LPCB news

Watermist fire suppression systems for commercial low hazard occupancies

Watermist fire protection systems are fire suppression systems that have emerged as an alternative fire safety solution for specific applications over the last few decades – but are they suitable for commercial low hazard occupancies?

Watermist fire suppression system

A watermist system is a fire suppression system that, when activated, will discharge a spray of water droplets from a nozzle (or array of nozzles). The sizes of watermist droplets will typically be smaller than those discharged by traditional sprinkler systems. A system may operate automatically when nozzles are exposed to a sufficiently high level of heat to activate a frangible glass bulb or solder link contained in a nozzle. Some systems can be linked to a detection system and use open nozzles while other systems can be manually operated. The system will comprise a number of components to provide a water reservoir, water pressurising system and pipework to deliver water to spray out from the system nozzle/s. Different watermist systems operate at different system pressures between about 3 bar and 100 bar or more. Watermist systems can suppress fires by wetting, cooling and through localised oxygen displacement (by conversion of water droplets into steam in the flame zone).

Background

In the UK and elsewhere, watermist systems are increasingly being considered and used for the fire protection of buildings, including offices, hotels and other commercial premises. Watermist is seen as an exciting new technology by many in the fire industry and systems may also offer additional environmentally attractive design. However, for those responsible for specifying systems, approving building designs and insuring properties, there is a challenging lack of relevant, independent advice and information on their suitability.

Watermist systems for protection against the damaging effects of fires come in a multitude of different shapes and sizes. Historically, different systems have been tested and demonstrated to be effective against a number of specific applications. A few examples include their use in cabins on board ships, in machinery spaces or for specific localised protection of objects. There are further examples of effective watermist systems tested for the protection of small rooms (such as hotel bedrooms, prison cells or domestic dwellings).

The mechanisms for successful watermist operation in a fire event and the variables that influence the effective performance of systems – where the volume of the compartment is limited – have now become well established through many testing and research programmes.

Watermist systems will typically discharge significantly less water than traditional sprinkler systems. For many applications this is an advantage both in terms of the design requirements of the system and the reduced potential for water damage in the event of a system operation. However, what is critical is that the ability of a system to tackle a fire, using less water, is not compromised. For large open spaces where there may be significant quantities of combustible material, the suitability of water mist protection needs to be carefully assessed.

Third party certification

Due to the diversified nature of watermist systems and their many bespoke designs it has been a great challenge to standards writing authorities' and third party certification bodies across the world to establish suitable standards and certification schemes. This has led to a loosely regulated installation history for watermist systems and often, a lack of confidence in their fire suppression performance.

To address this issue, The Loss Prevention Certification Board (LPCB) in the UK will be publishing a Loss Prevention Standard (LPS 1283) and certification scheme for the approval and listing of watermist systems for use in commercial low hazard occupancies. The scheme will support and augment the requirements of DD 8489 '*Fixed Fire Protection Systems – Industrial and Commercial Watermist Systems'*. In addition, LPCB also intends to establish a water mist system installer scheme (LPS 1284).

Manufacturers and suppliers will be able to undertake LPS 1283 to verify the components and design methodology of their watermist system. Installers of the manufacturer's watermist systems will be able to undertake LPS 1284 to verify their competency for design, installation and maintenance. End users of watermist systems will be responsible for the ongoing maintenance of systems and in particular maintenance of the building fire load and fire hazard classification consistent with the watermist system design. This will mean it is necessary for the 'Responsible Person' under the Regulatory Reform (Fire Safety) Order, 2005 in the UK and more broadly anyone responsible for fire safety in buildings, to conduct a fire risk assessment and ensure compliance with the specified criteria of the certified system.

As stated previously, critical to the successful operation of a watermist system are the system design details. Of equal importance are the building design details – the fire loads, obstructions, ventilation, ceiling height, compartmentation and openings in the protected space. These design details need to be fully addressed in both the fire performance tests and installed systems to ensure their effectiveness. Therefore, the LPCB certification scheme will contain restrictions with respect of floor area (for certain systems), ceiling height, ventilation, fire load density, fire growth rate, height of combustibles and obstructions. The development of this Loss Prevention Standard was underpinned by a programme of research by the BRE Trust as explained below.

Experimental programme

The BRE Trust has recently funded a three year watermist research programme, supported by industry partners. The programme included large scale fire tests conducted by BRE Global at its Burn Hall laboratory near Watford in the UK.

