VID FIREKILL

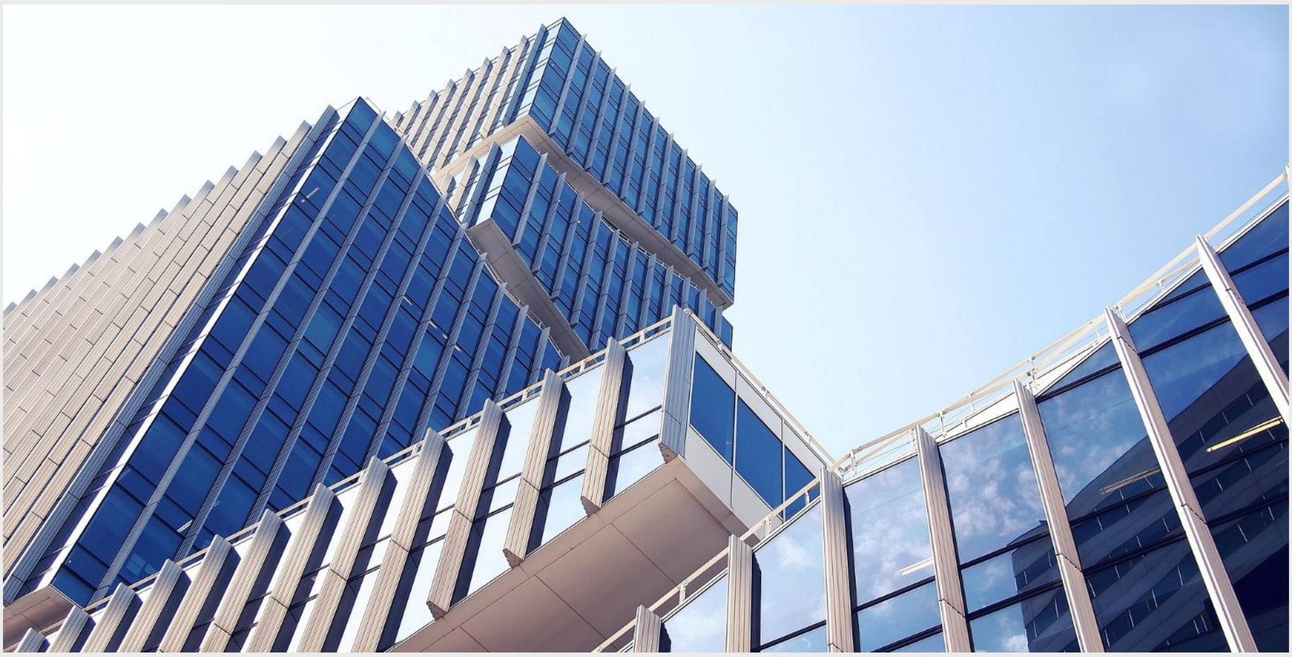
LOW PRESSURE WATERMIST

ELECTRIC VEHICLE FIRE PROTECTION

ELBAS PROJECT

SUMMARY AND CONCLUSION

LOW PRESSURE WATER MIST



Executive Summary of EV fire test with water mist suppression

Sales of electric and hybrid-electric cars grew to 27.7% of all new car sales in Europe in 2022*. Fire risks from EV parking and charging areas are an increasing concern, due to high temperatures involved, rapid spreading to adjacent vehicles and structural damage to buildings. VID Fire-Kill has developed and tested water mist fire suppression solutions to address these concerns.

This document is a summary of the fire test carried out by DBI in the ELBAS PROJECT (ELECTRIC VEHICLE FIRES AT SEA: NEW TECHNOLOGIES AND METHODS FOR SUPPRESSION, CONTAINMENT, AND EXTINGUISHING OF BATTERY CAR FIRES ONBOARD SHIPS) but the data should also be considered for on-land underground car parks.

The purpose of the test program was to prove that VID Fire-Kill water mist solutions would sufficiently suppress fire and heat in an electric vehicle and prevent spreading to adjacent vehicles.

