker;
- c) other appropriate public authorities;
- d) the fire insurers.

COMMENTARY AND RECOMMENDATIONS ON 3.1.

There may be statutory or local bye-laws requirements, life safety requirements and other requirements of these authorities which should be coordinated in the planning stages of the contract.

Local water authorities and local water undertakers in England and Wales operate under the provisions of the Water Acts 1989, in Scotland under the Water (Scotland) Acts 1946/67 and in Northern Ireland under the Water Supplies and Sewerage Act (Northern Ireland) 1945, the Public Health Acts (Northern Ireland) 1878–1955 or under Private Acts and under Water Byelaws which may differ slightly between undertakings.

Although there is a duty to supply water for domestic purposes (subject to conditions), water supplies for sprinkler installations are given only upon request and on terms and conditions which are subject to agreement. The usual conditions in Great Britain and Northern Ireland include compliance with Byelaw to prevent contamination and waste of water. Attention is drawn to BS 6920-1 which may be relevant to systems using water drawn from town mains.

Connections to a town main within the highway remain the property of the water undertaking which usually requires a valve under its own control on each connection between the town main and the highway boundary. Any valve on the town main will be under the control of the water undertaking. Branches for hose reels and for non-industrial purposes may or may not be allowed in certain circumstances.

Water authorities and undertakers will not normally allow the use of booster pumps.

Water authorities and undertakers will not normally allow any connection between their mains and another source of water, whether by permanent pipework or, for example, by means of a fire brigade inlet even where a check valve is fitted.

The supply to any tank under atmospheric pressure should be controlled by a float valve discharging above the top level of the tank. There should not be any connection between town mains and a discharge pipe from such a tank.

3.2 Outline design

Consideration should be given to any benefits that might be gained by changes in building design, work procedures etc., when preparing the outline design.

COMMENTARY AND RECOMMENDATIONS ON 3.2.

In planning site layout and building design, particular consideration should be given to the following:

- a) *the occupancy hazard class and goods category which determine the water discharge density and water supply pressure and flow;*
- b) *the siting of any town main water supply connection(s);*
- c) *the siting of any water supply tank(s) or reservoir;*
- d) *the siting of any pump house;*
- e) *the maximum quantity of water available and maximum rate of supply (based on site tests at periods of maximum demand) from the supply source compared with the system requirements;*
- f) *the location of sprinkler installation control valves, together with the access thereto, indication of their position (see section 5), and the disposal of drainage and water supply test water;*
- g) *the source and means of supply of electric power, etc.;*
- h) *the protection of valve sets, pipework and sprinklers against accidental damage.*

It is important to consider building design in the context of fire protection, e.g. choice of materials, support of sprinkler pipework having regard to the load imposed on structure by the weight of sprinkler pipework and the contained water, building heating, need for inbuilt drainage (which is strongly advised for computer areas) or raising of base of stacked goods above the floor where water damage may be severe, etc. When storage of goods is involved it may be appropriate to consider the height of the building and of material stacks, and the height and type of any storage racks, which may have a considerable bearing on fire protection costs.

The design of double entry storage racks may be influenced by the need to mount sprinklers therein. Where sprinklers are fitted in racks additional rack structural members may be needed to prevent impact damage to the sprinkler head and pipework.

3.3 Interaction with other fire protection measures

Account shall be taken of possible interaction between sprinkler systems and other fire protection measures.

COMMENTARY AND RECOMMENDATIONS ON 3.3.

Examples of possible adverse interaction between sprinkler protection and other fire protection measures are:

- a) *water damage to an inadequately shielded fire alarm control panel in a sprinkler-protected area with consequent possible failure of the fire alarm system;*
- b) *operation or failure of smoke detectors in zones adjacent to one in which water discharge is taking place because of the water spray mist travelling into adjacent zones.*

Such possible interactions need particularly careful consideration in the case of systems which are part of life safety measures.

4 Extent of sprinkler protection

4.1 Buildings to be sprinkler-protected

The sprinkler system shall provide protection to all parts not specified as exceptions in 4.2 of the following:

- a) the building under consideration;
- b) any building communicating directly or indirectly with the building under consideration.

COMMENTARY AND RECOMMENDATIONS ON 4.1.

Sprinkler protection should also be provided in any neighbouring building which is of more than 150 m³ capacity, and which is within 10 m of, and may present an exposure hazard to, any building protected by the system. Where there are unprotected buildings the exposure hazard can be reduced by using cut-off sprinklers over unsealed openings and drenchers over combustible walls in the protected building.

Other means of fire protection may be appropriate in some instances. For protection of rooms and areas containing oil-filled transformers etc. see 5.4.5.

BS 5655-1 specifies that lift wells shall not be provided with sprinklers and to comply with both that standard and this specification lift wells complying with 4.2.2.1 a) are essential.

4.2 Exceptions (buildings and parts of buildings not sprinkler-protected)

4.2.1 *Obligatory exceptions.* Sprinkler protection shall not be provided in the following parts of a building or plant:

- a) grain silos or grain bins inside buildings forming part of a corn mill, distillery, maltings or oil mill;
- b) ovens, hovels and kilns in pottery, earthenware, brick, tile and glass works;
- c) areas, rooms or places where the water discharged from a sprinkler may present a hazard.

COMMENTARY AND RECOMMENDATIONS ON 4.2.1.

Sprinklers should not be fitted over salt baths, metal melt pans or frying ranges, or in positions where water may discharge into them or indirectly drain into them nor should waterpipes be fitted in these positions (see 7.1).

4.2.2 Optional exceptions

4.2.2.1 *General.* Sprinkler-protection shall be considered for, but need not be provided in, the following parts of a building or plant:

- a) stairs, spaces below stair headings (but not rooms above a stair) and lift wells. Any part not provided with sprinkler protection shall be enclosed by walls, ceilings and floors with a fire resistance of not less than 2 h, in which all doors are of not less than 1 h fire resistance, and in which all glazed areas either are of not less than 1 h fire resistance or in the case of stairs are protected by cut-off sprinklers. The area of glazing in any part not provided with sprinkler-protection shall not exceed 1.5 m² in each storey;
- b) washrooms, toilets and WCs (but not cloakrooms). Any part not provided with sprinkler-protection shall be enclosed by walls, ceilings and floors with a fire resistance of not less than 2 h, in which all doors are of not less than 1 h fire resistance, and in which all glazed areas are of not less than 1 h fire resistance or are protected by cut-off sprinklers;
- c) rooms or compartments containing electric power distribution apparatus, such as switchgear and transformers, and used for no other purpose(s). Any part not provided with sprinkler protection shall be enclosed by walls, ceilings and floors of not less than 2 h fire resistance in which all doors are of not less than 1 h fire resistance;
- d) in papermaking machines, the undersides of screens or of shields erected over the wet end (where there is no other fire hazard);

e) areas containing oil or similar flammable liquids.

4.2.2.2 Communicating buildings. Sprinkler protection shall be considered for, but need not be provided in, the following communicating buildings or structures:

a) a building or storey separated from the sprinklered building by walls of not less than 6 h fire resistance in which each opening is protected by two (arranged in series) fire doors or fire shutters each of not less than 2 h fire resistance;

b) canopies of non-combustible construction, not extending beyond 2.3 m from the building wall. Any such canopy not provided with sprinkler protection shall be fitted with cut-off sprinklers under the canopy over each opening between it and the sprinklered building. Any opening 2.5 m or less in width shall be provided with a cut-off sprinkler, positioned centrally over the opening. Openings exceeding 2.5 m in width shall be provided with cut-off sprinklers over the opening, not more than 2.5 m apart and with a sprinkler not more than 1.25 m from each side;

c) exterior loading docks and platforms either of non-combustible construction or with the space beneath closed off against accumulation of debris;

d) buildings used solely as offices and/or private dwelling(s). Any part not provided with sprinkler protection shall be separated from the sprinkler-protected building by a wall of not less than 6 h fire resistance in which any glazed areas are of not less than 1 h fire resistance and are provided with cut-off sprinklers, and in which all door openings are protected by either:

- 1) single fire doors or single fire shutters of not less than 2 h fire resistance; or
- 2) fire doors of not less than 1 h fire resistance and cut-off sprinklers;

e) buildings, storeys or rooms of non-combustible construction used mainly for wet processes;

f) stairs, washrooms and WCs external to the sprinkler-protected building, in which all openings to the sprinkler-protected building are protected by doors of not less than 1 h fire resistance;

g) staircases, washrooms, toilets and WCs external or internal to the sprinkler-protected building which form a means of communication between the sprinklered building and a non-sprinklered building. In any such part not provided with sprinkler protection all openings into the communicating area from the sprinklered and from the non-sprinklered building shall be protected by fire doors of not less than 1 h fire resistance.

4.2.2.3 Life safety systems. Sprinkler protection shall be considered for, but need not be provided in, the following.

a) In general, rooms adjacent to areas where a life safety sprinkler system is required by an authority solely to maintain safe conditions for the evacuation of persons from the sprinkler-protected areas. Any part not provided with sprinkler protection shall be enclosed by walls, ceilings and floors with a fire resistance of not less than 1 h in which any openings are fitted with cut-off sprinklers on the non-sprinklered side and either with a fire door or fire shutter with a fire resistance of not less than 30 min.

b) Auditoria in theatres with separated stages (i.e. where there is a safety curtain between the stage and auditorium) where a life safety sprinkler system is required as a licensing condition by an authority solely to maintain safe conditions for the evacuation of persons from the theatre. Where sprinkler protection is not provided in the auditorium the safety curtain shall be provided with a line of drenchers controlled by a quick opening valve (e.g. a plug valve) fitted in an accessible position. The water supply for the drenchers shall not be taken downstream of any sprinkler installation valve set.

COMMENTARY AND RECOMMENDATIONS ON 4.2.2.3.

In theatres with a separated stage it may be necessary, in order to satisfy the requirements of some licensing authorities, to provide sprinklers throughout the stage and associated areas including workshops, dressing rooms, scenery and other storerooms but not in the auditorium, etc. The licensing authorities will normally require drenchers to be fitted as specified here.

Subject to the requirements of the authorities it is recommended that life safety sprinkler systems be extended to all areas except those specified in 4.2.1, 4.2.2.1 and 4.2.2.2.

5 Classification of occupancies and fire hazards

5.1 General

Occupancies or parts thereof shall be classified as:

- light hazard; or
- ordinary hazard; or
- high hazard.

Ordinary- and high-hazard occupancies shall in addition be assessed for any special variation to normal requirements specified in 5.5.

In storage areas the goods including any packaging shall be categorized as category I, II, III or IV (see Table 1 and Table 2).

COMMENTARY AND RECOMMENDATIONS ON 5.1.

Hazard classification provides the basis for the design of sprinkler systems and is a skilled operation which is best carried out by the authorities (see 2.13). The range of occupancies and hazards encountered is extremely large, and it may be necessary to classify a particular case by analogy. The classification affects the choice of installation, operational method, water supply arrangements, components, pipework design etc.

Although this specification deals mainly with sprinkler systems which are installed primarily to reduce loss of property in fire, some sprinkler systems are installed which additionally may serve for the protection of life. In particular circumstances these may form an integral part of measures approved by the fire authority for the protection of life, for example in covered and enclosed shopping complexes, where automatic sprinkler systems serve to prevent the spread of fire and its products to adjacent exit routes (see BS 5588-10³).

Where a system is a high-rise system or a life safety system, additional safeguards are considered necessary to ensure reliability although the hazard is classified in the normal manner. These are detailed under the heading "Life safety" in the appropriate sections.

Figure 3 shows the relationship between classes and may be used in the process of classification.

