Evidence from the experience in the field of electronically operated domestic water mist systems

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Introduction

There has been extensive research demonstrating the theoretical benefits of using electronically controlled water mist systems, such as faster activation and reduced damage. However, given its recent introduction, there has been very little evidence of its benefits in the field.

Part of the reason has been that these systems were installed primarily in new or refurbished homes where the risk of fire is small. Since the Grenfell fire, there has been a duty of care drive to retrofit suppression systems into homes where the risk of fire is higher or where the occupant is less able to escape.
These are often identified through Person Centred Fire Risk Assessments, as opposed to being installed where building regulations dictate the requirement for a suppression system.

This has meant that there are more suppression systems present in environments where they can actually make a difference.

Research

Dr. Yibing Xin
Research Group Manager FM Global

In 2022 at the NFPA conference in Florida, Dr Yibing Xin, Group Research Manager at FM global spoke about their internal proof of concept research project looking at SMART Fire Sprinkler systems.

Their definition of SMART was Simultaneous, Monitoring, Assessment and Response Technology.

"In a smart system we would expect to separate the detection device from the discharge system"

"SMART protection system is the future of fire protection"

Source https://www.nfpa.org/news-blogs-and-articles/podcasts/are-smart-sprinklers-the-next-big-thing

- **Traditional sprinklers**
  - High HRR @ suppression
  - Uncontrolled fire
  - Excessive CDF
- **SMART sprinkler**
  - Low HRR @ suppression
  - Controlled fire
  - Est. CDF ↓ >50%

Test Conditions	Water Applied	1 min after Water Applied	2 min after Water Applied
Simulated traditional sprinklers			
Simulated SMART sprinklers			

Source FM global SMART sprinkler to save water [PowerPoint Presentation (firesprinklerinternational.com)]

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Replicating the activation time of electronically controlled watermist system nozzles in B-RISK

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ABSTRACT

This paper presents two series of enclosure fire experiments in which the activation time of electronically controlled watermist system nozzles and concealed sprinklers have been obtained. The first series experiments were aligned to the procedure given in the BS 8458 standard whereas the second series were configured to give slower growing fires than in the standard test.

The activation of the two systems have been simulated in the B-RISK zone fire model. Activation characteristics for the concealed sprinklers have been taken from elsewhere in the literature. Representative activation characteristics for the electronically controlled watermist system nozzles have been determined. The selection of these characteristics has required a balance between the results from the two experimental series. By using an effective response time index of 20 $m^{½}s^{½}$ and an effective conductivity factor of 0.25 $m^{½}s^{-½}$ the predicted activation times are on average 14% slower across all of the enclosure fires.

1. Introduction

1.1. Background

A report on a recent a study on the causes of fire fatalities and serious fire injuries in Scotland and potential solutions to reduce them [1] suggested that "*More needs to be done in terms of reliable early detection and suitable intervention, to either delay the development of the fire or to notify people – using technology – so they can take suitable action at the early stages of the fire.*" Automatic water fire suppression systems (AWFSS), comparison with those in Series A, as well as considering the impact of shielding the fire. In addition to the watermist system, the Series B experiments also included measuring the activation time of concealed residential sprinkler heads.

In this paper the measured activation times of the watermist system and the concealed sprinklers have been compared. The B-RISK zone model [5] has then been used to reproduce the experiments as closely as possible, comparing simulation outputs to data for system activation time. As part of this, representative thermal sensitivity properties for the watermist system have been identified through a parametric analysis,

Several fire engineering assessments of Electronically activated nozzles have been made.

June 2022 a fire engineering research paper was published in the fire safety journal.

This study used B-Risk modelling to compare a variety of fire scenarios.

For the scenarios modelled an RTI of 20 m½s½ was determined for the electronically activated nozzle.

"….When comparing the results for the nozzles to concealed sprinkler heads, in all instances the nozzles are shown to activate more quickly than the concealed heads. The activation times of the concealed head is shown to be 2.0 and 13.7 times greater than those observed for the activation of the first nozzle."

