HI-FOG®
water mist fire protection

Fire protection for buildings

HI-FOG® high pressure water mist

Marioff
United Technologies

Protecting people, property and business continuity

A fire in a building can lead to serious consequences. Even a harmless fire can grow out of control in minutes unless immediately suppressed. With proper fire protection, damage and downtime can considerably be reduced.

HI-FOG® high pressure water mist fire protection system is the result of great innovation: fire is suppressed with less water. The technology is incredibly versatile, and its performance has been verified in thousands of full-scale fire tests.

NFPA 750 Standard on Water Mist Fire Suppression Systems	FM Global Property Loss Prevention Data Sheet 3-26	VdS 3188 Guideline for Water Mist Systems	Fire Load and Heat Release Rate (HRR)	Typical Application or Areas
Light Hazard (LH)	Hazard category 1 (HC-1)	Light Hazard (LH) or Ordinary Hazard 1 (OH1)	Low	Office spaces, class rooms, museums, hotel rooms, hospitals
Ordinary Hazard 1 (OH1)	Hazard category 2 (HC-2)	Ordinary Hazard 2 (OH2)	Low to medium	Car parks, laundries
Ordinary Hazard 2 (OH2)	Hazard category 3 (HC-3)	Ordinary Hazard 3 (OH3)	Medium to high	Storage areas, archives

Fire hazard classification by NFPA, FM and VdS.

HI-FOG® fights fire in three ways: by cooling the fire and the surrounding area, by blocking the radiant heat, and by removing the oxygen from the seat of the fire.

Control	Limitation of fire size, decrease of heat release rate and prevention of structural damage
Suppress	Sharp reduction in rate of heat release and prevention of re-growth
Extinguish	Complete suppression until there are no burning combustibles

What it takes to suppress a fire

Fire is a process which involves chemical reaction between combustible fuel and oxygen. The prerequisites for sustained burning are:

- Combustible fuel
- Oxygen
- Heat for ignition
- Uninterrupted chemical reactions

To extinguish a fire, at least one of the four prerequisites must be removed. The fuel itself can rarely be removed, but the other parameters can be affected by different fire fighting agents.

For instance, oxygen concentration can be lowered by adding inert gas into the fire, heat can be removed by wetting the combustibles, or chain reactions can be interrupted by adding a chemical.

Fixed and manual fire fighting

Fires can be fought by fixed fire fighting systems or manually. Fixed systems typically control and suppress fires, and manual intervention is required to completely extinguish a fire.

