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BRE Global Test Report

Fire tests to BS 8489-7 with a DualMIST low pressure water mist system incorporating DM4-C 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 series of test fires to 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 scenarios given in Clauses 7.7, 7.8 and 7.9. This report summarises the findings from the test programme and reports the results against the relevant fire performance requirements in Clause 8 f) and g).

2 Test programme

A series of three tests was conducted in accordance with BS 8489-7, using the DualMIST DM4-C pendent nozzle (see section 0) as follows:

1. Work station between four nozzles (Clause 7.9)
2. Work station between two nozzles (Clause 7.8)
3. Work station under one nozzle (Clause 7.7)

2.1 Test ceiling

The non-combustible 6 m by 6 m ceiling was installed at a height of 5 m above ground level. A plan view schematic drawing of the test ceiling is shown in Figure 1.

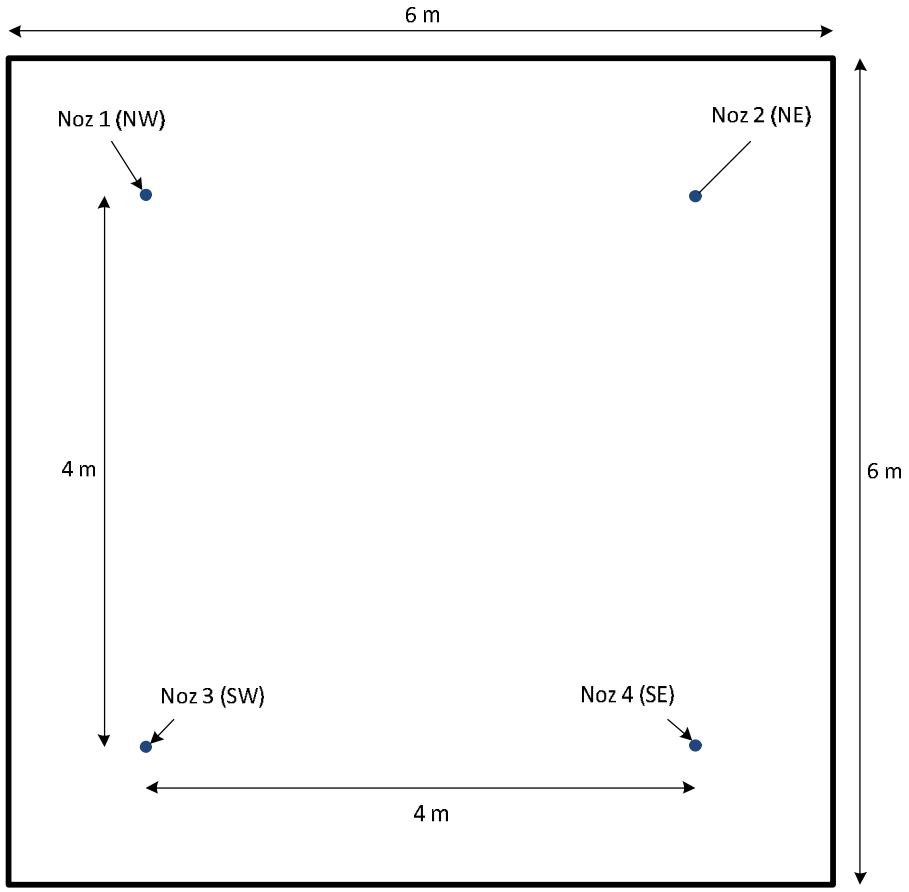

Figure 1 – Schematic plan view drawing of the test ceiling

2.2 Fuel package

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

Figure 2 – Fuel package

2.3 Instrumentation

The 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
Fire scenario Clause 7.9: Centre of four nozzles (above the ignition location), 76 mm below the ceiling (see Figure 5)	1.5 mm k-type thermocouples
Fire scenario Clause 7.8: Mid-point of two nozzles (above the ignition location), 76 mm below the ceiling (see Figure 6)	1.5 mm k-type thermocouples
Fire scenario Clause 7.7: Next to all four nozzle frangible bulb positions (95 mm below the ceiling)	1.5 mm k-type thermocouples
All scenarios: 100 mm above each wood crib, centrally	1.5 mm k-type thermocouples
All scenarios: 100 mm above corner box file arrangement, centrally	1.5 mm k-type thermocouples
All scenarios: 2.5 m above the floor at the ends and corner of the walls	1.5 mm k-type thermocouples
All scenarios: 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 water mist system

The client installed their automatically operating low pressure water mist system for the testing. BRE Global was not involved in the specification or selection of the products tested. Photographs of the pump set and pipe delivery components are shown in Figure 3.

The nozzles used during the programme (nozzle designation DM4-C) were of the pendent type with a vertically mounted 57 ^{o}C frangible 3 mm F3 Job^{TM} glass bulb. A datasheet for the nozzle was supplied by the client, see Appendix A.

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.

A DualMIST DM4-C nozzle used in the test programme was determined to have a k-factor of 28 by BRE Global.

	
Water tank, pumps (two DAB NKV 3kW, three phase electrical units in parallel) and system components	Strainer
	
Pressure switch with visual pressure display (Sick AG, PBS Model 6039828)	Flow meter with visual flow display (Kobold DUK 0.6-150 l/min)
	
Isolation valve	Non-return valve
	
Visual pressure gauge	System control box

Figure 3 – Premier Mist water mist system components

For each test, four nozzles were installed into the test ceiling at a spacing of 4 metre centres. The nozzles were mounted such that the centre of the 57 ºC frangible bulb was 95 mm below the ceiling, see Figure 4.

Ceiling mounted pipe

Installed nozzle

Figure 4 – Premier Mist pipe array and pendent nozzle

2.5 Test arrangements

The fuel loading configuration in relation to the ceiling and nozzle positions for the tests conducted is shown in Figure 5 to Figure 7.