5.2 Light hazard

In non-industrial occupancies where the quantity and combustibility of the contents are low, rooms and corridors not more than 126 m² in area and bounded by elements of construction with a fire resistance of not less than 30 min shall be classified as light hazard.

COMMENTARY AND RECOMMENDATIONS ON 5.2.

Typical light-hazard occupancies are given in Figure 3. No room may have more than six sprinklers (see 14.2).

Rooms larger than 126 m² or with walls of lower fire resistance are classified as ordinary hazard, group I.

5.3 Ordinary hazard

5.3.1 In non-industrial occupancies, rooms which exceed the limits specified in 5.2 for light-hazard classification shall be classified as ordinary hazard, group I.

5.3.2 Commercial and industrial occupancies involving the handling, processing and storage of mainly ordinary combustible materials, which are unlikely to develop intensely burning fires in the initial stages, shall be classified as:

- ordinary hazard, group I; or
- ordinary hazard, group II; or
- ordinary hazard, group III; or
- ordinary hazard, group IIIS (group III special).

COMMENTARY AND RECOMMENDATIONS ON 5.3.

Table 2 gives examples of goods categories.

Examples of the four ordinary-hazard occupancy groups are given in Table 3.

Goods stored not higher than the eaves height of roofs, or within 1 m of a flat ceiling, and not higher than as specified in column 3 of Table 1 for the appropriate method of storage and goods category, whichever is the lowest, and within the appropriate limits of column 5 of Table 1 in ordinary-hazard areas, should be classified as ordinary hazard group III.

To allow flexibility in change of use, warehouses and high-rise buildings should be classified as group III. See 5.5 for occupancies for which special variation may be needed.

5.4 High hazard

5.4.1 General. Commercial and industrial occupancies having abnormal fire loads shall be classified as high hazard, and subclassified as:

- process high hazards; or
- high-piled storage hazards; or
- potable spirit storage hazards; or
- oil and flammable liquid hazards.

COMMENTARY AND RECOMMENDATIONS ON 5.4.1.

See 5.5 for occupancies for which special variation may be needed.

5.4.2 Process high hazards. Processes using materials mainly of a hazardous nature likely to develop into rapidly and intensely burning fires shall be subclassified as type 1, 2, 3 or 4.

COMMENTARY AND RECOMMENDATIONS ON 5.4.2.

Typical examples of the four types of process high hazard are given in Table 4.

³) In preparation.

Table 1 — Classification of stacked goods and limitations on storage methods

Type (and storage method)	Goods category reference (see 5.1 and Table 2)	Maximum storage height for protection by roof or ceiling sprinklers only		Limitations (ordinary and high hazard)	Design density and stack height given in
		Ordinary hazard Group III	High hazard		
S1 free standing or block stacking	I II III IV	m 4.0 3.0 2.1 1.2	m 7.6 7.5 7.2 4.4	None	Table 8 for high hazard, or Table 7 for ordinary hazard
S2 post or box pallets in single rows	I II III (except rubber tyres) IV	3.5 2.6 1.7 1.2	6.8 6.0 6.0 4.4	Aisles shall be not less than 2.5 m wide	Table 9 for high hazard, or Table 7 for ordinary hazard
S3 post or box pallets in multiple rows	I II III (except rubber tyres) IV	3.5 2.6 1.7 1.2	5.7 5.0 3.2 3.0	No storage block shall exceed 150 m ² in plan area. Each storage block shall have aisles all round not less than 2.5 m wide	Table 10 for high hazard, or Table 7 for ordinary hazard
S4 open-bottom post pallets	III (rubber tyres only)	1.7	7.2	None	Table 8 for high hazard, or Table 7 for ordinary hazard
S5 palletized rack (beam pallet racking)	I II III IV	3.5 2.6 1.7 1.2	6.8 6.0 6.0 4.4	Intermediate sprinklers shall be fitted where the aisles are less than 1.2 m wide (see 26.1.4)	Table 9 for high hazard, or Table 7 for ordinary hazard
S6 solid or slatted shelves 1 m or less wide	I II III IV	3.5 2.6 1.7 1.2	5.7 5.0 3.2 3.0	Gangways shall be not less than 1.2 m wide, or storage blocks shall be not more than 150 m ² with aisles all round not less than 2.5 m wide	Table 10 for high hazard, or Table 7 for ordinary hazard
S7 solid or slatted shelves over 1 m and not more than 6 m wide	I II III IV	Note applicable	Not applicable	As S6 above. Intermediate sprinklers should be fitted under each shelf and shall be installed where storage blocks exceed 150 m ² in plan area or do not have aisles all round not less than 2.5 m wide	Table 10
S8 solid or slatted shelves over 1 m wide where intermediate sprinklers cannot be installed	I II III IV	Not applicable	5.7 5.0 3.2 3.0	Continuous non-combustible full height vertical bulkheads shall be fitted longitudinally and transversely within each shelf (see 26.1.4) No storage block shall exceed 150 m ² in plan area. Each storage block shall have aisles all round not less than 2.5 m wide	Table 10
NOTE 1 Intermediate sprinklers shall be fitted under shelves where the maximum heights specified are exceeded.					
NOTE 2 See clause 14 for design density and AMAO according to storage heights and goods category.					

Table 2 — High-piled storage hazards showing typical examples in goods categories

Category I	Category II	Category III	Category IV
carpets clothing electrical appliances fibreboard glassware and crockery, in cartons groceries metal goods, in cartons textiles all forms of paper storage not listed under categories II or III ordinary combustible materials, and non-combustible materials in combustible wrappings	baled cork baled waste paper cartons containing alcohols in cans or bottles cartons of canned lacquers which dry by solvent evaporation chipboard flammable liquids in non-combustible containers ^a linoleum products palletized whisky stocks plastics (non-foamed) other than cellulose nitrate rolled pulp and paper, horizontal storage rolled asphalt paper, horizontal storage veneer sheets wood patterns wooden furniture	bitumen-coated or wax-coated paper cellulose nitrate esparto (loose) foam plastics and foam rubber products, with or without cartons, other than those specified in category IV flammable liquids in combustible containers ^a rolled asphalt paper (vertical storage) rolled pulp and paper (vertical storage) rubber goods ventilated wood stacks waxed or asphalt-coated paper and containers in cartons wood wool wooden pallets and wooden flats (idle) all materials having wrappings or preformed containers or foamed plastics	offcuts and random pieces of foamed plastics or foamed rubber rolls of sheet foamed plastics or foamed rubber
NOTE The lists are not exhaustive. Category I does not automatically include goods or materials not listed here as categories II, III or IV. ^a Excluding aerosol dispensers which are a special case.			

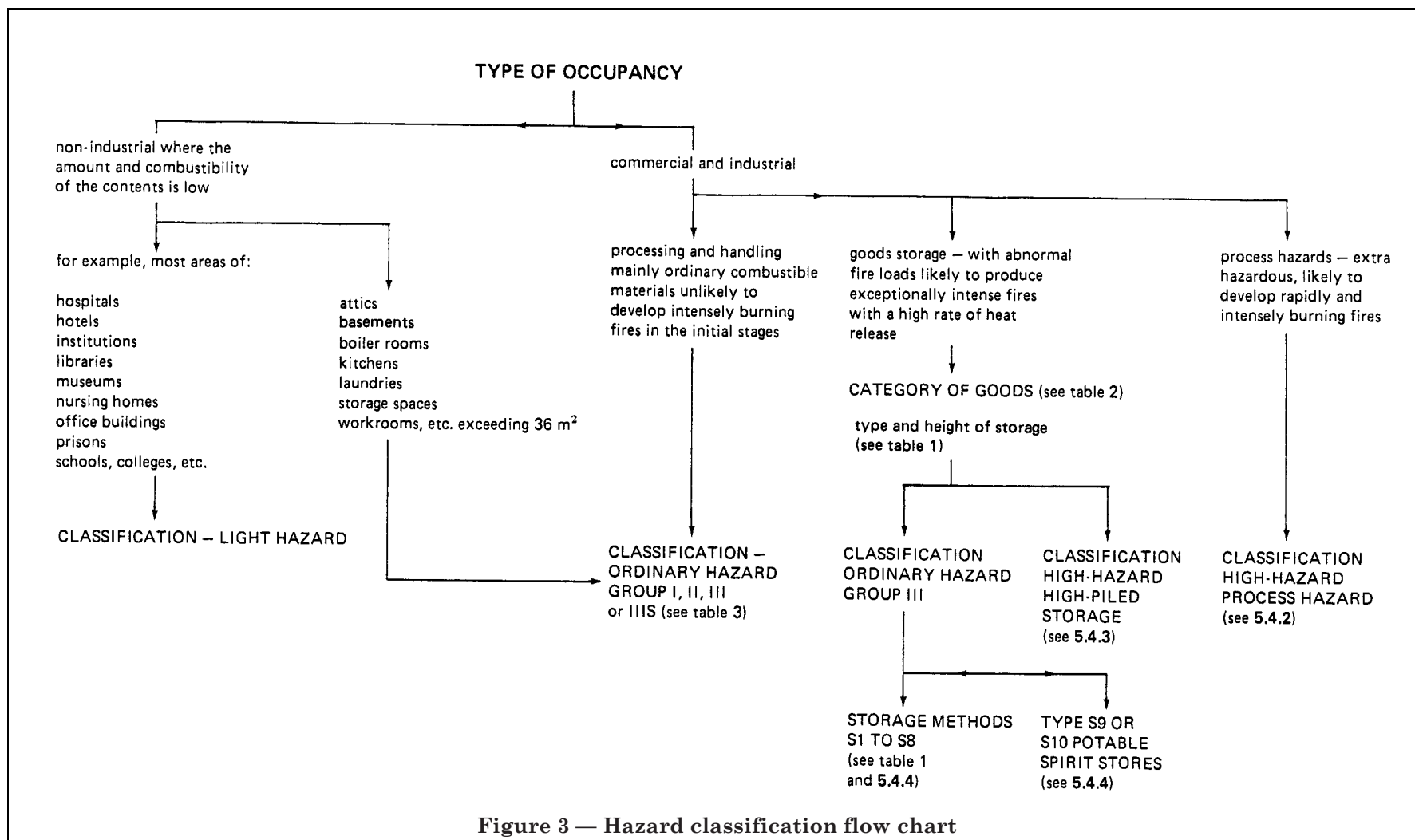


Figure 3 — Hazard classification flow chart

Table 3 — Typical examples of ordinary-hazard occupancies

Type of business	Ordinary hazard group			
	I	II ^a	III ^b	IIIS
Ceramics	abrasive wheel and powder factories	potteries	glass factories	
Chemicals	cement works	chemical works (ordinary)	soap and candle factories	match factories
Engineering	jewellery factories	engineering works including light metal works	aircraft factories excluding hangars, radio and television and electronic equipment factories, motor vehicle manufacturing and assembly plants	
Food and beverages	abattoirs, breweries (excluding bottling sections, maltings and cooperages) creameries and wholesale dairies	bakeries and biscuit factories, brewery bottling sections, brewery maltings and cooperages of non-combustible construction, confectionery factories, sauce, pickle and preserved foods factories	corn, flour and provender mills, sugar refineries	distilleries (still houses), oil mills (except areas where flammable solvents are stored)
Miscellaneous	restaurants and cafes		laundries, motor garages broadcasting studios and transmitting stations, brush factories, tanneries car parks (above or below ground)	theatres, film and television and studios
Paper			paper mills and paper goods factories, printing (and allied trades) works, wallcovering factories	
Rubber and plastics			plastics and plastics goods (excluding foamed plastics) factories, rubber and rubber goods factories (excluding foamed rubber), wallcovering factories	
Shops and offices	Offices (not high-rise) not meeting the requirements of 5.2 for light hazard		departmental stores and retail shops	
Textiles and clothing			bleach, dye and print works, boot and shoe manufacturers, carpet factories, clothing factories, cotton mills (excluding preparatory processes), flax, jute and hemp mills (excluding preparatory processes), hosiery and lace factories, shirt factories, woollen and worsted mills	cotton mills, (processes preparatory to spinning) flax, jute and hemp mills, processes preparatory to spinning, flax and hemp scutch mills
Timber and wood			Saw mills, woodworking and furniture (without foam upholstery) factories	

^a Where there is painting or such other areas of high fire load treat as group III.^b Warehouses generally, multi-storey and high-rise buildings to ensure flexibility.

