

# Water Mist Fire Suppression



How less water has a big impact.

## INTRODUCTION

Many buildings have specific areas that could benefit from using a water mist system. These systems use less water than traditional sprinkler systems, causing less damage to high-value assets. This white paper provides a general overview of water mist technology, the types of water mist systems currently on the market and what to look for when specifying a water mist system.

## HOW FIRE OCCURS

In order to understand how water mist systems work, we need to understand how fires occur. Four things must be present at the same time in order to produce fire: fuel, heat, oxygen and a chemical reaction. The first three elements are frequently referred to as the "Fire Triangle." Adding the fourth element (chemical reaction) will result in the "Fire Tetrahedron." Removal of any one of these elements will result in fire extinguishment and the disruption or weakening of one of these elements will result in fire control or suppression. Essentially, water mist takes away one or more elements of the Fire Triangle or Tetrahedron.

## HOW DOES WATER MIST WORK?

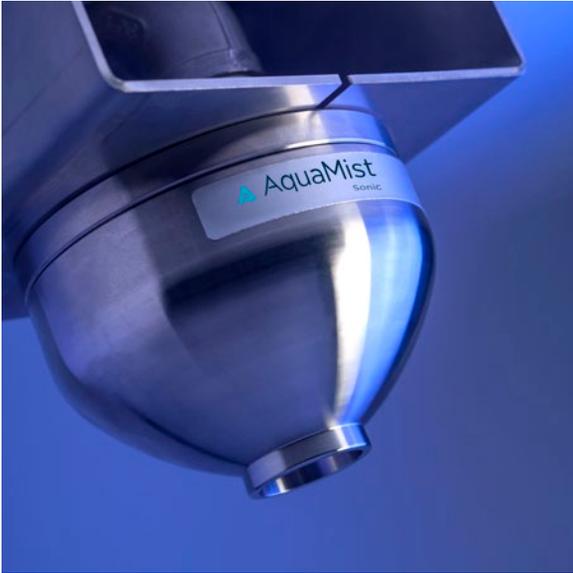
Water mist systems can control fire by reducing heat, displacing oxygen and controlling the fuel source by wetting and cooling the surrounding fuel surfaces. The key to water mist technology lies in the design of the nozzle along with established pressure criteria to create a mist of small water droplets. Water mist systems will have droplet sizes where 99% of the volumetric diameter is less than 1mm. Smaller droplets absorb heat at a faster rate than larger droplets due to the higher surface area-to-mass ratio. A volume of water that consists of smaller droplets has a comparatively larger cumulative surface area than the same volume of water made up of larger droplets – such as those from a standard spray sprinkler. As a result, a rapid absorption of heat and evaporation of the smallest droplets will occur, causing temperatures to decrease while oxygen is displaced.

When the water droplets absorb enough heat, they evaporate, rapidly creating steam.

Due to this vaporization, oxygen will be displaced in the area of the fire, disrupting the Fire Tetrahedron. Small water droplets tend to remain suspended in the air and fill the entire space. The result being that any air the fire draws in becomes saturated with these droplets and vaporization occurs. Water mist also helps to pre-wet and block the transfer of radiant heat to the adjacent combustibles, reducing the risk of fire to spread and grow.

## TYPES OF WATER MIST SYSTEMS

There are three main categories of water mist systems: low pressure (175 psi or less), intermediate pressure (175 psi-500 psi) and high pressure (500 psi or greater). Within these categories you may have single-fluid systems (water only) or twin-fluid systems (water and an atomizing medium like nitrogen). All these system types are tested and approved for a variety of fire hazards and should be handled as an engineered water mist system, each requiring specific design and calculation criteria. An example of a low to intermediate pressure water mist system is the AquaMist® Ultra Low Flow (ULF) which operates at working pressures up to 250 psi (17.2 bar). The AquaMist® FOG, which is a high-pressure system, operates at working pressures of 1015 psi to 2900 psi (70 to 200 bar). The high-pressure system typically produces very fine droplets (less than 50 um) and uses even smaller pipe sizes than that of low to intermediate pressure systems.



