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An independent guide on water mist systems for residential buildings

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(version 2)

The authors of this report are employed by BRE. The work reported herein was carried out under a Contract placed by the DCLG. Any views expressed are not necessarily those of the DCLG.

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Acknowledgements

The authors of this guide are employed by BRE. The work reported herein was carried out under a contract placed by the then ODPM*. Any views expressed are not necessarily those of the Department.

In addition, an industry Steering Group informed, reviewed and commented on the guide, and provided relevant data/information. The individual Steering Group members that participated and the organisations they represent are as follows.

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The authors would also like to thank fire safety officers from Merseyside Fire and Rescue Service and building control officers from Halton Borough Council who were interviewed and provided valuable initial feedback on the water mist pro-forma and checklist.

* Following machinery of government changes on 5 May 2006 ODPM became the Department of Communities and Local Government (DCLG)

1.	Introduction
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This is a guide to water mist systems primarily intended for use by approving authorities, e.g. building control bodies and fire safety officers, to detail current knowledge, improve education about systems, to dispel myths/misunderstandings and to assist them in assessing water mist systems in residential buildings that they may be faced with.

This guide also includes recommendations, cautions and commentary relating to the use of water mist systems for life safety in residential building applications and suggests when it may be appropriate to obtain specialist advice.

This guide applies to the majority of building types covered by Approved Document B⁶ (Fire safety) Residential purpose groups, group 1 and the sleeping areas of group 2.

A water mist system is a fixed fire protection system, comprising components for automatic detection and actuation, water supply delivery and water atomisation. A water mist system discharges a spray of small water droplets.

Water mist systems are currently the subject of debate information about the overall effectiveness of these systems for residential life safety applications is not well established.

Water mist systems have been demonstrated to be suitable and effective for the protection of spaces on board ships and are an emerging technology for life safety building applications on land. They have successfully been applied to protect assets, e.g. electronic equipment, machinery spaces and deep fat fryers in buildings and now are being increasingly considered for a range of building applications, e.g. for residential premises.

Assessment of water mist systems requires case by case review. This guide contains an assessment checklist and pro-forma to assist building control professionals and fire safety officers in coming to a judgement on the suitability of a particular water mist system for life safety purposes in specific residential building applications.

Although this guide is focused on life safety applications, information and principles contained in it may also be appropriate for water mist systems installed for property/asset protection. However, it is recommended that insurers should be consulted for property/asset protection applications.

This guide is not a regulatory document. It does not specifically cover water mist systems for use in non building applications, non residential types of buildings, e.g. commercial and industrial, object protection water mist systems or portable water mist systems.

2. Background

This section includes a brief historical context and the current emerging water mist scene in the UK, the reasons for considering these systems, how water mist systems fit in with other fire protection measures and cost considerations.

A form of water mist system was originally used in the 1930s in industrial applications for asset protection. In the last decade, water mist came to prominence for fire protection use on board ships and for industrial and commercial applications. In the last ten years, water mist has been the subject of extensive research and development, resulting in systems that have been optimised and proven for some applications, e.g. machinery spaces. Currently, water mist systems are an emerging technology for life safety building applications, including residential buildings.

In 2004, BRE carried out a survey on behalf of DCLG on water mist, fog and similar systems used in buildings¹. The survey found that there were over 1000 water mist systems installed in buildings in the UK. Most of the water mist systems installed in life safety applications had been provided in the last two or three years. The building control professionals and fire safety officers reported high numbers of systems installed in dwellinghouses and flats and maisonettes. Many of the water mist systems had been installed as a compensatory feature to meet provisions of the Building Regulations and on fire and rescue service recommendation.

The main concern and challenge for a building control professional or fire safety officer, when considering the approval of a water mist system for a life safety residential application, is that the information available is limited.

The approval process would normally rely on the application of appropriate system standards. However, in the case of water mist systems, there are currently no published British or European standards for components or systems. A European Technical Specification is in preparation, but this does not currently include residential applications. Other existing water mist standards, e.g. USA and marine, are not directly applicable to UK building applications. Therefore, expert interpretation and further work is required.

However, the sources of further information on which to base expert interpretation are limited. Issues relating to the equivalence of performance of water mist systems compared to other active and passive fire protection measures have not been investigated. Aspects such as reliability, real fires history and long-term maintenance are largely unknown or unproven.

The potential reasons for considering water mist systems include:

- Life safety benefit additional to the current provisions of the Building Regulations
- Life safety compensatory feature to meet current provisions of the Building Regulations
- Fire service recommendation
- Property/asset protection
- Alternative to an automatic sprinkler system (life safety/property/asset protection).

Examples of circumstances where water mist systems have been applied are:

- Where there is a risk of life loss
- Where there is a high incidence of fires occurring or where vulnerable occupants are housed

- Where extended travel distances or reduced fire separation requirements are sought
- Where fire and rescue service access to the building and facilities may be restricted
- Where there are high value items or historic features requiring protection.

If a water mist system is being proposed as a compensatory feature to meet provisions of the Building Regulations or other Regulatory requirements, it is critical that all aspects of this guide are considered. Approving authorities should carry out a thorough assessment of the water mist system to confirm that it is appropriate and acceptable as for any compensatory feature.

Water mist systems are part of the overall package of fire safety measures in a residential building and should not be considered in isolation. For example, there would generally be smoke alarms or a fire detection and alarm system installed and passive fire protection measures in place.

Consideration of the costs of a water mist system for residential premises does not simply include the costs of installation and provision of water supplies, but also includes the costs for annual inspection, testing and ongoing system maintenance.

If a water mist system is being proposed as a compensatory feature, there may be indirect cost reductions due to building design changes.

There are other building life safety applications for water mist systems, which include: office, shop and commercial, assembly and recreation, industrial and storage. Although this guide is focused on residential premises, the methodology laid out in this guide may be appropriate for these applications. However, the specific water mist systems details will differ for each application, such as:

- Reasons for considering the system
- Fire hazards
- Building types and features
- System type
- System design, installation and maintenance
- Fire performance tests.

3.	Terms used
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Related to Q1 in checklist in Appendix A: Is this a water mist system?

The common terms used in this guide and their meanings are as follows.

Approving authorities. Examples of approving authorities are: Building control bodies, fire safety officers, environmental health officers, registered social landlords

Deluge system is a system in which, when the control valve is opened, water flows into the pipework and discharges simultaneously through all the nozzles attached to the system

Dry pipe system is a system in which the pipework is charged with air or inert gas under pressure

High pressure water mist system is a system in which the system pressure is greater than or equal to 35 bar

Light hazard sprinkler system is an automatic sprinkler system designed, installed and maintained to British Standard BS 5306 or European Standard EN 12845 for a light hazard occupancy, i.e. occupancies with low fire loads and low combustibility, with no single compartment greater than 126 m², with a fire resistance of at least 30 minutes. *(Not covered in this guide)*

Low pressure water mist system is a system in which the system pressure is less than or equal to 12.5 bar

Medium pressure water mist system is a system in which the system pressure is between 12.5 and 35 bar

Object protection system (also known as local application system) is a water mist system designed to discharge water mist directly onto an object or hazard. These systems have been installed to protect inside enclosures, unenclosed objects within buildings and outdoor applications. A typical example would be a gas turbine. *(Not covered in this guide)*

Pre-action system is a dry system in which the control valve can be opened by an independent fire detection system in the protected area, prior to the independent operation of any automatic nozzle

Residential sprinkler system is an automatic sprinkler system for domestic and residential premises, designed, installed and maintained to British Standard BS 9251. *(Not covered in this guide)*

Water application rate is the water flow rate, in litres/minute

Water fog is another name sometimes used to describe the sub category of high pressure water mist systems

Water mist system provides a water spray for which 90% of the flow-weighted cumulative volumetric distribution of water droplets is less than 1000 microns. This value is found at the minimum design operating pressure and is measured in a plane 1 m from the nozzle²

Water mist system contractor is a contractor who is appropriately assessed, qualified and experienced to carry out design, installation and maintenance of water mist systems

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Water spray system is similar, in principle, to a sprinkler system, designed to extinguish flammable liquid fires, or to provide cooling to an exposed area likely to be subjected to intense heat radiation from a neighbouring fire, widely used in the process industry. *(Not covered in this guide)*

Wet pipe system is a system in which the pipework is always charged with water

Volume protection system is a system designed to discharge water mist to protect all hazards in a predefined volume, usually a room. A typical example would be rooms in a dwelling

4.	Description of water mist systems
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Related to Q1 in checklist in Appendix A: Is this a water mist system?