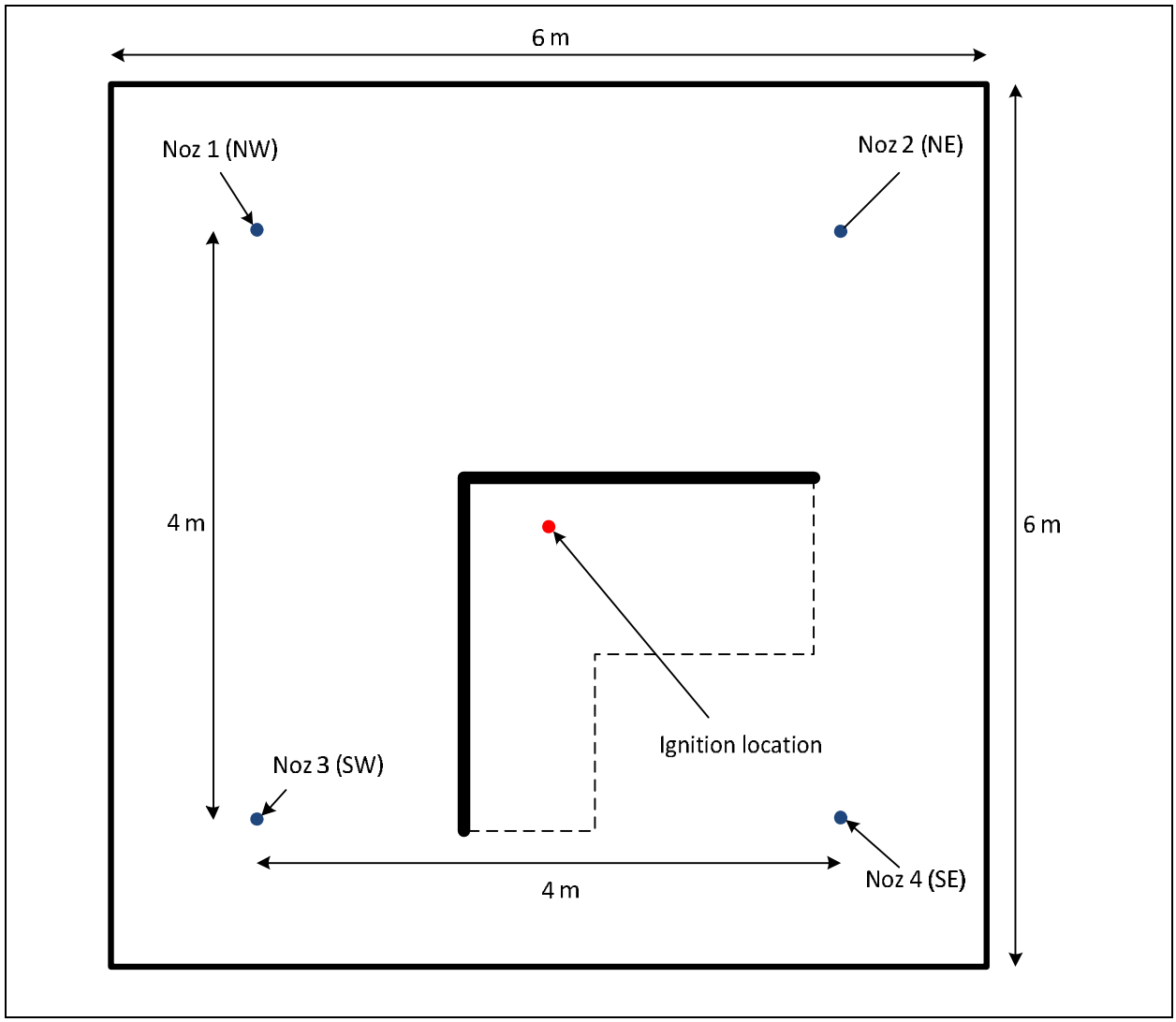

Figure 5 – Fuel loading position for Test 1 (Clause 7.9)

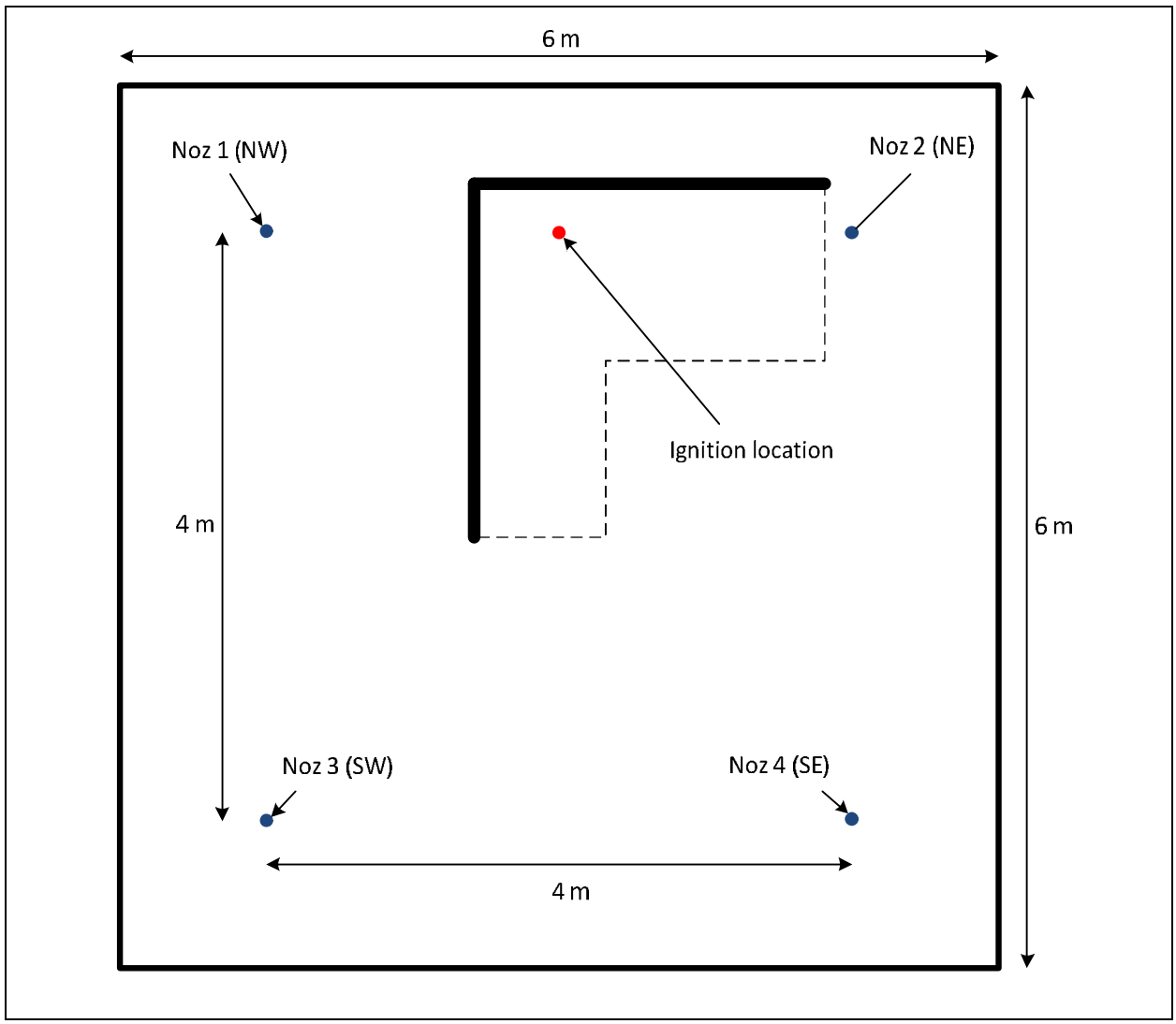

Figure 6 – Fuel loading position for Test 2 (Clause 7.8)