A twin-fluid system is a hybrid water mist system like the AquaMist® SONIC System. This system requires water and nitrogen gas to extinguish the fire. Both the water and the nitrogen gas require separate sources towards the nozzle and then the gas is used to “shear” the water stream into fine water droplets. AquaMist® SONIC uses operating pressures of 58.02 psi to 101.52 psi for nitrogen and 29.00 psi to 58.02 psi (4 to 7 bar for nitrogen and 2 to 4 bar for water) at the nozzles before entering the protected area to extinguish the fire.

The hybrid water mist system works as described previously; by cooling the surroundings and displacing oxygen, but now the inert nitrogen gas helps to further reduce the overall oxygen level in the space for faster extinguishment of fire. This system uses less inert gas than what is required in a traditional clean agent system because it utilizes the benefits of the local oxygen displacement created by the conversion of water mist to steam.

For each water mist system, different configurations can be found. There are automatic systems which utilize nozzles that have a thermal responsive element that hold back water until it operates. When exposed to a certain high temperature (from a fire) for a period of time, this thermal response element operates and allows water to come out of the nozzle. These nozzles can be piped from a wet sprinkler valve or a pre-action valve. Regardless of the system type, wet or pre-action, water only enters the protected area from those nozzles of which the thermal response element has operated.

Another type of system is the deluge system. This system utilizes open nozzles (no thermal element). With this system, an independent detection system (smoke or heat) is installed in the same area as the nozzles to control the deluge alarm valve. When smoke or heat is detected, an electronic signal is sent to a control panel which in turn sends a signal to the deluge valve and opens the valve. Water enters the system and provides water to all the nozzles connected to the deluge valve. This provides protection for hazards within the space and is commonly seen in machinery and turbine enclosures. The common name used for these types of water mist systems is a “total flooding” or “total compartment” system.

When the compartment containing the machinery or turbine enclosure is of such a volume that a total compartment solution is not feasible, it will be decided to just protect the hazard locally with open nozzles and separate detection. This water mist system type is called a “local application.”

## BENEFITS OF WATER MIST

The main benefit of water mist is that it uses less water compared to a traditional sprinkler system. This minimizes damage to the property and the critical assets. Also, due to the lower water requirements, the system can use smaller diameter piping. This may reduce the material cost as well as the installation cost of the system.

A trade-off of using less water is that the water mist system typically needs higher pressure than what a municipal water



Digital integrity is a crucial aspect of commercial organizational operations around the world.

main can provide. This can be accomplished by using positive displacement pump(s) which provide high-pressure output at lower water volumes, or by using stored nitrogen or air cylinders as a propellant for the water. Since the water demand is lower, water mist systems are suitable for standalone applications where access to water may be limited. In such situations, a water tank or cylinder(s) filled with water and pressurized by stored nitrogen or air cylinders can be used to supply the pump with water. With these standalone solutions, there is a finite discharge duration due to limited amount of water stored.

## WHAT APPLICATIONS ARE BEST SUITED FOR WATER MIST TECHNOLOGY?



Machinery spaces are facilities providing process critical services, such as water, electricity, heating and power.

Water mist systems can be used as a complete solution for nearly every class of fire. Examples of where water mist systems have been used include, but are not limited to, archives, cable tunnels, data centers, heritage, hotels, industrial fryers, libraries, machinery spaces, offices and turbine enclosures.

Machinery spaces that utilize hydrocarbon fuels and lubricants, as well as flammable and combustible liquids under pressure, can create fast-growing spray and pool fires. This type of fire suppresses quickly when using an applicable water mist solution due to its rapid heat absorption.