Types of fires

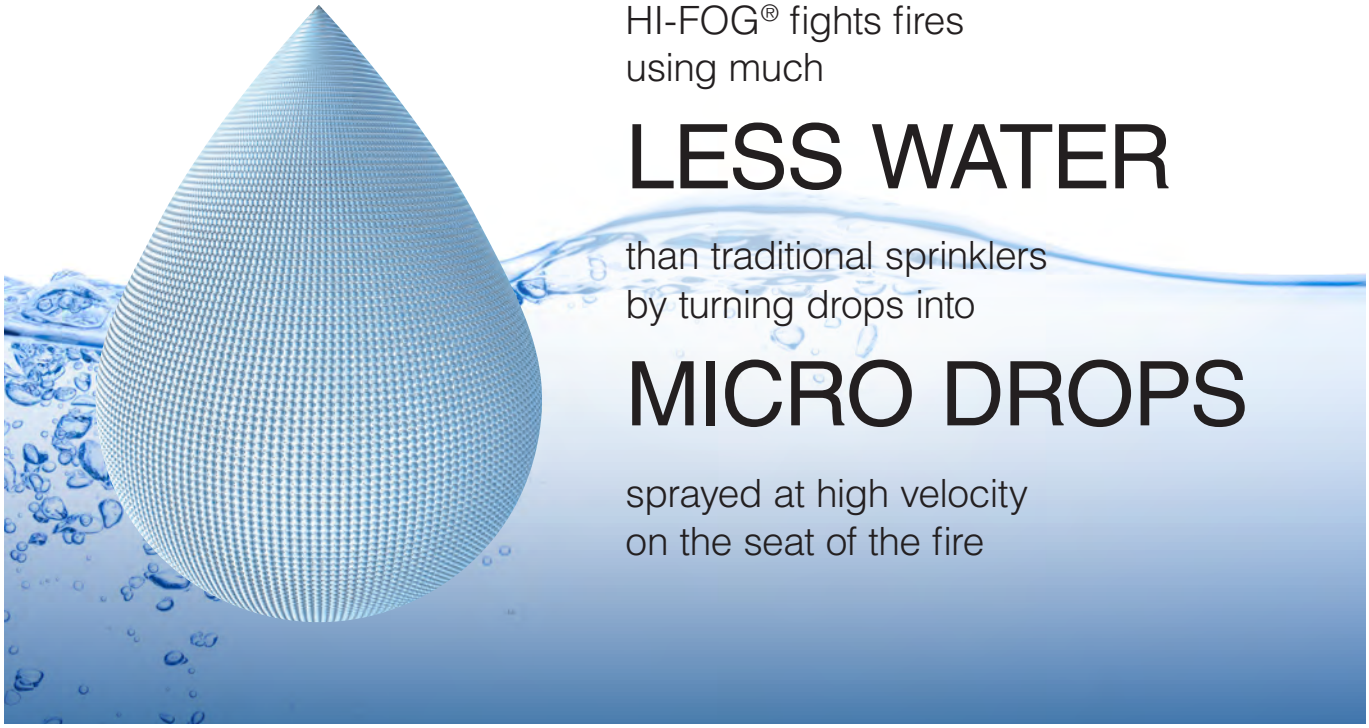
Not all fires are the same. Different fuels create different fires which require different fire fighting solutions. High pressure water mist is a highly efficient fire suppression technology for fighting Class A and Class B fires.

Fires in buildings are typically Class A fires. In Class A fires, the combustibles are solid materials, such as furniture, textiles, plastics, wood and building & insulation boards. In Class B fires, the combustibles are flammable liquids.

Fire hazard classes

Typically, fire risk assessment begins with an identification of the fire hazard classes. A fire hazard refers to the occupancy and fire load: the quantity and combustibility of the content in an occupation. Fire hazard classifications vary between the different standards and guidelines.

One building typically contains different areas that are classified to different fire hazard classes. The hazard classes determine the requirements for the water mist system design, installation, operation and maintenance.



HI-FOG® fights fires
using much

LESS WATER

than traditional sprinklers
by turning drops into

MICRO DROPS

sprayed at high velocity
on the seat of the fire

High pressure water mist
High pressure water mist represents water in its most efficient fire fighting form.

Cooling
When water turns into vapour, it absorbs more heat than any other fire fighting agent, cooling the fire and the surroundings very efficiently.

Inerting
When water evaporates, its volume expands over 1700 times, inerting the atmosphere by displacing oxygen.

The evaporation rate of water depends on the surface area: water in a bucket evaporates more slowly than water spread out on a floor. The surface area and the evaporation rate can be increased by turning water into small drops, which leads to more efficient cooling and inerting.

Small drops as such do not guarantee the efficient fire fighting. The drops also need to reach the seat of the fire which can be enhanced with high pressure.

Radiant heat blocking
When water is dispersed as tiny drops at high pressure, it blocks the radiant heat very efficiently, helping to prevent the fire from spreading or reigniting.

With high pressure, it is possible to deliver both tiny drops and high velocity, which enables the most efficient use of the water characteristics.

Safe and sustainable
HI-FOG® is the safe and sustainable way to fight fires. The system activation does not require evacuation or enclosure integrity and the spaces can also be entered while the system is discharging without risking human life or affecting fire fighting efficiency.

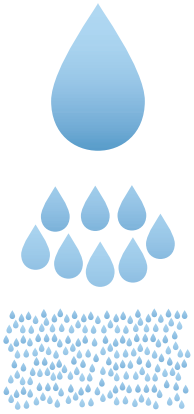
Low water usage
HI-FOG® water mist fights fires with less water but just as effectively as traditional sprinkler systems.

