Watermist nozzle issues and test methods

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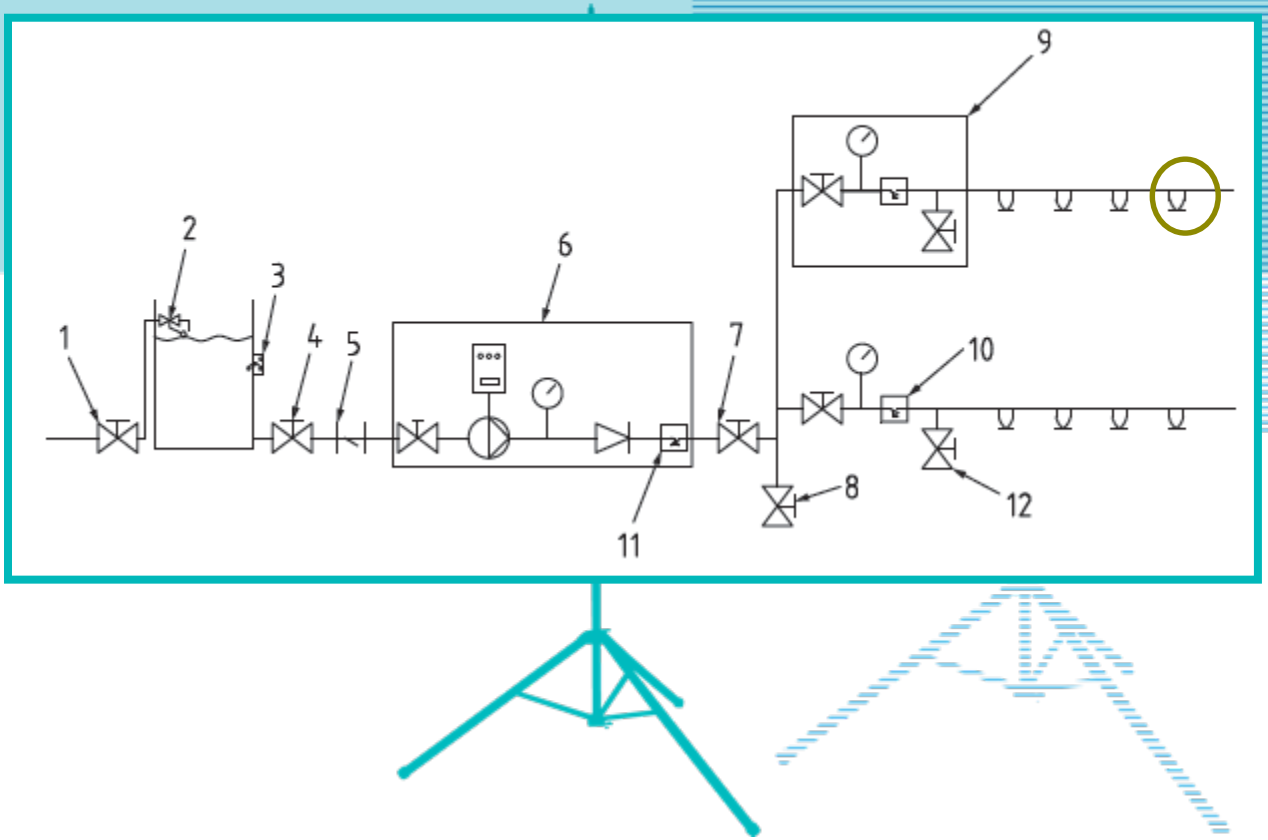
Fire Protection Systems: Fit for purpose and reliable in service?
BRE Global and the National Fire Chiefs Council (NFCC) seminar
24 April 2018

What's special about watermist nozzles?



Watermist nozzle

Bespoke designs

- Engineering precision
- Material selection (e.g. stainless steel, Teflon)
- Dynamic forces (e.g. valve function)
- Integral detection (e.g. bulb)
- Flow paths (K-factor)
- Availability (e.g. strainers)

