

Application of Water Mist to Saunas

Introduction

A number of fires are reported every year in saunas not only within the UK, but throughout Europe and North America. Such fires, occurring as they do in sauna compartments predominately of timber construction, are prone to develop rapidly. These fires cause severe and significant property damage along with major business interruption potentially leading to the added loss key customers. An appropriate and suitable fixed fire suppression system is therefore needed for the protection of saunas.

Where extending existing sprinkler protection is not possible, water mist is often proposed as an alternative. This article explains the complexity of providing a suitable water mist system as an alternative to sprinklers and specifically how a robust solution was developed for saunas.



Figure 1: Aftermath of a sauna fire.

What are the potential causes of fires within saunas?

- Defective electrical equipment i.e. failure of the control thermostat and/or over-temperature cut-out.
- Poor facility management such as leaving heaters on and unattended for long periods.
- Failure to turn the power off at the close of business.
- Incorrect or insufficient stones or packing of stones too tightly.
- Using undiluted flammable/combustible essence on the heated stones.
- Not installing heating units in accordance with manufacturers' instructions.
- Inappropriate actions by users, such as interfering with thermostats to achieve higher bathing temperatures.
- Introduction of combustible materials such as towels, newspapers and plastic cups, which may be left in close proximity to heating units.

What is a suitable form of fixed fire protection?

There have been at least three recently reported cases where water mist systems fitted within saunas have failed to operate. The failure of these water mist systems to operate as intended is currently under investigation. The conclusions of the investigation may well lead to litigation and financial recovery for the any losses incurred. The failure of these water mist systems to operate is of grave concern to insurers and raises a number of important questions surrounding the choice, selection and suitability of the systems that failed as being suitable for the protection of saunas. The system failure analysis will be expected to concentrate on the following five key areas:

- The system design and installation.
- The operational and performance reliability.
- Maintenance and testing regimes in place.
- The listings, approvals and certification for nozzles, equipment and components used.
- Robustness, suitability and scale of the test protocol used.

Where should water mist be applied as a form of fixed fire protection?

Ideally sprinkler protection should be extended to the sauna in premises where sprinkler systems are installed. However, in premises where no sprinkler system exists, water mist is often proposed. Can water mist be considered a suitable alternative to sprinkler protection?

Water mist is a specific application solution and therefore requires to be proven by suitable fire tests at a recognised and approved testing laboratory, who should then issue an independent report or formal endorsement of the manufacturers report. Equipment used such as nozzles and controls are to be listed or approved for the intended application. This is to ensure reliability of the equipment and components and overall system performance for this type of application.

Unfortunately, it is common to encounter water mist protection systems for saunas which are inappropriate, not proven, or not suitable for the risk and furthermore not

backed up by suitable fire test data for the specific application the water mist system is intended to protect. A thorough and robust analysis of each and every water mist system designed for the protection of saunas is required to ensure the system is appropriate for the risk and to also give insurance underwriters the confidence that the sauna is suitably protected.

Saunas can be typically found in fitness clubs, gyms, municipal sports and leisure centres, private homes, hotels, hospitals, healthcare and rehabilitation centre's and football clubs. Saunas typically vary in size from 8m³ to 12m³.

Fires occurring within saunas are an extreme challenge and need to be protected by a suitable fixed fire protection system. There is a history of large financial loss where either an unsuitable fire protection system has been installed or where there has been a total absence of protection. Recent fire losses in unprotected saunas in the UK have resulted in a total loss of a well-known high street health & fitness gym and fitness club which resulted in premises being unable to open for fifteen months. On another site in the North of England, once again unprotected, resulted in a £100,000 clean-up operation as the result of fire-fighting water entering the swimming pool.



Figure 2: Flashover occurring as a result of an uncontrolled sauna fire.

Is water mist suitable for sauna protection?

Water mist may be a suitable form of protection for protection for the severe fire challenges presented by saunas. This is due to the ability of water mist to absorb heat from the fire, by turning small water droplets to steam, thus quenching the fire and at the same time rapidly cooling surfaces of the enclosure to prevent re-ignition. Water mist is a specific application technology which is required to have representative test data for the risk to be protected and where possible follow specific recognised test protocols to ensure that the protection proposed or installed can be considered effective. This is to ensure reliability of the equipment and components and overall system performance for this type of application.

What are the benefits of water mist?

The development of fine water droplets produces a greater surface area to mass ratio and as a result it offers the following benefits:-

- Rapid cooling
- Radiant energy blocking

Rapid cooling occurs as small particles absorb heat and flash to steam. Radiant energy blocking occurs as the smaller water particles have a longer residence time suspended in air obstructing the heat transfer from the fire to surrounding combustibles.

