TECHNICAL INFORMATION

HIGH-PRESSURE WATER MIST

FINE WATER SPRAY FIRE-FIGHTING SYSTEMS

The Smarter Way of Fire Fighting

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1 INTRODUCTION

The company FOGTEC Brandschutz GmbH & Co. KG with headquarters in Cologne is one of the leading international manufacturers of high-pressure water mist systems.

The company is continually developing and researching new fire fighting solutions with high-pressure water mist, working closely together with independent authorities and recognised testing institutes.

The following technical information provides assistance with the design of safe, effective and economical system solutions. If necessary, fire detection and alarm options can be incorporated.

Services and Advantages – An Overview

- Proven successful fire fighting
- Consulting on holistic solutions: high-pressure water mist systems and their activation by fire detection systems
- Support with coordination meetings with local authorities, fire experts and fire services
- Participation and support in the compilation of fire safety inspection reports
- Compilation of technical specifications
- Support for tailor-made service specifications
- Preparation of fire fighting concepts
- Performance of all services for high-pressure water mist systems and their fire protection related activation
- Maintenance, inspection and servicing by experienced and professional engineers

These documents have been compiled in accordance with the latest technology and to the best of our knowledge and belief and are addressed exclusively to experienced experts working in the field of fire protection. Any evaluations, recommendations, planning instructions etc. which they contain are not necessarily transferable to all applications and should only be understood as an approximate guideline.

It remains the responsibility of the reader to evaluate and implement the data, instructions and information provided with respect to their applicability for each individual case and to draw correct and appropriate conclusions from them.

For the sake of good order FOGTEC Brandschutz GmbH & Co. KG would like to point out that FOGTEC hereby rejects any responsibility for designs which have not been prepared by FOGTEC even in the event that information contained in this document has been used for the designs.

Further information can be obtained from

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2 BASIC PRINCIPLES OF WATER MIST TECHNOLOGY

In order that a fire can develop, the following conditions must be present in the correct mixing ratio:

- Combustible material
- Energy for igniting and maintaining the fire
- Oxygen (O_2)

In order to fight a fire effectively, the above conditions have to be removed – at least in part – from the combustion process. As a rule this is achieved either by means of cooling, and therefore the removal of energy, or by reducing the oxygen that is available.

Fig. 1: Combustion triangle according to Emmons

Water mist fights fires with smallest droplets of pure water. Depending on the application, droplet sizes from approximately 20 to 200 µm are used (class I water mist according to NFPA 750, 1996 edition). These systems are particularly effective and require only small quantities of water. The most important effects of fire fighting with water mist are the cooling and oxygen displacement effect (local inerting).

Cooling Effect

Through the atomisation of water under high-pressure, the reaction surface available for the cooling process is significantly enlarged in comparison to conventional low pressure systems.

As a result, FOGTEC systems can remove energy from the fire considerably faster and more effectively. As a result of the high cooling effect, the fire is effectively fought and people and materials are protected against the effects of heat. The high cooling effect is mainly achieved by vaporisation of the fine water droplets in the vicinity of the fire.

This effect is supported by the shielding effect of the small droplets against heat radiation. In this way it is also possible to create effective water mist partitions (curtains) for building elements, wall openings, facades etc.

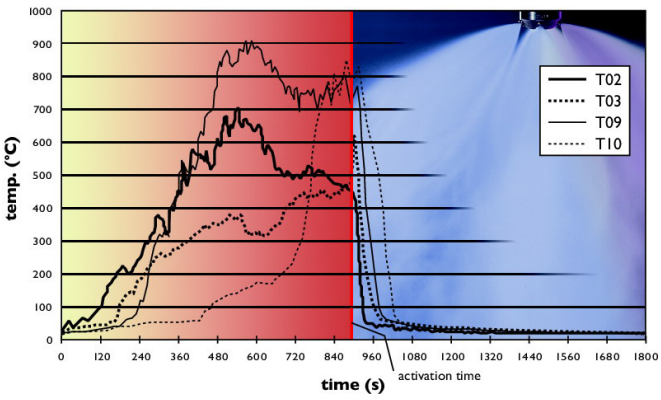

Fig. 2: Cooling effect after the activation of a high pressure water mist system from FOGTEC during a fire test

Oxygen Displacement

Due to the high temperature levels in the immediate vicinity of the fire, the small droplets evaporate very quickly and thereby remove energy from the fire. In the neighbouring areas to the fire no steam is produced by vaporisation, ensuring safe evacuation of the area.

As a result of the evaporation of the water in the direct vicinity of the fire its volume is increased 1640-fold, so that part of the oxygen is displaced locally at the seat of the fire. As a consequence, an inerting effect is produced at the seat of the fire, similar to that of an inert gas system. However, in contrast to the use of inert gases, the oxygen concentration is not reduced throughout the room.

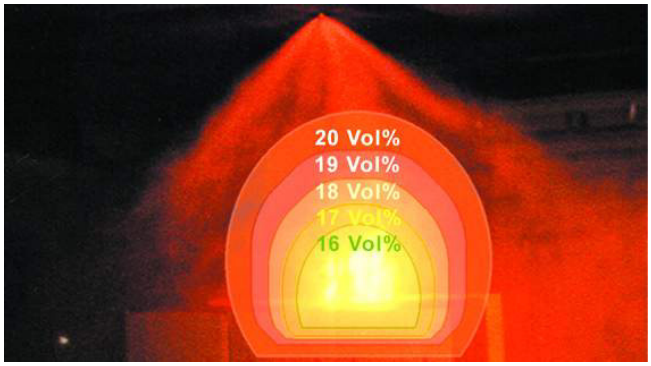

Fig. 3: Local displacement of the oxygen by evaporation of the water droplets at the seat of the fire

In comparison to low pressure water mist systems or other conventional water fire fighting systems, the extinguishing effect is far more effective due to the small droplets used with the high-pressure technology, so that a much smaller quantity of water is required. The system pressure of 50 to 200 bar is required to create the small droplets and convey these with the required energy to the seat of the fire.

