# Technical description

## Water Mist Fire Suppression System

## Local protection

# Amendments

| AMENDMENT INCORPORATION RECORD | | |
|---|---|---|
| **Amendment Number** | **Brief Description of Content** | **Name of Person Incorporating Amendment** |
| 1 2010-12-03 | Issued for information | L. Elsrud |
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# 1 FOREWORD

This manual is written for those who design, install and maintain Autronica Fire and Security Local protection Water Mist Systems.

IMPORTANT

Autronica Fire and Security AS assume no responsibility for application of any system other than those addressed in this manual. The technical data concerned herein is limited strictly for information purposes only. Autronica Fire and Security AS believe this data to be accurate, but it is published and presented without any guarantee or warranty whatsoever. Autronica Fire and Security AS disclaim any liability for any use that may be made of the data and information contained herein by any and all other parties.

The Autronica Fire and Security Local Protection Fire Suppression Systems are to be designed, installed, inspected, tested and recharged by qualified and trained personnel in accordance with the following.

All instructions, limitations, etc. contained in this manual.

Storage, handling, transportation, service, maintenance, recharge and test of agent storage containers shall be performed only by qualified and trained personnel in accordance with the information in this manual and the relevant compressed gas standard.

Regulations imposed by the class, flag state or Authorities Having Jurisdiction for the hazard to be protected.

Any questions concerning the information presented in this manual should be addressed to:

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# 2 GENERAL.

The water Mist System is designed in accordance to SOLAS Regulation. All fire tests according to IMO MSC Circ. 913 local protection machinery space.

The system is a dry pipe system which consists of a water pump, a control panel, touch screen operating panel or push button panel, a piping system with strainers, pressure indicators, valves and nozzles.

Activation of the different systems in the following ways:

- Automatically by a fire alarm system (no heat element). Local protection Dry System
- Manually (no heat element). Dry System

The water mist system extinguishes or controls fires by cooling, oxygen displacement by water vapour and radiant heat attenuation. The exceptional cooling effect of water mist is a result of the division of water into very fine droplets, which increase the total surface area available to absorb heat and maximises the evaporation rate of the water. The process of evaporation takes the heat away from the flame and fire plume. It is not necessary to extract all of the heat being generated in a combustion reaction to stop it. By extracting 30 to 60 percent may be enough to drop it below a threshold burning condition.

The second mechanism by which water controls or extinguishes a fire is oxygen displacement. The expanding water vapour displaces normal air and reduces the amount of oxygen in the vicinity of the fire. If the water vapour can be confined to the vicinity of the fire in an enclosure or directed against the base of the fire, flammable vapour concentrations and free oxygen levels at the fuel surface will be reduced and the fire will be extinguished or reduced in intensity. The third Suppression mechanism that water mist suppression systems use is radiant heat attenuation. Small water droplets suspended in air reduce the radiant heat transfer between the flames and nearby objects by scattering or absorbing the heat. Droplet size, as well as volume concentration, is critical to radiation attenuation.

## 2.1 Low Pressure System vs. High Pressure System

Generally 3 pressure ranges for water mist are defined:

| Pressure Regime | Bar | kPa | psi |
|---|---|---|---|
| Low pressure | 1 to 17 | 101 to 1.725 | 15 to 250 |
| Intermediate pressure | 17 to 34 | 1.725 to 3.450 | 250 to 500 |
| High Pressure | 34 - 280 | 3.450 to 28.400 | 500 to 4.120 |

Commercially available low-pressure type nozzles, requiring pressure between 4 and 10 bar, produce spray with suitable drop size distribution, volume flow rate and spray angle for use in water mist fire suppression systems. There are engineering advantages to working with low pressure nozzles, primarily in savings in energy costs to produce the high pressures, and in reduced system cost and complexity.

Average droplet size for FlexiFOG Nozzles:

| | |
|---|---|
| FlexiFOG M5 | $DV_{0,9}$ 3 Bar 277 µm |
| | $DV_{0,9}$ 7 Bar 255 µm |
| | $DV_{0,9}$ 12 Bar 247 µm |

Low weight on the system, due to the reduced number/sizes of components in the system and then special in the pump station gives better stability onboard.