In the test, a Tesla and eight other cars were parked inside a steel container, protected by VID Fire-Kill water mist nozzles. A fire was created under the Tesla and was allowed to burn for 7.5 minutes before activating the nozzles. Heat monitoring during the test showed that the temperature of the EV battery was reduced down from +880°C to 30°C within 30 minutes. More details of temperature readings can be found in the report below.

Disclaimer

This document may be subject to change, and it is therefore recommended that eventual users of the system keep themselves updated. The newest version, or revision, of this document may be obtained by contacting the VID Fire-Kill sales team at sales@vidaps.dk.

Should any queries arise, VID Fire-Kill welcomes readers to contact the company headquarters. Concerns and corrections regarding this fire test summary, or any other documents, products or services of which VID Fire-Kill provides are welcome as well. VID Fire-Kill's contact information can be found at the bottom of this page as well as on the website, www.vidfirekill.com

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*Source InsideEVs.com

AMENDMENT INCORPORATION RECORD		
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1 Foreword

VID FIREKILL was invited by the Danish Institute of Fire and Security Technology (DBI) to participate in the ELBAS project with our low pressure water mist technology.

The project aimed to develop performance-based fire strategies for EV car fires when transported onboard ferries.

Part of the strategy was also to test existing products already tested to international standards for car fires, such as IMO MSC.1/Circ. 1430 "GUIDELINES FOR THE DESIGN AND APPROVAL OF FIXED WATER-BASED FIRE-FIGHTING SYSTEMS FOR RO-RO SPACES AND SPECIAL CATEGORY SPACES"

The ELBAS-project included several fire tests using different firefighting strategies.

One of the tests incorporated a fixed system using VID Fire Kill's IMO-approved OHO-PX1 water mist nozzle.

The OHO-PX1 is an open version of the automatic OH-PX1 water mist nozzle.

1.1 Properties of water mist - fire and heat suppression

Low pressure water mist was selected for this trial, as it operates in the same pressure class as sprinklers - but generates a spray with much smaller water droplets than sprinklers. Water mist droplets have a large surface area compared to their mass, which allows them to quickly absorb heat energy and transform into steam.

The transformation of droplets from water (liquid face) to steam (gas face) requires a large amount of heat energy. This effectively cools the surroundings of the fire by approximately 2400 kJ per litre of evaporated water. The steam that is generated by the evaporation of one litre of water will fill 1.64m^3 at a temperature of 70°C surrounding the fire. The evaporation of water in small droplets both cools and reduces the oxygen concentration in the surroundings of fires. The cooling removes energy from the fire processes. The reduction in the oxygen concentration works by reducing the oxidation processes and the energy surplus.

1.2 OH-OPX1 Water mist nozzle - Product description

The OHO-PX1 water mist nozzle operates from 6 to 16 bar, creating water mist with droplets in the region of 250 to 350 microns. 6 bar water pressure was used for the ELBAS project.

The coverage for the OHO-PX1 varies from 3,5 m x 3,5 m to 4,0 m x 4,0 m depending on the ceiling height.

The OH-OPX1 has been tested at 2,5 m and 5,0 m ceiling heights as described in IMO MSC.1/Circ. 1430.

The OHO-PX1 is supplied in either brass with NiSn coating or stainless steel.

The automatic version, the OH-PX1 is supplied in brass with NiSn coating and stainless steel cover plate.

For more information – Contact VID FIREKILL for Nozzle Data Sheet.

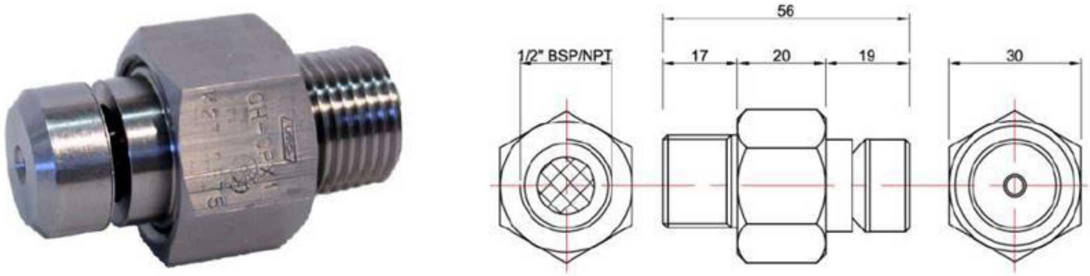


Fig. 1.1 OH-OPX1 Nozzle

2 Test set-up

Nine cars were positioned inside a construction made from steel containers, with the measurements 12,2 x 7,07 x 2,39m (LxWxH). The steel construction consisted of two walls and a ceiling. It was fully open in both ends.

