ENGINEERING
TOMORROW

Fire fighting technology

The intelligent use of water

SEM-SAFE® high-pressure water mist system for fire fighting in buildings

Danfoss Fire Safety A/S

www.semsafe.danfoss.com | SEM-SAFE®

Engineering a safer tomorrow in fire fighting

The power behind SEM-SAFE® high-pressure water mist system

For centuries, water has been used to fight fires. Research and development efforts resulted in the use of water as a fire fighting medium for cooling the fire. As the fire increases the temperature of the water, energy is absorbed from the fire, resulting in a cooling effect. The breakthrough that high-pressure water mist represents is to use the same method as traditional sprinklers, but to add the effect of converting the water into steam.

Danfoss Fire Safety A/S, an integral member of the Danfoss Group, is one of the pioneers in the high-pressure water mist fire fighting market. For decades, Danfoss has been developing, manufacturing, selling, installing and servicing high-pressure water mist systems under the brand name **SEM-SAFE®**.

In the **SEM-SAFE®** high-pressure water mist system, clean water is forced by Danfoss high-pressure water mist pumps through a tested stainless steel piping network and specially engineered **SEM-SAFE®** nozzles from 60 to 100 bar working pressure.

The very fine water droplets discharged by the **SEM-SAFE®** high-pressure water mist system have an average size ranging from 50 to 100 µm. When the mist comes into contact with flames, the small droplets quickly evaporate, while expanding a minimum of 1,700 times, cooling the fire like a traditional sprinkler and simultaneously displacing the oxygen at the fire like a fire extinguishing gas system.

Combined cooling and oxygen displacement effects provide higher cooling capability (up to 7 times better than traditional sprinkler) and reduce water consumption by up to 80% compared to traditional sprinklers.

High-pressure water mist technology is now one of the most progressive fire fighting technologies and is commonly used:

- to protect buildings and other objects from heat exposure from fire
- for fire extinguishment in enclosures, controlling smoke and chemical clouds
- as self-protection by fire fighters

Up to 7 times better cooling

The ideal fire fighting system for any building type

Danfoss has proven expertise with high-pressure water mist installations worldwide.
Danfoss has built a successful track record for more than two decades, which stands as proof of our reliability, expertise and professionalism in engineering, manufacturing and servicing high-pressure water mist systems for museums and heritage buildings, data centres, hotels, high-rise office buildings, hospitals, care homes and a large variety of industrial applications.

Tested and approved

The design of the **SEM-SAFE®** high-pressure water mist system is based on full scale fire tests.
For industrial and commercial applications, approvals are obtained through testing in accordance with specifications from, for example, FM, VdS, UL, ISO and NFPA standards.
SEM-SAFE® has been tested in accordance with CEN/TS 14972.

VdS

FM APPROVED

EHS&Q system in accordance with:

- ISO 9001:2015
- ISO 14001:2015
- ISO 45001:2018

BIM models from MagiCloud

Access Danfoss **SEM-SAFE®** high-pressure water mist fire fighting **BIM models** from **MagiCloud** and benefit from:

- High-quality 3D models with accurate dimensions and comprehensive technical data
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- Plug & play **SEM-SAFE®** fire fighting technologies supported by BIM

danfoss.magicloud.com
Magic words
Danfoss & sprinkler | Danfoss & pump

MagiCloud

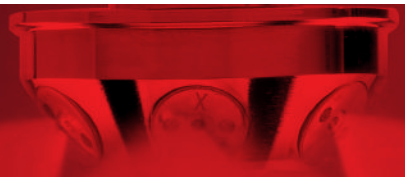
Largest **B**uilding **I**nformation **M**odelling
Helping MEP designers make everyday living easy

Benefits of SEM-SAFE® high-pressure water mist fire fighting system

The **SEM-SAFE®** high-pressure water mist system is increasingly being considered as a suitable and competitive option for the protection of public and commercial buildings.

After conducting a comparative analysis with a conventional sprinkler system on each specific project, key benefits of effective fire protection with high-pressure water mist system can be appreciated by end users as well as the opportunity to identify and quantify important savings.

In many circumstances, the high-pressure water mist "solution" is proving to be a cost-effective solution, leaving more space for other money generating activities and providing a lower total cost of ownership.



Less water consumption, water damages & **minimum downtime**

Small droplet size and fast evaporation of water, yet sufficient droplet speed to penetrate the fire means less water. There is reduced water consumption and no need for a large water supply reservoir.
The size of the water supply reservoir is up to 66% smaller than with a conventional sprinkler system.