Table 4 — Process high-hazards showing typical examples of types

Type 1	Type 2	Type 3	Type 4
floor cloth and linoleum manufacture paint, colour and varnish manufacture resin, lamp black and turpentine manufacture rubber substitute manufacture wood wool manufacture	fire lighter manufacture manufacture of category III (see Table 2) foam plastics, foam rubber, foam plastics goods manufacture and foam rubber goods manufacture excluding category IV (see Table 2) tar distilling	cellulose nitrate manufacture	firework manufacture

5.4.3 High-piled storage hazards. Goods including packaging, and stored so as to be likely to produce exceptionally intense fires with a high rate of heat release shall be classified as high hazard.

COMMENTARY AND RECOMMENDATIONS ON 5.4.3.

The reference height of goods used as the basis for design of the sprinkler system should be taken as:

- a) *for flat ceilings and roofs: the appropriate maximum given in Table 1, or the height 1 m below the ceiling or roof, whichever is the less; or*
- b) *for pitched roofs: either*
 - 1) *where the goods are not stacked above eaves height, the appropriate maximum given in Table 1, or the height 1 m below the ceiling or roof, whichever is the less; or*
 - 2) *where goods are stacked above eaves height, the appropriate maximum given in Table 1, or the height 1 m below the ceiling or roof, whichever is less.*

If goods are stored above this height the basis for design is invalidated.

5.4.4 Potable spirit storage hazard. Potable spirits not in racked barrels, stored to heights exceeding those given in column 3 of Table 1, shall be classified as high-piled goods storage categories II or III.

Potable spirit in racked barrels exceeding the ordinary-hazard class storage height specified in column 3 of Table 1 (reference S5) shall be classified as either:

- type S9, for double rack storage with aisles between, having walkways at various levels; or
- type S10, for continuous racking without aisles or walkways.

COMMENTARY AND RECOMMENDATIONS ON 5.4.4.

Additional sprinkler protection at intermediate levels is specified for type S9 exceeding 9.7 m storage height, and for type S10 exceeding 5.0 m storage height (see 14.5 and clause 26).

5.4.5 Oil and flammable liquid hazards.

Occupancies where oil and flammable liquids are stored or used in such quantities, and in such a manner, that standard sprinkler protection may not be effective shall be classified as oil and flammable liquid hazards.

COMMENTARY AND RECOMMENDATIONS ON 5.4.5.

A deluge installation with medium-and/or high-velocity sprayers may be effective against these hazards. Only some aspects of the design of such systems are considered in this specification (see 6.9).

5.5 Sprinkler installation variations

Special consideration shall be given to ordinary-and high-hazard occupancies where variations of the generally applicable requirements are specified.

COMMENTARY AND RECOMMENDATIONS ON 5.5.

Variations are specified for the following:

- a) *hazardous processes and explosion hazards (see 6.1.2, 12.5, 20.1.2.1 and 21.2.2.4);*
- b) *bleach, dye and textile print works, paper mills (see also Item (h) below), tanneries, premises or parts of premises where corrosive conditions exist (see 21.2.1.3, 22.1.2, 25.11 and 35.2.3);*
- c) *alkali plants, electroplating and galvanizing works, foundries, organic fertilizer plants, pickle and vinegar works (see 25.11 and 35.2.3);*
- d) *cold-storage warehouses (see 6.5.1.2, 6.5.3.3, 20.3.4, clause 23, 25.8, 26.6.4, Table 70 and 27.2);*
- e) *computer areas (see 6.1.2, 10.1.2, 20.1.4, 26.9.3 and 27.4.6);*
- f) *corn, rice, provender and oil mills (see Table 70 and 26.7.2);*
- g) *film and television production studios (see Table 70 and 26.9.1);*
- h) *papermaking machines (see 20.1.4 and 26.8.4);*
- i) *theatres and auditoria (see 4.2.2.3, 26.9.2 and Table 70);*
- j) *drying ovens and enclosed paint lines (see 25.7.4 and 26.7.7);*

k) *high-rise buildings (see 6.3.2, 6.3.4, 12.3, 13.2, 15.2.2.2, 17.3.2, 17.4.6.1, 17.4.6.3, 20.1.4, 20.3.1, 24.2.3.2, 27.1.1, 27.2.3, Table 3 and Table 28).*

6 Selection of installation type, size and design

6.1 General

6.1.1 Suitability. The type, size and design of each sprinkler installation used in the system shall be appropriate to the hazards covered by the installation.

6.1.2 Size of an installation. In addition to the size limits appropriate to types given in this clause an installation shall not cover more than the following:

- a) if protecting an explosion hazard, the containment area of the hazard; or
- b) if protecting a computer area, the computer area except where the installation includes a zone covering only the computer area.

6.2 Types

A sprinkler installation shall be based on one of the following main types:

- a) wet pipe;
- b) alternate (wet and dry pipe);
- c) dry pipe;
- d) pre-action;
- e) recycling.

COMMENTARY AND RECOMMENDATIONS ON 6.2.

Installations based on a) and/or b) of 6.2 may also include extensions of the following additional types:

- a) *tail-end alternate;*
- b) *tail-end dry pipe;*
- c) *deluge.*

Wet pipe installations are preferred. However if the temperature of the premises cannot be guaranteed to remain above freezing at all times an alternate installation should be fitted. Where only part of the premises may fall below 5 °C during the winter, a tail-end alternate extension should be installed in that part as an extension to the wet installation.

Where freezing or elevated temperatures are experienced either frequently or continuously a dry pipe installation should be installed, or only in small areas tail-end dry pipe extensions should be installed as extensions to the main installation. See 6.3 to 6.9 for the limits on size of the various types of installation.

Sprinkler installations may incorporate deluge systems to cover small areas of flammable liquid hazards such as oil-fired boiler rooms etc.

6.3 Wet pipe installations

6.3.1 General. Wet pipe installations shall only be installed where there is no danger at any time of the water in the pipes freezing, and where the temperature will not exceed 70 °C. Anti-freeze shall not be employed as a means of preventing the water freezing in the pipes.

COMMENTARY AND RECOMMENDATIONS ON 6.3.1.

Where non-freezing conditions cannot be ensured throughout the premises, unheated areas may be protected by a tail-end alternate wet and dry pipe system subject to the limits on number of sprinklers concerned given in 6.6, or by the use of dry upright or dry pendent sprinklers projecting into the low-temperature area or less preferably by the use of trace heating and lagging of the pipework.

BS 6351-3 gives recommendations for trace heating. BS 5422 and BS 5970 give recommendations for lagging.

6.3.2 Size of installations, sections and zones. The number of sprinklers in an installation, section or zone (including tail-end extensions (see 6.6) but not including sprinklers in concealed spaces or in machines etc.) shall not exceed the following.

- a) Light hazard: 500 per installation.
- b) Ordinary hazard:
 - 1) In single-storey buildings, or unheated service areas and car parks near or below ground level in multi-storey buildings, ordinary and/or high hazard inclusive of any light-hazard sprinklers on the same installation main control valve set: 1 000 per installation.
 - 2) In multi-storey buildings, and for high-rise systems, excluding unheated service areas and car parks near or below ground level: 500 per zone, or if an installation is not divided into zones, 1 000 per installation.
- c) High hazard: 1 000 per installation.
- d) Installations with intermediate level sprinklers
 - 1) Installations with only intermediate level sprinklers (i.e. fed from a set of installation control valves separate from the roof or ceiling sprinkler distribution pipework): 1 000 per installation.

- | | |
|--|--|
| 2) Installations with ceiling and intermediate level sprinklers: | 1 000 per installation of which not more than 50 shall be intermediate level protection. |
| e) In a life safety system: | 200 per zone or, for an installation not divided into zones, 200 per installation. |

6.3.3 Life safety

6.3.3.1 Sprinkler installations for life safety shall be of the wet pipe type and any tail-end extension shall comply with 6.6.

6.3.3.2 Sprinkler installations shall, if necessary, be arranged in zones; no unzoned installation or zone shall:

- a) cover an area under more than one ownership;
- b) cover more than one floor level, but this level may include additionally a mezzanine floor not exceeding 100 m² in area.

COMMENTARY AND RECOMMENDATIONS ON 6.3.3.2.

6.3.2 e) restricts the size of zones to 200 sprinklers.

6.3.4 High-rise buildings. The height difference between the lowest and highest sprinklers in an installation shall be not more than 45 m. The distribution pipes shall be independently connected to the main rise pipe at the floor they serve. No section shall extend to more than one floor and each section shall be served by a separate main rise pipe.

6.4 Alternate (wet and dry pipe) installations

6.4.1 General. Alternate installations shall only be installed where there is an intermittent danger of the water in the pipes freezing, for example, during the winter months, and where the ambient temperature does not exceed 70 °C.

COMMENTARY AND RECOMMENDATIONS ON 6.4.1.

Alternate installations are not recommended for the protection of high-hazard storage.

Areas where freezing conditions may be experienced at times when the installation is in the wet mode may be protected by a tail-end dry or alternate system, or with dry upright or dry pendent sprinklers projecting into the low-temperature area.

6.4.2 Mode of operation. Alternate installations shall be operated in the wet mode only when there is no danger of water in the pipes freezing. In the dry mode the installation shall be pressurized with air to within the pressure range recommended by the alarm valve manufacturer.

6.4.3 Size of installation

6.4.3.1 The number of sprinklers, including any in tail-end extensions, shall not exceed the following.

- | | |
|---|-----------------------|
| a) In a light-hazard installation with accelerator or exhauster: | 250 per installation. |
| b) In a light-hazard installation without accelerator or exhauster: | 125 per installation. |
| c) In an ordinary-and/or high-hazard installation with accelerator or exhauster: | 500 per installation. |
| d) In an ordinary-and/or high-hazard installation without accelerator or exhauster: | 250 per installation. |

6.4.3.2 The notional number of sprinklers, including any in tail-end extensions, shall not exceed the following.

- | | |
|--|-----------------------|
| a) In a combined light-and ordinary-hazard installation: | 500 per installation. |
| b) In a combined light-and high-hazard installation: | 250 per installation. |

The notional number shall be calculated as the actual number of ordinary-and/or high-hazard sprinklers plus twice the actual number of light-hazard sprinklers in the installation.

6.4.4 Sprinkler types. The installation shall be fitted with upright sprinklers, or dry pendent sprinklers.

6.5 Dry pipe installations

6.5.1 General

6.5.1.1 Dry pipe installations shall only be installed where the conditions are such that a wet pipe system or alternate installation cannot be used.

COMMENTARY AND RECOMMENDATIONS ON 6.5.1.

For example, wet pipe and alternate installations cannot be used in buildings where the temperature is artificially maintained close to or below 0 °C, such as in cold stores, fur vaults, etc., or where the temperature is maintained or may be raised above 70 °C such as in drying ovens, etc., and where the pipework cannot be run outside the cold or hot areas.

6.5.1.2 In cold-storage warehouses refrigerated by air circulation, automatic means shall be provided to automatically shut down the air circulation fans when the sprinkler system operates.