- Manufacturing
- Assembly

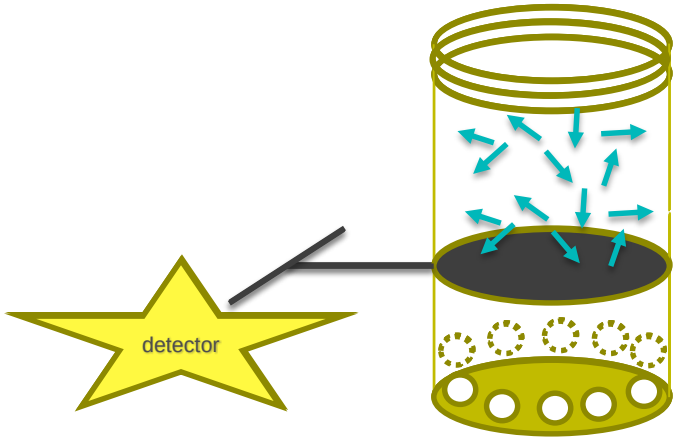
Elements of a watermist nozzle

Automatic nozzle

- Body, fittings and openings

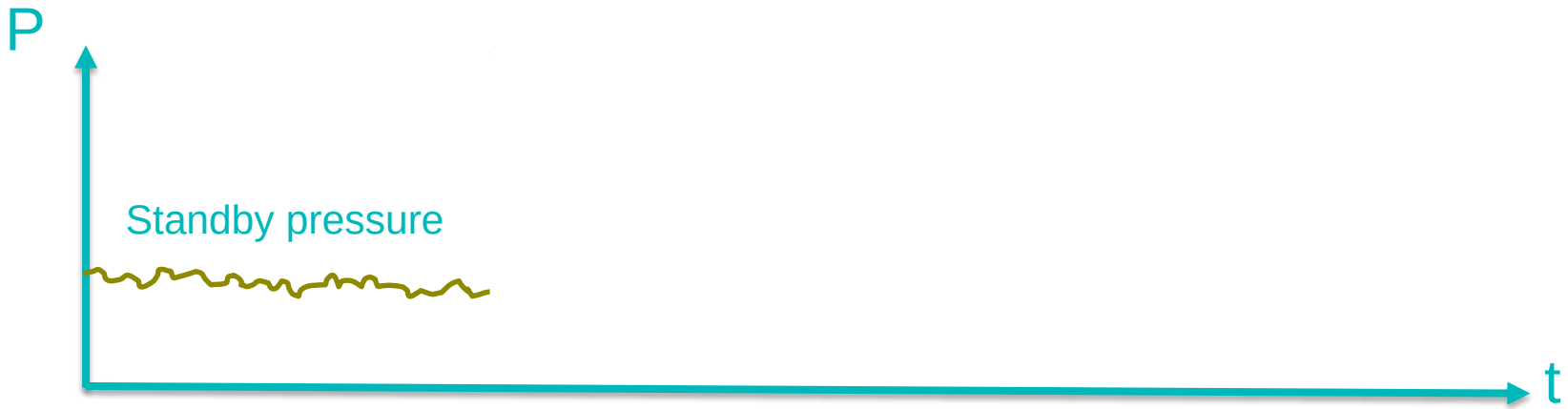
- Valve
- Detector

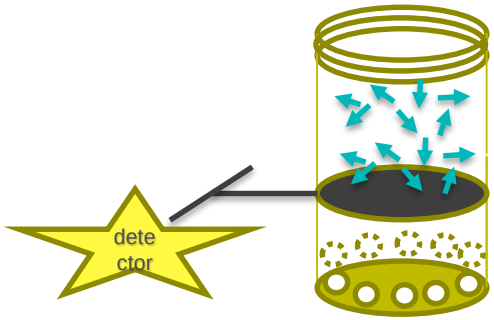
- Water-filled
- Under-pressure
- Openings exposed to atmosphere



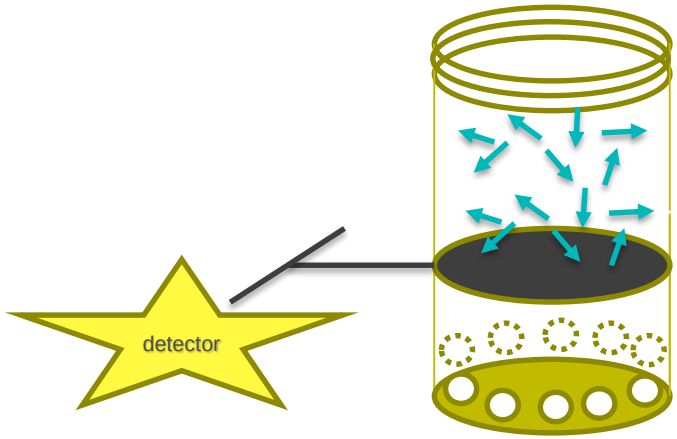
Timeline of a watermist nozzle

Pressure at a remote nozzle





Watermist nozzle challenge – ambient (no fire)

