



REPORT

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Underground garage fire tests using a low-pressure water mist system from Prevent Systems AS

(4 appendices)

Introduction

The department of Fire Technology at SP Technical Research Institute of Sweden has conducted a series of underground garage (OH2) fire tests for Prevent Systems AS with an automatic low-pressure water mist system.

The tests were conducted in principle in accordance with "Brandversuche für Tiefgaragen (OH2)" (Fire Tests for Underground Car Parks (OH2)) published by VdS Schadenverhütung, dated July 2, 2004 and the revised version dated March 1, 2012.

This report contains the applicable fire test results, whilst Test Report PX26439-1 contains all fire tests results, including the system development tests.

Deviations from fire test protocols

The primary deviation from the test protocols was that no reference testing was undertaken with the prescribed traditional sprinkler system. Therefore, there is no benchmark data for the judgement of the performance of the tested low-pressure system relative to a traditional sprinkler system. Instead, a qualitative and quantitative judgment based on the probability for damage to the ceiling construction, fire spreading to adjacent cars and the potential for multiple nozzle activations were undertaken.

The following deviations also applied:

- Either four or nine nozzles were installed, all dependent on the point of fire ignition relative to the nozzles, not the 21 nozzles required by the protocols.
- No Plate Thermometers were positioned in front of the target cars. Instead, one Plate Thermometer was positioned in front of the middle car (as required) and one Plate Thermometer was positioned behind this car.
- Measurement of ceiling gas temperatures close to the nozzles involved the four or five (dependent on scenario) nozzles closest to the fire, not all nine nozzles.
- The earlier version of the test protocol requires 20 litres of petrol in the fuel tanks of the cars, the later version that no petrol is used in the tanks. For these tests, the fuel tanks were empty.

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These results indicate that the average K-factor of the tested nozzles (approximately 13.1 L/min)/bar^{1/2}) was slightly lower than the nominal value (13.4 L/min)/bar^{1/2}). This observation is in line with the measured water flow rates and system operating pressure during the tests.

Discussion

Sufficiently good test results were experienced in all the tests. Due to slightly higher ceiling gas and surface temperatures on the target cars when the point of fire ignition was positioned between four nozzles, this particular scenario was repeated. The repeatability of this scenario was fairly good.

Conclusion

Although no benchmark sprinkler tests were conducted, it can be concluded that the test results achieved were sufficiently good as:

- The ceiling gas temperature directly above the fire was very low. The temperatures and the exposure times are well below levels that can be considered hazardous for fire spread or for the integrity or stability of a ceiling construction in an underground garage.
- Fire spread to the target cars was prevented and surface temperature measurement on the target cars as well as in front and behind the car on fire indicate temperatures well below levels where fire will spread.
- Multiple activations of nozzles are unlikely based on the numbers that activated in the particular tests as well as the recorded ceiling gas temperatures at the corners of the suspended ceiling.

In our judgement, a system designed with the following system design parameters, is as good as a traditional wet-pipe sprinkler system utilizing automatic sprinklers with standard or special response characteristics and designed for the protection of Ordinary Hazard Group 2 hazards according to EN-12845:

- Upright PREV2 nozzles with fast response characteristics, a nominal activation temperature of 57°C, having a nominal K-factor of 13.4 (L/min)/bar^{1/2} should be used.
- The minimum system operating pressure should be 8.4 bar.
- The maximum horizontal nozzle spacing should be 3.5 m by 3.5 m corresponding to a maximum nozzle coverage area of 12.25 m².
- The maximum horizontal distance from a nozzle to the nearest wall should be 1.75 m.
- A rectangular nozzle spacing of 3.0 m by 4.0 m may be used, given that the maximum nozzle coverage area does not exceed 12 m² and that the maximum horizontal distance to any wall is 1.75 m.
- The vertical nozzle-to-ceiling distance should be between 20 mm and 40 mm.