Fig 2.1 Test Mock-up with cars.

Fig. 2.2 Tesla fire developing.

Fig 2.3 Tesla after fire.

6 pcs OH-OPX1 low pressure water mist nozzles were evenly distributed inside the compartment with 3,5 x 4,0m spacing, above cars no. 1, 2, 3, 7, 8 and 9.

The electric vehicle underneath which the fire was started was located in the central position (5).

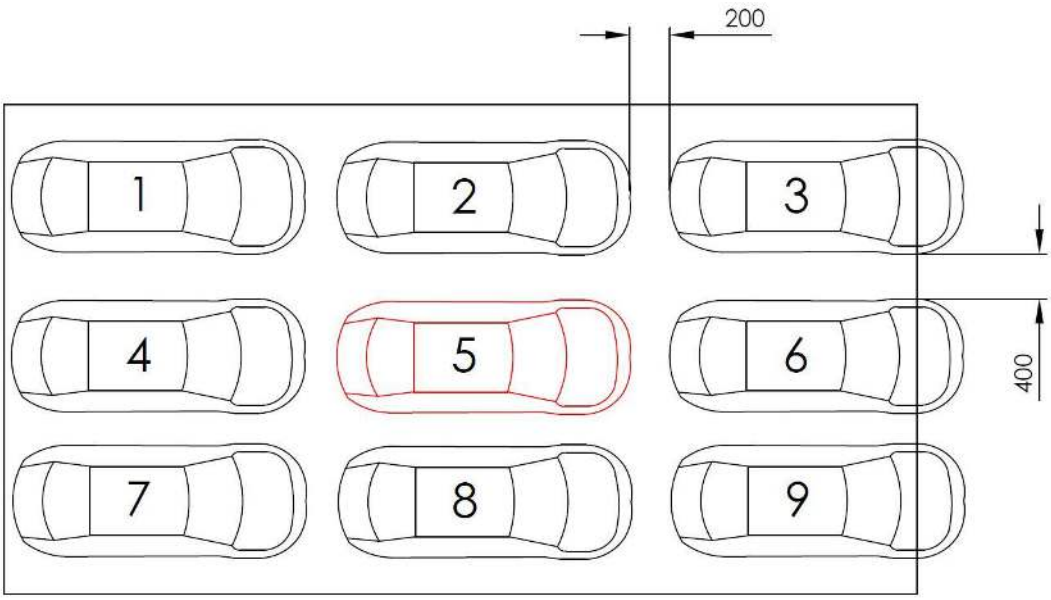


Fig. 2.5 Configuration of cars

2.1 FIRE TEST

The fire was started using a diesel pool below the battery pack in EV car no. 5.

The EV Car was a Tesla model 3, 2021 with a new battery used for the experiment.

The water mist system was activated 7,5 minutes after the first detector reported a fire.

At this point the fire had spread to the adjacent cars. All 9 cars had caught fire mainly at the bumpers and tires.

The activation delay of 7,5 minutes was chosen to simulate the reaction time of a ship's crew.

The temperature was measured at different locations, as shown in Fig. 2.6.

<u>Temp. Chart 1 – Temperature in the battery pack:</u>

From the curve it can be concluded that the temperature of the EV battery was reduced from 880°C to 70°C within 15 minutes of system activation.

30 minutes after activation of the water mist system, the battery temperature was reduced to a merely 30°C.

Temp. Chart 2 – Smoke layer temperature directly above EV.

During system activation delay the temperature rose to just under 900°C at the ceiling above the EV. The extreme temperature continued for several minutes.

Temp. Chart 3 – Temperatures of exposed sides of the surrounding vehicles.

A steep drop in temperatures were registered after system release.

2 minutes after release average temperatures of the exposed surfaces of surrounding cars were 50-60°C.

