



## Fire Protection Guidance Note

# **Water Mist Fire Suppression Systems for Complete Building Protection**

### **Introduction**

Water mist systems have a proven track record in marine and local applications. Recently they have been increasingly put forward, by the installers of such systems, as an alternative to conventional sprinkler protection, in providing complete building protection, particularly for occupations such as schools, hospitals and offices.

The objective of this document is to provide guidance, to Zurich Risk Analysts and Risk Engineers, on Zurich Risk Engineering's approach to the use of such systems for complete building protection.

### **Zurich Risk Engineering Approach**

Zurich Risk Engineering does not consider water mist systems to have been proven to provide an equivalent level of fire protection, to that of a sprinkler system, in terms of effectiveness and reliability, for the following reasons:

- Lack of appropriate design standards.
- Lack of third party certification of water mist companies and equipment.
- Limited fire test data and relevance of test compared to premises to be protected.
- Ability to protect all areas of premises, e.g. stock rooms, gym stores, external canopies, kitchens and plant rooms, etc. not proven.
- Ability to provide protection for different methods of construction, or products used in construction, not proven.
- Ability to deal with design features of premises, which may affect performance of systems, e.g. Atriums, areas with ceilings over 5m high, open cell ceilings and plenums etc. not proven.
- Ability to provide the protection against incidents involving deliberate ignition, where doors and windows to protected areas, may well be open, following forcible entry.

## Design Standards

Sprinkler installations are designed and installed by supervised companies to BS EN 12845. In addition to this, other fire protection standards are used such as Factory Mutual (FM) and National Fire Protection Association (NFPA). There is currently no equivalent British or European Standard to cover the design and installation of water mist systems, however, there are the standards described below.

### BS EN 12845: 2009

The design of sprinkler installations for buildings, such as modern schools, offices and hospitals, is particularly challenging due to the diversity of areas to be protected, the high number of other services to coordinate with and the nature, and form, of the structures themselves. This inevitably leads to extensive Risk Improvement Action points being created within our reports to cover the spacing and location of sprinkler heads, accuracy of hydraulic calculations and areas of protection. All these items are, however, prescriptively set out within BS EN 12845, providing us with a base level of acceptability.

For reference purposes the following table sets out Ordinary Hazard Classification design criteria for sprinkler systems as stated in BS EN 12845:2009

<b>Occupancy Classification</b>	<b>Design Density</b>	<b>Area of Operation</b>	<b>Examples</b>
<b>OH1</b>	5 mm/min	72m <sup>2</sup>	Class Rooms, Hospital Wards
<b>OH2</b>	5 mm/min	144m <sup>2</sup>	Offices, Laboratories, Metal Workshops, Car Parks.
<b>OH3</b>	5 mm/min	216m <sup>2</sup>	Plant Rooms, Storage Rooms, Retail Areas.
<b>OH4</b>	5 mm/min	360m <sup>2</sup>	Theatres, Exhibition Spaces

### NFPA 750

Tender specifications received for water mist systems often state 'in accordance with NFPA 750'. This is not a fully formed design document (such as BS EN12845 for sprinklers) and is not considered an extensive standard, but is viewed as a guidance document. It defines water mist, based on droplet size, as low pressure and high pressure and it refers to local application and area protection systems.

It states that all systems and applications are required to have proven capability by means of risk specific, realistic fire performance tests, which must be carried out to suit the application and risk features. These tests must be verified by recognised approved test laboratories and all equipment must also be listed, as approved for that application, and listed with UL FM, Vds, LPCB or similar approvals listing organisation.

NFPA 750 states that systems with proven extinguishing capability, usually local applications such as industrial fryers, are required to have twice the proven water duration. Control systems, usually area protection systems, must have at least 30 minutes of water supply.

Many installers have not had their equipment, such as nozzles, control valves and pumping equipment, tested or evaluated by an approvals listing organisation for corrosion, blockage and reliable performance, nor have they completed suitable tests for each application or design feature, as described in this document.

### International Maritime (IMO) Standard A800

The International Maritime Organisation (IMO) Standard A800 is intended for water based vessels. It is not adequate to simply transfer this standard to land based applications, as the construction, compartment sizes and fire loadings, of marine vessels, bear no resemblance to those generally found within buildings.