Related to Q10 and Q10a in checklist in Appendix A: What are the design assumptions? Are the design assumptions acceptable?

Related to Q11, Q11a and Q11b in checklist in Appendix A: Has the relevant documentation been provided? Does the documentation contain all the relevant information? Is the system design, installation and maintenance acceptable?

Related to Q12 and Q12a in checklist in Appendix A: Have all the system components been assessed? Are all the system components acceptable?

Related to Q13 in checklist in Appendix A: Are the proposed system details acceptable?

4.1	Overview
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A water mist system is a fixed fire protection system that uses water to control, suppress or extinguish a fire. The system comprises automatic nozzles attached to a piping system containing water and connected to a water supply. At operation, the water mist system discharges a cone of spray containing small water droplets that fills the protected zone with water mist. Some systems additionally discharge other gases or include additives. An effective water mist system should generate, distribute, and maintain a concentration of small droplets sufficient for the protection of the fire risk for sufficient time to meet the objective of the protection. Fundamental to achieving this is:

- Maintaining the correct pressure/flow characteristics at the nozzle for sufficient time
- Careful placement of the nozzles to ensure full coverage of the space and minimal water wastage due to collisions of the spray with solid surfaces (beams, walls, cupboards)

Also, it may be important to shut down air flows, e.g. from ventilation systems, to minimise water mist loss from the protected volume.

4.2	Design criteria
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The system contractor should detail the criteria upon which the water mist system design is based. These include:

- Fire control mechanisms
- Fire control objective
- Duration of water mist protection.

4.2.1 Fire control mechanisms

In the event of a fire, a heat sensitive quick response glass bulb is generally used to actuate the water mist system. Therefore, at the time of actuation in a residential premise, the fire is likely to be well established and appropriate for water mist control. In some cases, other forms of detectors are employed.

Following actuation, the water droplets discharged from a water mist system penetrate the fire. The intention is to reduce the temperature, the radiative heat and the oxygen concentration in the zone where the fire and water mist interact. The remainder of the room is protected by cooling of the hot fire gases and smoke, and some wetting of other potential combustible fuels in the room.

Because water mist does not primarily extinguish by direct wetting of solid fuels, its impact on, for example, deep-seated fires will be slow. Other scenarios where water mist may not be able to extinguish fires include: small fires and shielded fires.

4.2.2 Fire control objective

The design fire control objective for a water mist system can be:

- Fire extinguishment. A sharp reduction in heat release rate leading to complete elimination of any flaming or smouldering fire or
- Fire suppression/control. A steady reduction in the heat release rate resulting in a lower controlled level of burning/limitation of fire growth and protection of structure (by cooling of the objects, fire gases and/or by pre-wetting adjacent combustibles).

The fire control design objective for a water mist system needs to be clearly stated by the water mist contractor with supporting evidence, so that an approving authority can make judgements about the fire risk assessment and interactions with other fire protection systems for the residential premises.

4.2.3 Duration of water mist protection

An appropriate minimum duration of water supply needs to be selected for each project as it is currently not a prescribed standardised value. Values of minimum duration of water supply could be taken as for automatic sprinkler systems, for similar premises, e.g. minimum durations for:

Domestic - in excess of 10 minutes for BS 9251⁵ sprinkler systems

Residential - 30 minutes for BS 9251⁵ sprinkler systems

or in excess of 60 minutes for BS EN 12845³ or BS 5306 Part 2⁴ sprinkler systems.

The system contractor should detail the minimum duration of protection with supporting evidence.

People in sleeping areas can be categorised as at a higher risk from fire as they may:

- Need to be woken up
- Be disorientated
- Be aged or infirm

- Be under the influence of drugs or alcohol
- Need assistance to escape.

In institutional residential buildings, there may be only a few staff available to assist people to escape at night. Therefore, it may be important to extend the duration of water mist protection.

Premises which are occupied by people requiring assisted escape may need special consideration e.g. provision of a longer duration of water mist protection, provision of detectors with greater sensitivity and development of an appropriate management strategy.

4.3 Protection of means of escape and fire-fighting access

Aspects that need to be considered and addressed by the system contractor (see sections 7 and 9), in particular for water mist systems that are being installed as a compensatory feature to meet the Building Regulations requirements, are:

- Extent of fire suppression/control
- Tenability of conditions inside premises
- Time required for safe escape of occupants
- Time required for safe fire-fighter access
- Likely scenario after the water mist has finished discharging.

Questions that need to be considered by building control professionals, include:

- Will the conditions in the room of fire origin remain tenable for a specified period of time?
- Will the conditions in adjacent rooms and escape routes remain tenable for a sufficient time for occupants to escape safely to a place of safety?
- Will there be sufficient time for fire and rescue service personnel to enter the premises safely to effect firefighting (and rescue) activities?

For water mist project design solutions, there will be assumptions about interactions with fire and rescue service activities. For example, water mist systems may allow conditions in the room of origin to remain tenable for a specified period of time, and fire and rescue service personnel may be expected to enter the room to extinguish the fire.

Therefore, early consultation with the fire and rescue service is strongly recommended.

4.4 Key components

Commercially-available water mist systems are all distinctly different. They are not standardised or of pre-described forms, unlike automatic sprinkler systems. However, they can be categorised by reference to the following key components:

- Fire fighting medium - potable water, water with antifreeze, water with additive, water with inert gas

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- Detection – automatic quick response glass bulb nozzles, smoke detectors and actuators, with or without cover plates, alarms and control panel and alarm system
- Atomisation – nozzle and orifice, filters and strainers, single fluid system, twin fluid system, low pressure (≤ 12.5 bar); medium pressure (> 12.5 bar and < 35 bar), high pressure: (≥ 35 bar)
- Delivery - wet pipe system, dry pipe system, pre-action system, deluge system, pipe (material e.g. stainless steel, fire rated CPVC plastic[†], copper, supports)
- Supply – storage vessel (e.g. tanks, cylinders), towns mains, propellant (e.g. nitrogen), pumps.

Most water mist systems for use in residential buildings will be low pressure, wet pipe systems, with automatic, quick response glass bulb nozzles, supplied by cylinders or tanks containing potable water.

[†] Chlorinated Polyvinylchloride

An example layout of a water mist system in a dwellinghouse, showing pressurised water cylinders and optional mains water supplies, is shown in Figure 1.