Minimal damage and downtime
Thanks to swift fire suppression using low amounts of water, HI-FOG® helps keep damage and downtime to a minimum.

Installation flexibility
Small piping, modular pump units and discrete sprinklers make HI-FOG® easy to install into retrofits and new buildings alike with minimal structural impact.

Scalable
HI-FOG® is easy to extend to adjacent areas or buildings using the same main components, making HI-FOG® a flexible and cost-efficient choice in the long run.

How much is 1l of water?



Drop size (mm)	Number of drops	Surface area (m^2)
124	1	0.05
10	1 900	0.6
1	1 900 000	6
0.1	1 900 000 000	60
0.01	1 900 000 000 000	600
0.1 x	1000 x	10 x

WATER MIST

Performance-based approach
Marioff has always been a staunch supporter of research. Yet even today, the only acknowledged way to evaluate the performance level of a water mist system is to conduct full-scale fire tests.

A fire test is a means of determining whether the system meets the standardized and pre-determined performance criteria.

Most of the testing aims at type approvals for different applications. Full-scale fire tests are usually witnessed by independent third party approval bodies.

HI-FOG®'s fire fighting performance has been verified in thousands of full-scale fire tests. As a result, HI-FOG® has received more than 120 type approval certificates for a wide range of applications.

Engineered solutions
Thanks to thousands of fire tests and thorough understanding on how fire and HI-FOG® systems behave in different applications, Marioff has strong know-how on developing also justified engineered solutions when fire test criteria for type approvals do not yet exist.

Simulation
Supplementary to full-scale fire testing, numerical simulations can be applied for studying and demonstrating different aspects of fire and the performance of the HI-FOG® systems. Simulations are often used to support the development of customized solutions.

Savings in structural fire protection
Depending on local rules and regulations, it may be possible to compensate structural fire safety requirements by equipping the building with an active fire protection system.

When a high pressure water mist system is in place, it may be possible to lower the fire rating of the construction materials, such as glass structures, fire doors and partition walls.

Not all water mist systems are the same. The fire fighting properties are entirely system -specific. One way to compare the different fire protection systems are the type approvals as the performance criteria are the same for all.

System design

International standards and guidelines outline the design, installation, maintenance, and testing requirements for the water mist fire suppression systems. Codes and regulations vary from country to country, and the fire protection system designs are usually approved by local authorities.

All critical water mist system design and installation parameters are defined in full-scale fire tests, such as sprinkler or spray head type, spacing, operating pressure, flow rate and installation height. Due to different, system-specific design and installation parameters, one supplier's water mist systems should never be designed using other supplier's design parameters.

Relevant regulations

NFPA 750	Standard on Water Mist Fire Protection Systems
VdS 3188en	VdS Guidelines for Water Mist Sprinkler Systems and Water Mist Extinguishing Systems (High Pressure Systems), Planning and Installation
CEN/TS 14972	Fixed Firefighting Systems. Water Mist Systems. Design and Installation
FM 5560	Approval Standard for Water Mist Systems
UL 2167	Standard for Water Mist Nozzles for Fire Protection Service

System types

Different water mist system types are sometimes needed to protect the entire building. HI-FOG® is extremely flexible which means it is suitable for protecting even the most challenging areas, and the system can easily be extended to protect new areas and buildings by using the same, main components.

Wet pipe system
A wet pipe system normally has closed, heat-activated sprinkler heads. The activation bulb bursts when the ambient temperature at the sprinkler head exceeds the prescribed rating. Water mist is discharged from that particular sprinkler head.

Wet pipe systems are the most common type of system because they are the most economical for medium-size and large areas that need to be protected against normal fire hazards. They also have the benefit of only discharging at the point of detection.

Deluge system
A deluge system normally has open spray heads. The water flow is usually controlled by a closed-type valve. When a section valve is opened –manually or by a detection system – water mist is discharged from all the spray heads in the area controlled by that valve.

Deluge systems are typically used for protecting machinery spaces because they provide full, homogeneous protection throughout the space.

