

### Foreword

Over the past twenty years, water mist technology has increasingly been considered a viable method of protecting buildings. This BAFSA information file (BIF) provides a quick introduction to what mist systems can (and cannot) do and also provide a guide to existing equipment availability and the standards that are presently available for use. The BIF also provides some helpful guidance for end-users and authorities on what to look for when specifying and reviewing systems. Further, more detailed information and guidance will be found in BAFSA Technical Guide No 3 Water Mist Systems and their Applications (to be published in Summer 2011).

Unlike sprinkler systems, water mist systems are “project specific” and each particular hazard or occupancy requires its own very specific design. It is therefore not possible to design a mist system simply by reference to one of the various standards available – unlike sprinkler systems where reference to BS EN 12845 or BS 9251 enables a full design to be produced and a fully compliant system to be installed.

### The Technology

Water mist systems may have advantages relative to water requirements in terms of the physical space demanded by their tanks and pumps and pipework. However it is a fallacy that mist systems, especially high-pressure systems, are always cheaper than an equivalent sprinkler system.

It has long been known that water divided into smaller droplets quickly evaporates, thus absorbing the heat produced by a fire and generating steam vapour that reduces the oxygen concentration close to the fire and interrupts the chain reaction which is what propagates fire. Small droplets also block radiant heat that can help to protect people and structures in and around a fire. These three aspects have been the subjects of much research and development to create systems that

can still suppress and control a fire but be economic in water use.

Originally developed for the protection of shipboard accommodation and marine engine spaces, water mist has since been increasingly used for a wide range of onshore applications. These systems were originally limited to very specific applications requiring full scale tests before deciding whether mist was a suitable agent. Over the last twenty years however, much research has been carried out in the use of water mist in land-based applications and as experience grows and test standards are developed, water mist systems are an option for a wider range of hazards.

### Using Water Mist

Water mist systems are usually engineered to extinguish fire involving flammable liquids, or to suppress fires involving ordinary (Class A) combustibles. They can be used for object protection (for example on a steam turbine) or area protection (for example, a hotel bedroom).

As stated earlier, the “project specific” characteristics of water mist make it generally impossible for example, to take mist nozzles from one supplier and incorporate them in a system with components from another supplier.

Components for water mist systems should be tested, evaluated and approved as an assembly of compatible parts which have been tested as a whole and as such should only be used together. The supplier may allow certain items (such as the pipework or pumps) to be altered but in general, changes to the way components are used may create a situation where the system is outside its approvals or certification. All deviations from the manufacturer’s instructions or guidance should be subject to the approval of the authority

<sup>1</sup> AHJ's include: the fire authority for the area, building control/ approved inspector and the insurers.

### Water mist system components consist of the same three main parts as a sprinkler system:

A water supply	Usually a pumped supply with strainers to prevent clogging of nozzles or a rack cylinders containing water pressurised by stored gas in high pressure cylinders
An alarm system	To provide a local alarm, in case of activation
A distribution system	Pipework (CPVC, stainless or galvanised steel) and nozzles which activate automatically, either individually (after operation of the heat sensing element in the nozzle) or all at the same time following operation of a fire detection system where open nozzles have been specified. The nozzle design in combination with the correct water pressure creates a range of different sized mist droplets which attack the fire.

Table 1: Components of Mist Systems

having jurisdiction (AHJ)<sup>1</sup>

While recent design standards have been published by BSI as Drafts for Development (DD), due to the sheer number and type of systems available these must always be read in conjunction with the design manual supplied by the manufacturer, and applied in accordance with their specific successful fire test/s which must be closely representative of both the risk and environment for which the water mist system is being considered.

The economies in terms of the space needed for water storage and system use and reduced consequential damage may well be among the most significant benefits of mist systems – especially in locations such as historic buildings, galleries, museums and churches. There may sometimes be other benefits in respect of installation costs and ease of installation of pipework. However, there are certain areas where it is unlikely water mist systems will be capable of providing complete protection against fire such as large open areas in buildings.

While low pressure mist systems typically use similar pipework to other fire suppression systems (although usually with additional strainers), high pressure water mist systems typically use high purity water, stainless steel piping and other high-grade materials due to the higher operating pressures and lower tolerance of water containing particulate matter which could block the very small nozzle orifices. CPVC pipework may not be suitable for applications where **very low flow rates are likely** as its approvals for fire suppression systems depends on the ability of the fire water to conduct away heat. The CPVC supplier should be contacted for advice prior to specifying its suitability in water mist systems in terms of pressure limits and flow rates.

It is a characteristic of the mechanisms by which water mist controls or extinguishes fires that the mist generated consists of a range of droplets of different

sizes and these behave more like a gas than a liquid, but generally high heat release fires would be necessary to achieve this. The mist cloud can be affected by a series of physical conditions including air movement, either natural or forced and even by the fire dynamics<sup>2</sup>

However, in larger spaces water mist may not be as effective, as small water droplets are not contained in the vicinity of the burning fuel and air/fire dynamics can deflect droplets away from combustion gases.

