Foreword

Over the past twenty five 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 provided in an update to BAFSA Technical Guide No 3 Water Mist Systems and their Applications.

Unlike sprinkler systems, water mist systems are “application 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. Water mist manufacturers set out their application specific designs in their Design Manuals.

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 subject 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 from the full scale tests use to determine the suitability of a manufacturer’s mist. Over the last twenty five 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 have been 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 “application 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 application specific fire testing, usually carried out by independent third parties, will define the manufacturer specific components and their use limitations. 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 design manual should be subject to the approval of the authority having jurisdiction (AHJ)¹

BSI have now published British Standards for both Commercial and Industrial applications (BS8489), and for Domestic and Residential applications (BBS8458). The requirements still remain for manufacturers to base all applications in their design manuals 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, whilst sprinkler systems will always provide protection throughout a building, watermist systems can be used to provide protection for specific hazards/areas within a building. There are certain areas where it is currently unlikely water mist systems will be capable of providing complete protection against fire such as high piled storage within 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 fine water filtration, stainless steel pipings and other high-grade materials due to the higher operating pressures and lower tolerance of water containing particulate matter which could block the small nozzle oriﬁces.

CPVC pipework may not be suitable for applications where very low flow rates are likely as its approvals for

¹ AHJ’s include: the fire authority for the area, building control/ approved inspector and the insurers.
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 small droplets. These small, lightweight, droplets remain airborne longer and to some degree will swirl around obstructions, as well as being drawn into combustion air streams.

High heat release fires can enable conversion of these small droplets into steam enabling fire to be extinguished by oxygen displacement at the flame front. The mist, delivered at high momentum to be effective, can be affected by a series of physical conditions including air movement, either natural or forced and even by the fire dynamics. Boundary conditions affect water mist dispersion so applications in smaller rooms, such as bedrooms, and protection effectively in open areas each need to be tested to verify performance. Extrapolation of test parameters and results is generally not permissible.

Serious concerns regarding the ‘ad hoc’ nature of hybrid systems have been expressed by a number of authorities and industry members 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, and for Commercial and Industrial 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 BS 8458 2016.

BAFSA recommends where there is an intention to install a water mist system in a commercial occupancy the design and installation must comply with BS 8489 2016. Part 1 sets out the design and installation requirements, with subsequent parts providing fire test criteria for turbines, industrial oil cookers, local applications, and low hazard applications. Other fire test protocols may also be used.

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 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

By water mist systems, however, development work is ongoing so it is essential to check with the proposed system’s manufacturer or supplier for information on which types are applicable to the intended occupancy.

Where the standards do not cover specific applications, the installer must be listed under a water mist specific third party certification scheme.

It is essential that specifiers, end users and regulators take great care when reviewing the performance claims of published standards and specifications. Standards also include test criteria that are applicable for domestic cover applications for water mist systems. The water mist industry has grown from a small base from real world experience, it does not have the legacy of more established systems such as fire sprinklers. The new British Standards, BS8489 and BS 8458 for both industrial and commercial systems and residential and domestic premises. Must be read by installers of water mist systems. It is understood that BRE manufacturer or supplier for information on which types are suitable for the intended occupancy.

Must be read by installers of water mist systems. It is understood that BRE manufacturer or supplier for information on which types are suitable for the intended occupancy.

### Table 1: Water mist system components consist of the same three main parts as a sprinkler/waterspray system

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A water supply</td>
<td>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</td>
</tr>
<tr>
<td>An alarm system</td>
<td>To provide a local alarm, in case of activation</td>
</tr>
<tr>
<td>A distribution system</td>
<td>Pipework (copper, 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 small mist droplets which attack the fire.</td>
</tr>
</tbody>
</table>

### Table 2: Water mist systems generally fall into one of two categories

<table>
<thead>
<tr>
<th>Pressure Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure</td>
<td>Head pressure, typically 5-10 bar but less than 12 bar Steel or copper – pipework 20 – 65mm Normally use stored water and electric pumps Maintenance schedule similar to sprinkler/waterspray systems Fire service may be able to supplement stored water supply by pumping-in subject to availability of connections. 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) Nominal water flux density typically 2 – 3.5 lpm/ m3 Wet and dry systems available (dry using separate fire detection)</td>
</tr>
<tr>
<td>High Pressure</td>
<td>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 Smaller bore, stainless pipework, typically 12mm – 30mm. Can be either stored water (tanks) &amp; high pressure pumps, or high pressure cylinders Maintenance schedule similar to sprinkler/ waterspray systems Fire service may be able to supplement stored water for tank systems provided filters are in place. Cylinder systems cannot share existing water supplies with other water based fire protection. Typical water flux density 1 – 2 lpm/ m3 Wet and dry systems available (dry using separate fire detection)</td>
</tr>
</tbody>
</table>

---

2 "Jackman L and Annable K: 2010. ‘Hence water mist system designs for larger spaces will often require"

3 ‘Hybrid systems’ are those where, for example, a range of components is sourced from different manufacturers or suppliers, some of which may not intended or suitable for the type of use being considered. (Eg mist heads listed for marine use but installed in a residential system).
'Hybrid systems' are those where, for example, a range of mist heads available cannot be fully concealed (as necessary maintenance regime. Properties where they have an interest before any contract is for Commercial and industrial applications, and for Commercial and residential cover applications for water mist systems. The standards also include test criteria that are applicable for a 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 successful test data and the test/s and data are directly applicable to the intended occupancy.