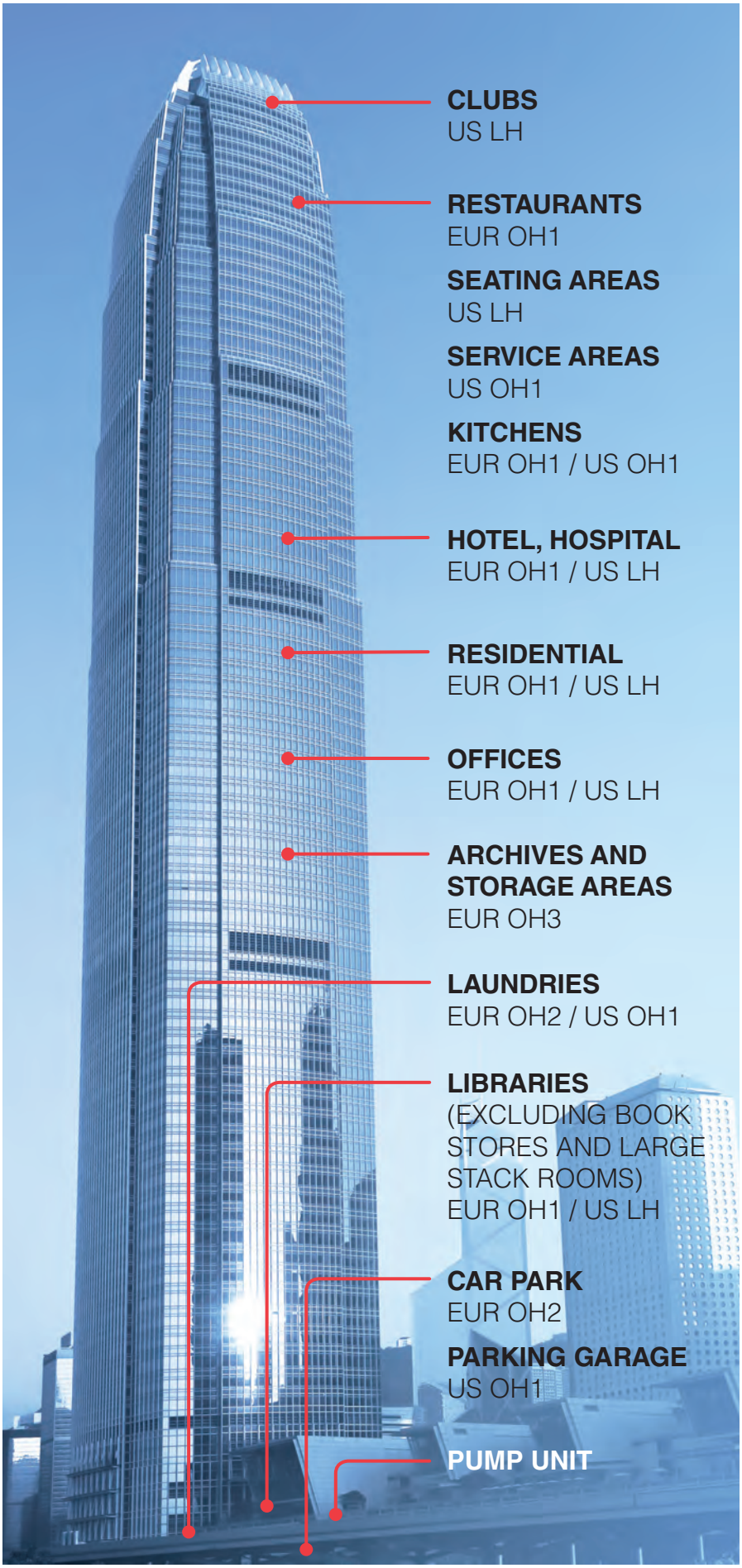
Dry pipe system
A dry pipe system operates in much the same way as a wet pipe system, but the valve keeps the water on the pump side of the tubing in normal operation. The tubes from the valve to the sprinklers are filled with compressed air, which is monitored.

The monitoring switch detects the loss of air pressure when a sprinkler bulb breaks and opens the section valve. Water fills the tubes to the sprinklers and water mist is discharged from the activated sprinklers.