6.5.2 Charging pressure. The installation shall be pressurized with air to within the pressure range recommended by the alarm valve manufacturer.

COMMENTARY AND RECOMMENDATIONS ON 6.5.2.

A higher pressure may cause undesirable delay in water discharge.

6.5.3 Size of installation

6.5.3.1 The number of sprinklers shall not exceed the following.

- a) In a light-hazard installation with accelerator or exhaustor: 250 per installation.
- b) in a light-hazard installation without accelerator or exhaustor: 125 per installation.
- c) In an ordinary-and/or high-hazard installation with accelerator or exhaustor: 500 per installation.
- d) In an ordinary-and/or high-hazard installation without accelerator or exhaustor: 250 per installation.

6.5.3.2 The notional number of sprinklers (including any in tail-end extensions) shall not exceed the following.

- a) In a combined light-and ordinary-hazard installation: 500 per installation.
- b) In a combined light-and high-hazard installation: 250 per installation.

The notional number shall be calculated as the actual number of ordinary-and/or high-hazard sprinklers plus twice the actual number of light-hazard sprinklers in the installation.

6.5.3.3 In cold-storage warehouses with air circulation refrigeration where:

- a) the pipework is within the cold chamber; and
- b) the number of sprinklers excluding any sprinklers above a false ceiling exceeds 50;

each installation shall comprise two, three, four or five tail-end extensions each containing not more than 50 sprinklers plus any sprinklers in the plenum fed directly from the pipework below.

6.5.4 Sprinkler types. The installation shall be fitted with:

- a) upright sprinklers; or
- b) dry pendent sprinklers; or
- c) in cold-storage warehouses where the pipework is in the cold chamber, pendent sprinklers.

6.6 Tail-end alternate pipe and tail-end dry pipe extensions

6.6.1 General

6.6.1.1 Tail-end alternate extensions shall be installed only in comparatively small areas where there is a possible frost danger in an otherwise adequately heated building as extensions to wet pipe installations. They shall comply with the appropriate requirements of 6.4.

6.6.1.2 Tail-end dry extensions shall be installed only as the following:

- a) extensions to wet or alternate installations in high-temperature ovens or stoves; or
- b) extensions to wet, dry or alternate installations in buildings where freezing conditions may occur and with an air/gas pressure not less than the air/gas pressure between the main installation control valve and the tail-end valve.

They shall comply with the appropriate requirements of 6.5.

6.6.2 Size of tail-end extensions. The number of sprinklers on any tail-end extension shall not exceed 100. Where more than two tail-end extensions are controlled by one installation control valve set, the total number of sprinklers in the tail-end extensions shall not exceed 250.

6.7 Pre-action installations

6.7.1 General. There are two types of pre-action installation as follows:

- a) *Type 1*, which shall be installed only to prevent a premature discharge of water from pipework or sprinklers that have suffered mechanical damage; and
- b) *Type 2*, which shall be installed only to facilitate an early discharge of water from a dry pipe or alternate installation by opening the installation main control valve, thus filling the installation pipework with water, upon operation of a fire detection system.

COMMENTARY AND RECOMMENDATIONS ON 6.7.1. *Type 1 installations are appropriate to hazards where the cost or inconvenience of water damage may be exceptionally high. Because the sprinkler installation control valve opens only as a result of operation of the fire detection system much reservation should be exercised when considering the use of Type 1 installations. Where a pre-action installation is to be used for high hazard Type 2 should preferably be used. The fire detectors may be expected to signal the presence of fire at a early stage (before operation of any sprinkler) so that hand or manually operated appliances may well be successfully used to prevent sprinkler water discharge.*

Type 2 installations are appropriate to large alternate dry pipe sprinkler installations where rapidly developing intense fires may occur. The possible early detection of a fire by fire detectors will prime the sprinkler installation with water, so that discharge will not be delayed when a sprinkler or sprinklers operate. Failure of the fire detector system does not prevent normal operation of the sprinkler installation.

For high-hazard occupancies Type 2 is preferable to Type 1.

Because they are more complicated, pre-action installations should be used only where a wet, dry or alternate system would be unsuitable. The detection system should be installed as recommended in BS 5839-1.

6.7.2 Mode of operation

6.7.2.1 The sprinkler installation pipework shall be normally charged with air under pressure, and monitored to give a warning indication on reduction of the air pressure. Complete loss of air pressure shall initiate the visual and audible indications for a fire alarm (see clause 27).

6.7.2.2 The fire detection system shall automatically give an alarm on operation and shall operate a continuously energized valve or other trip mechanism, suitable for sprinkler service, to release (Type 1) or prime (Type 2) the pre-action alarm valve when the valve or trip mechanism becomes de-energized.

6.7.3 Sprinkler head orientation. In type 1 installations, sprinklers shall be installed in the upright position or only in a building free from the danger of freezing, in the upright or pendent position. In type 2 installations, sprinklers shall be installed in the upright position.

6.7.4 Size of pre-action installations. The number of sprinklers shall not exceed the following.

- | | |
|--|-------------------------|
| a) In a light-hazard installation: | 500 per installation. |
| b) In an ordinary-hazard installation: | 1 000 per installation. |
| c) In a high-hazard installation: | 1 000 per installation. |

6.8 Recycling installations

6.8.1 General. Recycling installations shall only be installed where it is necessary for the following reasons:

- to restrict water damage after a fire is extinguished;
- to avoid closure of the main installation stop valve if modifications are made to the installation pipework or if sprinkler heads are to be replaced;
- to prevent water damage caused by accidental mechanical damage of the installation pipework or sprinklers.

The heat detectors and control equipment shall be suitable for use in recycling pre-action sprinkler installations.

COMMENTARY AND RECOMMENDATIONS ON 6.8.1. *Heat detectors used in this application may be exposed to flame during the course of the on/off cycling process, and it is therefore essential that the operating temperature characteristics do not change during the course of a fire incident.*

The requirements detailed in b) above may only be met if a safe working practice can be devised to meet the contingency that the installation may operate while work progress (see 7.4). Full details of the practice should be provided at the planning stage.

6.8.2 Mode of operation

6.8.2.1 Water discharge cycling shall be controlled by heat detectors installed at the roof or ceiling which operate as an electrical interlock causing a water flow control valve to open and close. A timer shall be provided to delay closure of the flow control valve for a predetermined period in each cycle after lowering of the temperature of the heat detectors.

COMMENTARY AND RECOMMENDATIONS ON 6.8.2.1. *A 5-min delay is recommended.*

6.8.2.2 The flow control valve, monitoring devices, and the electrical interlock system shall be suitable for sprinkler use.

COMMENTARY AND RECOMMENDATIONS ON 6.8.2.2. *Closure of the flow control valve during the automatic cycling sequence should not cause excessive water hammer.*

6.8.2.3 Heat detectors to operate the installation flow control valve cycling sequence shall be provided at the roof or ceiling as specified in BS 5839-1.

6.8.3 Sprinkler head orientation. Where there is a danger of freezing, sprinklers shall be installed in the upright direction.

COMMENTARY AND RECOMMENDATIONS ON **6.8.3.**
Where there is no danger of freezing, sprinklers may be installed in the upright or pendent position.

6.8.4 Size of recycling installations. The number of sprinklers shall not exceed 1 000 per installation.

6.9 Deluge installations

6.9.1 General. Deluge installations shall be installed only where it is necessary to apply water over an entire area in which a fire may originate.

6.9.2 Mode of operation. The installation shall be provided with the following:

- a) a manual release; and/or
- b) an automatic release, which shall be either:
 - 1) a multiple control or controls; or
 - 2) a deluge valve;

to initiate discharge.

COMMENTARY AND RECOMMENDATIONS ON **6.9.2.**
A manual release should only be provided where a process is continuously supervised by personnel, and where the disruption caused by unwanted discharge may be excessive. Installations without an automatic release should be used for small area protection only. A multiple control should only be used for small areas of hazard. The area is limited because fire detection is possible only at the multiple control, and also by the water-carrying capacity of the multiple control. The number of detection points may be increased by the use of two or more controls delivering water into a ring pipework arrangement feeding all of the open sprayers in the installation.

6.9.3 Pipework. Pipework shall be fully hydraulically calculated (see clause **18** and **24.3**).

The installation pipework shall drain automatically after operation, by means not involving excessive loss of water during normal operation.

COMMENTARY AND RECOMMENDATIONS ON **6.9.3.**
*Design densities and AMAOs for process hazards are specified in **14.4.1**. Design densities and AMAOs for oil and flammable liquid hazards are not given in this specification.*

7 Hazard to personnel

7.1 High-temperature liquids

Sprinklers shall not be installed in locations where water discharge from sprinkler heads or sprayers, or water leakage from installation pipework, may come into contact with high-temperature liquid baths such as salt baths, metal melt pans, frying ranges, hot dip bitumen baths etc.

COMMENTARY AND RECOMMENDATIONS ON **7.1.**
Water falling into the bath would produce steam and might cause dangerous splashing or overflow of the bath contents. It may be possible to fit sprinkler heads or sprayers and pipework above such locations if adequate shielding of water discharge, drainage and leakage is provided. In either event consideration should be given to the need for alternative forms of fire protection in these areas.

7.2 Water reactive chemicals

The consequences of sprinkler water discharge onto water reactive chemicals below shall be considered and safe storage and usage practices adopted.

COMMENTARY AND RECOMMENDATIONS ON **7.2.** *Water discharge may ignite certain chemicals, or cause a violent reaction and/or emission of poisonous or noxious fumes.*

Where water run-off from sprinkler discharge may be dangerous owing to contact with water-soluble chemicals or by waterborne dispersion of hazardous materials, construction of suitable drains, sumps, bunds etc. should be considered at the planning stage.

BS 5908 gives advice on these matters.

7.3 Electrical earthing

7.3.1 All exposed metalwork in systems shall be efficiently earthed to prevent the metalwork becoming electrically charged.

7.3.2 Sprinkler pipework shall not be used as a means of earthing electrical equipment.

COMMENTARY AND RECOMMENDATIONS ON **7.3.**
Electrical equipment below sprinkler installations should have normal earthing and overload protection.

Where the electrical installation is covered by the Regulations for Electrical Installations (Wiring Regulations 15th edition⁴) the sprinkler system metalwork should be efficiently connected to the main earthing terminal of the electrical installation, as required by the Wiring Regulations (15th edition).

⁴ Available from Institution of Electrical Engineers, Publications Sales Department, Station House, Nightingale Road, Hitchin, Herts. SG5 1RJ.

7.4 During maintenance

Where sprinkler or deluge installation pipework is normally unpressurized, work shall not be undertaken involving removal or fitting of sprinkler heads or water sprayers when operation of the installation is possible unless measures are taken to ensure the safety of the erection personnel concerned.

Section 3. Contract arrangements

8 Contract drawings/information documents

8.1 General

The information specified in 8.2 and 8.3 shall be provided to the user, together with details of the authorities consulted (see 3.1) and any response to the consultation.

All drawings and information documents shall carry the following information:

- a) the name of the user and the owner;
- b) the address and location of premises;
- c) the occupancy of each building;
- d) the name of the designer;
- e) the name of the checker, who shall not be the designer.

COMMENTARY AND RECOMMENDATIONS ON 8.1.
Drawings should follow the recommendations of BS 1192 and use the symbols of BS 1635. The authorities may wish to be provided with some, or all of this, or other information.

8.2 Preliminary or estimating stage

The information provided shall include the following:

- 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 stock 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; and
- c) particulars of the water supplies, which if a 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 installation will comply with this specification including details of any deviation(s) from its recommendations with reasons for the deviation(s).