To assess the performance of watermist systems, three key experimental tasks were undertaken:

1. A series of single wood crib fire tests to evaluate the influence on the effectiveness of the watermist system fire suppression capability of; water flow/pressure, nozzle position in relation to fire position, obstructions, ventilation and compartmentation;
2. Development of a full scale fire test protocol for commercial low hazard occupancies based on a ‘stylised’ office fuel loading;
3. Testing of a sprinkler system and industry provided low and high pressure watermist systems to establish their performance against the developed fire test protocol.

The BRE Trust is a charitable company in the UK whose objectives are through research and education, to advance knowledge, innovation and communication in all matters concerning the built environment for public benefit.

As a charity for research and education, the BRE Trust commissions 'for public benefit' research from the BRE Group of companies and elsewhere. The Trust is the largest UK charity dedicated specifically to research and education in the built environment.

Key findings from the research

1. From the series of tests with a single wood crib, it was demonstrated that, for the specific conditions tested:

- The position of the fire in relation to the position of the watermist discharge nozzle was critical to the fire suppression effectiveness of the spray, even within the nominal area of coverage provided by the nozzle.

- The presence of shielding, i.e. an obstruction in the direct path of the water spray to the fuel source, resulted in reduced suppression effectiveness.
- Ventilation flows detrimentally affected the performance of the watermist suppression and influenced the fire growth characteristics.
- Watermist flow rate/pressure and ceiling height can influence the effectiveness of the suppression provided by a system.
- For otherwise equivalent situations, the watermist system tested was more effective when tackling a fire in a compartment than in open conditions.

2. In the development of the full scale test protocol an assessment was made of typical open office areas. Information was gathered and reviewed from an office survey, office fire load surveys, office fire test data and standard test fires. A 'stylised' office scenario was arranged consisting of two combustible walls, a chipboard table with foam sheets, cardboard and paper loading and with two wood cribs (but also containing plastic material) beneath the table top. The scenario met the following criteria:

- The fuel loading was representative of a commercial low hazard occupancy, fire growth rate and heat release rate.
- It was a challenge to a watermist system with a shielded fire source and open ceiling.
- The materials were closely specified, easily sourced and could be repeatedly obtained. The scenario was simple and relatively cost effective.
- The arrangement allowed for clear system 'pass/fail' criteria to be developed.

3. In the full scale tests carried out, the results were as follows:

- The sprinkler system, operating at a water coverage density of 5 mm/min provided effective fire suppression.
- All the watermist systems demonstrated lower temperatures at ceiling level and reduced fire damage compared to a 'baseline' unsuppressed fire 'freeburn'.
- However, the low pressure watermist system at a nozzle spacing of 3 x 3 m did not provide effective suppression of the fire and did not meet the test criteria.
- The high pressure watermist system (installed on a 3 m and 4 m spacing) did not provide effective suppression of the fire and did not meet the test criteria.
- A low pressure system, tested at a spacing of 2.5 x 2.5 m and a water coverage density of 5 mm/min (equivalent to the sprinkler system coverage) did suppress the fire and meet the test criteria successfully.

The scope of the testing was necessarily limited and other system arrangements may perform differently.

Conclusions

Overall, the full-scale test results were of concern. A significant number of water mist system arrangements were not able to provide expected levels of fire protection for the tested scenario (open plan area with obstructed fire loads and a high ceiling). In terms of the design of the tested systems, in many instances, the spacing between nozzles was too great and the quantity and momentum of water discharged too low to provide effective fire suppression. The test work demonstrated that watermist system effectiveness cannot be assumed and that it is essential to verify system performance against realistic, reliable and repeatable fire test protocols.

Output

A report titled “Water mist fire protection in offices: experimental testing and development of a test protocol”, published by IHS BRE Press (FB 34), provides the detailed results from the research carried out. The report describes the experimental study and provides fire test evidence to assist in the understanding of watermist systems.

The test protocol has now been adopted by the British Standards Institution and forms part of a recently published water mist draft for development standard in the UK, DD 8489 ‘Fixed fire protection systems – Industrial and commercial watermist systems’.

Summary

For many in the fire industry, watermist systems will continue to offer an alternative to more traditional systems. The progress being made now has the potential to result in robustly tested and certified water mist systems for low hazard commercial premises. This will help to provide confidence to authorities having jurisdiction, building owners and insurers that a watermist system is suitable for the intended application to which it is being installed.