BS 8458:2015

BSI Standards Publication

Fixed fire protection systems – Residential and domestic watermist systems – Code of practice for design and installation

bsi.

...making excellence a habit.™

Publishing and copyright information

Published by BSI Standards Limited 2015

ISBN 978 0 580 85527 6

ICS 13.220.01; 13.220.20

The following BSI references relate to the work on this document:
Committee reference FSH/18/5
Draft for comment 14/30295812 DC

Publication history

First published as DD 8458-1, October 2010
First published as BS 8458, November 2015

Amendments issued since publication

Date	Text affected

Contents

List of figures

List of tables

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 54, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2015. It was prepared by Subcommittee FSH/18/5, *Watermist systems*, under the authority of Technical Committee FSH/18, *Fixed fire fighting systems*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

This British Standard supersedes DD 8458-1:2010, which is withdrawn.

Relationship with other publications

Attention is drawn to the requirements of BS EN 806, with particular regard to backflow prevention, and to BS 1710 for guidance on identification and marking of pipework.

Guidance on the application of automatic fire suppression systems is given in BS 9991, BS 9999, the Building Regulations 2010, Approved Document B for use in England [1], [2], Wales [3], [4] and its equivalents in Scotland [5] and Northern Ireland [6].

Information about this document

Watermist fire suppression systems for residential and domestic applications are designed to provide an additional degree of protection of life and property, above that to be achieved by the installation of smoke and/or fire detectors and systems.

This British Standard presumes that the watermist fire suppression system will form part of an integrated fire safety system as part of the building design.

This document converts DD 8458-1 into a full British Standard. It is a full revision of the Draft for Development, and incorporates the following principal changes:

- clarification of the application of residential and domestic building categorizations based on occupancy and risk;
- change to building height limit (from 20 m to 45 m);
- changes to fire test protocols:
    - removal of one ventilation fire test;
    - addition of two optional “open room” fire tests;
- changes to the limits of application dependent on fire tests successfully completed;
- increase in maximum nozzle spacing;
- expanded guidance on water supplies;
- additional measures for vulnerable people;
- additional recommendations for components.

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

This British Standard is intended for the use of designers, engineers, architects, surveyors, contractors, installers and authorities having jurisdiction.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions in this British Standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

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

Compliance with a British Standard cannot confer immunity from legal obligations.

Particular attention is drawn to the Water Supply (Water Fittings) Regulations 1999 [7], the Water Supply (Water Fittings) (Scotland) Byelaws 2014 [8] and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 [9] in respect of requirements for any fire suppression system which conveys, or is likely to convey, water supplied by a water undertaker or licensed water supplier.

Introduction

Watermist fire suppression systems have demonstrated their value in assisting the protection of life and property in industrial and commercial applications for many years. The advent of watermist nozzles that operate at an earlier stage in the development of a fire, together with the recognition that the largest numbers of deaths from fire occur in the home, have led to the introduction of watermist fire suppression systems specifically designed for residential and domestic occupancies.

A correctly designed, installed and properly maintained watermist fire suppression system can detect, suppress and control a fire at an early stage of development, and activate an alarm. Operation of the system rapidly reduces the rate of production of heat and smoke, allowing more time for the occupants to escape to safety or be rescued.

This British Standard accordingly covers design, installation, water supplies, maintenance and testing of residential and domestic watermist fire suppression systems installed to reduce the risk to life.

However, fire-fighting and life protection encompasses a wide field of endeavour and as such it is impracticable to cover every possible factor or circumstance that might affect implementation of this British Standard.

Residential and domestic watermist systems are seen as emerging technology in the market and their performance can be more sensitive than traditional sprinkler systems to small design changes, which can compromise their effectiveness. They can have features such as smaller bore waterways and they generally operate at higher pressures, which poses a number of design and maintenance challenges. They produce smaller droplets of water, which can be prone to being adversely affected by compartment geometry and fire plumes.

Smaller bore waterways and small orifice size in nozzles can be prone to being blocked by particles and debris. Attention to good quality installation and commissioning practices coupled with adequately maintained filtration by means of strainers is therefore essential. Subsequent contamination or deterioration of water supply quality, through ingress of matter, corrosion or microbial activity, could compromise system effectiveness.

The use of components that have been tested and approved in accordance with appropriate component specifications for fire protection applications is also important for system performance and reliability. At the time of writing of this British Standard, the testing and approval of watermist system components for residential and domestic applications is a developing area. In some cases it might be appropriate to select components that have been approved for use in sprinkler or commercial watermist systems.

The fire tests detailed in this British Standard are an important method of demonstrating that the water spray pattern and smaller droplet sizes produced by each specific system are capable of suppressing the test fires and reducing temperatures in the fire test room. The ventilation fire test also provides an assessment of the effect of air flows on the watermist droplets. However, it needs to be recognized that these tests represent a limited range of fire scenarios and there are limits to their applicability to all scenarios that might be encountered in application. The scope of application of this British Standard is therefore limited, as detailed in **6.2**. Attention is also drawn to **4.5** which contains guidance about circumstances when enhanced performance, reliability and resilience measures are to be provided.

Residential and domestic watermist fire suppression systems consist of a water supply, filter, non-return valve, stop valve, priority demand valve (where required), automatic alarm system and pipework to automatic watermist nozzles.

The watermist nozzles are fitted at specified locations, the appropriate watermist nozzle type being used for each location.

The main elements of a typical watermist fire suppression system are shown in Annex A. Automatic watermist nozzles operate at a pre-determined temperature to discharge water over a known area below. The flow of water thus initiated causes the sounding of an alarm. Only those watermist nozzles operate which are individually heated above their operating temperature by the heat from the fire.

The provision of a watermist fire suppression system does not negate the need for other fire precautions or practical measures, which can include structural fire resistance, escape routes, smoke or fire detectors and safe housekeeping practices. Even with the installation of a watermist fire suppression system, normal actions on the discovery of a fire need to be taken, such as immediate evacuation and the calling of the fire and rescue service.

Watermist fire suppression system maintenance is not complex but is essential (see Clause **8**). It is important that owners and occupiers pay particular attention to precautions issued by the watermist system supplier, such as the avoidance of obstructions to the watermist nozzle, or not painting the watermist nozzle or its mounting.

1 Scope

This British Standard gives recommendations for the design, installation, water supplies, commissioning, maintenance and testing of watermist systems with automatic nozzles installed in residential and domestic occupancies up to a maximum ceiling height of 5.5 m. It primarily covers watermist systems used for life safety, but might also provide property protection.

The recommendations of this British Standard are also applicable to any addition, extension, repair or other modification to a residential or domestic watermist system.

The British Standard does not cover watermist systems in industrial and commercial buildings. Recommendations for these systems are given in DD 8489-1 [1)].

2 Normative references

Standards publications

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

ASTM A269-10, *Standard specification for seamless and welded austenitic stainless steel tubing for general service*

ASTM A312, *Standard specification for seamless, welded, and heavily cold worked austenitic stainless steel pipes*

ASTM F442, *Standard specification for chlorinated poly(vinyl chloride) (CPVC) plastic pipe (SDR–PR)*

BS 5839 (all parts), *Fire detection and fire alarm systems for buildings*

BS 7671, *Requirements for electrical installations – IET Wiring Regulations*

[1)] At the time of publication of BS 8458, DD 8489-1 is undergoing conversion to a full British Standard as BS 8489-1.

BS 8558, *Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – Complementary guidance to BS EN 806*

BS EN 520:2004, *Gypsum plasterboards – Definitions, requirements and test methods*

BS EN 805, *Water supply – Requirements for systems and components outside buildings*

BS EN 806 (all parts) [2)], *Specifications for installations inside buildings conveying water for human consumption*

BS EN 1057:2006+A1:2010, *Copper and copper alloys – Seamless, round copper tubes for water and gas in sanitary and heating applications*

BS EN 10226-1, *Pipe threads where pressure tight joints are made on the threads – Part 1: Taper external threads and parallel internal threads – Dimensions, tolerances and designation*

BS EN 10226-2, *Pipe threads where pressure tight joints are made on the threads – Part 2: Taper external threads and taper internal threads – Dimensions, tolerances and designation*

BS EN 10255, *Non-alloy steel tubes suitable for welding and threading – Technical delivery conditions*

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

BS EN 13238, *Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates*

BS EN 15004-1, *Fixed firefighting systems – Gas extinguishing systems – Part 1: Design, installation and maintenance*

BS EN ISO 9453, *Soft solder alloys – Chemical compositions and forms*

BS EN ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

FM 5560, *Water mist systems*

Other publications

[N1] BUILDING RESEARCH ESTABLISHMENT. *Requirements and test methods for the approval of watermist systems for use in commercial low hazard occupancies*. LPS 1283. Issue 1.1. Watford: BRE Global Ltd, 2014.

3 Terms and definitions

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

3.1 additive
chemical or mixture of chemicals or gases, intentionally introduced into a watermist system for one or more of the following purposes:

a) enhancement of, or compliance with, fire protection requirements;

b) corrosion protection;

c) frost protection

[2)] This standard also gives an informative reference to BS EN 806-2:2005.

3.2 alarm device
device for detecting water flow in or through a watermist system and initiating an alarm signal

3.3 alarm receiving centre
continuously manned premises, remote from those in which a fire detection and fire alarm system is fitted, where the information concerning the state of the fire alarm system is displayed and/or recorded, so that the fire and rescue service can be summoned

3.4 alarm test valve
valve through which water can flow to test the operation of an alarm device

3.5 assumed maximum area of operation (AMAO)
maximum area over which it is assumed, for design purposes, that watermist will operate in a fire

3.6 authority having jurisdiction (AHJ)
organization, office, or individual responsible for enforcing the requirements of legislation or standards, or for approving equipment, materials, an installation, or a procedure

3.7 authorized supplier
company that is fully trained and authorized by a manufacturer for the design, installation, commissioning and maintenance of its fixed watermist systems and has documentation providing evidence of this

Assessed capability. *Users of this British Standard are advised to consider the desirability of using a contractor who has quality system assessment and registration by an accredited third-party certification body. Appropriate conformity attestation arrangements are described in BS EN ISO 9001.*

3.8 backflow
movement of the fluid from downstream to upstream within an installation

[SOURCE: BS EN 1717:2000, **3.5**]

3.9 backflow prevention device
device that is intended to prevent contamination of wholesome water by backflow in a water supply system

[SOURCE: BS EN 1717:2000, **3.6**, modified – additional words included]

3.10 compartment
area completely enclosed by walls and a ceiling, where any single internal opening is not more than 2 500 mm in width, and has either:

a) a lintel depth of not less than 200 mm; or

b) a single opening of not more than 900 mm in width without a lintel, with no other openings

NOTE This is not the same as a compartment as defined by building regulations.

3.11 competent person
person, suitably trained and qualified by knowledge, understanding and practical experience, and provided with the necessary instructions, to enable the required task(s) to be carried out correctly

3.12 control
<of fire> prevention of fire spread beyond a defined fire zone

3.13 crawl space
area not used for storage, under a floor or roof, giving access to building services

3.14 discharge duration
time that watermist discharges throughout one fire-fighting event measured from the operation of the first nozzle

3.15 effective capacity
volume of stored water available to a pump, taking into account the air gap at the top and the unusable water at the base of the tank, which is affected by a vortex letting air into the pump suction

3.16 fire pump
pump that is automatically operated in the event of a fire and that supplies water to a watermist system from a water storage facility or from a mains supply

3.17 mains water supply
permanent network of pipes that convey wholesome water from a public or private water supply system to a customer service connection or user draw-off point

3.18 maintenance
combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

3.19 manufacturer
organization responsible for manufacturing watermist systems, including nozzles, and for producing the watermist system design manual and the fire test programmes to which it is linked

3.20 manufacturer's design and installation manual
document containing design and installation instructions for all details of a watermist system

3.21 priority demand valve
valve for isolating the water supply to the domestic service in the event of watermist operation

3.22 responsible person
person(s) responsible for or having effective control over fire safety provisions adopted in or appropriate to the occupancy

3.23 service pipe
pipe supplying water from a water supply to any premises that are subject to water pressure and flow from that water supply

3.24 stop valve
manually operated valve for controlling the flow of water into the system pipework which is normally kept in the open position

3.25 suppression
<of fire> reduction in the heat release rate and prevention of re-growth of a fire over the discharge duration

3.26 vulnerable people
people who are at greater risk from fire because they are unable to easily evacuate without assistance, or who have a higher than average likelihood of experiencing a fire, or a combination of the two

3.27 water undertaker
company licensed to provide a public water supply

3.28 watermist
water spray for which the $D_{v0,90}$ is less than 1 mm measured in a plane 1 m from the nozzle at its minimum operating pressure

NOTE $D_{v0,90}$ is the drop diameter such that the cumulative volume, from zero diameter to the respective diameter, is nine tenths of the corresponding sum of the total distribution.

3.29 watermist nozzles

3.29.1 watermist nozzle
component, with one or more orifices, which is designed to produce and discharge watermist automatically, held closed by an integral quick-response thermal release element

3.29.2 concealed watermist nozzle
watermist nozzle with a cover plate that disengages when heat is applied

3.29.3 fusible link watermist nozzle
watermist nozzle which opens when an element provided for that purpose melts

3.29.4 glass bulb watermist nozzle
watermist nozzle which opens when a liquid filled glass bulb bursts

3.29.5 recessed watermist nozzle
watermist nozzle in which all or part of the heat sensing element is above the lower plane of the ceiling

3.30 watermist system
distribution system connected to a water supply, fitted with one or more watermist nozzles and intended to control, suppress or extinguish fire

NOTE Watermist systems can discharge water or a mixture of water and some other agent or agents, e.g. inert gases or additives.

3.31 wet pipe system
watermist system using watermist nozzles in which the pipework is always charged with water

3.32 wholesome water
water suitable for human consumption

NOTE Attention is drawn to the definitions given in the Water Supply (Water Fittings) Regulations 1999 [7] and equivalents in Scotland [8] and Northern Ireland [9].

4 Preliminary work and consultation

4.1 Initial considerations

Before undertaking the design of a domestic or residential watermist system for a specific property, the designer should evaluate at least the following factors before starting work on the project:

a) the risk to be protected;

b) the type of occupancy of the property (i.e. domestic or residential);

c) the water supply requirements and availability;

d) any special circumstances (see **4.6**).

NOTE In buildings where there is a mix of residential and commercial use (e.g. where flats are above shops), it is generally appropriate to protect the residential parts using BS 8458, and the commercial parts using DD 8489-1 [3] *or BS EN 12845.*

4.2 Consultation

*COMMENTARY ON **4.2***

Some premises might have multiple authorities having jurisdiction (AHJs), who might be concerned with life safety, property protection, business continuity, heritage preservation, and environmental protection. Some AHJs might impose additional requirements beyond those of this British Standard.

Where a watermist system or an extension or alteration to a watermist system is being considered within new or existing buildings, the designer should at an early stage contact any AHJs or others who might have a direct interest in the installation, including but not limited to:

a) the water undertaker or licensed water supplier;

NOTE Attention is drawn to the requirement to gain consent under water regulations [7–9] [4]*. Further guidance is given in the WRAS* Water Regulations guide *[10].*

b) the fire authority;

c) the licensing authority;

d) the building control body;

e) the insurer(s) of the dwelling and its contents;

f) the client, to take into account further considerations of vulnerability (see Annex B).

4.3 Category of system

The designer should at an early stage determine which category of system is applicable, as this affects various design considerations, such as the water requirements for the system. The category of system should be determined by the type of building as shown in Table 1, up to a maximum height of 45 m. If the type of building is not listed in Table 1, or for buildings over 45 m, then the AHJs should be consulted to agree which type of occupancy should apply, whether additional measures are needed (see **4.6**) or whether an alternative system (e.g. DD 8489-1 [3] or BS EN 12845) is more appropriate.

