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BRE Global Client Report

Fire experiment with an open nozzle detection activated DualMIST low pressure water mist system incorporating DM3 nozzles

Prepared for: Premier Mist (UK) Ltd

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Table of Contents

1 Introduction

BRE Global was requested by Premier Mist (UK) Ltd (hereafter referred to as the client) to undertake a fire experiment based on the methodology of British Standard 8489-7 'Fixed fire protection systems – Industrial and commercial watermist systems – Part 7: Fire performance tests and requirements for watermist systems for the protection of low hazard occupancies', 2016, against the scenario given in Clause 7.9. However, the fire experiment was carried out with the client's low pressure fixed open, detection actuated, water mist system.

The following deviations to the British Standard methodology were employed:

1. The ceiling height for the fire experiment was 7 m (maximum ceiling height of 5 m in BS 8489-7);
2. Open nozzles were used and the system was operated by the actuation of a smoke detection system (sealed automatic nozzles are required in BS 8489-7).

This report summarises the findings from the fire experiment carried out.

2 Experiment programme

A single fire experiment was conducted, using the DualMIST open pendent nozzle DM3 (see section 2.4) with the work station fuel loading positioned between four nozzles based on Clause 7.9 of BS 8489-7.

2.1 Ceiling

The non-combustible 6 m by 6 m ceiling was installed at a height of 7 m above ground level. A plan view schematic drawing of the experimental ceiling showing the position of nozzles and detector heads is shown in Figure 1.

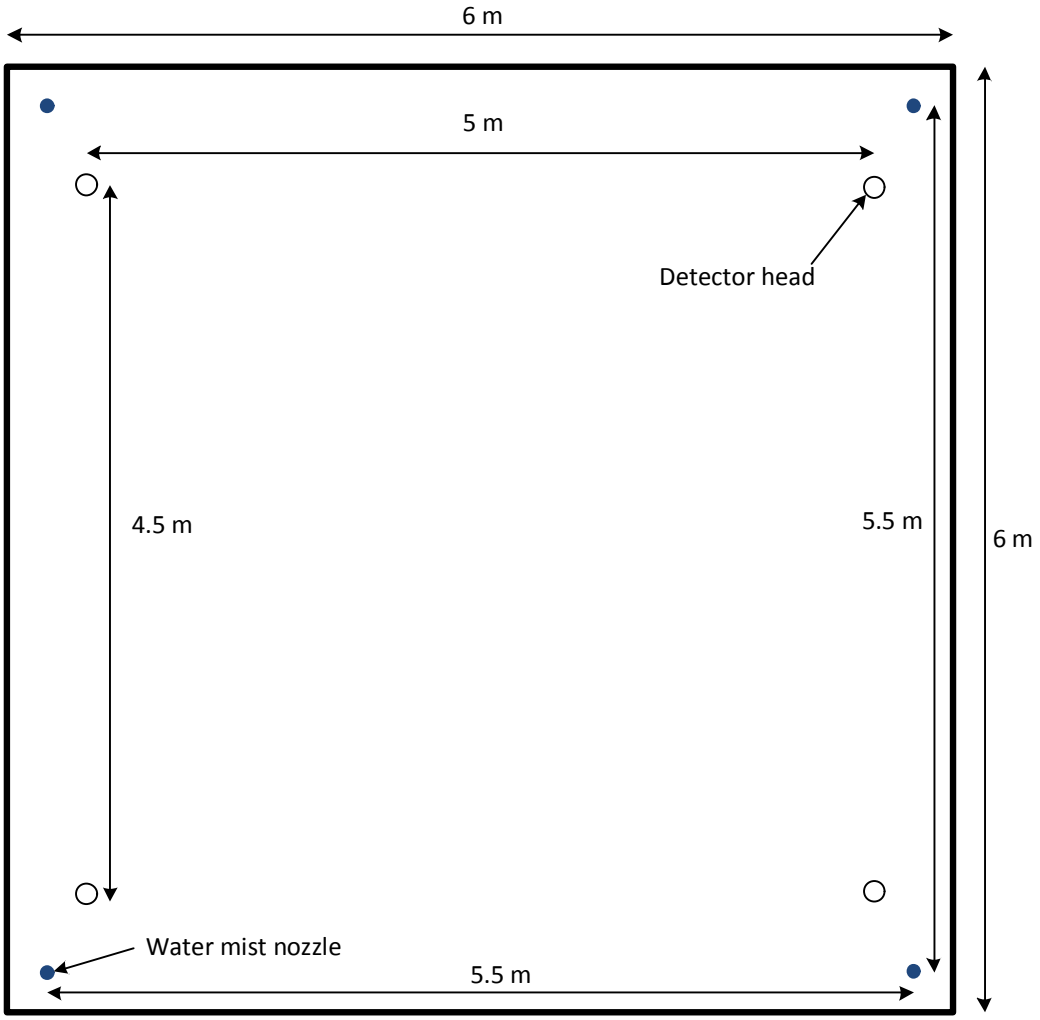

Figure 1 – Schematic plan view drawing of the ceiling

2.2 Fuel package

The fuel package for the experiment was as described in BS 8489-7 Annex B.4 and the fuel loading arrangement prior to the fire is shown in Figure 2.