Low power consumption (very important when system is driven by emergency power onboard).

Low dimensions on pump station and cabinets, saves spaces onboard.

Less stress in piping compared to a high-pressure system reduces the possibilities to leakage and failure in the system during testing and service.

More effective installation which saves time and money.

No welding on pipes needed during installation.

Easier to maintain. Time saving during installation.

Time saving during maintenance.

Cost saving during installation and maintenance.

Safer to maintain.

Possibilities for injury to human if a nozzle accidentally is opened is significant reduced

## 2.2 Use limitations.

It is important to use engineering judgement to take into account design factors that are beyond the scope of experimental work, such as the ventilation conditions, fuel geometry and obstructions at the time of fire. The limitations of water mist systems are the inability to completely extinguish deep-seated Class A fires and with difficulties Suppression shielded/obstructed fires. The difficulties associated with the Class A fires are related to the system's inability to adequately wet the fuel surface (due to low water usage rates) preventing complete Suppression of all glowing/smouldering embers. During most fire tests, the flaming combustion was extinguished/eliminated, but the glowing part embers remained. The difficulty with shielded/obstructed fires is associated with high mist fall out losses (due to gravity) which tend to significantly reduce the mist concentration in areas away from the spray pattern of the nozzles.

## 2.3 Quality.

The water mist Suppression system is a low pressure, low water consumption system with a complete absence of propellant gases. The water used in the system shall be free from contaminants that may cause corrosion and/or clogging of the nozzles. Maximum size of any particles allowed in the system, is 500 microns.

## 2.4 Personal protection and safety aspects.

The water mist Suppression system using pure water do not present a toxicological or physiological hazard and are safe for use in occupied areas. Pure water in this meaning is either water that is potable (drinkable) or natural sea water, that is, water coming from the sea.

# 3 SYSTEM DESCRIPTION.

The Autronica Fire and Security water mist systems are fully microprocessor controlled using a PLC for inputs and outputs. The system is either operated by a touch screen or a 10 zone push button panel. The system may consist of more than one touch screen or push button panel.

PROFINET is used for communication between the main control panel and the touch screen(s). Push button panels are hard wired.

Machinery space field equipment:

All the field equipment is hard wired to the main control cabinet.

The main control cabinet is connected to a separate battery back-up unit supplying the PLC and the touch screen(s) or push button panel(s) with 24 VDC at all time. This to avoid the PLC unit going down, when the mains power is lost.

The dry pipe systems for the machinery spaces are grouped into separate zones. It is one main zone for each machinery space, which again can be grouped into separate zones, one for each local protected object and one for the remaining part of the machinery space.

Each of the local protection zones will have its own dedicated zone valve, alarm siren, zone pressure switch and manual release button. When activating a local protection zone, either from one of the operating panels or from a local push button, only the zone valve belonging to that object will be activated. The amount of water required for the system shall be calculated based on the flow to the hydraulically most demanding area for 20 minutes operation.

The pump package(s) are to be designed to be capable of supplying the required pressure and flow to the hydraulically most demanding area(s). The pump package consists of 1 main pumps. A hard-wired pressure transmitter constantly monitors the pressure in the riser.

# 4 COMPONENT DESCRIPTION.

## 4.1 Main control panel.

The main control panel is reporting the status of the system back to the operating panels. All actions require for operation of the system, is handled by this panel such as:

- Starting of pumps, when required.
- Opening/closing of correct valves.
- Signals to SMS (Ships monitoring system)

## 4.2 Operating panel.

The main operation of the system is from a touch screen or push button panel located at the bridge. In addition touch screen(s) or push button panel(s) or information panel(s) can be located throughout the vessels in such areas as Engine Control Room, Safety Centre Fire Station etc. All alarms and faults will be displayed in the touch screen. In addition, the stand-by pressure can be monitored.