[3] At the time of publication of BS 8458, DD 8489-1 is undergoing conversion to a full British Standard as BS 8489-1.

[4] The Water Supply (Water Fittings) Regulations 1999 [7], the Water Supply (Water Fittings) (Scotland) Byelaws 2014 [8] and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 [9].

Table 1 **Category of system**

Category of system	Description of building/occupancy
Domestic occupancy	Single family dwellings such as:
	• Individual dwelling house
	• Individual flat
	• Individual maisonette
	• Transportable home
	Houses of multiple occupation (HMOs) [A)]
	Bed and breakfast accommodation [A)]
	Boarding houses [A)]
	Blocks of flats 18 m or less in height and with a maximum total floor area of 2 400 m^2 [B), C)]
Residential occupancy	Blocks of flats greater than 18 m in height [C)]
	Sheltered and extra care housing
	Residential care premises
	Residential rehabilitation accommodation
	Dormitories (e.g. attached to educational establishments)
	Hostels

A) Buildings with more than two floors and five or more lettable bedrooms should be treated as a residential occupancy.

B) Where the fire strategy requires the communal rooms and corridors to be protected by a watermist system, then the building should be treated as a residential occupancy.

C) This height is the height of the floor of the top storey above ground.

4.4 Cylinder-based systems

Systems using pressurized gas as a form of propellant for the watermist should conform to the safety requirements specified in BS EN 15004-1.

4.5 Use of watermist systems as a compensatory feature

*COMMENTARY ON **4.5***

There are occasions when a suppression system is used as a means of demonstrating compliance with building regulations or to compensate for, or overcome, circumstances where a building is unable to achieve compliance with guidance issued in support of building regulations. For example:

- *an older building where the existing construction cannot achieve the required fire resistance appropriate to the use of the premises;*
- *a new build that cannot meet the necessary access requirements for fire appliances;*
- *loft conversions where it is either not practical or not possible to secure adequate means of escape.*

It would be impractical for this standard to cover all circumstances. It is therefore essential that consultation take place, and where deemed appropriate to the circumstances there might be a need to increase the discharge duration, the design density and/or the resilience of the system. It is not implied that in all cases that there is necessarily a need to upgrade the category or increase resilience.

It would be beneficial to justify any proposals by means of a fire safety strategy in such cases to support the proposals for the specific case.

Where a watermist system is proposed as a compensatory feature, the following recommendations should be met.

a) There should be consultation between the designer and any necessary or relevant AHJs, and the category of system (see Table 1) and design discharge duration (see **6.6**) should be agreed and recorded on the compliance certificate (see **7.2.5**).

b) Where necessary, proposals should be supported by a fire safety strategy. This should set out how the watermist system and any appropriate resilience measures (see Note 1 to **4.6**) would provide equivalence to guidance in support of building regulations.

c) System resilience measures, where deemed necessary, should be appropriate to the risk and be agreed and recorded on the compliance certificate (see **7.2.5**).

4.6 Special circumstances

In some circumstances, enhanced performance, reliability and resilience arrangements should be provided, if an assessment shows them to be necessary. Where appropriate, the designer should consult the relevant AHJ(s).

NOTE 1 Examples of such arrangements include:

- *extended duration of water supply;*
- *making water supplies more robust, such as by the provision of redundancy in the pumping arrangements, back-up electrical supplies, or a fire service infill connection to a stored water tank;*
- *increasing the design discharge density or design assumed maximum area of operation (AMAO).*

NOTE 2 Situations where this might be necessary include:

- *dwellings with a fire load greater than that which would normally be found in a residential or domestic living room, kitchen or bedroom, or if the fire hazard is greater than that of a conventional residential or domestic occupancy;*
- *buildings where the time for fire-fighters to commence fire-fighting in the fire compartment might exceed the duration of water supply of the expected category of system, e.g. buildings over 45 m in height or complex buildings;*
- *older buildings with hidden voids and/or where compartmentation might not meet current standards;*
- *buildings with atria or where a risk assessment shows that the spread of fire could involve two or more enclosed volumetric spaces;*
- *buildings with adjacent areas not protected by an automatic fire suppression system;*
- *buildings housing vulnerable people (see Annex B);*
- *buildings with fire engineered design solutions;*
- *mixed use buildings (see Note to **4.1**);*
- *premises providing secure accommodation, asylum centres or similar premises (specialist nozzles are available for institutional situations where ligature or malicious tampering are a concern).*

5 System actuation

System actuation should be automatic by glass bulb or fusible link, initiated by heat generated from the fire.

6 Design

*COMMENTARY ON CLAUSE **6***

*Watermist systems for residential and domestic premises are designed to suppress and control fires. The watermist system design parameters are established by carrying out fire tests as recommended in Annex C. The tests are used to establish for each manufacturer's equipment the necessary number of nozzles and their flows, operating pressures and spacing, together with other required design characteristics. The recommended minimum discharge durations are given in **6.7**.*

6.1 Fire tests

To determine the system design and component characteristics, tests should be carried out in accordance with Annex C, and the following recommendations should be met.

***System testing.** Users of this British Standard are advised to use a test facility that operates a quality system. General requirements for the competence of testing and calibration laboratories are described in BS EN ISO/IEC 17025:2005.*

a) When tested in accordance with **C.1** to **C.4**:

   1) automatic watermist nozzles should be capable of suppressing the test fires for a discharge duration of 10 min for domestic premises or 30 min for residential premises, measured from nozzle operation;

   2) within 2 min from the operation of the first nozzle, the mean recorded temperatures 75 mm below the underside of the ceiling should remain steady or decrease.

b) From the start of the test, the recorded temperatures should not exceed the values indicated in Table 2.

c) The third nozzle, external to the room, should not operate.

Table 2 **Fire test maximum temperatures**

Thermocouple location	Maximum allowable temperature °C
75 mm below the underside of the ceiling	320
1.6 m above the floor	95
1.6 m above the floor	55 (for not more than any 120 s interval)

When a successful set of test results is obtained [see a) to c) above], those results should be used to determine the design parameters for the systems to be installed. The system should then be designed using those parameters and in accordance with this British Standard.

All design and installation parameters determined by the fire tests and any other system constraints crucial to the required performance of the system should be specified in the manufacturer's design and installation manual.

Sufficient and relevant design and installation information should be provided to enable the replication of the system as tested.

The manufacturer should describe and/or specify the procedure for the installation of the system.

6.2 Limits of application

The limits of application should be determined according to the fire test protocols against which the system has been successfully tested.

The limits of application for the fire test programmes are shown in Table 3. Tests should be carried out as follows.

a) Fire tests a, b, c and d should be carried out for all systems.

b) Fire tests e (open room test) and f (increased ceiling height test) are optional and should be carried out only if requested by the manufacturer.

Table 3 **Limits of application based on fire tests**

Fire tests	Maximum room size	Maximum ceiling height
a, b, c, d	Fire test room	3.5 m
a, b, c, d, e	80 m^2	3.5 m
a, b, c, d, f	Fire test room	5.5 m
a, b, c, d, e, f	80 m^2	5.5 m

6.3 System design

The system should be designed by an authorized supplier.

Watermist systems should meet the following criteria.

a) Nozzles should be positioned and oriented in accordance with the manufacturer's design and installation manual, and should meet at least the established design parameters [see **6.1**a) to **6.1**c)]. The system design should address at least the following:

   1) minimum and maximum heights. For systems tested in the standard height test room detailed in **C.1.1** or **C.1.2** (i.e. 2.5 m) the maximum design height for an installation is 3.5 m. For installations at design heights between 3.5 m and 5.5 m the procedure in **C.4**f) should be followed;

   2) minimum and maximum distances between nozzles;

   3) minimum and maximum distances from nozzles to walls;

   4) location of nozzles with regard to obstructions;

   5) positioning of nozzles with regard to ceiling (flat, sloping or curved);

   6) nozzle protection;

   7) nozzle ceiling plates used with flush, recessed or concealed watermist nozzles;

   8) minimum and maximum water flow rates and water pressures at the nozzles;

   9) additive requirements, where applicable.

b) The watermist system should be a wet pipe system (i.e. one that is permanently charged with water).

   NOTE Attention is drawn to the requirements of the Pressure Equipment Directive [11].

c) Thermally activated nozzles should have quick-response thermal elements in accordance with BS EN 12259-1 in terms of temperature ratings and selection of the temperature rating for installed maximum ambient conditions.

6.4 Extent of watermist system protection

Watermist system protection should be provided in all parts of the dwelling, with the exception of the following areas, which may be excluded unless required by a fire strategy or risk assessment:

a) bathrooms fitted with a door and with a floor area of less than 5 m^2;

b) cupboards and pantries fitted with doors and with a floor area of less than 2 m^2, and rooms in which the smallest dimension does not exceed 1 m, where the walls and ceilings are covered with non-combustible or limited-combustible materials;

c) non-communicating, attached buildings such as garages, boiler houses, etc.;

NOTE 1 "Non-communicating" means separated from the protected premises by not less than 30 min fire resisting construction in accordance with the relevant part of BS 476 or the equivalent European Standard, for example:

- *BS 476-21/BS EN 1365-1 for load-bearing walls;*
- *BS 476-22/BS EN 1364-1 for non-load-bearing walls and partitions;*
- *BS 476-21/BS EN 1365-2 for floors;*
- *BS 476-23/BS EN 13381-1 for suspended ceilings;*
- *ad hoc BS 476-20/BS EN 1366-3 for penetrations of walls and floors by services.*

The parts of the BS 476 fire resistance test standards are to be read in conjunction with BS 476-20. The European fire resistance test standards are to be read in conjunction with BS EN 1363-1.

Depending on the design of the building, there might occasionally be a need to refer to other fire resistance test standards. Certain authorities might require 60 min fire-resisting construction.

d) crawl spaces;

e) uninhabited loft/roof voids;

f) ceiling voids;

g) external balconies permanently open to the outside.

NOTE 2 A fire strategy or risk assessment might demonstrate that extensive spread of fire or smoke, particularly between rooms and compartments, is likely to take place and therefore that the fire risk in the area is such that watermist coverage is necessary.

6.5 Hydraulic calculations

Hydraulic calculations should be based upon recognized methods (see Notes).

NOTE 1 NFPA 750 [12] provides useful information and guidance on appropriate methods including the Hazen–Williams and Darcy–Weisbach calculation methods.

NOTE 2 Calculations may be carried out using computer software provided that the results can be shown to be accurate.

System piping should be hydraulically designed to deliver the required water flow and pressures as determined by the fire tests in Annex C.

Hydraulic calculations should be carried out to determine the hydraulically most unfavourable area for the system based on the maximum number of heads assumed operating, the pipe configuration, head selection and classification of risk.

For systems with no additives and working pressures not exceeding 12 bar [5], hydraulic calculations may be carried out using the Hazen–Williams calculation. If this method is used it should be carried out in accordance with Annex D.

6.6 Discharge performance

6.6.1 Domestic occupancies

For domestic occupancies, the system should be capable of providing pressures and flow rates to permit all the watermist nozzles in the fire test room or largest compartment, whichever is the greater, up to a maximum area of operation (AMAO) of 64 m^2, to operate simultaneously at not less than the greater of:

a) the nozzle pressure given by the pass criteria determined by the test in Annex C; or

b) the approval listed discharge performance.

Any flow for alarm purposes should be added to the system flow.

6.6.2 Residential occupancies

For residential occupancies, the system should be capable of providing pressures and flow rates to permit all the watermist nozzles in an assumed maximum area of operation (AMAO) of 64 m^2 to operate simultaneously at not less than the nozzle pressure given by the pass criteria determined by the test in Annex C, or their approval listed discharge performance, whichever is the greater. Any flow for alarm purposes should be added to the system flow.

6.7 Discharge duration

The water discharge rates and duration should be as follows.

a) For systems in domestic occupancies, the duration should be at least 10 min from the operation of the first nozzle, and the system should meet the recommendations in **6.1** for the total time of the discharge duration in the most hydraulically demanding area.

b) For systems in residential occupancies, the duration should be at least 30 min from the operation of the first nozzle, and the system should meet the recommendations in **6.1** for the total time of the discharge duration in the most hydraulically demanding area.

6.8 Water supplies

6.8.1 General

The design should identify water supply requirements (pressure, flow and duration) for the watermist system.

NOTE 1 Where water is drawn from a public mains supply, attention is drawn to the legal requirement for water undertaker approval to be sought.

A suitable water supply should be identified at an early stage to avoid unnecessary work at a later stage. The water supply should be sufficient for the system design parameters identified in **6.5**, **6.6** and **6.7**.

NOTE 2 For information on Legionella and fire-fighting systems, see Legionella and fire-fighting systems – A technical briefing note *[13].*

[5] 1 bar = 10^5 N/m^2 = 100 kPa.

6.8.2 Types of supply

Watermist systems should be connected to one of the following water supplies:

a) stored water supply:
   1) pump supplied from a water tank;
   2) regulated pressurized vessel;
   3) gravity fed stored water system;

b) mains water supply:
   1) mains water supply boosted by a pump;
   2) site water main controlled by the building owner.

6.8.3 Stored water supply

6.8.3.1 General

Where stored water supplies are used, the most appropriate location for the storage volume should be identified.

The storage tank should have a cover.

6.8.3.2 Stored water capacity

To establish the correct effective water storage capacity, the hydraulically most favourable area calculation should be balanced with the pump's performance curve to find the system's maximum flow demand. The maximum flow demand should then be multiplied by the system duration for the classification of risk to establish the minimum effective capacity of the tank. The maximum flow demand calculation should be carried out in accordance with Annex D.

NOTE 1 The flow requirements at the most hydraulically favourable location are dictated by the performance of the pump selected for the system.

The volume of a stored water supply should be large enough to ensure that the effective capacity of the stored supply (see Figure 1) is sufficient for the duration for the category of system, or any increased capacity required of an agreed enhanced duration. The air gap at the top and unusable water at the base, which is affected by a vortex letting air into the pump suction, should be taken into account.

NOTE 2 An anti-vortex device can be installed to increase the amount of usable water at the base of the tank.

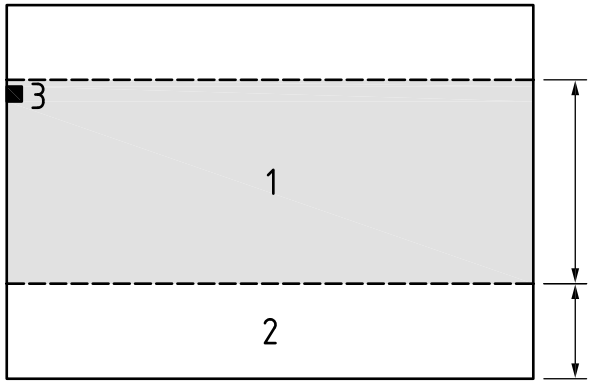
6.8.3.3 Low water level alarms

An alarm to indicate low water levels should be provided.

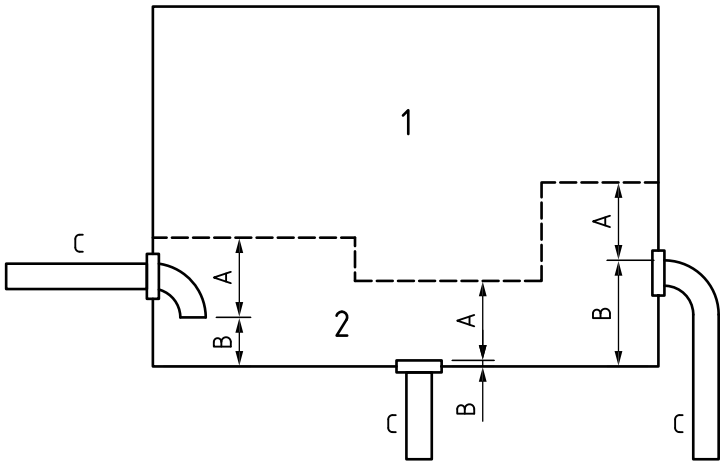
For dedicated stored water supplies, an indication should be given if the water storage level drops more than 10% below the design storage capacity for the watermist system.