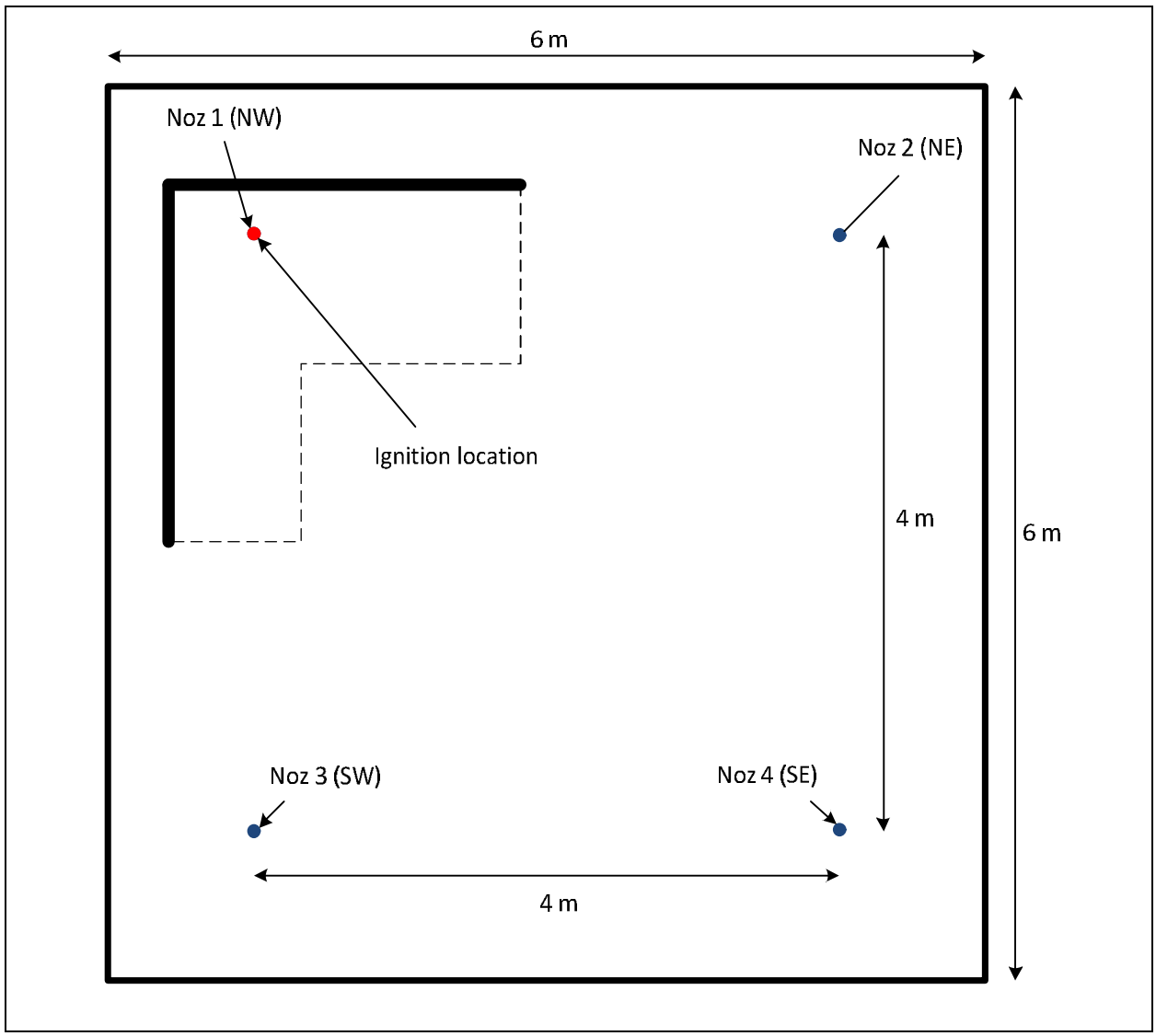

Figure 7 – Fuel loading position for Test 3 (Clause 7.7)

3 Test results

3.1 Test 1 to BS 8489-7 Clause 7.9

The fire test was carried out on 24 November 2015 by BRE Global in the Burn Hall laboratory. Table 2 summarises the nozzle activation times. The water mist system was operated for 30 minutes.

Nozzle (see Figure 1)	**Activation time (after ignition)**
Nozzle 1	6 minutes 32 seconds
Nozzle 2	6 minutes 59 seconds
Nozzle 3	6 minutes 52 seconds
Nozzle 4	Did not operate

Table 2 – Summary on nozzle activation times

The calculated average water flow rate during the 30 minutes of system operation was 206 l/min (associated coverage density of 4.3 mm/min based on a 16 m^2 coverage area).

The temperatures in the centre of the ceiling 76 mm below the surface (over the ignition point) are shown in Figure 8.

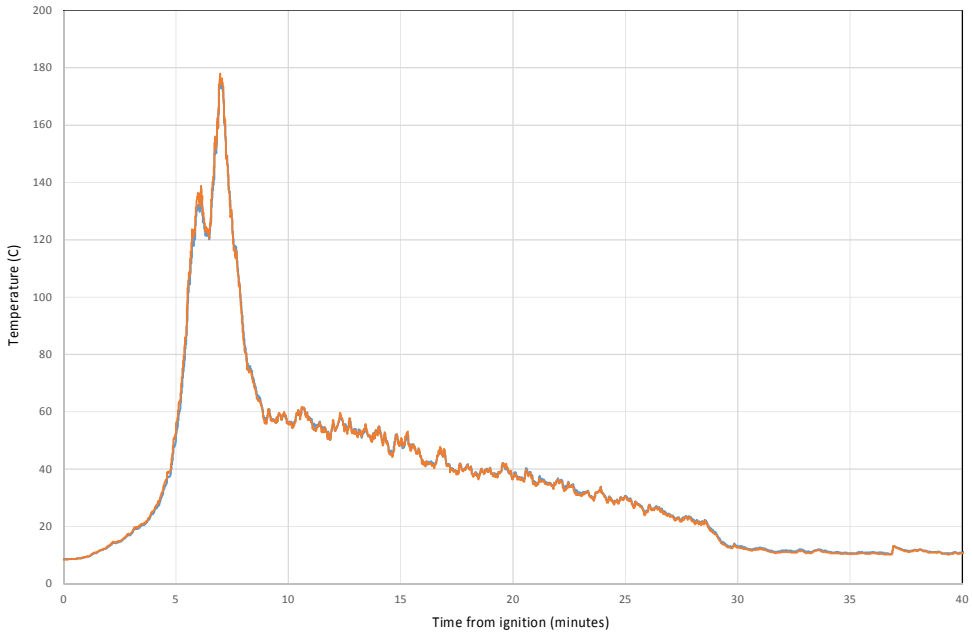

Figure 8 – Temperatures 76 mm below the ceiling

The temperatures next to the frangible bulbs at each of the nozzles are shown in Figure 9.