In case of a fire, there is little water damage to furniture and equipment. The clean-up is easier with no business interruption and, consequently, lower risk of losing market shares and lower insurance costs.

Simplicity & flexibility in installation

High-pressure water mist is a minimally invasive technology, with a piping network that is easier to integrate into both retrofit installations and modern buildings. The stainless steel pipes are easy to handle due to low weight and they can be bend on site, due to the very small diameter.

The weight of the installed water mist pipes, including water, is typically 85% less than a traditional sprinkler system. The installation of the **SEM-SAFE®** high-pressure water mist system is up to 70% faster.

The **SEM-SAFE®** high-pressure water mist system will not compromise the architectural design, increasing architectural freedom. The modular design of the system provides flexibility for future extensions to cover more protected areas.

Lower costs for maintenance

All key components of the **SEM-SAFE®** high-pressure water mist system are high-quality components that are manufactured in-house.

Danfoss high-pressure pumps are multi-axial piston pumps made from corrosion-resistant stainless steel. Water is used as a lubricant, making the pumps virtually maintenance free.

The piping network, nozzles and section valves are also made from corrosion-resistant stainless steel. This ensures a long service life for the system installed.

CFD simulations: the future in fire fighting solutions

Water mist standards are focused on controlling, suppressing or extinguishing a fire, like traditional sprinkler systems.

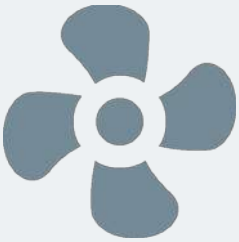
The base function of the water mist system can be documented through the fire test reports issued by an internationally recognized third-party laboratory and/or through the approval certificates issued by an international notified body.
Very often only the equivalencies with sprinkler systems are documented.
The important cooling effect and absorption of radiation are only indirectly included in the fire test protocols. The capability to control smoke & gas from the fire is not included at all.

High-pressure water mist system is not only a modern fire suppression system, but a new technology with a better performance than more traditional active systems such as sprinkler systems.

Besides the traditional benefits of the **SEM-SAFE®** high-pressure water mist system, Danfoss has been looking at how to further prove very important indirect benefits of the **SEM-SAFE®** system.

CFD (computational fluid dynamics) simulations have been introduced to reproduce the results of **SEM-SAFE®** high-pressure water mist system fire testing for use in extended fields of application based on results from large scale fire tests.

Rigorous CFD calculations show:



Superior cooling effect for reliable fire fighting

High-pressure water mist has superior capabilities to absorb heat from the fire and is characterized by effective cooling of combustion gases in enclosure and steel structures.

Absorption of heat radiation for fire control

High-pressure water mist is characterized by effective absorption of heat radiation (the transfer of heat from a fire caused by electromagnetic waves). The droplets absorption of heat from the gas layer and/or the plume can be calculated and verified.

Smoke & gas control for safer evacuation

High-pressure water mist helps with controlling smoke and reduction of soot & particles from a fire. The droplets' capability to control smoke and gasses can be estimated.

CFD
calculations for SEM-SAFE® testing

Innovation in designing safer buildings

Throughout 100 years of fire safety design, a predominant principle has been to mitigate the risk of fire spread by using passive fire separation. Separation units have been used in order to mitigate the risk of a fire spreading inside a building or between several buildings.

As modern architecture has developed extensively over the same period to include more and larger areas of open space within public and commercial buildings, such as atriums, the opportunities for traditional passive fire separations design have been greatly challenged.

In addition, there is a growing demand for fire safety initiatives supporting instead of restricting processes & flows within public and commercial buildings. The starting point of the overall fire safety strategy is expected to consider not only the total cost for a new building, but also the running costs of ineffective working processes counted over a long period, since they could exceed the total building cost of the fire safety initiatives.

Performance-based design

Performance-based design is increasingly used in Europe to define prevention and protection measures that must be taken in applications of public and commercial building types that present fire hazards.

The methods of **fire safety engineering (FSE)** are used in the pre-flashover phase to verify / dimension the escape route systems according to the propagation of fires and the development of the products of combustion, while in the post-flashover phase fire engineering methods are used to calculate the fire resistance of structures and the intervening of the fire brigade.

High-pressure water mist technology provides an opportunity to rethink traditional ways of designing fire safe buildings.