Figure 2 – Fuel package

2.3 Instrumentation

Instrumentation was installed, as detailed in Table 1. A Graphtec GL800 data logger (water flow and pressure) and an Agilent 34980A data logger (temperatures) were used for data acquisition at a sample rate of 1 Hz.

Location	Instrumentation
Centre of four nozzles (above the ignition location), 76 mm below the ceiling (see Figure 6)	1.5 mm k-type thermocouples
Next to all four nozzle frangible bulb positions (95 mm below the ceiling)	1.5 mm k-type thermocouples
100 mm above each wood crib, centrally	1.5 mm k-type thermocouples
100 mm above corner box file arrangement, centrally	1.5 mm k-type thermocouples
2.5 m above the floor at the ends and corner of the walls	1.5 mm k-type thermocouples
Water supply pipe	1½" Barton turbine flow meter, 0 – 280 l/min. Druck PMP 4070 0 – 16 bar pressure transducer.

Table 1 – Summary of installed instrumentation

2.4 Premier Mist low pressure open nozzle water mist system

The client installed their detection operated low pressure open nozzle water mist system for the experiment. BRE Global was not involved in the specification or selection of the products assessed. Photographs of the pump set and pipe delivery components are shown in Figure 3. A datasheet for the nozzle was supplied by the client, see Appendix A.

The nozzles used during the programme (nozzle designation DM3) were of the pendent type.

The pipe system was coupled to a BRE water supply flow meter. A pressure transducer was installed 1.3 m downstream of the BRE water flow meter.

The DM3 nozzles used during the fire experiment were determined to have a nominal k-factor of 27 by BRE Global.

	
Water tank and pumps (three DAB NKV 3kW, three phase electrical units in parallel)	Strainer
	
Non-return valve	Isolation valve
	
Water supply line to nozzles	System control box

Figure 3 – Premier Mist water mist system components

The detection system was provided and installed by Faelsafe (SMC) Ltd, 1 Kings Croft, Drighlington, Bradford, BD11 1LA. The detection system comprised 4 photo electric ceiling mounted detectors, as shown in Figure 1. The detectors were wired to a detection control panel and alarm sounders. The detection system was set so that a minimum of two detectors were required to go into alarm mode ("double knock" system) before the control panel sent a signal to activate the water mist system. The system utilised a 30 second delay between activation of the detection system and operation of the water mist system. The water mist system was operated by the opening of an electrical isolation valve from a control panel signal. Further details on system components are included in Appendix B.

	
Detection system components	Alarm control panel
	
Ceiling arrangement	Ceiling mounted photo electric detector
	
Electrical isolation valve	Alarm sounders

Figure 4 – Detection system components

For the experiment, four nozzles were installed into the ceiling at a spacing of 5.5 metre centres. The nozzles were mounted such that the base of the nozzle was 180 mm below the ceiling, see Figure 5.

Ceiling mounted pipe and nozzle

Installed nozzle

Figure 5 – Premier Mist pipe and pendent DM3 nozzle

2.5 Experimental arrangements

The fuel loading configuration in relation to the ceiling and nozzle positions for the experiment conducted is shown in Figure 6.