Further Effects

In addition to the main extinguishing effects referred to above, further positive effects can be observed during fire fighting with water mist:

- **Shielding of the heat radiation:** Due to the small water droplets, the heat radiation is effectively shielded and therefore its effect on humans, building elements and other fire loads considerably reduced.
- **Dilution:** As a result of the fine water droplets and their evaporation in the immediate vicinity of the fire, the concentration of combustible gases is diluted. This has a positive effect when the fires are being fought.
- **Washing-out of smoke:** Soot particles and water-soluble flue gases are partly washed out and bound by the fine water droplets.

Fire Control, Suppression and Extinguishing

Depending on the field of application, two different objectives are usually pursued when a fire is fought.

Extinguishing a fire is understood to be the complete elimination of the fire by inerting and cooling, so that no further re-ignition occurs.

This is the objective in the following applications, amongst others:

- Fuel and lubricant fires in engine test beds and machinery rooms
- Oil fires in deep fat fryers
- Combustible liquids in warehouses and production facilities
- Thermal oils in transformers
- Fuels and lubricants in turbines / diesel engines etc.

In these fields of application it is possible to use high-pressure water mist instead of gas or foam extinguishing systems which are commonly used, as well as deluge systems in some cases.

Fire control and suppression is understood to be a significant reduction in temperatures around the area of the fire, as well as minimisation of the spread of the fire until the remaining fire and the embers are extinguished by the fire brigade.

Typical applications, amongst others:

- Office areas
- Hotels
- Hospitals and laboratories
- Archives and libraries
- Historic buildings
- Garages

In these fields of application, high-pressure water mist represents an alternative to conventional sprinkler or deluge systems.

Volume Protection and Object Protection

Generally a distinction is made between two types of fire fighting system: volume or area protection and object protection.

Volume or area protection is understood to be total protection of the entire volume with a fire fighting system. This is used if there are numerous risk areas or no risk areas which can be precisely localised, as well as in cases where object protection is very expensive or not possible for other reasons. Typical fields of application for room protection are hotels, office buildings, archives, server rooms or storage areas.

In the case of volume protection it is also possible to selectively activate the FOGTEC high-pressure water mist system through automatic nozzles (nozzles with glass bulbs, analogous to conventional sprinklers, which are also known as high-pressure water mist sprinklers) or through compartmentalisation.

Object protection is the safeguarding of local risk areas or objects in large halls. Here the high-pressure water mist system is specifically used for the object to be protected, for example for the protection of deep fat fryers, all types of machines, hydraulic systems, transformers etc.

3 HIGH-PRESSURE WATER MIST SYSTEMS

3.1 System Concepts

Analogous to conventional sprinkler, water spray or gas fire fighting systems, FOGTEC high-pressure water mist systems also make use of various system concepts depending on the field of application. Corresponding flow diagrams (P&ID) can be found in the appendix.

As with conventional systems, high-pressure water mist systems can also be subdivided into several sections. Depending on the specific project and the local circumstances, section valves are installed either in the pump room or decentrally in the respective protected areas. Generally, the pipe to the section valve is filled with water, so that the time between the start of the system and its full effect on the fire can be reduced to a minimum.

Deluge Systems

Only open nozzles are used. The pipe system between the nozzle and the pressure generating unit or the section valve is dry. These systems always require separate fire detection for activation of the fire fighting systems. When the system is activated the pipe is filled with water and water mist is sprayed through all of the nozzles in this area.

The size of the system is influenced significantly by the size of the individual areas to be protected.

Fig. 4: Open high pressure water mist nozzle

Wet Systems

In wet systems or automatic systems the network of pipes is permanently filled with water and kept at a stand-by pressure by means of a pressure-maintaining device (jockey pump). These systems always use automatic nozzles (high-pressure water mist sprinklers) which are normally closed.

Due to the effects of heat the glass bulb of the nozzle bursts and water mist is sprayed from the activated nozzle. The fall in pressure in the pipe network is registered and the high-pressure water mist pump unit is started. The system is dimensioned using the effective area (area of operation), which is defined by the fire hazard in the respective area.

Fig. 5: Automatic high pressure water mist nozzle

Dry Pipe Systems

The principle of dry pipe systems is comparable to wet systems. However, these are used for areas in which a pipe which is permanently filled with water is considered problematic. This can be the case, for example, in areas which are exposed to the danger of frost. Instead of water, the pipe is filled with air. If an automatic nozzle is activated, the drop in pressure is registered and the high-pressure water mist pump system is started. Only then the pipework is filled with water.

Pre-Action Systems

Pre-action systems are dry systems which are used in combination with an external fire detection system. If a fire is detected, the corresponding pre-action valve is opened by the fire alarm system and the high-pressure water mist pumps are started. Only by additional activation of an automatic nozzle by the heat of a fire, high-pressure water mist is discharged in the respective area.

