Fire tests conducted to BS 8458:2015 and analysis of results based on BSI BS 8458 sub group's recommendations, conducted with Nationwide Fire Sprinklers watermist system used in conjunction with the DualMIST DX25 watermist nozzle

Prepared for Nationwide Fire Sprinklers Limited in consortium with DualMIST International Limited by the Fire Protection Association

Ref. FPA/100839

3rd April 2018

INVESTOR IN PEOPLE

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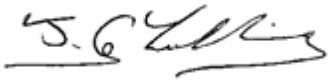
Review

Approval	Name, Position	Date
Author	Mr John Harbottle, Fire Test Laboratory Manager	11/03/2018
Reviewed by	Dr James Glockling, Technical Director	29/03/2018
Reviewers signature		

Distribution

Name	Company
Keith Rhodes	Nationwide Fire Sprinkler Ltd

Document version history

Version	Date	Superseded documents/description/details
1.0	06/12/2017	Draft for comment
2.0	03/04/2018	Incorporating results of additional test conducted 12th February 2018

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1. Introduction

This report records the finding of a series of fire tests conducted in accordance with BS 8458:2015: Fixed fire protection systems – Residential and domestic watermist systems – Code of practice for design and installation, clause 6.1 and Annex C – Room fire tests for watermist system with automatic nozzles.

This assessment excludes any evaluation of: components, compliance of the system, proposed design and installation parameters, review of design and installation manual.

The client wished to conduct testing to BS 8458 test scenarios: a, b, c, d (which are all compulsory according to the standard) and optional test scenario 'e'. Testing to optional test scenario 'f' was not requested or performed. Correspondingly, the limits of application as specified by BS 8458 clause 6.2 should be noted.

The tests were conducted by the Fire Protection Association at their Fire Test, Research and Training Laboratory in Gloucestershire, UK. Tests 1 to 5 were conducted between the 19th July 2017 and the 11th September 2017, test 6 was conducted on the 12th February 2018.

The watermist system tested was produced by Nationwide Fire Sprinklers Limited (Grinnell House, Private Road No.7, Colwick Industrial Estate, Colwick, Nottingham, UK) and used in conjunction with DualMIST International Limited (Merlin Way, Quarry Hill Industrial Estate, Ilkeston, Derbyshire, UK) DX25 pendant nozzle incorporating a 3mm fast response 68 ˚C frangible glass bulb. The system is designed to operate at a maximum head spacing of 4 metres at a minimum head pressure of 7bar.

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2. Deviations from the BS 8458:2015

2.1. Assessment criteria

Testing was conducted to BS 8458, except as modified by interpretation clarifications by BSI. The clarifications are recorded within BSI document FSH/18/5_17_0033 “BS 8458 sub group comments and recommendations”. It is recognised that these clarifications are not yet formally published.

Consequently, BS 8458:2015, Clause 6.1.a.2 which states “When tested in accordance with C.1 to C.4 *of BS 8458:2015*: Within 2 min from operation of the first nozzle, the mean recorded temperatures 75mm below the underside of the ceiling should remain steady or decrease”. This clause was not used in the evaluation of the test results as the responsible BSI committee have recommended this clause is deleted and the pass/fail criteria be based upon “maximum allowable temperatures”.

Full details of the BSI FSH/18/5_17_0033 BS 8458 sub group comments and recommendations are reproduced in Annex C of this report.

3. Test programme

3.1. Test compartment

A test compartment with a floor area of 8m x 4m and a ceiling height of 2.5m was constructed from 12mm type F fire rated plasterboard.

Prior to testing the temperature in the compartment was conditioned to be between 15 and 30 ˚C and the relative humidity in the compartment was below 70%.

The geometry of the compartment was as specified in BS 8458.

3.2. Instrumentation

All instrumentation was monitored via a PC connected datalogger at sample rate of 1hz.

Temperature was monitored using 1.5mm mineral insulated type k thermocouples at specified locations at heights of 1.6m above the floor and 75mm below the ceiling.

Pressure was measure at two locations (near the pump and near head 1), using solid state pressure transmitters.

Flow-rate to each head was monitored using ultrasonic flow meters.

3.3. Fuel package

Prior to the testing the fuel package, consisting of plywood sheets, sacrificial wooden boards, wooden frames, foam sheets and wood crib sticks were conditioned at a temperature of 23 ± 2 ˚C and relative humidity of 50 ± 5 % for the periods recommended in BS EN 13238.

For each test, the fuel package, its location relative to the test compartment and the method of ignition were as specified in BS 8458.

3.4. Suppression system

For the test programme, the water mist system was installed and set up by Nationwide Fire systems. The system employed a 230V electric multistage pump (pump manufacturer: Lowara, model 5SV15) and pressure switch. The pump set was connected to the nozzles with CPVC fire sprinkler piping.

3.5. Water mist nozzles

The nozzles used in the tests were the DualMIST DX25 water mist nozzle with a 68 ˚C fast response frangible glass bulb. The nozzle was installed in the pendant orientation with the blow-off cover and 4mm ceiling rose. Photographs of the nozzle is shown below and the nozzle data sheet is provided in Annex A.

DualMIST DX25 watermist nozzle

DX25 nozzle waterway

DX25 Blow-off cover plate

DX 25 complete nozzle assembly

Figure 1 – DualMIST DX25 watermist nozzle

4. Test results

4.1. Test 1 – Fuel package in corner of compartment

Test 1 was conducted with the fuel package in the corner of the of the compartment as specified by BS8458 section C.4.a) *Corner test*.

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 3 and Figure 4.
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in
- Table 1 and Table 2.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 3.
- Full test data and photographs of the test can be found in Annex B1.