This type of system is typically used when the protected area is subject to freezing.

Pre-action system
A pre-action system is very similar to dry pipe except that it is connected to a fire detection system. Typically, a pre-action system valve requires both a sprinkler bulb to break and an activation signal from an independent fire detection system before it opens.

This type of system usually protects areas where the risk of accidental discharge needs to be minimized. Pre-action systems are ideal for buildings such as large data centres and museums.



Main components

HI-FOG® system is made of high quality components that all contribute to long system life. A typical HI-FOG® system consists of water supply, reliable high pressure pump or accumulator unit, section valves, stainless steel pipes, and compact sprinklers and spray heads. The main system components are manufactured at Marioff's factory in Finland, using top of the line CNC machinery.

Water supply
The water supply may be a mains feed or a water tank. The size of the water tank depends on the application, system operation time, pump unit and other possible local requirements.

The required water inlet pressure into the HI-FOG® system powered by an electric pump unit is 2-6 bar with the required flow. If needed, the feed water line can be equipped with one or several feed water pumps which can be controlled by the HI-FOG® Electric Pump Unit's control cabinet.

Pump units
HI-FOG® water mist is always generated by high pressure. The systems are powered by electric pumps or pressurized gas cylinders.

The new HI-FOG® Electric Pump Unit (EPU) revolutionizes the pumping technology for the high pressure water mist segment with its advanced control system and simplified mechanical design. The modular structure together with practical service access enables flexible installation and optimised use of footprint.

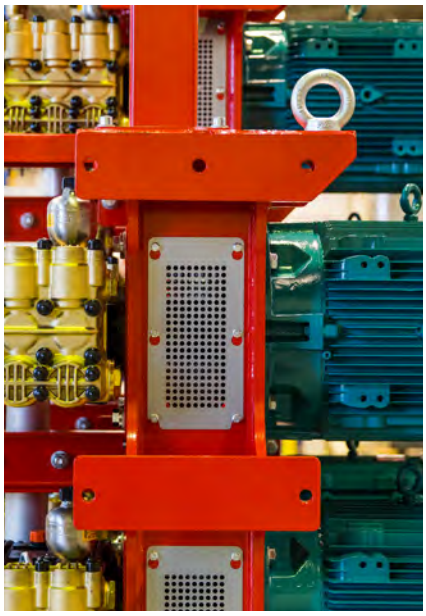
The HI-FOG® Gas-Driven Pump Unit (GPU) can be supplied as an independent, stand-alone system that does not require mains electricity, municipal water supply or a large water reservoir.

The HI-FOG® GPU is suitable for low hazard areas and places where electricity is not available, or where the water damage should be minimized. The HI-FOG® GPU is driven by compressed air, and uses small amounts of water.

Section valves
HI-FOG® section valves are used to divide the system into sections, which make it easy to locate the fire and service the system in one area while the other parts are kept up and running.

Section valves are normally open or normally closed. Normally open section valves are used with sprinkler systems, and normally closed section valves are suitable for spray head systems and pre-action systems.

Piping
HI-FOG® piping is made of high quality AISI 316 grade stainless steel. All piping components are designed for 140 bar working pressure and tested to 210 bar on-site.



Pump unit type	Minimum space, including service area (mm/in)		
	Length	Width	Height
EPU 02	1855 / 73	2220 / 87	1319 / 52
EPU 03			1719 / 68
EPU 04	2345 / 92		
EPU 05			
EPU 06			
EPU 07	3020 / 119		
EPU 08			
EPU control cabinet	1250 / 49	1500 / 59	2000 / 79
GPU module	1100 / 45	900 / 35	2300 / 90
GPU cylinder rack 4+4	1200 / 50	1500 / 60	
GPU cylinder rack 6+6	1800 / 70		

Typical risers and main pipes are 38mm in diameter, and the section pipes and branches are 30mm or 12mm in diameter.

Piping is done with mechanical cutting ring connections where welding is not needed.