## 4.3 Strainer.

The strainers are fitted in the piping system to avoid particles to flow into the FlexiFOG nozzle. One strainer is fitted after the fire pump and one strainer is fitted in filling line for the FlexiFOG tank All strainers have a filter with 320 microns.

## 4.4 Pressure transmitter.

The pressure transmitter is installed on the main pipe line after the fresh water tank. The transmitter gives continuous feedback to the main control panel about the pressure in the system.

## 4.5 Pneumatic operated butterfly valve with solenoid valve.

Two pneumatic operated valves are installed before the pump. Seawater valve is normally closed, and freshwater valve is normally open. Only used when sea water is connected. Not required if there are dedicated fresh water for 20 minutes operation.

## 4.6 Pump Test/Drain valve.

The test/drain valve is a ball valve, which is normally closed. The valve can be used as a drain valve or to test the pump without discharging water into the protected zone.

## 4.7 Test valve.

The test valve is a ball valve, which is normally closed. The valve is used to test the operation of the system using compressed air to bed discharged through the zone valves.

## 4.8 Main water pump.

The pump package is to be designed to be capable of supplying the required pressure and flow to the hydraulically most demanding area.

## 4.9 Pump isolation valves.

Both upstream and downstream of each pump, an isolation valve is installed. These valves are installed, to make it possible to isolate one or more pumps for maintenance, replacement etc.

## 4.10 Pump starter cabinet.

The pump starter is included in the main control cabinet, i.e. there is no requirement for a separate pump starter cabinet.

# 5 LOCAL PROTECTION

To design the Local protection Fire Suppression System, carry out the following steps:

## 5.1 Perform a hazard analysis and survey of protected spaces.

The system should be designed in accordance with the guidelines of the International Maritime Organisation (IMO) MSC Circ. 913, and SOLAS 2000 Amendments II-2 Reg. 10 Sec. 5.6 and the guidelines and requirements of the authorities and societies in request..

## 5.2 Activation times.

Local protection systems should be designed for immediate activation in case of fires.

## 5.3 Water.

The system should be designed for continues flow, and no less than 20 minutes-duration time based on the largest object protected. The water supply should be fresh water only, Sea water should only be used as a back-up. If seawater is used, the emergency generator IP-Rating should not be less than IP54 due to the content of salt in the seawater. By using fresh water the Emergency Generator IP rating could be IP 21 or in accordance with the authorities having jurisdiction.

## 5.4 Hydraulic calculated systems.

Local application systems shall be hydraulic designed to be cable of supplying the required pressure and flow at the most demanding nozzle zone. (See table 1). If two local application zones are positioned closed to each other, and if there is a risk of that fire may spread from the one application to the other, the capacity of the pump should be calculated for dual zone protection.

William Hazel model may be used for hydraulic calculation of the systems. Considerations should be taken to filters in the system, when calculating the systems

## 5.5 System activation.

On ships with class notation “unattended machinery space”, these systems must have both automatic and manual release capabilities. In case of continuously manned machinery spaces, these systems are only required to have manual release capability. For passenger ships with class notation “unattended machinery space”, the requirements for automatic or manual is decided by the flag state.

### *5.5.1 Manual activation.*

There shall be at least two manual activation stations for each local protection zone. The manual activation stations should be positioned at locations, which are easy to access. One activation station should be installed inside the machinery space, adjacent to the hazard being protected, and one activation station should be located inside a normally manned area. The activation stations should be clearly marked with the application system they activate, and how to operate the system. Manual system activation stations should be protected against accidental activation. They should not be liable to be cut off by a fire in the protected spaces.

### *5.5.2 Automatic activation.*

Automatic activation is performed by a signal received from the ship’s main fire alarm panel. The fire detectors shall as a minimum be smoke and flame detectors monitoring each area. Minimum two detectors are needed to detect a fire before initiating the release. Activation of one detector shall cause an alarm.

## 5.6 Design of pipe installation.

Systems should be designed and installed in ways, which make it easy to maintain components and systems.

Pipes, components, and nozzles should be installed so that they are protected against damage. Attendance should be taken to design the pipe system in such a way that pipes and components do not need to be dismounted when applications are maintained or repaired. Pipes and components should not obstruct passages, openings, doors or hatches in the room.