### Draft British Standard for Water Mist Systems

There is currently a draft British Standard for the design and installation of water mist systems. It has to be recognised that this is a very generic document, placing complete reliance on non-certified or regulated contractors. They will have to produce and adhere to their own design and performance specifications, and the responsibility will be placed on the contractor to ensure the relevant fire testing is carried out, for the application in which the water mist system is to be installed.

Recently received specifications, for water mist installations, have made reference to the use of a combination of the above named standards, with additional references for compliance with aspects of BS EN 12845 and BS9251: Sprinkler Installations for Residential & Domestic Occupancies. Such systems have been described as 'alternative sprinkler installations'. It will not be possible to control, or verify, the use of this type of hybrid system, as the different standards quoted have conflicting requirements for various aspects.

As water mist systems are performance based, and each installer produces their own design guide, this will make verification of these systems extremely difficult and time consuming, as specialist knowledge, of each contractor's design guides, systems and components, will be needed. Without the presence of a single standard to cover the design, installation and commissioning of these systems, this will leave open to question the adequacy of the level of protection provided.

### **Third Party Certification**

To ensure that installed sprinkler systems meet the prescriptive standards, set out in BS EN 12845, sprinkler installation contractors are required to be registered with an approved third party certification body. Within the United Kingdom, the leading organisation, in this regard, is the LPCB (Loss Prevention Certification Board). There is a secondary scheme to which contractors may be registered, namely FIRAS.

There is currently no third party certification scheme available within the United Kingdom to control and supervise the installation of water mist systems or the installing companies and staff. This leaves the industry unregulated and provides no peace of mind, for end users and stakeholders alike, as to the quality of the installation or the equipment used.

## **Fire Testing**

The design of sprinkler installations is based on historic fire loss data and extensive full scale fire testing of the areas and fire loadings to be protected. This testing is carried out by recognised bodies such as the Building Research Establishment (BRE), Factory Mutual (FM), National Fire Protection Association (NFPA), and Underwriters Laboratories (UL).

To date, no comparable data is available for water mist systems and the latest draft British Standard calls for fire testing to be carried out for all new applications. Other than the water mist testing, undertaken by the IMO for marine based applications, some additional land based application testing has been carried out by water mist companies, however, the test criteria used bears no resemblance to the fire loadings for the purposes of this document and is inadequate, when compared with the expected practice throughout the fire protection industry.

## **Fire Engineered Building Design**

In addition to the obvious benefits of installing sprinkler protection to protect a premises Approved Document B: Fire Safety Volume 2 - Buildings other than Dwelling Houses and BB100: Fire Safety in Schools offer other attractive benefits, which will appeal to architects, local authorities, project sponsors and end users.

Based on the provision of a fully compliant sprinkler system, it is acceptable to look to reduce other fire protection measures for both property protection and life safety elements. These include the level of automatic fire detection to be provided and fire resistance of compartments, e.g. from 60 minutes to 30 minutes fire resistance. These reductions can offer significant financial savings which can be offset against the cost of a conventional fire sprinkler system. In addition, unparalleled design freedoms can be achieved, in the form of larger compartment sizes, e.g. from 800m<sup>2</sup> to 2000m<sup>2</sup>, extended travel distances and the potential reduction in the number of fire escape staircases.

A significant number of other trade-offs, or design freedoms, exist and the provision of sprinklers can bring unparalleled flexibility in design.

The use of water mist systems will not permit the same deviations from the building regulations, as afforded to the use of sprinkler systems. The main reason for this, is that currently, there is no applicable proven design standard for water mist systems and, as such, the same level of reliability cannot be assumed.

## **Modern Methods of Construction**

The desire to create an innovative and sustainable built environment is constantly increasing. The introduction of such schemes as the BRE Environmental Assessment Methods (BREEAM) has charged architects, engineers, designers and end users, with ensuring that their new buildings have a low environmental impact, reduced running costs, and demonstrate progress towards corporate and organisational environmental objectives. Due to this requirement, most new projects are using modern methods of construction to achieve a "very good" or "excellent" rating. This has had a huge effect on the materials used in construction, the type of services provided and as such an effect on the way a building will behave under fire conditions.

An example of this is the use of treated or untreated timber, which is particularly prevalent in new build projects, as it is seen as a sustainable material and has been ethically sourced. This not only includes the use of timber cladding on the external face of a building as a finish, but also the structural frame and internal walls.