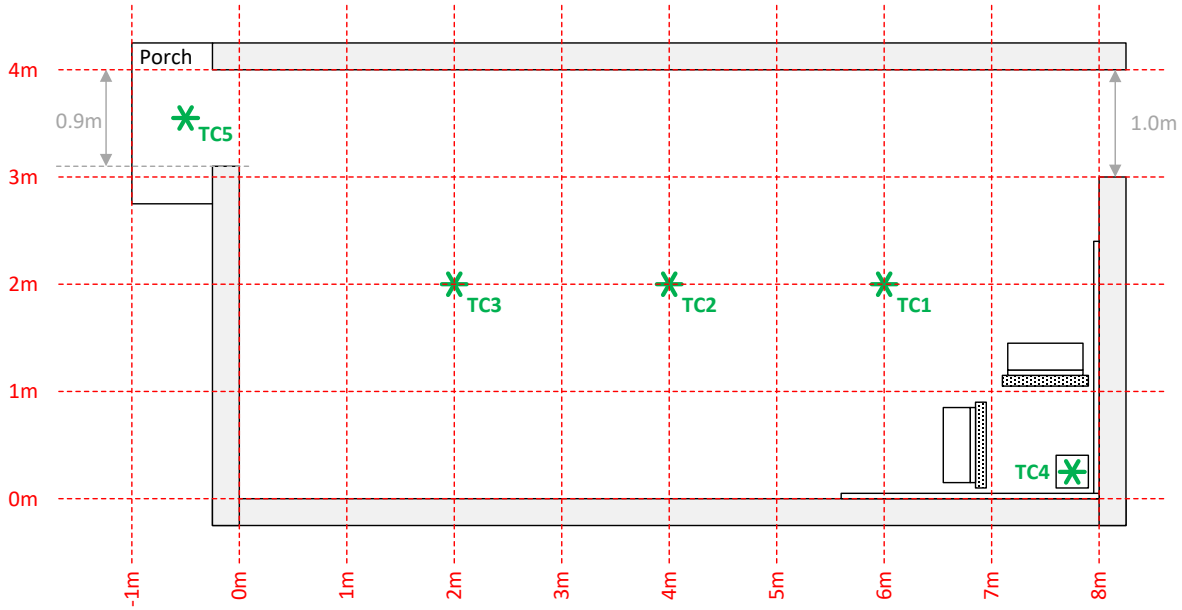


Figure 2: Test 1 – Plan view of test compartment

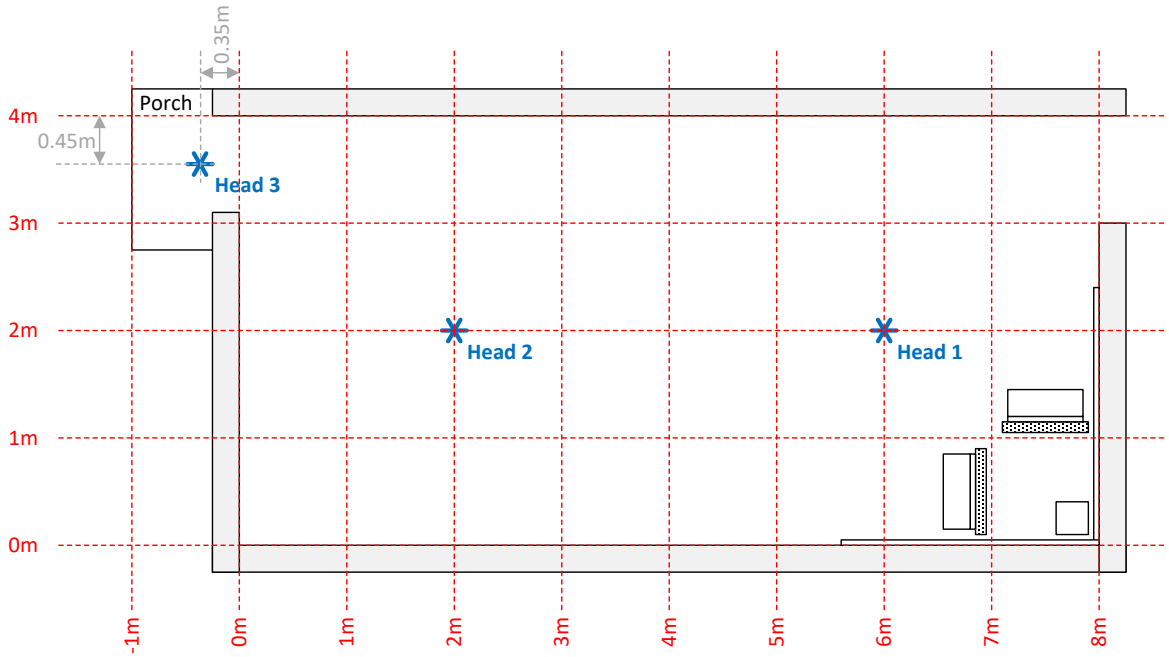


Figure 3: Location of water-mist nozzle for tests 1, 2 and 3

Table 1: Test 1 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	7.1 bar
Mean pressure near head 1	6.8 bar
Mean pressure near head 2	6.8 bar
Mean flow rate from head 1	26 litres/minute
Mean flow rate from head 2	0 litres/minute
System operation time, from activation of first head	30 minutes

Table 2: Test 1 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	65 seconds
Head 2	Did not activate
Head 3 (external to test room)	Did not activate

Table 3: Test 1 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC4, 75 mm does not exceed 320℃	Maximum recorded temperature: 259 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 32 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC2, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 40 ℃	Yes
6.1.b	Maximum temperature at location TC2, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 53 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.c	Head 3 external to the room does not operate	Did not operate	Yes

4.2. Test 2 – Fuel package between two nozzles

Test 2 was conducted with the fuel package in the centre of the of the compartment as specified by BS8458 section C.4.b) *Fuel package between two nozzle test*.

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 5 and Figure 4.
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in Table 4 and Table 5.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 6.
- Full test data and photographs of the test can be found in Annex B2.

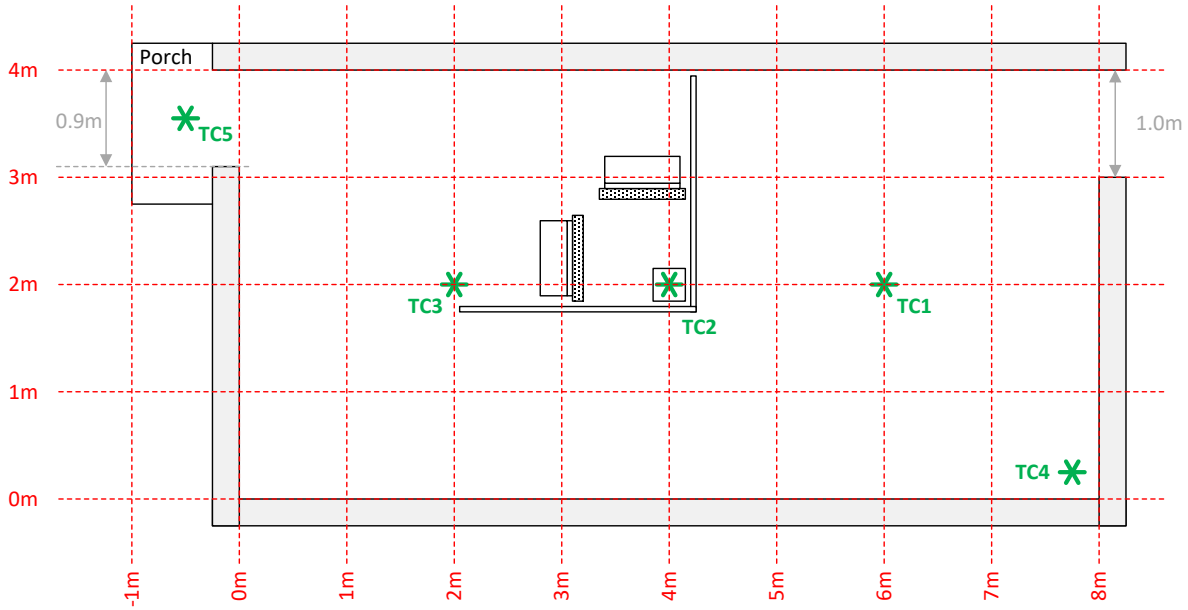


Figure 4: Test 2 – Plan view of test compartment

Table 4: Test 2 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	7.6 bar
Mean pressure near head 1	7.3 bar
Mean pressure near head 2	7.3 bar
Mean flow rate from head 1	25 litres/minute
Mean flow rate from head 2	25 litres/minute
System operation time, from activation of first head	30 minutes

Table 5: Test 2 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	69 seconds
Head 2	60 seconds
Head 3 (external to test room)	Did not activate

Table 6: Test 2 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC2, 75 mm does not exceed 320℃	Maximum recorded temperature: 222 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 45 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 39 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.c	Head 3 external to the room does not operate	Did not operate	Yes

4.3. Test 3 – Fuel package beneath nozzle

Test 3 was conducted with the fuel package directly below head 1 as specified by BS8458 section C.4.c) *Fuel package beneath a nozzle test*.

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 6 and Figure 4.
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in Table 7 and Table 8.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 9.
- Full test data and photographs of the test can be found in Annex B3.