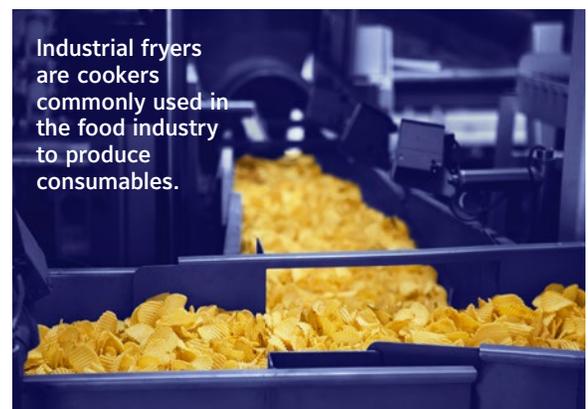
Large, industrial fryers can also benefit from water mist technology. Food manufacturers using large industrial fryers can suffer significant loss with fires that cause widespread damage and product loss (up to \$1 million per day). Water mist nozzles can be installed directly within the hood system of the fryer to prevent fire from spreading.

Heritage sites, such as museums, libraries and art galleries contain high-value, irreplaceable assets. While fire poses a tremendous risk to the preservation of these assets, saturation from fire suppression systems can also cause significant damage. The lower water discharge of water mist systems helps reduce collateral damage to these assets without sacrificing fire protection capabilities.

## SPECIFYING A WATER MIST SOLUTION

The following considerations should be taken into account when specifying a water mist system. The first is the on-site water supply. The available water pressure often dictates the required water supply for the water mist system. If there is no adequate water supply, then a standalone system may be required as described previously.

Secondly, water mist systems should conform to all local and state codes, where applicable, as well as the requirements of the authority having jurisdiction (AHJ). For example, water mist systems should meet the requirements outlined by NFPA 750, "Standard on Water Mist Fire Protection Systems." Systems and/or components of water mist systems are tested and approved by certifying bodies such as Factory Mutual (FM), Underwriters Laboratory (UL) and VdS, and these listings and approvals are often required by standards and AHJs.



Industrial fryers are cookers commonly used in the food industry to produce consumables.

## MAKE THE RIGHT CHOICE

Although water mist systems have been around for many years, they've only recently gained popularity in the U.S. These systems offer a powerful and economical solution that will help suppress or control the fire with minimal water usage and collateral damage.

The innovative, dependable and environmentally safe technology behind AquaMist® systems is supported by comprehensive industry approvals as well as independent, third-party testing and verification. The diversity of the AquaMist® line, backed by the forward-thinking technology of Johnson Controls, assists in allowing companies to select a water mist solution that fits the unique needs of their business. For more information on AquaMist® Water Suppression Systems, submit a contact form at <http://tycoaquamist.com>

### AquaMist<sup>®</sup> ULF



AquaMist® ULF produces droplets of water through a range of nozzles, which are specifically engineered and approved for a variety of fire hazards. Designed to function as one dedicated fire protection system, it's a complete engineered solution that includes pumps, valves, discharge nozzles, pipes and fittings.

### AquaMist<sup>®</sup> SONIC



Environmentally friendly AquaMist® SONIC uses readily available water and nitrogen as extinguishing material. Two supersonic atomizers create 1.5 trillion superfine water droplets per second and propel them at high velocity to provide non-toxic fire suppression protection. This system also provides automatic detection and actuation and/or remote manual actuation.

### AquaMist<sup>®</sup> FOG



As a pre-engineered cylinder or engineered pumped system, AquaMist® FOG provides fire protection for class A and B fires. Because these systems reduce water consumption and pipe diameters, they are perfect for machinery spaces, as well as fragile infrastructures that requires specialist care, such as in heritage buildings, libraries and archives. This system is not yet available in North America.

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Johnson Controls is a global diversified technology and multi-industrial leader serving a wide range of customers in more than 150 countries. Our 120,000 employees create intelligent buildings, efficient energy solutions, integrated infrastructure and next generation transportation systems that work seamlessly together to deliver on the promise of smart cities and communities. Our commitment to sustainability dates back to our roots in 1885, with the invention of the first electric room thermostat. We are committed to helping our customers win and to creating greater value for all of our stakeholders through strategic focus on our buildings and energy growth platforms.

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