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AUTOMIST SMARTSCAN PRE-ENGINEERED WATER MIST AUTOMATIC NOZZLE

MANUFACTURER'S ASSESSMENT TO BS 8663: 2019

Introduction

BS 8663-1 takes the form of a 'Specification and test method'. As per BS-0:2021 9.4.1, it '*Gives a coherent set of absolute requirements, each objectively verifiable.'* It is why its clauses carry the term *shall* instead of *should*. It also states that '*The result is a non-negotiable set of criteria for products, services or systems.*'.

BS 8663-1:2019 does not explicitly exclude Automist Smartscan from its scope: '*this British Standard specifies requirements and gives test methods for the construction and performance of open and automatic nozzles for the use in watermist systems conforming to BS 8458 or BS 8489-1*'.

Automist Smartscan is an electronically controlled automatic nozzle, part of the broader category of automatic nozzles, as opposed to open nozzles. For example, the latest publication of NFPA 750 water mist systems, includes electronically controlled nozzles as an automatic nozzle. Its operation is automatic, but its stand-by condition is closer to that of dry-pipe pre-action system (not permanently charged, wet pipe, even though the air in its piping is not pressurised either).

For further clarification, stakeholders may interpret from the scope statement in BS 8663-1 '*this British Standard does not cover the electrical actuation of water mist nozzles. Note 1 Electrical actuation of watermist nozzles is covered in BS 7273-3 and BS 7273-5'* that electronically operated nozzles are out of scope of this standard. However, these are two different types of standards which have very distinct scopes: design and installation versus component robustness: BS 7273 is a code of practice, which '*gives recommendations for the design, installation and commissioning of electrical actuation arrangements for watermist systems. It covers the interface between fire detection and fire alarm systems (see BS 5839-1) and watermist systems).*' It is therefore, not a replacement to BS 8663-1, evaluates the robustness of the nozzle as a key component of the water mist system. The guidance in BS 7273-5 will only apply with respect to the installation practices of when Automist Smartscan is driven by an alarm system, which is a possible but uncommon application, and with a distinct scope from this document.

The existing framework in the standards would, therefore, allow Plumis to make a valid declaration of product conformity to the standard BS 8663-1 with the explicit declaration of where clauses do not apply to its construction method. This is analogous to the many clauses of this standard that do not apply to open nozzles even though it is also within the scope of this standard. If the clause is applicable to an electronically operated automatic water mist nozzle because the same failure mode would apply regardless of its method of operation, then it is relevant to stakeholders to see evidence that the nozzle would pass such a test, as evidence of its robustness to that failure mode.

The BRE is the only laboratory in the UK which will run some of these BS 8663-1 test protocols. Other international labs will not run a number of these tests in BS 8663-1 because they follow their own (albeit similar) test protocols, like UL, FM and VdS. In contrast to other international labs, the BRE has shown no interest in exploring component testing for electronic controlled nozzles against BS 8663-1. Plumis has therefore run analogous tests to BS 8663-1 at laboratories which have experience running these tests, all of

which have third party accreditation to BS EN ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*. Because the exact BS 8663-1 test protocols are not followed in some of these (very similar) tests, Plumis cannot make a declaration of compliance to this standard. This document, instead, explains to stakeholders which requirements do apply and how Plumis has sought to demonstrate Automist's robustness to these failure modes with internationally recognised analogous test protocols, run at third party laboratories.

As opposed to the many designated standards that mandatorily apply to Automist Smartscan, such as those from the Low Voltage Directive, Electromagnetic Compatibility and the Pressure Equipment Directive, compliance to BS 8663-1 is not mandatory, given this British Standard's voluntary status, as per BS-0:2016 4.1.4:

'British Standards are voluntary in that there is no obligation to apply them or comply with them, except in those few cases where their application is directly demanded by regulatory instruments. They are tools devised for the convenience of those who wish to use them.'

