Certification of Electronically Operated, Targeted, Domestic Water Mist Nozzles to UL 2167A for Compliance with NFPA 750

William Makant
Plumis Ltd
Email: william@plumis.com

1. Introduction

Mechanically activated sprinkler systems have long served as the default fire suppression method for domestic settings. However, their design parameters were developed in a different era—before modern furnishings, electronics, and energy systems redefined residential fire dynamics. In recent years, advances in detection, actuation, and nozzle design have enabled a new generation of suppression systems: electronically operated nozzles. These systems integrate detection, control logic, and actuation within a single unit, enabling faster and more precise response to incipient fire conditions.

In many jurisdictions, the uptake of conventional sprinklers remains low due to concerns about water supply costs, aesthetic disruption, and collateral water damage. As a result, there is a growing interest from consumers and insurers for alternative approaches to fire suppression.

Electronically operated nozzles present this different approach: rather than waiting for a fire to grow large enough to trigger a thermal bulb, they enable rapid detection and targeted activation—often within the incipient phase of fire development. This not only improves safety but also opens opportunities for water damage mitigation and broader acceptance in retrofit applications.

2. System Overview

The electronically operated nozzle system is wall-mounted, uses a smoke detector to initiate the scanning and uses thermal imaging to validate the fire risk and to localize it. It employs a servo-controlled nozzle capable of horizontal rotation, both for the purposes of scanning and for targeting. Upon confirmation of a dangerous fire event, the nozzle rotates toward the heat source and discharges a fine mist directly at the fire source, suppressing the fire well before flashover occurs. The system is designed for domestic spaces and complies to NFPA 750 given that it has obtained a certification (Listing) against UL 2167A, a newly

developed standard for targeting water mist systems, based on the established UL 2167 for water mist nozzles.

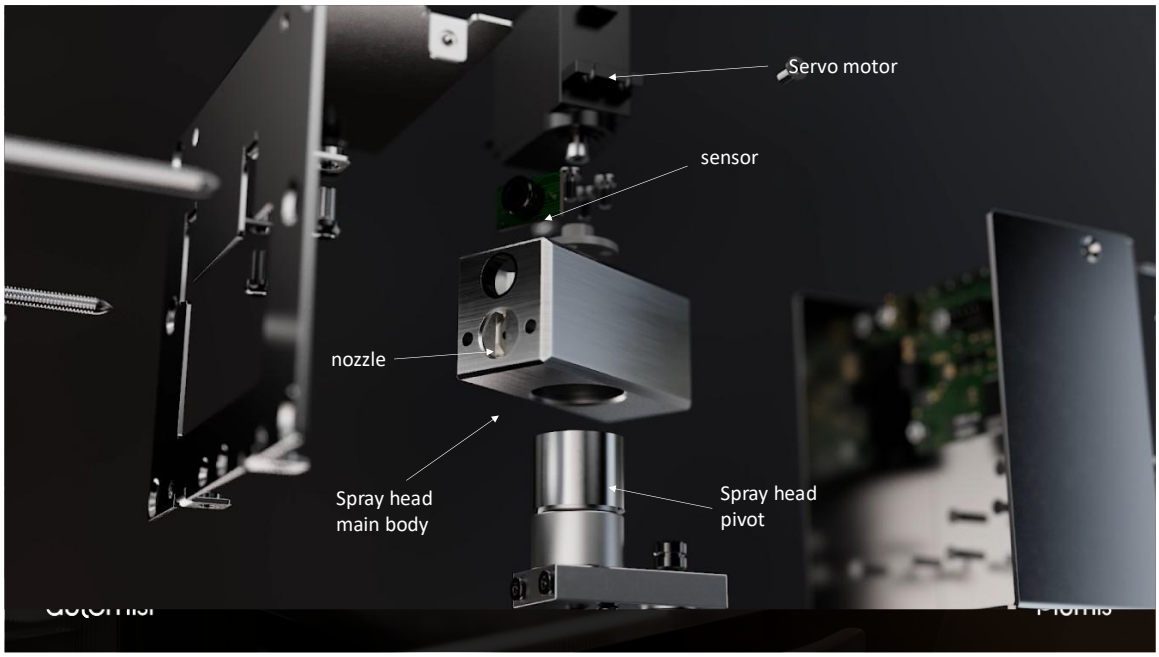

Figure 1: Spray head assembly overview

In contrast to ceiling-mounted systems designed for uniform discharge, these nozzles are wall-mounted with a narrow and directional discharge pattern, relying on droplet momentum and entrained airflow to reach the fire plume. Key benefits include reduced water use, faster activation, reduced fire and water damage and minimal aesthetic impact.

