

EUROFEU FIXED EXTINGUISHING INSTALLATIONS SECTION

GUIDANCE NOTES FOR WATER MIST SYSTEMS

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FOREWORD

The purpose of these guidance notes is to assist all interested parties involved in the application, specification, design and installation of water mist systems. It is not intended to be a design code or approval guide, but simply to provide fundamental information on the subject of water mist which can be used to determine the best course of application for this technology.

These guidance notes have been prepared under the direction of the BFPSA Water Mist Systems Working Group. As time progresses, more information on the subject will become available and it is the intention of the Working Group to expand and translate this document into a Code of Practice.

INTRODUCTION

Water Mist as a concept is not new. Investigation into the use of finely divided water droplets was first recorded in the 1930s. However, historically, water based fire protection has been based on the use of copious quantities of water to control and extinguish fires. Water mist as a new technology uses minimal amounts of water and its application is risk specific and normally confined to enclosed areas. The advantages of water mist systems are: (1) *Rapid extinguishment using minimal water quantities;* (2) *Safe for use in manned areas;* (3) *No environmental risk;* (4) *Rapid temperature reduction.*

Wide ranging applications present a major problem for those tasked with writing a Code of Practice because the influencing parameters are so broad. It is therefore important to separate the types of application and focus separately on these requirements. They involve risk specific designs and may be for the protection of single or multiple zoned application techniques.

Water mist systems are not equivalent to total flooding gaseous systems which completely fill the risk volume with a homogenous extinguishing agent concentration for a predetermined retention period. Water mist systems operate through a combination of directional and volumetric dispersion of the spray relative to a specific risk (object) within the enclosure during a predetermined discharge time.

A primary difference between water mist systems and sprinkler systems is the philosophy of protection. The objective of sprinkler systems is to provide an acceptable degree of fire control/fire suppression prior to intervention by the Fire Service or others.

Water mist systems however are generally designed for fire extinguishing which takes place quite rapidly with limited water supplies. Water mist systems can be used to give fire control, but where this is the primary objective of the system consideration should be given to the duration of discharge with respect to intervention of the Fire Service or others. This situation also applies where water mist systems are considered for temperature control and exposure protection; consideration should be given in the design to the occurrence of re-ignition and appropriate measures taken.

Water mist systems are currently available as single³ or twin fluid systems³ which operate over a range of pressures typically from 4 Bar to 300 Bar.

Nozzles used in water mist systems are specifically designed for the purpose and can be open deluge type or closed with an integral detector. Systems can be integrated with traditional detection to form automatic deluge and wet pipe type arrangements.

Water mist technology is extremely effective on Class 'B' fires¹ involving flammable liquids². It can also be used on class 'A' fires¹ involving solid materials including fires involving electronic equipment. The relationship between droplet size, distribution and extinguishing capabilities are complex and involve such factors as spray flux density momentum, enclosure effects and fuel types. Research shows that water droplets smaller than 400 microns in diameter are a key parameter of water mist systems. In contrast, sprinkler systems operate with water droplet sizes between 100 and up to 2000 microns, which are also effective on Class A and some Class B fires.

- 1 When considering Class 'A' fires account should be taken of the potential for deep seated fires as water mist is largely ineffective unless discharge is maintained over a lengthy period.
- 2 Pool fires involving flammable liquids with low flashpoint are normally expected to be controlled rather than extinguished.
- 3 Refer to Sections – Key Definitions.

Chapter 1

KEY DEFINITIONS

The following definitions are relevant to the equipment and systems included in this Guidance document:

1-1 WATER MIST SYSTEM

A risk specific fire suppression system employing one or more special purpose nozzles connected by a pipework system.

1-2 Water Mist

A water spray for which the $D_{V_{0.99}}$ as measured at the coarsest part of the spray in a plane 3.3ft (1m) from the nozzle, at its minimum design operating pressure, is less than 1000 microns.

1-3 Water Mist Nozzle

A special purpose device with one or more orifices which is designed to produce and discharge water mist.

1-4 Open Nozzle System

A water mist system which uses open nozzles connected to a piping system fed by a suitable water supply. The system is controlled by a valve which is activated by a detection system or by manual means. When the valve is open and the system pressurised, water flows into the pipework system and discharges simultaneously through all the nozzles. Systems may sometimes be sub-divided into zones.