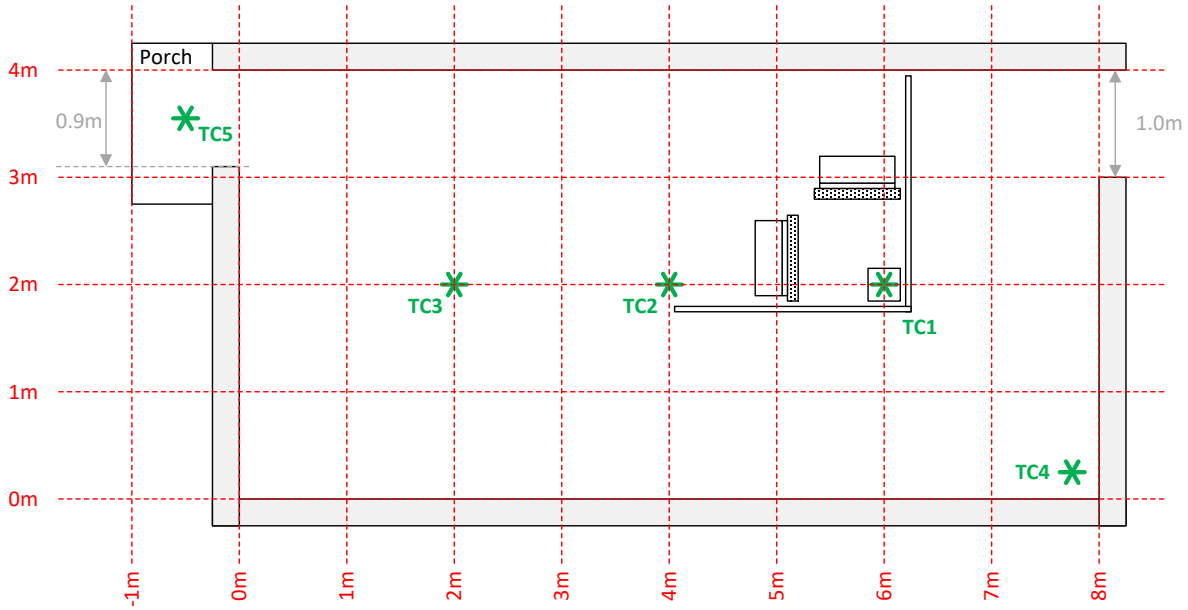


Figure 5: Test 3 – Plan view of test compartment

Table 7: Test 3 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	7.8 bar
Mean pressure near head 1	7.5 bar
Mean pressure near head 2	7.5 bar
Mean flow rate from head 1	26 litres/minute
Mean flow rate from head 2	0 litres/minute
System operation time, from activation of first head	30 minutes

Table 8: Test 3 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	58 seconds
Head 2	Did not activate
Head 3 (external to test room)	Did not activate

Table 9: Test 3 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC1, 75 mm does not exceed 320℃	Maximum recorded temperature: 110 ℃	Yes
6.1.b	Maximum temperature at location TC2, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 45 ℃	Yes
6.1.b	Maximum temperature at location TC2, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 39 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.c	Head 3 external to the room does not operate	Did not operate	Yes

4.4. Test 4 – Ventilation test, fuel package between two nozzles

Test 4 was conducted with the fuel package in the centre of the room, a forced air flow through the room was achieved by use of a mechanical fan situated in the doorway nearest head 1 as specified by BS8458 section C.4.d) *Ventilation test*.

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 7 and Figure 8.
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in Table 10 and Table 11.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 12.
- Full test data and photographs of the test can be found in Annex B4.

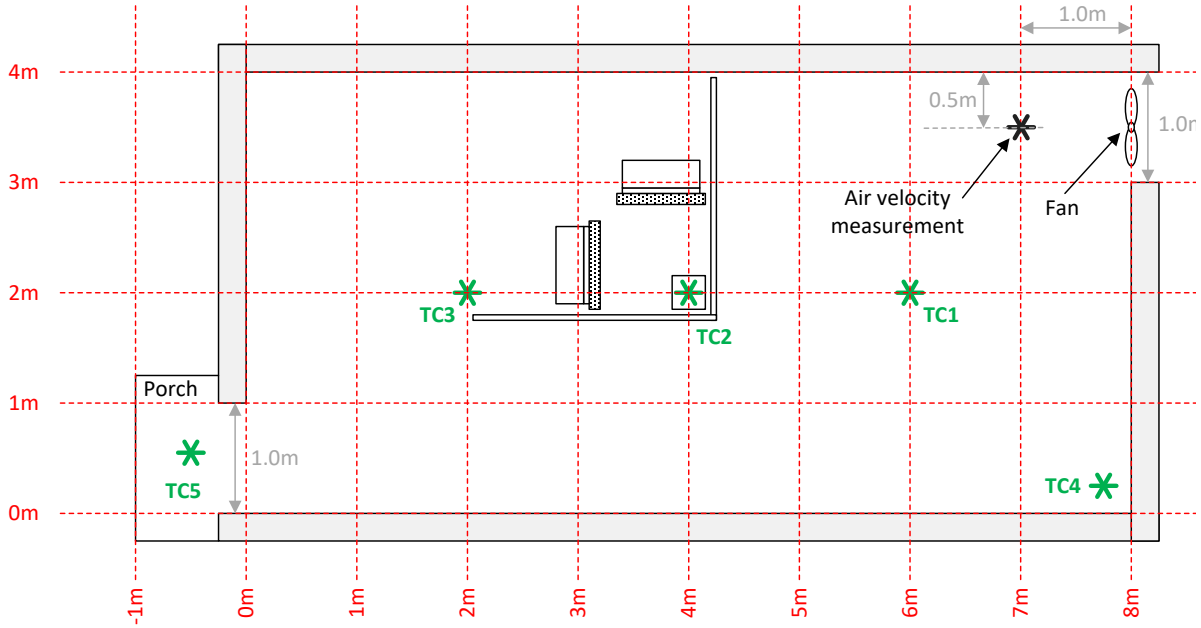


Figure 6: Test 4 – Plan view of test compartment

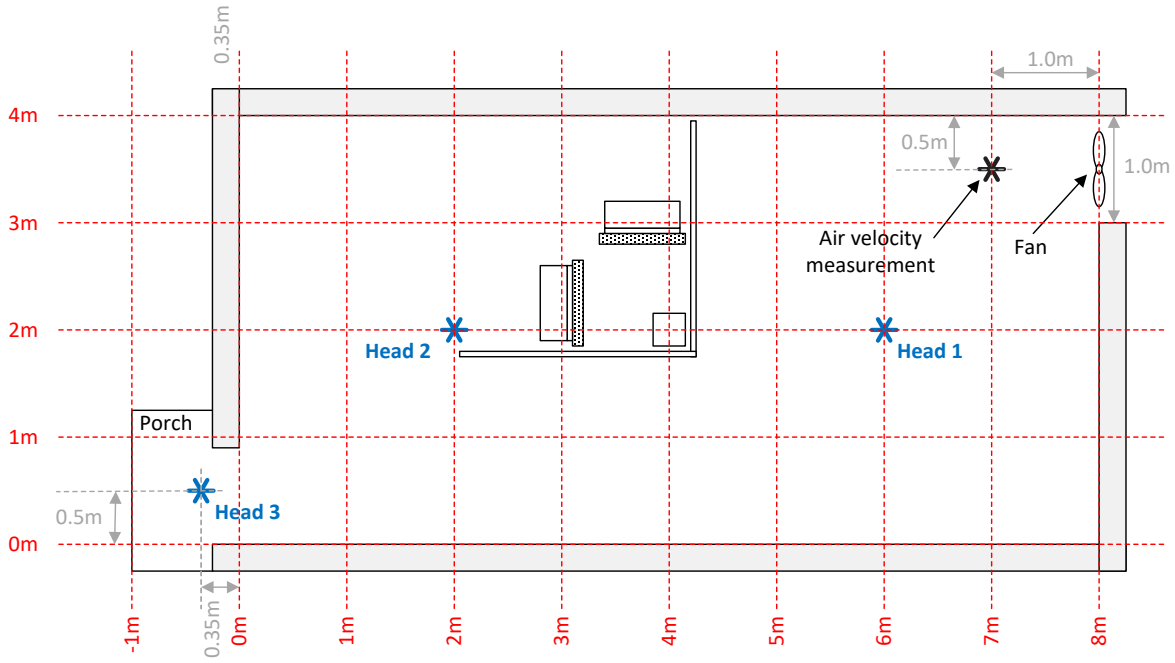


Figure 7: Location of water-mist nozzle for test 4

Table 10: Test 4 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	7.0 bar
Mean pressure near head 1	6.7 bar
Mean pressure near head 2	6.6 bar
Mean flow rate from head 1	25 litres/minute
Mean flow rate from head 2	25 litres/minute
System operation time, from activation of first head	30 minutes

Table 11: Test 4 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	72 seconds
Head 2	86 seconds
Head 3 (external to test room)	Did not activate

Table 12: Test 4 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC2, 75 mm does not exceed 320℃	Maximum recorded temperature: 205 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 43 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 34 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.c	Head 3 external to the room does not operate	Did not operate	Yes

4.5. Test 5 – Open room 1, fuel package in corner

Test 5 was conducted with the fuel package in the corner of the room, as specified by BS8458 section C.4.e) *Open room test* (1 of 2).