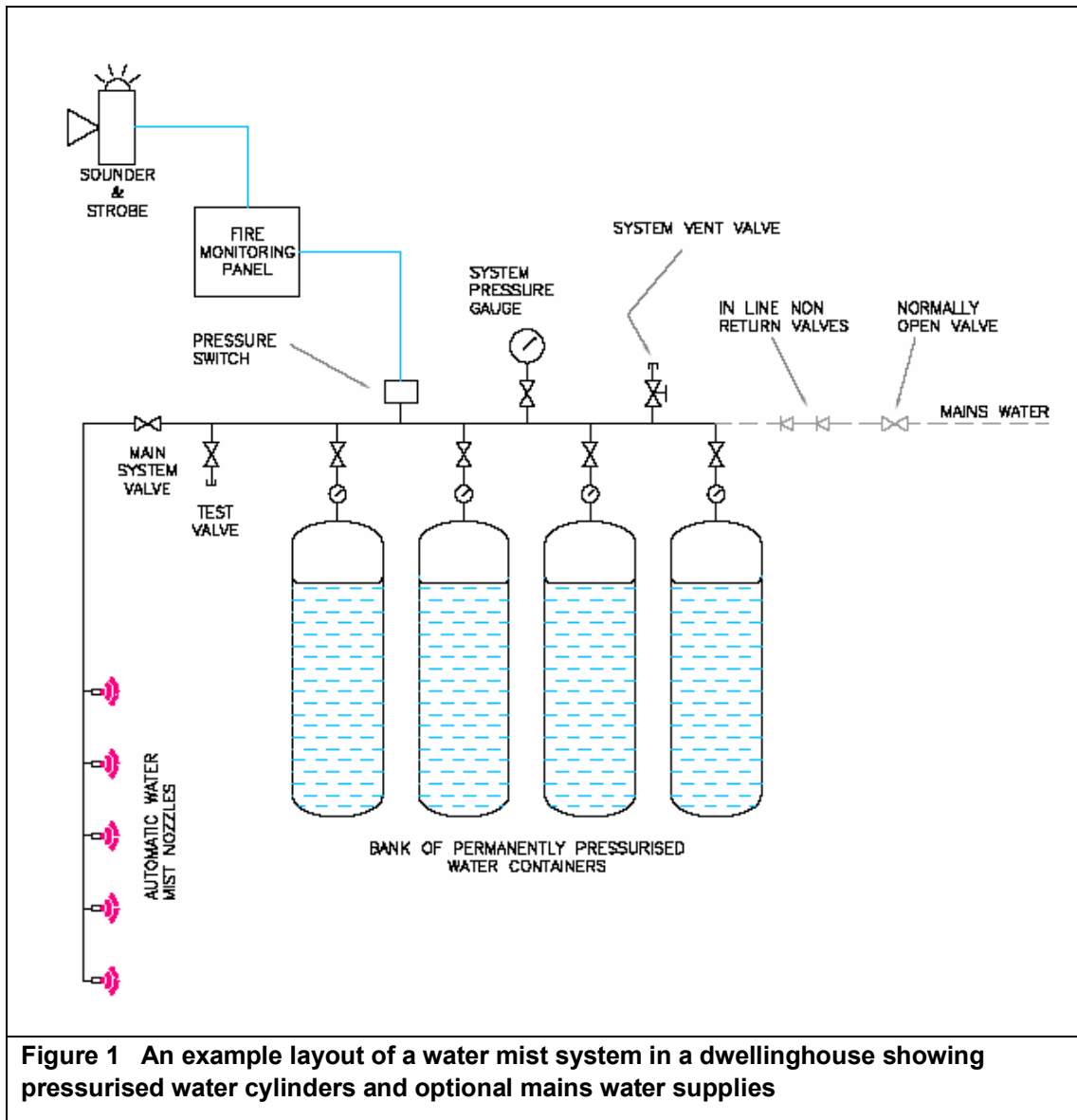


Figure 1 An example layout of a water mist system in a dwellinghouse showing pressurised water cylinders and optional mains water supplies

An example layout of a water mist system in a residential premises showing a pump and tank arrangement is shown in Figure 2.

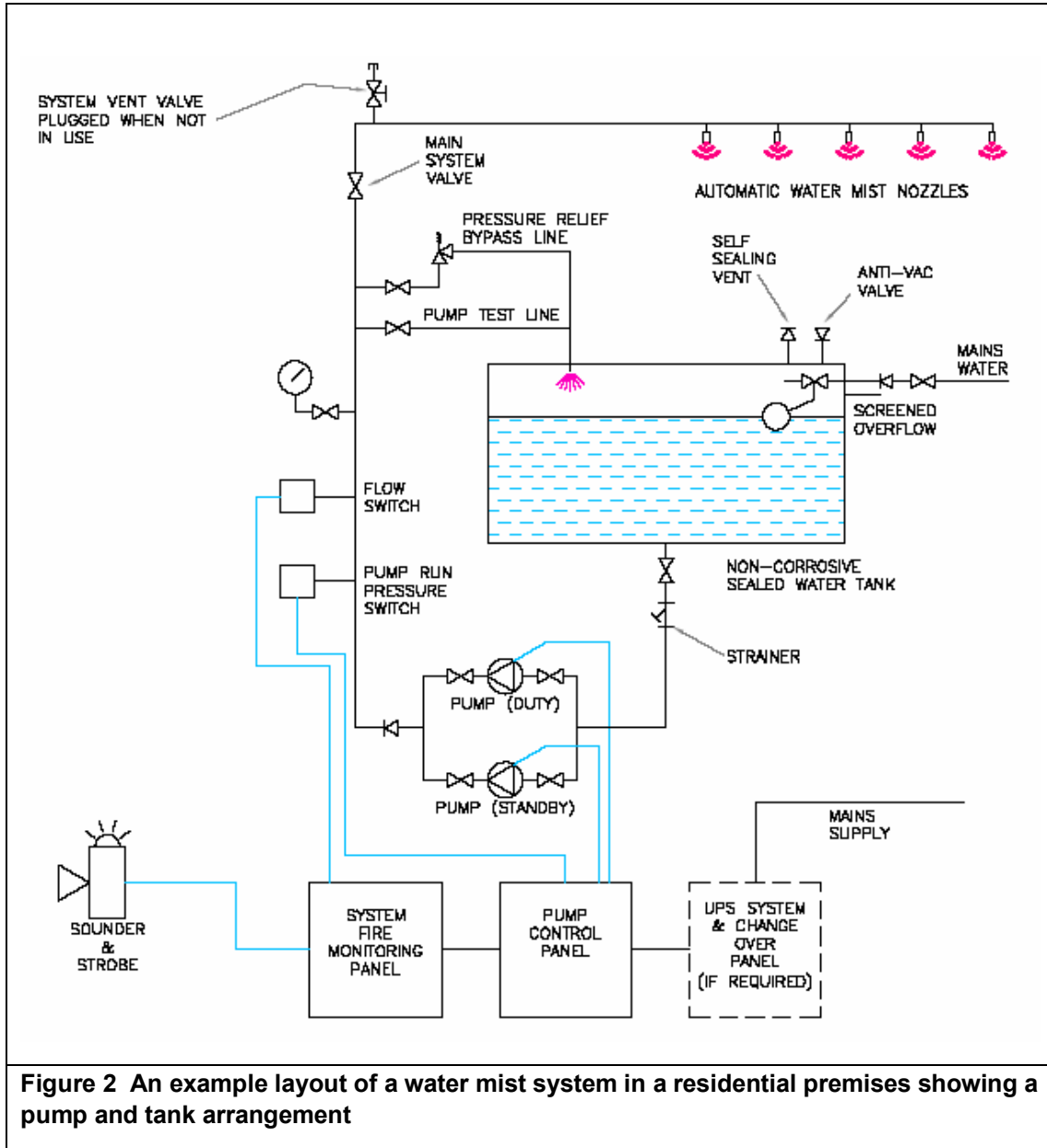


Figure 2 An example layout of a water mist system in a residential premises showing a pump and tank arrangement

Figures 1 and 2 are indicative schematic diagrams and show some of the key components. They do not represent actual systems. For example, an actual system may have additional or alternative components and/or water supplies with additives.

For further information regarding components and system design, see section 9.

5.	Description of building types and fire hazards
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Related to Q2 in checklist in Appendix A: What is the main purpose of this water mist system?

Related to Q3 in checklist in Appendix A: Is this proposed water mist system being installed in residential building types covered by this guide?

Related to Q4 in checklist in Appendix A: What areas are protected?

5.1	Building types
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This guide is primarily concerned with the majority of building types covered by Approved Document B⁶ purpose groups 1 and 2 - Residential. Approved Document B is the fire safety guidance document that supports Part B (Fire safety) of the Building Regulations. Definitions of purpose groups can be found in Appendix D of Approved Document B. These have been summarised as follows:

- Flat or maisonette 1(a)
- Dwellinghouse 1(b and c)
- Residential homes for elderly people (2a)
- Residential home for disabled people (2a)
- Residential home for children (2a)
- Boarding school (2a)
- Nursery (2a)
- Place of lawful detention (2a)
- Hotel (2b) - residential areas
- Boarding house (2b)
- Residential college (2b)
- Hall of residence (2b)
- Hostel (2b).

This guide only applies to the sleeping areas in purpose group 2 of Approved Document B⁶, e.g. bedrooms, corridors, hotel suites and associated rooms. This guide does not apply to other areas in these buildings, e.g. restaurants, places of assembly and storage areas.

Special considerations apply to places of lawful detention.

In UK residential sprinkler standards^{5, 7} the categories of domestic and residential occupancies are described. These categories are covered by this guide, as follows.

Domestic occupancy is an individual dwelling for occupation as a single family unit, e.g. individual dwellinghouses, individual flats, maisonettes and transportable homes, with a maximum individual room size of 40 m².

Residential occupancy is a building for multiple occupation not exceeding 20 m in height, with a maximum individual room size of 180 m², e.g. residential homes, Houses of Multiple Occupancy (HMO), blocks of flats, boarding houses, aged persons homes, nursing homes, residential rehabilitation accommodation and dormitories.

5.2	Typical hazards and fire scenarios
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Related to Q4a in checklist in Appendix A: Are there any special hazards?

This section considers typical hazards and fire scenarios inside those buildings in which water mist systems might be expected to perform.

In residential premises, there are many sources of heat and many things that could burn. Sources of heat include: cigarettes, matches, candles, cooking appliances, heaters, electrical or mechanical appliances, faulty wiring.