The small diameter pipes are easy to bend which makes the installation flexible. Detailed piping routing can be designed on-site. The pipes fit in small spaces and around obstructions, which is especially beneficial in cultural heritage sites where space is often limited.

Mounting adapters
Sprinklers and spray heads are always attached to mounting adapters.

The mounting adapter for sprinklers include a check valve which enables fast maintenance inspections and sprinkler replacements. The sprinkler can be replaced even when the system is on stand-by, because the check valve prevents the water discharge.

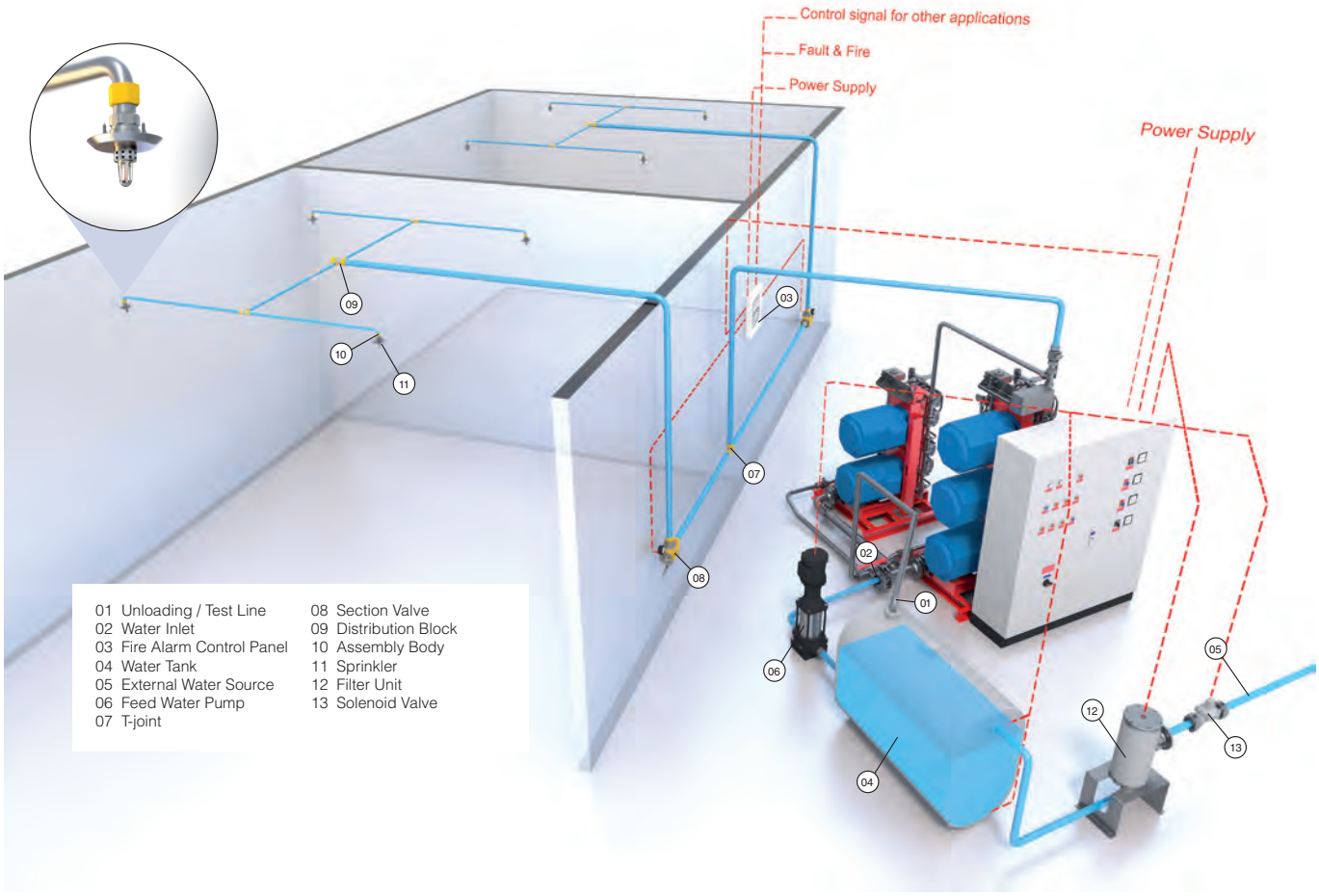
Sprinklers and spray heads
HI-FOG® sprinklers and spray heads are the core items of the HI-FOG® systems. Choosing the appropriate sprinkler or spray head type ensures optimized water usage in each space.