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 9 and Figure 10 .
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in Table 13 and Table 14.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 15.
- Full test data and photographs of the test can be found in Annex B5.

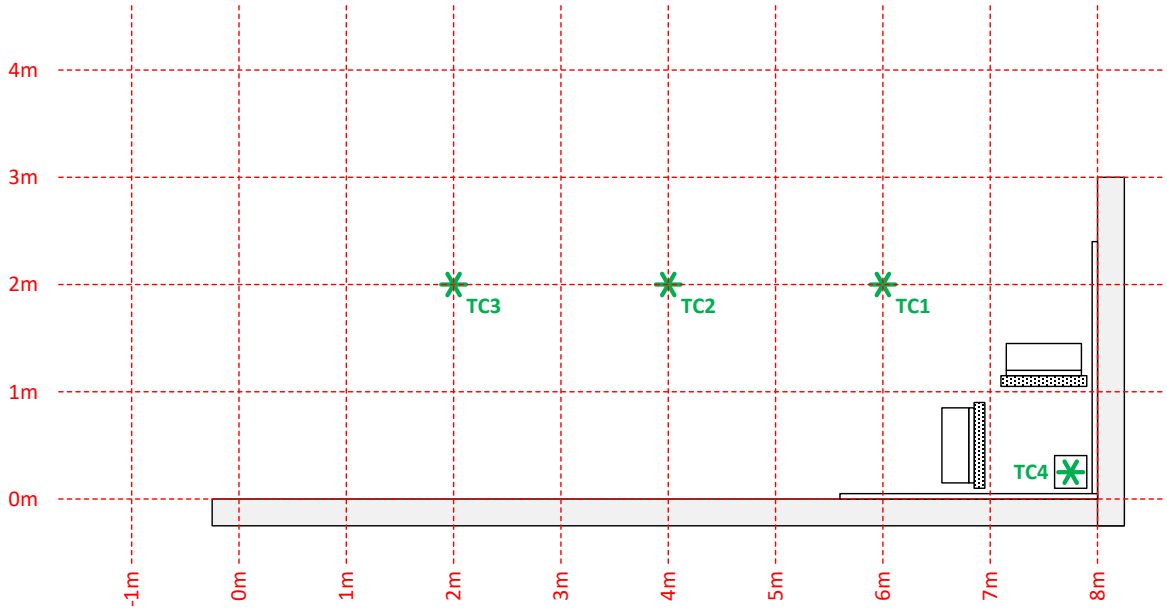


Figure 8: Test 5 – Plan view of test compartment

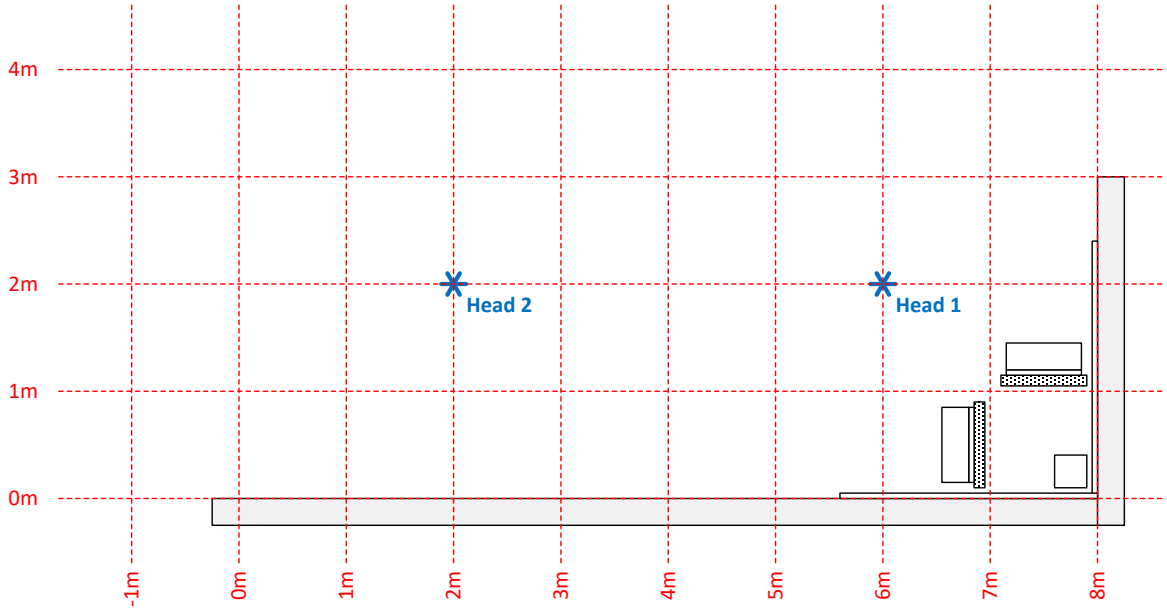


Figure 9: Location of water-mist nozzle for tests 5 and 6

Table 13: Test 5 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	6.9 bar
Mean pressure near head 1	6.7 bar
Mean pressure near head 2	6.6 bar
Mean flow rate from head 1	22 litres/minute
Mean flow rate from head 2	0 litres/minute
System operation time, from activation of first head	30 minutes

Table 14: Test 5 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	62 seconds
Head 2	Did not activate

Table 15: Test 5 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC4, 75 mm does not exceed 320℃	Maximum recorded temperature: 303 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 27 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 22 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 19 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes

4.6. Test 6 – Open room 2, fuel package between two nozzles

Test 6 was conducted with the fuel package in the centre of the room, as specified by BS8458 section C.4.e) *Open room test* (2 of 2).

- Details of the compartment geometry and relative location of the watermist nozzles are shown in Figure 10 and Figure 9.
- Measurements of the systems operational parameters and details of the nozzle activation time are shown in Table 16 and Table 17.
- An assessment of the systems performance against the recommendations of BS8458 as presented in Table 18.
- Full test data and photographs of the test can be found in Annex B6.