8.3 Design stage

8.3.1 General. The information provided shall include a summary schedule (see 8.3.2), complete working drawings of the sprinkler installation(s) (see 8.3.3) and details of the water supplies (see 8.3.4).

8.3.2 Summary schedule. The summary schedule shall give the following information:

- a) the name of the project;
- b) all drawing or document reference numbers;
- c) all drawing or document issue numbers;
- d) all dates of issue of drawings or documents;
- e) all drawing or document titles;
- f) the number of sprinklers on each installation control valve set;
- g) the height of the highest sprinkler on each installation control valve set;
- h) the type(s) of installation(s) and the nominal diameter(s) of the main control valves;
- i) the number or reference of each installation main control valve set in the system;
- j) a statement that the system will comply with this specification including details of any deviation(s) from its recommendations with reasons for the deviation(s).
- k) a list of the components suitable for sprinkler use, included in the system each identified by manufacturer's name and model/reference number.

8.3.3 Installation layout drawings

8.3.3.1 General. The scale shall be not less than 1 : 100. Layout drawings shall include the following information:

- a) north point indication;
- b) the class or classes of installation according to hazard class including stock category and design storage height;
- c) constructional 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, fluorescent light fittings, heaters, suspended open cell ceilings etc. which may adversely affect the sprinkler distribution;
- g) the sprinkler type(s) and temperature rating(s);
- h) the location and type of main control valves and location of alarm motors and gongs;
- i) the location and details of any water flow, and air or water pressure, alarm switches;

- j) the location and size of any tail-end air valves, subsidiary stop valves and drain valves;
- k) the drainage slope of the pipework;
- l) the location and specification of any orifice plate;
- m) a schedule listing the numbers of sprinklers, medium- and high-velocity sprayers etc., and the area of protection;
- n) a key to the symbols used.

8.3.3.2 Precalculated pipework. For precalculated 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 29);
- b) a summary of the pressure losses between the control valve and the design points at the following design rates of flow.

- 1) In a light-hazard installation: 225 L/min.
- 2) In an ordinary-hazard installation: 1 000 L/min.
- 3) In a high-hazard installation: the flow corresponding to the appropriate design density given in Table 16, Table 17, Table 18 or Table 19.

The calculation as specified in 24.2, showing that:

- i) in light- and ordinary-hazard installations, for each run of distribution pipework

$$P_f - P_h$$

is not more than the appropriate value specified in 24.2; and/or

- ii) In high-hazard installations designed using Table 60 or Table 61

$$P_f + P_d + P_s$$

is not more than the residual pressure available at the control valves 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 16, Table 17, Table 18 or Table 19 as appropriate;
- P_f is the frictional pressure loss in the distribution pipework between the design point and the control valve "C" gauge;
- 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; and

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.

COMMENTARY AND RECOMMENDATIONS ON 8.3.3.2.

A typical summary is shown in Figure 4. The relevant layout drawing should also be supplied.

For light- and ordinary-hazard installations with precalculated pipework the pressure needed at the design point is not stated. Instead the friction loss in the pipework between the control valve and the design points is limited to a predetermined quantity, incorporated in the value specified for pressure at the control valves in section 4. Static head is added to this pressure to give the value defining the minimum actual water supply running pressure.

8.3.3.3 Hydraulically calculated pipework. For hydraulically calculated pipework (see 24.3), the following shall be given, with detailed calculations, either on purpose-designed work sheets or as a computer print-out:

- a) for each design area of operation:

- 1) the area identification;
- 2) the hazard class;
- 3) the specified density of discharge (in mm/min);
- 4) the assumed area of maximum operation (AMAO) (in m²);
- 5) the number of sprinklers in the AMAO;
- 6) the sprinkler nominal orifice size (in mm);
- 7) the maximum area covered per sprinkler (in m²);
- 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 AMAO;
 - iii) the position of the hydraulically most favourable AMAO;
 - iv) the four sprinklers upon which the design density is based (see 24.3.4);
 - v) the height above datum of each point of identified pressure value.

- b) for each operating sprinkler:

- 1) the sprinkler node or reference number;
- 2) the sprinkler nominal k factor;
- 3) the flow through the sprinkler (in L/min);
- 4) the inlet pressure to the sprinkler or sprinkler assembly (in bar);

c) for each hydraulically significant pipe:

- 1) the pipe node or other reference;
- 2) the pipe nominal bore (in mm);
- 3) the Hazen-Williams constant, C , or the k factor, for the pipe (see Table 36);
- 4) the flow through pipe (in L/min);
- 5) the nominal fluid velocity (in m/s);
- 6) the length of pipe (in m);
- 7) the numbers, types and equivalent lengths of fittings;
- 8) the static head change in pipe (in m);
- 9) the pressures at inlet and outlet of pipe (in bar);
- 10) the friction loss in pipe (in bar);
- 11) the indication of flow direction.

COMMENTARY AND RECOMMENDATIONS ON 8.3.3.3.

A line diagram of the pipe layout should be prepared showing the following:

- i) the node or pipe reference numbers;
- ii) the distribution pipes;
- iii) the range pipes;
- iv) the sprinkler heads under consideration;
- v) the four hydraulically most unfavourably placed heads (see 24.3);
- vi) the flow through, and pressure at the end of, each hydraulically significant pipe.

8.3.4 Water supply

8.3.4.1 Water supply drawings. The drawings shall show water supplies and pipework therefrom up to the installation control valves. The drawings shall be on an indicated scale of not less than 1 : 100. A key to the symbols shall be included. The position and type of stop and check valves and any pressure reducing valve, water meter, water lock, orifice plate and any connection supplying water for other services (see 12.3), shall be indicated.

8.3.4.2 Hydraulic calculation. An hydraulic calculation (with relevant flow tests) shall show that each trunk main together with any branch main, from each water supply to a main installation control valve set water supply test and drain valve and control valve “C” gauge (i.e. including the installation control valves) is capable of providing the required pressure and flow at the installation control valve test and drain valve.

8.3.4.3 Town main. Where a town main forms one or both of the supplies or provides infill to a suction tank type C (see 17.1.4) 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 test at a period of peak demand. 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 installation control valve.

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

f) a modified pressure-flow characteristic graph [see 8.3.4.3 c)] indicating the usable pressure at any flow up to the maximum installation demand;

g) the demand pressure-flow characteristic graph for each installation for the hydraulically most unfavourable (and if required the most favourable) AMAO with pressure taken as at the control valve “C” pressure gauge.

8.3.4.4 Automatic pump set. Where automatic pump sets form one or more of the water supplies a pump characteristic curve for low water level “X” (see Figure 23) shall be provided. The curve shall show the estimated performance of the pump or pumps under installed conditions at the control valve “C” gauge.

In addition where the pipework is fully hydraulically calculated the following details of the automatic pump set shall be provided:

- a) the pump manufacturer’s data sheet showing the following:
 - 1) the generated head graph;
 - 2) the power absorption graph;
 - 3) the net positive suction head (NPSH) graph;
 - 4) a statement of the power output of each prime mover.
- b) the installers’ data sheet showing the pump set installed performance pressure-flow characteristics, at the control valve “C” gauge for normal water level and for low water level “X” (see Figure 23), and at the pump outlet pressure gauge for normal water level;
- c) the height difference between the control valve “C” gauge and the pump delivery pressure gauge;
- d) the installation number and the hazard classification(s);

Statement of distribution pipe losses between the various design points and the installation valves

HAZARD GROUP: ORDINARY HAZARD DESIGN FLOW RATE: 1000 L/min.

NAME & ADDRESS: A.B. CEE COMPANY, DEE LANE, ENDING

1	2	3	4	5	6	7		
Run of distribution pipe from valves to (letter)	Pipe size	Pipe length	No. of turns	Equiv. pipe length of turns	Total equiv. length of pipe	Pressure loss at design flow rate		
						Pipe losses	Static head gain (Ph)	Difference
	mm	m		m	m	mbar	mbar	mbar
A-FLOOR 3	65	3.5	—	—	3.5	122		
	80	7	—	—	7	111		
	100	49	2	6	55	240		
						473		
							0	473
B-FLOOR 3	65	7	—	—	7	243		
	80	1.9	—	—	1.9	30		
	100	20	1	3	23	101		
						374		
							0	374
C-FLOOR 2	65	10.5	—	—	10.5	365		
	80	16.9	—	—	16.9	268		
	100	28.3	2	6	34.3	150		
						783		
							380	403
D-FLOOR 2	65	8.8	—	—	8.8	306		
	80	—	—	—	—	0		
	100	16.3	1	3	19.3	84		
						390		
							380	10
E-FLOOR 1	65	10.5	—	—	10.5	365		
	80	38.9	2	6	44.9	712		
	100	2.5	—	—	2.5	11		
						1088		
							760	328
F-FLOOR 1	65	8.9	—	—	8.9	309		
	80	9.9	1	3	12.9	205		
	100	2.5	—	—	2.5	11		
						525		
							760	
IN ALL SECTIONS THE PRESSURE LOSS IN THE DISTRIBUTION PIPE IS LESS THAN 500mbar								-235

NOTE The pressure drop caused by any orifice plate in the distribution pipework should be taken into account by a corresponding reduction of the static head gain.

Figure 4 — Typical statement of pressure loss calculations

e) the demand pressure-flow characteristic for the hydraulically most unfavourable and most favourable AMAO, calculated at the control valve "C" gauge as specified in clause 24;

f) the available and the specified NPSH at maximum predicted flow ($Q_{\max}$; see Figure 20).

COMMENTARY AND RECOMMENDATIONS ON 8.3.4.4.
Typical examples of pump manufacturer's data sheets are shown in Figure 5. Figure 20 is an illustration of an installer's data sheet.

9 Work on site

9.1 Care of materials on site

Components shall be properly stored on site until required for installation.

COMMENTARY AND RECOMMENDATIONS ON 9.1.
Unloading, stacking and storage should be carried out with care to prevent damage to pipes and pipe threads, valves and sprinklers, gauges and any pumps and power units used in the system.

Components should be stored so that they are not damaged by building operations. Site locations should be prepared in advance of delivery so that heavy items such as fire pumps, strainers and pressure tanks can be transported directly to their final locations.

Pipes should be protected (for example by caps) against entry of foreign matter such as rubble, cordage, etc. into the bore, and they should be examined for such matter immediately prior to erection. Open ends of pipes should be capped as building construction proceeds.

Sprinklers, controls and sprayers should preferably be fitted to pipes in situ. Where fabricated ranges are used the sprinklers may be fitted immediately before erection using pipe racks to hold the ranges off the ground.

9.2 Fire protection of buildings under construction or modification

9.2.1 General. Work on the system shall proceed with the progress of the building. Installations and zones shall be made operational as soon as is practical.

COMMENTARY AND RECOMMENDATIONS ON 9.2.
It is particularly important that there should be no storage of combustible materials within any area of the building below, or more than 7.5 m above, ground level until the installation in that area is operational.

Huts erected within the building should be as follows:

a) made of non-combustible materials and, if the contents are combustible, protected by portable fire extinguishers (see BS 5306-3);

b) sited not less than 6 m from each other or from any combustible material store;

c) not sited on floors below, or more than 7.5 m above, ground level

9.2.2 Hot work. Suitable precautions shall be taken when carrying out hot work.

COMMENTARY AND RECOMMENDATIONS ON 9.2.2.
The precautions outlined in Appendix C should be taken.

The user should notify the insurers of the premises and contents before work commences. Occupiers of communicating and/or neighbouring buildings (see 4.1) should be advised that hot work is to be carried out.

See 21.3 for welding procedures.

