

High-pressure water mist – suitable for modern data centre cooling methods

If you design data centres, you will have noticed that facilities are getting bigger – and hotter. As a result, data centre cooling is evolving towards new techniques that provide effective, sustainable and cost-effective cooling that maintains the right temperature, even as server rack power continues to grow. But no matter which cooling technology is used at the facility, high-pressure water mist systems are evolving too in order to continue to provide efficient fire suppression and thus remains the key to optimal fire-safety design in any data centre.



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Growing industry, growing demands

The data centre industry is growing rapidly – as are the demands placed on it. The increasing adoption of artificial intelligence (AI), cloud services, edge computing and the Internet of Things (IoT) means that the need for storage space and processing power is skyrocketing. Server racks are getting more powerful, but their increasing power density also means higher rack temperatures.

At the same time, data centre owners and operators need to minimise operating costs and reduce power consumption as much as possible to minimise the climate impact of their systems to comply with client expectations and sustainability legislation.

Evolution driven by power density

Adopting new cooling techniques is a good solution to these challenges. Liquid cooling such as direct-to-chip cooling and

immersion cooling offers high performance plus efficiency improvements that can increase power usage effectiveness (PUE) and reduce climate impact.

This evolution is largely driven by increasing power density: With the more powerful, and hotter, server racks being deployed, traditional air cooling including CRAC (computer room air conditioning) and CRAH (computer room air handling) in many cases is no longer sufficient. Liquid cooling, by contrast, offers the required performance.

■ In **direct-to-chip cooling**, small pipes deliver liquid coolant directly to the server motherboard. The liquid absorbs processor heat which is then transported out of the server and evaporated (using a chilled-water loop or similar).

▼ **FM Approvals data centre halls – below floor double tier cable trays fire test.**



- In **immersion cooling**, the server itself is submerged into liquid coolant, for example mineral oil or another dielectric liquid. The coolant is pumped through an evaporator system, efficiently removing the heat from the server hardware.

Varying risk profiles

But how exactly do cooling methods affect fire protection? Do they make any difference? It depends on how the data centre is designed. Data centre designers take many different approaches to cooling depending on their targets, and the risk profile depends very much on the actual design in each case.

A couple of examples:

- If air cooling is used, how are the airflows designed? Does the cooling system use forced ventilation, and does it use hot and cold aisles? What role do the airflows play in a fire – and how do you design a fire-suppression system that delivers the required performance in each case?
- If the data centre relies on immersion cooling, what liquid is being used? Some dielectric fluids have a flash point low enough for them to constitute a fire hazard. And what would happen if unforeseen events or mechanical failure were to result in liquid leakage or heating?

In any case, the increased temperatures in modern data centres constitutes an increased risk. If the cooling system fails, today's high-powered data centre server racks will quickly rise to higher temperatures, increasing the risk of asset breakdowns – and of fire.

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◀ SEM-SAFE® high-pressure water mist from Danfoss Fire Safety.

High-pressure water mist remains effective

Fortunately, the wide variety of cooling technologies and general design principles doesn't have to give the fire-safety designer sleepless nights: in a changing data centre industry, high-pressure water mist systems remain a reliable method for suppressing data centre fires.

When activated, a high-pressure water mist system emits a fine mist of water droplets through a localised section of nozzles. The droplets attack two elements of the fire triangle, removing both oxygen and heat, and combining the suppression effect of gas and traditional sprinkler systems.

In data centre applications, high-pressure water mist has several benefits over gas or sprinklers. It uses less water, reducing damage to data centre assets. Only the nozzles in the affected area are activated, further reducing water consumption. And because the system uses only clean water, it is harmless to humans, and excess water can quickly be removed after a fire, shortening downtime.

The physical properties of high-pressure water mist systems mean that they are capable of handling any type of data centre fire. This applies to all commercially available solutions that conform to the FM 5560 Approval Standard for Water Mist Systems (Appendix M and N), and some manufacturers go beyond that basic requirement.

Lewis Oxley, Regional Manager, Europe and Global Manager Data Centres, Danfoss Fire Safety, explains: 'The nozzles of the SEM-SAFE® system from Danfoss Fire Safety, for example, have been tested and approved for higher nozzle release temperatures,

allowing for an increase in the ambient temperature within the data halls. This reduces demand on the cooling system and minimises cooling system energy consumption significantly.'

As new cooling methods introduce these challenges in fire protection, whether that be from increase air velocities, liquid cooling or higher temperatures, Danfoss Fire Safety works with third parties to evaluate its solutions, such as tests from FM 5560 Data Centre tests (Appendix M and N) and additional fire tests with RISE Fire Research in Norway.

Additional benefits with future-proof technology

In addition to reliable fire suppression, high-pressure water mist systems provide other benefits to the fire-system designer, installer and data centre operator: the small pipe size and compact pump units typically used make the solutions easy to integrate and install, and their low water use and reduction in raw materials makes them a good match for clients looking to reduce their climate footprint.

You may find yourself faced with many different rack-space and cooling-system designs, and with the need to design and install fire-protection systems that deliver satisfactory performance for all of them. High-pressure water mist has been an excellent choice for fire extinguishing systems in data centres for years. As the industry evolves to tackle new challenges and client demands, the technology remains the key to ensuring adequate fire safety.

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