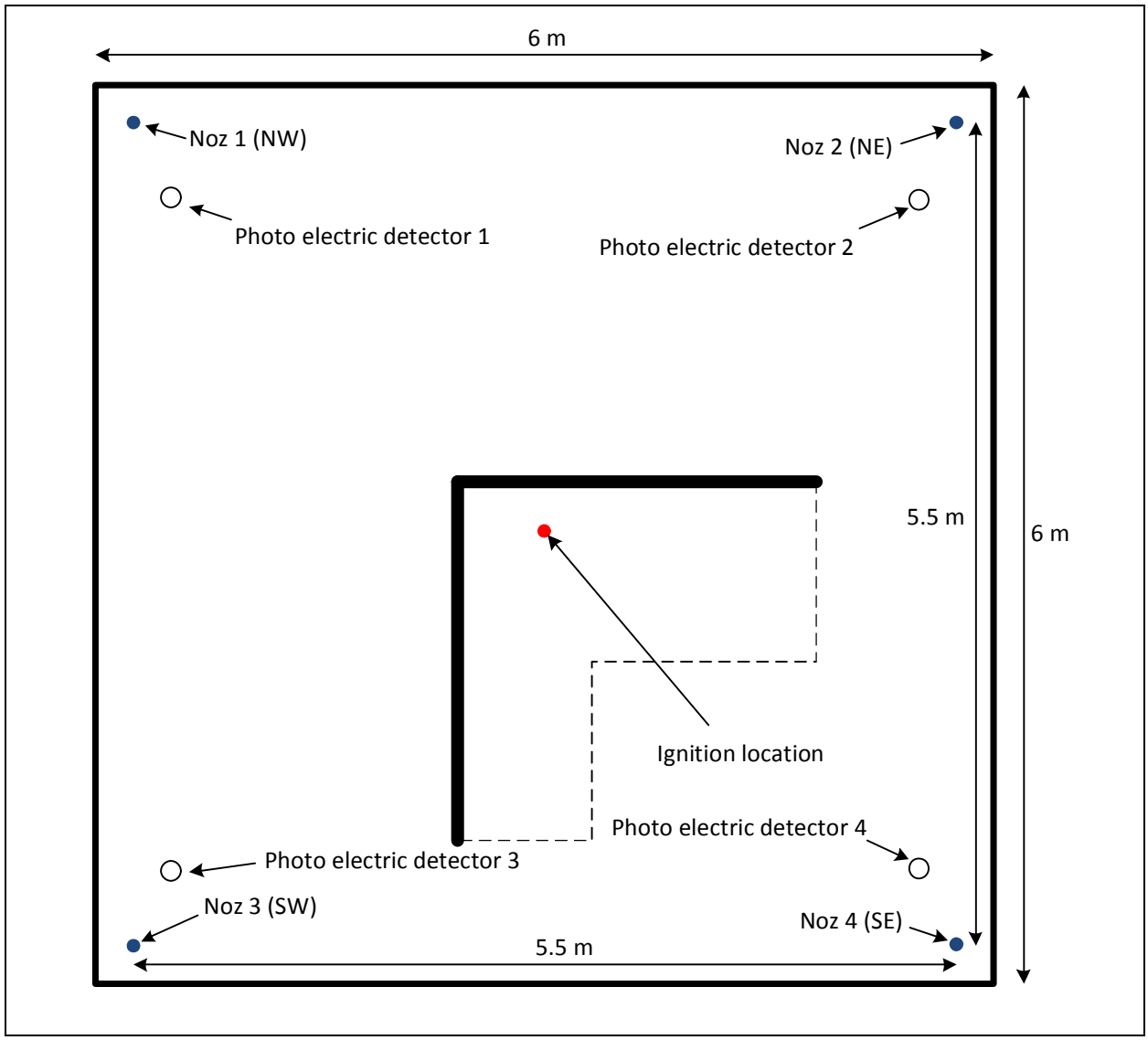

Figure 6 – Fuel loading position for the fire experiment

3 Experimental results

3.1 Experiment 1

The fire experiment was carried out on 12 January 2016 by BRE Global in the Burn Hall laboratory. Table 2 summarises the system activation times. The water mist system was operated for 30 minutes.

Nozzle/Detector (see Figure 1)	**Activation time (after ignition)**
Detector 1	1 minute 15 seconds (South East detector)
Detector 2	1 minute 26 seconds (North East detector)
Nozzle 1 (open)	1 minute 56 seconds
Nozzle 2 (open)	1 minute 56 seconds
Nozzle 3 (open)	1 minute 56 seconds
Nozzle 4 (open)	1 minute 56 seconds

Table 2 – Summary on nozzle activation times

The calculated average water flow rate during the 30 minutes of system operation was 258 l/min (associated coverage density of 2.1 mm/min over the 30.3 m^2 protection area).

The temperatures in the centre of the ceiling 76 mm below the surface (over the ignition point) are shown in Figure 7. Also included are thermocouples 76 mm below the ceiling on a 4 x 4 m array.