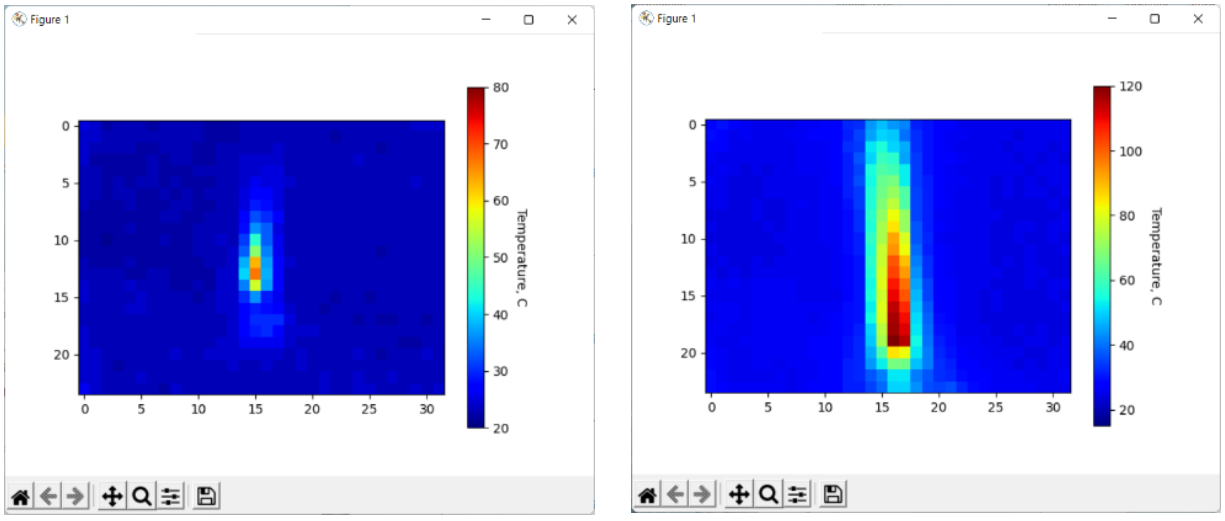

Figure 2: Examples of thermal images observed by the system's sensor

3. Certification under UL 2167A and its challenges

UL 2167A is a performance-based standard created to accommodate suppression systems that depart from the traditional frangible bulb model.

The major challenge in achieving certification was the absence of a suitable standard. UL 199, designed for mechanically triggered sprinklers, did not account for electronic detection, logic-based decision-making, or targeted discharge. The certification of electronically operated nozzles required collaboration across previously siloed domains: suppression, detection, and control systems inside UL.

Challenges also included testing the integrated smoke and thermal imaging detection to assess the system's performance, accommodating the nozzle's horizontal discharge in the system's evaluation, and defining new test protocols to evaluate dynamic threats such as traveling fires. The resulting list of fire test protocols can be seen below, compared to a typical run of 2 tests for a traditional UL 2167 water mist Listing and a typical run of 5 tests for a EN 14972-17 water mist protocol.

Test No.	Fuel package	Location of fire in regard to the nozzle	Nozzle obstructed?	Room size
1	Fabricated sofa with combustible wall (A)	Far wall	No	Small
2	Fabricated sofa with combustible wall (A)	Near wall	No	Small
3	Fabricated sofa with combustible wall in centre of room (A)	Near wall	No	Small
4	Corner fire (B)	Far corner	No	Small
5	Corner fire (B)	Near corner	No	Small
6	Same as Test No. 4 with drapes in lieu of plywood walls (B)	Far corner	No	Small
7	Same as Test No. 5 with drapes in lieu of plywood walls (B)	Near corner	No	Small
8	Cooking oil (C)	Near wall	No	Small
9	Cooking oil (C)	Far wall	No	Small
10	Fire considered to be closest to failure from Test No. 1 to Test No. 7	Far wall or corner – obstruction near nozzle	Yes	Small
11	Fire considered to be closest to failure from Test No. 1 to Test No. 7	Near wall of corner – obstruction near nozzle	Yes	Small

12	Fire considered to be closest to failure from Test No. 1 to Test No. 7	Far wall or corner – obstruction near fuel package	Yes	Small
13	Fire considered to be closest to failure from Test No. 1 to Test No. 7	Near wall or corner – obstruction near fuel package	Yes	Small
14	Fabricated sofa with combustible wall (A)	1m from corner with 4 nozzles	No	Large
15	Corner fire (B)	On corner, with 4 nozzles	No	Large
16	Fabricated sofa with combustible wall (A)	1m from corner with 4 nozzles	Yes	Large
17	Corner fire (B)	On corner, with 4 nozzles	Yes	Large

Figure 3: Table of fire test protocols in UL 2167A

However, UL 2167A is not only a fire test protocol, but also a full system certification as it includes requirements for component durability (leveraging tests from UL 217 and UL 268), fire detection consistency and resilience (using FM 3260 flame detection protocols), and integrated system response. A total of 23 sperate projects over seven years were undertaken with UL to achieve certification of the system and its unlisted components. The breakdown of the components and the applied standards for testing can be seen below.