Given its voluntary nature and the limited availability of laboratories in the UK to run all the applicable tests in this standard, Plumis has sought the maximum possible third-party testing to demonstrate its product's robustness, as detailed below.

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Manufacturer's Automatic Nozzle Assessment to BS 8663:2019

CLAUSE	APPLICABILITY	COMMENTS
4.1 Product Assembly	Applicable	Complies. A Plumis seal on the nozzle assembly indicates when it has been disassembled by severing the label. The cover can be removed with a Torx tool to reveal the product code and serial number.
4.2 Technical Literature	Applicable	Complies. Nozzle technical specifications are present in the system DIOM.
4.3 Dimensions and Pressure rating	Applicable	Complies. Nozzle technical specifications are present in the system DIOM. Note: there is no standby pressure given it is a dry pipe system.
4.4 Nominal operating temperatures for automatic nozzles	Not Applicable	Does not use a frangible bulb for activation so the table is irrelevant. However, fire engineering research has demonstrated that the electronically controlled nozzle operates with a response equivalent to a 57C bulb with an effective Response Time Index (RTI) of 20 m½s½ and an effective conduction factor (C factor) of 0.25 m½s-½
4.5 Operating temperatures for automatic nozzles	Not Applicable	Does not use a frangible bulb for operation so the table, designed for a mechanically activated automatic nozzle, is not relevant.
4.6.1 K-factor	Applicable	Complies. K-factor of 0.62 +/-0.03 included in nozzle technical specification present in the system DIOM. 100% controlled in production.
4.6.2 Water flow and distribution	Not Applicable	Not a top-down system with nozzle close/on to the ceiling which creates a distributed discharge density. DIOM states the area of coverage of the movable nozzle. Impingement onto adjacent nozzles has no consequence because the system is electronically controlled with only one nozzle ever activates
4.7 Function	Not applicable	This automatic nozzle does not contain a deflector, a thermally sensitive element or blow-off cap so the tests listed are irrelevant. Automist Smartscan is an electronically controlled automatic spray head system which rotate the spray nozzle to

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		the target angle. The discharge initiation is also electronically controlled and initiated only when the nozzle is targeting the hazard. Typically, electronic detection is tested for 6000 cycles. The nozzle has completed up to 70,000 full angle range scan cycles before failure.
4.8.1.1 Mechanical strength test	Not applicable	Nozzle does not use a thermal sensitive element, so the mechanical strength test, designed for a mechanically activated automatic nozzle, is irrelevant.
4.8.1.2 Hydrostatic strength test	Applicable	Procedure E.1.2 can be carried out on this nozzle in the closed position. Internal tests have demonstrated robustness up to 4 times (400 bar) the maximum operating pressure (100 bar). Third-party report available "Pressure Testing Report 400 bar.pdf"
4.8.2 Strength of nozzle deflector	Not applicable	The nozzle does not contain a deflector, so the strength of nozzle deflector test, designed for a mechanically activated automatic nozzle, is irrelevant.
4.9 Strength of release element for automatic nozzles	Not applicable	Nozzle does not use a thermal sensitive element, so the strength of release element test, designed for a mechanically activated automatic nozzle, is irrelevant.
4.10 Leak resistance for automatic nozzles	Not applicable	Nozzle does not use a thermal sensitive element, so the leak resistance test, designed for a mechanically activated automatic nozzle, is irrelevant. System also is not permanently charged with water, so there is no water pressure to induce a leakage.
4.11 Heat exposure for automatic nozzles	Not applicable	Nozzle does not use a thermal sensitive element, so the heat exposure test, designed for a mechanically activated automatic nozzle, is irrelevant.
4.12 Thermal shock for automatic glass bulb nozzles	Not applicable	Nozzle does not use a glass bulb, so the thermal shock test, designed for a mechanically activated automatic nozzle, is irrelevant.
4.13.1 Stress corrosion	Not Applicable	As this research paper from the HSE demonstrates, stress corrosion is relevant for parts that have consistent exposure to water and are pressure cycled. This therefore makes it relevant for a wet pipe automatic nozzle but not to an open nozzle or electronically controlled nozzles such as Automist Smartscan, which is dry and atmospheric pressure except for when it is being commission or is discharging.