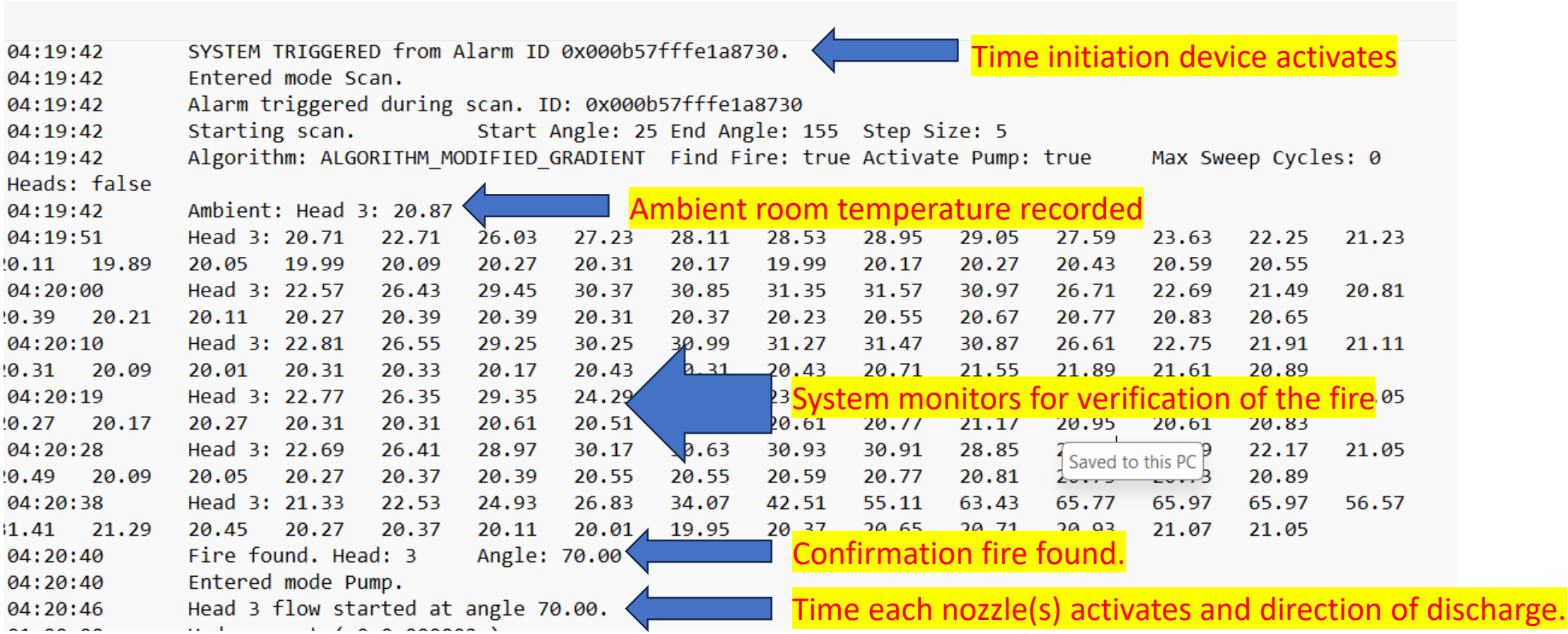
Credit to the authors Charlie Hopkin, Martin Sprearpoint, Yusuf Mohammad and William Makant Replicating the activation time of electronically controlled watermist system nozzles in B-RISK - ScienceDirect

Electronically activated water mist nozzles can be used with a variety of detection devices.

- Smoke detectors
- Heat detectors
- Flame detectors
- IR thermal camera images
- Gas alarms

The choice of detection device offers flexibility for the environment and expected fire loads to achieve the earliest nozzle activation time.