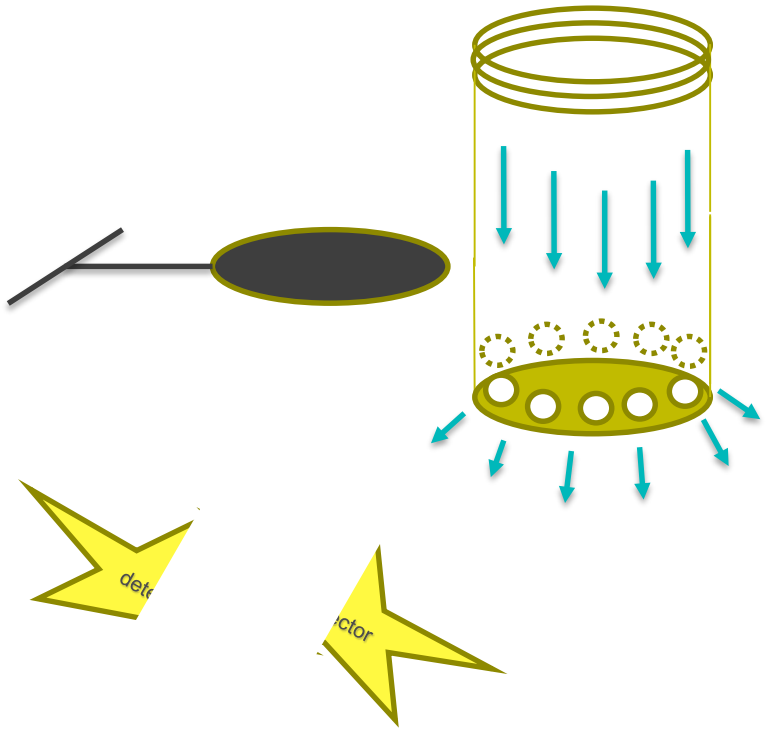


Exposure (years):
- Pressure changes
- Temperature cycling
- Movement
- Mass concentration changes
- Environmental pollutants (paint, cleaning products…)

On-going status:
- Detection 100% available
- No accidental detection
- Pressure maintained
- No Leaks

Potential problems:
- Corrosion (cracks, pits, deposits)
- Valve seat (leak, lock)
- Elastomer migration, adhesion
- Detector (cracks, deposits)

Watermist nozzle challenge - fire



Functions:

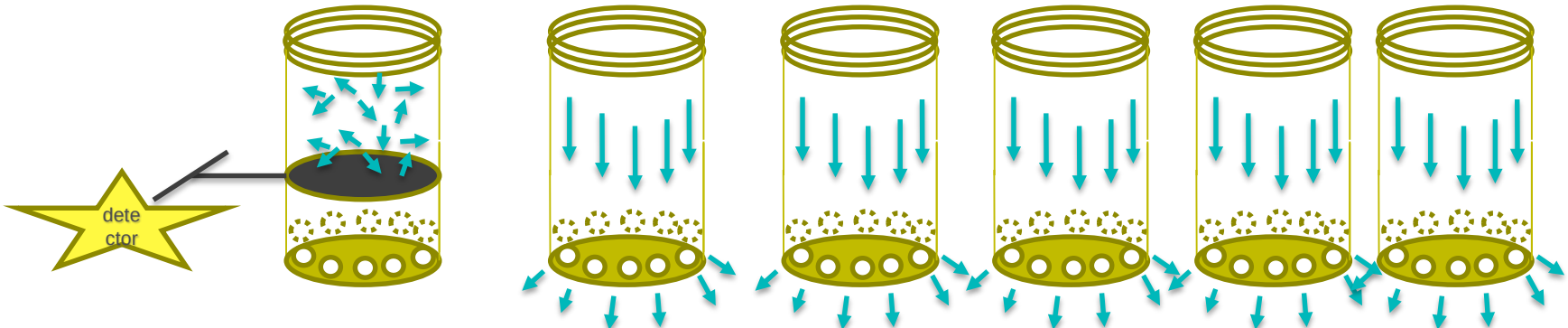
- Immediate action
- Detection
- Actuate, open valve
- Water flow through openings

Need:

- Sensitive detector
- Sufficient force to open valve, i.e. no stuck valves
- No obstruction to small orifices, i.e. pressure/flow regime for spray achieved