3.2 Types of High-Pressure Water Mist Systems

Depending on the application and size of the areas to be protected, there are two different types of system available.

Pump Systems

Pump systems are always used if large risk areas are to be protected by a FOGTEC high-pressure water mist system or continuous high-pressure water mist discharge is required on the basis of the protection concept.

The FOGTEC high-pressure water mist pump system has a modular design and consists of one or more robust triplex plunger pumps, a break tank and a control and indicating cabinet. If necessary, the system is supplemented by a jockey pump and compressor.

Fig. 6: Modular FOGTEC pump system, 3 x 120 l/min with jockey pump

Cylinder Systems

Cylinder systems are mainly used for protection of smaller areas. Generally, these are risks in which the protection concept provides for extinction of the fire within a limited discharge time.

FOGTEC cylinder systems consist of separate pressure cylinders that are filled with water and a propellant (nitrogen). In the case of activation the nitrogen flows into the water cylinders and forces the water into the pipe and to the nozzles.
Cylinder systems can work independently of any energy supply.

Fig. 7: FOGTEC cylinder system

4 REGULATIONS AND APPROVAL PROCEDURES

The standard CEN/TS 14972 "Fixed Fire-Fighting Systems – Water Mist Systems – Design and Installation" is considered the state-of-the-art for the design, installation and operation of high-pressure water mist systems.

Further regulations can be used in analogy. Examples of these are NFPA 750 or FM 5560. More details of these regulations can be found in section 6.

National approval and certification bodies, e.g. VdS, LPC or APSAD are still developing own regulations and standards for water mist systems. However, in Europe reference is made to the European standard CEN/TS 14972 or recently published standards like BS DD8458 and BS DD8489 in the UK and APSAD D2 in France. Also VdS has developed a number of own system approval standards for various risk areas.

Fig. 8: Fire test according to CEN/TS 14972, OH1 Office

Additionally, standards for conventional fire fighting systems, like CEA 4001for sprinklers can be applied in part for water mist systems.

The layout of water mist systems, for example the positioning and type of the nozzles or installation conditions, is always based on full scale tests which have to be carried out by each manufacturer for each respective application. These fire tests are witnessed and subjected to acceptance tests by an independent authorised fire expert or recognised testing institute.

In general it can be differentiated between a system approval procedure and proof of system efficiency.

An approval procedure is usually based on regulations such as CEN/TS 14972 and has a universally valid character for specific fields of application. Such a procedure includes not only the fire tests, but also an inspection and test of the individual components or the system in accordance with the requirements from the corresponding regulations.

For applications which are not covered by a universally valid approval, fire tests shall be independently carried out in order to demonstrate efficiency and to determine the system layout parameters, unless transferable results from tests that have already been carried out can be used. As a rule, this process is carried out in close cooperation between the design office, the authorised fire expert performing the acceptance test and the system integrator.

Unlike conventional systems, water mist system components are not approved, but approval always refer to entire systems. For this reason FOGTEC systems are "VdS approved" or "FM approved", but not individual components. The components inspection, as part of system approval, can however be used for other applications.

If the respective layout has not been approved, for example by inspection bodies, e.g. VdS, CNPP, BRE or others, an inspection of the system layout is carried out on site by an independent authorised fire expert such as the German Technical Inspection Agency (TÜV) or equivalent. In such cases it is determined whether a certificate of efficiency is available and whether the specifications contained in this certificate have been installed accordingly. Furthermore, a technical inspection is carried out in accordance with the appropriate norms and the technical regulations.

5 DESIGN OF HIGH-PRESSURE WATER MIST SYSTEMS

Frequently asked questions relating to the design of a high-pressure water mist system are answered below.

What are the minimum requirements which the company installing high-pressure water mist systems should fulfil?

The company carrying out the installation must be experienced in the installation of high-pressure water mist systems and be authorised by the manufacturer of the offered system. Corresponding certificates of training in theory and practice, as well as proof of successfully performed reference projects which are comparable to the offered application are required.

Moreover, membership of professional associations such as the IWMA (International Water Mist Association) and FIA (Fire Industry Association UK) is recommended.

The installation company and any significant subcontractors and supplier must be certified for all of the offered scopes of services according to ISO 9001. Insofar as design and/or installation work is carried out by subcontractors, references relating to comparable risks with high-pressure water mist systems are to be requested from the subcontractor.

Moreover, the quality of the project design/installation documents and drawings, as well as hydraulic calculations, shall be verified.

What interfaces exist and what form should these take?

The definition and coordination of interfaces with other systems also form an essential part of project planning. These include:

- Activation by a fire alarm system/fire fighting control unit
- Equipment shutdowns
- Switching off/control of the building equipment and appliances (ventilation etc.)
- Messages to local or remote manned locations (fault, pump start etc.)
- Power supply, emergency power supply
- Water supply

Depending on the type of system, the fire fighting system is activated by means of an on-site fire alarm system/fire fighting control unit or automatic activation in the case of nozzles with a glass bulb. If necessary, activation of the system is forwarded to a central monitoring unit, such as the fire brigade.

Additionally, monitoring of operating states - such as position switches on valves and shut-off devices - as well as fault messages are included in the interfaces that are to be defined. It is important whether such messages have to be provided in the form of a collective message or multiplied in the form of individual messages. Moreover, the installation locations for devices, sensors, actuators, indicator boards etc. have to be complied with.

How should detection, alarms and system activation be designed?