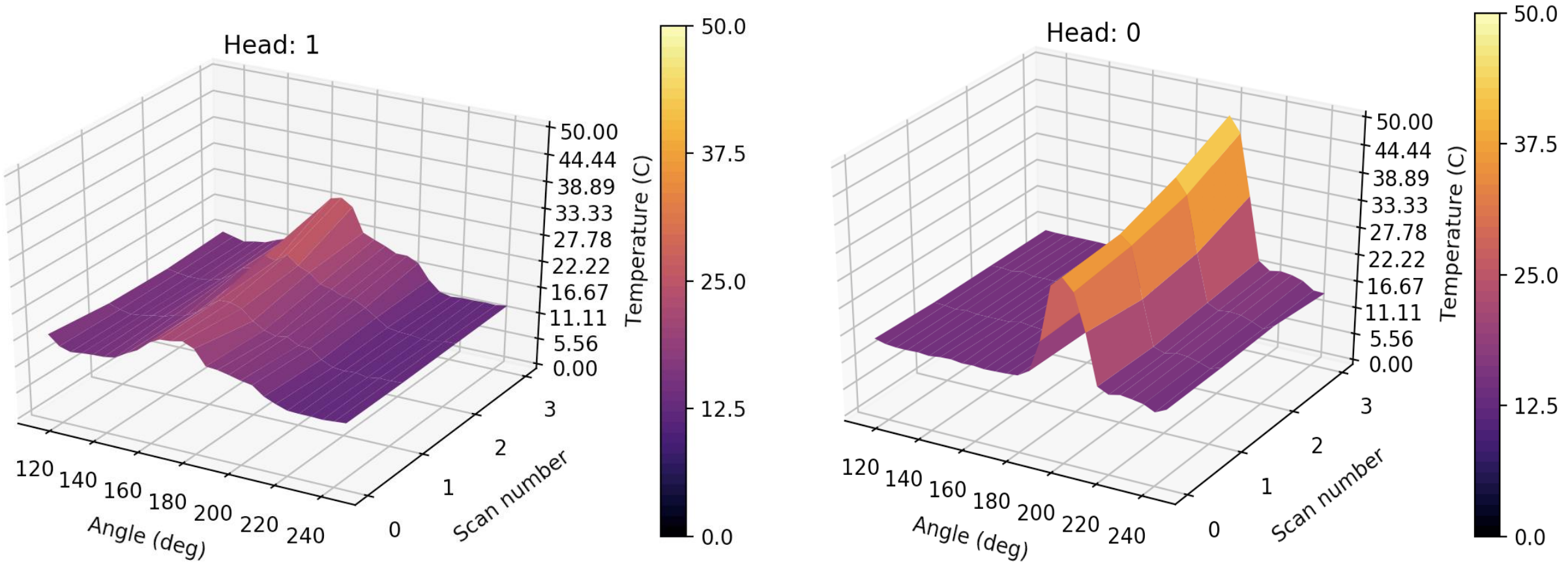
Field data from electronically activated water mist systems



This example was taken from a kitchen fire. The room is divided into 27 sections.
In each section the temperature can be monitored and recorded.

The temperature reading does not have to be measured at ceiling height.

Field data from electronically activated water mist systems



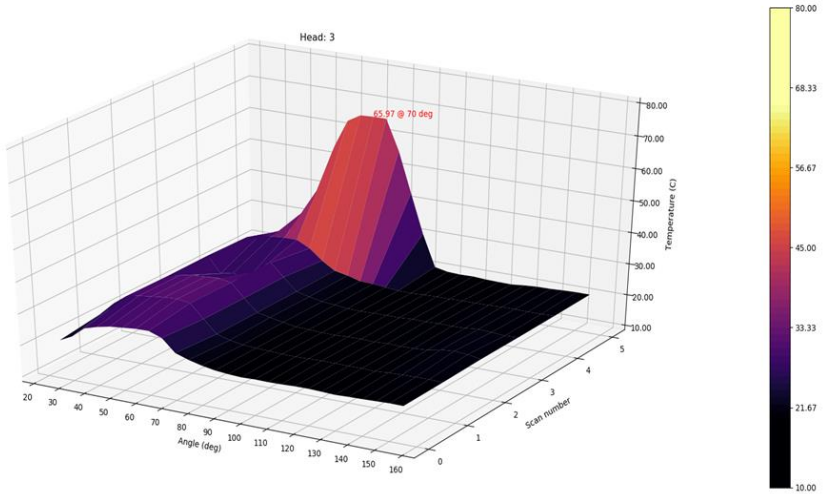
Where multiple nozzles are located in the same room, each nozzle can independently record data.

This has proved useful to avoid the fire “skipping” the nozzle.

House kitchen fire December 2022

Actual:
- Head to fire: 3 at 70.0 deg on sweep 5

New:
- Head to fire: 3 at 70 deg on sweep 5 B



A frying pan containing oil caught fire producing smoke but with a slow release of heat.