Watermist nozzle pressure

Pressure at a remote nozzle

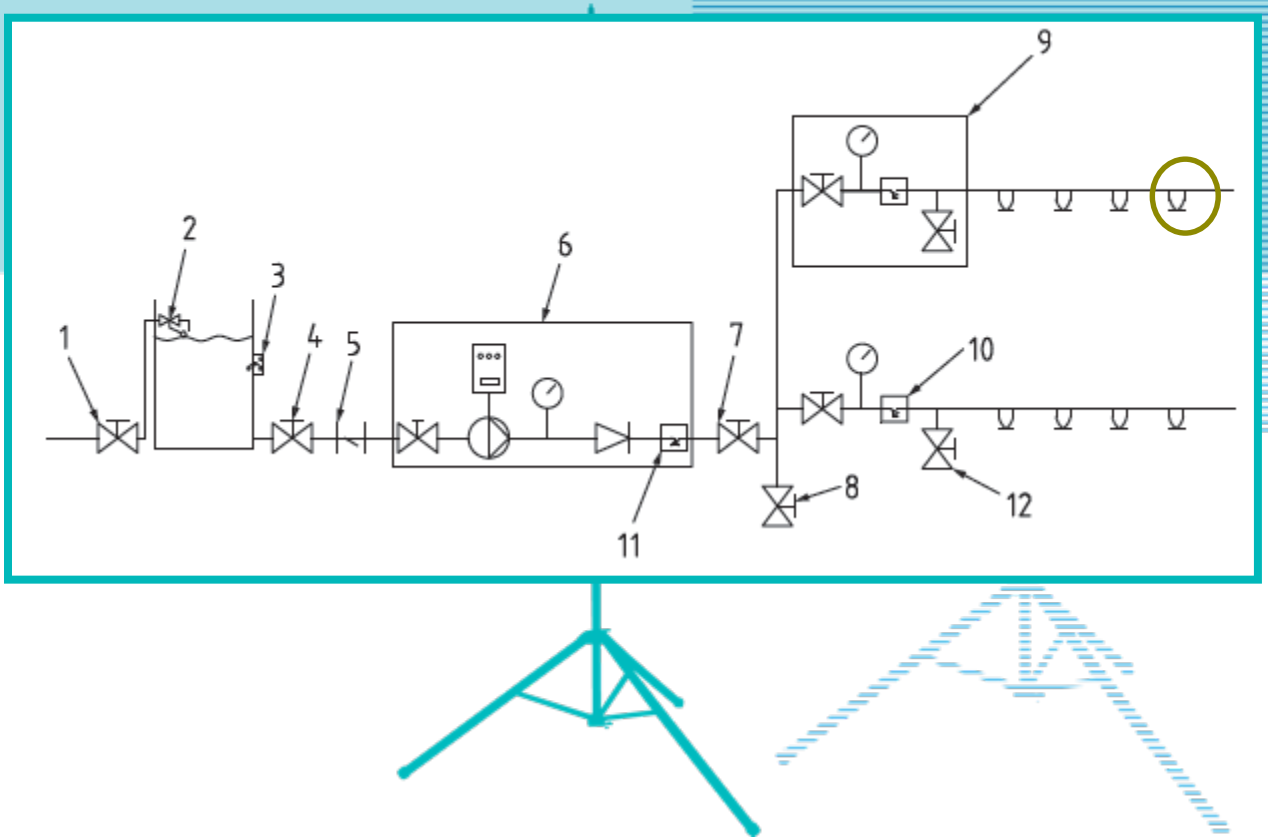


Sprinkler heads: qualitative analysis - causes of failures

SERGE ZHUIYKOV, Ph.D.* and VINCE DOWLING *Materials Scientist
CSIRO, Manufacturing and Infrastructure Technology, Industrial & Research Services, Australia
FIRE SAFETY SCIENCE–PROCEEDINGS OF THE EIGHTH INTERNATIONAL SYMPOSIUM, 2005

- 3% “O-ring adhesion” of the sprinkler head;
- 4% Undetected rupture of bulb wall;
- 4% Systems “dosed” with sodium silicate in order to overcome small leaks;
- 7 % Heavy deposits of hardened sediment;
- 8% Heavy build-up of dirt and debris on the frame, heat sensitive element and deflector;
- 15% “Intergranular” corrosion of the lead-tin-bismuth “eutectic solder”;
- 29% Unlisted sprinkler heads;
- 30% Extensive deposit of paint on the deflector and the glass bulb or fusible link.

How are watermist nozzles tested?

