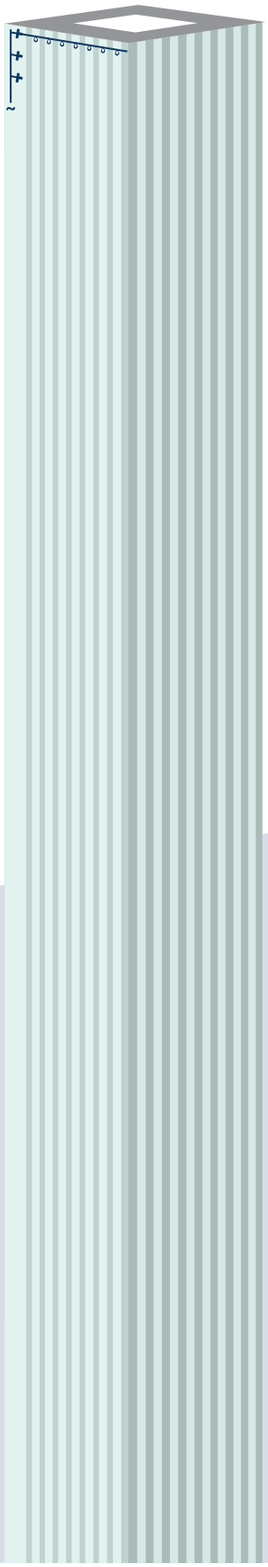
FOGTEC®
FIRE PROTECTION

Case Study

High-rise Buildings



Standard sprinkler system

vs.

High pressure water mist

High-rise buildings require a specific approach when designing a fixed fire fighting system. The differences in elevation need to select the right system following the required parameters required.

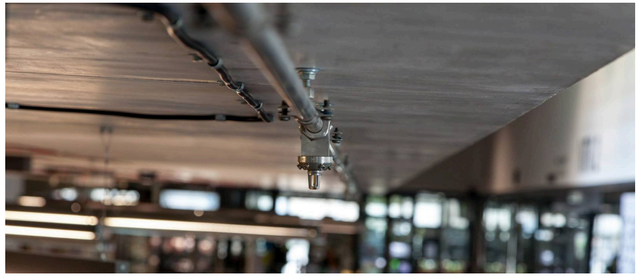
The present study compares the standard sprinkler system with a modern system, which makes use of high pressure water mist. Using high pressure water mist in public buildings has become more common in recent years.

The study includes a comparison of the technical design of a building with a height of 80 m and one that is 270 m tall.

HIGH PRESSURE WATER MIST

Water mist systems are designed to detect and fight fires in its early stages, or to keep the fire under control so that its extinguishing can be completed by other means. The system makes use of high pressure water mist that is generated using special automatic nozzles and high pressure. The minimum pressure is 60 bar. The system consists of a high pressure water source, alarm and monitoring devices, sectional valves and pipes with automatic nozzles.

Compared to the volume of water the droplets possess a large reactive surface area and are capable of absorbing large amounts of energy from the source of the fire. Effective absorption of the fire energy leads to an immediate decrease of the ambient air temperature while protecting the surrounding objects from the radiated heat. Rapid conversion of the droplets into steam absorbs further large amount of energy. At the same time, volume of water becomes 1,640 times increased due to evaporation, thus reducing the amount of oxygen in the source of fire.



Basic Components

Piping

Piping is made from high quality 316L stainless steel, ensuring high durability compared to sprinkler systems. The high pressure and the reduced consumption of water permits to reduce the pipe size up to 3 times compared with sprinkler systems. The reduced pipework dimension results in a smaller installation space requirment and facilitates coordination with other installed systems. The main pipeline is made with pipe sizing of 28 mm to 42 mm while pipes leading to each of the nozzles is only 12 mm.

Automatic heads

Similar to sprinklers, the automatic heads (nozzles) make use of heat-sensitive glass bulbs ensuring head opening in case of fire. The standard opening temperature is 57 °C. The heads are made of stainless steel, thus ensuring high quality along with durability.

Water supply

The system uses a water storage tank and an assembly of high-pressure pumps (98 l/min. at 140 bar), with the number of the pumps determined based on the demanded water flow rate and backup requirements. The high-pressure pump system includes a jockey pump which maintains the pressure of 40 bar throughout the system under stand-by condition. The pump's high pressure (140 bar) permits pressure losses in the pipework to be as much as 80 bar, allowing to reduce the cost of pipelines. The high-pressure pumps start in cascade to ensure a lower starting current.