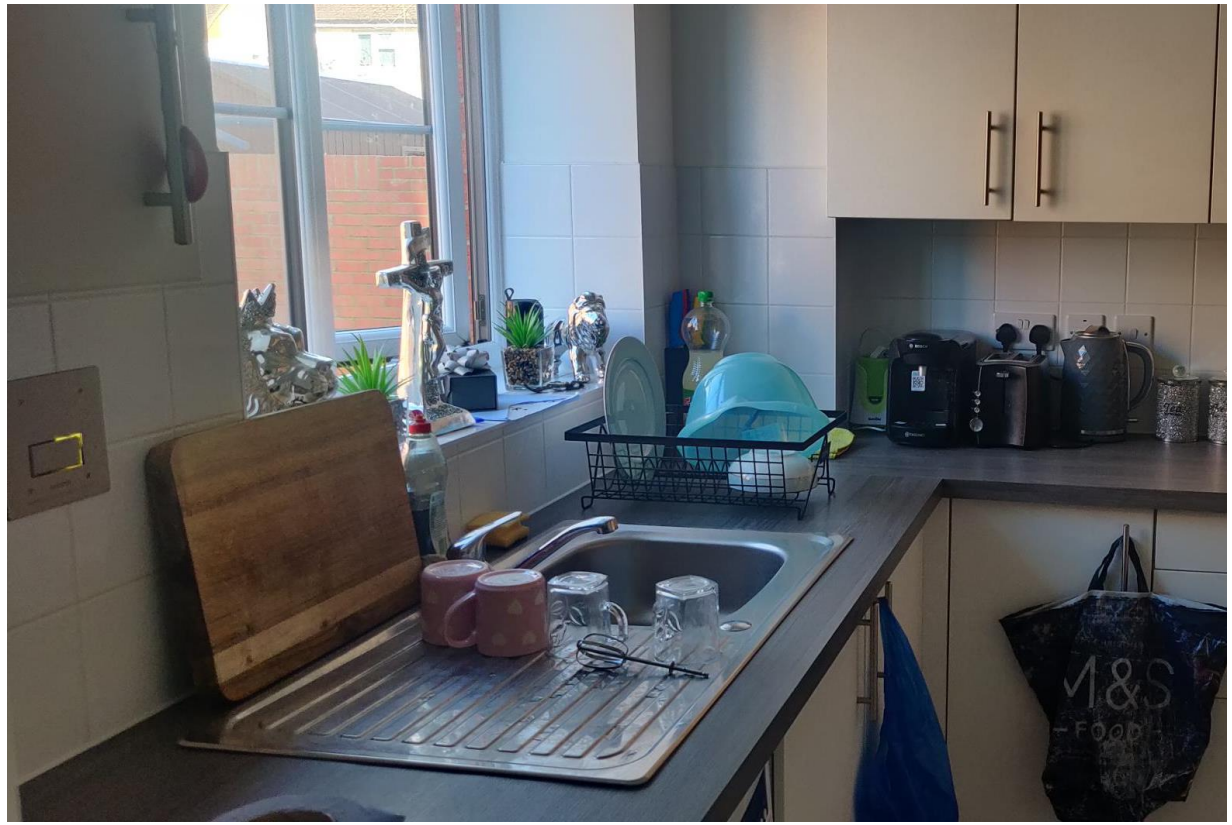
The electronic nozzle activated 64 seconds after the smoke detector initiating the water mist system.

Due to the early activation the fire was extinguish and did not spread beyond the frying pan.

The BS 5839-6 heat alarm did not activate because the ceiling temperature did not reach the required temperature to activate the alarm.