Due to the characteristics of water mist technology, it is natural to base the fire safety strategy on water mist applications to match the overall environment requirements for a project.

High-pressure water mist technology can attenuate temperatures and radiation. This **performance** is evaluated by determining the level of critical temperatures and radiation according to acceptance criteria for human safety and fire safety in relation to fire and smoke spread.

A **fire performance safety analysis** can be conducted on typical fire safety focus areas like evacuation & rescue measures, fire brigade's intervention, fire safety installations, fire and smoke spread and structures.

By combining additional advantages of high-pressure water mist's superior characteristics with the performance based fire safety strategy, a safer building design and very important indirect savings can be ensured.

Successful fire fighting solution

Among the available special solutions studied by Danfoss to enhance safety within public and commercial buildings, the following were successfully provided:

Glass facades protection
The excellent cooling features of the **SEM-SAFE®** high-pressure water mist system make it the perfect choice for protecting glass facades.
SEM-SAFE® has passed the EN-1364-1 fire resistance test for non-loadbearing elements. Instead of spraying water on the glass, the **SEM-SAFE®** system atomises the water in front of the glass.

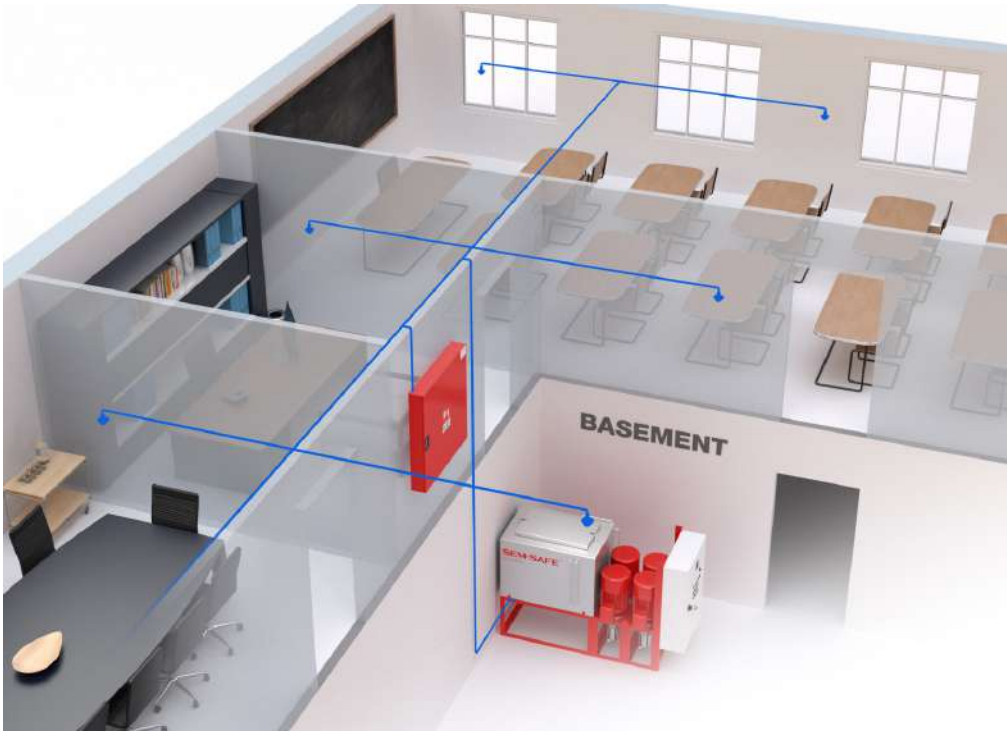
The cooling removes the risk of thermal stress cracks associated with traditional water-based sprinkler systems and allows the use of a thinner class of glass. This means significant savings for the building owner.

Section valves with automatic test
The possibility to test all the flow switches from a flow switch panel at the supervision central room of the building reduces time and personnel required for the test and maintenance of the **SEM-SAFE®** high-pressure water mist system.

High-pressure water mist fire hose reel cabinet
The possibility to directly connect a fire hose reel cabinet to the **SEM-SAFE®** high-pressure water mist system by sharing the same pump unit and pipes means significant savings for the building owner.

Ventilation system
Numbers of fire and smoke dampers in the ventilation system can be reduced and it is possible to keep the ventilation system for smoke extraction running during a fire.

Water spray curtains
Absorption of radiation for fire control can be implemented by using the ability of a high-pressure water mist curtain to serve as an active fire barrier for the protection of building and people.