Sprinklers are fine machined state-of-the-art objects which are equipped with heat-activated glass bulbs. Water is pushed through the small holes, creating just the type of water mist needed for the fire hazard in question.

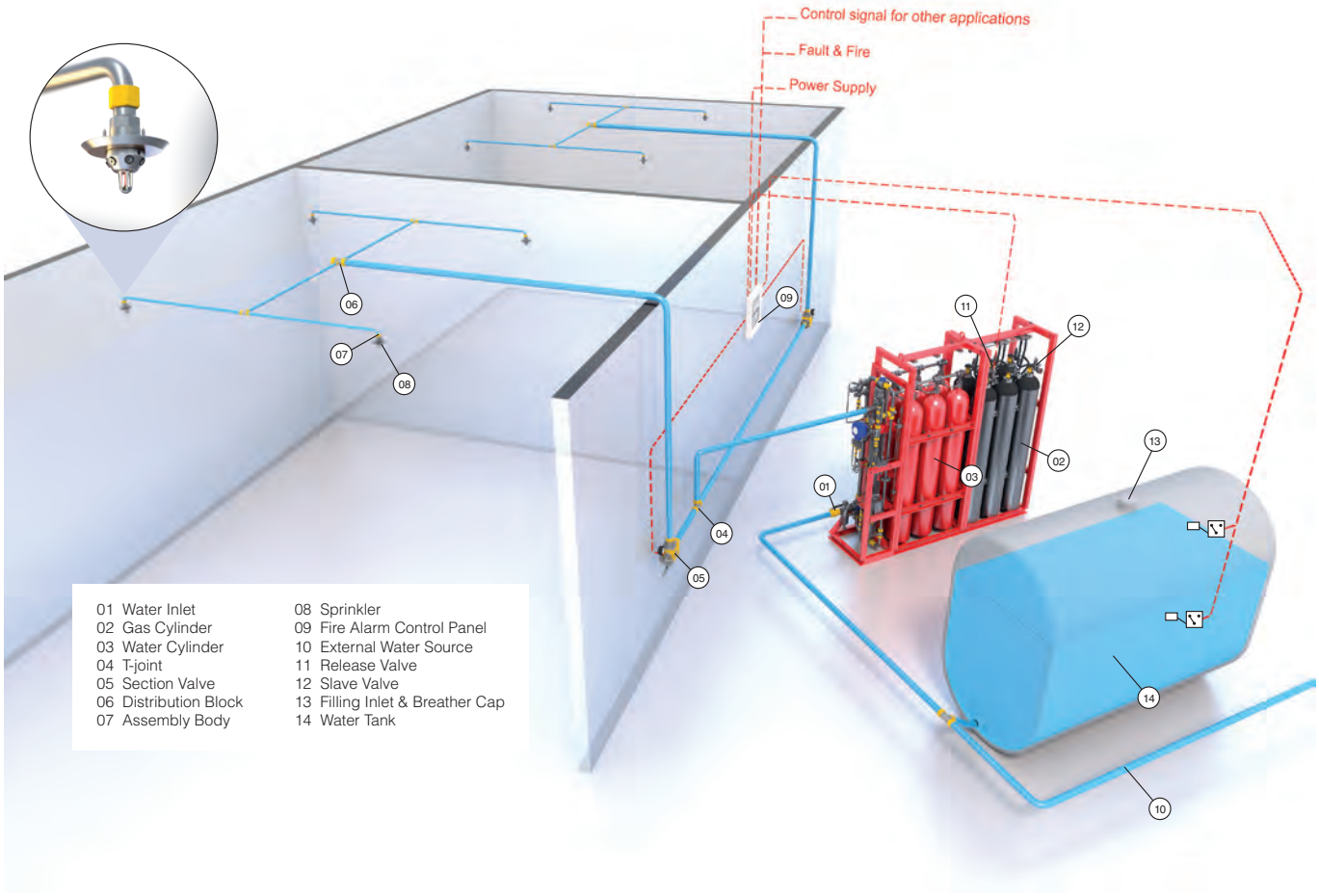
Spray heads are used in deluge systems found in technical spaces. When activated, the detection system opens the section valve and water is discharged through all spray heads in the designated area.