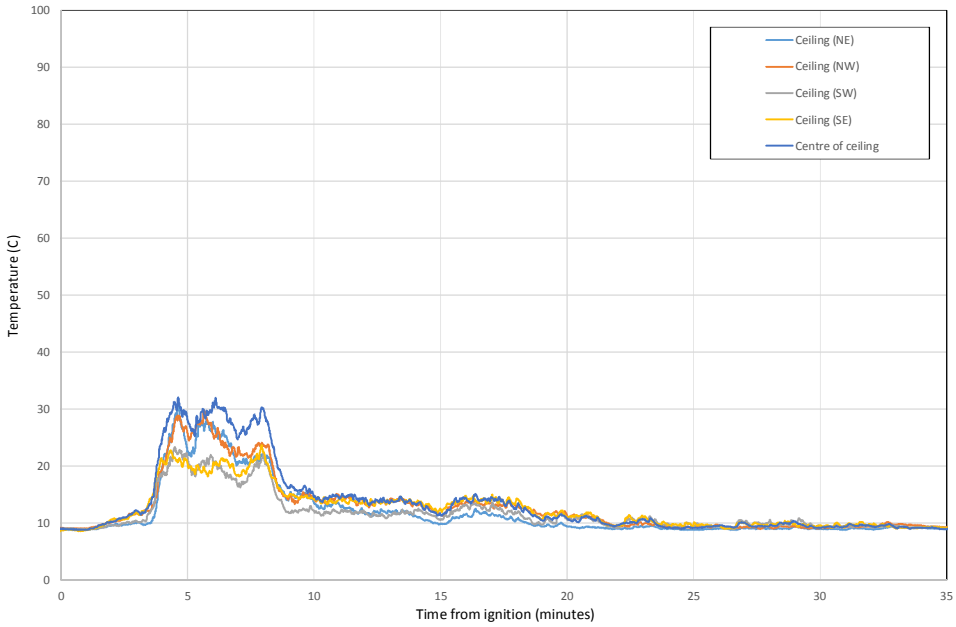

Figure 7 – Temperatures 76 mm below the ceiling

The fire temperatures are shown in Figure 8.

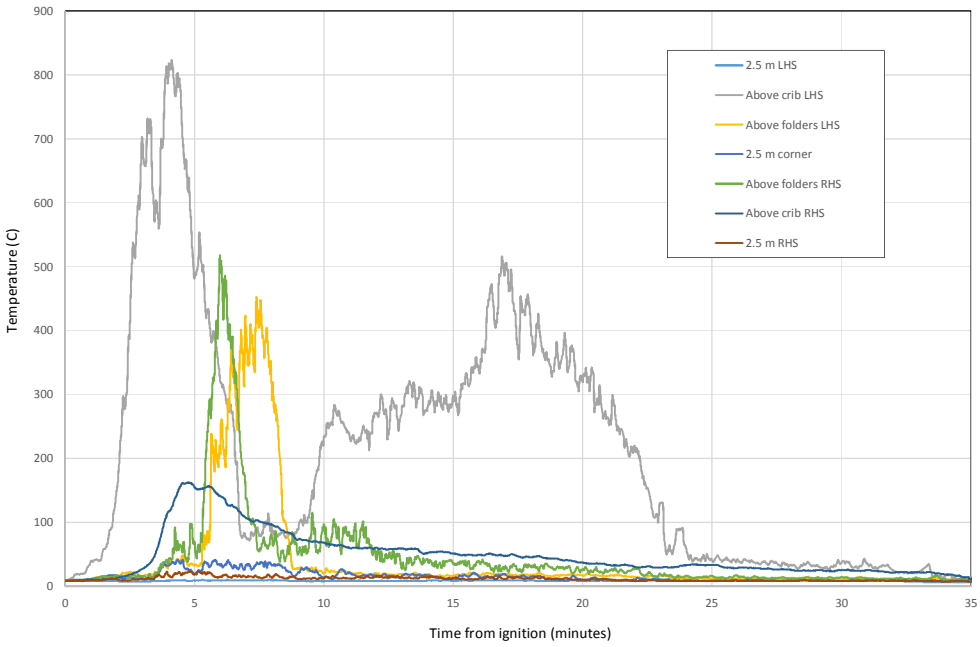

Figure 8 – Fire temperatures

The water supply flow rate for the experiment is shown in Figure 9.