Systems subject to this type of restriction require to be supported by proven tests relative to the specific application/building

Concerns regarding the 'ad hoc' nature of hybrid systems<sup>3</sup> have been expressed by a number of authorities mainly due to the use of uncertified components and lack of system test data. To obviate this, it is suggested that the checklist provided in Table 4 below should be used when considering the use of a mist system.

### Water mist for Residential and Domestic Applications.

BAFSA recommends where there is an intention to install a water mist system in a residential occupancy the design and installation must comply with BD DD 8458 2010 and the installer must be listed under a water mist specific third party certification scheme. Forthcoming guidance from BAFSA should be followed, as should the system or component, manufacturer's specifications. As always, insurers' views should be sought for properties where they have

<sup>2</sup> Jackman L and Annable K: 2010. 'Hence water mist system designs for larger spaces will often require

<sup>3</sup> 'Hybrid systems' are those where, for example, a range of components is sourced from different manufacturers or suppliers, some of which may not be intended or suitable for the type of use being considered. (Eg mist heads listed for marine use be installed in a residential system).

#### Water mist systems generally fall into one of two categories

Low Pressure	High Pressure
<ul style="list-style-type: none"> <li>• Head pressure, typically 5-10 bar but less than 12 bar</li> <li>• Steel or copper – CPVC may be appropriate in some cases; pipework 20 – 65mm</li> <li>• Normally use stored water and electric pumps</li> <li>• Maintenance schedule similar to sprinkler systems but extra checks of nozzles may be needed to ensure these are not blocked</li> <li>• Fire service may be able to supplement stored water supply by pumping-in subject to availability of connections.</li> <li>• Can share water supply with other water based fire protection system (but in the case of sprinkler systems this would create a non compliance with BS EN 12845)</li> <li>• Nominal water flux density 2 – 3.5 lpm/m<sup>3</sup></li> <li>• Wet and dry systems available (dry using separate fire detection)</li> </ul>	<ul style="list-style-type: none"> <li>• Head pressure typically not less than 35 and usually at least 50 bar.. For cylinder based systems, system pressure may be up to 200 or even 300 bar</li> <li>• Smaller bore, stainless pipework, typically 12mm – 30mm.</li> <li>• Can be either stored water (tanks) &amp; high pressure pumps, or high pressure cylinders</li> <li>• Maintenance schedule similar to sprinkler systems but extra checks of nozzles may be needed to ensure these are not blocked</li> <li>• Fire service may be able to supplement stored water for tank systems provided filters are in place..</li> <li>• Cylinder systems cannot share existing water supplies with other water based fire protection.</li> <li>• Nominal water flux density 1 – 2 lpm/m<sup>3</sup></li> <li>• Wet and dry systems available (dry using separate fire detection)</li> </ul>

Table 2: Types of Mist Systems

an interest before any contract is entered into (See below, Insurers' Views).

The end-user or occupier should be made aware of the necessary maintenance regime.

It should be noted that as at the time of writing, the range of mist heads available cannot be fully concealed (as can sprinkler heads) and that the use of recessed mist heads should comply with the manufacturer's technical data and the requirements of the AHJ.

### **Published Standards and Specifications**

At present, there are a number of standards and other documents applicable to water mist technology for land based applications and a summary of these is given below. As the water mist industry does not have the legacy of more than a hundred years of test data and real-world experience (as there is for sprinklers), none of these water mist standards could be said to either have the same proof of performance nor cover the extent of the range of hazards included in BS EN 12845. For this reason there may be a great deal of variance in the level of performance of the water mist systems presently available and so it is essential that specifiers, end users and regulators take great care when reviewing the performance claims of any particular system proposed. Note that the recently published BS documents are 'Drafts for Development' and do not have the status of full British Standards just as EN TS 14972 is a 'Technical Specification' and not a European Standard. It is anticipated that the DD's will progress to become British Standards in their own right over the next 4/5 years. However, if CEN moves to upgrade TS 14972 to 'full EN standard' status then it will supersede at least BS 8489 Parts 1 - 7 which will have to be withdrawn.

### **Suitable Applications for Water Mist**

The new Drafts for Development, DD8489 and DD 8458 for both Industrial and commercial systems and residential and domestic cover applications for water mist systems. The drafts also include test criteria that is applicable for product to be tested against to confirm the suitability of the system for use in that particular application.

Where the standards do not cover specific applications it is imperative that any proposed system is certificated or listed by a suitable approvals scheme for which there is full-scale test data and the test/s and data are directly applicable to the intended occupancy and do not include unwarranted assumptions or extrapolations.

While there may be systems that have non-UK 3rd party approvals for specific applications and sizes, these are likely to be specific to the individual systems tested so that specifiers, users and authorities having jurisdiction must satisfy themselves that the approvals claimed are relevant to the specific application.

At the time of writing there is a widely held view that

premises such as warehouses and large industrial buildings are not generally deemed suitable for protection by water mist systems. Development work is ongoing so it is essential to check with the proposed system's manufacturer or supplier for information on which types of hazards their systems are deemed to be suitable and for which applications their systems are certificated.

Insurers' views should be sought for properties where they have an interest before any contract is entered into (See below, Insurers' Views).