The activation of separate fire fighting areas is carried out using fire fighting control technology, which as a rule is made up as follows: a central unit with control panel, fire detectors and alarms, as well as a wiring system which is specific to the equipment.

For the majority of the systems it is necessary to comply with the relevant norms and directives and the legislation in the individual territory, e.g. EN 54, VdS 2095, VdS 2496, BS 5839 Pt 1, BS 7273 among others.

Triggering of the fire-fighting system will in most cases also result in triggering of the main detector and the associated alarm of the fire brigade. For this reason it is strongly recommended that the connection conditions of the relevant fire brigades are taken into account. In particular, fire protection concepts and requirements contained in the approval documents must be adhered to.

One possible system configuration is described below:

The central unit consists of a integrated operating and display system via which the relevant information from the fire fighting control system is recorded and processed. According to the relevant directives, in the case of a simple fault in the system not more than one fire fighting, monitoring or alarm area may fail.

The fire fighting control system is designed accordingly. Each fire fighting area has its own monitoring unit with its own CPU and emergency power supply. These monitoring units are networked together by means of a ring bus which can tolerate short-circuits and interruptions and is connected to the central unit. Furthermore, if necessary this takes over interface communication between the overriding fire alarm system and the fire brigade connection.

For fire detection, manual non-automatic fire alarm devices (pushbutton alarms) and automatic fire detectors are used. In addition, smoke aspirating systems and flame detectors are gaining importance, particularly for object protection concepts.

When pressed, the manual pushbutton alarm triggers the associated fire fighting area. Via the central unit the message "fire" is transmitted to the higher-level periphery.

Automatic fire detectors are used for monitoring e.g. false ceilings, false floors and rooms. In order to avoid false alarms the fire detectors should be arranged as double knock systems for activating automatic fire fighting systems.

When a main alarm is given, which is defined as the activation of at least two detectors from a group, this is followed immediately by activation of the water mist pump control system. The start of the pump unit is confirmed by means of a pump start message. Subsequently the respective section valves are activated. While this is occurring, alarm-related processes start which have previously been defined in an action plan with all of the responsible parties. The status "fire fighting area activated" is integrated into the system by means of flow monitors and transmitted if necessary to a permanently manned station.

The automatic detectors should reliably detect the fire parameters of smoke and heat in a logical connection. Modern optical measuring principles have two separate sensing elements as well as various evaluation logarithms, so that deceptive factors such as "water vapour patterns" are largely suppressed.

The wiring system must be designed in accordance to the respective norms and standards. For this reason different cable qualities are used, which mainly differ in respect to whether cables are passed through areas which are monitored by detectors or not.

How should safety, availability and redundancies be considered?

Particularly high requirements are placed on the availability of a fire fighting system. For this reason these requirements also have to be placed on all individual components and units, for example the high-pressure water mist pump unit.

For example, in a unit with more than one pump each pump has to be provided with its own drive motor.

Multiple drives, for example one motor for two pumps, as well as gear or V-belt drives, are not permitted. In order to minimise the risk of breakdowns and the servicing costs of the pump units, the number of individual components used must be limited. One way of achieving this is that the smallest possible number of pumps and motors must be used.

In order to determine and inspect the performance of the pump units as part of the test runs that are to be carried out regularly, pump test equipment and an overflow device are to be provided.

The time between the activation of the fire fighting system and the discharge of water mist in the fire fighting area must be reduced to a minimum and must not be more than 60 seconds in the case of glass bulb-activated or pre-action systems and 30 seconds in the case of open systems.

Drives of air compressors and the jockey pump must be monitored electrically. Furthermore, any drop in pressure or leakage must be displayed as fault messages and documented as a collective fault.

In order to avoid dry running of the high-pressure water mist pump, the pumped fire fighting agent should not be used to lubricate the pump.

The system must allow the possibility of a test run of the high-pressure water mist pumps without feeding water into the pipe network. Furthermore, the system must be equipped with an overflow device that is independent of any pump safety valve.

For safety reasons each pump is to be fitted with a safety valve.

If the level measurement device in the tank fails, a forced intake must be ensured.

In order to prove that the above-mentioned minimum requirements have been complied with, a P&ID that corresponds to the offered system, corresponding drawings of all components and units, as well as a description of the system control are required.

In most cases section valves should be ball valves with a drive (for example pneumatic, hydraulic, motor-driven etc.) due to the required torques after a prolonged idle time, or also as solenoid valves in the case of smaller valve designs. Section valves must be fitted with a shut-off and test ball valve, as well as an emergency manual operating device. The condition of the section valve must be monitored. All shut-off valves must be lockable.

Where a compressed air supply is used, at least 25 switching operations of the section valves must be guaranteed without operation of the compressor.

In particularly sensitive protected areas a declaration of conformity for the system is to be submitted in accordance with EC Machinery Directive 89/392/EEC, the EC Directive on Electromagnetic Compatibility (EMC) in the version 89/336/EEC.

Which filters are required?

Filters must be present in the tank inlet, in the suction line in front of each pump and in front of each individual high-pressure nozzle.

What type of power supply is requested for the high-pressure water mist systems?

The requirements concerning the power supply are to be given by the fire authority.

How are high starting currents limited?

In order to keep starting currents to a minimum, each pump must start up at zero pressure. The bypass valves required for this are to be fitted by means of pressure hoses. Electrical motors are started in star/delta configuration.

How are vibrations prevented?

Any vibrations that may occur are to be taken into account when the system is designed and the materials, connections and components are selected. It must be ensured that the high-pressure water mist pump system is decoupled from the pipe network.