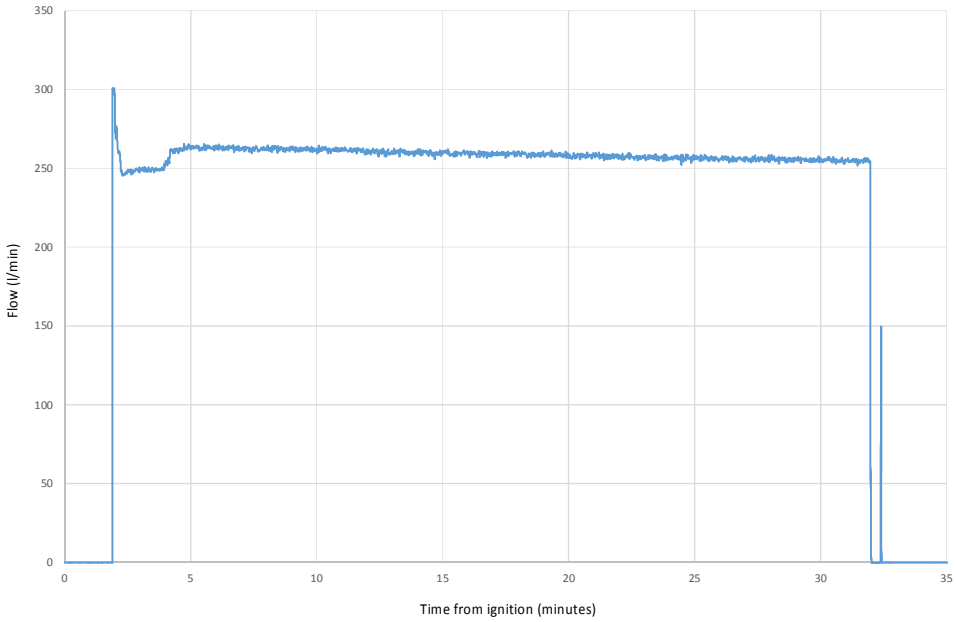

Figure 9 – Water supply flow rate

The water supply pressure (measured 1.3 m downstream of the BRE Global water flow meter) for the experiment is shown in Figure 10.

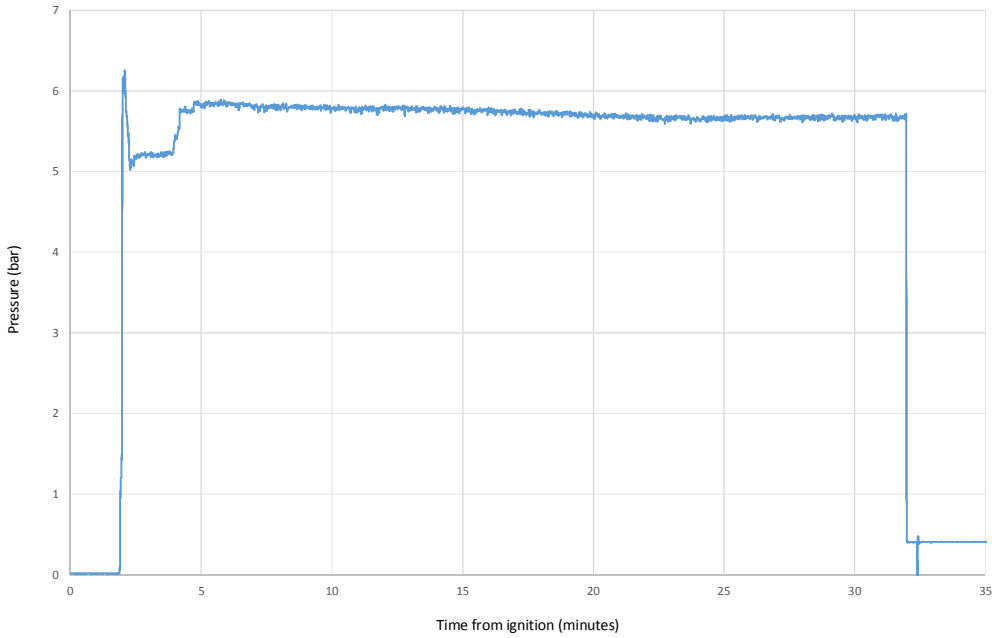

Figure 10 – Water supply pressure

A measured temperatures assessment for the experiment is shown in Table 3.

Thermocouple positions	Temperature assessment
76 mm below the ceiling, above the ignition location	The maximum gas temperature over ignition 76 mm below the ceiling did not exceeded 80 °C for the 30 minute duration of the system operation.
Ceiling level	After 5 minutes of system operation the mean temperature trend line remained steady or decreased.

Table 3 – Temperature assessment

The fire damage to the plywood walls is shown in Figure 11.

Figure 11 – Fire damage to the plywood walls, foam sheets and box files

The post-experiment fuel package fire damage assessment is summarised in Table 4 together.

Fuel package	**Fire damage assessment**
Plywood walls	Damage to the plywood walls did not extend to the full height at the ends of the walls.
Foam and box files	Damage to the foam and box files did not extend to all areas.

Table 4 – Fire damage assessment

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4 Conclusion

The Premier Mist water mist system, as detailed in this report, achieved the experimental fire results described in section 3 of this report.

Appendix A Premier Mist DM3 nozzle datasheet

DualMIST

DM3 Nozzle

Data Sheet 7.1

Product Description:

The DualMIST **DM3** pendant nozzle is to be installed in conjunction with the DualMIST low-pressure water mist EDA system. The nozzle has undertaken stringent fire testing by the globally recognised third party BRE Global to commercial & industrial water mist standards.