Another example is the insulation of buildings taking many different forms and using alternative materials to achieve high standards of thermal performance. Whilst most of these materials are tested and found to have fire resisting qualities, some being used do not, such as recycled newspaper. In such buildings, the active fire suppression system plays a large role in ensuring that a fire will not lead to a total loss. Sprinkler installations have been extensively tested and installed throughout a wide range of differing building types.

The testing referred to within the IMO standards for water mist systems is based on the construction of a ship, where each individual room is a relatively small steel fire resistant compartment. The only additional fire loadings in this instance would be the furnishings within the room and items brought into the space by the occupant. In most buildings, regardless of the hazard classification, the fire loading will be significantly higher.

## **Hazard Classification**

### Schools

Originally, sprinkler installations for schools were deemed to be Light Hazard within BS 5306 Part 2:1990. It soon became apparent that the fire loadings within these premises, coupled with the larger compartment sizes being created, meant that this classification needed to be increased. Following the introduction of Technical Bulletin 34 – Sprinkler Protection of Schools in July 2003, the classification was increased to a minimum of Ordinary Hazard Group 1, with the condition that this may need to be increased further should there be higher fire loadings present. To date, this classification has remained the same and was carried forward into the new European Standard BS EN 12845 Technical Bulletin 221.

What has not remained the same, however, are the buildings being protected by these systems. With the advent of the Building Schools for the Future project and the need to provide innovative and inspiring educational facilities for today's children, these buildings are now taking an appearance more commonly associated with shopping malls and city centre office blocks. As insurers of these premises, we need to take a balanced view of the level of fire protection systems, which will be acceptable to ourselves, not only to protect our own bottom line, but also to safeguard the assets and investments of our customers.

Generally sprinkler installations within schools are designed as Ordinary Hazard Group 1, although the presence of areas, such as theatre stages, stock rooms, car parks, plant rooms, etc., would ideally require a higher classification, typically Ordinary Hazard Group 3. From the outset, one of the main stumbling blocks of achieving sprinkler protection of schools was the size of the water supplies, due to the requirement for 60 minutes of stored water. This problem was addressed within the Technical Bulletin which permitted 30 minutes of stored water for Ordinary Hazard Group 1 occupancies, only with the provision of a Fire Brigade inlet connection. No such reduction, in stored water capacity, is currently offered for higher classifications.

Due to the safety margins, built into sprinkler installations, we can take comfort in the knowledge that should one of these systems be called into action, the additional flows and pressures achieved from the operation of the first sprinklers, will inevitably control a fire within its area of origin and in many cases achieve extinguishment.

As water mist systems are entirely performance based, with no level of over-engineering, we cannot have the same faith.

#### Offices, Hospitals, etc.

These premises include some of the same features mentioned in the above section relating to school premises, such as plant rooms, stock rooms, etc. There are some features unique to these premises that also create big challenges for sprinkler installations and at present are well beyond the capability of water mist systems. These will include areas such as multi floor atriums, lift motor rooms and voids crammed with services such as ducting, cable trays and other services.

Hospitals have other issues, in addition to those mentioned, such as on-site laundries and stores, large commercial kitchens and even some retail outlets, all beyond proven capability of water mist systems for land based applications.

### **Areas to be Protected**

Sprinkler installations are capable of effectively protecting all areas of a building. There are several areas, however, in which the application of water mist would simply not be appropriate. The following list of features, whilst not being exhaustive, would typically be found in educational, retail, commercial and local authority buildings:

#### External canopies

Due to the smaller droplets produced by water mist systems, this would make protection of these areas not possible due to the effects of the weather. This would leave buildings vulnerable to exposure hazards from externally set fires, which would not be uncommon below such areas.

#### Halls/Atria

Currently water mist systems are limited in their capabilities to protect areas greater in height than 5 metres. Virtually every new school and office building will incorporate areas in excess of this height, be it a Games or Assembly Hall, Central Atrium or a 'street'. Only water mist deluge type applications are suggested for ceilings, higher than 5 metres, but are not proven by suitable fire tests.

#### Ceiling Voids

Currently water mist systems are limited in their capabilities to protect voids with a depth in excess of 800mm, with a suggestion to treat larger voids as rooms, but ignoring likely obstructions and issues found in voids such as ducts, cable trays and forced air plenums.

For sprinkler installations to be deemed compliant, voids in excess of 800mm require to be protected.