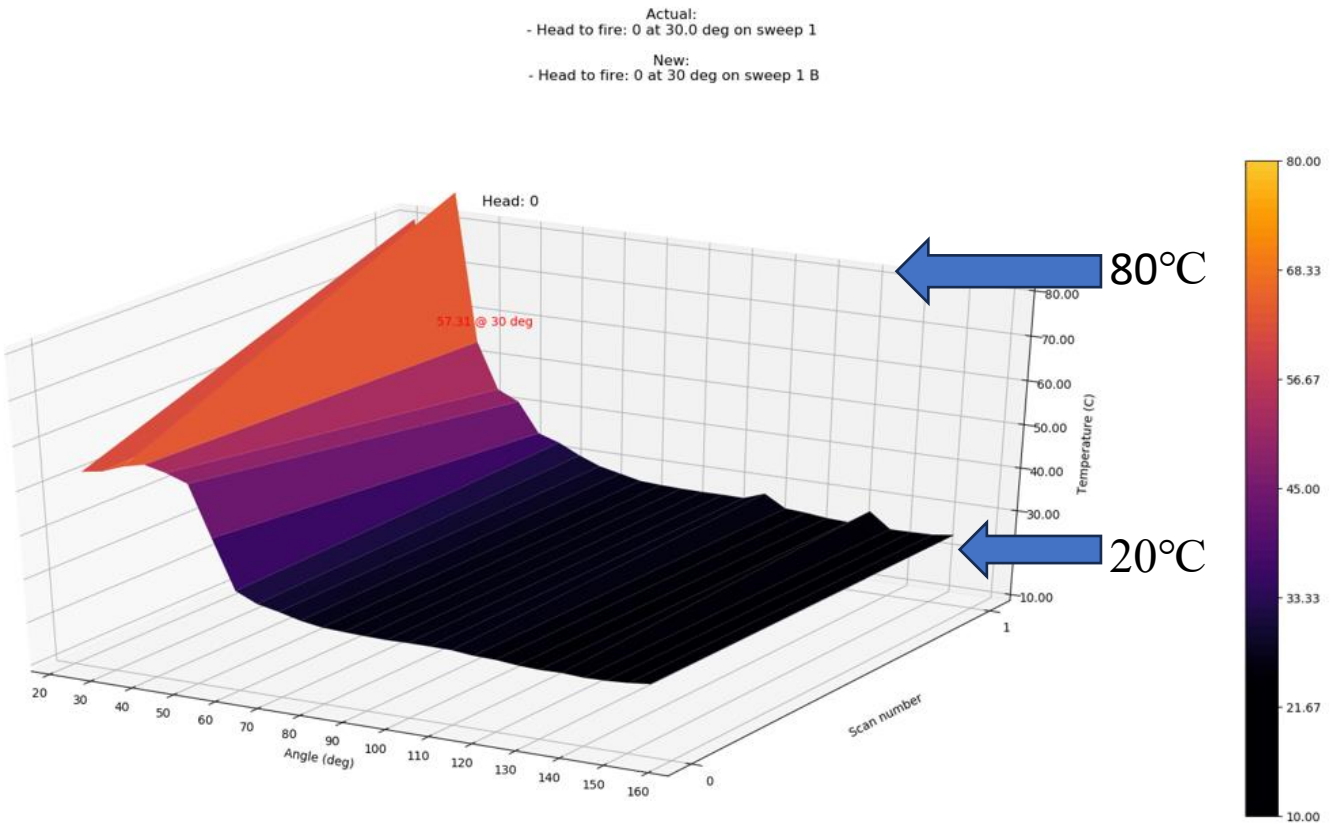
House kitchen fire December 2022

There was no fire damage to the property and the resident was able to mop up the water.