Activation:

In a fire condition, smoke activates local double knock smoke detectors which trigger the DualMIST EDA panel to open inline solenoid valves , thus releasing water into multiple nozzles to create a zonal deluge which then extinguishes or controls the fire.

Performance:

The nozzles' dual suppression technology produces remarkable results via multiple jet type ports giving a 30m² coverage per nozzle.

Technical Details:

Nozzle Reference: **DM3**
Bulb Temperature Rating: **N/A**
K Factor: **29**
Typical flow rate / pressure: **65 L/min @ 5 bar**
Minimum Working Pressure: **4 bar**
Maximum Working Pressure: **10 bar**
Factory Pressure Test: **40 bar**
Standard Adapter Thread Size: **15mm BSP**
Strainer: **Yes**

Finishes:

Brass (Natural)
Brass (Nickel Plated)
Brass (Gold Plated)

Accessories:

Single Piece Escutcheon (Rosette)
DM3 Nozzle Installation Tool

Approval:

Third Party Approval Organisation: **BRE GLOBAL**
Date of Testing: **November 2015**
Fire Test Undertaken: **BS 8489-7**

Design Parameters:

Style: **Pendant**
Maximum Spacing: **5.5m centres**
Maximum From Boundary: **2.75m centres**
Minimum Spacing: **1m centres**

T : 0845 838 4361 Approved Installer: Premier Mist UK LTD W : www.premiermist.com

Dual MIST

DM3 Nozzle

Data Sheet 7.1

Installation:

1. The **DM3** nozzle must be installed and maintained in compliance with this document and according to the standards, or the requirements which are specified by the Authority Having Jurisdiction. It is the installers responsibility to conform to such standards and requirements, deviations from the requirements will void any warranty.

2. To ensure that the minimum flow requirement is met the system piping must be correctly sized.

3. To avoid mechanical damage the nozzles must be installed after the piping is in place. Any damaged nozzles must be replaced.

4. The **DM3** nozzle is to be installed in the pendant orientation only.

5. Hand tighten the nozzle into the fitting, then use the **DM3** nozzle installation tool to tighten the nozzle into the fitting.

Care & Maintenance:

1. Nozzles must be carefully handled

2. Nozzles must never be painted, plated, coated or otherwise modified after leaving the factory.

3. The nozzles should remain packaged as supplied by the factory until the time of installation.

4. Do not install nozzles which have been dropped or damaged in any way.

5. Installed nozzles should be inspected by a competent person through the life time of the nozzles.

Warranty:

From dispatch a 12 month warranty period is in place.
For full details please refer to our standard terms & conditions.

Page 2 of 2

T : 0845 838 4361 Approved Installer: Premier Mist UK LTD W : www.premiermist.com

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Appendix B Detection system components

HOCHIKI
World Class Leaders in Fire Detection Since 1918

Analogue Photoelectric Smoke Sensor

ALN-EN

Features

- Removable, High Performance chamber
- Twin LEDs allow 360° viewing – green when polling, turn red in fire
- Locking mechanism (sensor to base)
- Variable sensitivity
- Electronically addressed
- Pulsing/non-pulsing controlled from panel*
- Approved by LPCB & VdS
- SIL Level 2 approved variants available
- Available in white

Description

Model ALN-EN is a Photoelectric Smoke Sensor, which is fully compatible with Hochiki's ESP Analogue Addressable Protocol.

The ALN-EN incorporates Hochiki's newest High Performance Chamber Technology removing the need to use Ionisation Smoke Sensors in the majority of applications. This also allows the sensor threshold level to be increased, thereby improving the signal to noise ratio and reducing susceptibility to false alarms.

The ALN-EN smoke chamber is easily removed or replaced for cleaning and utilises a unique improved baffle design which allows smoke to enter the chamber whilst keeping out ambient light.

Specification	
Ordering Code	ALN-EN ALN-EN(WHT)
Operating Voltage	17 – 41 V d.c.
Low Power Mode (typ)	120 A
Quiescent Current (typ)	400 µA
Alarm Current (controlled by CIE)	9.1 mA (excluding remote indicator)
Transmission Method	Digital Communications Using ESP
Operating Temperature Range	-10 °C to + 50 °C
Operating Humidity	95% RH - Non Condensing (at 40 °C)
Storage Temperature Range	-30 °C to +60 °C
Storage Humidity	<80% RH at 60 °C
Colour / Case Material	Ivory or White / ABS
Weight (g)	95
Diameter (mm) / Height (mm)	100 / 45
Compatible Bases	YBN-R/3, YBO-R/SCI, YBO-BS, YBO-BSB, YBN-R/3(SCI)
Base Fixing Centres (mm)	48 ~ 74
Approvals	LPCB & VdS