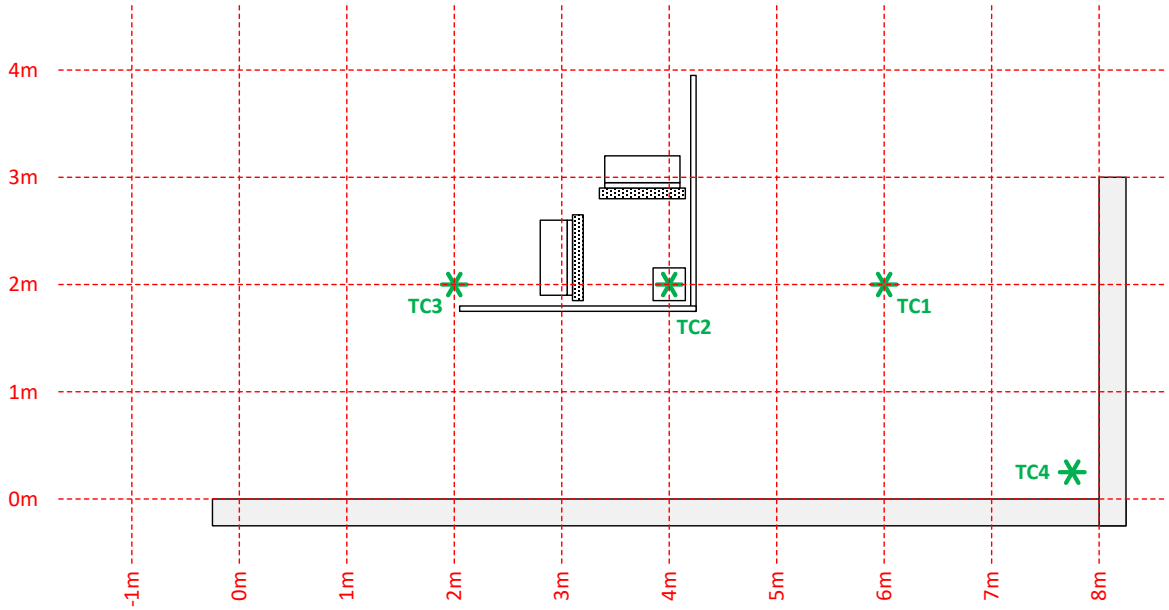


Figure 10: Test 6 – Plan view of test compartment

Table 16: Test 6 – Summary of systems operating parameters

Parameter	Result
Mean pressure near pump	7.0 bar
Mean pressure near head 1	6.7 bar
Mean pressure near head 2	Not recorded
Mean flow rate from head 1	25 litres/minute
Mean flow rate from head 2	25 litres/minute
System operation time, from activation of first head	30 minutes

Table 17: Test 6 – Head activation time

Head ID	Activation time from ignition of the fire
Head 1	95 seconds
Head 2	79 seconds

Table 18: Test 6 – Assessment of systems performance

BS8458 clause	BS8458 recommendation	Assessment	Requirement met
6.1.a.1	The fire is supressed for 30 minutes from activation of the system	The fire was suppressed for 30 minutes	Yes
6.1.b	Maximum temperature at location TC2, 75 mm does not exceed 320℃	Maximum recorded temperature: 256 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 24 ℃	Yes
6.1.b	Maximum temperature at location TC1, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 95℃	Maximum recorded temperature: 30 ℃	Yes
6.1.b	Maximum temperature at location TC3, 1.6m above floor does not exceed 55℃ for more than 120 seconds	Duration maximum temperature above threshold: 0 seconds	Yes

5. Summary

The watermist system summited for testing by Nationwide Fire Sprinklers Ltd installed at a nozzle operating pressure of 7.0 ± 0.5 bar and a head spacing of 4m was found to meet the recommendations of clause 6.1 of BS8458: 2015 when tested in accordance with Annex C, Clause C.1 to C.4.

An additional observation is recorded. Testing to BS 8458 is intended to determine key system design parameters (as reported in the first paragraph of this section) based upon fire test performance. BS 8458 assumes by determining the lowest required head pressures, the head will perform (fight fires) at least as well at higher pressures up to the heads maximum specified operating pressure. In the course of conducting this testing, it was observed that the distribution characteristic of this head changed markedly at even slightly higher pressures. This gave FPA cause for concern that the firefighting performance may not be as expected at higher pressures. However, BS 8458 gives test laboratories no means to resolve this issue. This is considered to be a limitation and issue with the standard BS 8458.

This report is 60 pages long and shall always be reproduced and supplied in full.

6. References

- *BS 8458:2015, Fixed fire protection systems – Residential and domestic watermist systems – Code of practice for design and installation*, British Standards Institution, 2015.
- BSI. Document FSH/18/5_17_0033 “BS 8458 sub group comments and recommendations”

Annex A Nozzle data sheet

Spte

DualMIST

DX25 Nozzle

Product Description:

The DualMIST **DX25** pendant nozzle is an integral proprietary feature of the DualMIST low-pressure water mist system. Developed for the residential and domestic sector this component delivers remarkable suppression via dual multi jet type ports.

Activation:

In a fire condition, heat causes the fluid within the glass bulb to expand which shatters the glass thus releasing the integral blow off cap and water into all ports which then suppresses the fire.

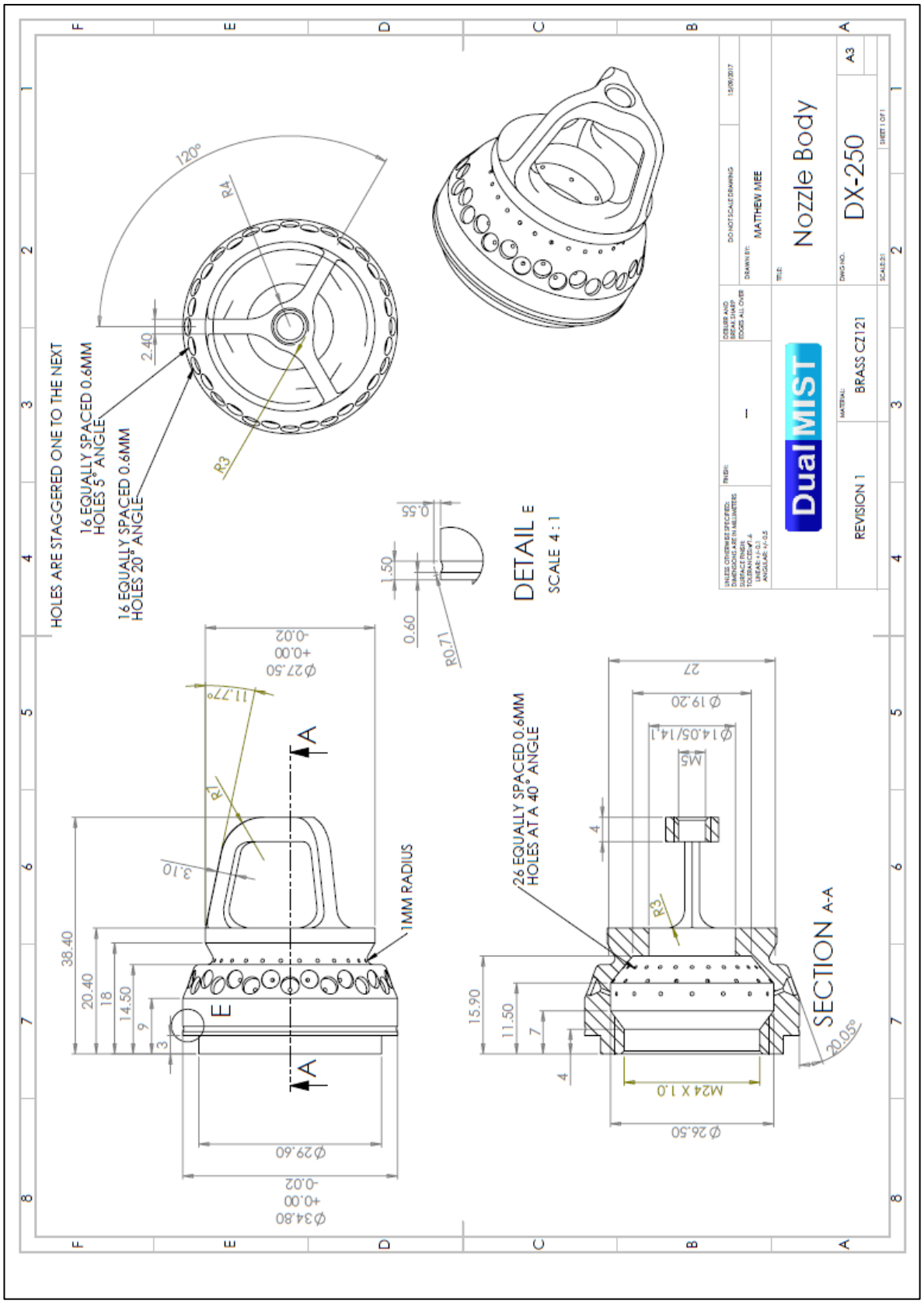
Design Parameters:

Style: **Pendant**
Maximum Spacing: **4m centres**
Maximum From Boundary: **2m centres**
Minimum Spacing: **2m centres**
Coverage: **16m²**

Technical Details:

Nozzle Reference: **DX25**
Finish: **Brass**
Bulb Temperature Rating: **68°C**
K Factor: **9**
Flow rate : **25 L/min**
Pressure: **7 bar**
Factory Pressure Test: **40 bar**
Standard Adapter Thread Size: **15mm BSP**
Strainer: **Yes**
Blow Off Cap Available: **Yes**

T : 0115 932 5809 Manufacturer: DualMIST LTD W : www.dualmist.com


Nozzle Body
DX-250
A3
DualMIST
MATTHEW MEE
BRASS CZ121
REVISION 1
DO NOT SCALE DRAWING
HOLES ARE STAGGERED ONE TO THE NEXT
16 EQUALLY SPACED 0.6MM HOLES 5° ANGLE
16 EQUALLY SPACED 0.6MM HOLES 20° ANGLE
120°
R4
R3
2.40
DETAIL E
SCALE 4 : 1
0.55
1.50
0.60
R0.71
Ø27.50 +0.00 -0.02
11.77°
R1
3.10
1MM RADIUS
38.40
20.40
18
14.50
9
3
Ø29.60
Ø34.80 +0.00 -0.02
A
A
E
26 EQUALLY SPACED 0.6MM HOLES AT A 40° ANGLE
27
Ø19.20
Ø14.05/14.1
M5
4
R3
15.90
11.50
7
4
M24 X 1.0
Ø26.50
SECTION A-A
20.05°

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JOB® F 3

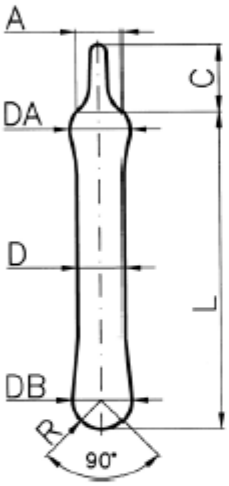
Fast Response

TECHNICAL SPECIFICATION

THERMO BULBS

The **JOB® Thermo Bulb®** model **F 3** is a Fast Response high strength thermally actuated release element for automatic sprinklers, smoke vents, fire dampers and other release devices requiring a thermal release function.

It is designed for Fast Response applications and meets the requirements of UL, FM, VdS, LPCB, TFRI, KENTEI and KOFEIC in this category. It can be used to meet the requirements of Fast Response, Residential, Concealed and Extended Coverage Sprinklers. It holds UL and LPCB Component Recognition.



Dimensions		mm	inch
D	diameter	3	.118
DA	reinforcement [max]	4,1	.161
DB	reinforcement [max]	3,9	.154
L	length	20,0 - 20,8	.787 - .819
C	capillary [max]	4,5	.177
A	seat diameter[1]	2,85	.112
R	radius	1,8 ± 0,22	.062 - .080
Bulb Strength[2]		**kN**	**lb**
average crush load		3,5	770
lower tolerance limit TL[3]		2,0	440
Response Time Index[4]		**RTI 36 (ms)^{½}, 65 (fts)^{½}**	
Color Code		**Temperatures ± 3,5% °F**	
orange		57 °C	135 °F
red		68 °C	155 °F
yellow		79 °C	175 °F
green		93 °C	200 °F
blue		141 °C	286 °F

1 Seat diameters have influence on bulb strength and other properties
2 Tested in Job test inserts (specifications available on request)
3 TL as per UL 199
4 Tested under UL standard conditions depending on customer design
Other temperatures on request

A hermetically sealed liquid in the glass bulbs expands with rising temperatures breaking the bulbs into small fragments at a predetermined release temperature. The operational temperature will always be within ± 3,5 % of the nominal temperature rating in °F.

The **unique bone shape design** of JOB Thermo Bulbs (US Patent No. 4,796,710 and other international patents) combined with the **special F-liquid** (US Patent No. 4,938,294) are decisive factors for the outstanding thermal response performance and the superior strength of the glass bulbs. All main features of JOB Thermo Bulbs can be taken from the above chart.

The reinforced bone shape support ends are almost spherical and allow a simple self alignment assembly. The ideal seating configuration in sprinklers is a patented spring type sealing arrangement (US Patent No. 4,167,974) directly in contact with the waterway which forms a mounting location and a flexible seal in one. JOB GmbH can assist in all aspects of Thermo Bulb application upon request.

VdS Zertifiziert nach ISO 9001

QM-System certified in accordance with ISO 9001

The specification data quoted is for use as reference only.
JOB reserve the right to alter the product specification.

Jan 2005 US

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Annex B Full test results

B1 Test 1 – Fuel package in corner of compartment

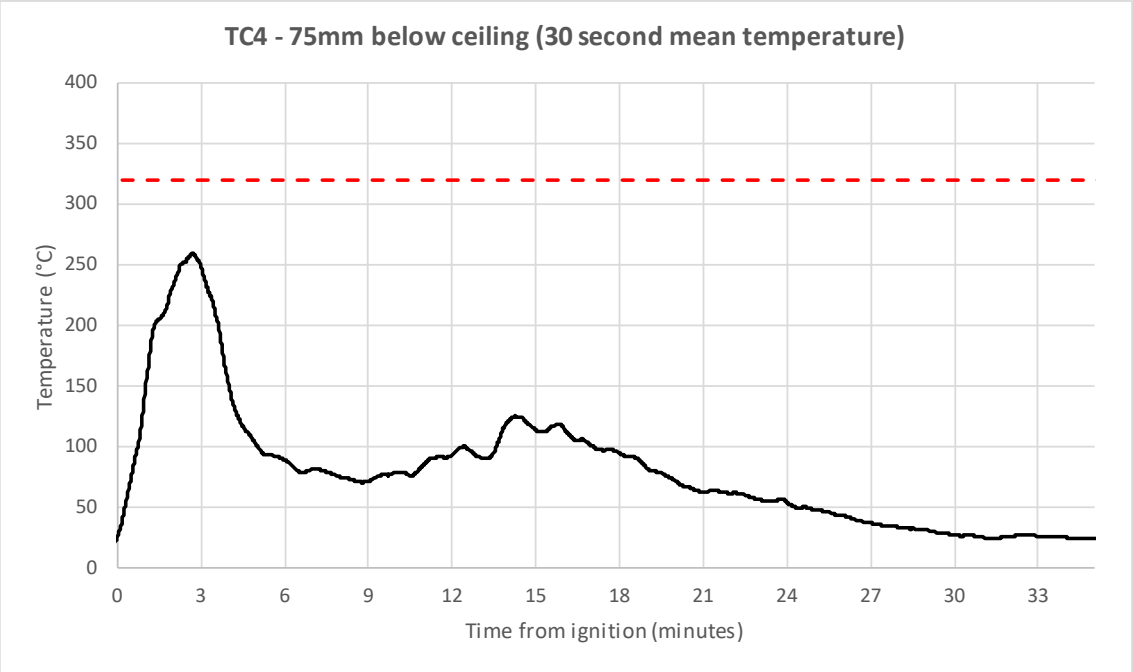

Figure 11: Test 1 – Temperature above the fire (TC 4, 75mm below the ceiling)