10 Commissioning and acceptance tests

10.1 Commissioning tests

10.1.1 Installation pipework. All installation pipework shall be pressure tested hydraulically to not less than:

a) 15 bar; or

b) 1.5 times the working pressure;

whichever is the greater, for not less than 1 h. Any faults disclosed, such as permanent distortion, rupture or leakage shall be corrected and the test repeated.

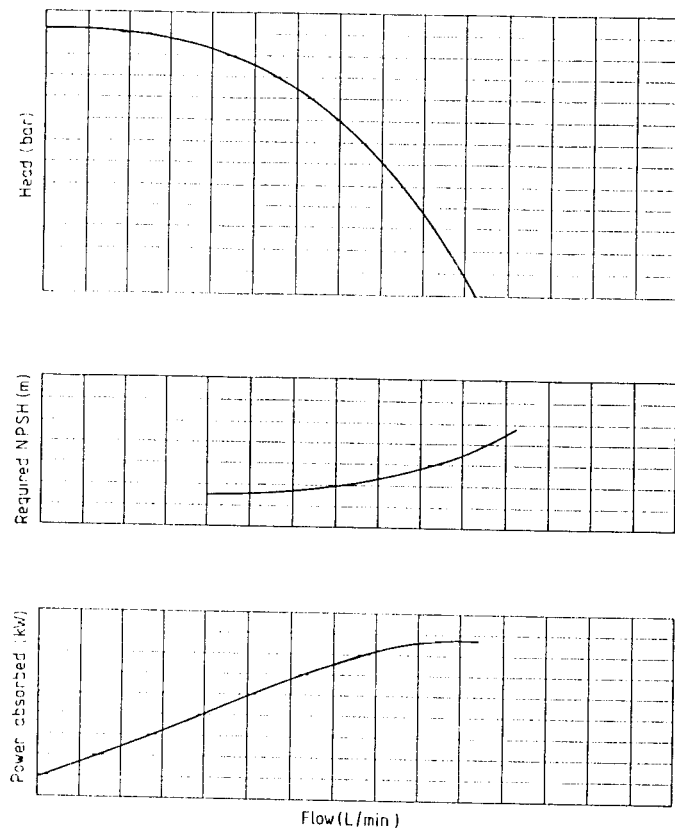
COMMENTARY AND RECOMMENDATIONS ON 10.1.1.
An initial pneumatic test is advisable where special conditions apply, for example in water-sensitive areas such as computer suites, or cold stores or other places where the hydraulic test will require that the protected area be non-functional.

10.1.2 Initial testing to regular routine procedures. The system shall be tested as specified in 34.2, 34.3 and 35.2, i.e. making the tests which will be made on a routine daily, weekly and quarterly basis, and any faults shall be corrected.

10.2 Acceptance tests

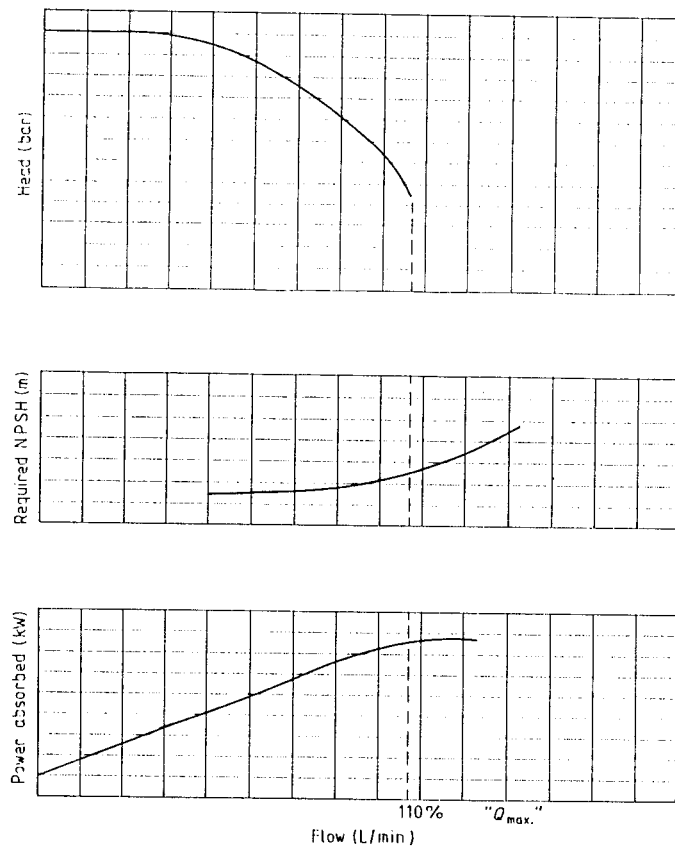
10.2.1 The authorities shall be invited to witness the tests specified in 10.2.2 and to inspect the system.

10.2.2 Water supplies shall be tested as specified in clause 19, and diesel engine driven pumps shall be tested as specified in 17.4.13.11 b) and 35.4.3.



Pump details			Driver details		
Model			Manufacturer and model		
Nominal rating	L/min	bar			
Maximum flow (NPSH = 5.38 m)			Rated power output		
Maximum power absorbed			Speed	RPM	Insulation class

a) electrically driven



Pump details			Driver details		
Model			Manufacturer and model		
Nominal rating	L/min	bar			
Maximum flow (NPSH = 5.38 m)			Rated power output		
Maximum power absorbed			Speed	RPM	

b) diesel driven

Figure 5 — Typical pump data sheet

10.3 Completion certificate and documents

10.3.1 General. The installer of the system or his supervising supplier shall provide to the user the following:

- a) a completion certificate (see Figure 6) stating that the system complies with all appropriate requirements of this standard, and giving details of any departure from appropriate recommendations; and
- b) a copy of the independent laboratory test report where pipe assemblies do not comply with the recommendations of **22.1.3**;
- c) a complete set of operating instructions and as-installed drawings including identification of all valves and instruments used for testing and operation and a user's programme for inspection and checking (see clause **34**); and
- d) if requested by the user a certificate giving the results of in-situ testing of pipe fasteners (see **22.7.1**).

10.3.2 Components suitable for sprinkler service. If requested by the user appropriate certificates stating that components used in the system are suitable for sprinkler service shall be provided.

COMMENTARY AND RECOMMENDATIONS ON **10.3.2**.

For the purposes of inspection the purchaser or his representative may request access to the component manufacturer's works.

For some components it may be possible to consider the desirability of independent certification of product conformity with a British Standard coupled with assessment of a supplier's quality system against the appropriate Part of BS 5750.

11 Extension and alteration of sprinkler systems

Any addition, extension, alteration or repair to a sprinkler system complying with this specification shall be carried out following the requirements and recommendations of this specification.

COMMENTARY AND RECOMMENDATIONS ON

CLAUSE 11. *After completion of the work the restored system should comply with this specification.*

*The consultation procedures of **3.1** apply. Any addition, extension, alteration or repair to a sprinkler installation should be carried out by the installer or his agent.*

COMPLETION CERTIFICATE

We (name of sprinkler engineers) _____
 of _____
 hereby certify that we have completed on (date) _____
 an automatic sprinkler installation/s designed and erected in accordance with all
 the appropriate requirements and, except as detailed here, recommendations of
 BS 5306 : Part 2

Details of alternatives provided in lieu of recommendations

Name of client _____

Address of protected premises _____

Buildings protected	Hazard class*	Installation No.	No. of sprinklers

Extra high hazard areas

High piled storage (if any), (type, height and location) _____

Water supplies

The following water supplies have been provided:

* Town main (Primary) Diameter _____ mm

* Town main (Secondary) Diameter _____ mm

* Elevated private reservoir Capacity _____ m³

* Gravity tank _____ Capacity _____ m³

(If sole supply)

Rate of replenishment by town main

_____ L/hr

Delete where not applicable
 † Pump Motive power _____
 Nominal rating _____
 L/min _____ bar _____
 Drawing water from _____

† Pressure tank Total capacity _____ m³
 Ratio air to water _____
 Required air pressure (taking into
 account any losses referred to below) _____

Delete whichever not applicable
 * These supplies were tested on (date) and met/did not meet the
 relevant requirements of BS 5306 : Part 2 for pressure and flow
 for each hazard class. Particulars are set out in the attached test
 data sheet.

† The pressure losses under the flow conditions for the respective
 hazard class in the pipework and fittings check valves and alarm
 valves between the pump or pressure tank and the various
 installation pressure gauges (gauge 'C') are calculated to be as
 follows:

Installation No.	Pressure losses in bar*
No.	
No.	
* Including pipework, fittings, check valves and alarm valves.	

Date _____ Signature _____

WATER SUPPLIES TEST DATA SHEET

accompanying Completion certificate in respect of sprinkler systems

completed on _____ for

Name of client _____

Premises protected _____

Instal- lation No.	Water supply	Hazard class	Test requirements		Installation C gauge reading			
			Flow	Pres- sure	(a) under test con- ditions	(b) with drain valve fully open	(c) after tests com- pleted (stand- ing pres- sure)	Static pressure loss between installation gauge and highest sprinkler in hazard class area (pre- calculated systems only)
			L/min	bar	bar	bar	bar	bar

Note. Where an installation protects more than one hazard class the static pressure loss is that between the installation gauge and the highest sprinkler in the particular hazard class.

Static pressure loss values are not given for hydraulically calculated systems; the required pressure at the C gauge includes the static loss component.

TEST APPARATUS. The test apparatus used in the above tests complied with the appropriate requirements of BS 5306 : Part 2.

INSTALLED TEST ORIFICES. Test orifices, complying with the appropriate requirements of BS 5306 : Part 2, have been fitted to the following ordinary-hazard installations, and have the following k factors:

Installation No.	k factor

Figure 6 — Typical completion certificate and test data sheet

Section 4. Water supplies

12 General

12.1 Reliability

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

COMMENTARY AND RECOMMENDATIONS ON 12.1.1.

The flow from town mains to the sprinkler system may be reduced by fire brigade operations.

Water supplies should preferably be under the control of the user, or guaranteed by the organization having control. The pressure and flow capacity of town mains are not guaranteed by water authorities.

WARNING. *Where an installation has a town main supply a reduction in pressure may have adverse consequences. Stored water supplies provide more security in this respect.*

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

12.2 Quality

Water supplies for sprinkler installations shall be free from suspended fibrous or other matter which may accumulate in the system pipework.

Salt or brackish water shall not be retained in sprinkler installation pipework.

COMMENTARY AND RECOMMENDATIONS ON 12.2.

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

12.3 Connections supplying water for other services

Water for other services shall be taken from a sprinkler system only in accordance with the following:

- a) through a stop valve, fitted upstream of the installation control valve set(s), as close as is practical to the point of connection to the sprinkler system supply pipe; and
- b) if the system is not a high-rise system; and
- c) if the system is not protecting a multi-storey building;
- d) as specified in Table 5.

The sprinkler system pumps and water source shall be separate from any hydrant system pumps and water source.

COMMENTARY AND RECOMMENDATIONS ON 12.3.

The water authority will not normally allow water for non-sprinkler use to be taken from sprinkler installation supply pipes, and where allowed will require such use to be metered (see Commentary and recommendations on 3.1).

See 31.3 for marking of connections for other services.

Preferably the water supply to fire hose reels should be such that the hose reels and the sprinkler system are simultaneously not out of service during maintenance.

12.4 Ring mains

Where sprinkler systems are fed by a ring main supply pipe arrangement on the premises, any isolating valves on the ring main shall be of the interlocking key type.

COMMENTARY AND RECOMMENDATIONS ON 12.4.

Isolating valves positioned at various suitable points on a ring main enable the supply to be maintained to the maximum possible extent in the event of fracture or other need to close down part of the ring main.