In the figure 2.6 it is also indicated where the system would have been activated if automatic nozzles had been installed. The indication is based on similar test results in connection with car park testing using automatic nozzles.

Early system release results in early water mist cooling and a lower max. battery temperature at thermal runaway.

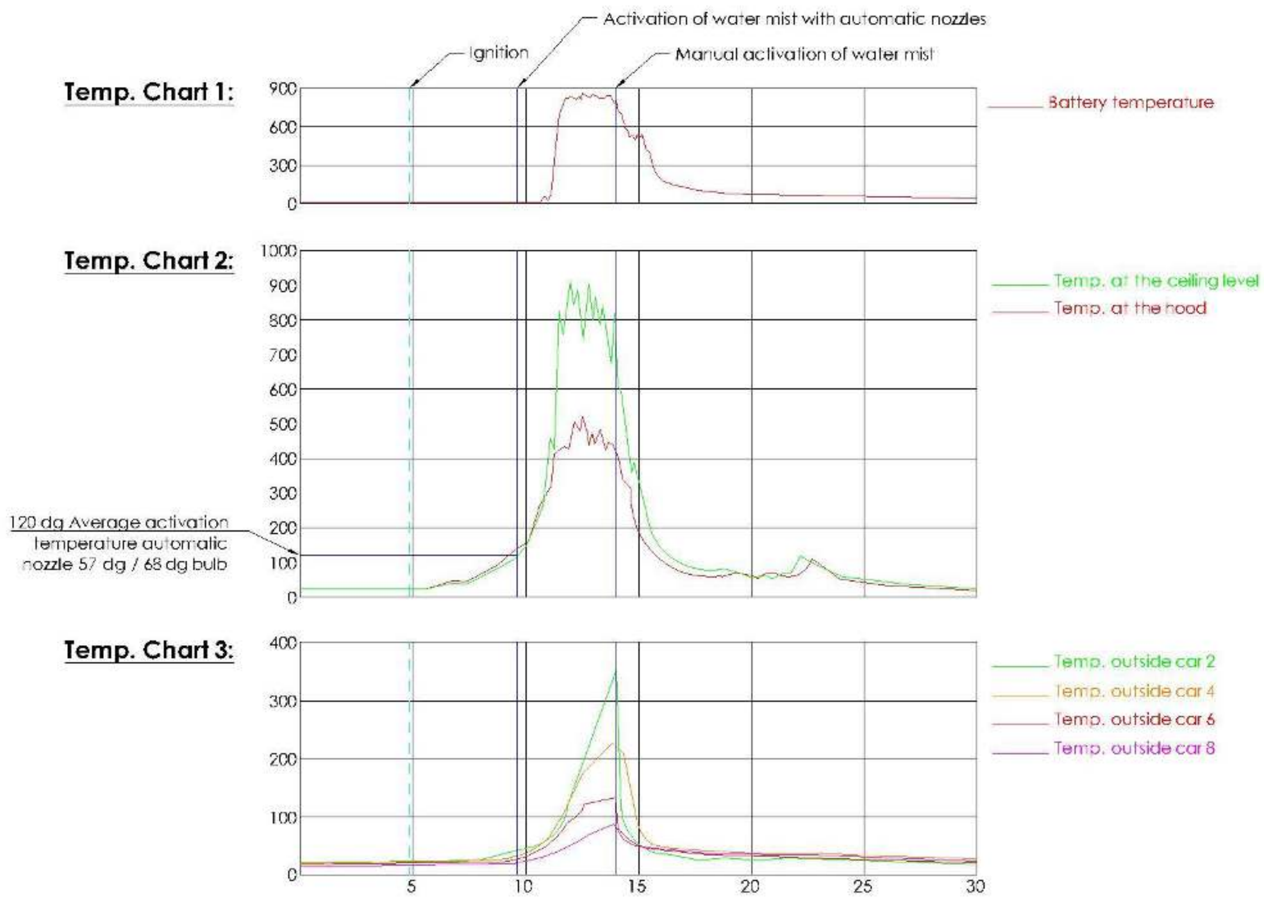
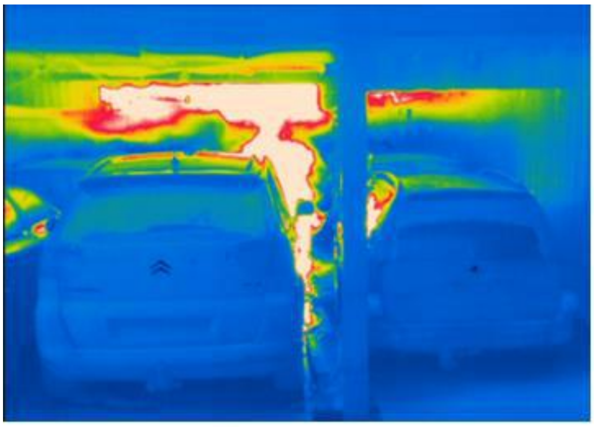