Potential fuels include: wooden, plastic or upholstered furniture (beds, cupboards, tables, sofas, chairs), furnishings (curtains, bedding), and other items (televisions, clothing, videos, compact discs, newspapers, books, magazines, computers, plastic storage containers).

Some examples of fire scenarios are:

- A cooking accident in a kitchen (chip pan of oil catching fire, leaving something too close, in or on the cooker, forgetting to turn cooker off, leaving something in the grill) resulting in a fire which could spread to curtains or cupboards.
- Ignited candle too close to a television setting the television alight, which could spread to curtains and furniture in a lounge.
- Matches or smokers' materials thrown away into a waste paper bin causing a waste bin fire which spreads to furniture in a bedroom or lounge.
- A faulty electrical item placed close to furniture, fabrics or papers, causing a fire which then spreads.
- Overloaded plugs or faulty circuit breakers setting appliance and curtains alight which then spreads to other furniture.
- Matches or smokers' materials setting bedding alight, which spreads to the bed itself and other furniture and fabrics in a bedroom.

It is recommended that any special hazards, e.g. high fire loadings, are considered.
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If there is any change of use of the building in the future, the assessment of hazards needs to be reviewed.
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6. Assessment of water mist systems

This is the key part of the guide.

6.1 Recommended questions for water mist systems contractors

The following are recommended questions that approving authorities could ask of water mist systems contractors to assist building control professionals and fire safety officers to come to a judgement on the suitability of a water mist system use for specific residential building applications.

Project description:

- Is this a water mist system? (see section 3 of this guide)
- What is the main purpose of this water mist system? (see sections 2 and 5 of this guide)
- Is this proposed water mist system being installed in residential building types covered by this guide? (see section 5 of this guide)
- What areas are protected? (see sections 5 and 9 of this guide).
- Are there any special hazards? (see section 5.2 of this guide).

Assessment of system performance:

- Is the proposed system performance acceptable? (see section 7 of this guide)
- What standards have been used for the system design, installation and components? Is this/are these appropriate standard(s)? (see section 7.1 of this guide)
- What other evidence has been presented? Is this appropriate technical evidence? (see sections 7.2 and 7.2.2 of this guide)
 - What fire tests have been undertaken? Is the fire testing applicable to the real building scenario? What fire test details have been provided? Is the fire testing appropriate and sufficient? (see sections 7.1 and 7.2.1 of this guide)
 - Has any other evidence of suitability of water mist system been supplied? (see sections 7.2 and 7.2.2 of this guide)

Assessment of system details:

- What are the design assumptions? Are they acceptable? (see section 4 of this guide)
- Has all the relevant documentation been provided? Does the documentation contain all the relevant information? (see sections 4 and 9 of this guide and section 8 for water supplies)
- Is the system design, installation and maintenance acceptable? (see section 9 of this guide)
- Have all the system components been assessed? Are all the system components acceptable? (see sections 4, 7.1 and 9 of this guide)

- Are the proposed system details acceptable? (see sections 4, 7, 8 and 9 of this guide)

6.2

Checklist and pro-forma for a water mist system assessment

Appendix A contains an assessment checklist and pro-forma to assist approving authorities to come to a judgement on the suitability of a water mist system for specific residential building applications.

7.	Evidence of suitability of water mist system
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Related to Q9 in checklist in Appendix A: Is the proposed system performance acceptable?

Related to Q13 in checklist in Appendix A: Are the proposed system details acceptable?

7.1	Standards relating to water mist
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Related to Q5 and Q5a in checklist in Appendix A: What standards have been used for the system design, installation and components? Are these appropriate standards?

Related to Q7 in checklist in Appendix A: What fire tests have been undertaken?

Related to Q12 and Q12a in checklist in Appendix A: Have all the system components been assessed? Are all the system components acceptable?

The approving authority needs to satisfy itself whether there are relevant adequate published standards or equivalent for design, installation and maintenance and for components to ensure the effective performance of the system in the event of a fire.

Three key elements that need to be covered in water mist standards are:

- Design and installation. The standards should specify requirements for the whole system from the start of the design process to on-going activities once the system is in use. These could reference other standards for particular aspects, e.g. for actuation and pressurised systems.
- Components. The standards should specify functionality and environmental compatibility requirements and tests. Typically, these could include tests as shown in Table 1.

Requirement	Examples of tests
Functionality	Operating temperature Water flow Water distribution Water droplet size and velocity Functional tests
Environmental compatibility	Strength (nozzle body, release element) Leak resistance Heat exposure Thermal shock Stress corrosion Salt spray corrosion Moist air exposure Water hammer Dynamic heating Resistance to heat Resistance to vibration Impact test Lateral discharge test 30-day leakage test Vacuum test Clogging test

Table 1 Example requirements and tests for water mist components

- Generic fire performance tests. The standards should detail generic fire performance tests appropriate for particular applications against which a water mist system can be assessed.

The following summarises the current British, European, International, USA and approval standards relevant to water mist systems in buildings.

7.1.1 British Standards

Currently, there is no published British Standard for water mist systems or water mist system components. The relevant British Standards committee is drafting water mist standard(s) for domestic and residential premises which will be published initially as British Standard Draft(s) for Development.

It is recommended that the British Standard(s), for domestic and residential premises, when published, should be used to assess against.

Two residential sprinkler standards have been published, British Standard BS 9251 (Sprinkler systems for residential and domestic occupancies – Code of Practice) and British Standard Draft for Development BS DD 252 (Components for residential sprinkler systems – Specification and test methods for residential sprinklers). The standards are for life-safety sprinkler systems, not water mist systems, in domestic and residential applications. They cover components, design and generic fire performance tests.

Whilst not entirely relevant to water mist systems, these residential sprinkler standards provide a valuable comparator for performance requirements for water mist systems in these applications.

7.1.2 European standards

The relevant European standards committee has prepared a draft European standard PrEN 14972 (Fixed fire fighting systems - Water mist systems – Design and installation)⁸ for the design and installation of water mist systems which will be published as a Technical Specification. In parallel, the relevant British Standards committee will be developing this document.

This draft Technical Specification covers the significant issues of water mist. It is based on a combination of prescriptive and performance based requirements, with reliance on contractor's instructions. The draft Technical Specification includes selected fire test methods for evaluating systems, for flammable liquids, cable tunnels and office occupancies. The intention is for fire test methods for particular applications to be added when available in the future. This draft standard does not currently include a fire performance test for residential occupancies for which we are concerned with in this guide.

It is recommended that this European Technical Specification is not used for residential applications, until all the components and design details are appropriate for a residential application and a specific proving residential fire test is included.

7.1.3 International standards

The relevant ISO committee has prepared a draft international standard for water mist nozzles ISO DIS 6182 Part 9 (Fire protection – automatic sprinkler system - Requirements and test methods for water mist nozzles)⁹. This draft standard covers nozzle component testing. The emphasis of the draft standard is for shipboard applications. It is unclear if building applications are covered. The draft standard includes fire performance tests for shipboard applications.

This ISO nozzle standard is of little relevance to residential premises.

7.1.4 USA standards

The published National Fire Protection Association (NFPA) 750 Standard on Water Mist Fire Protection Systems² provides guidance on the installation of water mist systems. This is a comprehensive standard for components and design. It gives details of fire performance tests specified by others, IMO (International Maritime Organisation), FM (Factory Mutual, USA), UL (Underwriters' Laboratories, USA). However, it is aimed at the USA industry and focuses on their specific industrial applications. It does not specifically cover residential applications.

It is currently recommended that this USA standard is not used in its entirety for UK life safety residential applications until relevant UK experience has been gained.

Using selected parts of this standard may be appropriate for UK residential applications, provided that additional assessment is carried out to ensure all components and design details are appropriate for residential premises and specific proving fire performance tests are conducted that are relevant to the application.

7.1.5 International Maritime Organisation standards

The following International Maritime Organisation (IMO) water mist standards for shipboard protection have been produced.

- IMO FSS Code, International code for fire safety systems, Resolution A.800 (19), Revised guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS regulation 11-2/12¹¹
- IMO MSC/Circ. 913, Guidelines for the approval of fixed water-based local application fire-fighting systems for use in category a machinery spaces¹²
- IMO MSC/Circ. 668, Alternative arrangements for halon fire-extinguishing systems in machinery spaces and pump-rooms¹³

IMO Resolution A.800 gives requirements for components and system design, in addition to system tests for particular shipboard fire hazards, i.e. cabin, corridor, luxury cabin, public spaces, shopping and storage, machinery spaces.