Premises such as warehouses and large industrial buildings are not currently deemed suitable for protection by water mist systems, however, 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

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS 8489 part 1: 2016</td>
<td>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.</td>
</tr>
<tr>
<td>BS 8489 part 4: 2016</td>
<td>Test requirements for mist systems protecting flammable liquid fires</td>
</tr>
<tr>
<td>BS 8489 part 5: 2016</td>
<td>Test requirements for mist systems protecting machinery spaces and turbines up to 80m³.</td>
</tr>
<tr>
<td>BS 8489 part 6 2016</td>
<td>Test requirements for mist systems protecting industrial oil cookers.</td>
</tr>
<tr>
<td>BS 8489 part 7: 2016</td>
<td>Test requirements for water mist systems for the protection of low hazard occupancies.</td>
</tr>
<tr>
<td>BS 8458: 2016</td>
<td>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.</td>
</tr>
<tr>
<td>EN/TS 14972</td>
<td>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.</td>
</tr>
<tr>
<td>FM 5560</td>
<td>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.</td>
</tr>
<tr>
<td>FM DS 4-2</td>
<td>Guidance on installation of systems approved to FM 5560.</td>
</tr>
<tr>
<td>UL 2167</td>
<td>Test standard for water mist systems covering machinery spaces, combustion turbines, light hazard, ordinary hazard and residential</td>
</tr>
</tbody>
</table>

**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. The water mist industry has grown from a small base from twenty five years ago and, whilst this has provided some real world experience, it does not have the legacy of more than a hundred years of test data and real-world experience that the sprinkler industry benefits from. Thus these water mist standards cannot be said to provide the same proof of performance nor cover the extent of the range of hazards included in BS EN 12845.

It is essential that specifiers, end users and regulators take great care when reviewing the performance claims of any particular system proposed. The recently published BS documents are full British Standards created to reflect industry best practice. At present the CEN water mist document, EN TS 14972, is a 'Technical Specification' and not a European Standard and is envisaged to be several years away from being so. Various American documents also cover watermist. NFPA 750 code covers the design and installation of mist systems in accordance with manufacturers' design manuals. Underwriters Laboratories (UL) 2167 covers test protocols for various hazards (see Table 3). Factory Mutual (FM) 5560 sets out the design and test requirements for systems underwritten by them (see Table 3).

**Suitable Applications for Water Mist**

The new British Standards, BS8489 and BS 8458 for both Industrial and commercial systems and residential and domestic cover applications for water mist systems. The standards also include test criteria that are 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 successful test data and the test/s and data are directly applicable to the intended occupancy.

Premises such as warehouses and large industrial buildings are not currently deemed suitable for protection by water mist systems, however, 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).
Certification (using the LPCB brand) may be setting up a similar installers’ scheme and also developing a scheme to complement their 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-compliances 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. Whilst some water mist applications have gained ready insurer acceptance for hazards such as industrial oil cookers and combustion turbines, some insurers still express concerns regarding their 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 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 recognised fire tests nor include extrapolations, or unwarranted assumptions.

While there may be systems that have non-UK 3rd party approvals for specific applications and sizes, these will 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.

The Fire Protection Association in support of the insurers’ group, RISC Authority, have developed a series of questionnaires for use by those offering, procuring or approving the installation of water mist systems. At present these address both pre-purchase considerations as well as post contract design details. These very comprehensive documents can be downloaded at no cost from www.riscauthority.co.uk.

References


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

Checklist for specifiers and end-users when reviewing water mist proposals

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?

Has all testing been carried out by a capable laboratory such as BRE, FM, UL, SINTEF, VdS, SP, VTT or CNPP?

Are products and components specific to the system approved for such use by a qualified third party approval body?

Can all claims made by the system supplier be verified?

Is there a formal agreement between manufacturer and installer? Has the installer received training from the manufacturer?

Does the testing and approval data correspond to the intended use of the system?

Does the geometry of the space to be protected, including ceiling height, correspond to the testing and approval data?

Where insurers are the AHJ, ensure compliance with the insurer’s requirements /questionnaire / checklist.

Presented by:

BAFSA

2 Kenmore Street, Aberfeldy, Perthshire, Scotland PH15 2BL
Tel: +44(0)1887 829428 Fax: +44(0)1887 829428
Email: info@bafsa.org.uk Web: www.bafsa.org.uk

© 2016 BAFSA