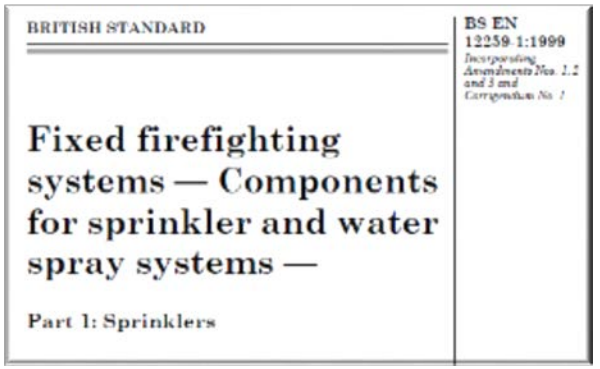


Watermist nozzle

Component tests

- Assessment of performance against standardised methodologies
- Testing to address: robustness, continuous availability ….
- Ensure a consistent approach with a standard baseline
- 100 + samples, minimum 6 months testing, BREG test report

Watermist nozzle test based on sprinkler component tests from EN 12259-1


BRITISH STANDARD

BS EN 12259-1:1999

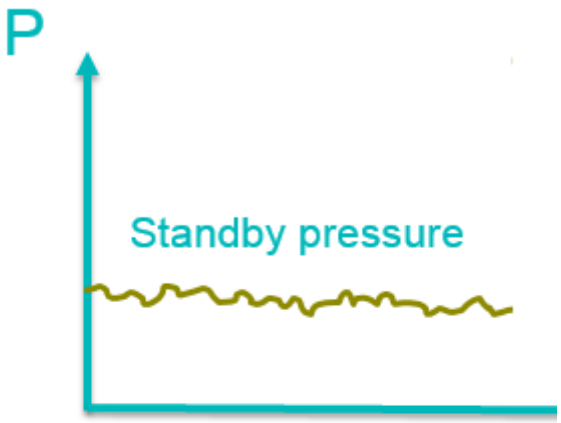
Incorporating Amendments Nos. 1, 2 and 3 and Corrigendum No. 1

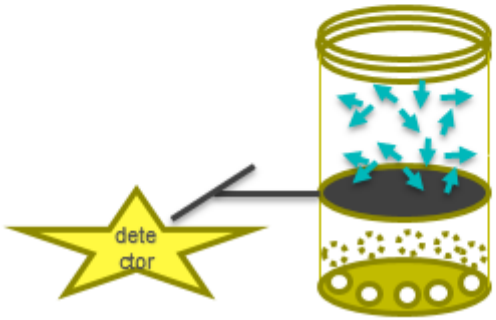
Fixed firefighting systems — Components for sprinkler and water spray systems —