12.5 Housing of equipment for water supplies

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.

13 Types of water supply

13.1 Low-rise systems

13.1.1 Selection of suitable supplies

13.1.1.1 Light- and ordinary-hazard occupancies.

Systems for light- and ordinary-hazard occupancies shall be provided with the following:

- a) a single supply complying with 13.1.2; or
- b) a superior supply complying with 13.1.3; or
- c) duplicate supplies complying with 13.1.4.

COMMENTARY AND RECOMMENDATIONS ON 13.1.1.

Wherever practical a superior supply or duplicate supplies should be provided.

13.1.1.2 High-hazard occupancies. Systems for high-hazard occupancies shall be provided with the following:

- a) a superior supply complying with 13.1.3; or
- b) duplicate supplies complying with 13.1.4.

13.1.1.3 Provision of fire brigade inlet. Systems supplied only from a pressure tank and/or a gravity tank and/or a pump suction tank shall, if possible, be fitted with a fire brigade inlet.

COMMENTARY AND RECOMMENDATIONS ON 13.1.1.3.

It is strongly recommended that a fire brigade inlet be fitted to all systems to allow the brigade to pump water into the system using their own equipment.

The water authority will not normally allow a fire brigade inlet on systems with town main supplies, because water from the inlet could enter the town main.

Table 5 — Connections for water for other services in low-rise systems

Water supply type	Acceptable number, size and purpose of connection(s)
<i>Single or superior supplies</i>	
Town main. Main and supply pipe not less than 100 mm	one, not more than 40 mm, for non-industrial use or one, not more than 50 mm, for fire hose reels, to which may be made a further connection (close to the first connection, and fitted with a stop valve close to the feed end), not more than 40 mm, for non-industrial use
Elevated private reservoir, gravity tank or automatic pump	one, not more than 50 mm, for fire hose reels
<i>Duplicate supplies</i>	
Elevated private reservoirs gravity tanks, or automatic pumps in any combination	any number, each not more than 50 mm, for fire hose reels
Duplicate town mains	any number, each not more than 50 mm, for fire hose reels to one of which may be made a further connection (close to the first connection fitted with a stop valve, feed end), not more than 40 mm, for non-industrial use
Duplicate supplies, where one is a pressure tank with automatic maintenance of pressure and water level	one, not more than 50 mm, for fire hose reels
NOTE Connections to high-rise and multi-storey systems for other services do not comply (see 12.3).	

13.1.2 Single supplies. A single supply shall be one of the following:

- a) a town main complying with 17.1.1; or
- b) a single automatic suction pump, drawing water from a source complying with 17.4.3.1; or
- c) a single automatic booster pump, drawing water from a town main complying with 17.1.1.

13.1.3 Superior supplies. A superior supply shall be one of the following:

- a) a town main; or
- b) two automatic suction pumps drawing water from a suction tank complying with 17.4.3.2; or
- c) two automatic booster pumps; or
- d) an elevated private reservoir; or
- e) a gravity tank; or
- f) for light- and/or ordinary-hazard group I occupancies only, a pressure tank.

COMMENTARY AND RECOMMENDATIONS ON 13.1.3.
Typical superior supply arrangements are shown in Figure 7 to Figure 11.

13.1.4 Duplicate supplies. Duplicate supplies shall include at least one of the suitable combinations given in Table 6. The supply pipes from each source shall be joined into a common trunk main at a point as close as possible to the protected premises.

The common trunk main shall neither: traverse ground not under the control of the user; nor be under a public roadway.

COMMENTARY AND RECOMMENDATIONS ON 13.1.4.
The common trunk main may serve more than one installation in a system. Typical duplicate supplies are shown in Figure 12 to Figure 18. In general water authorities will not permit a town main to form a duplicate supply with another source except another town main or pressure tank. In the latter case special conditions may be applied by the water authority.

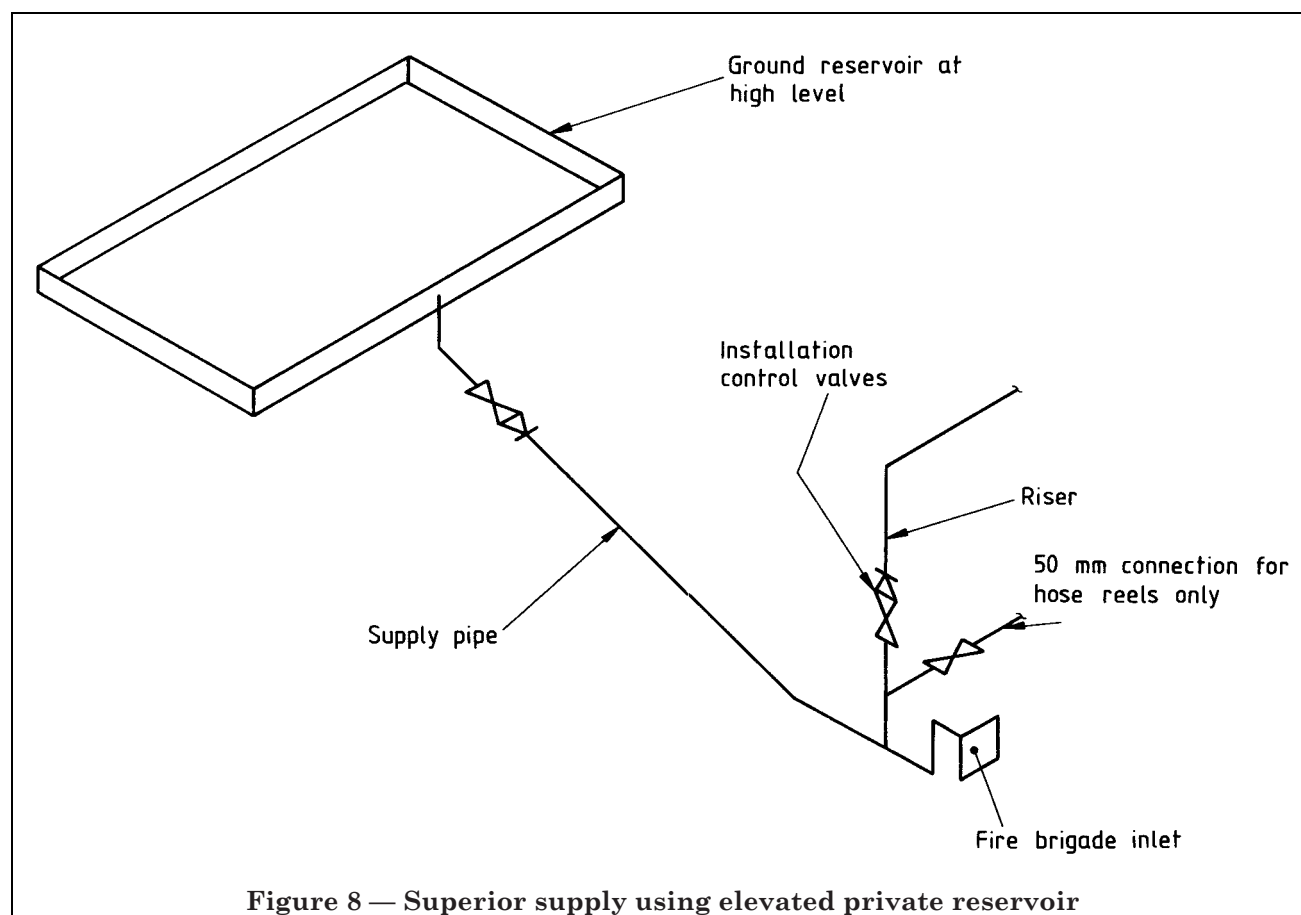
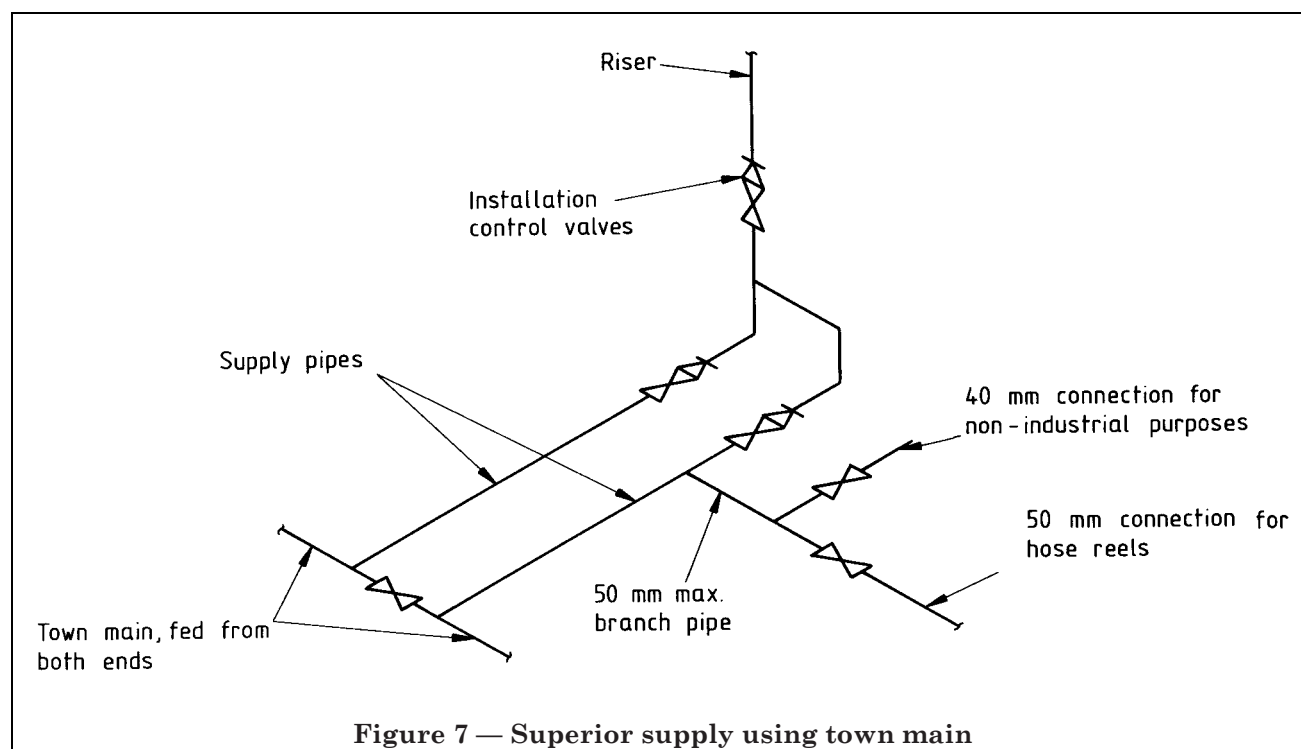
13.2 High-rise systems

The water supply for a high-rise system shall be either:

- a) a gravity tank; or
- b) an automatic suction pump arrangement in which each installation is served by either a separate pump or a separate stage of a multistage pump.

13.3 Life safety systems

Life safety systems shall be provided with duplicate water supplies conforming to 13.1.4.