### **Third Party Certification**

At the time of writing Warrington Certification Ltd have announced a FIRAS Scheme to provide third party listing for installers of water mist systems. It is understood that BRE Certification (using the LPCB brand) will be setting up a similar installers' scheme and also developing a scheme for the testing and certification of components.

In order to discharge their duty under the Regulatory Reform (Fire Safety) Order 2005 (in England and Wales – similar but different legislation applies in Scotland and Northern Ireland) successfully, persons deemed to be dutyholders ie 'Responsible' or 'Competent' persons under the Order should be aware that utilisation of third-party, certified installers and suppliers is the most effective way to be sure that the specified duties in respect of fire protection systems intended for the safety of life has been complied with. Civil and criminal liabilities may attach where systems intended for the protection of life fail to operate as intended due to non-compliance with published standards or the manufacturers instructions. In addition, the use of non-approved or non-certificated systems may result in a breach of insurance policy wordings and result in the denial of a claim.

### **Insurers' Views**

In the UK insurers play a leading role in the specification of fire suppression systems and they have a great deal of experience in this area. Until recently, most insurers were unwilling to consider the installation of mist systems as an alternative to sprinklers. Some insurers still express concerns regarding the lack of real fire experience of mist systems and are unwilling to issue blanket approvals for the use of water mist.

Where insurers are likely to have an interest in the levels of protection for a new building or structure it is essential to determine their views before any fire suppression systems are procured. Failure to do so can result in an uninsurable building or, where there is evidence that a fire suppression system failed to extinguish a fire, denial of a claim. It should be remembered that insurers tend to adopt very conservative approaches to new technology so in the case of proposals to install protection that falls outside the bounds of the fire tests covered in Parts 4-7 of BS

DD 8489, applications will certainly need to be supported by technical evidence.

The Fire Protection Association in support of the insurers' group, RISC Authority, have developed a questionnaire (IQ1-Water Mist Questionnaire) to be used by those offering, procuring or approving the installation of water mist systems. The very comprehensive document runs to 17 pages and can be downloaded at no cost from [www.riscauthority.co.uk](http://www.riscauthority.co.uk).

**References:**

Jackman C and Annable K: 'Research testing with water mist systems for commercial office buildings' 24 March 2010. <http://www.info4fire.com/in-depth-content/full/research-testing-with-water-mist-systems-for-commercial-office-buildings>

**Presented by:**



**BAFSA recommends that specifiers and end-users use the following checklist :**

<b>Checklist for specifiers and end-users when reviewing water mist proposals</b>
<ul style="list-style-type: none"> <li>• Has the system been tested and approved by a third party approval body such as LPCB, VdS, UL or FM for the specific application intended?</li> </ul>
<ul style="list-style-type: none"> <li>• Has all testing been carried out by a capable laboratory such as BRE, FM, UL, SINTEF, VdS, SP, VTT or CNPP?</li> </ul>
<ul style="list-style-type: none"> <li>• Are products and components specific to the system approved for such use by a qualified third party approval body?</li> </ul>
<ul style="list-style-type: none"> <li>• Can all claims made by the system supplier be verified?</li> </ul>
<ul style="list-style-type: none"> <li>• Is there a formal agreement between manufacturer and installer? Has the installer received training from the manufacturer?</li> <li>• Does the testing and approval data correspond to the intended use of the system, including hazard classification?</li> <li>• Does the geometry of the space to be protected, including ceiling height, correspond to the testing and approval data?</li> <li>• Where insurers are the AHJ, ensure compliance with the insurer's requirements /questionnaire / checklist.</li> </ul>

**Table 3 : Standards for Mist Systems**

<b>Document</b>	<b>Description</b>
BS DD 8489 part 1: 2011	Standard providing guidance for the design, installation and maintenance of water mist systems for commercial and industrial risks. Must be read in conjunction with the supplier design requirements. BAFSA is in the process of drafting a technical guidance note to the BS BS DD 8489
DD 8489 part 4: 2011	Test requirements for mist systems protecting flammable liquid fires
BS DD 8489 part 5: 2011	Test requirements for mist systems protecting machinery spaces and turbines up to 80m <sup>3</sup> .
BS DD 8489 part 6 2011	Test requirements for mist systems protecting industrial oil cookers.
BS DD 8489 part 7: 2011	Test requirements for water mist systems for the protection of low hazard occupancies.
BS DD 8458: 2010	Standard providing guidance for the design, installation and maintenance of water mist systems for residential and domestic premises. Must be read in conjunction with the supplier design requirements.
EN/TS 14972	European technical specification providing guidance for the design, installation and maintenance of water mist systems for commercial and industrial risks. Must be read in conjunction with the supplier design requirements.
FM 5560	Test standard for water mist systems covering machinery spaces, combustion turbines, light hazard, wet benches, local application, oil cookers, sub-floors and chip board presses.
FM DS 4-2	Guidance on installation of systems approved to FM 5560.
UL 2167	Test standard for water mist systems covering machinery spaces, combustion turbines, light hazard, ordinary hazard and residential
NFPA 750:2010	Standard on Water Mist Fire Protection Systems: 2010 – outline of mist systems' performance and their application.