A review of proposals from water mist companies in conjunction with existing test protocols was completed to determine if any existing solutions were proven by test to be suitable and adequate for the protection of saunas. Unfortunately, no proposal could be considered effective. The suggested test protocols did not reflect the risk to be protected as required by all recognised published standards.

Not deterred, Gary engaged in multiple discussions and meetings with the water mist industry. The meetings included recognized testing laboratories and initially other property insurers. The intent was to develop a robust test protocol for the protection of saunas which reflected their unique challenges and features in the event of a fire. The aim of this project was to provide a single test protocol for saunas that could be successfully applied to various sizes and configurations of saunas found in the current market place.

Saunas can vary significantly in length, width and height. These features are known to affect fire characteristics. As such a rigorous set of tests would be required to prove a single test protocol for saunas. Otherwise, testing would have to be completed for every single variation.

In the absence of readily available specific test protocol for saunas, Zurich Risk Engineering in conjunction with a UK fire protection company and the Danish Fire Laboratory (DFL) developed a robust, specific, challenging and relevant ¹protocol for saunas (Danish Fire Laboratory Fire Test Protocol: 131216-105A). The protocol was developed to reflect the known features and challenges of saunas in terms of size,

layout and construction. It also considers the known operating variables of heater placement, doors left open and forced air ventilation.

What is an acceptable test protocol?

The National Fire protection Association (NFPA) code 750 standard for water mist states that reliance is to be placed on the procurement and installation of listed water mist equipment or systems that have demonstrated performance in fire tests as part of a listing process which must include verification of design critical documents by the testing laboratory, as demonstrated below:-

Testing

- A rigorous set of tests specifically designed to prove the water mist system as effective for a risk which reflects the compartment, area, fire load, equipment or process to be protected.
- The test protocol and parameters of the test are to be designed and written by an independent 3rd party accredited test laboratory

Equipment

- Requires use of listed, or approved equipment and components in line with their intended purpose
- Results endorsed and certified by a recognized testing laboratory with clear parameters for application.

Design manuals

- Manufacturers design manuals, installation guides, commissioning and maintenance instructions are checked to ensure compliant system installation to provide consistent results in the field from each system.
- Verification of system design and hydraulic calculations of design manual against test model

Application

- Use of a manufacturer's system is limited to specific occupancies represented by test protocols successfully passed and documented by a recognized testing laboratory.
- Each manufacturer must separately prove their system passes a test protocol (successful testing by one manufacturer does not imply all water mist systems are appropriate for the same application).

Care should be taken to ensure any proposed system is supported by test data that meets the full requirements of an acceptable test protocol. Systems are often proposed with little or no testing at all. Other proposals have only been supported by manufacturer tests, sometimes at recognised laboratories but crucially without the independent test report or endorsement of the laboratory. This would indicate limited testing which may not fully demonstrate capability or compliance to protect the proposed risk. Only system tests certified by a recognized testing laboratory and made available should be considered effective.

What were the objectives of the sauna fire test protocol?

- To prove and verify water mist is effective for sauna protection.
- To verify water mist system performance is comparable to effective sprinkler installation under the same conditions.
- To replicate typical sauna conditions, not just similar. Sauna included bench seating and natural air vents.
- To provide robust and challenging conditions:
 - Forced ventilation at a rate of 5.75 x volume changes per hour.
 - A minimum pre burn period of 60 seconds prior to water mist activation.
 - Sauna door to remain open during testing.
 - Heater unit located in an obscured and challenging position within sauna.
- To confirm no spread of fire to cavities or areas beyond the compartment of origin.

Testing was undertaken within two brand new saunas within the Danish Fire Laboratory test hall in

Svendborg, Demark. Inside the hall two identical Saunas with benches and voids of 12m³; constructed of 18mm spruce wood tongue and groove boarding on the inner side with 45mm layer of glass fibre insulation.