SPRINKLER

Sprinkler systems are designed to detect and fight fires with water in the initial stages, or to keep the fire under control, so that extinguishing can be completed by other means. Sprinkler systems cannot be assumed to fully replace the need for other fire extinguishing means and it is important to assess fire protection measures in buildings as a whole. Sprinkler systems use water under relatively low pressure (0.35 bar is the minimum) which is discharged in the form of a sprayed stream.

Sprinkler systems involve automatic fire fighting equipment that consists of a water storage tank, fire pumps, valve stations, piping, sprinkler heads, and alarm & monitoring devices.

Multi-storey buildings with a difference in elevation between the highest and the lowest sprinkler being more than 45 m need applying special measures for high-rise facilities. The structure, more specifically, the sprinkler technology, needs to be split vertically into sprinkler sub-systems to ensure proper operation.

Basic Components

Piping

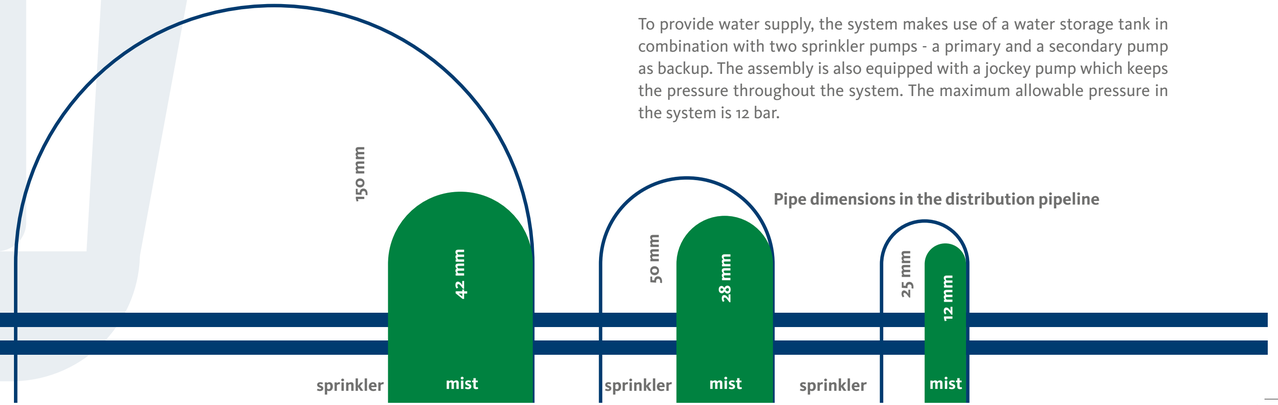
Wet pipelines are made of steel pipes. Piping used in a dry system must be galvanised. The main distribution pipes are made of sizes 65 mm to 150 mm, range pipe are 50mm and 25 mm pipe, and pipes supplying the individual nozzles are of 25 mm size.

Automatic heads

Similarly to water mist head, the sprinkler heads (nozzles) make use of heat-sensitive glass bulbs ensuring head opening in fire. For sprinkler heads the standard opening temperature is 68 °C.

Water supply

To provide water supply, the system makes use of a water storage tank in combination with two sprinkler pumps - a primary and a secondary pump as backup. The assembly is also equipped with a jockey pump which keeps the pressure throughout the system. The maximum allowable pressure in the system is 12 bar.



TECHNICAL SPECIFICATIONS OF SPRINKLERS AND HP WATER MIST

Ordinary Hazard (Office space)

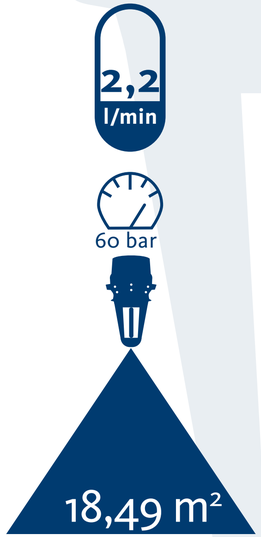
In high-rise buildings the OH1 risk protection requirement is increased to OH3.