Pipes and nozzles should be installed above hoists and other moving equipment in the location.

Pipes and components should be chosen in materials suited for the Suppression agent (fresh or seawater) and the ambient temperature. Attentions should be taken to avoid corrosion of the system. When possible pressurised pipe system should be charged with clean fresh water. Means of connection to fresh water supply, and sufficient drainage, should be made to allow all pipes to be firmly rinsed with fresh water after having been exposed to seawater.

Autronica Fire and Security AS recommends piping to be made in stainless steel, and joints between stainless steel pipes and system components in other materials to be flanged, and isolated from each other with the flange gaskets, and plastic isolation bushes on the flange bolts.

Water Mist systems require extra high attentions on avoiding impurities in the pipe work.

After the installation of pipes, the internal surfaces of the pipes should be firmly cleaned from shavings, chips, and left over sealant materials, before system components are joined to the pipes. When sealing threaded joints, the sealant should only be applied on the male thread, and care should be taken not to apply sealant materials in the cavities. Attentions should be taken to firmly clean re-used thread for old sealant before re-using the threads.

Pipe system should always be rinsed with lots of fresh water after being exposed to seawater.

System supports.

The support system should be accepted by the authorities, and by the societies in charge. The local protection systems should be supported with pipe supports, which holds the system firmly supported. The spacing of the supports should be sufficiently small not to allow the pipe system to move, and cause vibrations in the pipe system. The supports should be strong, and they should allow the system to be maintained, and sections to be changed if necessary. Supports should be attached to foundations, which are ridged and strong enough to support the pipe system against the vibrations of the ship, and the harshest movements of the ship at sea.

Supports should be protected against corrosion. If steel supports are used together with stainless steel or copper pipes, the two materials should be galvanic isolated from each other to prevent galvanic corrosion between the two metal alloys

## 5.7 Nozzle design and nozzle installation

The model M5 Nozzle is a key component in the local protection system.

### *5.7.1 FlexiFOG M5 Water Mist Nozzle key data.:*

| **Key parameters** | **Specification**<br>**Model M5** |
|---|---|
| Nozzle connection | **½"** BSPT Thread |
| Nozzle materials<br>System with fresh water priming<br>Systems for sea-water | SnNi plated Brass, w. SS 316 deflectors & filter |
| Nozzle protection | Transport/fly-off nozzle cap.<br>Caps should stay on nozzles when being installed in pipe work.<br>Caps should stay on nozzles installed in occupancies where objects may risk touching nozzles. Caps will fly off from water pressure in pipe system. |
| Nozzle k-factor (water) | 5 l/min √bar |
| Droplet size. (Dv90) | 247 μm at 12 Bar |
| Smallest water passage | Filter: 1mm, Orifices: 2mm |
| Water pressures | 4 Bar for height 0,5 – 8,0 meter above the object<br>9 Bar for height 8,0 – 14,5 meter above the object |
| Nozzle spacing | Maximum 3m between nozzles vertical |
| Minimum Water flows and waters densities for pendent installed Nozzles. | 10 l/min at 4 Bar<br>15 l/min at 9 Bar |
| Maximum obstructions between pendent installed nozzles and fire risk (obstructions larger than 0.5m wide.) Before additional nozzle should be installed. | The object seen from single nozzle must not obstruct more then 20° of the spray.<br>The object seen from the fire risk must not obstruct more than 20°. |
| Nozzle pipes | It is recommend the use of stainless steel or copper pipes for nozzle pipes. Systems shall be hydraulic calculated. |

## 5.8 Nozzle installation in machinery space.

Personnel, who have the necessary skills, should install nozzles and pipe system and understandings of installing water mist sprinkler systems. The installers should know this manual, and they should be aware of the risks of system male-function, if the instructions and precautions listed in this manual are not followed.

Nozzles should be installed in such a way that installation heights, nozzle distances and water pressures, as listed in table 3.8.1, and Fig. 4.1 & 4.2 are satisfied.