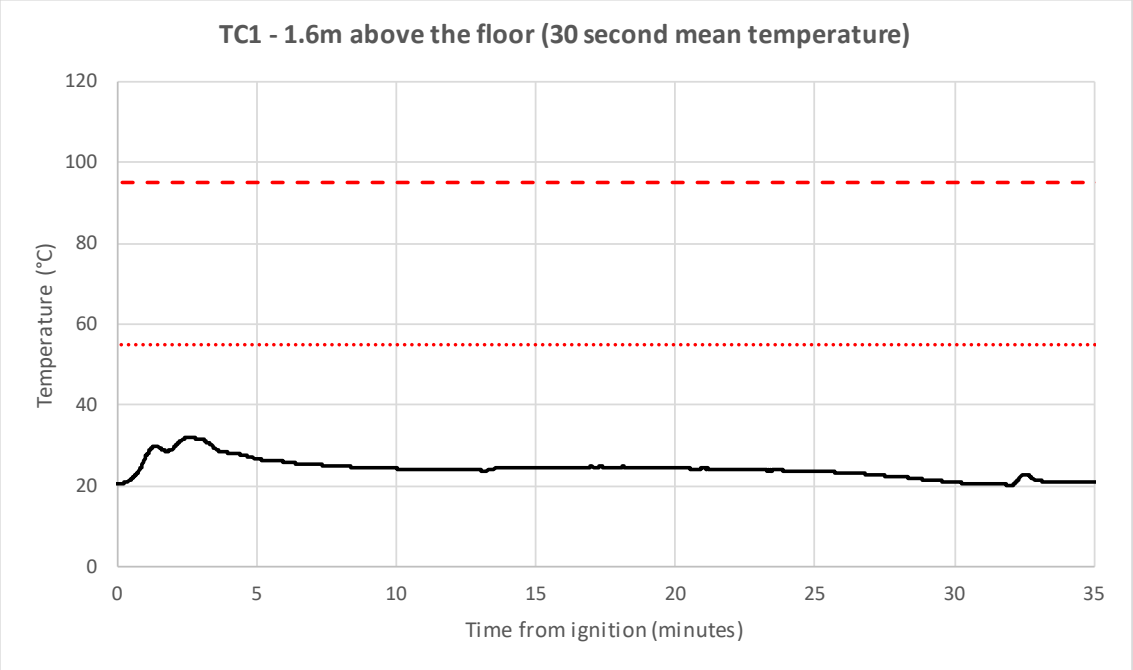

Figure 12: Test 1 – Temperature at TC1, 1.6m above the floor

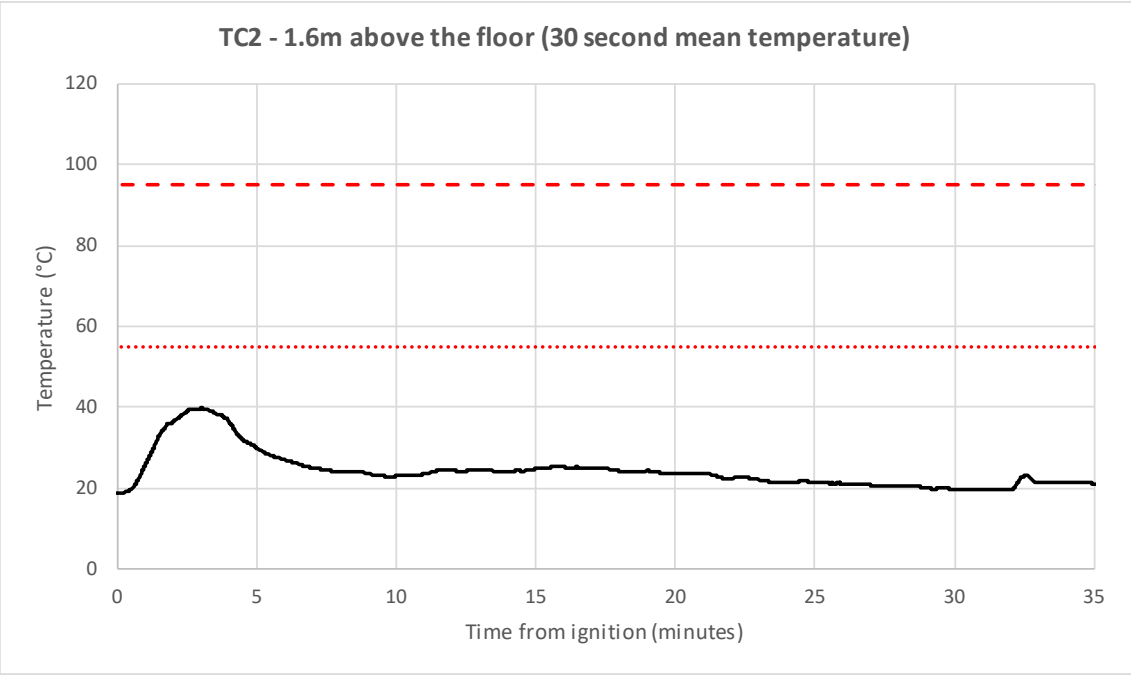

Figure 13: Test 1 – Temperature at TC2, 1.6m above the floor

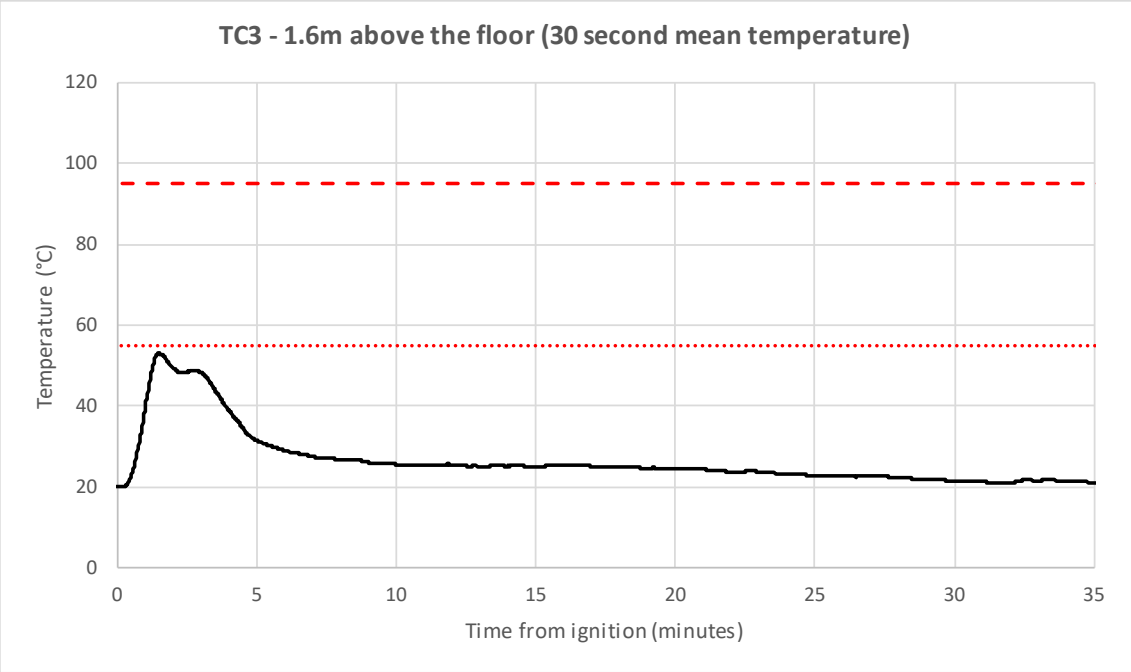

Figure 14: Test 1 – Temperature at TC3, 1.6m above the floor

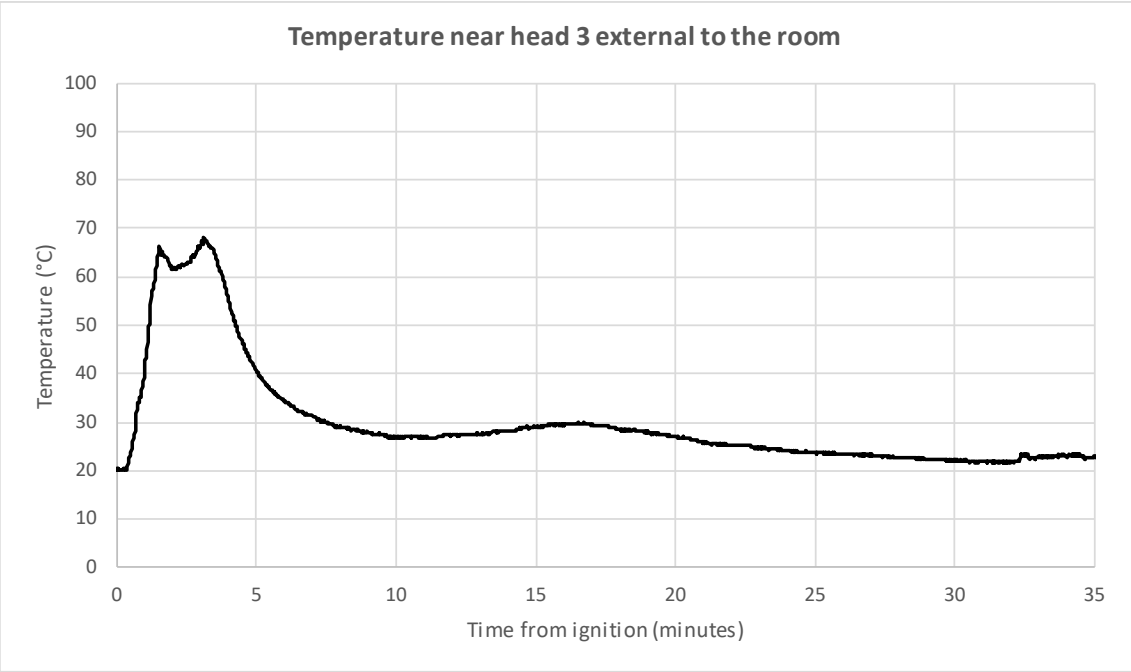