Apartment chip pan fire June 2023

Apartment chip pan fire June 2023



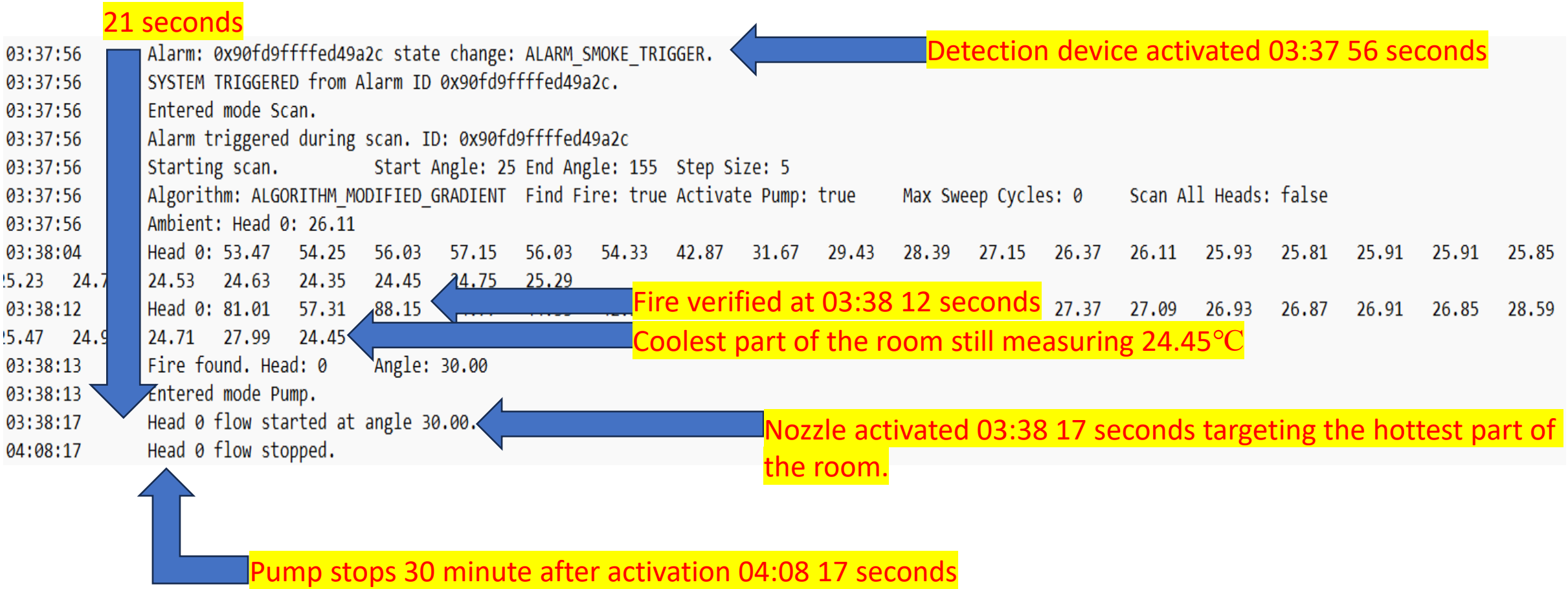
The water mist system observed two sets of temperature readings before activating.
An increase in temperature at the location of the fire 9 seconds apart ranged from 24.4 to 88℃ which activated the nozzle.

The ambient room temperature was 26.1℃

The nozzle activated 21 seconds after the smoke detector activated

This graph shows the extreme temperature in the corner where the chip pan was located but a relatively low temperature in the rest of the room