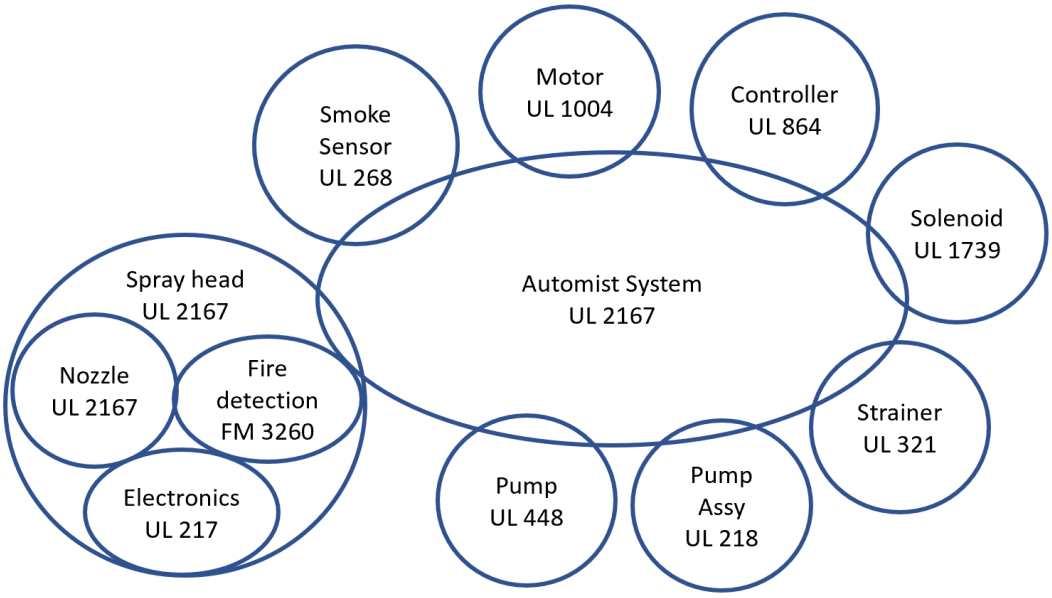

Figure 4: Diagram of the electronically controlled system components

The investment and development timeline far exceeded those typically required by legacy residential systems, due in part to the absence of pre-existing standards. The formal certification process took 7 years and over £6M of R&D investment.

4. Methodology and Results

The electronically operated nozzle underwent a rigorous series of fire scenarios including corner furniture fires, cooking oil fires, and custom couch fires, where most of them were run with and without obstructions and some with the use of drapes. These scenarios were designed to challenge its ability to a) meet the fire performance requirements of existing systems, b) to suppress an oil fire using a horizontal spray, c) overcome barriers that simulate furniture blocking line-of-sight and, d) track and suppress travelling fires, such as fire propagation along a couch. Each test room was instrumented to assess suppression performance in both small and large volume spaces.

Figure 5: Custom developed couch for UL 2167A, the "couch from hell"

In one test, a couch was ignited in the corner of a room with a barrier placed close to the nozzle (1.5m), and the fire spread horizontally along its frame. The nozzle had to recognize the lateral growth and adjust its targeting in real time. Performance metrics were aligned to UL 199 and UL 2167 protocols which are, in practice, the same as EN 14972 residential maximum temperature requirements at 1.6m and at ceiling heights. However, the test durations were all of 30 minutes despite the certification being for a domestic system. Below are pictures of some of the newly implemented fire loads and test protocols.

Figure 6: Corner test fire load at the end of fire test (with obstruction)

Figure 7: Corner fire test with drapes

Figure 8: Couch fire load at the end of test with load on centre of room

Figure 9: Cooking oil fire with nozzle at 1.5m distance test in progress

A pass for all of the 17 fire test protocols was achieved to allow for the system's certification.

6. Implications and Future Direction

The successful certification of electronically operated nozzles under UL 2167A establishes a

new fire suppression category within NFPA 750, as recognized in the 2023 edition. It has also allowed the development of prEN 14972-22 the proposed European test protocol for electronically operated water mist nozzles, a process that has been attempted, unsuccessfully, through the British Standards for over a decade. The recognition of such a category demonstrates that this is not a gadget or curiosity, it is a recognized fire safety system with clear performance and benefits.

The use of the technology unlocks new fire suppression capabilities considered impossible with traditional systems, such as dynamic response, where the system can turn off once it is confident the fire has been extinguished, or it can address multiple fires resulting from wildfire ember intrusion. These are developments that are aligned with consumer and insurer expectations of effective yet undisruptive fire protection.

7. References

1. UL 2167: Standard for Water Mist Nozzles
2. UL 2167A Outline of Investigation for Targeting Water Mist System Units for One- and Two-Family Dwellings and Manufactured Homes for Fire Protection Service
3. NFPA 750: Standard on Water Mist Fire Protection Systems
4. FM 3260: Approval Standard for Radiant Energy-Sensing Fire Detectors for Automatic Fire Alarm Signaling