Part 1: Sprinklers

Nozzle tests – body and valve

- No accidental detection
- No Leaks
- Pressure maintained



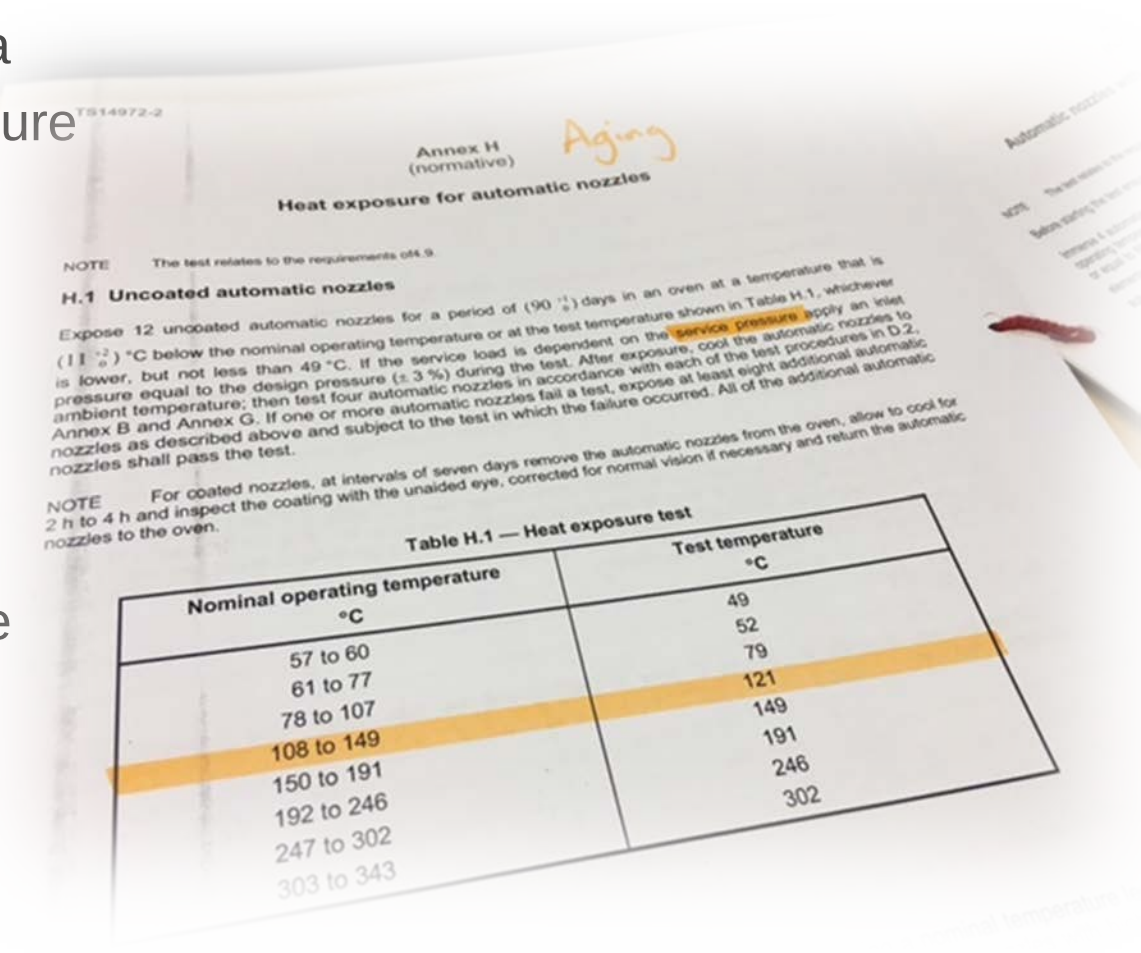


Tests:

- Thermal shock
- Strength of body
- Service load
- Leakage
- Water Hammer
- Vibration
- Impact resistance
- Corrosion (with parts exposed)
  - Stress (brass/SS)
  - Sulphur dioxide
  - Salt mist
  - Moist air
- Long term aging

Long term aging (heat exposure)

- Sprinkler baseline criteria
  - Standby/service pressure
  - 121 degC minimum
  - 90 days
- Post aging tests
  - Function (at Pmin)
  - Leak (at Pmax)
  - Operating temperature



TS14972-2

Annex H
(normative)

Aging

Heat exposure for automatic nozzles

NOTE The test relates to the requirements of 4.9.

H.1 Uncoated automatic nozzles

Expose 12 uncoated automatic nozzles for a period of (90 $^{+1}_{0}$) days in an oven at a temperature that is (11^{+2}_{0}) °C below the nominal operating temperature or at the test temperature shown in Table H.1, whichever is lower, but not less than 49 °C. If the service load is dependent on the service pressure apply an inlet pressure equal to the design pressure (± 3 %) during the test. After exposure, cool the automatic nozzles to ambient temperature; then test four automatic nozzles in accordance with each of the test procedures in D.2, Annex B and Annex G. If one or more automatic nozzles fail a test, expose at least eight additional automatic nozzles as described above and subject to the test in which the failure occurred. All of the additional automatic nozzles shall pass the test.

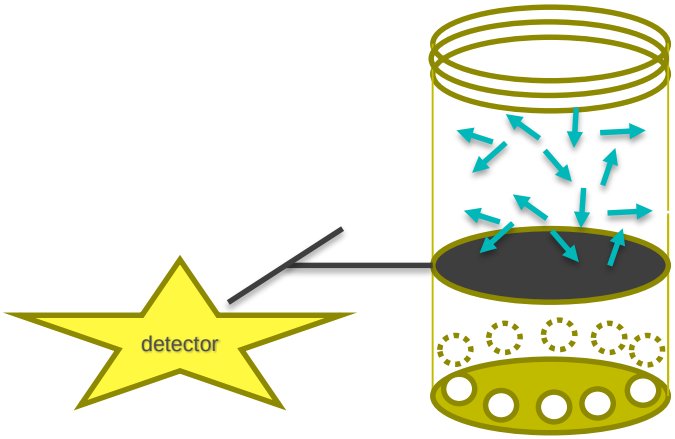
NOTE For coated nozzles, at intervals of seven days remove the automatic nozzles from the oven, allow to cool for 2 h to 4 h and inspect the coating with the unaided eye, corrected for normal vision if necessary and return the automatic nozzles to the oven.

Table H.1 — Heat exposure test

Nominal operating temperature °C	Test temperature °C
57 to 60	49
61 to 77	52
78 to 107	79
108 to 149	121
150 to 191	149
192 to 246	191
247 to 302	246
303 to 343	302