*Control Panel compatibility required

DS58.09.2016

Syncro XT+

Multi-Area Addressable Extinguishant Control Panels

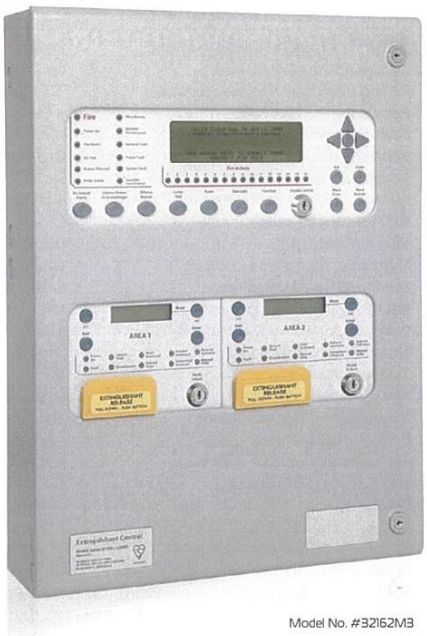
BS-EN12094-1
KM 96761

Features

- Approved to EN12094-1, EN54-2 and EN54-4
- 16 detection zones
- Up to 4 extinguishant areas
- Dual extinguishant outputs for each area (configurable as Main/Reserve)
- First and second stage sounder outputs for each area
- First and second stage volt free changeover contacts for each area
- Released volt free contact per area
- Fault volt free contact per area
- Programmable extinguishant delays
- Programmable output duration
- Countdown indicator shows time until release in seconds
- Mode select and manual release controls per area
- Monitored remote manual release input
- Monitored remote hold input
- Monitored remote mode select (door interlock) input
- Monitored remote released pressure switch input
- Monitored Abort input
- Serial connections for Sigma Si status units and ancillary boards. (KS88)

Product Overview

- Syncro XT+ control panels are multi-area extinguishant control panels complying with EN12094-1, EN54-2 and EN54-4.
- Up to 16 zones of addressable detection over 1 or 2 loops are availabel for extinguishant release. Up to 4 extinguishant areas are available.
  Stand alone extinguishant control units are also available with 2 monitored inputs to receive initiating signals from remote fire detection control panels or addressable modules.
- Each extinguishant area has a comprehensive set of inputs and outputs and is configurable via a simple programming interface. All extinguishant areas may have up to 7, serially connected Sigma Si status indication and control units or ancillary relay boards connected via a simple 4 core cable.
- For compatible status units see Sigma Si data sheet DS41.



Model No. #32162M3

Panels

Product Code	Loop	Areas	Size (mm)
#31161M3	1	1	385 x 520 x 110
#32161M3	2	1	385 x 520 x 110
#31162M3	1	2	385 x 520 x 110
#32162M3	2	2	385 x 520 x 110
#31163M4	1	3	385 x 700 x 145
#32163M4	2	3	385 x 700 x 145
#31164M4	1	4	385 x 700 x 145
#32164M4	2	4	385 x 700 x 145

'#' - replace with 'A' for Apollo protocol or 'H' for Hochiki protocol.