HI-FOG® Fire Hose Nozzle
HI-FOG® Fire Hose Nozzle is a compact and efficient add on the HI-FOG® system to manually extinguish liquid and solid fuel fires.

HI-FOG® Fire Hose Nozzle can be operated either in jet or fog modes. The jet mode can put out solid fuel fires with a throw reaching 26 meters, while the fog mode can be used to extinguish also the liquid fires. The performance has been verified in fire tests and approved by VNIIPO, a Russian fire protection certification body.



01 Unloading / Test Line
02 Water Inlet
03 Fire Alarm Control Panel
04 Water Tank
05 External Water Source
06 Feed Water Pump
07 T-joint
08 Section Valve
09 Distribution Block
10 Assembly Body
11 Sprinkler
12 Filter Unit
13 Solenoid Valve



01 Water Inlet
02 Gas Cylinder
03 Water Cylinder
04 T-joint
05 Section Valve
06 Distribution Block
07 Assembly Body
08 Sprinkler
09 Fire Alarm Control Panel
10 External Water Source
11 Release Valve
12 Slave Valve
13 Filling Inlet & Breather Cap
14 Water Tank

HI-FOG® Services

Just as any system needs care, so does HI-FOG®. Our services extend from the optimized maintenance and original spare parts to turnkey system upgrades and modernizations.

Corrective maintenance
Thanks to its global partner network, Marioff is able to provide local field service engineers on-site to repair the system in timely manner to ensure minimal downtime. Original spare parts are used to secure reliable functioning of the HI-FOG® system.

Preventive maintenance
Timely and well-planned maintenance procedures result in increased system reliability. HI-FOG® service contracts provide long-term maintenance budget predictability and cost efficiencies through optimized maintenance procedures.

Upgrades
The performance and capability of the HI-FOG® system can be improved by upgrading the existing system. A system upgrade is a sustainable way to respond to new fire safety regulations or extended protection requirements.

Modernization
The new technological developments can be implemented to ensure new features and functionalities. Modernization also extends the system life time by replacing obsolete technology with new optimal solutions and ensuring the availability of spare parts.

Training
All HI-FOG® operators can be trained to monitor the system, perform regular checks and basic troubleshooting, reset the system after activation and operate it in case of an emergency.

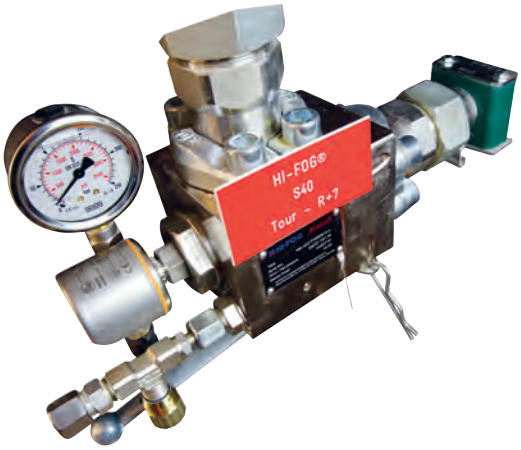
HI-FOG® Spray Head

HI-FOG® Spray Head Assembly Body

HI-FOG® Sprinkler Surface Mounting Adapter

HI-FOG® Pendent Mounting Adapter

HI-FOG® 2000 Sprinkler



HI-FOG® Section Valve

HI-FOG® Machinery Valve

HI-FOG® 1000 Sprinkler

HI-FOG® Electric Pump Unit

HI-FOG® Gas-Driven Pump Unit

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