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4.13.2 Sulphur dioxide corrosion	Applicable	Comparable test carried out per UL 2167 by a third party. K-factor consistency was tested in-house, and the test passed. Third-party report available "Spray Head Sulphur dioxide corrosion 1.pdf" and "Spray Head Sulphur dioxide corrosion 2.pdf". *Note: K factor of 0.82 was used instead of 0.62 for this test with no expected impact on results expected given a larger K-factor results in reduced wall thicknesses at nozzle tip, otherwise the exact same construction.*
4.13.3 Salt mist corrosion	Applicable	Exposure test carried out as per BS 8663-1 by a third party. K-factor consistency was tested in-house, and the test passed. Third-party report available "Spray Head Salt mist corrosion.pdf". *Note: K factor of 0.82 was used instead of 0.62 for this test with no expected impact on results expected given a larger K-factor results in reduced wall thicknesses at nozzle tip, otherwise the exact same construction.*
4.13.4 Moist air exposure	Applicable	Exposure test carried out as per BS 8663-1 by a third party. K-factor consistency was tested in-house, and the test passed. Third-party report available "Spray Head Moisture Air Test Report.pdf". *Note: K factor of 0.82 was used instead of 0.62 for this test with no expected impact on results expected given a larger K-factor results in reduced wall thicknesses at nozzle tip, otherwise the exact same construction.*
4.14 Integrity of water mist nozzle coatings	Not applicable	The nozzle has no coatings, so the test of coating resistance is irrelevant.
4.15 Water hammer for automatic nozzles	Not applicable	Not a wet pipe system with a permanently charged water pipe which will suffer from water hammer. The pressure on Automist Smartscan rises progressively as air is expelled from the discharging nozzle.
4.16 Thermal response	Not applicable	Nozzle does not use a thermal sensitive element, so the thermal response test, designed for a mechanically activated automatic nozzle is irrelevant.
4.17 Resistance to heat	Not applicable	The nozzle's body does not protrude from the ceiling, there is no thermally sensitive element to be immersed in the water bath as proposed in the procedure, so the resistance to heat test is irrelevant.

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4.18 Resistance to vibration	Applicable	Comparable test carried out as per UL 2167 at a third party. Visual inspection and electrical function tests were carried out in-house. Test report available "Spray Head Vibration Test Report.pdf". *Note: K factor of 0.82 was used instead of 0.62 for this test (as it was intended for a future model) with no expected impact on anticipated results given the same construction and bigger wall thicknesses.*
4.19 Resistance to impact	Applicable	No test has been carried out yet using the BS 8663-1 procedure by a third party. In-house tests were carried out using UL 2167 procedure, and the test passed. Test report available "Spray Head Impact Test Report.pdf".
4.20 Resistance to low temperatures for automatic nozzles	Applicable	A more severe version of this test (10 cycles down to -40C), as per UL 2167, was carried out by a third party and passed. Exposure test carried out as per UL 2167 by a third party. K-factor consistency was tested in-house, and the test passed. Third-party report available "Spray Head Temperature cycle.pdf".
4.2.1 Filter rating or strainer mesh opening	Not applicable	The nozzle does not contain a mesh within the nozzle, so the requirement is not applicable.
5 Marking	Applicable	Complies. All applicable data is marked on the spray head assembly, including "to not cover" instead of "do not paint".
6 Data sheet	Applicable	Complies. Nozzle installation instructions are present in the system DIOM.
8.2 Initial type testing	Applicable	Initial type testing has been carried out by a number of laboratories, in the UK and in China, primarily to UL 2167, in preparation for its product approval process.
8.3 Factory Production control	Applicable	Plumis is ISO 9001 accredited for the design, manufacture and supply of water mist fire suppression systems and installer support. The spray head assemblies are tested for spray pattern, k-factor and target angle accuracy.
8.4 Inspection and testing of in-service nozzles	Applicable	System servicing includes a complete system discharge which verifies function and k-factor annually on every installation