Nozzle tests - detection

- Detection within limits
- No accidental detection

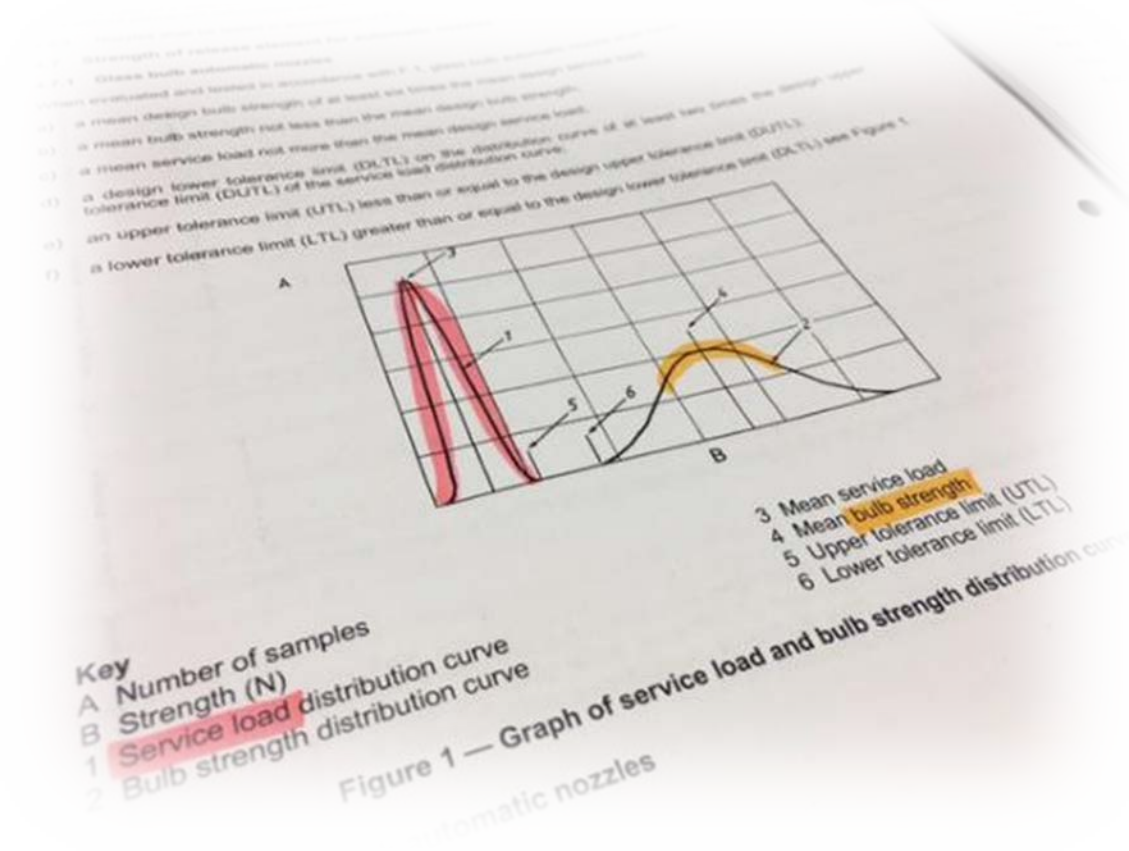


Tests:

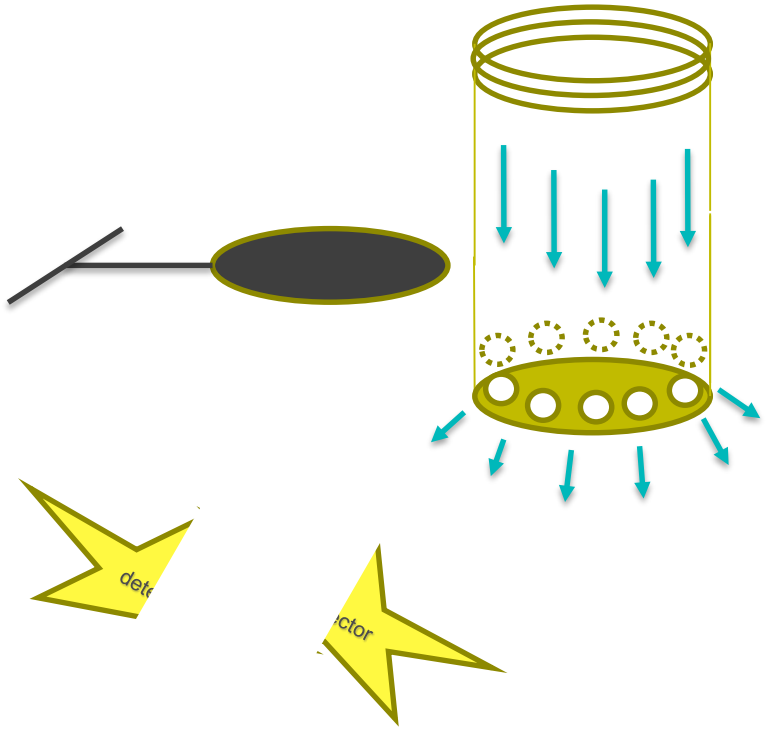
- Operating temperature
- Thermal response
- Thermal shock
- Strength of body
- Service load