IMO MSC/Circs. 913 and 668 are not suitable for life safety residential applications.

There is a large amount of available test data relating to these three IMO standards.

IMO MSC/Circs. 913 and 668 are not suitable for life safety residential applications.

It is currently recommended that IMO Resolution A.800 is not to be used in its entirety for UK life safety residential applications.

Additional work needs to be carried out to determine whether any of the fire performance tests in IMO Resolution A.800 (19) are relevant to residential buildings in the UK.

7.1.6 Approval standards

There are a number of agencies/laboratories which carry out independent testing and certification to evaluate water mist systems and components. These agencies/laboratories use their own approval standards or those of others (e.g. standards in sections 7.1.1 to 7.1.5) and issue approvals. The approval standards require the completion of an evaluation/test schedule, including application-specific fire performance tests. Water mist components and systems are then listed for specific applications and protection objectives. The laboratory test reports and the details of the listing are fundamental to the approvals.

It is recommended that the details of any water mist system or components approval listing and test reports are examined by the approving authority to check that the product approval is appropriate for the protection of UK residential premises.

The published FM Approval Standard 5560¹⁰ on water mist systems specifies requirements for components, design and generic tests. It contains a set of generic fire tests for machinery spaces, combustion turbines, 'light hazard occupancies', wet benches, object protection applications, industrial oil cookers, and computer room sub floors.

It is currently recommended that this US approval standard is not used in its entirety for UK life safety residential applications, until UK experience has been gained.

Additional work applicable to the UK needs to be carried out to ensure all components and design details are appropriate for residential premises and specific proving fire performance tests are conducted that are relevant to the application.

7.1.7 Summary table of standards and relevance

Table 2 summarises standards and specifications for water mist systems and their relevance for volume protection water mist systems for residential applications.

Standard/specification	Summary	Relevance
British, European or international building related standard	Proposed BS DD	For water mist, not drafted
	Draft EN TS 14972 ⁸	For water mist, current draft does not include fire performance test for residential premises
	BS 5306 Part 2 ³ EN 12845 ⁹	For sprinklers
	BS 9251 ⁵ BS DD 252 ⁷	For residential sprinklers
	ISO DIS 6182 Part 9 ⁹	For nozzles for shipboard applications
USA standard	NFPA 750 ²	USA standard for water mist, no UK experience
	NFPA 13R ¹⁴ NFPA 13D ¹⁵	USA standards for sprinklers in residential and domestic occupancies
IMO standard	IMO FSS Code resolution A.800(19) ¹¹ IMO MSC Circ. 913 ¹² IMO MSC Circ. 668 ¹³	For shipboard applications
Manufacturers' literature/data sheet	Manufacturers' letter listing approvals to standards	Needs to be assessed by relevant independent expert
	Design manual	
Approvals body standard	FM Approval Standard 5560 ¹⁰	No UK experience
Table 2 Summary of standards and specifications for water mist systems		

7.2	Other technical evidence
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Related to Q6 and Q6a in checklist in Appendix A: What other evidence has been presented? Is this appropriate technical evidence?

The approving authority needs to satisfy itself whether there is appropriate technical evidence of the effectiveness of a water mist system for the particular residential application.

Technical evidence that may be offered to demonstrate that systems are fit for purpose includes:

- Fire tests, e.g. generic fire performance tests specified in a standard, project specific fire performance tests, fire demonstrations, see section 7.2.1 for details.
- Mathematical modelling, using e.g. Computational Fluid Dynamics (CFD), may be utilised to demonstrate the performance of a water mist system. Mathematical modelling may be utilised where a water mist system is being proposed as a compensatory feature, to demonstrate the level of safety provided by the original level of fire protection for which the water mist system is compensating.

It is important to check that the particular model used has been adequately validated for water mist residential applications.

- Similar previously approved design.
- Case studies of activations in real fires, see section 7.2.2 for details.

7.2.1	Fire performance tests
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Related to Q7 and 7a in checklist in Appendix A: What fire tests have been undertaken? Is the fire testing applicable to the real scenario ?

Related to Q8 and Q8a in checklist in Appendix A: What fire test details have been provided? Is the fire testing appropriate and sufficient?

This section covers the purpose and principles of fire performance acceptance tests and influencing parameters.

The purpose of fire performance testing is to assess the performance of the water mist system. These fire tests need to be representative of the residential premises and the likely realistic fire scenarios.

It is essential that fire performance tests are carried out for the proposed water mist system in the residential premises.

It is recommended that fire performance tests are either generic fire tests as specified in a standard or project specific adhoc fire performance tests.

General fire demonstrations should not be accepted as technical evidence to demonstrate the performance of a water mist system.

It is recommended that the relevant approving authority is consulted at all stages of any project specific fire test.

Performance fire tests for residential premises are expected to consist of the following elements:

- Objectives and assumptions
- Agreed acceptance criteria
- Water mist system design and components similar to proposed real installation, e.g. nozzle placement, system pressures, pressure at the nozzle, water application rates, concentration of any additive, nozzle type
- Test enclosure(s) similar to actual residential premises including structure, appropriate room size(s), appropriate ventilation conditions
- Test fire(s), using appropriate and/or realistic fuel load arrangement(s)
- Relevant measurements/instrumentation to measure parameters for acceptance criteria
- Test results, analysis and conclusions.

The fire test conditions could be taken as for residential sprinkler systems i.e. the fire performance test in BS DD 252. Other generic fire performance tests specified in a standard may also be appropriate.

Independent laboratory test reports detailing these tests should be supplied to the relevant approving authority.

Thorough test programmes will include some form of sensitivity analysis to check the robustness of the design, e.g. testing at the extremes of the operating pressure, maximum nozzle spacing and changes in the fire location/type.

7.2.2	Case studies
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Related to Q6 and Q6a in checklist in Appendix A: What other evidence has been presented? Is this appropriate technical evidence?

There have been some reported water mist activations in fire incidents in residential buildings in the UK, as follows.

Case 1 A kitchen fire in sheltered housing fire where fire was extinguished and occupant saved (Wakefield, Leeds, West Yorkshire, occurring at 7.40 am on 3 October 2003).

“Wakefield MDC had low pressure residential water mist suppression system installed and commissioned in a sheltered housing unit during July 2003. The system covers the apartments lounge, hall, bedrooms and kitchen and the building’s common areas except corridors. Either pendant ceiling nozzles with activation at 68°C or sidewall system units with activation at 57°C are used. The pipework and actuation heads are concealed from sight within the residential occupancies.

A fire broke out in the sheltered housing unit on Friday morning 0740 hrs 3 October 2003. The apartment contained an elderly occupant. The fire was in the kitchen where a toaster’s outer casing caught fire under the kitchen cupboards. A sidewall system unit was located on the wall of the kitchen. It is estimated that the ceiling temperature would have reached 90–95 degrees, which activated the units nozzle extinguishing the fire in seconds. The system contained the fire to the kitchen, with no smoke damage to any other part of the flat.”¹⁶

Case 2 A settee fire in a ground floor maisonette where occupant was saved (3 August 2005 at 11.13pm, Dewsbury, West Yorkshire).

“The fire was in a ground floor maisonette and a neighbour raised the alarm. On arrival at the incident, a 'person reported' message was sent to West Yorkshire Fire Service Mobilising and Communications Centre by the fire crew. The property was secure when the first fire crews arrived and when a breathing apparatus team entered the building they found a settee was alight.

While there was visible flame when the BA crew entered the room, the fire was confined to a small part of the settee, which the crew quickly extinguished using a hose reel. The crew found the occupant in the same room as the fire.

The water mist system, recommended by Kirklees Council's fire safety officer, had actuated and fully discharged, suppressing the fire and protecting the occupier from the heat and smoke produced by the fire. This probably saved the occupant's life. An ambulance transported the occupant to hospital, where they were treated for the effects of smoke inhalation”.¹⁷

There is anecdotal evidence of other activations in residential premises. The water mist systems were reported to be effective in these cases.

8.	System supplies
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Related to Q11, Q11a and Q11b in checklist in Appendix A: Has all the relevant documentation been provided? Has all the relevant information been provided in the documentation? Is the system design, installation and maintenance acceptable?

Related to Q13 in checklist in Appendix A: Are the proposed system details acceptable?

For water mist systems which use cylinders, pressure regulations requirements relating to stored pressure vessels may need to be considered ^{18, 19}.

It is recommended that specialist advice is sought on any pressure regulations requirements.
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For water mist systems which involve connection to the towns mains, water regulations requirements need to be considered ²⁰.