For shared stored water supplies, an indication should be given if the water storage level drops below the design storage capacity for the watermist system.

Figure 1 **Stored water supply**



a) Effective capacity of stored water supply



b) Unusable water of stored water supply

Key

1 Effective capacity
2 Unusable water
3 Low level alarm
A Distance from suction outlet to lowest level of effective capacity (see Note)
B Distance from suction outlet to base of stored water supply (see Note)
C Suction pipe to pump

NOTE The depth of unusable water is calculated as measurement A + measurement B, and varies depending on:

a) *the diameter of the suction outlet;*
b) *the location and type of the suction outlet.*

Measurement A is identified from either:

1) the manufacturer's recommendations; or
2) at least 2.5 times the suction pipe diameter.

6.8.3.4 Shared stored water supply

Where the stored water supply is used to supply both the watermist system and domestic system (hot and cold water), the stored volume should be at least 110% of that recommended for the watermist system.

*NOTE 1 Where any proposed combined volume of stored water exceeds that required for domestic purposes, as set out in BS EN 806-2:2005, **19.1.4**, it is likely that separate storage arrangements will be required by the water undertaker.*

Where the water is derived from the building's stored water supply, the following recommendations should be met.

a) The domestic cold water tank should be capable of providing:

   1) the building's peak demand for the required duration of the watermist system's run time; and

   2) the watermist system maximum demand.

b) All draw-off points from the tank should be at the same level, and they should be taken from the base of the tank.

NOTE 2 If the watermist system is being supplied from the domestic cold water tank and booster pump with a dedicated watermist riser, the tank size can be that required for the watermist system only as long as the domestic draw is via a demand valve that closes on watermist activation.

6.8.3.5 Reduced capacity of stored water supply

The stored volume may be reduced if there is a proven rate of automatic infill from the water main. Only 80% of the proven infill may be used for reduction. The proven infill rate should be measured at peak demand.

The reduced capacity should be not less than 60% of the effective capacity without infill.

6.8.3.6 Pressurized cylinders

NOTE Attention is drawn to the Pressure Equipment Regulations 1999 [14]. Some watermist systems might require a written scheme of examination.

Cylinders should be supported and secured to prevent cylinder movement and possible physical damage. Facilities should be provided for servicing or verification of the contents of each cylinder. When any cylinder in a manifold system is removed for maintenance, means should be provided to prevent leakage from the manifold if the system is operated.

Cylinders should be installed in an area maintained within the temperature range specified by the manufacturer, or external heating/cooling should be provided to keep the temperature of the storage container within the specified ranges.

Cylinders should be located such that they are unlikely to be affected by a fire.

Cylinders should be internally protected against corrosion.

6.8.4 Mains water supply

6.8.4.1 General

When planning to use a mains water supply, the minimum mains dynamic pressure and flow should be ascertained at a time of peak demand at the earliest opportunity to ensure that there will be sufficient pressure and flow available to allow the system to perform as designed.

NOTE 1 Where there is concern with regard to a mains water supply, a data logger may be used to establish a record of the standing pressure.

Where systems are to be directly mains fed, the size of service pipe to the premises that will feed the watermist system should be agreed with the water supplier.

If the mains pressure is insufficient, a pump may be attached to the mains (with permission from the water undertaker) to boost pressure. It should not be used to increase flow rates.

NOTE 2 Although an in-line booster pump increases pressure, it has virtually no effect on increasing flow.

When the lowest pressure and flow characteristics from the mains water supply do not meet the watermist system design requirements, an alternative supply should be provided, e.g. a stored water supply (see **6.8.3**).

6.8.4.2 Design flow rate for mains water supply connections

Where the mains water supply connection serves only the watermist system, the flow rates at the watermist nozzles should be in accordance with the recommendations given in **6.6**.

Where the mains water supply connection serves both the watermist system and the domestic or residential occupancy supply, the watermist system should be capable of providing flow rates at the watermist nozzles in accordance with the recommendations given in **6.6** by:

a) the operation of an automatic priority demand valve; or

b) for domestic occupancies, the flow rate recommended in **6.6.1** plus at least 25 L/min; or

   NOTE 1 Attention is drawn to the water regulations [7–9] [6], which might require a greater minimum flow rate.

c) for residential occupancies, the flow rate recommended in **6.6.2** plus at least 50 L/min.

   NOTE 2 Attention is drawn to the water regulations [7–9] [6], which might require a greater minimum flow rate depending on the design demand for the occupancy.

When relying only on a direct mains water supply, only 85% of the water pressure and flow rates at the lowest flow/pressure characteristics anticipated should be allowed in the calculations.

If the required pressure and flow rate cannot be achieved, the installation should not proceed and the designer should be consulted. Where the system is to be fed from an existing service pipe, the hydraulic characteristics should be determined at the point of connection.

Where the connection to the mains water supply serves more than one dwelling, the system should be capable of providing the flow rates at the watermist nozzles in accordance with the recommendations given in **6.6** at times of simultaneous peak demand from all of the dwellings concerned.

[6] The Water Supply (Water Fittings) Regulations 1999 [7], the Water Supply (Water Fittings) (Scotland) Byelaws 2014 [8] and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 [9].

6.9 Backflow prevention

The arrangement or device used to prevent backflow should be appropriate to the highest applicable fluid category to which the fitting is to be subjected on the downstream side.

NOTE 1 BS EN 1717 defines fluid categories and suitable arrangements and devices to protect against backflow. The requirements vary according to whether there is a direct connection or a tank supply, and whether additives are used.

NOTE 2 Attention is drawn to the Water Supply (Water Fittings) Regulations 1999 [7] and equivalents in Scotland [8] and Northern Ireland [9] in respect of the requirement for backflow prevention and for materials that are in contact with wholesome water (e.g. upstream of the backflow prevention device).

NOTE 3 Further information and guidance on the appropriate level of backflow prevention can be found in the WRAS Water Regulations guide *[10] or obtained from the water supplier.*

6.10 Watermist nozzle coverage and location

6.10.1 General

Watermist nozzles should be installed in accordance with the manufacturer's instructions and the recommendations of this British Standard.

6.10.2 Watermist nozzle spacing

6.10.2.1 General

The maximum area protected by each watermist nozzle, its spacing and distance from any wall or partition, should be as tested in accordance with Annex C. Automatic watermist nozzles should be not less than 2 m apart.

6.10.2.2 Sloping ceilings

Where nozzles are fitted within a sloping ceilings, nozzle positions should be determined by the pitch of the ceiling.

Where the pitch is below 30°, nozzles should be mounted at standard spacings when measured in line with the pitch of the ceiling.

Where the pitch is 30° and above, the first row of nozzles should be mounted within 300 mm radially from the apex of the ceiling.

All nozzles should be mounted perpendicular to the ceiling as shown in Figure 2.

6.10.3 Watermist nozzle positioning

Watermist nozzles should be positioned in accordance with the following recommendations.

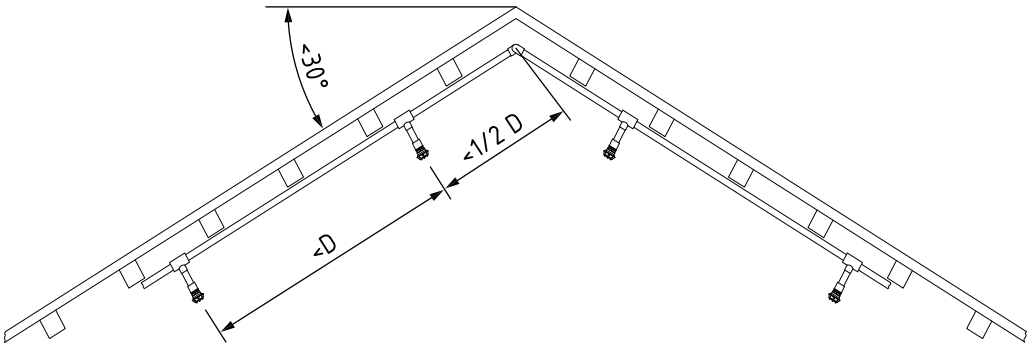
a) The heat-sensitive elements should be as tested in accordance with Annex C.

b) The impact on thermal sensitivity and discharge pattern of the watermist nozzles by obstructions such as constructional features and light fittings should be taken into account.

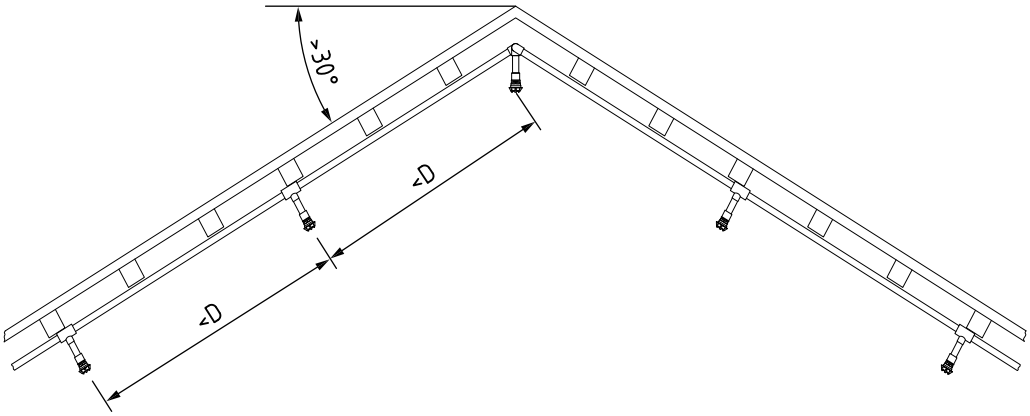
c) The potential for a shielded fire to develop (e.g. below walkways or galleries) should be taken into account.

NOTE Numbers of nozzles, nozzle spacing and/or positioning might need to be adjusted to take into account items b) and c).

Figure 2 **Mounting of nozzles within sloping ceilings**



a) Pitch below 30°



b) Pitch 30° and above

Key

D Nozzle spacing

6.11 Components

6.11.1 General

Components should be in accordance with BRE publication LPS 1283 [N1], FM 5560, or other appropriate standard that can be shown to give equivalent performance (e.g. a listed component in the LPCB Red Book Live [15]).

NOTE Tests for nozzles, check valves, pressure switches and strainers are under development in CEN. They are at committee draft stage at the time of publication of this British Standard.

6.11.2 Watermist nozzles

6.11.2.1 General

When tested in accordance with Annex C, watermist nozzles should meet the recommendations given in **6.1**a) to **6.1**c).

Watermist nozzles should be suitable for use with fittings threaded in accordance with BS EN 10226-1 and BS EN 10226-2.

Watermist nozzles should be fitted with an inlet filter to prevent blockage during service. Filters should be made of corrosion-resistant materials and should be designed in such a way that spheres with a diameter of more than 0.8 times the minimum nozzle waterway dimension cannot pass through the filter. The total open area of the filter should be a minimum of three times the total open nozzle waterway.

The free flow through the distribution pipes should not be obstructed, i.e. no part of the filter should protrude into that pipe waterway.

Any watermist nozzle removed from the system should be discarded or returned to the manufacturer for factory refurbishment. Replacement nozzles, including filters, should be fitted and only new or refurbished equipment should be used.

6.11.2.2 Temperature rating of watermist nozzles

Watermist nozzles should have quick-response thermal sensitivity rating in accordance with BS EN 12259-1.

Fusible link watermist nozzles should be colour coded on the frame or watermist nozzle body. Glass bulb watermist nozzles should be colour coded by the bulb liquid in accordance with BS EN 12259-1.

The temperature rating of the watermist nozzles should be:

a) the closest to but at least 20 °C greater than the highest anticipated ambient temperature of the location;

b) within the range of 79 °C to 100 °C when installed under glazed roofs.

NOTE For normal conditions in the United Kingdom, the watermist nozzle temperature ratings are between 57 °C and 68 °C.

6.11.2.3 Pipes and fittings

All pipes and fittings should be supplied and installed in accordance with the manufacturer's instructions and should be suitable for use at the pressures and flows to be experienced in the systems with the necessary factors of safety.

All pipes should be used within their manufacturer's pressure ratings and recommendations, and should meet the following recommendations as appropriate for the type of material used.

a) Stainless steel pipes and fittings should conform to ASTM A269-10 and ASTM A312.

b) Steel pipes and fittings should be galvanized, and the piping and galvanizing should conform to BS EN 10255. A strainer should be fitted at any termination of the galvanized piping upstream of the piping feeding the nozzles.

c) Copper pipes and fittings should meet the following recommendations.

   1) Copper pipe with compression or cold pressed fittings approved for use in fire protection systems should be used within the manufacturer's pressure rating and application recommendations.

   2) Capillary fittings should be jointed by soldering or brazing with alloys with a melting point of not less than 230 °C as specified in BS EN ISO 9453.

   3) Copper used in underground locations should conform to BS EN 1057:2006+A1 and should be R220 (annealed), thick walled, factory plastic-coated tube. In this case, fittings should be manipulative Type B. Brass fittings in underground locations should be resistant to de-zincification.

d) Plastics and other pipes and fittings should be approved for use in fire protection systems and acceptable to the AHJ and should be installed in accordance with the supplier's instructions. Plastic pipe should be used only in wet pipe systems, and should be behind a fire-resisting barrier if it could be affected by a fire, e.g. if the pipework runs through an area without the protection of a suppression system.

Appropriate measures should be taken when using flexible connectors to ensure that they are installed in accordance with the manufacturer's instructions and that the correct hydraulic calculations are applied.

6.11.2.4 Pipework support

Pipework supports should meet the following recommendations.

a) Pipe supports should be fixed directly to the structural elements or primary supports of the building.

b) Pipe supports should not be used to support any other services.

c) The material used for pipe supports should be approved for use in fire protection systems.

d) Pipe supports should prevent the pipe from being dislodged.

e) Supports should be secured in accordance with the manufacturer's instructions.

f) Supports should not be glued, welded or soldered to the pipe or fittings.

g) Where necessary, supports for pipes should be suitably lined to prevent corrosion and abrasion.

h) Supports should be fitted as close as practically possible to the watermist nozzles in order to ensure that no movement occurs which would recoil heads into the ceiling or loft voids.

i) The maximum pipework support spacing should be in accordance with the manufacturer's installation instructions.

6.11.3 Valves and alarm devices

6.11.3.1 General

Valves and alarm devices suitable for residential and domestic systems should be installed in accordance with the supplier's instructions.

6.11.3.2 Alarm devices

*COMMENTARY ON **6.11.3.2***

Because watermist systems have a high level of reliability in fire situations, coupled with very few unwanted actuations, an alarm generated by the alarm device needs to be treated as a confirmed fire signal.

Owing to the burden caused by false alarms, many fire and rescue services have introduced measures to reduce attendance to alarms generated by automatic fire alarm systems. Therefore to ensure an emergency response to a watermist alarm, consideration needs to be given to clearly distinguishing a watermist-initiated alarm from a signal generated by automatic fire detection. Early consultation with the local fire and rescue service can assist in developing an appropriate solution.

Whilst in some residential and domestic buildings, the actuation of the fire alarm triggers immediate and total evacuation of the premises, other residential buildings are designed so that the initial alarm is sounded only in the dwelling where the fire starts, as only this dwelling needs to evacuate immediately. It is important that the configuration of the watermist alarm is matched to the building's fire evacuation strategy.