How long shall the system remain activated?

A fire fighting system may only be switched off by authorised safety personnel such as the fire services.

In the case of fire control systems, the activation time - and therefore the water supply - must also cover at least the period required to carry out evacuations and transport emergency personnel of the fire brigade to the site.

However, the activation time shall be at least 30 or 60 minutes, or in the case of fire extinguishing systems double the extinguishing time required in the supporting fire tests. If the extinguishing times achieved in the fire tests should be particularly short, these values are to be increased in agreement with the manufacturer and, where appropriate, with an authorised fire expert, the insurer etc.

What happens concerning the fire water run-off?

Due to the small amount of water used, a high-pressure water mist system allows to keep the water damage to a minimum. In case of applications which require the collection and disposal of the fire fighting water, for example in laboratories, high-pressure water mist represent alternatives to conventional gas extinguishing technology.

What droplet qualities and distributions are used?

The selection of the nozzles depends on the application and protection objective, as well as the area to be protected. According to Class I NFPA 750 (1996 edition), the droplet distribution of the nozzle relates to a droplet size of 20 to 100 µm.

If the system is used to protect electrical and electronic equipment rooms, proof of the electrical conductivity of the fire fighting agent for the nozzles that are to be used must have been carried out in accordance with DIN EN 3-2:1996. The limiting value specified by DIN EN 3-2:1966 of 0,5 mA (500 µA) for the permitted stray current must not be reached or exceeded.

Nozzles should have been tested by an independent test laboratory, such as Factory Mutual or VdS, in accordance with the specifications of CEN/TS 14972.

How should the piping be designed?

Stainless steel pipes according to DIN EN ISO 1127, material AISI 316 or higher grade, are to be used. After installation, the pipe network is to be subjected to 1,5 times the system pressure for a period of 2 hours and flushed to ensure that it is particle-free. The pressure tests and flushing procedures are to be protocolled.

Welded Connections

Amongst others, the following norms are to be complied with when stainless steel fittings are used for welding:

- Pipe bends DIN 2605
- T-pieces DIN 2615
- Reducer DIN 2616
- Caps DIN 2617

Welding may only be carried out by certified welders. Corresponding certificates of suitable employees together with comparable references are to be submitted.

Pipe Connections

In order to ensure high quality standards of the connection technology used, compression fittings, mechanically pressed connections (Walterscheid Walform Plus or Pipelok) or welded connections should be used. Threaded pipe connections with sealants such as hemp or Teflon are not permitted. Each pipe end is to be equipped with a corresponding flushing/drain ball valve.

Pipe Clamps

Pipe clamps, including accessories (threaded rod, metal anchors etc.) must be suitable for fire fighting systems and designed in accordance to fire protection approvals.

Mounting Supports

If due to the local conditions pipelines are installed in auxiliary structures, appropriate mounting supports including system accessories and connecting pieces made of galvanised steel with fire protection approval must be statically designed for the respective pipes.

What must be considered with respect to the use of hoses?

High-pressure water mist hoses must satisfy the requirements of the pipes. In the case of fire they must maintain their integrity and functionality.

How is the pipe network drained?

The pipe network shall have drain ball valves so that the entire system can be drained.

How is the hydraulic calculation carried out?

The hydraulic calculation is to be carried out using the Darcy-Weisbach formula. This is part of the system documentation. Corresponding software is commercially available.

What on-site conditions are to be taken into account?

During the project development and planning of a water mist system the on-site conditions are to be taken into account as early as possible. These include preparations of the technical infrastructure and the definition of interfaces of technical and organisational nature like:

- Laying of the power supply cable/network supply up to the fire fighting control cabinet; if necessary, installing cables with functional integrity (E90) in non-monitored areas
- Drinking water supply according to the high-pressure pump flow rate with a flow pressure of 1,5 to 6,0 bar, connection by means of backflow preventers like a double check valve unit
- Water of drinking quality (chlorine <100 mg/l (=100 ppm), pH value 6,5 to 9) according to 80/778 ECC (98/83/EC)
- Appropriately dimensioned floor drain (size according to the tank inlet) in the pump room
- Anti-vibration foundations, if necessary
- Earthen of all pipe and system components
- Central fire alarm system/fire fighting control unit, if necessary including activation of the section valves
- Production and sealing of the necessary openings and penetrations, as well as core drillings
- Painting, masonry and dry construction work
- Opening and closing of false ceilings and similar panelling
- Installation, including wiring, of a fire alarm system or integration of the fire fighting system into a building services management system
- Production of a fire fighting pump room with the following conditions:
    - Design according to the applicable guidelines for workplaces
    - Illumination and ventilation
    - Protection against frost
    - F90 rating of walls and doors

What should be kept in mind with respect to frost protection?

The water storage system and pump room should be maintained at a temperature of at least 4°C for electric pumps and 10°C for diesel pumps. The maximum temperature in the plant room should not exceed 35°C.

What should be considered with respect to the electrical power supply in the protected area?

The electrical power supply in the protected area should be switched off automatically if necessary when the system is activated. This does not apply to alarm equipment, emergency lighting etc. The specifications of a fire protection concept must be taken into account.

How much maintenance is required for high-pressure water mist systems?

In general maintenance requirement are similar to those of a conventional sprinkler or gas extinguishing system.

What is the minimum documentation that is required?