The relevant water authority must be consulted on water regulations requirements.

Water quality issues need to be considered ^{20, 21}.

Where additives are used in water mist systems, the chemical nature, the purpose and the concentration of the additive in the water are important. The additives safety data and water regulations requirements should be considered ^{e.g. 20, 22}.

It is recommended that measures are taken to avoid blockages in the water mist system, e.g. removal of foreign bodies at installation, the use of strainers.
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Storage containers and pipework exposed to freezing conditions can fail and cause water leakage and prevent effective water delivery to the water mist system. Measures need to be considered to protect water storage containers and water-filled pipework from freezing, e.g. trace heating, lagging. These measures may require regular maintenance.

The use of antifreeze solutions will require specialist expertise to ensure the water mist system will perform correctly and that the antifreeze solution is compatible with other system components.

It is recommended that measures are taken to avoid water freezing of storage containers and water-filled pipework in the water mist system.

For water mist systems which involve electrical supplies, electrical requirements need to be considered ^{23, 24, 25}.

It is recommended that the relevant authority is consulted on relevant regulations and requirements for electrical work.
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9.	Design, installation, commissioning and maintenance of water mist systems
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Related to Q4 in checklist in Appendix A: What areas are protected?

Related to Q11 and Q11a in checklist in Appendix A: Has all the relevant documentation been provided? Does the documentation contain all the relevant information?

Related to Q11b in checklist in Appendix A: Is the system design, installation and maintenance acceptable?

Related to Q12 and Q12a in checklist in Appendix A: Have all the system components been assessed? Are all the system components acceptable?

Related to Q13 in checklist in Appendix A: Are the proposed system details acceptable?

This section covers: water mist system design and installation issues, the importance of commissioning and regular maintenance, who should carry this out, inspection periods, documents and log books.

The approving authority needs to review the residential water mist system design details to ensure that the system is designed, installed, commissioned and regularly maintained to ensure that it will work properly in the event of a fire in the premises.

Where the approving authority is unsure about reviewing the water mist system design, it is recommended that advice from a relevant independent expert is sought.

9.1	Design and installation
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The design and installation of a water mist system for a residential building should be carried out by a suitable water mist contractor.

9.1.1	Documentation
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The water mist system contractor should provide relevant documentation on the design and installation to the approving authority for review

This documentation should include:

- Plans and specifications
- System design manual
- System flow calculations.

9.1.1.1 Plans and specifications

The plans should:

- show structural features and hazards that could impact on the design, e.g. doors, windows, ducts, cookers
- show the dimensions, components and layout of the water mist system in relation to the hazards in the premises
- clearly indicate the protected areas, the location and size of pipe, location of nozzles, water/gas storage, water supply, and any other ancillary equipment
- include the specification of the components and any standards that have been utilised.

9.1.1.2 Design manual

The design manual should contain procedures for the system contractor to follow for the selection of components, the design and engineering of the system and related requirements, verified by fire performance tests.

Currently, system contractors rely on system design manuals because the published standards are incomplete for use in UK residential buildings.

The design manual contains the working limits and parameters of the system. Any departures from the values contained in the design manual and verification tests could result in poor and inefficient systems, e.g. excessive nozzle spacing can result in large gaps and minimal protection between cones of water mist spray, and nozzles located too close to walls, pipes, ceiling details and large furniture can result in water wastage.

9.1.1.3 System flow calculations

The engineering of water mist systems requires flow calculations to determine the pump pressures, the water application rates, nozzle pressures, pipe size, area or volume protected by each nozzle. Integral to the calculations are the number and types of nozzles, the nozzle placement in a specific system and the capacity of the water supplies to meet the required duration of protection. Account should be taken of all components which affect pressure losses including containers, pipes and fittings.

9.1.2 Information

This documentation should cover the following information:

- Background
- Building
- Fire hazards
- Details of the water mist system design, including water supplies and components.

9.1.2.1 Background

Background information is described in sections 4.2 and 4.3.

9.1.2.2	Building
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Building information will influence the water mist system design, for example:

- details of the selected building (e.g. internal layout of rooms, corridors and doors, number of storeys, dimensions of rooms, corridors and other spaces, dimensions of doors, locations of cupboards, bathrooms, roof spaces, details of fire-resisting elements of construction, details of room ventilation and obstructions)
- the reason for the system (e.g. for life safety)
- which water mist standard, if appropriate, will be utilised
- the role of the water mist system in the fire safety design.

9.1.2.3	Fire hazards
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All fire hazards should be identified and included in the water mist system design, including any special hazards, see section 5.2.

It is recommended that gas supplies to cooker hob/hearth have automatic shut-offs.

It is recommended that all areas in the residential building containing or which may contain combustible materials should be considered for water mist protection. There should be a clear understanding about the extent of water mist protection in the premises.

If there is any change of use of the building, in the future, the assessment of hazards needs to be reviewed.

9.1.2.4	Details of the water mist system design and components
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Design of a water mist system has been covered in sections 4.1 to 4.4. System design details should be provided to the approving authority for review, see sections 9.1.1 and 9.1.2.

In particular, there are a number of room factors that need to be taken into account in the design which influence the performance of the residential water mist system, e.g.

- room volume and shape
- room ventilation
- obstructions inside the room.

Details of the room volume, shape and obstructions are required for the correct placement of nozzles.

Details of the room ventilation, e.g. windows, doors and air conditioning systems, are required, as water mist can be susceptible to airflows, so that appropriate system design decisions can be made to compensate for or minimise water mist loss from the protected volume.

Details of the location and size of obstructions are required to ensure that any water wastage is compensated for or prevented.

Since the fire performance of a residential water mist system is dependent upon satisfactory installation and maintenance, independent schemes of certification and accreditation of installers and maintenance firms of residential water mist systems will provide confidence in the appropriate standard of workmanship being provided.

Components of a water mist system have been covered in section 4.4. Components details should be provided to the approving authority for review.

Water mist nozzles are particularly important. There are a number of water mist nozzle factors that need to be taken into account in the design which influence the performance of the residential water mist system, which include:

- Nozzle model and type
- Nozzle orifice size
- Nozzle placement
 - Nozzle to nozzle spacing
 - Nozzle to wall spacing
 - Nozzle distance above floor
 - Nozzle distance below ceiling.
- Area or volume protected by each nozzle
- Number of nozzles in room
- Nozzle pressure
- Nozzle water application rates
- Response of detector or automatic nozzle.

Nozzle placement is important. Each nozzle has a limit for height above floor, height below ceiling and separation between nozzles. Where the nozzle spacing is too great there may be large gaps between mist spray envelopes, leaving areas of reduced protection. Where nozzles are too close, or where sprays are obstructed by walls, pipes, ceiling details and large furniture, this can result in more wetting of surfaces and less mist being generated.

The minimum water mist pressure and flow should be available for the duration of the water mist protection.

Water mist nozzles have small orifices and can be prone to partial or complete blocking by debris in the system.

It is recommended that measures are taken to avoid blockages in the water mist system, e.g. removal of foreign bodies at installation and maintenance, the use of strainers.

Water mist nozzles and all other water mist components that are third party certified for use in UK residential premises will provide confidence in the appropriate standard of components being provided.

9.2	Commissioning and maintenance
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Related to Q11 and Q11a in checklist in Appendix A: Has all the relevant documentation been provided? Does the documentation contain all the relevant information?

It is recommended that commissioning and regular maintenance of the residential water mist system is carried out by a suitable water mist contractor.

The water mist system contractor should provide relevant documentation on commissioning and maintenance to the approving authority for review.

Commissioning tests should be undertaken by the water mist contractor to ensure that the water mist system is properly installed and will operate as intended. Commissioning tests include:

- testing for leakage and tightness of piping
- removing/blowing out foreign bodies e.g. swarf and debris from the system
- checking water flow from the nozzles and testing for correct water application rates at specified pressures at a particular location by equivalence testing using a test point and calculations
- checking that alarms operate at required water application rates and are clearly heard in all the relevant rooms in the premises.

The water mist contractor should issue a signed certificate when the system is satisfactory. Documentation containing the commissioning test results should be inspected by the approving authority. In addition, the approving authority should consider being present at commissioning. This also may be appropriate as an educational activity for the building owner or occupier.

It is imperative that water mist systems are regularly maintained to ensure that the water mist system continues to properly operate as intended over the lifetime of the system. Poor maintenance can cause system failures. Regular inspection, tests and maintenance should be undertaken by the water mist contractor

Annual inspection and maintenance schedules are recommended.