If a building or dwelling has comprehensive automatic fire detection and alarm provision that provides adequate fire alarm and warning arrangements to initiate evacuation, additional watermist alarms to initiate evacuation might be unnecessary.

A watermist system may be interfaced with the fire detection and fire alarm system (e.g. by means of a flow switch), so that a fire alarm signal is given by the building's fire alarm system when a watermist nozzle operates.

Alarm system designers need to take account of the fact that the watermist alarm might have more than one function, e.g. to initiate evacuation, to alert management and/or alert the fire and rescue service.

In some cases there can be benefits for reducing property damage, especially in unoccupied areas, if an external alarm is installed in a prominent location where people can be alerted to a watermist actuation.

All systems should have an alarm device consisting of an electrically operated flow switch which should be initiated by the flow of water to the single nozzle with the lowest flow rate.

For all systems, actuation of the watermist alarm should be clearly distinguishable on any fire alarm control and indicating equipment.

The alarm device should meet one of the following recommendations.

a) The alarm device should be connected to an internal audible alarm.

b) Provided that the property is fitted with an automatic fire detection and alarm system meeting at least the minimum grade and category recommended in BS 5839, the watermist alarm device can be interlinked to this system. The automatic fire detection and alarm system should be in accordance with the recommendations of BS 5839-1:2013 or BS 5839-6:2013 as appropriate.

   NOTE BS 5839-1:2013, Table A.1 and BS 5839-6:2013, Table 1 provide guidance on the category of system for the relevant property types.

c) The alarm device should initiate a watermist alarm signal that should be configured and acted upon in accordance with the fire strategy for the building.

6.11.3.3 Multi-storey blocks of flats

In multi-storey blocks of flats, the alarm device may be configured to serve an alarm zone, rather than each individual dwelling, provided that the following recommendations are met:

a) the alarm zone should cover no more than a single floor, with a maximum of 200 automatic nozzles per zone or a maximum plan area of 2 400 m^2; which may however include a mezzanine floor no greater than 100 m^2;

b) the individual dwellings should be fitted with an LD1 automatic fire detection and alarm system with a minimum of a grade D power supply, designed, installed and maintained in accordance with BS 5839-6:2013; and

c) the alarm device should be connected to suitable control and indicating equipment so that management are alerted and the emergency action plan can be initiated.

In multi-staircase buildings, the control equipment should clearly indicate the floor level and appropriate staircase.

6.11.3.4 Transmission of alarm signals to alarm receiving centres

*COMMENTARY ON **6.11.3.4***

*Where a watermist system has been installed for the protection of vulnerable people, it is essential that the watermist alarm is also transmitted to an alarm receiving centre or a place where people are tasked with responding on a 24/7 basis, so that management action can be initiated and the fire and rescue service mobilized. BS 5839-6:2013, Clause **20** provides more detailed guidance and recommendations.*

In buildings housing vulnerable people, the watermist alarm should be transmitted as a confirmed fire signal to a permanently staffed location.

6.11.3.5 Valves

NOTE 1 Figure A.1 and Figure A.3 show typical arrangements where the system is not directly connected to the mains supply. Figure A.2 shows a typical arrangement where the system is directly connected.

The following valves should be provided for all systems:

a) a stop valve, of the full bore lever type, to isolate watermist nozzle pipework from mains water supply. The valve should be labelled and secured in the open position to prevent accidental interruption of the water supply to the watermist nozzle system;

b) a system test valve comprising a quick acting drain and test valve facility, fitted to allow functional testing of the watermist system, suitably sized to check the appropriate maximum flow recommended in **6.6**, but not less than the largest diameter pipe in the system;

c) a system drain valve comprising a quarter turn drain valve facility fitted at the lowest point of the watermist pipework to allow the complete draining of the system;

d) an alarm test valve or valves comprising a quarter turn test valve facility fitted downstream of any flow switch to allow testing of the switch, suitably sized to check the appropriate maximum system flow rate.

NOTE 2 The drain and test valves can be combined if suitably located to serve both functions.

Where the system is directly connected to the mains water supply (i.e. with a pump and without a break tank), the following should additionally be provided:

1) an appropriate backflow prevention device to prevent mains water contamination (see BS EN 806);

2) where appropriate, a priority demand valve.

6.11.4 Electrically operated devices

The electrical supply to the fire pumps should be installed in such a way as to minimize the risk of electrical supply failure by having a separately fused connection taken after the meter and from the supply side of the domestic or residential fuse box, using fire-resisting cable (see BS 7671).

In all other instances, the electrically operated alarm devices should be capable of carrying out their function in the event of a complete failure of the mains electrical power supply, in accordance with BS 5839-6:2013.

6.11.5 System strainers

Strainers should be made of corrosive-resistant materials. For pressure-bearing parts and for the sieve, metallic materials should be used. The flow direction should be given on the body of system strainers.

System strainers should be installed in each water supply connection. It should be possible to take out the sieve and the dirt particles of system strainers without having to remove the strainer housing.

All parts should be constructed in such a way that incorrect mounting will be obvious.

The free flow through the distribution pipes should not be obstructed, i.e. no part of the strainer should protrude into the pipe waterway.

If the nozzle strainer is projecting from the nozzle inlet into the pipe fitting, the design should be such that a sphere with a diameter of 3 mm can pass between the inner surface of the pipe fitting and the outer surface of the strainer.

The pressure loss of the strainer should be taken into account during hydraulic calculation.

The water supply to the system should be filtered. The strainer(s) should have a mesh not more than 0.8 times the area of the smallest orifice in the system, and the open area of the mesh should be at least four times the total orifice area of the maximum number of nozzles which are designed to be in operation simultaneously.

6.11.6 Fire pumps

6.11.6.1 General

Where a fire pump is used, it should be:

a) located such that it is unlikely to be affected by a fire;

b) located where the temperature can be maintained above 4 °C;

c) protected electrically by suitable fusing;

NOTE Circuit breakers are not suitable.

d) protected against the effects of fire;

e) of sufficient capacity to ensure that the recommendations given in **6.6** are met;

f) suitably designed and manufactured such that inspection and servicing is needed at not more than annual intervals;

g) operated automatically on demand and requiring manual shutdown;

h) continuously rated;

i) suitably protected against corrosion.

6.11.6.2 Automatic test and monitoring facilities

All pumps should be designed to include an automatic test cycle where the pump is churned over at least monthly.

A fault alarm should be raised if the electrical power fails or the automatic test cycle fails. The fault alarm should be situated in such a place and be of sufficient decibels that the alarm can be noticed and acted upon.

6.12 Electrical design and installation

Electrical installations should conform to BS 7671.

6.13 Additives

Additives should not be used unless they have been evaluated to be safe for human exposure at the maximum concentration of the additive that can be reached upon system discharge.

7 Installation, commissioning and documentation

7.1 Installation

7.1.1 General

The system should be installed by an authorized supplier.

The system should be installed in accordance with the manufacturer's design and installation manual, and should meet at least the established design parameters.

7.1.2 Pipework

7.1.2.1 General

The pipework should be installed in accordance with the manufacturer's design and installation manual and should be protected against internal corrosion and internal scaling. Where appropriate, pipework should be installed in accordance with BS EN 805, BS EN 806 and BS 8558.

Pipes and fittings should be installed in such a way that the pipework is not exposed to damage or by contact with dissimilar materials. It is expected that in residential and domestic premises, systems will not be subject to a corrosive environment. If a corrosive environment is present, then suitably corrosion-resistant materials and components should be used.

Bonding should be carried out in accordance with BS 7671.

Systems within switchrooms should be effectively bonded and earthed to prevent metalwork becoming electrically charged.

All pipework should be checked for electrical earthing connections. Pipework should not be used for earthing electrical equipment. Any earthing connections from electrical equipment should be removed and alternative arrangements made.

7.1.2.2 Drainage

All systems should be installed in such a way that the entire pipework system can be drained.

7.1.2.3 Pipework support

Only metallic pipe fixings should be used. Hanger components should be metal. Rubber inserts or linings may be used in the pipe fixings. Batons and lock type clips should be fitted in close proximity to the watermist nozzles to ensure that no movement occurs which would recoil the nozzles into the ceiling or loft voids.

7.1.2.4 Pipework through structural timbers

Structural timbers should not be notched or bored in such a way that the integrity of the structure is compromised.

7.1.3 Frost protection

*COMMENTARY ON **7.1.3***

Freezing can lead to burst pipes, inhibiting the movement of water through the watermist system and preventing discharge from the watermist nozzles.

Normal methods of protection against freezing include:

- *installing pipework within the heated envelope of the building;*
- *the use of lagging and trace heating;*
- *antifreeze.*

Unlike water in domestic water systems, water in watermist systems is not replenished by warmer water in normal circumstances. Therefore the water in a watermist system continues to lose heat until it reaches ambient air temperature and can easily freeze, despite being lagged. Exposed pipework, unless adequately protected, can also be affected by wind-chill leading to the freezing of the contents, even when ambient temperatures are above 0 °C.

Any water-filled pipework, pump(s) or container(s) used in the watermist system, which might be subjected to temperatures below 4 °C, should be protected against freezing.

If antifreeze is used, it should meet the following recommendations.

a) Antifreeze is flammable. It should therefore be sufficiently diluted and thoroughly mixed. Only approved premixed solutions that can be evidenced as suitable for watermist systems should be used.

b) Only glycerine-based anti-freeze solutions may be used with plastics pipe and fittings. Glycol-based anti-freeze solutions should not be used in CPVC systems as it can damage the plastic.

c) The use of antifreeze solutions in water systems connected to wholesome water supplies requires a level of backflow protection which is greater than for systems without antifreeze (see **6.9**). The water provider (e.g. water undertaker) should be consulted regarding the fluid categorization and the suitability of backflow prevention arrangements prior to installation.

7.2 Commissioning

7.2.1 General

In addition to a full visual inspection, all of the tests described in **7.2.2**, **7.2.3** and **7.2.4** should be passed for the system to become operational.

7.2.2 Leakage test

The watermist system should be tested for leakage by filling with air at 0.5 bar [7)] and checking for leaks at each joint. Any leaks found should be repaired.

The water supply to the system should be isolated and the system should be hydraulically tested for 1 h, to a minimum of 1.5 times the highest pressure to be experienced in the system. If the system fails to maintain pressure, the leak should be found and corrected and this test repeated.

7.2.3 Functional test

The watermist system should be tested in accordance with the manufacturer's instructions to determine whether at least the flow rate recommended in **6.6** and the duration recommended in **6.7** can be achieved at the required pressure at the system test valve [see **6.11.3.5**b)]. If this flow rate at the recommended pressure cannot be achieved, the system should not be approved for use until the system has been corrected and the test has been passed. The authorized supplier should correct the system.

7.2.4 Alarm test

The alarm device should be tested by opening the alarm test valve to ensure a flow of water and checking that the alarm operates as designed (see **6.11.3.2**). Where the alarm is configured for remote monitoring, the signal to the monitoring station should be checked (see **6.11.3.4**).

7) 1 bar = 10^5 N/m^2 = 100 kPa.

NOTE It is essential that any alarm receiving centre to which alarm signals are relayed is notified before, and immediately after completion of, any tests that could result in an alarm signal.

7.2.5 Compliance certificate

On satisfactory completion of the commissioning tests by the authorized supplier, a compliance certificate should be issued in accordance with **7.3.2**b), which attests that the watermist system has been designed, installed and commissioned in accordance with this British Standard (see Note) [8)].

NOTE The design element of the certificate may be provided by another party.

Any variations from this standard should be agreed with the AHJ and should be clearly stated on the compliance certificate.

7.3 Documentation

7.3.1 Content

For new and extended systems, all drawings and documents should include, as a minimum, details of the system which should include:

a) the address and location of the premises or, in the case of transportable homes, the chassis or reference number;

b) the name and address of the supplier;

c) the name of the person responsible for the design;

d) the date of installation.

7.3.2 Documents

The following information should be provided by the system supplier to the owner or occupier:

a) details of the authorities consulted and any response to consultation;

b) a general description of the system including water supply details, and a statement of compliance with this British Standard in the form of a signed compliance certificate (see **7.2.5**) [8)], together with any variations agreed with the AHJ and justification for the variation;

c) a layout drawing of the premises, which includes "as fitted" details showing the extent of the installation, together with a set of hydraulic calculations;

d) details of the water supplies which, if a mains water supply, should include pressure and flow rate data at a specified location for the commissioned installation, with the time and date of the test;

e) a list of components used, identifying supplier's name and parts reference number;

f) information about the configuration of the alarm device and whether it is connected to an alarm receiving centre;

g) a 24 h emergency telephone number which can be used to obtain assistance;

h) a log book containing inspection, checking and maintenance documents detailing a regular programme to be undertaken by a competent person

[8)] Such a certificate represents an installer's declaration of conformity, i.e. a claim by or on behalf of the installer that the product meets the recommendations of this British Standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

(including an annual inspection and test; see Clause **8**), and the actions to be taken in respect of operation of the system, faults, etc., including the importance of not shutting the system down until it is confirmed that the fire has been extinguished;

i) essential information for the user (e.g. "Do not paint, cover or in any way impede the operation of a watermist nozzle", "Any modifications should be carried out by an approved supplier").

7.4 System data label

A label or notice should be attached or fixed adjacent to or on the watermist riser next to the main watermist stop valve as a permanent record of a system's design data.

NOTE 1 An example is given in Annex E.

*NOTE 2 This is not the same as the compliance certificate (see **7.2.5**).*

8 Maintenance

8.1 Inspecting and testing after commissioning and whilst in service

When the maintenance programme detailed in the log book (see [**7.3.2**h)] is carried out, the watermist system should be inspected to check that:

a) the watermist nozzles' heat sensing capacity and their spray pattern is not impeded;

b) the hazard has not been changed;

c) the system has not been modified, except in accordance with this British Standard;

d) system strainers are unimpeded; they should be cleaned or replaced if necessary.

The system should be tested as follows.

1) The system should be visually inspected wherever possible for water leaks. If a leak is suspected, the pipework should be pressure tested for 1 h to the highest pressure to be experienced in the system.

2) The test valve should be operated to determine whether the system's design flow rate is achieved.

3) Alarms should be tested to determine whether they function as designed.

4) Stop valves should be exercised to ensure free movement.

5) Any remote monitoring arrangements should be tested to determine whether they are being transmitted and received correctly.

NOTE 1 It is essential that any alarm receiving centre to which alarm signals are relayed is notified before, and immediately after completion of, any tests that could result in an alarm signal.

6) Where trace heating is installed, its operation should be tested.

NOTE 2 Maintenance of the system might be a legal requirement in some circumstances. It might also be a requirement of the building fire strategy.

The person carrying out the inspection and tests should complete and sign the log book as stated in **8.3**.

8.2 Reinstatement of the system

Reinstatement of the system following maintenance or actuation should be undertaken by a competent person and the log book (see **8.3**) should be annotated to indicate the reason for reinstatement and any actions taken.

8.3 Log book

The log book referred to in **7.3.2**h) should be completed, giving details of:

a) the date of inspection;

b) details of all tests conducted and their results;

c) confirmation or otherwise of the watermist system's operational status;

d) confirmation or otherwise of the alarm system's operational status;

e) details of any recommendations or comments;

f) confirmation of hazard.

Any serious system faults should be relayed to the occupants or owners as soon as possible, and confirmed in writing within 24 h.

Annex A (informative) Elements of a typical watermist fire suppression system

The main elements of a watermist fire suppression system are shown in Figure A.1 to Figure A.3.