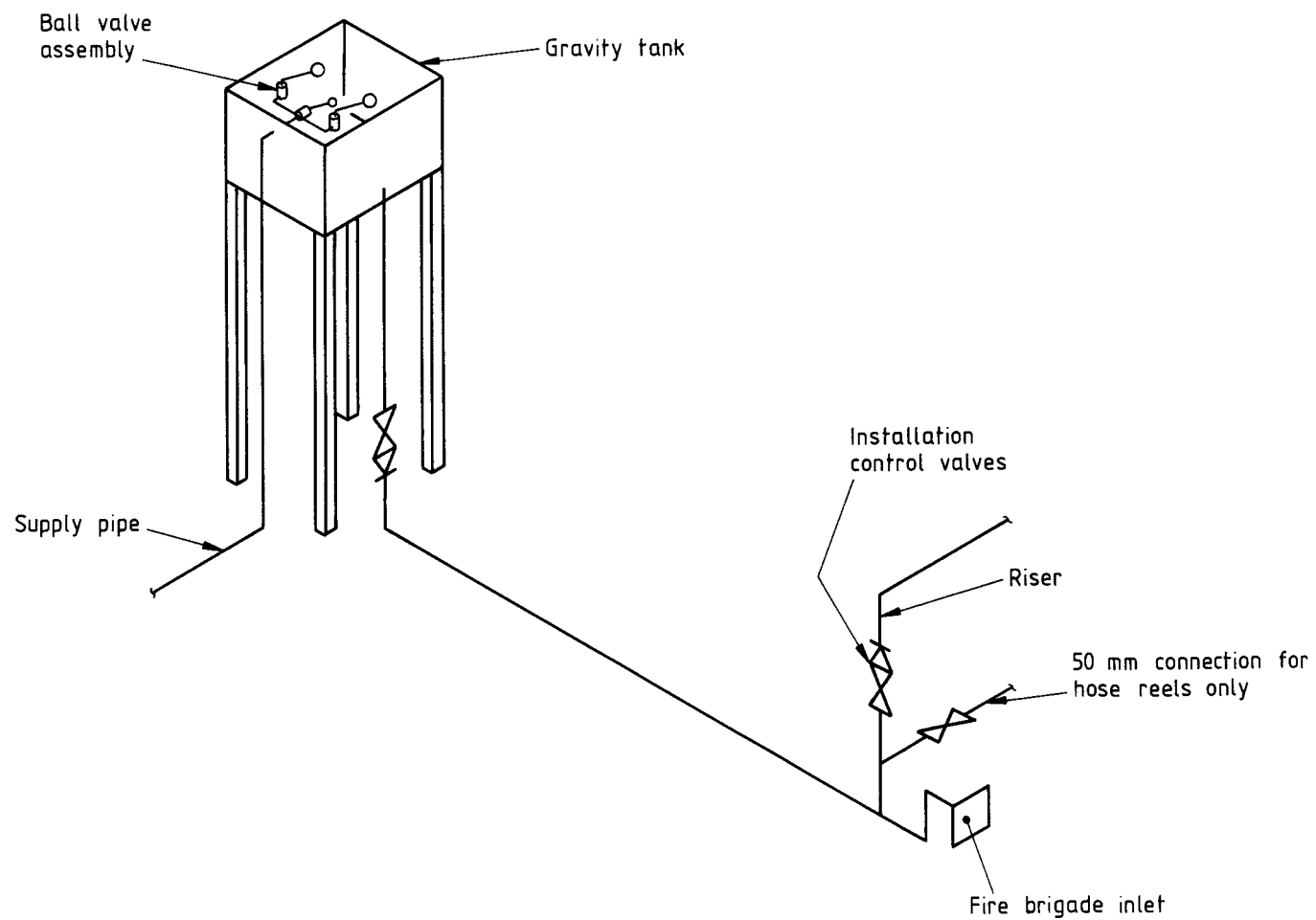


Figure 9 — Superior supply using gravity tank

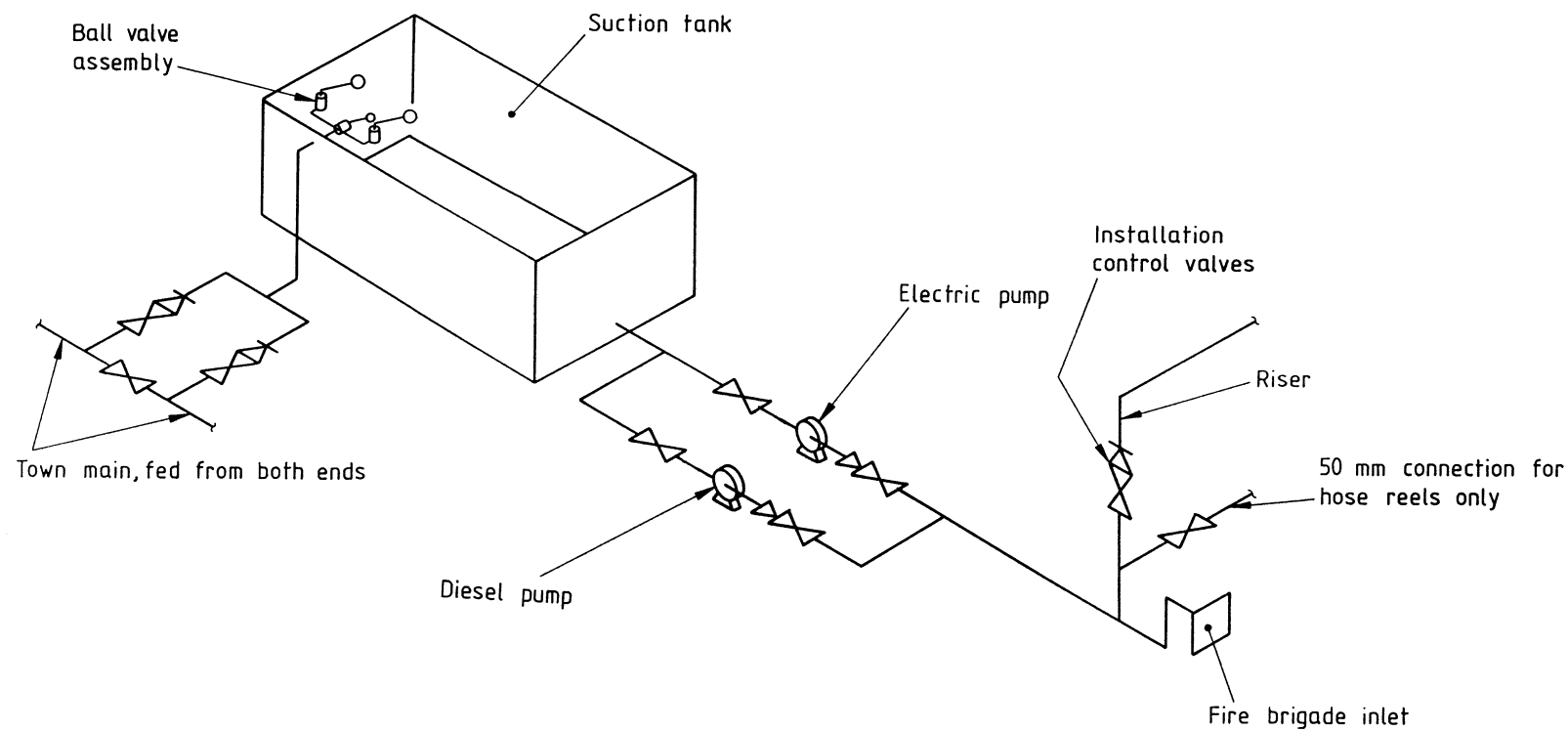


Figure 10 — Superior supply using suction pumps

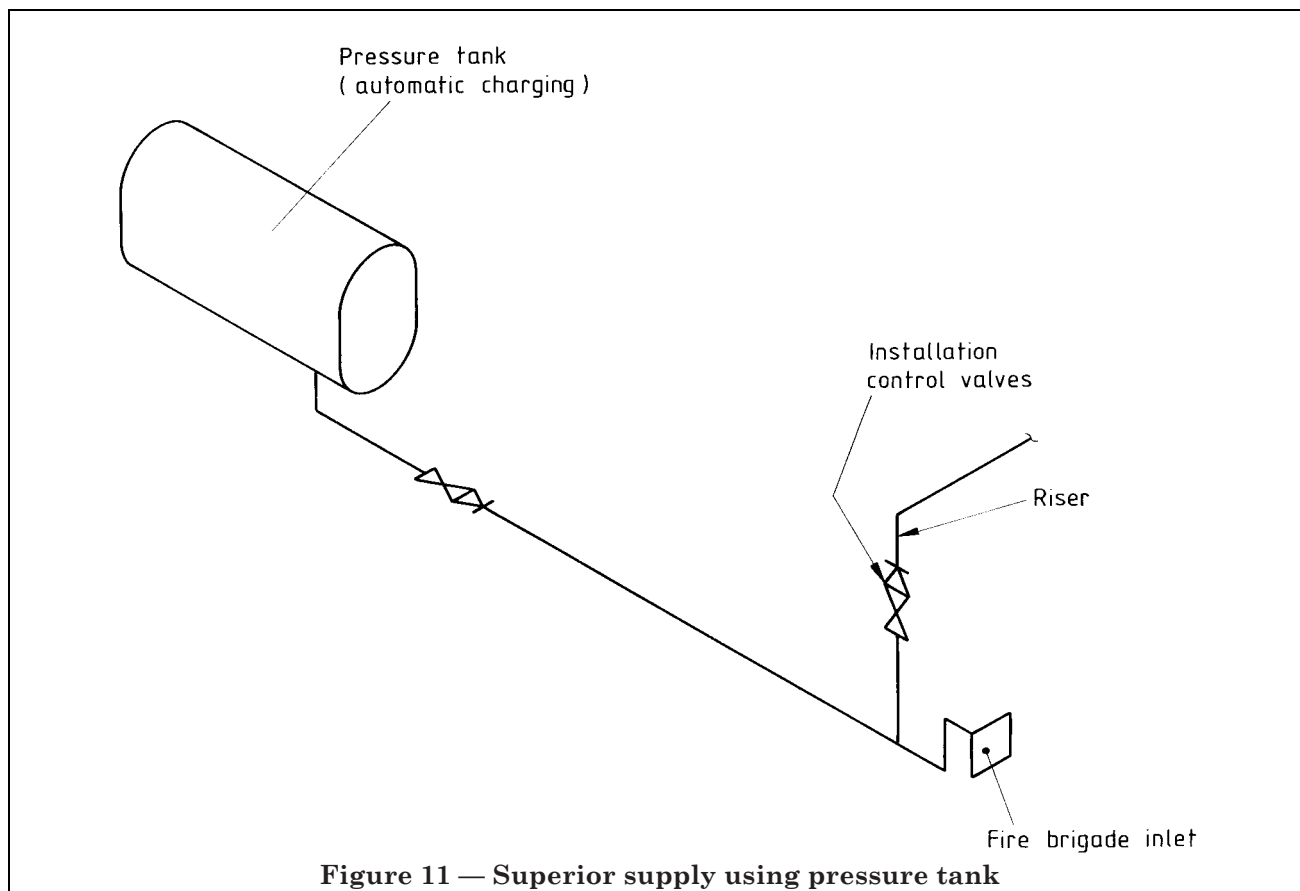


Table 6 — Combinations suitable for duplicate water supplies

Supply	Supply					
	Town main with or without booster pump	Booster pump from elevated private reservoir	Suction pump	Gravity tank	Elevated private reservoir	Pressure tank
Pressure tank	Light Ordinary	Light Ordinary	Light Ordinary	Suitable only with a third supply given as suitable	Light Ordinary	Suitable only with a third supply given as suitable
Elevated private reservoir	Not suitable	Light Ordinary High	Light Ordinary High	Light Ordinary High	Light Ordinary High	
Gravity tank	Not suitable	Light Ordinary High	Light Ordinary High	Light Ordinary High ^a		
Suction pump	Not usually permitted	Light Ordinary High	Light Ordinary High			
Booster pump from elevated private reservoir	Not usually permitted	Light Ordinary High				
Town main with or without booster pump	Light Ordinary High					

^a A divided tank or two separate tanks may be used.