Maintenance involves:

- visual checks (hazard, control panel, water and gas pressure gauges, correct position of mains stop valve, nozzle orifices and strainers clear, nozzles and pipe are undamaged)
- other checks (automatic pump starting, alarm transmission connection, trace heating and localised heating systems).

Inspection and testing details should be entered into the system log book. Any recommendations arising from the inspection should be carried out.

The water mist contractor should provide the building owner and occupier with relevant documentation, e.g. a general description of the system, a layout of the residential premises showing the extent of protection, details of the water supplies, a log book containing inspection, checking and maintenance documents.

10.	Alternative systems
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Related to Q1 in checklist in Appendix A: Is this a water mist system?

Water mist may not always be the best or an appropriate solution to a fire protection problem.

Prior to selecting a water mist system, a fire risk assessment should have been carried out. Also, it is recommended that alternative fire protection systems should have been considered to ensure the most appropriate form of fire protection is utilised.

Examples of alternative forms of fire protection systems include: enhanced detection, compartmentation (e.g. walls, doors), portable fire extinguishers, automatic sprinkler system.

10.1	Automatic sprinkler systems
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An automatic sprinkler system is an established alternative to a water mist system. This form of fire protection is largely understood and there are historic performance records for buildings, although sprinklers in residential buildings for life safety purposes are relatively recent. Sprinkler systems are usually designed to protect the whole building, delivering water only to the fire location to suppress and control or extinguish the fire, pre-wetting surrounding combustibles and structure and continue with this form of protection for residential occupancies for 30 minutes and domestic occupancies for 10 minutes. Sprinkler systems have standards^{3,4,5,7,15,16} and approvals for the components and the design and installation. The UK residential sprinkler standards include a residential fire performance test^{7, 26}.

Water mist systems are not the same as sprinkler systems. The design, installation and components of water mist systems are not standardised and the protection strategy tends to be limited to a short duration of protection rather than extended periods of protection. The use of water mist for volume protection in buildings is largely unproven. To date there appears to be very few reported fire events in buildings with water mist systems in the UK.

Some of the main differences between water mist systems and automatic sprinkler systems are:

- the system pressures for water mist can be significantly higher than for sprinklers
- the water droplets produced by a water mist system are generally smaller than for sprinklers
- fire control mechanisms are different
- inherently, water mist systems are hazard specific and need to be completely bespoke, unlike sprinklers
- can have different detection and operation methods
- in some cases water mist systems can have water additive or inert gas propellant
- different methods of production of droplets
- water mist systems are usually designed to protect an object or particular hazard within a volume (object protection) or to protect all fire hazards in the volume (volume protection) typically in a few rooms, whereas sprinkler systems are usually designed to protect all fire hazards in a whole building, although only the sprinklers over the fire operate.



Some of the advantages that water mist systems have compared to sprinkler systems are: they use less water; they are perceived to be cheaper where system weight is an issue; they produce less water damage; they do not always require a water mains connection.

However, some of their disadvantages when compared to sprinkler systems are: they are unproven for residential and domestic applications; there are no British, European or International systems design or components standards for residential/domestic applications; their performance can be detrimentally affected by, e.g. ventilation, small fires, some fire types. There is a danger of inappropriate application where appropriate performance test data are not available; there is no uniformity of design principles; they operate at comparatively higher pressures; they may depend on additives and may be susceptible to blocking of small orifices.

11. References

References used are listed as follows.

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4. British Standards Institution. BS EN 12845: 2004. Fixed firefighting systems – Automatic sprinkler systems – design, installations and maintenance, 2004.
5. British Standards Institution, BS 9251 Sprinkler systems for residential and domestic occupancies – Code of Practice, 2005.
6. Approved Document B (Fire safety), The Building Regulations 2000, (as amended 2004) Edition, <http://www.planningportal.gov.uk/england/professionals/en/4000000000084.html>.
7. British Standards Institution, BS DD 252 Components for residential sprinkler systems – Specification and test methods for residential sprinklers, 2002.
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9. ISO DIS 6182-9, Fire protection – automatic sprinkler system, Part 9: requirements and test methods for water mist nozzles, in draft, August 2003.
10. Factory Mutual Approvals. Approval Standard Water Mist Systems, Class Number 5560, May 2005, <http://www.fmglobal.com/approvals/resources/standards.asp>.
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12. IMO MSC/Circ. 913, Annex unified interpretations of the guidelines for the approval of fixed water-based local application fire-fighting systems, June 2003.
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14. National Fire Protection Association, NFPA 13R, standard for the installation of sprinkler systems in residential up to 4-storeys, multiple family dwellings, 1999.
15. National Fire Protection Association, NFPA 13D, standard for the installation of sprinkler systems in 1 and 2 family dwellings and manufactured homes, 1999.
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21. Water supply (Water fittings) Regulations 1999, Statutory Instrument No. 1148, <http://www.opsi.gov.uk/si/si1999/19991148.htm>.
22. Chemicals (Hazard Information and Packaging for Supply) Regulations 2002, <http://www.opsi.gov.uk/si/si2002/20021689.htm>
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24. The Electricity at Work Regulations 1989. Statutory Instrument 1989 No. 635, http://www.opsi.gov.uk/si/si1989/Uksi_19890635_en_1.htm.
25. The Electrical Equipment (Safety) Regulations 1994. Statutory Instrument 1994 No. 3260, http://www.opsi.gov.uk/si/si1994/Uksi_19943260_en_1.htm.
26. Williams C, Fraser-Mitchell J, Campbell S and Harrison R, Effectiveness of sprinklers in residential premises, BRE Report 204505, February 2004, <http://www.bre.co.uk/adb/section.jsp?sid=395>.

Appendix A	Checklist and pro-forma for a water mist system assessment
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The following is an assessment checklist and pro-forma to assist building control professionals and fire safety officers to come to a judgement on the suitability of a water mist system for specific residential building applications.

The checklist and pro-forma is arranged in three parts:

- Part 1 Project description
- Part 2 Assessment of system performance
- Part 3 Assessment of details of system.

Name of premises
Address
.....
Assessor(print name)
Signature Date

Part 1 Project description

Answer each question with a tick. Where you are unsure, seek further information from within the guide or from the water mist system contractor or a relevant independent expert.

Q1 Is this a water mist system? (see section 3 of the guide) tick all that apply		
System type	<input type="checkbox"/>	Answer and next stage
Residential sprinklers	<input type="checkbox"/>	No, outside the scope of the guide
Light hazard sprinklers	<input type="checkbox"/>	
Water spray	<input type="checkbox"/>	
Water mist (volume protection)	<input type="checkbox"/>	Yes, go to Q2
Water mist (object protection)	<input type="checkbox"/>	No, outside the scope of the guide
Water fog	<input type="checkbox"/>	Yes, go to Q2
Other	<input type="checkbox"/>	Maybe, seek further information as this may be outside the scope of the guide

Q2 What is the main purpose of this water mist system? (see sections 2 and 5 of the guide) tick all that apply		
Reason to install	<input type="checkbox"/>	Details and next stage
Life safety, compensatory feature to meet provisions of the Building Regulations	<input type="checkbox"/>	Approval should only be considered when all questions have been answered satisfactorily. Go to Q3
Life safety, additional feature to provisions of the Building Regulations	<input type="checkbox"/>	Go to Q3
Life safety, fire and rescue service recommendation	<input type="checkbox"/>	Go to Q3
Property/asset protection	<input type="checkbox"/>	Seek further information from the insurer, this may be outside the scope of the guide
Alternative to an automatic sprinkler system (Life safety/property/asset protection)	<input type="checkbox"/>	Go to Q3
Other (e.g. aesthetics, water supplies, performance, maintenance, cost)	<input type="checkbox"/>	Go to Q3
Other	<input type="checkbox"/>	Seek further information, this may be outside the scope of the guide