The documentation should comprise at least the following:

- Protection concept in accordance to the fire safety specification report
- System design
- Nozzle types and nozzle positioning
- Hydraulic calculation
- Isometric drawings and construction drawings
- Flushing and pressure test reports
- Detailed description of the function and operation of the entire system
- Maintenance instructions
- Fire detection system test reports (where applicable)
- Cable installation test reports

6 FURTHER LITERATURE

Standards and Regulations for Water Mist

CEN/TS 14972	Fixed Fire-fighting Systems – Water Mist Systems – Design and Installation) Available at www.beuth.de
NFPA[1] 750:	Standard on Water Mist Fire Protection Systems, 2010 Edition Available at www.nfpa.org
IMO[2] Res. A.800 (19):	Revised Guidelines for Approval of Sprinkler Systems Equivalent to in SOLAS Regulation II-2/12 Available at www.imo.org
IMO MSC 1165	Revised Guidelines for Approval of Equivalent Water-Based Fire-Extinguishing Systems for Machinery Spaces and Cargo Pump-Rooms Available at www.imo.org
FM[3] 5560	Approval Standard for Water Mist Systems Available at www.fmglobal.org
APSAD D2	Technical Document – Water Mist – Guide for the Installation of Water Mist Fire Protection Systems Available at www.cnpp.com
BS[4] DD 8489-1	Fixed Fire Protection Systems – Water Mist Systems – Design and Installation Industrial and Commercial Available at www.bsigroup.com
BS[5] DD 8458	Fixed Fire Protection Systems – Water Mist Systems – Design and Installation Residential and Domestic Available at www.bsigroup.com

[1] National Fire Protection Association. Further information available at www.nfpa.org.
[2] International Maritime Organisation. Further information available at www.imo.org.
[3] Factory Mutual. Further information available at www.fmglobal.com.
[4] British Standard. Further information available at www.bsigroup.com
[5] British Standard. Further information available at www.bsigroup.com

Further Norms and Regulations

DIN EN 12845	Fixed Fire Fighting Systems - Design, Installation and Maintenance Available at www.beuth.de
CEA 4001	Sprinkler Systems: Design and Installation

Literature Fundamentals

National Fire Protection Handbook, Issue 2008, National Fire Protection Association (NFPA)
Available at www.nfpa.org

Internet

FOGTEC Brandschutz GmbH & Co. KG
www.fogtec.com

International Water Mist Association
www.iwma.de

IFAB Institute for Applied Fire Research
www.ifab-fire.com

7 TYPICAL FIELDS OF APPLICATION

The following overview contains typical applications for high-pressure water mist systems. Details of other applications are available on request.

7.1	Hotels and Hospitals	23
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7.1 Hotels and Hospitals

Typical application examples

Hotel rooms, bedrooms, foyers, atria, restaurants, bars etc.

Description of the risk

Solid fires (Class A), e.g. beds, furniture, floor and wall coverings

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

System layout

Wet system (glass bulb nozzles)

The following minimum parameters must be taken into account with the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to CEN/TS 14972 or IMO Res. A800

The efficiency corresponds at least to that of a conventional sprinkler system.

7.2 Office Buildings and Museums

Typical application examples

Office areas, exhibition areas, foyers, atria, assembly rooms etc.

Description of the risk

Solid fires (Class A), and e.g. paper, furniture, floor and wall coverings

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

System layout

Wet system (glass bulb nozzles)

The following minimum parameters must be taken into account with the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to CEN/TS 14972 or IMO Res. A800

The efficiency corresponds at least to that of a conventional sprinkler system.

7.3 Cable Tunnels

Typical application examples

Cable tunnels, cable rooms

Description of the risk

Solid fires (Class A): various plastics (PVC, PE etc.)

Possible protection targets

Fire control and suppression, extinguishing if necessary

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

Restricting damage to the cables

System layout

Deluge system (open nozzle)

Activation should be as early as possible. An external fire detection system (e.g. smoke or heat detection) is recommended.

The following minimum parameters must be taken into account in the design:

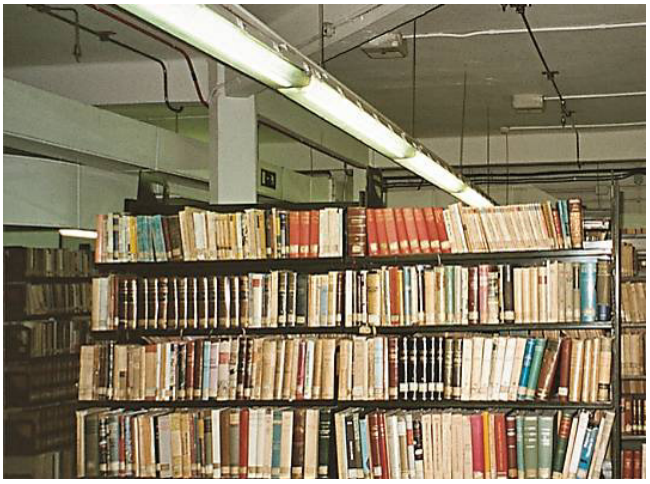
- Criteria for nozzle installation (height, protected area)
- Height and width of the cable duct
- Size of the file load
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle
- Ventilation conditions