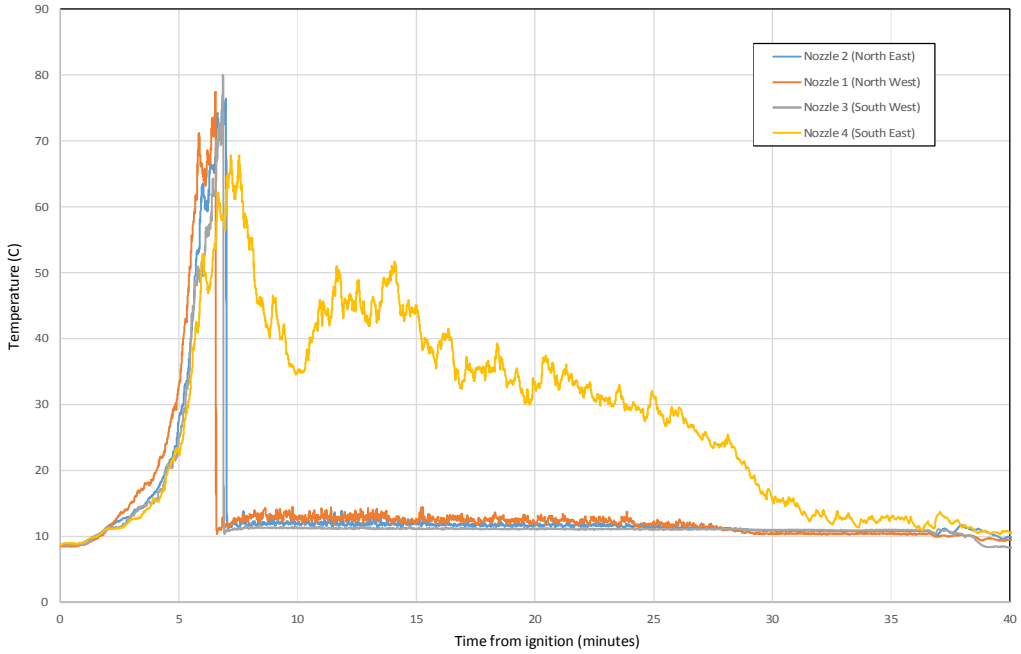

Figure 9 – Temperatures next to the nozzles

The fire temperatures are shown in **Figure 10**.

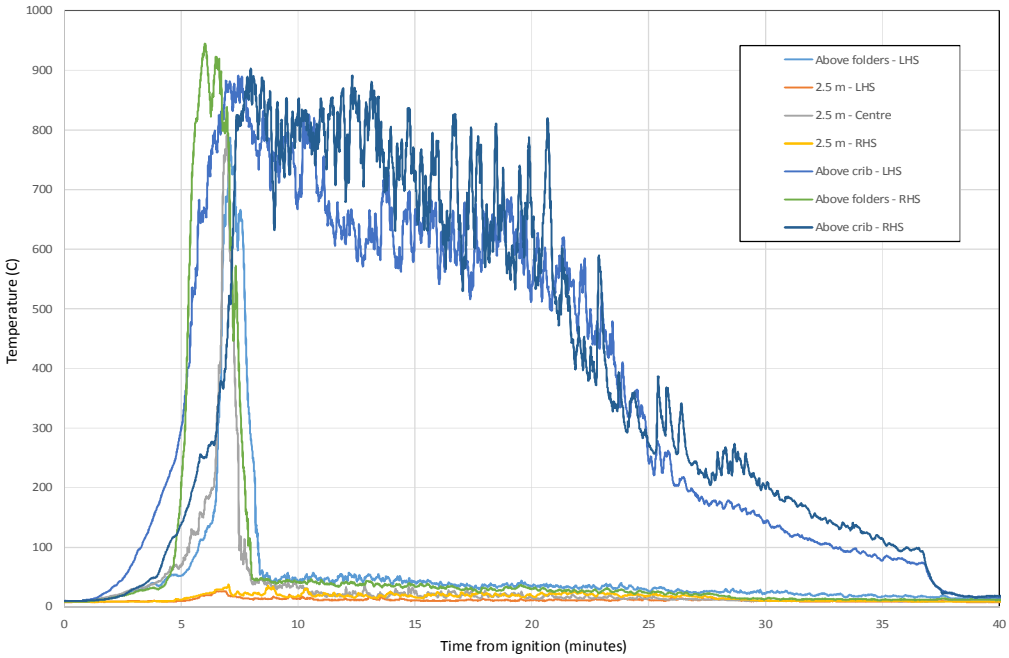

Figure 10 – Fire temperatures

The water supply pressure (measured 1.3 m downstream of the BRE Global water flow meter) for the test is shown in Figure 11.

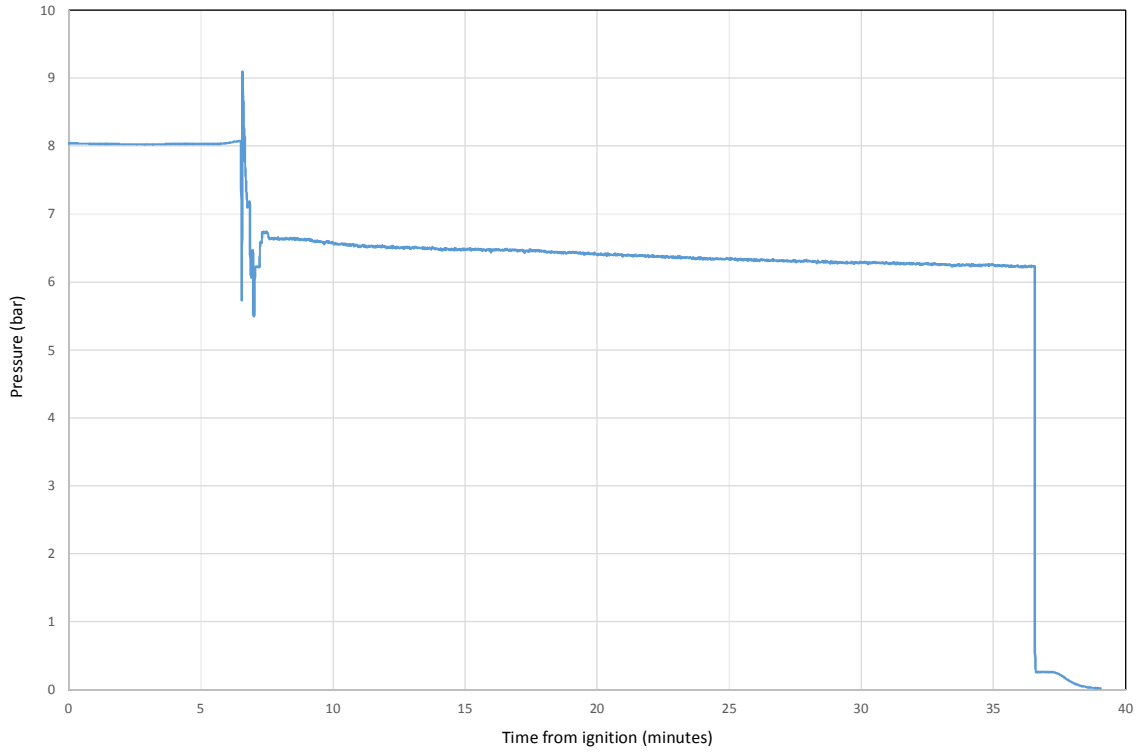

Figure 11 – Water supply pressure

A measured temperatures assessment for the test is shown in Table 3 together with the BS 8489-7 criteria.

Thermocouple positions	BS 8489-7 test pass/fail criteria	Temperature assessment
76 mm below the ceiling, above the ignition location	The maximum gas temperature over ignition 76 mm below the ceiling does not exceed 80 ºC, for a duration longer than 3 minutes for the 30 minute system discharge.	The maximum gas temperature over ignition 76 mm below the ceiling exceeded 80 ºC, for a duration of 1 minute 37 seconds (6 minutes 32 seconds until 8 minutes 9 seconds).
Ceiling level	After 5 minutes (from the start of system operation) the mean temperatures remain steady or decrease until the end of the test.	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 12.