1-5 Closed Nozzle System

A fine water spray water mist system which uses nozzles sealed with an integral detector connected to a piping system and fed by a suitable water supply so that water discharges immediately from all of the nozzles operated.

1-6 Single Fluid System

A system which generates water mist at the nozzle by passage of water through a single delivery pipe.

1-7 Twin Fluid System

A system which generates water mist at the nozzle by mixing water with an atomising gas fed from a separate pipe(s) to the one used for the water supply.

1-8 Object Protection System

A water mist system designed to discharge directly onto an object or hazard to provide extinguishment, control or cooling as required.

1-9 Volume Protection System

A water mist system designed to protect one or more objects within an enclosure.

Chapter 2 **SYSTEM DESIGN**

2-1 Variables

System design is a function of a number of variables which may include the following:

- Design objectives
- Fire hazard classification
- Risk analysis
- Risk geometry
- Ventilation
- Health, Safety and Environmental impact
- Enclosure characteristics
- Nozzle spray characteristics
- Effects of obstructions to mist coverage
- Detection systems and equipment interface
- Water quality
- Fuel and fire load
- Duration of discharge time

When protecting risks involving Class A combustibles, and an extended duration of discharge is required, the recommendations contained in the manufacturer's design manual shall be followed.

As many of the design elements are risk specific and relate to unique test work carried out by the original equipment manufacturer, only applications listed as suitable by the equipment manufacturer should be considered.

Parties involved in the selection, specification and use of water mist systems should consider the ability of the Equipment Manufacturer to demonstrate the performance of the system through an appropriate test programme. Design responsibility for the system should lie with the Equipment Manufacturer.

2-2 Toxicology

Human safety relating to the deployment of Water Mist in manned areas has been addressed by the U.S. Environmental Protection Agency (E.P.A.). A Medical Health Panel evaluated Water Mist under the Significant New Alternatives Policy (SNAP) and the results were published in August 1995. The overall conclusion of the Health Panel was that Water Mist Systems using pure water do not present a toxicological or physiological hazard and are safe for use in occupied areas.

However, the study considered that water droplets less than 20 microns in diameter could present a health risk with prolonged exposure. Therefore these Guidance Notes recommend that no more than 10 per cent of droplets by volume have a diameter of 40 microns or less.

2-3 Additives

The design objective of a Water Mist System is to extinguish or control a fire without reliance on additives. However, it is accepted that some additives improve flame knock down capacity and/or provide a means of sealing the fuel surface against re-flash conditions and running spill fires.

If additives are required for a particular application, consideration should be given to the toxicological effects when dispersed within finely divided droplets. Decomposition on hot metal surfaces and flames should also be considered together with shelf life and corrosive effects on system components and protected equipment. The same considerations should be given to additives used to prevent freezing of the stored water supply.

If additives are used within a water mist system it is the responsibility of the system provider to ensure that product material safety data sheets are made available to the user.

2-4 Water Quality

Water Mist is generated through small orifices and it is essential that precautions are taken to prevent particulate blocking the system. Potable drinking quality water can be used in the majority of systems, but it may be necessary to consider the addition of simple salts to prevent bacterial growth. Distilled, demineralised and dionised water can also be used.

Refilling of vessels and resetting the system after testing or discharge in a fire situation should be carried out by competent personnel, in accordance with the manufacturer's instructions.

Suitable filters and/or strainers shall be provided in the distribution pipework to ensure that nozzle orifices do not become blocked by pipe scale or other debris.

Chapter 3 **APPLICATIONS**

The following is a list of applications which can be protected by water mist systems. Not all available systems are universally suitable for all applications and only the manufacturer's recommendations should be followed. Water mist systems have been proven to be effective in controlling and suppressing the following types of fires:

- (a) Gas jet fires;
- (b) Flammable and combustible liquids;
- (c) Hazardous solids, including fires involving plastic foam furnishings;

Water mist systems are designed for use in enclosed areas. Where water mist systems are used in open air applications careful consideration should be given to the prevailing external conditions, e.g. wind, low temperature.