Proof of efficiency

For example according to CEN/TS 14972

7.4 Archives and Libraries

Typical application examples	Archives, libraries

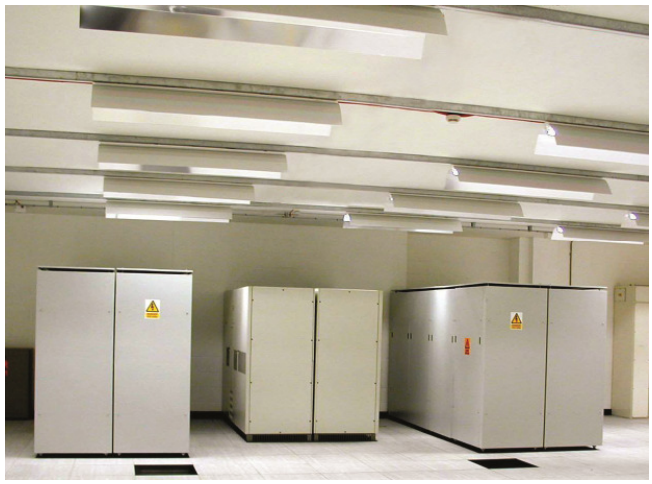


Description of the risk	Solid fires (Class A), e.g. paper, cardboard, archive folders, films, CDs etc.
Possible protection targets	Fire control and suppression
Important effects	Fighting the initial fire Cooling the surroundings Limiting the spread of the fire and damage
System layout	Wet or pre-action system (glass bulb nozzles) or deluge system (open nozzle) The deluge system should be activated as early as possible. The following minimum parameters must be taken into account in the design: - Criteria for nozzle installation (height, protected area) - Total effective area (presumed area of operation according to hazard classification) - Type and flow rate of the nozzle - Minimum pressure at the nozzle
Proof of efficiency	For example application-related fire tests The efficiency corresponds at least to that of a conventional sprinkler system.

7.5 Computer Rooms and Control Rooms

Typical application examples

Control rooms, server rooms, telecommunication switch areas



Description of the risk

Solid fires (class A), e.g. electric cables, electrical devices, switch cabinets

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

System layout

Wet or pre-action system (glass bulb nozzles) and deluge system (open nozzle)

The deluge system should be activated as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests or according to IMO A800

7.6 Engine Test Stands

Typical application examples

Engine test beds

Description of the risk

Liquid fires (Class B), e.g. lubricants, fuels

Solid fires (Class A), e.g. hoses, cables, measurement equipment

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire and damage

Extinguishing the fire

Prevention of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.7 Industrial Deep Fat Fryers and Industrial Furnaces

Typical application examples

Industrial deep-frying lines

Description of the risk

Fires involving oils and fats

Liquid fires (Class F), e.g. frying oils, greases

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling of oil, machine surroundings

Limiting the spread of the fire and damage

Extinguishing the fire

Prevention of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Dimension of the extraction hood
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.8 Deep Fat Fryers / Kitchen Areas

Typical application examples

Kitchen deep fat fryers

Description of the risk

Fires involving oils and fats (Class F): deep-frying oils and fats

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling of oil, machine surroundings

Limiting the spread of the fire

Extinguishing the fire

Prevention of re-ignition

System layout

Deluge system (open nozzle) and wet system (glass bulb nozzles) for small deep-fat fryers

The deluge system should be activated as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Dimensioning of the extraction hood
- Total effective area
- Type and flow rate
- of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.9 Exhaust Ducts

Typical application examples

Exhaust ducts

Description of the risk

Mixture of liquid fire (Class B),
e.g. lubricating oils, fat and solid fire loads (Class A), e.g. dust, residues

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

Extinguishing the fire

Prevention of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the designs:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.10 Gas Turbines

Typical application examples

Gas turbines in power stations and industrial plants

Description of the risk

Liquid fires (Class B), e.g. lubicants, fuels

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Careful cooling of the turbine outer surfaces

Limiting the spread of the fire

Extinguishing the fire

Prevention of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to FM 5560

7.11 Retail Areas

Typical application examples

Supermarkets, shops, department stores

Description of the risk

Solid fires (Class A), e.g. plastics, furniture, floor and wall coverings

Liquid fires (Class B) in limited amounts, e.g. solvents (spirit, alcohol)

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

System layout

Wet system (glass bulb nozzles)

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to CEN/TS 14972 or IMO Res. A800

The efficacy corresponds at least to that of a conventional sprinkler system.

7.12 Laboratory Areas

Typical application examples

Laboratories

Description of the Risk

Solid fires (Class A), e.g. furniture, floor and wall coverings

Liquid fires (Class B), e.g. solvents, small quantities of chemicals

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings to an acceptable level

Limiting the spread of the fire

System layout

Wet system (glass bulb nozzles) and deluge system (open nozzles)

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.13 Cleanrooms

Typical application examples

Cleanrooms in the semiconductor and photovoltaic industry

Description of the risk

Solid fires (Class A), e.g. furniture, floor and wall coverings, plastic and semiconductor material

Liquid fires (Class B), e.g. solvents

Possible protection targets

Fire control and suppression

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

System layout

Wet or pre-action system (glass bulb nozzles) and deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area (presumed area of operation according to hazard classification)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle
- Ventilation conditions