Figure A.1 **Fire pump and tank system**

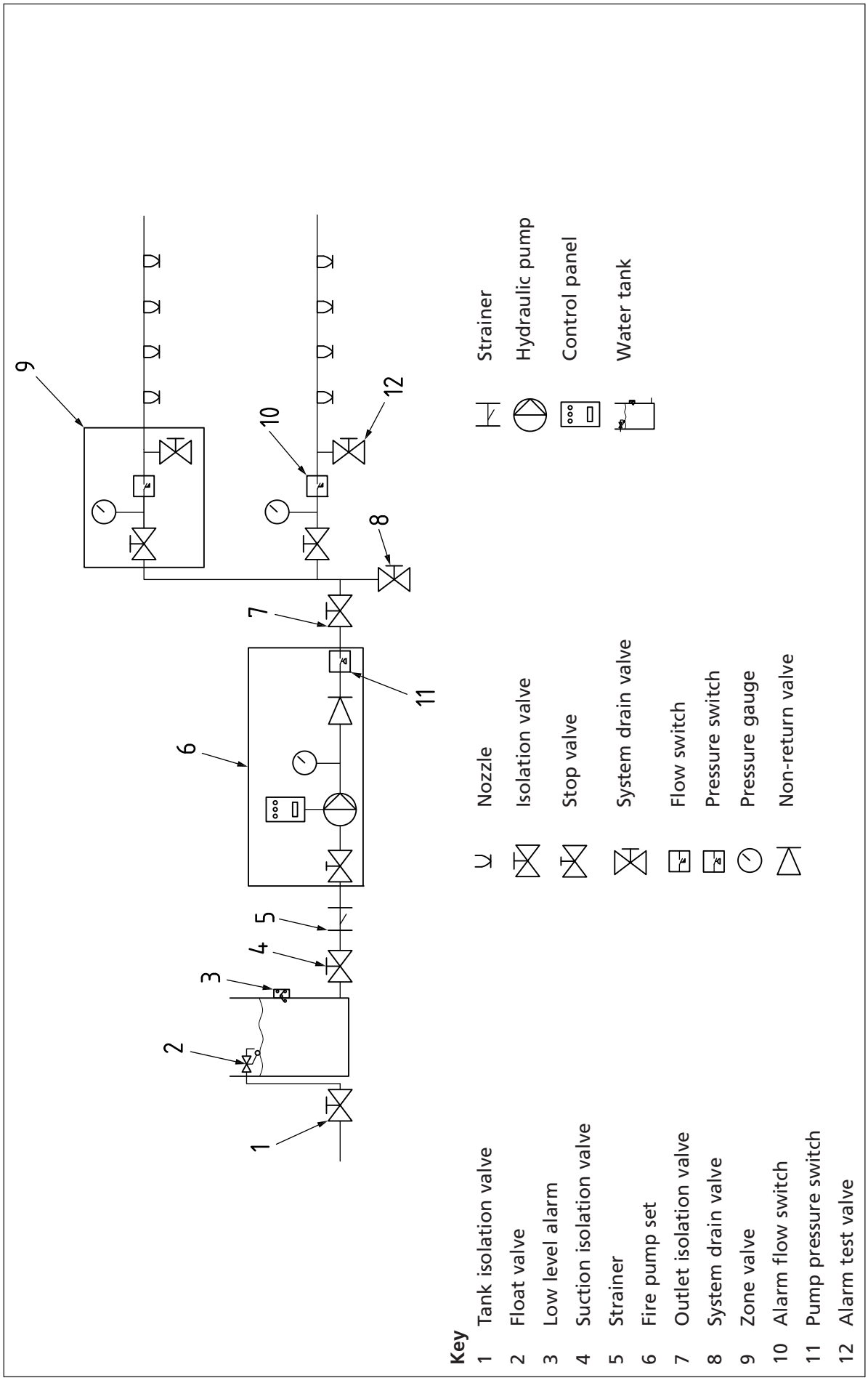


Figure A.2 **Fire pump and town mains system**

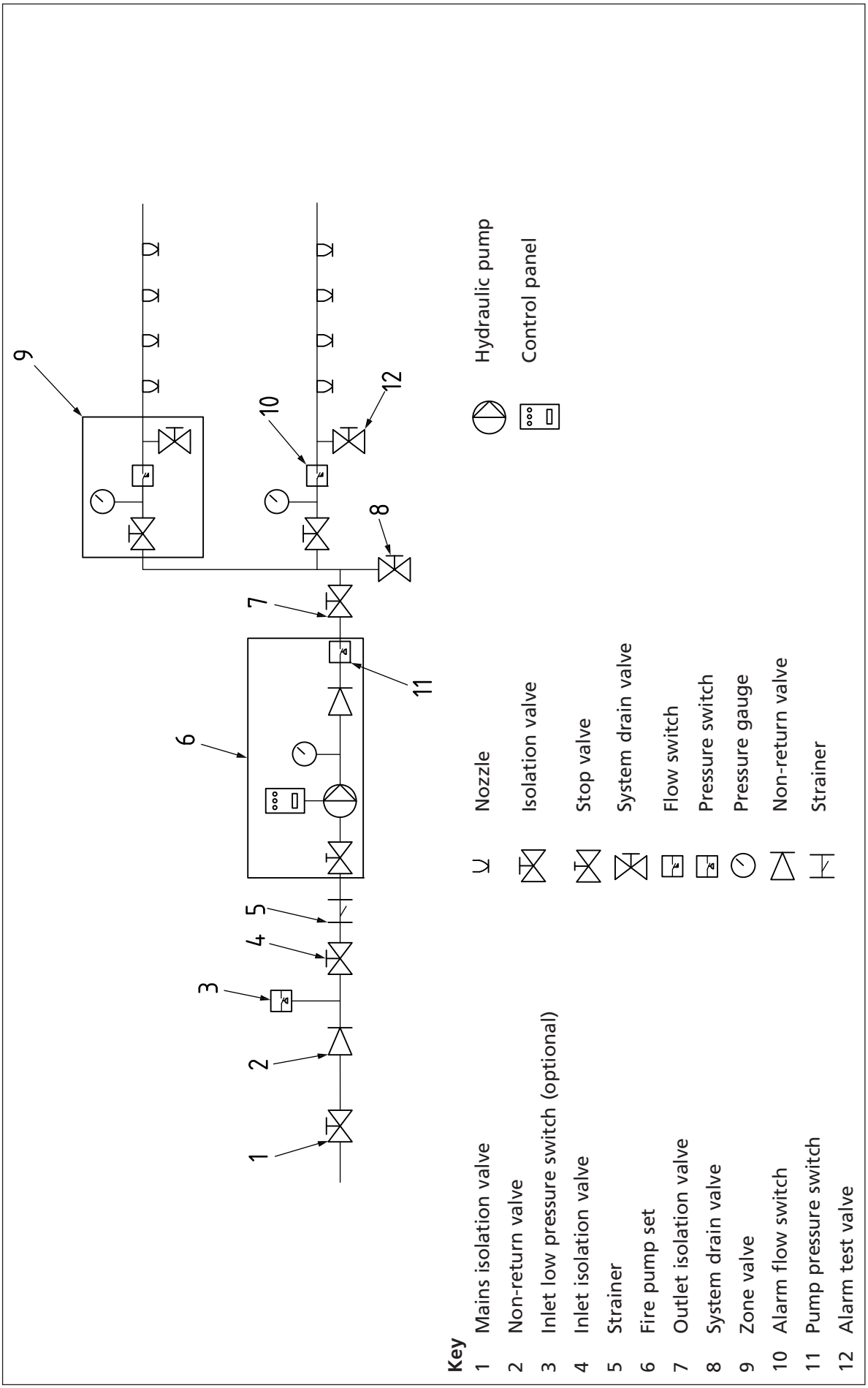
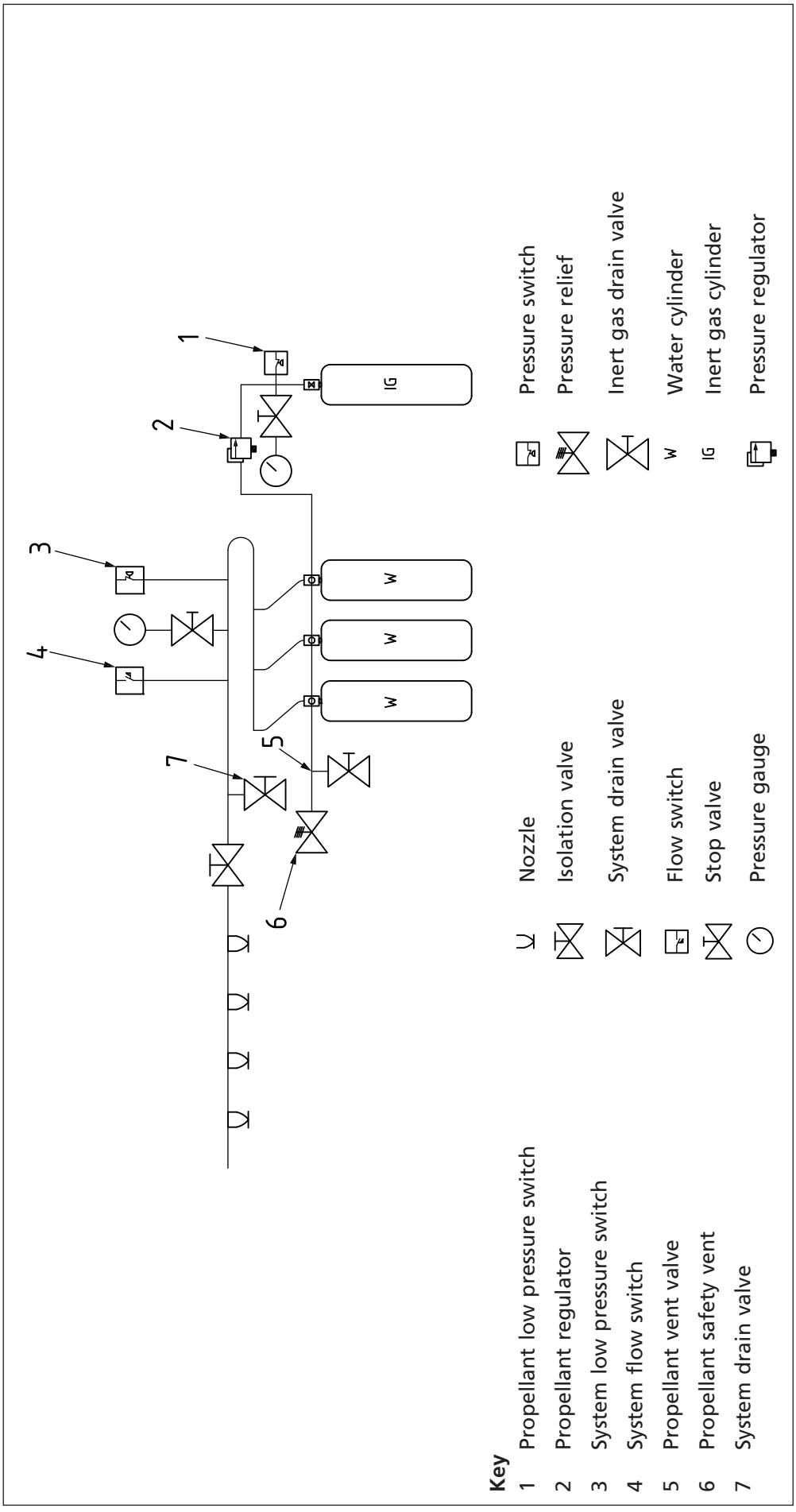


Figure A.3 **Cylinder-based system**



Key

1 Propellant low pressure switch
2 Propellant regulator
3 System low pressure switch
4 System flow switch
5 Propellant vent valve
6 Propellant safety vent
7 System drain valve

Nozzle
Isolation valve
System drain valve
Flow switch
Stop valve
Pressure gauge
Pressure switch
Pressure relief
Inert gas drain valve
Water cylinder
Inert gas cylinder
Pressure regulator

Annex B (informative) Watermist performance, reliability and resilience for systems installed in the homes of vulnerable people

COMMENTARY ON ANNEX B

In some situations the risk profile of the resident(s) might justify additional performance, reliability or resilience measures over and above the minimum recommendations in the main standard. This annex gives guidance on some of these situations.

It is the responsibility of the building owners, building management, and/or the responsible person for the building, to advise the watermist system's designer/installer whether this annex is applicable and to agree/approve any increased reliability requirements.

B.1 Identifying the most vulnerable from fire

It is important to consider vulnerability as a combination of hazard and likelihood and therefore a matter of risk.

In simple terms this can be thought of as:

- hazard: the ignition source for a fire and materials to aid combustion (the fire itself);
- likelihood: the likely occurrence of a fire starting (the hazard being realized);
- risk: the person being unable to escape in sufficient time to avoid injury or death from fire.

People who are vulnerable from fire can be considered as those with a higher than average likelihood of having a fire or with poor reaction or realization of the danger presented by fire, or a combination of both.

UK fire casualty trends indicate that many victims are older people who live alone, with mental and/or physical health issues. These trends have resulted in an increasing call, from housing and care providers and fire and rescue services, for suppression systems to be installed in the homes of identified vulnerable people.

B.2 Vulnerability: significant factors

The factors below are not a definitive list, but might be primary indicators for concern:

a) likelihood:
   - high fire risk activities or habits, such as careless disposal of smoking materials or leaving cooking unattended;
   - history of fire-setting behaviour;
   - history of previous fires or evidence of near misses, such as scorch marks on clothing or furniture;
   - threats of arson;

b) inability or willingness to escape:
   - impaired mobility affecting ability to escape;
   - impaired reaction to fire or warning devices;
   - impaired senses affecting ability to respond to alarm;

- poor situational awareness;
- alcohol or drugs, increasing the likelihood of a fire and lowering reaction to alarm.

Evidence for the first group [a)] can be through observation: these are factors affecting the likelihood of a fire occurring. The remainder [b)] might require confirmation from a medical or social care agency and are, importantly, linked with the matter of ability to escape.

The most vulnerable persons are influenced by factor(s) from both groups and are therefore at greater risk.

B.3 Additional performance, reliability and resilience measures

In order to address concerns with a higher than average risk profile, any of the following might be needed as part of the system design:

- increasing the duration of application and/or the resilience of the water supply;
- upgrading the system to a higher category or changing to an alternative system (DD 8489-1 [9] or BS EN 12845);
- arrangements to maintain system integrity during maintenance or repair;
- provision of a back-up power supply to pump(s);
- additional pumps to provide redundancy;
- remote monitoring of critical system components;
- automatic test facilities;
- installation of a fire and rescue service inlet.

Annex C (normative) Room fire tests for watermist systems with automatic nozzles

C.1 Apparatus

C.1.1 *For nozzle spacings (S) between 2 m and 4 m: test room* with the following internal dimensions:

a) width (X): (4.0 ±0.05) m;

b) length (Y): (8.0 ±0.05) m;

c) ceiling height: (2.5 ±0.05) m;

d) doorway height: (2.5 ±0.05) m.

The test room ceiling should be covered by 12.5 mm Type F fire-rated plasterboard conforming to BS EN 520:2004.

C.1.2 *For nozzle spacings (S) between 4 m and 5 m*: *test room* with the following internal dimensions:

a) width (X): (5.0 ±0.05) m;

b) length (Y): (10.0 ±0.05) m;

c) ceiling height: (2.5 ±0.05) m;

d) doorway height: (2.5 ±0.05) m.

[9] At the time of publication of BS 8458, DD 8489-1 is undergoing conversion to a full British Standard as BS 8489-1.

The test room ceiling should be covered by 12.5 mm Type F fire-rated plasterboard conforming to BS EN 520:2004.