Water mist systems shall not be used for direct application to materials that react with water to produce violent reactions or significant amounts of hazardous products. These materials include:

Reactive metals, such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium;

- (a) Metal alkoxides, such as sodium methoxide.
- (b) Metal amides, such as sodium amide.
- (c) Carbides, such as calcium carbide;
- (d) Halides, such as benzoyl chloride and aluminium chloride;
- (e) Hydrides, such as lithium aluminium hydride;
- (f) Oxyhalides, such as phosphorus oxybromide;
- (g) Silanes, such as trichloromethylsilane;
- (h) Sulfides, such as phosphorus pentasulfide; and
- (i) Cyanates, such as methylisocyanate.

Water mist systems shall not be used for direct application to liquefied gases at cryogenic temperatures (such as liquefied natural gas), which boil violently when heated by water.

Chapter 4

MATERIALS OF CONSTRUCTION

4-1 Corrosion

Non corrosive materials shall be used for all wetted parts of the system, including storage vessels. The equipment manufacturer's guidelines should be followed in the selection of materials for the distribution pipework.

4-2 Pressure Ratings

Appropriate European or national standards must be adhered to, ensuring pipework and pressure vessels are fit for purpose.

Chapter 5 **INSTALLATION AND COMMISSIONING**

5-1 Mechanical Components

The equipment manufacturer's installation and commissioning procedures shall be followed at all times. Consideration shall be given to the following:-

- ◆ During installation the distribution pipework shall be internally cleaned and inspected to ensure that no debris is left in the pipework or fittings. Filters and strainers shall be checked after discharging the system.
- ◆ The piping distribution system shall be inspected to determine that it is in compliance with the system layout drawings and hydraulic calculations.
- ◆ Nozzles and pipe size shall be in accordance with the system layout drawings. Means of pipe size reduction and attitudes of tees shall be checked for conformance to the drawings.
- ◆ Piping joints discharge nozzles and piping supports shall be securely fastened to prevent unacceptable vertical or lateral movement during discharge. Discharge nozzles shall be installed in such a manner that piping cannot become detached during discharge.
- ◆ All storage containers and associated equipment shall be properly located in accordance with the system layout drawings. All containers and mounting brackets shall be securely fastened in accordance with the manufacturer's requirements.
- ◆ All closed sections of pipework shall be tested to a minimum of 1.5 times the maximum working pressure. At the end of two minutes there shall be no leakage.

CAUTION: *Pneumatic pressure testing creates a potential risk of injury to personnel in the area as a result of airborne projectiles if rupture of the piping system occurs. Prior to conducting a pneumatic pressure test, the protected area shall be evacuated and appropriate safeguards shall be provided for test personnel.*

5-2 Electrical Components

Any automatic detection system and its associated wiring shall conform to the relevant requirements of BS.7273 Part 1 & BS.5839 Part 1 of the appropriate national standard.

All field circuitry shall be measured for ground fault and short circuit condition. When measuring field circuitry, all electronic components (such as smoke and flame detectors or special electronic equipment for other detectors or their mounting bases) shall be removed and jumpers properly installed to prevent the possibility of damage within these devices. Replace components after measuring.

Adequate and reliable primary standby sources of energy shall be used to provide for operation of the detection, signalling, control and actuation requirements of the system.

When all functional tests are complete, the system shall be returned to its operational status and the system user notified.

5-3 Completion Certificate and Documentation

The installer shall provide to the user a completion certificate, a complete set of instructions, calculations and drawings showing the system as installed, and a statement that the system complies with all the appropriate requirements of the guideline, and giving details of any deviations from standards.

Chapter 6 **INSPECTION, MAINTENANCE & TESTING**

6-1 Manufacturers' Recommendations

The manufacturer's recommendation should be followed at all times and will indicate periodic maintenance requirements and user responsibilities. There is a legal responsibility of the user to ensure that fire fighting and detection equipment is maintained in a fully operational status.

6-2 Training

It is the user's responsibility to ensure that all persons who may inspect, test, maintain or operate fire extinguishing systems shall be trained and regularly updated in the functions they are expected to perform.

All persons working in an enclosure protected by a water mist system should be adequately trained in the use and operation of the system, including safety related issues.