## Naturally Ventilated Buildings

Buildings with natural ventilation systems are becoming more popular, as architects and local authorities seek to provide environmentally friendly buildings, with lower running costs and reduced carbon footprint. These systems incorporate facilities for the automatic opening of windows to cool the building overnight. Such openings in the building fabric will present the same problem to water mist systems as that below external canopies in that the smaller water droplets will be affected by the air movement created.

## Air Plenums

These are typically an unoccupied space, such as a ceiling void, in which air is moved or circulated throughout the confines of the space, at above or below atmospheric pressure for heating, ventilating or air conditioning purposes. It is now a requirement that these areas are sprinkler protected. The size of the water droplets from the sprinkler spray should not be affected by this.

The behaviour of a water mist system is not known at this time, as no specific research has been carried out, however the fine droplets produced by the water mist system are likely to be affected by the air movement and atmospheric pressure within the plenum and, as such, render the system inadequate under such conditions.

## Storage

Storage areas are to be found in all buildings, regardless of the occupancy, an example of this being a Sports Store, within a school. Typically these areas would include the storage of gym mats and other plastic equipment, such as bats and balls. These items are generally produced using materials like expanded plastics, expanded foam plastics and unexpanded plastics.

Within BSEN12845: 2009 this situation is addressed under clause 6.2.2, where the presence of this type of storage facilitates the need to increase the hazard classification from Ordinary Hazard group 1 to Ordinary Hazard group 3. The flexibility afforded to sprinkler installations due to the robust nature of the design standard allows this increase to be accommodated relatively easily.

Water mist systems cannot be used at this current time for any hazard classification above Ordinary Hazard group 1.

## Open Cell Ceilings

This design feature is seen regularly in all types of occupancy. It is used in conjunction with other services such as heating and ventilation. The design standards for sprinkler installations again cover this issue and the sprinkler system can be designed to suit this type of ceiling.

The same cannot be said for the design standard for water mist systems. There is currently no guidance for the design of a Water Mist system for such a feature.

Overall substantial fire testing will need to be carried out on the performance of water mist systems for the above examples and other building features before they can be used to wholly protect entire properties.

## **Preferential Insurance Terms**

In many instances, Zurich offer preferential insurance terms for the installation of an 'approved' sprinkler installation. These terms are offered due to the confidence that insurers have in the capability of sprinkler installations to provide reliable and effective full building protection.

For the reasons detailed in this document, there would not be the same degree of confidence in water mist systems and, therefore, the same preferential terms would not be offered.

Some buildings present such a significant fire risk that insurance cover may not be available, without the installation of an approved fire suppression system, such as a sprinkler system. With the installation of a sprinkler system, insurers would be confident that their exposure was reduced to an acceptable level and cover may be provided.

For the reasons detailed in this document, there would not be the same degree of confidence in water mist systems.

## **Weekly Testing and Maintenance**

The standards produced for sprinkler installations prescriptively describe the requirements for the weekly testing, and the on-going maintenance, of the system throughout its life. The weekly testing is generally carried out by the maintenance team or trained and competent member of staff within the organisation. The maintenance of the sprinkler installation and its components can be carried out by any contractor who is certified by the LPC or FIRAS.

Some water mist systems utilise stored gas, to pressurise their systems, and no weekly testing can be carried out and the on-going maintenance will be carried out by the original contractor, who has no third party approval. In addition, there are no prescriptive time scales, in which the maintenance of the system and its components are carried out, that all water mist contractors work to.

## **Summary**

It must be recognised that water mist is an effective means of fire suppression in the correct application and indeed its worth has been proved in the past for marine based and local application uses.

However, until such time as there are extensive design standards, supported by appropriate fire testing, carried out by approved third party research laboratories and third party approval of installers and systems, we consider that the use of water mist, for the fire protection of entire buildings, remains unproven.

For the following reasons Zurich Risk Engineering does not consider water mist systems to be comparable with sprinkler installations:

- Lack of appropriate design standards.
- Lack of third party certification of water mist companies and equipment.
- Limited fire test data and relevance of test compared to premises to be protected.
- Ability to protect all areas of premises is not proven.
- Ability to provide protection for different methods of construction, or products used in construction, not proven.
- Ability to deal with design features of premises, which may affect performance of systems are not proven.

If the issues identified in this document are addressed, water mist would be considered to be appropriate for complete building protection for certain occupancies, although the preferential terms for insurance would not be equivalent to those given to buildings protected by a sprinkler system.

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