Figure 12 – Fire damage to the plywood walls, foam sheets and box files

The post-test fuel package fire damage assessment is summarised in Table 4 together with the BS 8489-7 criteria.

Fuel package	BS 8489-7 test pass/fail criteria	Fire damage assessment
Plywood walls	Damage to the plywood walls does not extend to the full height at the ends of the 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 does not extend to all areas.	Damage to the foam and box files did not extend to all areas.

Table 4 – Fire damage assessment

3.2 Test 2 to BS 8489-7 Clause 7.8

The fire test was carried out on 26 November 2015 by BRE Global in the Burn Hall laboratory. Table 5 summarises the nozzle activation times. The water mist system was operated for 30 minutes.

Nozzle (see Figure 1)	**Activation time (after ignition)**
Nozzle 1	5 minutes 34 seconds
Nozzle 2	7 minutes 21 seconds
Nozzle 3	Did not operate
Nozzle 4	Did not operate

Table 5 – Summary on nozzle activation times

The calculated average water flow rate during the 30 minutes of system operation was 138 l/min (associated coverage density of 4.3 mm/min based on a 16 m^2 coverage area).

The temperatures 76 mm below the ceiling (over the ignition point) are shown in **Figure 13**.

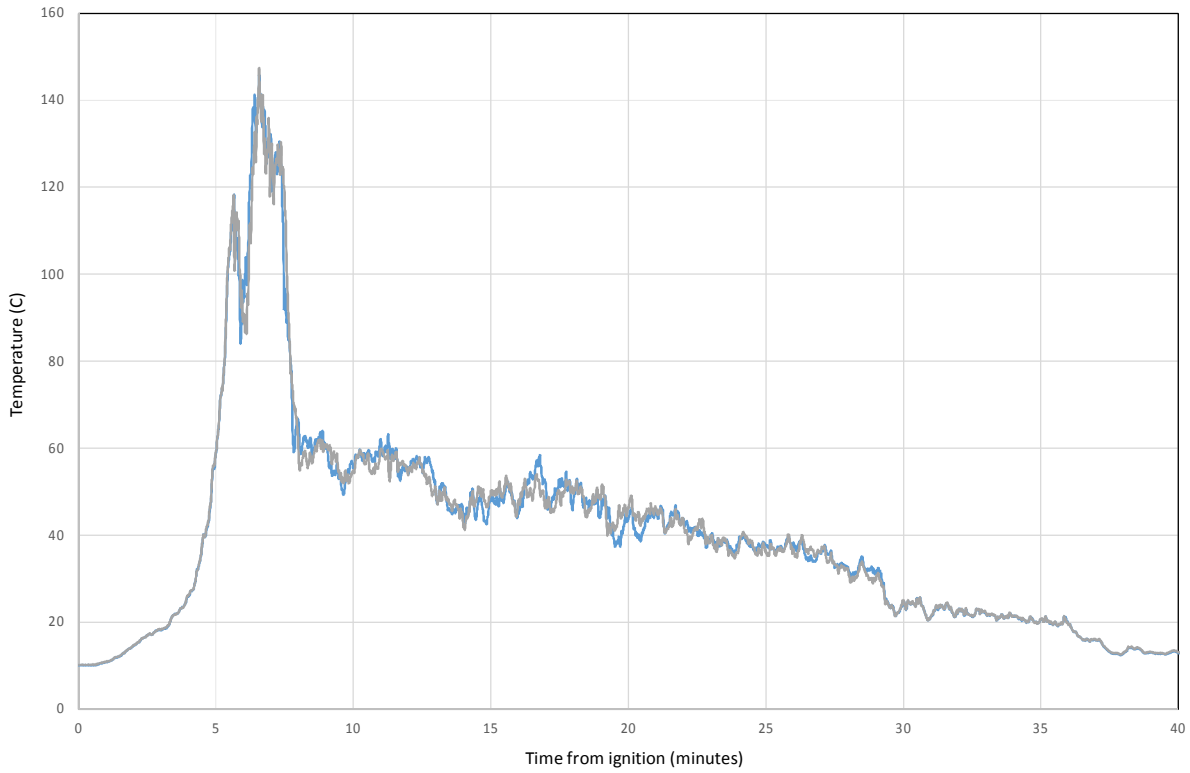

Figure 13 – Temperatures 76 mm below ceiling

The temperatures next to the frangible bulbs at each of the nozzles are shown in **Figure 14**.

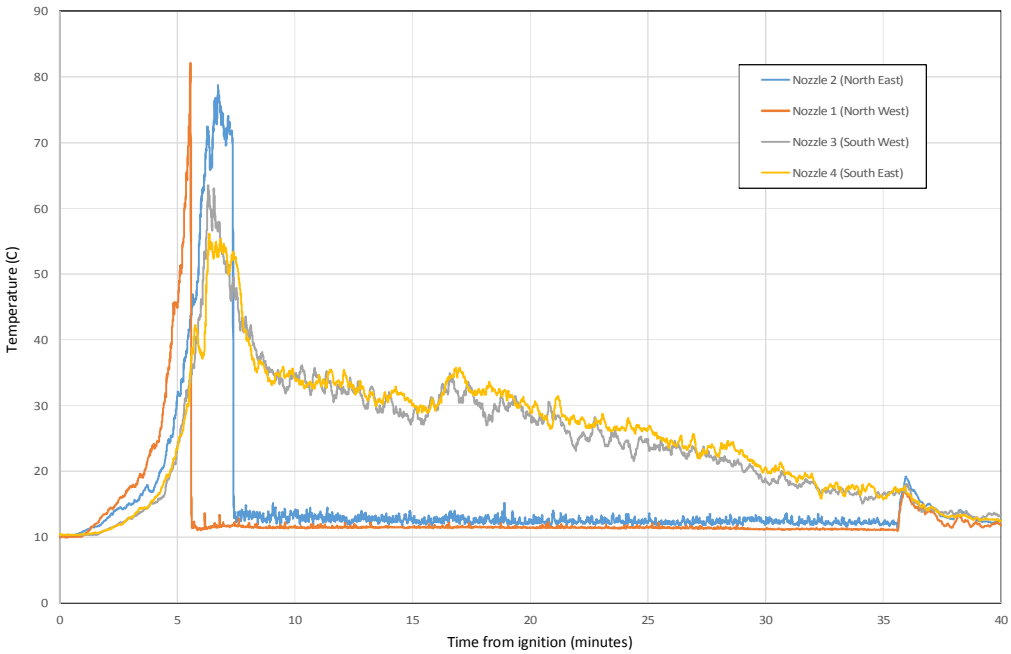

Figure 14 – Temperatures next to the nozzles

The fire temperatures are shown in **Figure 15**.