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Danish super hospital saves 11 million euros with SEM-SAFE® high-pressure water mist fire fighting system

Very large Danfoss SEM-SAFE® high-pressure water mist system for fire fighting has been installed in Aarhus University Hospital in Denmark.
More than 30,000 **SEM-SAFE®** high-pressure water mist nozzles have been delivered and installed in Aarhus University Hospital, which is Denmark's first super hospital. The hospital complex is 400,000 m^2 with buildings between four and eighteen storeys.

The benefits of the **SEM-SAFE®** high-pressure water mist system are many in comparison with traditional sprinklers. The most important is the economic advantage, as **SEM-SAFE®** is a money saving solution.
For Aarhus University Hospital, more than 11 million euros were saved with **SEM-SAFE®** high-pressure water mist system.

Key savings:

- Structural design, insulation of steel, insulation of breach through fire sections, piping etc. **Actual savings 3.45 million euros** plus added value as lower temperature secure options for reduced dimension of the steel structure.

- Standard glass instead of expensive fire glass. **Total savings 2.8 million euros.**

- Isolation & insulation of **ventilation system**, numbers of fire & smoke dampers in ventilation system. **Actual savings 4.15 million euros** plus added value by keeping the ventilation system for smoke extraction running, during a fire.

- Vertical fire spread. **Actual savings 0.16 million euros** plus added value as smoke in general is reduced.

- **Water curtains** instead of automatic fire doors. **Actual savings 0.14 million euros** plus reduced service cost at water curtain compared to higher service cost of alternative solution with automatic fire doors.

Aarhus University Hospital in Denmark,
*fully protected with **SEM-SAFE®** high-pressure water mist system for fire fighting*

SEM-SAFE®

Danfoss Fire Safety A/S · Middelfartvej 9 · DK-5000 Odense · Denmark
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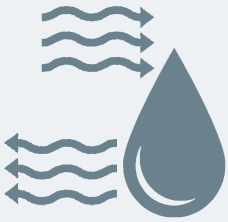

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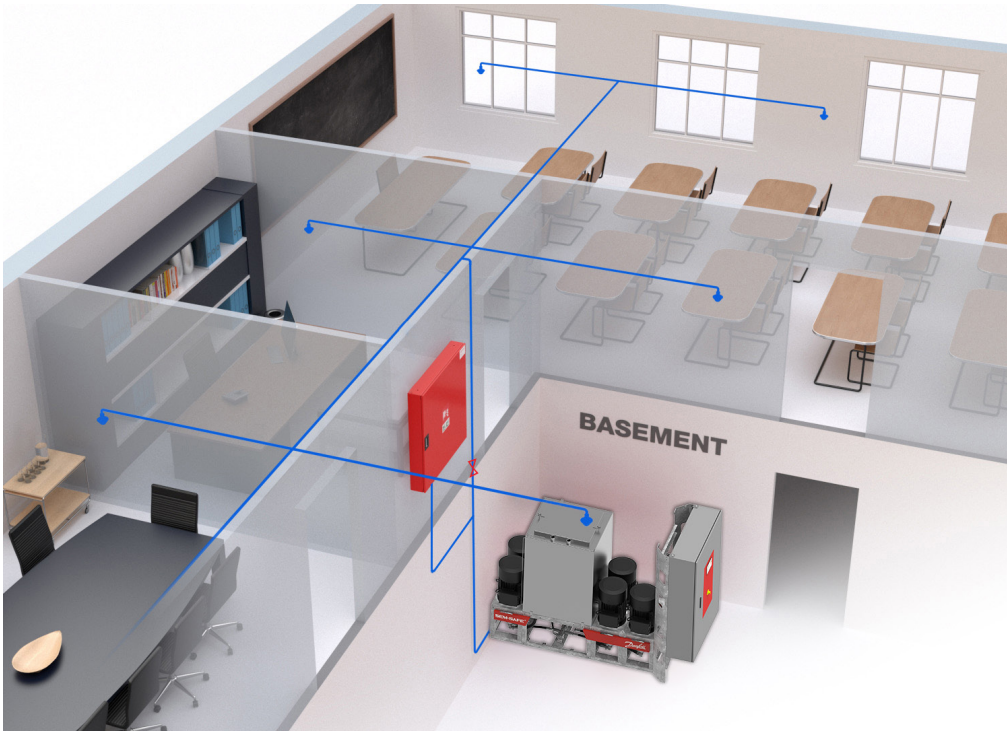

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