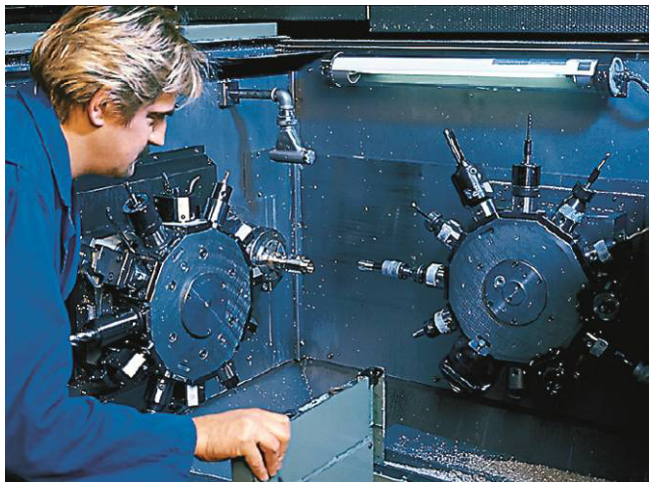
Proof of efficiency

For example application-related fire tests

7.14 Object Protection of Machines and Generators

Typical application examples

Combustion engines and generators in industrial plants and power stations etc.



Description of the risk

Liquid fires (Class B), e.g. diesel, kerosene, heavy oil, lubricants

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the object

Limiting the spread of the fire

Extinguishing the fire

Avoidance of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to IMO MSC 913 or application-related fire tests

7.15 Protection of Machinery Rooms

Typical application examples

Machinery rooms with combustion engines and generators in industrial plants and power stations etc.

Description of the risk

Liquid fires (Class B), e.g. diesel, kerosene, heavy oil, lubricants

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

Prevention of re-ignition

System layout

Deluge system (open nozzles)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example according to IMO MSC 668/728 or application-related fire tests

7.16 Storage and Production Facilities of Flammable Liquids

Typical application examples

Flammable liquids in production and storage facilities in industrial plants, paint factories etc.

Description of the risk

Liquid fires (Class B), e.g. flammable liquids, solvents, coatings, paints, process fluids etc.

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

Extinguishing the fire

Prevention of self-ignition and re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle
- Use of additives (AFFF)

Proof of efficiency

For example application-related fire tests

7.17 Transformers

Typical application examples

Transformers

Description of the risk

Liquid fires (Class B), e.g. thermal oil

Possible protection targets

Fire extinguishing

Important effects

Fighting the initial fire

Cooling the surroundings

Limiting the spread of the fire

Extinguishing the fire

Avoidance of re-ignition

System layout

Deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

7.18 Component Cooling / Compensation

Typical application examples

Protection of steel and glass constructions, compensation of structural fire protection requirements

Description of the risk

Solid fires (Class A) / Liquid fires (Class B)

Possible protection targets

Shielding against heat radiation

Important effects

Cooling the surroundings

Restriction of heat propagation

System layout

Wet system (glass bulb nozzles) and deluge system (open nozzle)

Activation should be as early as possible.

The following minimum parameters must be taken into account in the design:

- Criteria for nozzle installation (height, protected area, distance of the nozzle from the object, alignment of the nozzle)
- Total effective area
- Type and flow rate of the nozzle
- Minimum pressure at the nozzle

Proof of efficiency

For example application-related fire tests

8 SAMPLE SPECIFICATIONS WET SYSTEM

9 SAMPLE SPECIFICATIONS DELUGE SYSTEM

10 SAMPLE SPECIFICATIONS PRE-ACTION SYSTEM

11 DATA SHEET EXAMPLES

A. Nozzle

- Automatic glass bulb-activated nozzle
- Open nozzle
- Nozzle socket (Industrial)
- Nozzle socket (T design)

B. High-Pressure Water Mist Wall Hydrant with FOGGUN

- Surface-mounted wall hydrant cabinet with FOGGUN

C. Section Valves

- Section valve for wet system
- Section valve for deluge system (solenoid valve)
- Section valve for deluge system (pneumatic drive)
- Section valve for pre-action system

D. Cylinder Systems

- 80 l master cylinder with electric activation via fire alarm system
- 6 x 80 l slave cylinder module

E. Pump System

- Pump system as wet system
- Pump system as deluge system
- Compressor for pre-action system
- Break tank 1000 l
- Control cabinet

12 CD-ROM TABLE OF CONTENTS

A. Sample Specifications

- Specifications pump system as wet system
- Specifications pump system as deluge system
- Specifications pump system as pre-action system

B. System Flow Diagrams (P&ID)

- Cylinder system with electric activation via fire alarm system
- Pump system as wet system
- Pump system as deluge system
- Pump system as pre-action system

C. CAD Component Library (Extract)

The CAD files on the CD-Rom show the currently most commonly used system components with details of the external dimensions.

Pump Units

- 1 x 120 l/min
- 2 x 120 l/min
- 3 x 120 l/min
- 4 x 120 l/min
- 5 x 120 l/min
- 6 x 120 l/min
- Compressor

Break Tanks

- 500 l (with connection and minimum distance to the pump)
- 1000 l (with connection and minimum distance to the pump)
- 3000 l (with connection and minimum distance to the pump)

Control Cabinets for Pump Units

- 1 x 120 l/min
- 2 x 120 l/min
- 3 x 120 l/min
- 4 x 120 l/min
- 5 x 120 l/min
- 6 x 120 l/min

Wall Hydrant

- Wall hydrant with FOGGUN

Cylinder Systems

- 20/7 l
- 50/20 l
- 80/50 l

- 3 x 50 l
- 4 x 50 l
- 6 x 50 l
- 7 x 50 l
- 8 x 50 l
- 10 x 50 l

- 3 x 80 l
- 4 x 80 l
- 6 x 80 l
- 7 x 80 l
- 8 x 80 l
- 10 x 80 l