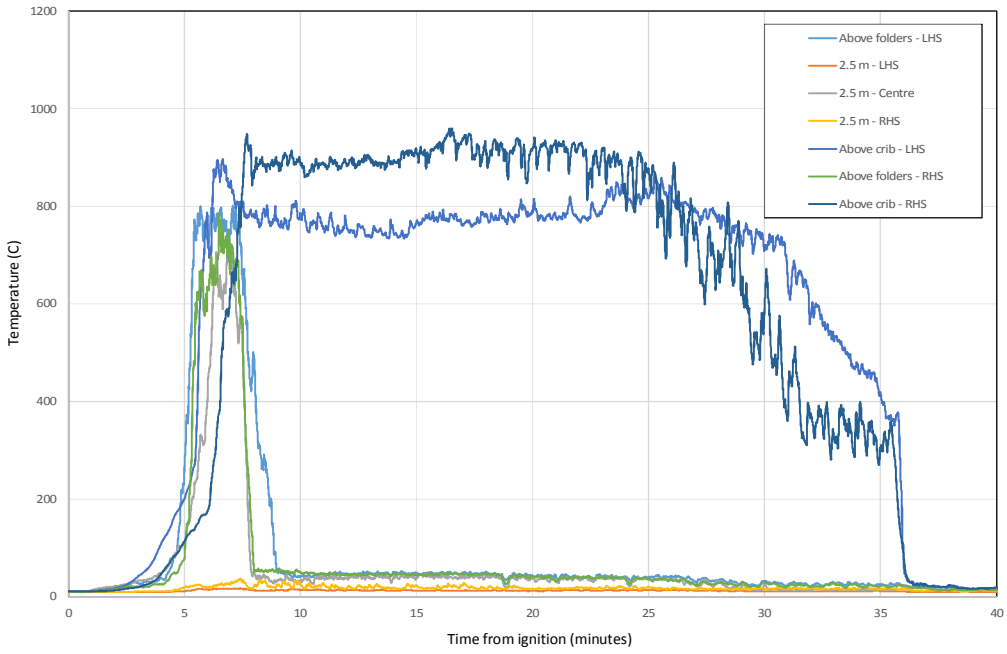

Figure 15 – Fire temperatures

The water supply pressure for the test is shown in **Figure 16**.

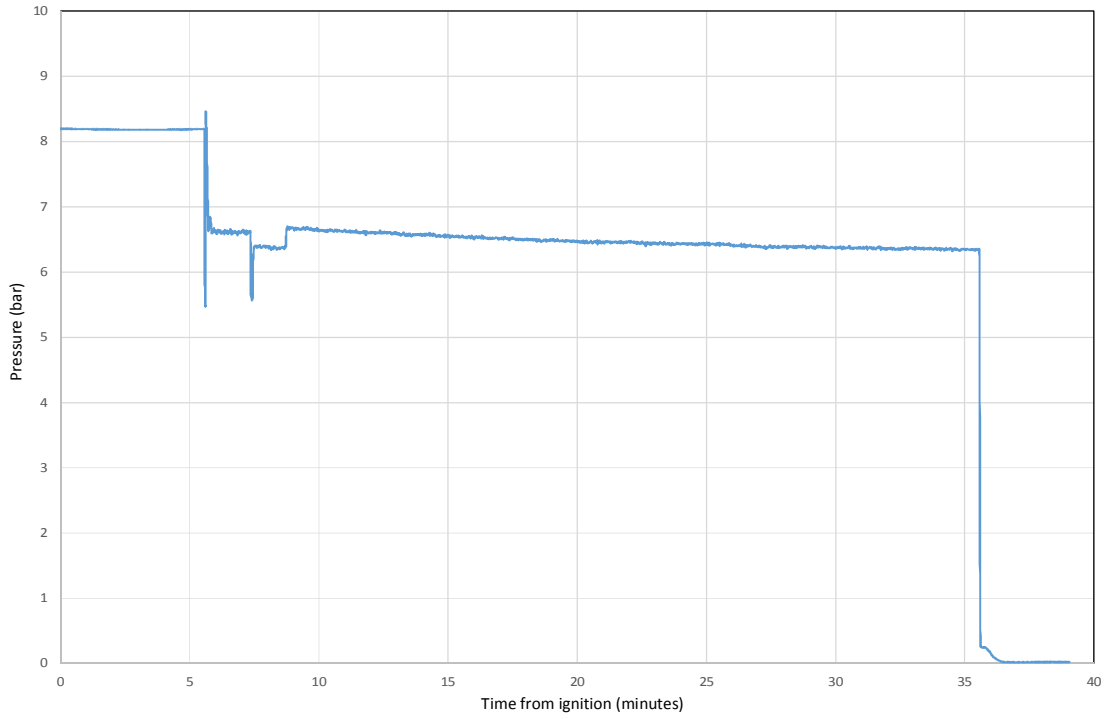

Figure 16 – Water pressure

A measured temperatures assessment for the test is shown in Table 6 together with the BS 8489-7 criteria.

Thermocouple positions	**BS 8489-7 test pass/fail criteria**	**Temperature assessment**
76 mm below the ceiling, above the ignition location	The maximum gas temperature over ignition 76 mm below the ceiling does not exceed 80 ºC, for a duration longer than 3 minutes for the 30 minute system discharge.	The maximum gas temperature over ignition 76 mm below the ceiling exceeded 80 ºC, for a total duration of 2 minutes 9 seconds during the 30 minute system discharge (5 minutes 34 seconds until 7 minutes 43 seconds).
Ceiling level	After 5 minutes (from the ignition of both wood cribs) the mean temperatures remain steady or decrease until the end of the test.	After 5 minutes of ignition of both wood cribs the mean temperature trend line remained steady or decreased.

Table 6 – Temperature assessment

The fire damage to the plywood walls is shown in **Figure 17**.

Figure 17 – Fire damage to the plywood walls, foam sheets and box files

The post-test fuel package fire damage assessment is summarised in Table 7 together with the BS 8489-7 criteria.

Fuel package	**BS 8489-7 test pass/fail criteria**	**Fire damage assessment**
Plywood walls	Damage to the plywood walls does not extend to the full height at the ends of the 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 does not extend to all areas.	Damage to the foam and box files did not extend to all areas.

Table 7 – Fire damage assessment

3.3 Test 3 to BS 8489-7 Clause 7.7

The fire test was carried out on 1 December 2015 by BRE Global in the Burn Hall laboratory. Table 8 summarises the nozzle activation times.

Nozzle (see Figure 1)	Activation time (after ignition)
Nozzle 1	6 minutes 16 seconds
Nozzle 2	Did not operate
Nozzle 3	Did not operate
Nozzle 4	Did not operate

Table 8 – Summary on nozzle activation times

The calculated average water flow rate during the test was 69 l/min (associated coverage density of 4.3 mm/min based on a 16 m^2 coverage area).

The temperatures 76 mm below the centre of the ceiling are shown in **Figure 18**.