C.1.3 *Ignition package*, consisting of a square tray of internal dimensions 300 mm × 300 mm × 100 mm deep made from 12 gauge steel containing 200 mL of commercial grade heptane floated on water of 25 mm minimum depth. A wood crib consisting of eight layers of wood sticks of *Pinus silvestris*, with four sticks per layer spaced 50 mm apart, should be placed on top of the steel tray. An optional lip can be added to the steel tray to provide stability to the crib. The wood sticks should be 38 mm × 38 mm cross-section by 305 mm long (actual) and plane finish. The complete wood crib should have the nominal dimensions of 305 mm × 305 mm × 305 mm and should weigh (8 250 ±250) g (see Figure C.1 to Figure C.5). Two cotton wicks, each 250 mm long, soaked in 100 mL of heptane, of which 150 mm of each wick should be placed on a fire brick and laid along the edge of the foam sheets with the remaining 100 mm exposed.

C.1.4 *Fuel package*, consisting of two sheets of polyether foam 775 mm × 865 mm × 75 mm having a density of 20 kg/m^3. Each sheet should be glued to a sacrificial backing board, 775 mm × 865 mm × 12 mm, which is attached to a wooden supporting frame (see Figure C.4 and Figure C.5). The foam sheets should be flush with the top and sides of the sacrificial board and frame.

C.1.5 *Plywood panels*, in two different arrangements as follows.

a) For the corner test, two walls should be covered, floor to ceiling, by 12 mm thick plywood panels covering (2.4 ±0.1) m in length (see Figure C.1). The distance of the ignition and fuel package from the plywood panels walls should be controlled to (50 ±5) mm (see Figure C.4).

b) For the centre tests, a partition arrangement of plywood panels should be used, made from two 12 mm thick plywood panels each (2.2 ±0.1) m in length and 1.2 m in height (see Figure C.2 and Figure C.3). The distance of the ignition and fuel package from the plywood partitions should be controlled to (50 ±5) mm (see Figure C.5).

NOTE Consistency of the flammability properties of the panels is essential for the repeatability of this test.

C.2 Watermist system set-up

The watermist manufacturer should declare the following for the set-up of the tests:

- nozzle *k* factor and manufacturer's part number;
- nozzle spacing (S), in metres;
- the manufacturer's recommended minimum design pressure at the nozzles, in bar [10)];
- any additives, at composition, rates and periods as defined by the manufacturer, as intended to be used in a real installation;
- any gases, as intended to be used in a real installation;
- water delivery system including nozzles, fire pumps, cylinders, pipework and filters/strainers, as intended to be used in a real installation.

[10)] 1 bar = 10^5 N/m^2 = 100 kPa.

C.3 Preparation

Nozzles of each temperature rating should be tested once, for each of the fire tests, with the fire loads shown in Figure C.4 and Figure C.5.

Install two or more nozzles of the same type in a test room of the dimensions shown in Figures C.1, C.2, C.3, C.6 and C.7 (if the optional open room test has been selected). For arrangements C.1, C.2, C.3 and C.6, install another nozzle of the same type, outside the test room near the open doorway. This external nozzle should be installed on an open length of vertical pipe work which is filled with a minimum of 70 mL of water. The nozzles should be installed in accordance with the manufacturer's instructions and this British Standard. Where there are differences, the conditions recommended in this British Standard should prevail.

Figures C.1, C.2, C.3, C.6 and C.7 show a two-nozzle arrangement, but other nozzle arrangements are permitted, providing the arrangement is symmetrical in the room.

The plywood sheets, sacrificial boards, wooden frames, foam sheets and wood crib sticks should be conditioned at a temperature of (23 ±2) °C and a relative humidity of (50 ±5)% for the conditioning periods recommended in BS EN 13238.

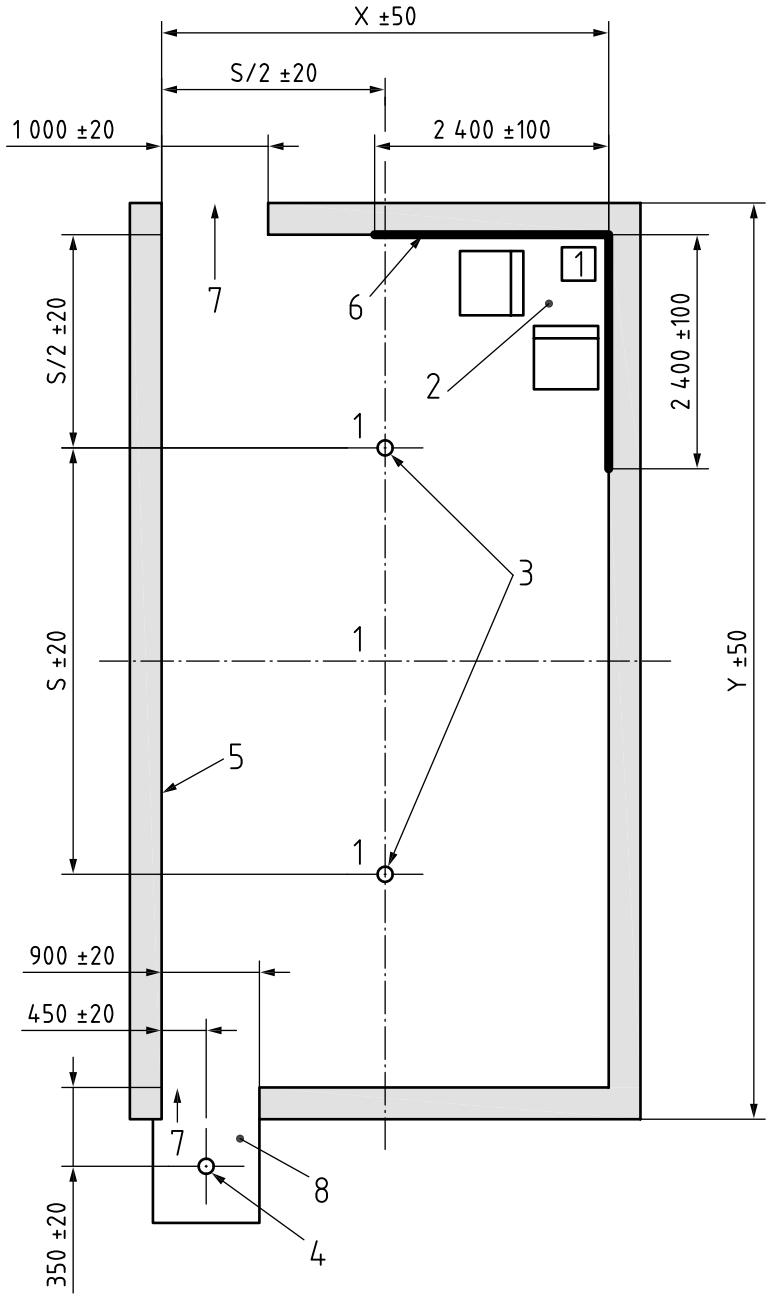
The crib should be conditioned before the test, such that the moisture content is (10 ±2)%, 3 mm below the wood stick surface.

Before the start of each test, the room temperature should be (20^{+10}_{-5}) °C. The room, wall panels, floor, fuel packages and contents should be dry and the room relative humidity should not be more than 70%.

Fuel packages and ignition packages should be placed in the test room as shown in Figures C.1, C.2, C.3, C.6 and C.7.

Figure C.1 **Corner test layout showing a two-nozzle arrangement**

Dimensions in millimetres

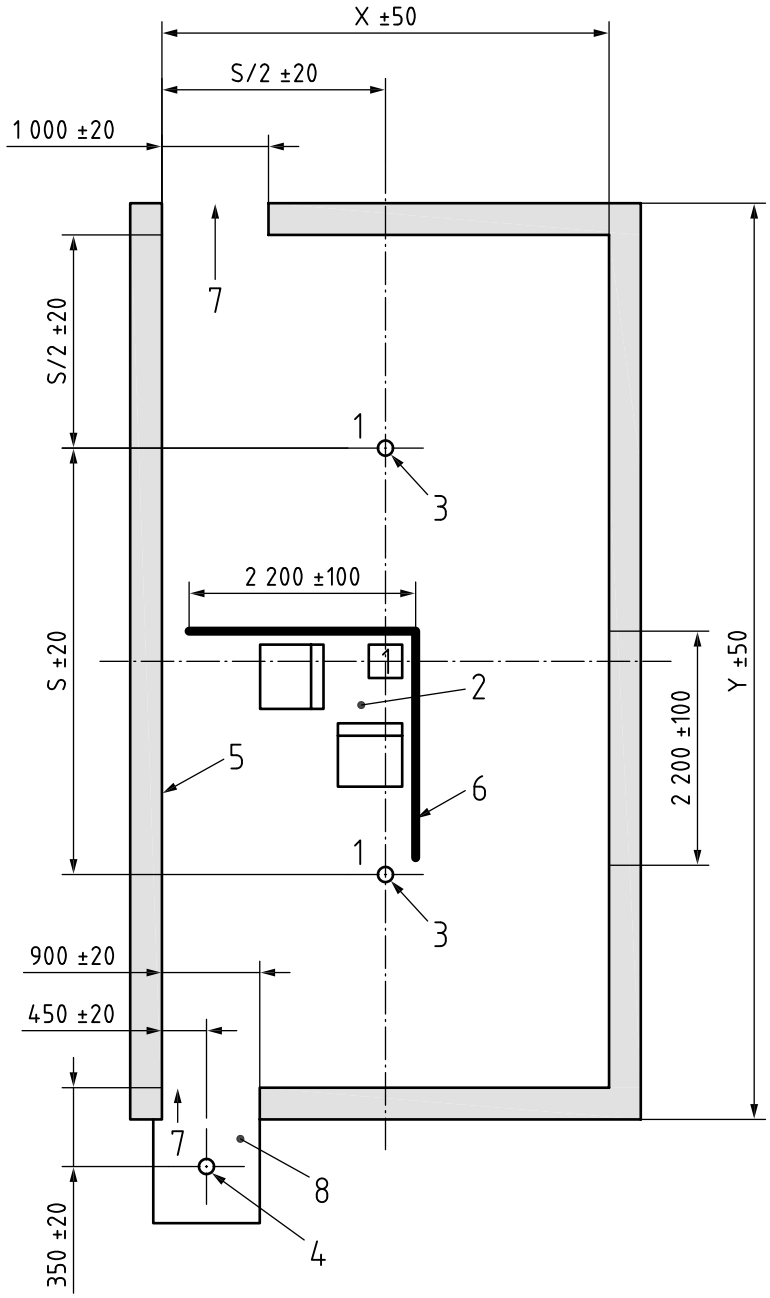


Key

1 Thermocouple
2 Corner fire test ignition and fuel package (see Figure C.4)
3 Nozzle connected to water supply (see **C.3**)
4 Nozzle connected to water-filled pipe
5 Test room
6 Full room height plywood panels
7 Doorway
8 Porch

Figure C.2 **Between two nozzles test layout showing a two-nozzle arrangement**

Dimensions in millimetres

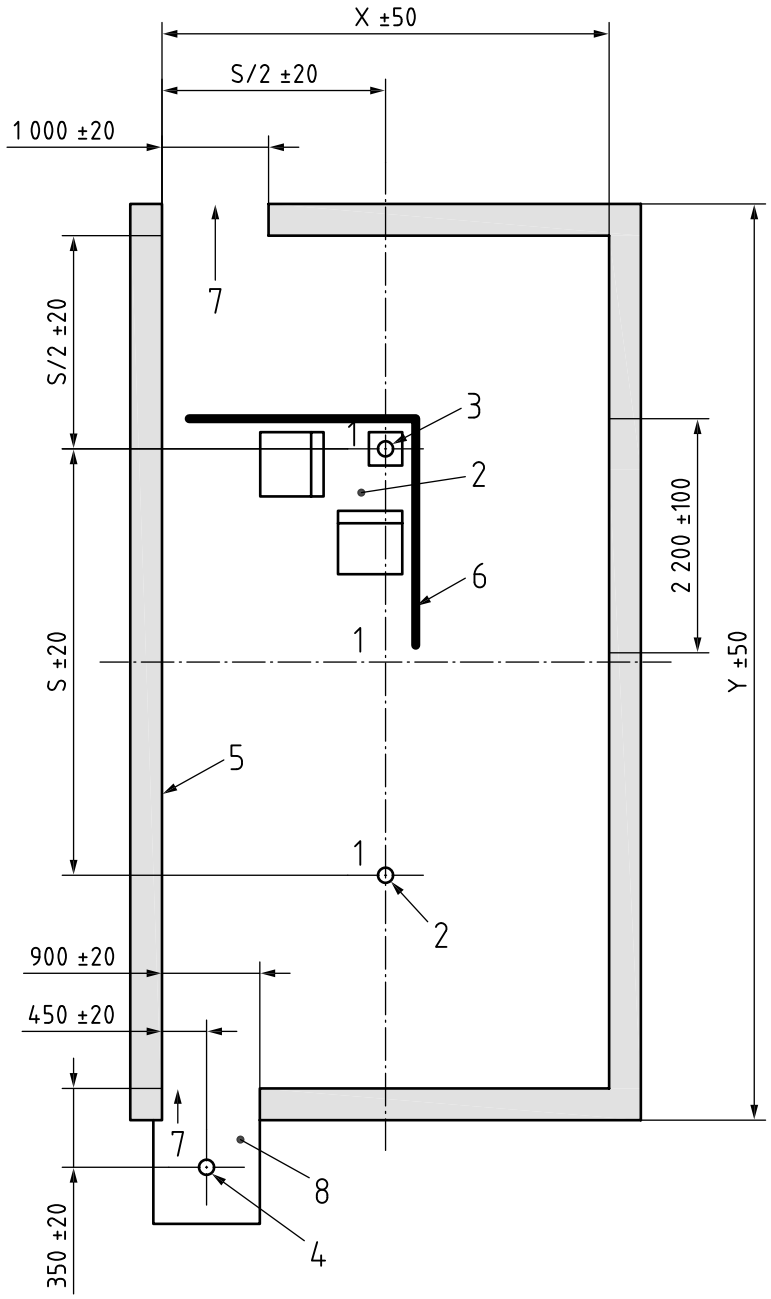


Key

1 Thermocouples
2 Between two nozzles fire test ignition and fuel package (see Figure C.5)
3 Nozzle connected to water supply (see **C.3**)
4 Nozzle connected to water-filled pipe
5 Test room
6 1.2 m height plywood panels
7 Doorway
8 Porch

Figure C.3 **Beneath a nozzle test layout showing a two-nozzle arrangement**

Dimensions in millimetres

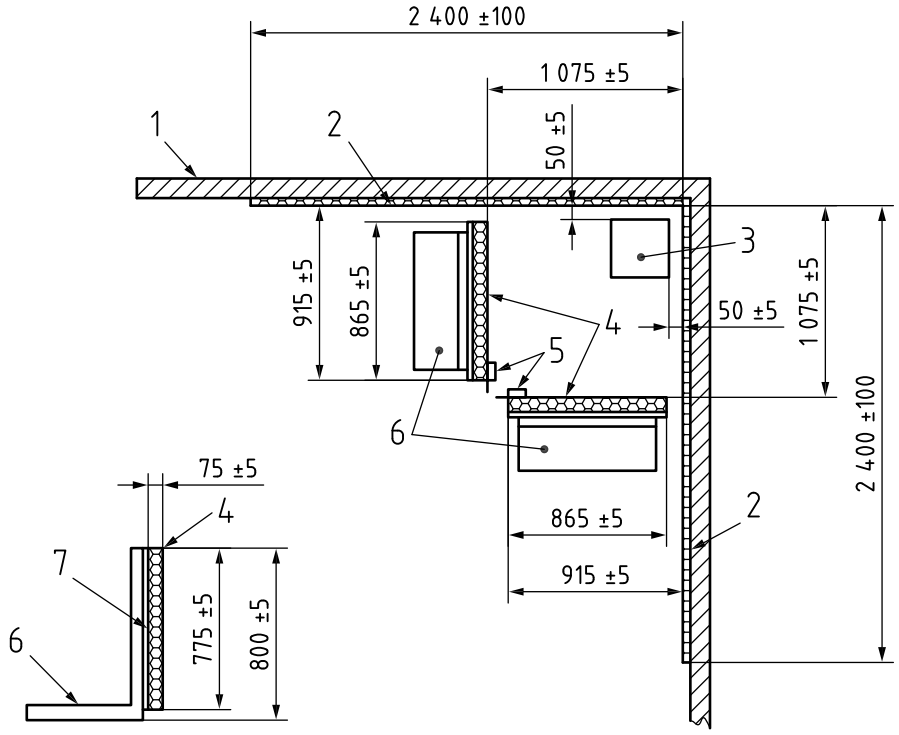


Key

1 Thermocouple
2 Beneath a nozzle fire test ignition and fuel package (see Figure C.5)
3 Nozzle connected to water supply (see **C.3**)
4 Nozzle connected to water-filled pipe
5 Test room
6 1.2 m height plywood panels
7 Doorway
8 Porch