Fire hazard classification: OH 3
Area of operation: 216 m²
System: Wet
Time of operation: 60 minutes

	Sprinkler	High pressure water mist
Maximum area per head	12 m²	18.49 m²
Intensity per 1m²	5 l/min.	2.2 l/min.
Opening temperature	68 °C	57 °C
Minimum pressure per head	0.35 bar	60 bar
Sprinkler sensitivity (RTI):	Standard	Quick response

SPRINKLER

HIGH PRESSURE WATER MIST



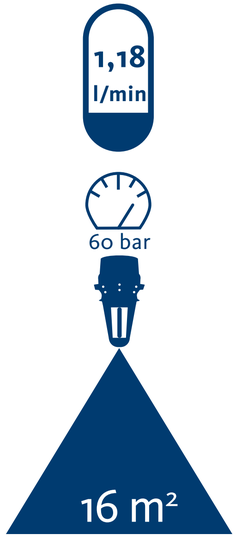
Parking garage

Fire hazard classification: OH 2
Area of operation: 180 m²
System: Dry
Time of operation: 60 minutes

	Sprinkler	High pressure water mist
Maximum area per head	12 m²	16 m²
Intensity na 1m²	5 l/min.	1.18 l/min.
Opening temperature	68 °C	57 °C
Minimum pressure per head	0.35 bar	60 bar
Sprinkler sensitivity (RTI):	Standard	Quick response to heat

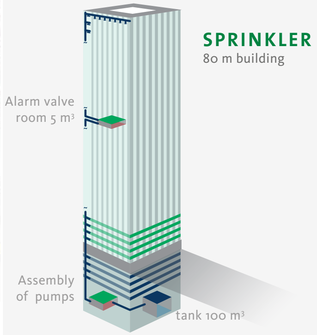
SPRINKLER

HIGH PRESSURE WATER MIST



HIGH-RISE BUILDING, 80 M

Pump Room



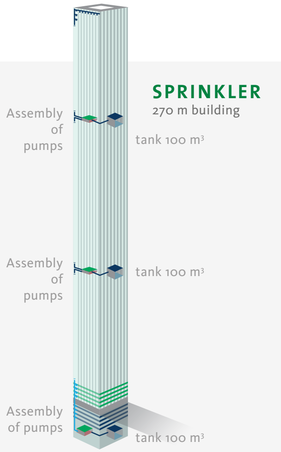
pump room, 45 m²

pump room, 24 m²

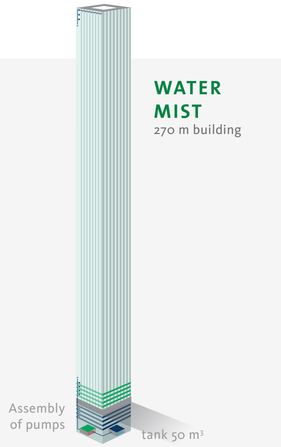
	Sprinkler	High pressure water mist
No. of pump rooms	1	1
Pump room floor area	45 m²	24 m²
Alarm valve room quantity	1	0
Alarm valve area	5 m²	
Tank capacity	100 m³	50 m³
Pump quantity	1 + 1	8 + 1
Backup input power	75 kW	240 kW
Electric pump starting current	828 A	428 A
Pump starting method	Full output immediately	Gradual (cascade) starting

HIGH-RISE BUILDING, 270 M

Pump Room



pump room, 3 x 30 m²

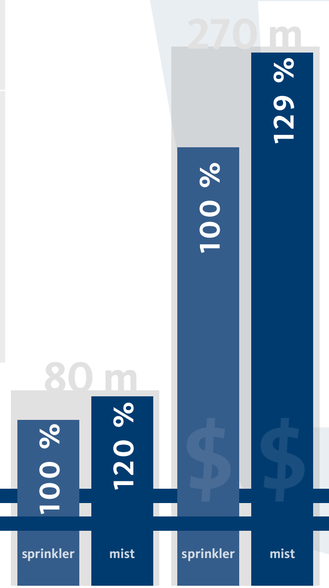


pump room, 30 m²

	Sprinkler	High pressure water mist
No. of pump rooms	3	1
Pump room floor area	3 x 30 m²	24 m²
Tank capacity	3 x 100 m³	50 m³
Pump quantity	1 + 1	8 + 1
Backup input power	3 x 45 kW	240 kW
Electric pump starting current	486 A	428 A
Pump starting method	Full output immediately	Gradual (cascade) starting