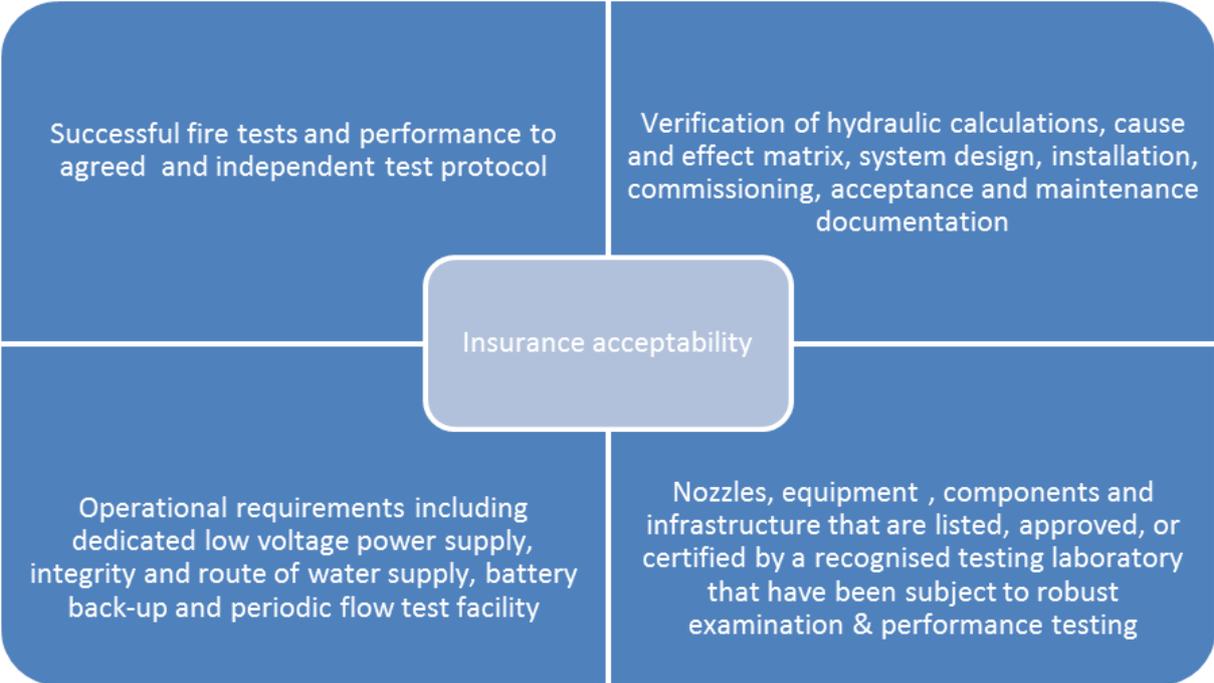
Figure 3: Test compartments within testing hall.

Sauna No 1 was fitted with a single K80 15mm 141°C sprinkler head. The test protocol was configured so that the sauna was first heated to 108 degrees centigrade and the heater then turned off and then removed. The ignition source was a timber crib on a metal frame with 500ml of base water and 250ml of Heptane. The test crib was ignited after 60 seconds and the test was run continuously for 30 minutes.

Throughout the test the gas and ceiling temperatures were monitored and data logged by thermocouple's located within the sauna.

The sprinkler head successfully activated after 2 minutes and 59 seconds. A peak gas temperature was measured above the test crib at 858 degrees centigrade. The sprinkler head successfully controlled the fire despite the fire test crib being located within an obscured and challenging position. The extent of damage and charring was quantitatively analyzed to the walls, voids, ceiling and benches within the sauna and measured at an overall 3.87%.

Sauna No 2 was fitted with five water mist nozzles, four on the wall at high level and one located above the heater unit each with a K factor of 1.73. The exact same test protocol was applied to the water mist sauna test. A peak gas temperature was measured above the test crib of 389 degrees centigrade; was recorded prior to water mist activation. The water mist system successfully controlled the fire. The extent of damage and charring was quantitatively analyzed to the walls, voids, ceiling and benches within the sauna and measured overall at 0.0597%.



Conclusion

Both tests were successful and met the objectives of the tests. Water mist has been validated as an effective alternative solution for premises without sprinklers for this specific application. Where sprinkler protection to the building is already fitted, the most economical solution is to add to an existing sprinkler system in order to protect the sauna.

Water mist now considered proven for the protection of saunas subject to the strict adherence to the design layout and requirements contained within the fire test certification.

Water Mist is a challenging market. Only systems using components and equipment approved by a recognized testing laboratory based upon a suitable test protocol, installed by trained personnel, in accordance with the manufacturer's system design manual should be considered as effective for property insurance purposes.

It should be noted that similar to other fixed fire protection systems, insurers may have additional operational criteria to satisfy their requirements for dependability and performance verification, such as power supply connections, water supply stipulations and periodic test facilities before they accept the complete system for property insurance purposes.

Ultimately whatever system is selected or chosen for the protection of saunas it is wise to consult the insurer at the earliest possible stage with details of the proposed system. Discussions and advice can then be sought over the acceptability of the system for property insurance purposes.

References

RISC Authority RC50 Fire Safety in the Construction and use of saunas published by the Fire Protection Authority.

Danish Fire Laboratory Fire Test Protocol: 131216-105A.

Dr. JH Burgoyne & Partners – Sauna Fires by Stuart Formby.

Flamefast sauna safe fire protection system - <http://flamefast-fire-suppression.co.uk/saunasafe/>.

National Fire Protection Association (NFPA) 750 - standard on water mist fire protection systems.

Gary Howe FIFireE