Service load

- Nozzle assembly criteria
  - Applied service load
  - Torque precision
- Tests
  - Determine frame load
  - Bulb strength



Nozzle tests - actuate and deliver



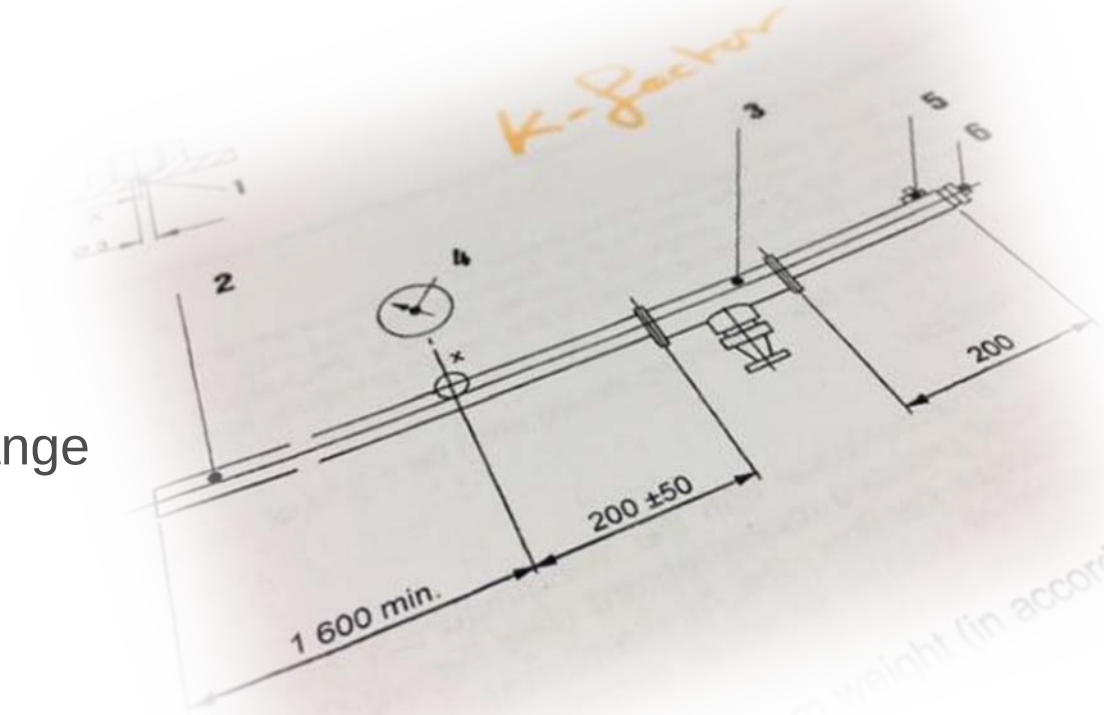
- Detector responds
- No stuck valves
- No obstructions

Tests:

- Function test (at standby pressure)
- Long term aging
- K-factor

K-factor

- Nozzle manufacturing criteria
  - Opening
  - Internal chambers
- Tests
  - Operating Pressure range
  - Measured flow
  - Determined k-factor



In conclusion

- BS 8489:2016 and BS 8458:2015
  - **“6.11 Components, 6.11.1 General**
  - Components should be in accordance with BRE publication LPS 1283 [N1], FM 5560, or other appropriate standard that can be shown to give equivalent performance (e.g. a listed component in the LPCB Red Book Live [15]).
  - *NOTE Tests for nozzles, check valves, pressure switches and strainers are under development in CEN. They are at committee draft stage at the time of publication of this British Standard.*
- LPS 1283:2014
  - “The LPCB approval of watermist systems requires both individual components and complete system fire performance to be assessed. The scope for the field of application of an LPCB watermist system approval is defined within the relevant LPS standard:
  - LPS 1283: Issue 1.1 - Requirements and test methods for the approval of watermist systems for use in commercial low hazard occupancies.
  - LPS 1285: Issue 1.1 - Requirements and test methods for the approval of watermist systems for use in domestic and residential occupancies.”

Product Name	Nominal orifice (mm)	Type	Temperature rating, °C	K-factor, LPM/bar $^{1/2}$	Design pressure (bar)	Standby pressure (bar)	LPCB Ref. No.

- BS xxxx (2018) watermist nozzle component test specification

www.redbooklive.com

Thank you

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Watermist components - nozzles
Watermist systems – LPS 1283 and LPS 1285
Third party approvals - increase confidence in product and system performance