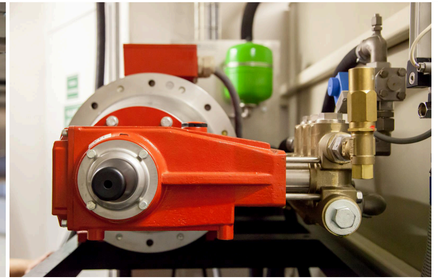
BENEFITS OF EACH SYSTEM

Sprinkler	*High Pressure Watter Mist*
+ Conventional system + Broader range of suppliers + Lower initial investment	+ Lesser area required for the pump room + Lesser pipe dimensions, easier to co-ordinate + Extended lifetime of piping & components + Single central pump room + Less water required, water used more efficiently + Smaller water tank + Lower damage on system activation + Simpler to design and execute with the high pressure of 140 bar + Single pressure zone, simpler system + Lower related cost of the construction part + Long lifetime
- Splitting into pressure zones - Need for a second and third machinery room incl. tanks for the 270 m high-rise building, limited use of commercial areas - Steel pipeline needs to be preserved by coating - Higher demand and consumption of water when fighting and extinguishing fire - Larger pipework & technology dimensions - Larger area required - More difficult co-ordination in shafts and suspended ceilings - Short lifetime	- Higher initial cost - More hangers required



PRICE COMPARISION OF TWO TECHNOLOGIES BY TOTAL COSTS OF OWNERSHIP ON A HIGH RISE BUILDING

	80 m High Building		*270 m High Building*	
	HP water mist	sprinkler system	HP water mist	sprinkler system
Initial investment	125 %	100 %	135 %	100 %
Lifetime	50 years	25 years	50 years	25 years
Estimate Yearly Maintenance costs	0,9 %	1 %	0,8 %	1 %
Estimate Sum of maintanance costs during 50 years lifetime	45 %	50 %	40 %	50 %
Piping renewal after 25 years due to internal corrosion	N/A	95 %	N/A	95 %
TCO for 50 years lifetime cycle	170 %	245 %	175 %	245 %
TCO per year	3,4 %	4,9 %	3,5 %	4,9 %



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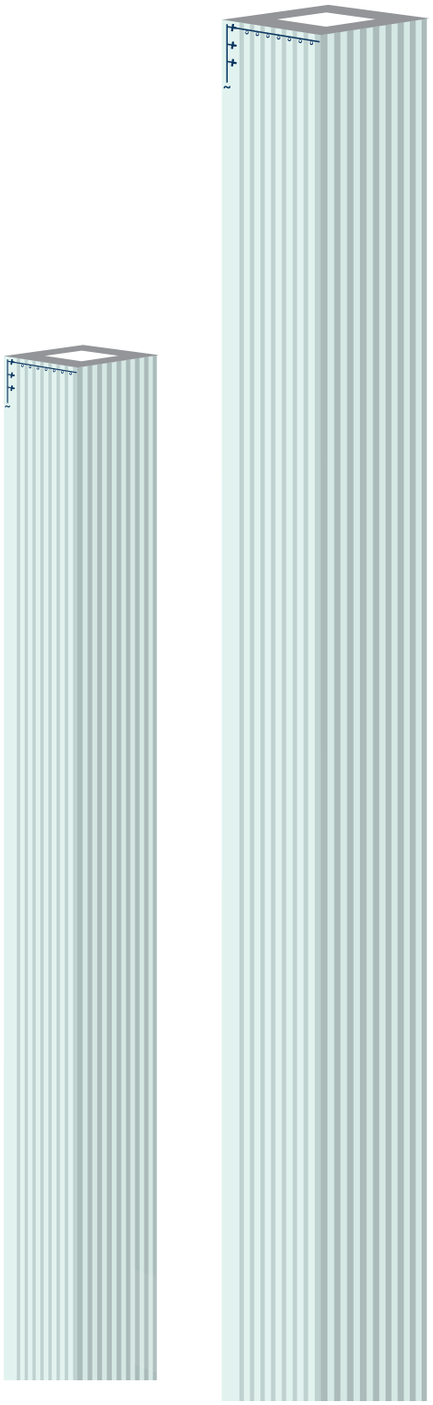

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High-rise building study