Nozzle pipes work should be hydraulic calculated to ensure that the water pressure is satisfy the recommended water pressure on all nozzles in an activated nozzle zone.

Nozzle pipe system should be made in materials, which are corrosion proof to the Suppression agent, and which do not cause galvanic corrosion between pipes and components, or pipes and pipe supports. It is recommended to use of stainless steel or copper pipe.

Nozzle pipe support must be designed to withstand vibrations and movement, which might occur on ships at sea.

Nozzle pipes and other pipe-works should be designed and installed in such a way, that the pipe works do not interfere with the normal use and maintenance, which take place in the occupancy.

Nozzle pipe-systems should be designed in such a way that nozzles only are installed in locations where there are no risks of damaging the pipe system, or the nozzles.

Nozzle pipes should, when possible, be installed above hoists and other moving equipment.

Nozzle pipe-work should be installed away from door openings and hatches, and other areas where nozzle pipes or nozzles may limit the free movements of personal in the engine room.

Nozzle pipe-work should be installed away from machinery and areas where maintenance often takes place, or where there is a risk for that the nozzle spray might be obstructed.

Nozzle pipes and nozzles should be installed in such a way that it is not necessary to dismount pipes or nozzles to be able to maintain or repair machinery or application in the engine-room.

Before installing the nozzles. It should be checked that the female nozzle fittings are positioned in such a way that the nozzles will be correct positioned. This is easily done with a ½" BSP threaded pipe screwed into the fitting.

Nozzles should only be installed in the pipe work, after that the full pipe-work has been installed and fully secured, and after all internal water-ways has been rinsed for impurities, and dried with compressed air.

Nozzles should be installed using a nozzle spanner for the M-series nozzles. The transport cap should be left on while installing the nozzles, not to risk damaging the nozzles. Nozzles should be tighten to the pipe system ½" female BSP thread applying a torque of 4 Nm± 1Nm.

If a deflector pin is bend, off centre the orifice hole, or knocked up against the deflector hole, the Nozzle will not distribute the right water mist distribution. Such nozzles should be replaced with new.

When installing nozzles and pipes, it is important only to apply thread sealant on the male parts, and to ensure that there are no sealant surfaces internally in the pipe system. This is important to avoid orifices from clogging.

Threaded female parts should be firmly cleaned before assembled with male parts, to avoid any impurities in the pipe.

## 5.9 Obstructions Between Applications and Pendent Installed Nozzles

Cautions should be taken to avoid obstructions between nozzles and the fire risks.

Additional nozzles should be installed if obstructions are wider than 0.5m, and shields an angle wider than 20°, when seen from a nozzle, or when seen from the fire risk.

If the obstruction is located between two nozzles the shielded angle from a single nozzle may be 40°.

## 5.10 Additional Nozzles

Additional nozzles should be installed to provide coverage on shielded surfaces. Additional nozzles may be installed in vertical position below the obstructions, or the nozzles may be installed in horizontal position away from the footprint of the application.

The number of additional nozzles needed is calculated from the maximum from the Nominal Spray Angle, and the distance from the nozzles to the object. The whole footprint surface of the application should be covered, and all shielded surfaces should be covered, too. The Nominal Spray Angles are shown in fig. 4.7.

## 5.11 Figures.

Following pages is giving some typical information of system design, obstructions etc. Please note that each vessel has to be designed in accordance with the actual lay-out, obstructions and complexity given in the arrangement drawings and if required, surveys on board.