Apartment chip pan fire June 2023

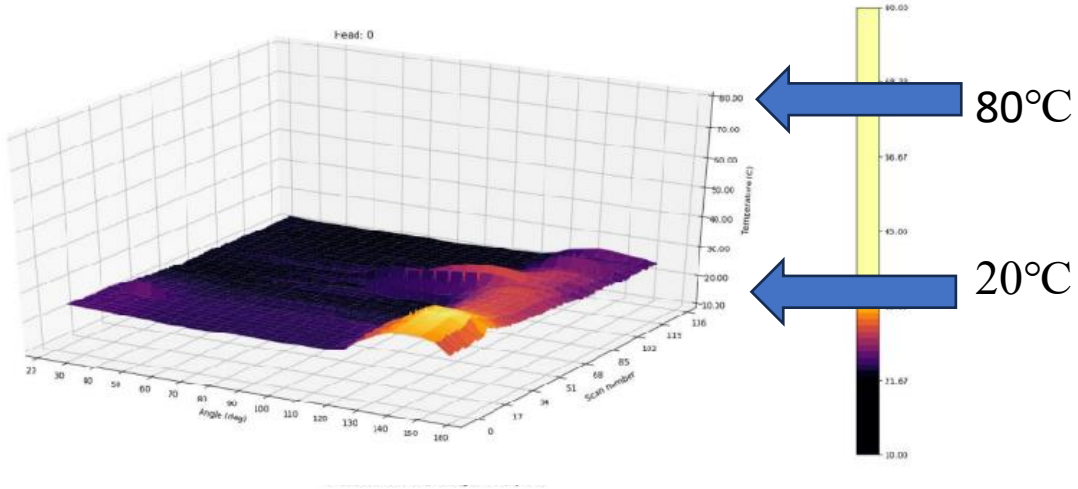


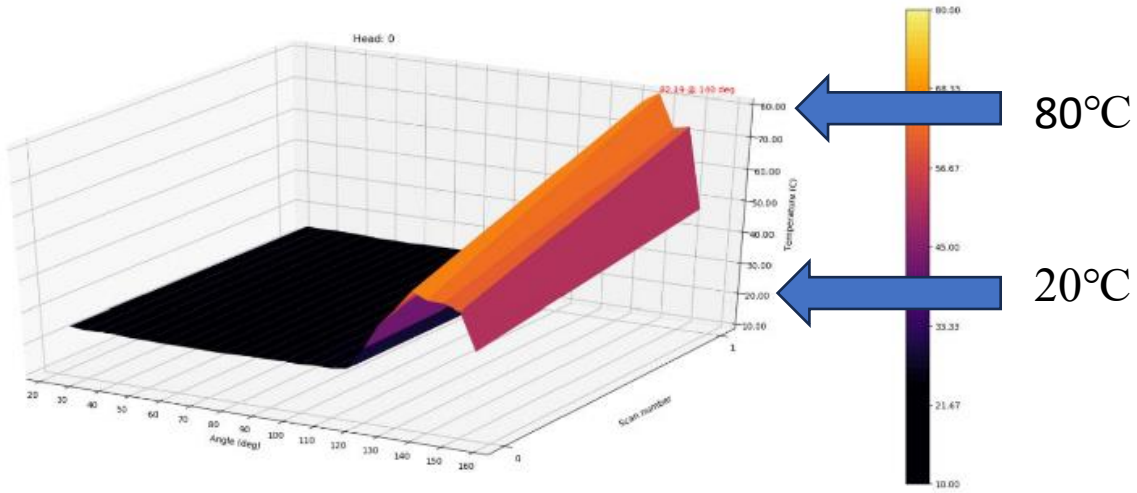
Apartment cooking oil fire – April 2024

There was minimal amount of smoke and heat damage to the kitchen during the fire.

There was no water damage to the kitchen floor.

Apartment cooking oil fire – April 2024





In this incident the system was initiated by a smoke detector activating due to the oil smoking before the fire had started.

Within 20 seconds the system had seen the fire develop and activated a single electronically controlled nozzle.

The nozzle was able to turn and spray the mist directly at the fire. The system could determine exactly where the fire was in the room.

Temperatures in the room varied from 23.8°C to 82.1°C in the section where the fire occurred

Adoption of Electronically controlled nozzles

In April 2023 Scottish building standards approved the use of an electronically controlled nozzle as a suitable alternative to the prescribed nozzles detailed in BS 8458:2015

***'Alternative suppression systems** - The applicant and **the verifier** should satisfy themselves that the alternative system has been designed, tested and approved for use in domestic and residential buildings and are **fit for their intended purpose**'*

Conclusion

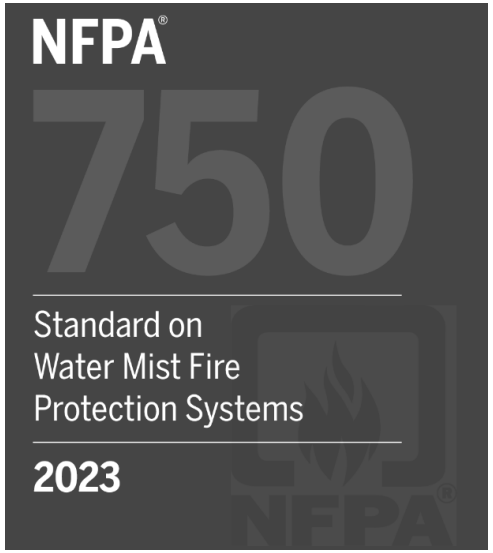
•Having carefully considered all the information submitted in this case, it is the view of Scottish Ministers that the proposals do meet the requirements of Standard 2.15

Source: report available on Scottish government website [Building standards - ministerial view: automatic fire suppression systems (ref. V2023/1) - gov.scot (www.gov.scot)]