Figure C.4 **Corner fire test ignition and fuel package**

Dimensions in millimetres



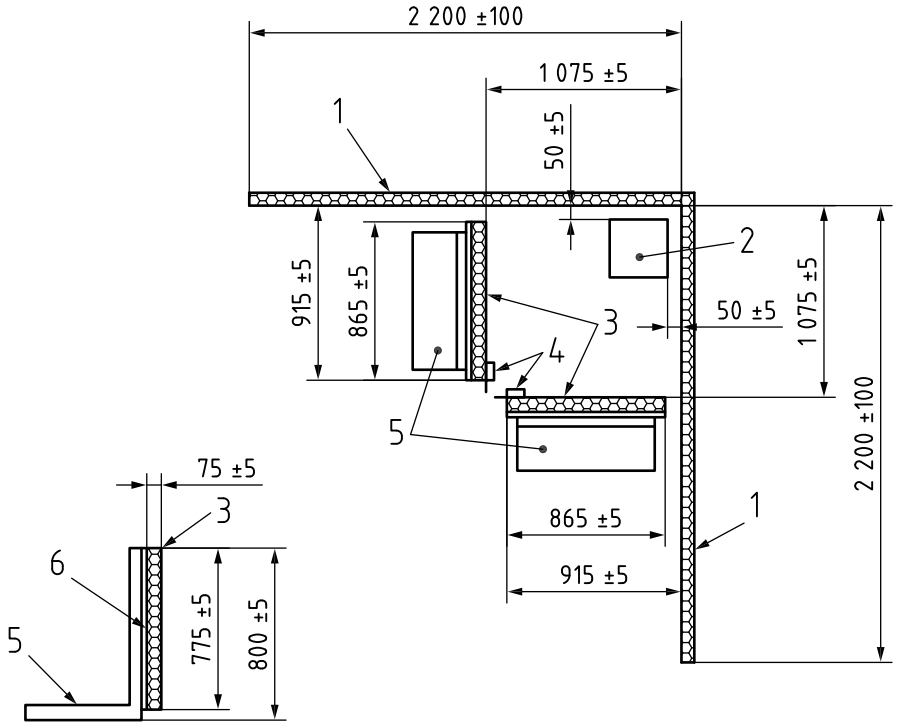
a) Side view of foam and stand arrangement b) Plan view

Key

1 Wall of test room
2 12 mm thick plywood sheets
3 Crib on tray containing heptane on water
4 Foam sheet glued to sacrificial board
5 Fire brick supporting ignition wick
6 Support stand
7 Sacrificial plywood board

Figure C.5 **Beneath a nozzle and between two nozzles fire test ignition and fuel package**

Dimensions in millimetres



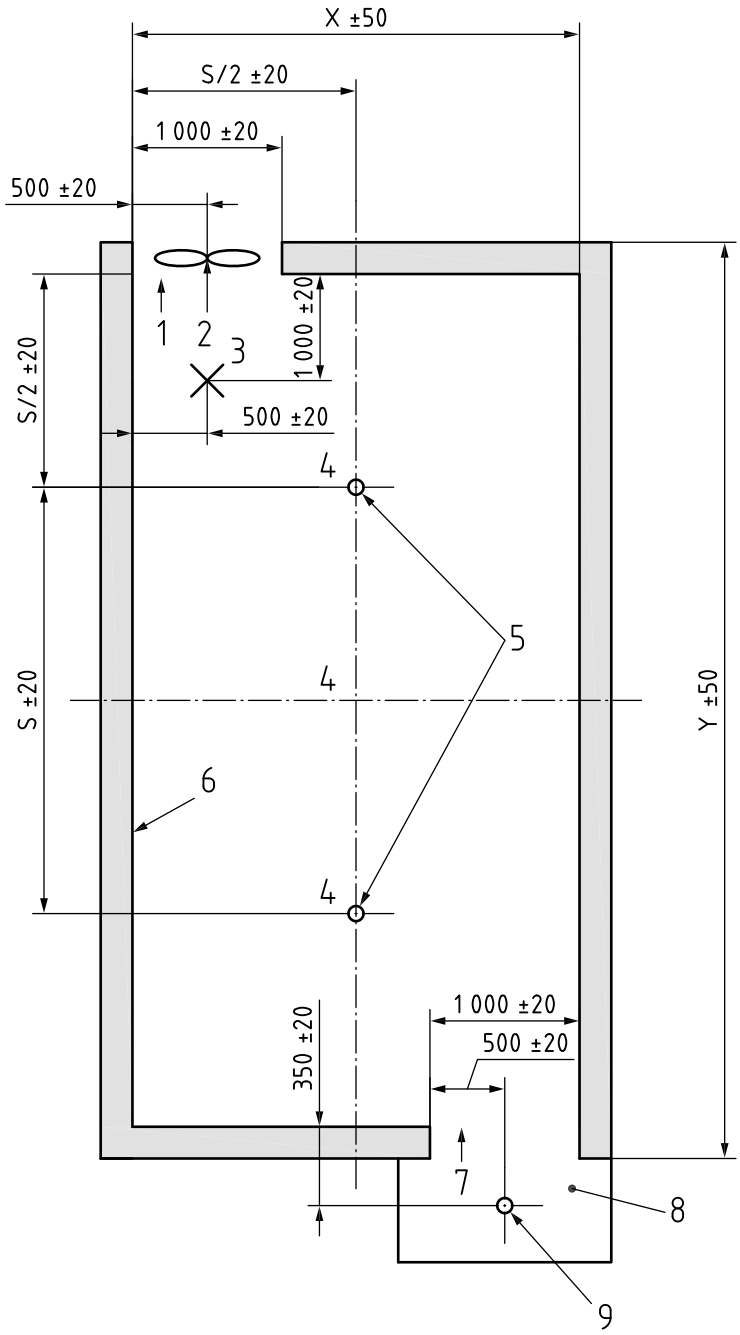
a) Side view of foam and stand arrangement b) Plan view

Key

1 12 mm thick plywood sheets
2 Crib on tray containing heptane on water
3 Foam sheet glued to sacrificial board
4 Fire brick supporting ignition wick
5 Support stand
6 Sacrificial plywood board

Figure C.6 **Ventilation test layout showing a two-nozzle arrangement**

Dimensions in millimetres



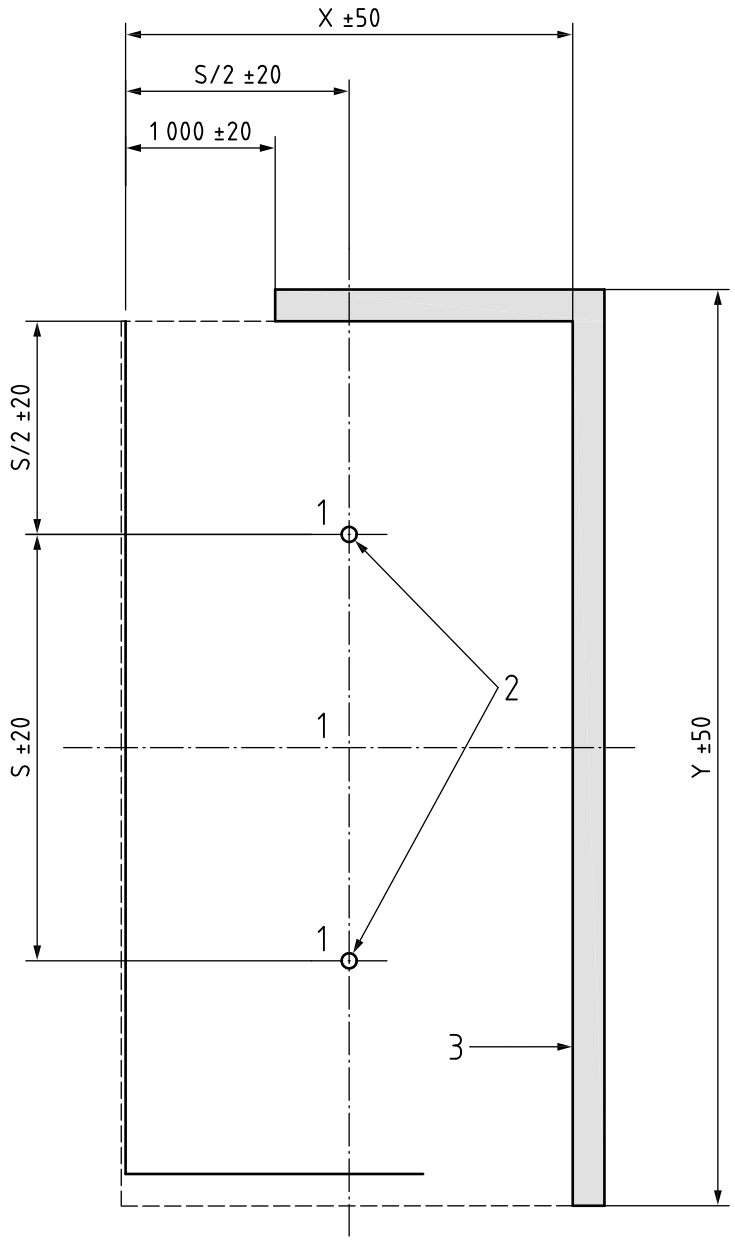
Key

1 Doorway A
2 Fan
3 Velocity measurement
4 Thermocouple
5 Nozzle connected to water supply
6 Test room
7 Doorway B
8 Porch
9 Nozzle connected to water-filled pipe

NOTE Fire test ignition and fuel package not shown.

Figure C.7 **Open room test layout showing a two-nozzle arrangement**

Dimensions in millimetres



Key

1 Thermocouple

2 Nozzle connected to water supply (see **C.3**)

3 Wall

NOTE Fire test ignition and fuel package not shown.

C.4 Procedure

Ignite the heptane in the steel tray and the cotton wicks simultaneously.

Record thermocouple temperatures at least every 2 s, throughout the tests and nozzle operating time(s) from ignition to 30 min after the operation of the first nozzle.

For every 15 temperature measurements (30 s), the 15 results should be added together and the total divided by fifteen to obtain the mean value. The highest mean values should then be taken as the maximum temperature recorded during the test.

Measure and record any flow of water to the room nozzles at intervals not exceeding 1 Hz to ensure that it does not fall below the minimum recommended design flow and that the most remote nozzles operate at the minimum recommended design pressure.

Measure and record water pressure to ensure that it does not fall below the minimum recommended design pressure.

Measure and record the rate of flow of any liquid or gas additive to ensure that the manufacturer's specification is met.

The following tests should be carried out.

a) **Corner test**. A test should be carried out with the fuel package positioned in the corner, as described in **C.3** and shown in Figure C.1 and Figure C.4.

b) **Fuel package between two nozzles test**. A test should be carried out with the fuel package positioned between two nozzles, as described in **C.3** and shown in Figure C.2 and Figure C.5.

c) **Fuel package beneath a nozzle test**. A test should be carried out with the fuel package positioned directly beneath a nozzle, as described in **C.3** and shown in Figure C.3 and Figure C.5.

d) **Ventilation test**. One test should be repeated [the test with the worst result out of a), b) and c)] with the ambient air having a minimum velocity of 1 m/s measured inside the room at a location at a height of 1 m above the floor, as shown in Figure C.6. The velocity should be provided by a 500 mm diameter mechanical fan mounted with its horizontal central axis located 1 m above and parallel to the floor. Figure C.6 shows the diagonal door arrangement for the ventilation test.

e) **Open room test**. Two tests should be repeated [the test with the best result out of a), b) and c) does not need to be repeated] with only two of the walls in place, as shown in Figure C.7.

f) **Increased ceiling height test**. If approval is required at a ceiling height between 3.5 m and 5.5 m at the request of the watermist manufacturer, tests a) to e) should be repeated at the increased height of 5.5 m. The height of the plywood partition arrangement for tests other than the corner tests should be increased to 2.4 m.

C.5 Test report

The results of the tests should be documented in a test report prepared in accordance with BS EN ISO/IEC 17025:2005, **5.10**. The test report should contain at least the following information:

a) a title;

b) the name and address of the laboratory, and the location where the tests were carried out, if different from the address of the laboratory;

c) unique identification of the test report (such as the serial number), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report;

d) the name and address of the client;

e) a description of the method used, including details of the test apparatus and a reference to the standard against which the system was tested, i.e. BS 8458:2015;

f) a description of, the condition of, and unambiguous identification of the item(s) tested;

g) the date of receipt of the test item(s) where this is critical to the validity and application of the results, and the date(s) of performance of the test;

h) the test results, with units of measurement where appropriate, together with the times and parameters recorded during each test;

i) a statement of compliance/non-compliance with the recommendations given in **6.1**;

j) confirmation of system design parameters relevant to the specific application, including, but not limited to, the following:

   1) the discharge duration;

   2) nozzle designation;

   3) room dimensions and nozzle positions (this should be in written form and also shown on a plan view drawing;

   4) test room height;

   5) operating flow rate to the nozzle(s);

   6) distance between the ceiling and nozzle orifice;

   7) pressure over the duration of the test;

   8) type of detection/actuation method;

   9) additives, propellants and atomizing media used;

   10) details of the test hall geometry;

   11) ventilation conditions during the test;

   12) environmental conditions during the test;

k) the name(s), function(s) and signature(s) or equivalent identification of person(s) authorizing the test report;

l) where relevant, a statement to the effect that the results relate only to the items tested.

Annex D (normative) Hydraulic calculations

D.1 Static pressure

The static pressure difference between two inter-connecting vertical points in a system should be calculated from:

$$p = 0.098h$$

where:

- p is the pressure, in bar;
- h is the vertical distance between the two points, in metres (m).

NOTE If the calculations are undertaken by hand then the value of p may be rounded to 0.1.

D.2 Flow from a nozzle

The flow from a nozzle should be determined by the following formula:

$$Q = kp^{0.5}$$

where:

- Q is the flow, in litres per minute (L/min);
- k is the constant, nozzle nominal *k*-factor;
- p is the pressure, in bar.

D.3 Pipe friction loss

For systems with no additives and working pressures not exceeding 12 bar, the pressure loss at a given flow through the pipework should be calculated using the Hazen–Williams formula:

$$p = \frac{6.05 \times 10^5}{C^{1.85} \times d^{4.87}} \times L \times Q^{1.85}$$

where:

- p is the pressure, in bar;
- C is a constant for the type and condition of the pipe (see Table D.1);
- d is the mean internal diameter of the pipe, in millimetres (mm);
- L is the equivalent length of pipe and fittings, in metres (m);
- Q is the flow, in litres per minute (L/min).

Table D.1 ***C* values for various type of pipes**

Type of pipe	Value of *C*
Carbon steel	120
Copper	140
CPVC	150

NOTE This list is not exhaustive. Other values are given in BS EN 12845.