### *5.11.1 Typical lay-out, plan.*

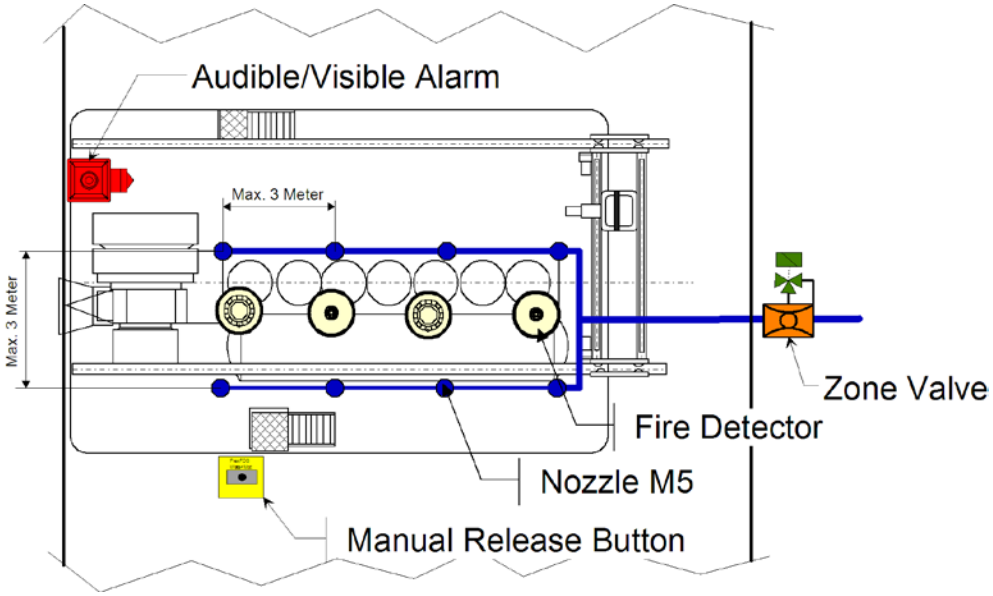


**Fig. 4.1**

### *5.11.2 Typical lay-out, section.*

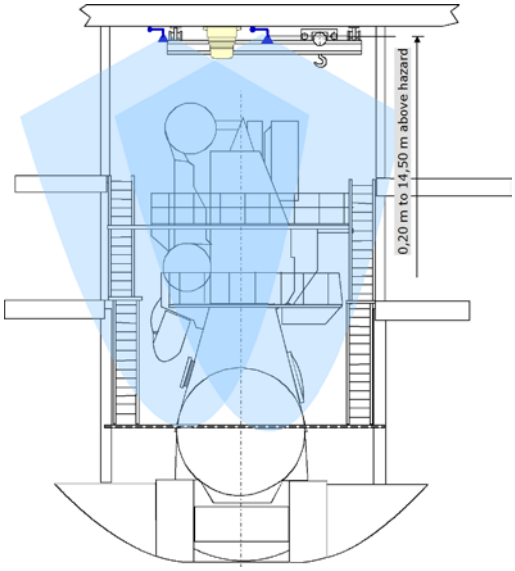


**Fig. 4.2**

### 5.11.3 Maximal obstruction seen from Nozzle, Single Nozzle Spray.

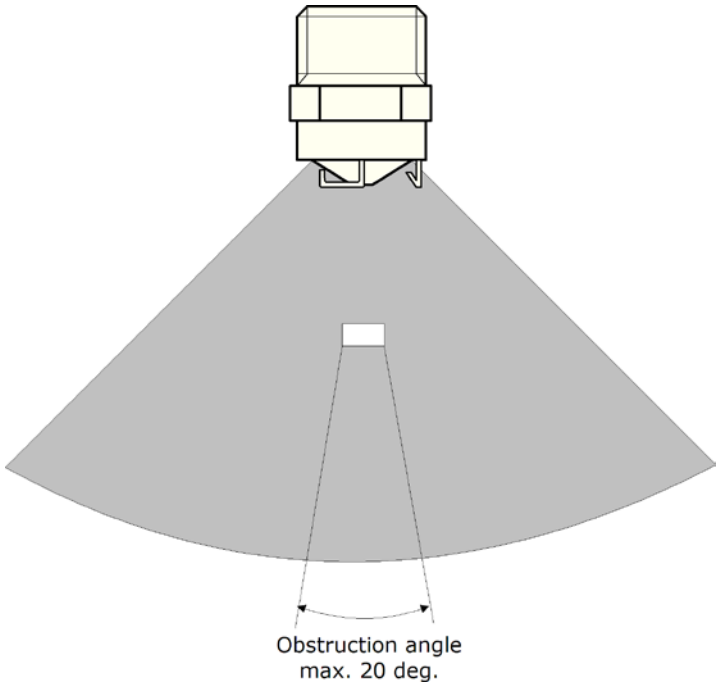


**Fig. 4.3**

### 5.11.4 Maximal obstruction seen from Nozzle, Dual Nozzle Spray

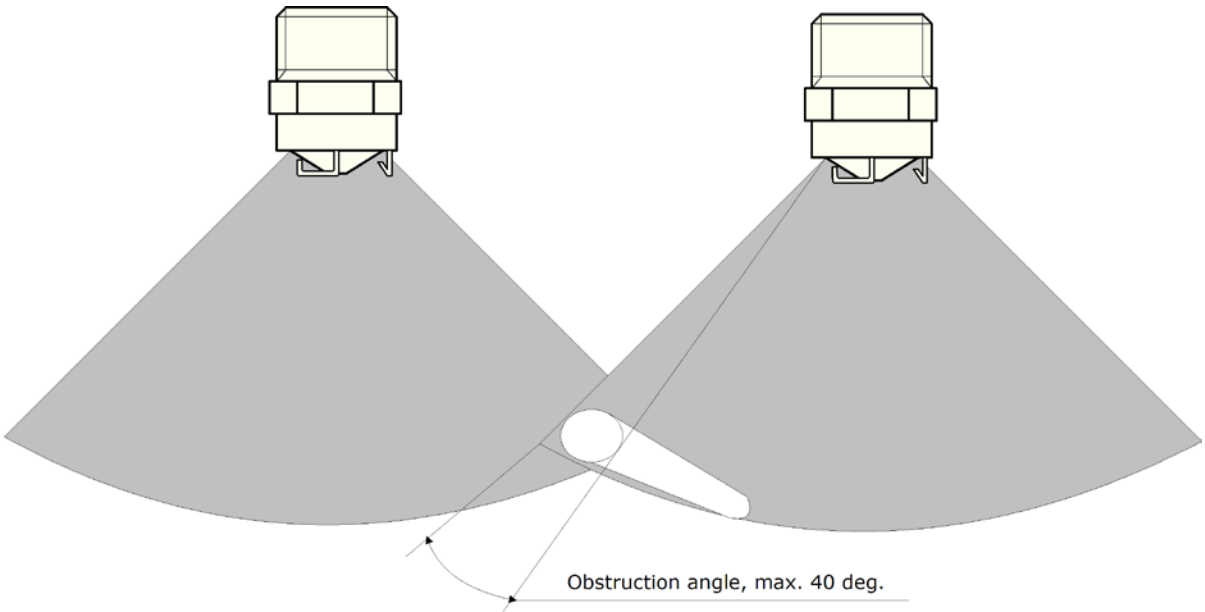


**Fig. 4.4**

**Autronica Fire and Security** is an international company, headquartered in Trondheim, one of the largest cities in Norway.

Our products cover a broad range of systems for integrated solutions, including fire detection systems, integrated fire and gas detection systems, control and presentation systems, voice alarm systems, public address systems, emergency light systems, plus suppression systems.

All products are easily adaptable to a wide variety of applications, among others, hospitals, airports, churches and schools, as well as to heavy industry and high-risk applications such as power plants, computer sites, offshore installations and to the marine market, world wide.

The company's strategy and philosophy is plainly manifested in the business idea:

*Protecting life, environment and property.*

**Quality Assurance**

Stringent control throughout Autronica Fire and Security assures the excellence of our products and services. Our products are CE marked and developed for worldwide standards and regulations, and conform to the CEN regulation EN54 in addition to IMO, classification societies and marine administrations. Our quality system conforms to the Quality System Standard NS-EN ISO 9001:2000 and is valid for the following product and service ranges: marketing, sales, development, engineering, manufacture, installation, commissioning and servicing of suppression, integrated fire and gas detection and alarm systems, plus petrochemical, oil and gas instrumentation systems for monitoring and control.

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