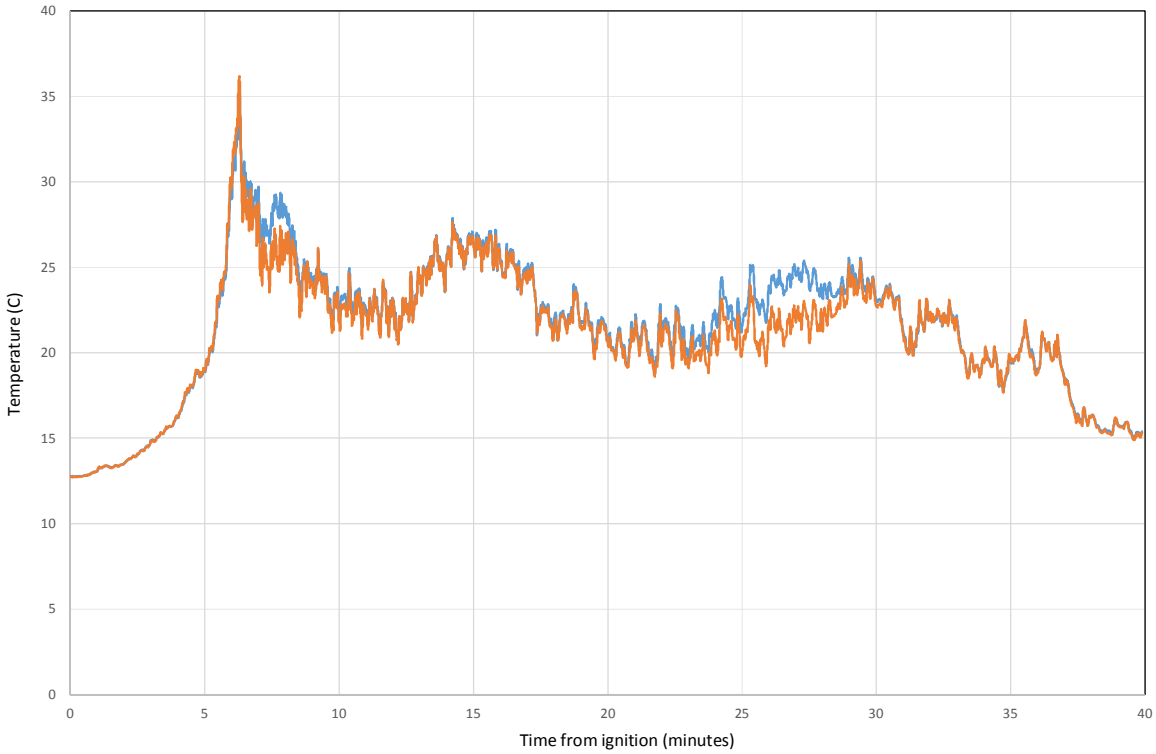

Figure 18 – Temperatures below ceiling

The temperatures next to the frangible bulbs at each of the nozzles are shown in **Figure 19**.

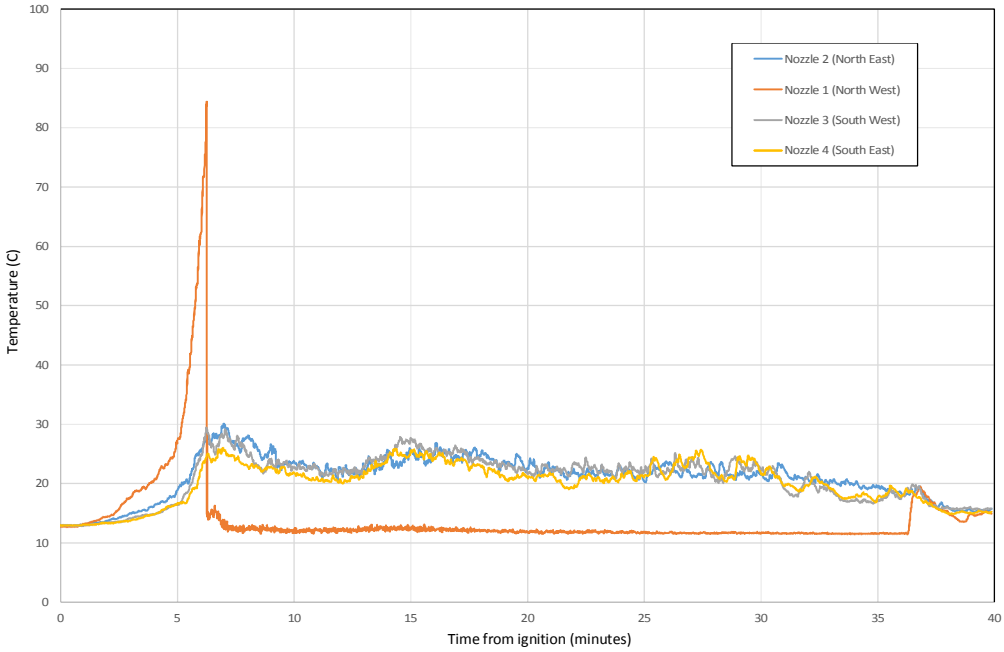

Figure 19 – Temperatures next to the nozzles

The fire temperatures are shown in **Figure 20**.

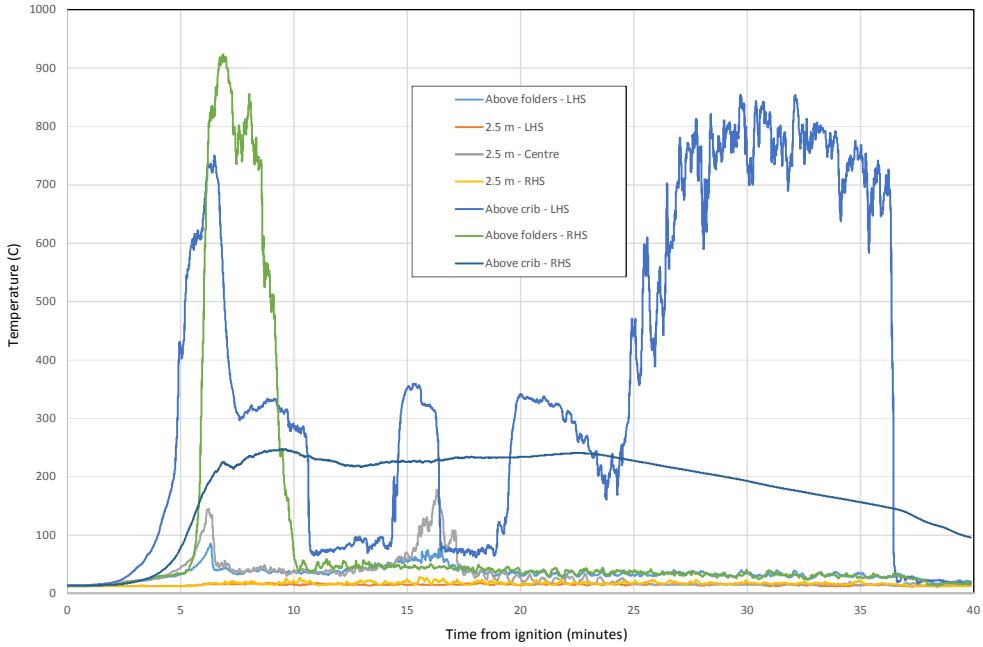

Figure 20 – Fire temperatures

The water supply pressure for the test is shown in **Figure 21**.