Q3 Is this proposed water mist system being installed in residential building types covered by this guide? (see section 5 of the guide)		
Purpose group	<input type="checkbox"/>	Answer and next stage
Flat or maisonette	<input type="checkbox"/>	Yes, go to Q4
Dwellinghouse	<input type="checkbox"/>	Yes, go to Q4
Residential homes for elderly people	<input type="checkbox"/>	Yes, go to Q4
Residential home for disabled people	<input type="checkbox"/>	Yes, go to Q4
Residential home for children	<input type="checkbox"/>	Yes, go to Q4
Boarding school	<input type="checkbox"/>	Yes, go to Q4
Nursery	<input type="checkbox"/>	Yes, go to Q4
Place of lawful detention	<input type="checkbox"/>	Yes, go to Q4
Hotel - residential areas	<input type="checkbox"/>	Yes, go to Q4
Boarding house	<input type="checkbox"/>	Yes, go to Q4
Residential college	<input type="checkbox"/>	Yes, go to Q4
Hall of residence	<input type="checkbox"/>	Yes, go to Q4
Hostel	<input type="checkbox"/>	Yes, go to Q4
House in multiple occupation (HMO)	<input type="checkbox"/>	Yes, go to Q4
Transportable homes	<input type="checkbox"/>	Yes, go to Q4
Other residential	<input type="checkbox"/>	Yes, go to Q4
Other	<input type="checkbox"/>	No, outside the scope of the guide

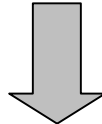
Q4 What areas are protected? (see section 5 and 9 of the guide) tick all that apply		
Areas	ü	Details and next stage
Hall		All areas containing combustible materials should be considered for protection.
Living room		
Kitchen		There should be a clear understanding about the extent of water mist protection in the premises. Go to Q4a
Office		
Corridor and stairs		
Bedroom		
Storage area		
Loft		
Conservatory		
Garage		
Basement		
Other		
Q4a Are there any special hazards? (see section 5.2 of the guide) tick if applies		
Special hazard	ü	Details and next stage
		Go to Q5

Part 2 Assessment of system performance

Answer each question with a tick. Where you are unsure, seek further information from within the guide or from the water mist system contractor or a relevant independent expert.

Q5 What standards have been used for the system design, installation and components? (see section 7.1 of the guide) tick all that apply		
Design standard	<input type="checkbox"/>	Details
BS for water mist	<input type="checkbox"/>	Not drafted yet
EN TS 14972 for water mist	<input type="checkbox"/>	Available in draft form, does not include fire performance test for residential premises
NFPA 750	<input type="checkbox"/>	USA standard, not evaluated for UK
IMO MSC A.800 (19)	<input type="checkbox"/>	For shipboard applications
IMO MSC Circ 668	<input type="checkbox"/>	For shipboard applications
IMO MSC Circ 913	<input type="checkbox"/>	For shipboard applications
ISO DIS 6182 Part 9	<input type="checkbox"/>	For nozzles for shipboard applications
BS 9251	<input type="checkbox"/>	For sprinklers
BS DD 252	<input type="checkbox"/>	For sprinklers
NFPA 13 R	<input type="checkbox"/>	For sprinklers
NFPA 13 D	<input type="checkbox"/>	For sprinklers
BS 5306 Part 2	<input type="checkbox"/>	For sprinklers
EN 12845	<input type="checkbox"/>	For sprinklers
Manufacturer's design manual	<input type="checkbox"/>	Needs to be assessed by relevant independent expert
FM approval standard 5560	<input type="checkbox"/>	USA test standard, not evaluated for UK
Other approval standard	<input type="checkbox"/>	Needs to be relevant to UK residential premises
Other	<input type="checkbox"/>	Needs to be assessed by relevant independent expert
		Go to Q5a
Q5a Are these appropriate standards? (see section 7.1 of the guide) tick if applies		Acceptable?
		Yes No
		Go to Q6
Q6 What other evidence has been presented? (see sections 7.2 and 7.2.2 of the guide)		
Evidence	<input type="checkbox"/>	Details
Mathematical modelling	<input type="checkbox"/>	
Previously approved design	<input type="checkbox"/>	
Case studies	<input type="checkbox"/>	
Fire tests	<input type="checkbox"/>	
Other	<input type="checkbox"/>	
		Go to Q6a
Q6a Is this appropriate technical evidence? (see sections 7.2 and 7.2.2 of the guide) tick if applies		Acceptable?
		Yes No
		Go to Q7

Q7 What fire tests have been undertaken? (see section 7.2.1 and 7.1 of the guide) tick all that apply		
Fire test type	<input type="checkbox"/>	Details
Fire demonstration	<input type="checkbox"/>	No, not acceptable
Generic fire performance test, specified in a standard	<input type="checkbox"/>	
Project specific fire performance test	<input type="checkbox"/>	
Other	<input type="checkbox"/>	
None	<input type="checkbox"/>	Go to Q9
		Go to Q7a
Q7a Is the fire testing applicable to the real building scenario? (see sections 7.2.1 of the guide) tick if applies		Acceptable?
		Yes
		No
		Go to Q8
Q8 What fire test details have been provided? (see section 7.2.1 of the guide) tick all that apply		
Specification to assess	<input type="checkbox"/>	Details
Independent laboratory test report	<input type="checkbox"/>	
Objectives and assumptions (acceptance criteria, premises, fire hazards)	<input type="checkbox"/>	
Water mist components	<input type="checkbox"/>	
Water mist system design	<input type="checkbox"/>	
Test enclosure (structure, size, location, ventilation)	<input type="checkbox"/>	
Test fire	<input type="checkbox"/>	
Test measurements/instrumentation	<input type="checkbox"/>	
Test results, analysis, conclusions	<input type="checkbox"/>	
		Go to Q8a
Q8a Is the fire testing appropriate and sufficient? (see sections 7.2.1 of the guide) tick if applies		Acceptable?
		Yes
		No
		Go to Q9



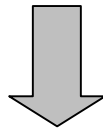
Q9 Is the proposed system performance acceptable? (see section 7 of the guide)		Acceptable?	
If all questions are answered satisfactorily the assessment is complete.		Yes	No
Otherwise you should NOT consider approving the system until the water mist system contractor addresses the outstanding issues and assessment of system details is completed.			
		Go to Q10	

Part 3 Assessment of system details

Answer each question with a tick. Where you are unsure, seek further information from within the guide or from the water mist system contractor or a relevant independent expert.

Q10 What are the design criteria? (see section 4 of the guide) tick all that apply				
Design criteria	ü	Details		
Fire control objective extinguishment suppression control			Go to Q10a	
Duration of water mist protection				
≤ 5 minutes				
≤ 10 minutes				
≤ 30 minutes				
≤ 60 minutes				
≤ 90 minutes				
Protection of means of escape				
Fire-fighting access				
Other				
Q10a Are the design assumptions acceptable? (see section 4 of the guide)			Acceptable?	
			Yes	
			No	
			Go to Q11	
Q11 Has following documentation been provided? (see sections 4 and 9 and for water supplies see section 8 of the guide) tick all that apply				
Documentation	ü	Details		
Plans and specifications			Go to Q11a	
System design manual				
System flow calculations				
Q11a Does the documentation provided contain the following information? (see sections 4 and 9 and for water supplies see section 8 of the guide) tick all that apply				
Information	ü	Details		
Room requirements Volume and shape Ventilation Obstructions			Go to Q11b	
Nozzle parameters Model and type Orifice size Response of nozzle Volume protected by each nozzle Placement Number of nozzles in room Water application rates Pressure				
Pipework sizes				
Water supply Pump pressures Water storage capacity				
Electrical requirements				
Commissioning tests				
Annual maintenance				
Third party approval of system design				
Third party approval of system installer				
Other				
Q11b Is the system design, installation and maintenance acceptable? (see sections 4 and 9 and for water supplies see section 8 of the guide)				Acceptable?
				Yes
				No

		Go to Q12
Q12 Have the following system components been assessed? (see sections 4, 7.1 and 9 of the guide) tick all that apply		
System component	ü	Details
Fire-fighting medium Potable water Water and additive Water and inert gas		
Detection Automatic glass bulb detectors Other detector and actuator Cover plates Control panels		
Atomisation Nozzle with orifice Single fluid system Twin fluid system Low pressure system (≤ 12.5 bar) Medium pressure system (12.5 to 35 bar) High pressure (≥ 35 bar) Filters/strainers		
Delivery Wet pipe system Dry pipe system Pre-action system Deluge system Pipework Pipe material Supports		
Water supply Storage vessels Towns mains Propellant Pumps		
Compatibility of components		
Third party approval of all components		
Other		
		Go to Q12a
Q12a Are all the system components acceptable? (see sections 4, 7.1, 9 of the guide)		Acceptable?
		Yes No
		Go to Q12



Q13 Is the proposed system acceptable? (see sections 4, 7, 8 and 9 of the guide)		Acceptable?	
<p>If all questions are answered satisfactorily the assessment is complete.</p> <p>Otherwise you should NOT consider approving the system until the water mist system contractor addresses the outstanding issues and a system design review is completed.</p>		Yes	No