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Testing of residential sprinklers and water mist nozzles in residential area fire scenarios

Magnus Arvidson
RISE Research Institutes of Sweden
Safety and Transport – Fire Research
Brinellgatan 4
SE-501 15 Borås, Sweden
Tel: +46 (0)10 516 56 90
magnus.arvidson@ri.se

Bio: Magnus Arvidson is a Fire Protection Engineer working at RISE Research Institutes of Sweden since 1991. He served as a member in the NFPA 750 technical committee on installation of water mist fire protection systems from 1993 to 2000, has been active in the Sub-Committee on Fire-Protection at the International Maritime Organization, and has been involved in a technical committee at CEN developing a standard for water mist systems. He is currently a member of the Scientific Council of the International Water Mist Association.

Commercial residential sprinklers are usually fitted with 3 mm glass bulbs having a nominal operating temperature of 68°C or a high-sensitivity solder link, usually with a nominal temperature rating of 74°C. Previous work show that there is a significant potential for improving sprinkler response times in a residential room fire scenario by using glass bulbs with a lower Response Time Index (RTI) and lower operating temperature than commonly used. The objective of the study was to investigate any improved performance due to earlier activation of residential sprinklers. A series of fire tests was conducted inside a test compartment sized 3.66 m by 3.66 m. The fire test source consisted of both a simulated and authentic upholstered chair. For the majority of the tests, the flow rate of the residential sprinkler was 30.3 liter/min (corresponding to 2.05 mm/min as per the recommendations in NFPA 13D and 13R). Additional tests were conducted at 60.6 liter/min (4.1 mm/min as per NFPA 13). Tests were also conducted with commercial low- and high-pressure water mist nozzles and a stand-alone high-pressure water mist system.

The results show that earlier activation of residential sprinklers had a small effect on its performance, especially for the authentic upholstered chair scenario, when flowing 30.3 liter/min. The rather small effect is probably due to that the discharge density was too low to provide fire suppression. When the flow rate was increased to 60.6 liter/min, the performance was considerably improved. It is likely that earlier activation (by using for example 57°C glass bulbs) at a flow rate of 60.6 liter/min would have resulted in more evident performance improvements. However, this was not investigated.

The flow rates of the commercial low- and high-pressure water mist water mist nozzles ranged from 17.2 liter/min to 36.7 liter/min. Roughly, it could be concluded that the performance of the water mist nozzles were comparable or better than the residential sprinkler at approximately half the water flow rate.

The stand-alone high-pressure water mist system had a flow rate of 8.2 liter/min. The performance was comparable to the performance of the water mist nozzles. However, the results indicate that the performance was relatively much influenced whether the point of fire ignition of the simulated upholstered chair was on the front or back side (poorer performance). This would suggest that the position of the fire test relative to the position of the unit is a crucial factor and underlines the importance of a thoughtful position of the unit in practical applications.

Key words: Residential sprinklers, water mist nozzles, large-scale fire tests.