The pressure loss in the pipework for any given flow should be calculated using the appropriate *K* value from Table D.2a, Table D.2b or Table D.2c and by using the following formula:

$$p = K \times Q^{1.85} \times L$$

where:

p is the pressure, in bar;

K is a constant for the pipe type given in Table D.2a, Table D.2b and Table D.2c;

Q is the flow, in litres per minute (L/min);

L is the equivalent length of pipe and fittings, in metres (m).

Table D.2a ***K* values for carbon steel tube conforming to BS EN 10255, Medium series**

Nominal diameter (mm)	Internal diameter (mm)	Value of *K*
20	21.70	2.67×10^{-5}
25	27.35	8.66×10^{-6}
32	36.05	2.25×10^{-6}
40	41.95	1.08×10^{-6}
50	53.05	3.44×10^{-7}
65	68.75	9.72×10^{-8}

Table D.2b ***K* values for CPVC conforming to ASTM F442**

Nominal diameter (mm)	Internal diameter (mm)	Value of *K*
20	22.20	1.58×10^{-5}
25	28.00	5.11×10^{-6}
32	35.40	1.63×10^{-6}
40	40.60	8.36×10^{-7}
50	50.90	2.78×10^{-7}
65	61.50	1.11×10^{-7}

Table D.2c ***K* values for copper tube conforming to BS EN 1057:2006+A1, half-hard, R250 designation**

Nominal diameter (mm)	Internal diameter (mm)	Value of *K*
22	21.10	2.30×10^{-5}
28	27.10	6.81×10^{-6}
35	33.50	2.42×10^{-6}
42	40.80	9.92×10^{-7}
54	52.80	2.64×10^{-7}

D.4 Pressure loss through fittings and valves

The pressure loss due to friction in valves and fittings should be calculated using the Hazen–Williams formula in **D.3** for the appropriate equivalent length.

The fitting or valve equivalent length should be taken from:

a) the manufacturer's instructions, when available; or

b) Table D.3a, Table D.3b and Table D.3c for the appropriate material; and

c) equivalent lengths of pipe for pulled bends in copper tube (in metres of pipe).

Table D.3a –Typical equivalent lengths for steel fittings and valves

Fittings and valves	Equivalent length in metres					
	20 mm [A)]	25 mm [A)]	32 mm [A)]	40 mm [A)]	50 mm [A)]	65 mm [A)]
90° elbow	0.76	0.77	1.00	1.20	1.50	1.90
45° elbow	0.34	0.40	0.55	0.66	0.76	1.00
Tee or cross	1.30	1.50	2.10	2.40	2.90	3.80
Gate or full bore ball valve	0.20	0.30	0.30	0.30	0.38	0.51
Butterfly valve	1.00	1.10	1.50	1.80	2.20	2.90
Globe valve	7.30	8.80	11.30	12.80	16.00	21.00
Non-return valve (swing type)	2.70	3.40	4.00	4.60	5.80	6.70
Non-return valve (mushroom or spring assisted disc type)	4.30	5.60	6.00	7.90	12.00	19.00
Flow switch [B)]	1.60	2.05	2.65	3.11	4.04	5.30

NOTE The values given are based on a C-value of 120.

A) Nominal diameter.

B) Flow switch equivalent lengths have been derived on the basis of UL 346 test parameters where UL listed flow switches are required to have a maximum loss of 0.207 bar (3.0 psi), at a flow rate equivalent to a velocity of 4.6 m/s.

Table D.3b **Typical equivalent lengths for CPVC fittings and valves**

Fittings and valves	Equivalent length in metres					
	20 mm [A)]	25 mm [A)]	32 mm [A)]	40 mm [A)]	50 mm [A)]	65 mm [A)]
90° elbow	2.13	2.13	2.44	2.84	3.35	3.66
45° elbow	0.30	0.30	0.61	0.61	0.61	0.91
Tee branch	0.91	1.52	1.83	2.44	3.05	3.66
Tee run or coupling	0.30	0.30	0.30	0.30	0.30	0.61
Gate or full bore ball valve	0.30	0.45	0.45	0.45	0.57	0.77
Butterfly valve	1.51	1.66	2.26	2.72	3.32	4.38
Globe valve	7.30	10.00	13.00	16.00	22.00	24.10
Non-return valve (swing type)	4.23	5.13	6.04	6.95	8.76	10.12
Non-return valve (mushroom or spring assisted disc type)	6.49	8.46	9.06	11.93	18.12	28.69
Flow switch [B)]	2.42	3.10	4.00	4.70	6.10	8.00

NOTE The values given are based on a C-value of 150.

A) Nominal diameter.

B) Flow switch equivalent lengths have been derived on the basis of UL 346 test parameters where UL listed flow switches are required to have a maximum loss of 0.207 bar (3.0 psi), at a flow rate equivalent to a velocity of 4.6 m/s.

Table D.3c **Typical equivalent lengths for copper fittings and valves**

Fittings and valves	Equivalent length in metres					
	22 mm [A)]	28 mm [A)]	35 mm [A)]	42 mm [A)]	54 mm [A)]	67 mm [A)]
90° elbow	0.80	1.00	1.40	1.70	2.30	3.00
45° elbow	0.45	0.53	0.73	0.88	1.01	1.33
Tee	1.00	1.50	2.00	2.50	3.50	4.50
Gate or full bore ball valve	0.27	0.40	0.40	0.40	0.51	0.68
Butterfly valve	1.33	1.46	2.00	2.40	2.93	3.86
Globe valve	11.02	13.29	17.06	19.33	24.16	31.71
Non-return valve (swing type)	3.60	4.52	5.32	6.12	7.71	8.91
Non-return valve (mushroom or spring assisted disc type)	5.72	7.45	7.98	10.51	15.96	25.27
Flow switch [B)]	2.00	2.50	3.20	4.00	5.50	6.40

NOTE The values given are based on a C-value of 140.

A) Nominal diameter.

B) Flow switch equivalent lengths have been derived on the basis of UL 346 test parameters where UL listed flow switches are required to have a maximum loss of 0.207 bar (3.0 psi), at a flow rate equivalent to a velocity of 4.6 m/s.

The frictional pressure loss in copper pipework bends where the direction of water flow is changed through 45° or more should be calculated using the formula:

$$L = 7.65 \times 10^{-3} Q^{0.15} d^{0.87}$$

where:

L is the equivalent length, in metres (m);

Q is the flow, in litres per minute (L/min);

d is the mean internal diameter of the pipe, in millimetres (mm).

D.5 Maximum flow demand calculation

The maximum flow demand should be determined by either:

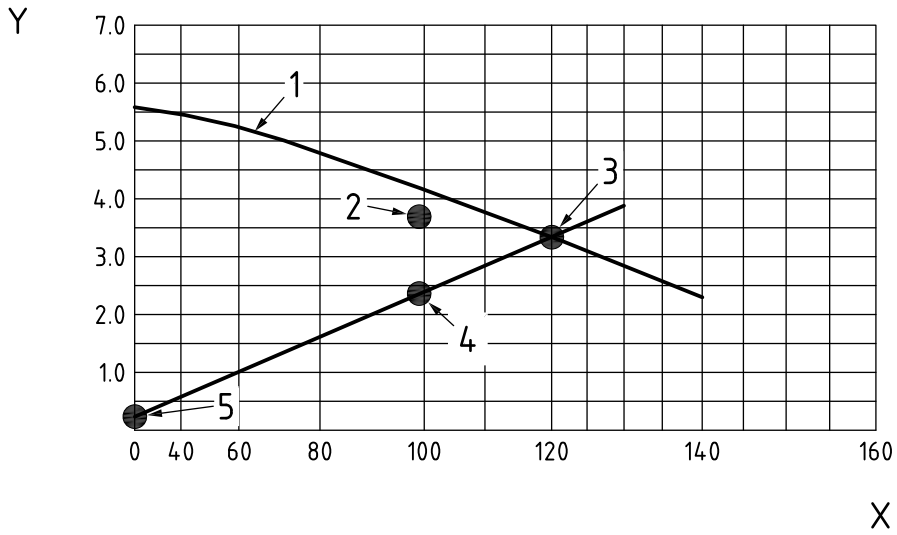
a) full calculation referencing the available water supply flow/pressure characteristics when applied to the calculated hydraulic demand point of the most favourable area; or

b) determination of the intersect point of the available water supply flow/pressure characteristics with the calculated hydraulic demand point of the most favourable area, using a square law graduation graph referenced as an installer's pump test data sheet.

NOTE An example of using a square law graduation graph is shown in Figure D.1, and a blank template covering a range of appropriate flow rate and pressure requirements in Figure D.2. Figure D.1 indicates:

- *the pump curve performance characteristics;*
- *the most unfavourable demand point at 98 L/min at 3.6 bar;*
- *the most favourable demand point at 98 L/min at 2.4 bar;*
- *the highest operating nozzle located within the favourable area at 2.0 m high (equivalent to 0.196 bar);*
- *the maximum flow demand of 120 L/min.*

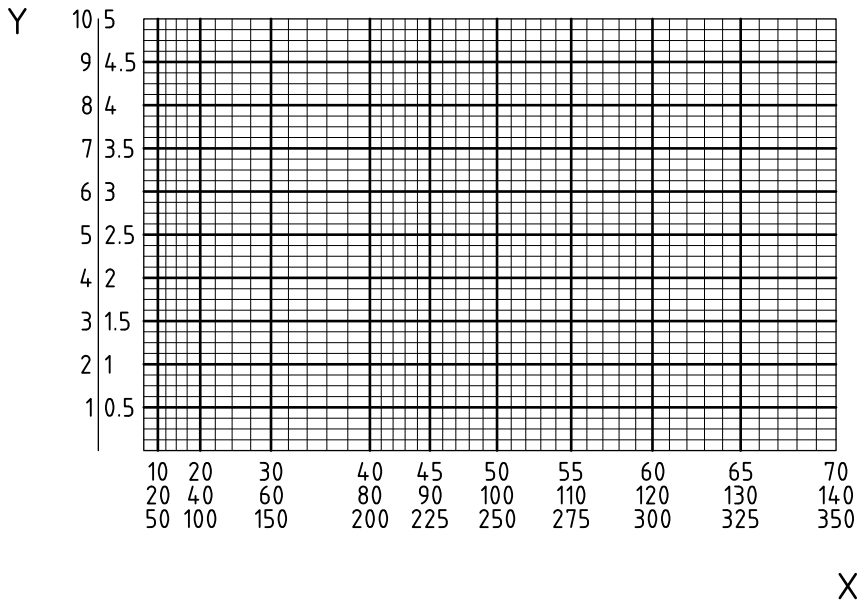
Figure D.1 **Example of a square law graduation graph**



Key

1 Pump curve
2 Most unfavourable demand point
3 Maximum flow demand (120 L/min)
4 Most favourable demand point
5 Height of highest most favourable nozzle in bar
X Flow, in litres per minute (L/min)
Y Pressure, in bar

Figure D.2 **Blank template of a square law graduation graph**



Key

X Flow, in litres per minute (L/min)
Y Pressure, in bar

Annex E (informative)

Example of system data label

An example of a system data label is shown in Figure E.1.

Figure E.1 **Example of system data label**

Watermist system data	
Installed at	*123 Main Street,* *Town,* *County,* *Postcode*
Installation date	*month/year*
Design specification	
Code of practice	*BS 8458:2015*
Category of system	*Domestic/Residential*
Hydraulic data	
Nozzles operating	*2 No.*
Flow/pressure demand	*100 L/min @ 5 bar*
Installing contractor	
Name *Address* *Logo*	Contract Reference No. *AB1234*
Third party certification body, if appropriate	*Name*
Certificate URN	*CD5678*

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476 (all parts), *Fire tests on building materials and structures*

BS 1710, *Specification for identification of pipelines and services*

DD 8489-1, *Fixed fire protection systems – Industrial and commercial watermist systems – Part 1: Code of practice for design and installation* [11)]

BS 9991, *Fire safety in the design, management and use of residential buildings – Code of practice*

BS 9999, *Code of practice for fire safety in the design, management and use of buildings*

BS EN 1363-1, *Fire resistance tests – Part 1: General requirements*

BS EN 1364-1, *Fire resistance tests for non-loadbearing elements – Part 1: Walls*

BS EN 1365-1, *Fire resistance tests for loadbearing elements – Part 1: Walls*

BS EN 1365-2, *Fire resistance tests for loadbearing elements – Part 2: Floors and roofs*

BS EN 1366-3, *Fire resistance tests for service installations – Part 3: Penetration seals*

BS EN 1717:2000, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

BS EN 12845, *Fixed firefighting systems – Automatic sprinkler systems – Design, installation and maintenance*

BS EN 13381-1, *Test methods for determining the contribution to the fire resistance of structural members – Part 1: Horizontal protective membranes*

BS EN ISO 9001, *Quality management systems – Requirements*

UL 346, *Waterflow indicators for fire protective signalling systems*

Other publications

[1] DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. *The Building Regulations 2010 – Approved Document B: Fire safety – Volume 1: Dwellinghouses*. 2006 ed. incorporating 2010 and 2013 amendments for use in England. London: National Building Specification (NBS), 2013.

[2] DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. *The Building Regulations 2010 – Approved Document B: Fire safety – Volume 2: Buildings other than dwellinghouses*. 2006 ed. incorporating 2010 and 2013 amendments for use in England. London: National Building Specification (NBS), 2013.

[3] WELSH GOVERNMENT (DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT publication). *The Building Regulations 2010 – Approved Document B: Fire safety – Volume 2: Buildings other than dwellinghouses*. 2006 ed. incorporating 2010 amendments for use in Wales. Crown copyright, 2010.

[11)] At the time of publication of BS 8458, DD 8489-1 is undergoing conversion to a full British Standard as BS 8489-1.

[4] WELSH GOVERNMENT. *The Building Regulations 2010 – Approved Document B: Fire safety – Volume 2: Buildings other than dwellinghouses*. 2006 ed. incorporating 2010 and 2013 amendments for use in Wales. Crown copyright, 2013.

[5] SCOTTISH BUILDING STANDARDS AGENCY. *The Scottish Building Standards Technical Handbook – Section 2: Fire*. Edinburgh: Scottish Government, 2013.

[6] NORTHERN IRELAND DEPARTMENT OF FINANCE AND PERSONNEL. *The Building Regulations (NI) 2000 Technical Booklet E – Fire safety*. Belfast: The Stationery Office, 2005.

[7] GREAT BRITAIN. Water Supply (Water Fittings) Regulations 1999. London: The Stationery Office.

[8] SCOTTISH WATER. Water Supply (Water Fittings) (Scotland) Byelaws 2014. Edinburgh: Scottish Water.

[9] NORTHERN IRELAND. Water Supply (Water Fittings) Regulations (Northern Ireland) 2009. Belfast: The Stationery Office.

[10] WATER REGULATIONS ADVISORY SCHEME. *Water Regulations guide*. Oakdale, Gwent: WRAS, 2000.

[11] EUROPEAN COMMUNITIES. 97/23/EC. Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment. Luxembourg: Office for Official Publications of the European Communities, 1997.

[12] NATIONAL FIRE PROTECTION ASSOCIATION. *Standard on water mist fire protection systems*. NFPA 750. Quincy, Massachusetts: NFPA, 2010.

[13] LOSS PREVENTION COUNCIL. *Legionella and fire-fighting systems – A technical briefing note*. Moreton in Marsh: Fire Protection Association, 1999.

[14] GREAT BRITAIN. Pressure Equipment Regulations 1999. London: The Stationery Office.

[15] BRE GLOBAL LIMITED. *LPCB Red Book 2014 – List of approved products and services*. Watford: BRE Global Limited, 2014. [12)]

[12)] Available at www.redbooklive.com [last accessed 25 November 2015].

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™