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Supporting documents:

Type	Link
Manufacturer's spray head data sheet	SH11
Manufacturer's spray head drawings	SH11
Manufacturer's system design manual andinstallation manual	DIOM 3.02

	System specification and limits	Data
Flow	Supply type (pump or cylinder)	Positive displacement pump
	Minimum operating pressure (bar) and flowrate(l/min)	80 bar and 5.6 lpm
	Maximum operating pressure (bar) andflowrate (l/min)	110 bar and 6 lpm
	Standby pressure, minimum (bar)	0 bar (dry, open pipe)
	Standby pressure, maximum (bar)	0 bar (dry, open pipe)
Installation design	Maximum nozzle spacing (m)	Custom to Smartscan: 6 m radius, chamfered laterally at 4m as per DIOM
	Minimum nozzle spacing (m)	0 m
	Maximum depth below ceiling (mm) Note: Nozzle depth > 300 mm is outside theintended scope of BS 8458: 2015	Depth from FFL of 1100mm to 1450mm
	Maximum room area (m^2) Note: either fire test room area or 80 m^2	80 m^2 as per fire test but unlimited for this targeted system
	Maximum ceiling height (m), for standardrooms	3.5 m as per fire test
	Maximum ceiling height (m), for taller spaces	Only as part of fire engineered solution

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Dimensioning of water supply	Minimum design area (m^2)	$46m^2$ which is the maximum area of 1 nozzle
	Minimum number of nozzles	1 nozzle, always, as it is electronically controlled
	Minimum design duration (min)	30 minutes
	Wet system only (dry and pre-action notallowed)	Dry system which performs to the fire performance requirements despite the 20 seconds delay to fill pipes. "Not Allowed" is a misleading statement when performance can nevertheless be met.
	Flat ceilings and limited slopes	Not limited as nozzles are not in the ceiling. Placement of detectors following BS 5839 should be followed
	Obstructions	As per details on DIOM and avoided by using "Preferred Positions"
	Other	

Definitions

(Mechanical) automatic nozzle: used on a pressurised wet pipe or dry-pipe system where a thermal frangible or fusible link (a thermal sensitive element) fails to trigger the water discharge from nozzle.

Open nozzle: system is not pressurised and an external signal (manual or from a detection or alarm system) discharges water from all nozzles liked to that water supply. Zoned systems might only allow from a portion of open nozzles.

Electronically operated automatic nozzle: a nozzle which might be open in a standby condition, but which once triggered, will further process data to decide whether to discharge or shut flow to it. It will not act simply in a binary manner (open/close) from an electrical input. Captured by NFPA 750:2023 edition.

Electrically actuated system: A system which uses a detection or alarm system to open a valve or activate a pump in an open nozzle or pre-action system. It acts in a binary manner (open/close).

Pre-action system: Uses both an automatic nozzle and electrical actuation to require both flow control systems to result in discharge of water from the nozzle.

BS 8663-1: 2019: 'requirements and test methods for the construction and performance of open and automatic watermist nozzles for use in water mist systems conforming to BS 8458 or BS 84891-1.'

BS 7273-3: 2008: Code of Practice for the 'design, installation and commissioning of electrical actuation arrangements for watermist systems. It covers the interface between fire detection and fire alarm systems (see BS 5839-1) and watermist systems.'

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BS 7273-5: 2008: Code of Practice for the 'design, installation and commissioning of electrical actuation arrangements for pre-action watermist and sprinkler systems. BS 7273-3 covers the interface between fire detection and fire alarm systems, sprinkler systems and watermist systems.'