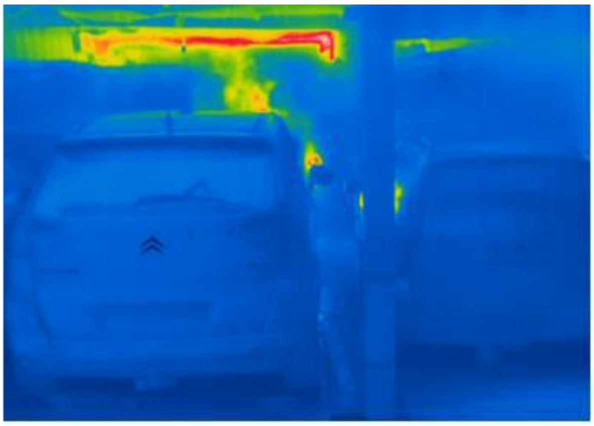
Fig. 2.6 Temperature of the battery compartment (Temp. Chart 1), smoke layer temperatures above the EV (Temp. Chart 2) and temperatures of the exposed sides of the surrounding cars (Temp. Chart 3)

Unlike other fire protection systems, water mist was not only targeting the battery of the EV but also cooling the car on fire, and the surrounding cars and the structures.

The temperature on the battery was reduced and the cooling effect on the surroundings can easily be seen on the snap shots from the thermal imaging camera as shown in Fig. 2.7



a) 3s after activation



b) 30s after activation

c) 90s after activation

d) 150s after activation

Figure 2.7: Thermal images of the surrounding after water mist activation; a) 2 sec after activation, b) 30 sec after activation, c) 90 sec after activation, d) 150 sec after activation.

3 CONCLUSION

Summary of conclusions from the ELBAS-project report:

"5.1.1 Results of the Live Fire Tests and Fire Simulations

The use of portable fire extinguishers alone is not as effective as the use of fixed, water based firefighting systems. Cooling is key and use of sprinkling with a water mist turned out to be highly effective. Not in fully extinguishing an EV fire, but for limit the spread of the fire, so that the shipboard firefighters can get to seat of the fire and continue extinguishing with traditional extinguishing methods, possibly combined with appropriate specialized tools."

"5.1.3 Use of Fixed Sprinkler (Drencher or Water Mist) System Provides a Quick Response

Early sprinkler activation is the key to stopping the fire spread. While a drenched or water mist system will not necessarily target the battery directly of the EV, it will produce a spray once activated from its fixed position causing a cooling effect, both on the burning car itself and to the surroundings including nearby structural elements. As soon as the fixed system in the ELBAS tests was activated, a drop in temperature on the battery, smoke layer above the EV and the surrounding cars were observed, helping to contain the fire and prevent spread."

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From the ELBAS fire tests, we can conclude, that the OH-OPX1water mist nozzles were able to demonstrate superior performance in EV fires, by rapidly suppressing the fire and reducing heat in the surrounding area, thus preventing the fire from spreading to adjacent vehicles or from causing damage to surrounding structures.

3.1 Using automatic nozzles to fight EV fires

The OH-PX1 is the automatic version of the IMO-approved OH-OPX1 nozzle.

The two nozzles have identical spray pattern and the automatic OH-PX1 can be used in car parks with standard combustion vehicles and electrical vehicles.

Contact VID FIREKILL for further details on fire protection of electrical vehicles in car parks.

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