Technical

Construction	-	1.2mm mild sheet steel
IP Rating	-	IP30
Finish	-	Epoxy powder coated
Colour - lid & box	-	BS 00 A 05 grey - fine texture
Colour - controls plate & labels	-	RAL 7047 light grey - satin
Weight	-	10kg
Mains supply	-	230V AC, 50Hz +10% - 15% (100 Watts maximum)
Mains supply fuse	-	1.6 Amp (F1.6A L250V)
Power supply rating (1 & 2 area units)	-	3 Amps total including battery charge 28V +/- 2V
Power supply rating (3 & 4 area units)	-	4 Amps including battery charge 28V +/- 2V
Maximum ripple current	-	200 millivolts
Battery charge voltage	-	27.6VDC nominal (temperature compensated)
Battery charge current	-	0.7A maximum
Battery fuse	-	20mm, 3.15A glass
Current draw in mains fail condition	-	54 milliamps per extinguishing module
Max. current draw from batteries	-	3A (#31161M3, #32161M3, #31162M3, #32162M3) 5.25A (#31163M4, #32163M4, #31164M4, #32164M4)
Sigma XT+ module Aux 24V output	-	Fused at 500mA with electronic fuse - 1 per extinguishant area
Syncro AS Aux 24V output	-	Fused at 2.5A - not available to user
1st and 2nd stage Sounder outputs	-	21 to 28V DC Fused at 1A with electronic fuse
Fault relay contact rating	-	5 to 30VDC 1A Amp maximum for each
Fire relay contact rating	-	5 to 30VDC 1A Amp maximum for each
Local fire relay contact rating	-	5 to 30VDC 1A Amp maximum for each
First stage contact rating	-	5 to 30VDC 1A Amp maximum for each
Second stage contact rating	-	5 to 30VDC 1A Amp maximum for each
Extract contact rating	-	5 to 30VDC 1A Amp maximum for each
Terminal capacity	-	0.5mm2 to 2.5mm2 solid or stranded wire
Number of sounders per circuit	-	Dependent on type and current consumption - typically 20+
Monitored input end of line	-	6K8 +/- 5% ½ Watt resistor
Sounder circuit end of line	-	10K +/- 5% ¼ Watt resistor
Extinguishant output end of line	-	1N4004 Diode
Number of detection loops	-	1 or 2
Number of zones	-	16
No. of sounder circuits	-	Dependent on model 21 to 28V DC
Extinguishant release output	-	21 to 28V DC. Fused at 1 Amp
Extinguishant release delay	-	Adjustable 0 to 60 seconds (+/- 10%)
Extinguishant release duration	-	Adjustable 60 to 300 seconds
SIL, AL, FLT, RST inputs	-	Switched -ve, min resistance 0 ohms, max resistance 100 Ohms
Cabling	-	FP200 or equivalent (max capacitance 1uF max inductance 1 mH
Monitored inputs normal threshold	-	10K ohm to 2K ohm
Monitored inputs alarm threshold	-	2K ohms to 150 ohms +/- 5%
Monitored inputs Short circuit threshold	-	140 ohms to 0 ohms +/- 5%
Status unit/Ancillary board connection	-	Two wire RS485 connection (EIA-485 specification)
Status unit power output	-	21 to 28V DC. Fused at 500mA with electronic fuse

Extinguishant System Control

The manufacturer reserves the right to amend specifications without prior notice

HOCHIKI
World Class Leaders in Fire Detection Since 1918

Analogue Wall Sounder
CHQ-WS2

Features

- Loop Powered
- Single Loop Address - addressed via the TCH-B100 Hand Held Programmer
- Variable Sound Output
  90 ~ 102 dB(A) (±2 dB(A)) output at 1 metre
- Fits Hochiki Standard or Isolator Base
- Weatherproof Kit available
- 51 User-Selectable Tones (all tones EN54-3 compatible)
- Also available in white
- Approved by LPCB & VdS
- SIL Level 2 approved variants available

Description

Model CHQ-WS2 is an addressable loop powered Wall Sounder innovatively designed to provide a range of tones and volumes with a maximum output of up to 102dB(A) (±2dB(A)) with low current consumption. The unit is designed to fit to the Standard Base (YBO-R/3(RED)) or the Isolator Base (YBO-R/SCI(RED)). The sounder is IP rated to IP21 for internal use but it can be made weatherproof by utilising the WS2-WPK Weatherproof Kit, which consists of a specialised back box and gasket set.

Also incorporates an auto shutdown mode* which allows the user to set a fixed time within which the sounder will operate, before automatically silencing itself, ideal for minimising noise pollution.

Specification	
Ordering Codes	CHQ-WS2 / CHQ-WS2(WHT) WS2-WPK (Weatherproof Kit)
Operating Voltage	17 ~ 41 VDC
Quiescent Current (typ)	150 µA (with YBO-R/3(RED)) 200 µA (with YBO-R/SCI(RED))
Sounding Current (typ)	2 mA (90 dB(A) (±2 dB(A)) @ 1 m) ~ 8 mA (102 dB(A) (±2 dB(A)) @ 1 m)
Sound Output (at 1 metre)	90 ~ 102 dB(A) (±2 dB(A)) @ 24 VDC or above
Number of Tones	51
Tone Frequency Range	300 Hz ~ 2850 Hz
Operating Temperature Range	-10 °C to +50 °C
Storage Temperature Range	-30 °C to +70 °C
Maximum Humidity	95% RH - Non Condensing (at 40 °C)
Colour/Case Material	Red or White/ PC ABS
Ingress Protection Rating	IP21 (IP65 with WS2-WPK)
Weight (g)/Dimensions (mm)	152 / H112 x W112 x D67
Base Fixing Centres (mm)	48 ~ 74

*Dependent on control panel compatibility.

Note: Although the TCH-B100 Hand Held Programmer will allow addresses between 128 and 254 to be programmed into the CHQ-WS2, addresses 1 to 127 ONLY should be used.

Report Ends