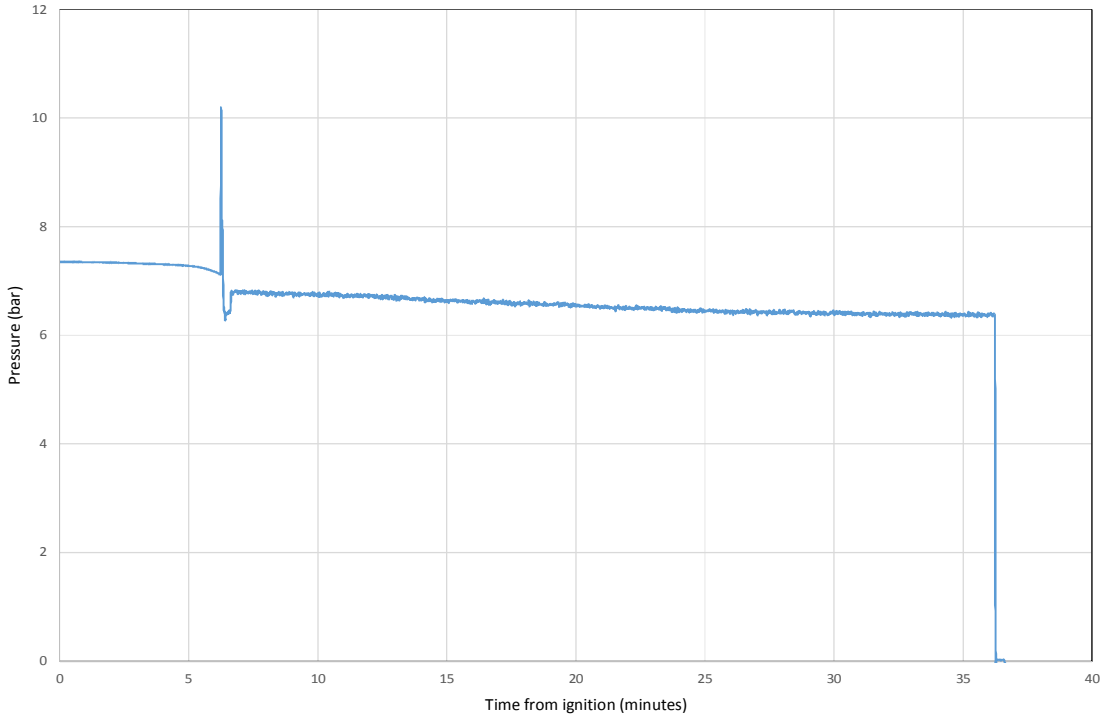

Figure 21 – Water pressure

A measured temperatures assessment for the test is shown in Table 9 together with the BS 8489-7 criteria.

Thermocouple positions	BS 8489-7 test pass/fail criteria	Temperature assessment
76 mm below the ceiling, in the centre of the ceiling	The maximum gas temperature, in the centre of the ceiling, 76 mm below the ceiling does not exceed 80 °C, for a duration longer than 3 minutes for the 30 minute system discharge.	The maximum gas temperature in the centre of the ceiling 76 mm below the ceiling did not exceed 80 °C.
Ceiling level	After 5 minutes (from the start of system operation) the mean temperatures remain steady or decrease until the end of the test.	After 5 minutes from system operation the mean temperature trend line remained steady or decreased.

Table 9 – Temperature assessment

The fire damage to the plywood walls is shown in **Figure 22**.

Figure 22 – Fire damage to the plywood walls, foam sheets and box files

The post-test fuel package fire damage assessment is summarised in Table 10 together with the BS 8489-7 criteria.

Fuel package	**BS 8489-7 test pass/fail criteria**	**Fire damage assessment**
Plywood walls	Damage to the plywood walls does not extend to the full height at the ends of the 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 does not extend to all areas.	Damage to the foam and box files did not extend to all areas.

Table 10 – Fire damage assessment

3.4 Conclusion

The Premier Mist water mist system, as detailed in this report, when tested in accordance with clauses 7.7, 7.8 and 7.9 of BS 8489-7:2016 '*Fixed fire protection systems – Industrial and commercial watermist systems – Part 7: Tests and requirements for watermist systems for the protection of low hazard occupancies*', and assessed against the pass/fail criteria specified in clause 8 (f) and (g) of the standard achieved the results as shown in Table 11.

BS 8489-7 Pass/fail criteria	**Test 1** **Clause 8 g)**	**Test 2** **Clause 8 g)**	**Test 3** **Clause 8 f)**
The maximum gas temperature in the centre of the ceiling, 76 mm below the ceiling does not exceed 80 °C, for a duration longer than 3 minutes for the 30 minute system discharge.	n/a	n/a	Criteria met
The maximum gas temperature over ignition, 76 mm below the ceiling does not exceed 80 °C, for a duration longer than 3 minutes for the 30 minute system discharge.	Criteria met	Criteria met	n/a
After 5 minutes (from the start of system operation or ignition of both wood cribs, whichever takes the longer) the mean ceiling temperatures remain steady or decrease until the end of the test.	Criteria met	Criteria met	Criteria met
Damage to the plywood walls does not extend to the full height at the ends of the walls.	Criteria met	Criteria met	Criteria met
Damage to the foam and box files does not extend to all areas.	Criteria met	Criteria met	Criteria met

Table 11 – Summary of BS 8489-7 criteria for the test programme

Appendix A DM4-C datasheet

DualMIST

DM4-C Nozzle

Data Sheet 6.1

Product Description:

The DualMIST **DM4-C** pendant nozzle is an integral proprietary feature of the DualMIST low-pressure water mist system. The nozzle has undertaken stringent fire testing by the globally recognised third party BRE Global to commercial and industrial water mist standards.

Activation:

In a fire condition, heat causes the fluid in the glass bulb to expand which shatters the glass thus releasing water into all ports which then extinguishes or controls the fire.

Performance:

The nozzles' dual suppression technology produces remarkable results via multiple jet type ports giving a 16m² coverage per nozzle.

Technical Details:

Nozzle Reference: **DM4-C**
Bulb Temperature Rating: **57°c**
K Factor: **27**
Flow Required: **60 L/min**
Minimum Working Pressure: **5 bar**
Maximum Working Pressure: **12 bar**
Factory Pressure Test: **40 bar**
Weight: **65 grams**
Standard Adapter Thread Size: **15mm BSP**
Adapter Size: **25mm**
Strainer: **Yes**

Design Parameters:

Style: **Pendant**
Maximum Spacing: **4m centres**
Maximum From Boundary: **2m centres**
Minimum Spacing: **1m centres**

Finishes:

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

Approval:

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

Accessories:

Single Piece Escutcheon (Rosette)
DM4 Nozzle Wrench
DM4 Cover / Blow Off Cap (various colours)

Page 1 of 2

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

Dual MIST

DM4-C Nozzle

Data Sheet 6.1

Installation:

1. The **DM4-C** 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 **DM4-C** nozzle is to be installed in the pendant orientation only.

5. Hand tighten the nozzle into the fitting, then use the **DM4** nozzle wrench to tighten the nozzle into the fitting.

Care & Maintenance:

1. Nozzles must be carefully handled and stored where temperatures will not exceed 100ºF/38ºC

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

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Report Ends