Adoption of Electronically controlled nozzles

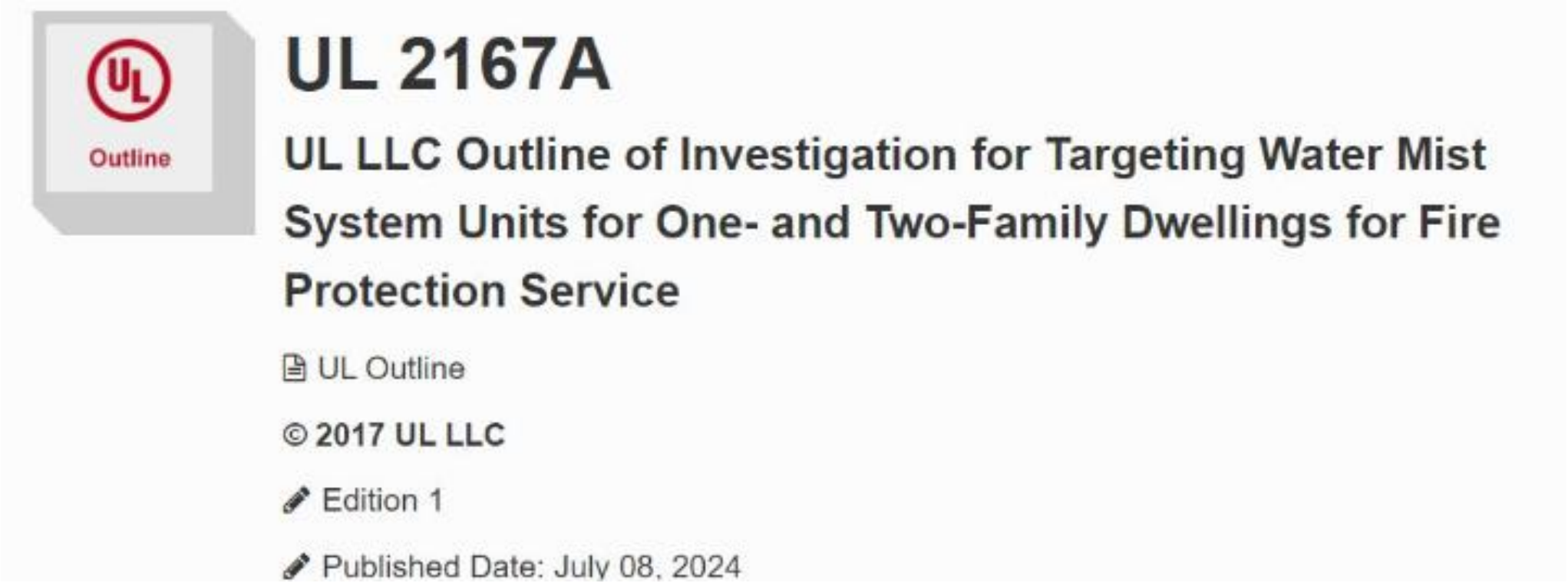
Electronically operated nozzles have been in the market for several years.

The industry has been slow to adopt the technology partly due to the lack of fire tests, standards and specifications specific to this type of nozzle



In 2023 NFPA 750 introduced a definition of an Electronically Controlled Automictic Water Mist Nozzle.

The standards definition is “Nozzles that are normally closed and operated by electrical energy that is initiated and supplied by fire detection and control equipment.”



Ul have recently published this standard for water mist systems the standard includes a suite of 13 small room fire tests and 4 large room fire tests

Source:
https://www.shopulstandards.com/ProductDetail.aspx?productId=UL2167A_1_O_20240708

UL 2167A

Ul 2167A includes a suite of 13 small room fire tests and 4 large room fire tests.

Fire tests use a traditional style fire crib as well as a domestic sofa as a fire load.

Summary

Whilst real fire data on electronically controlled nozzles is still small. These systems are now available in numerous countries including Holland, Belgium, Italy, China and South Korea.

As more systems are installed more data will become available internationally.

All the fire data gathered from domestic fire incidents align with the fire engineering modelling and assessments previously carried out on in this type of nozzle.

All the fire data aligns with FM global's summary report into SMART sprinkler research for commercial applications.

Manufacturers now have certification bodies such as UL and FM global to work with , to develop, improve and offer alternatives alongside their existing product range.

The evidence shows that SMART early activation = Better outcomes for people and property.

Thank you for listening

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