Figure 15: Test 1 – Temperature near head 3 external to the room (TC5)

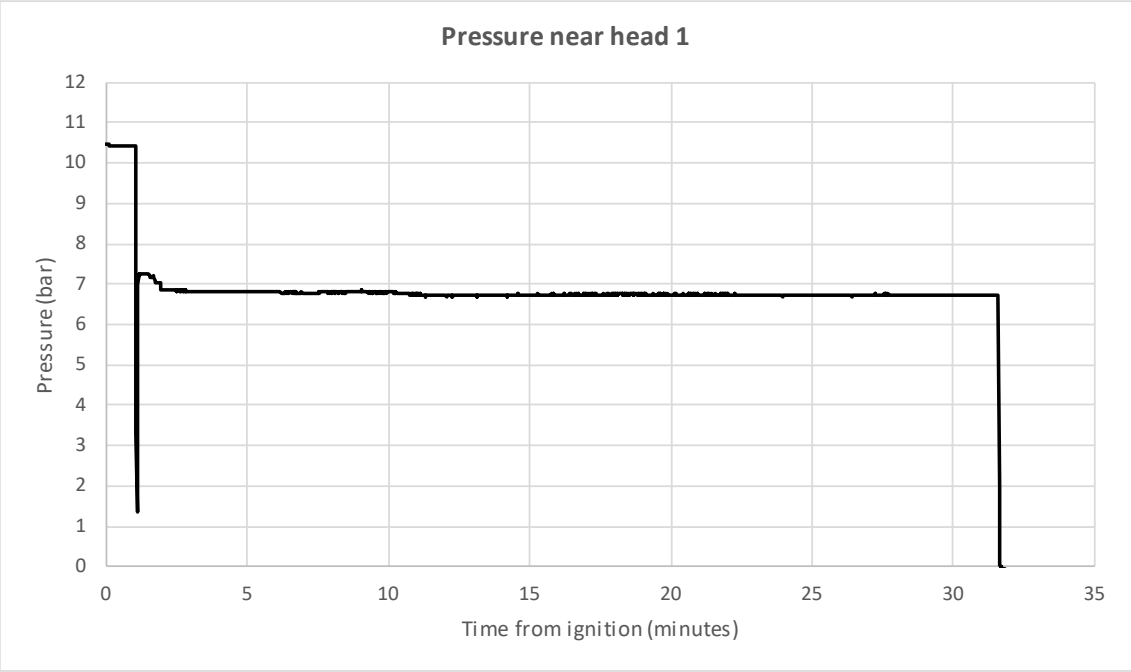

Figure 16: Test 1 – Pressure near head 1

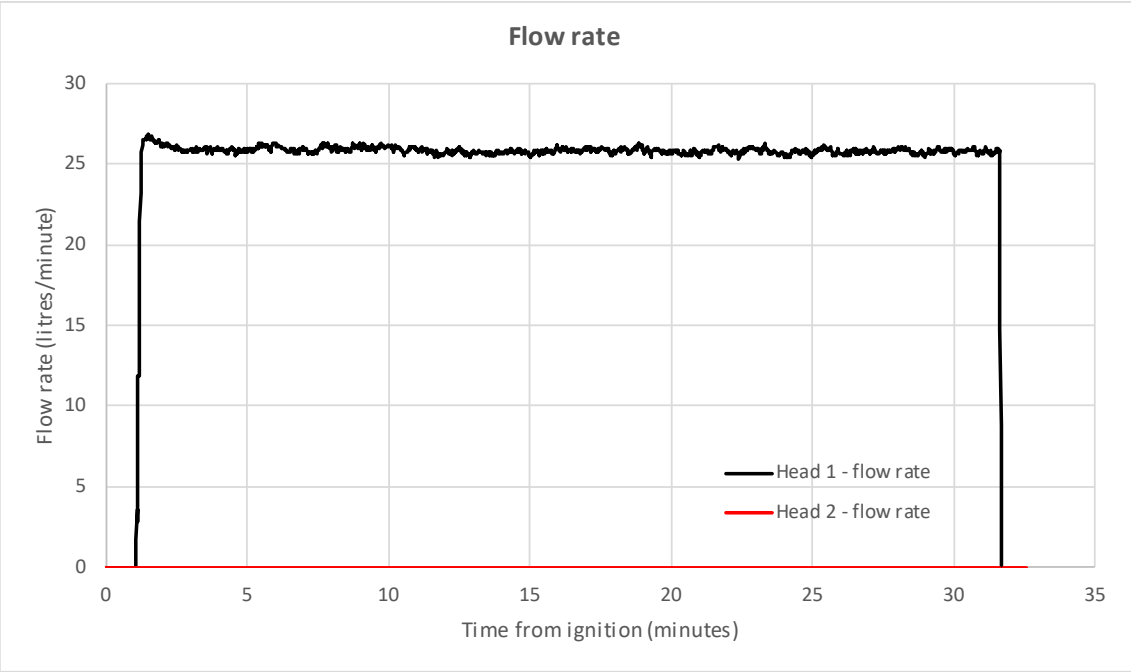

Figure 17: Test 1 – Water flow rate

Figure 18: Photographs of test 1 fire damage

B2 Test 2 – Fuel package between two nozzles

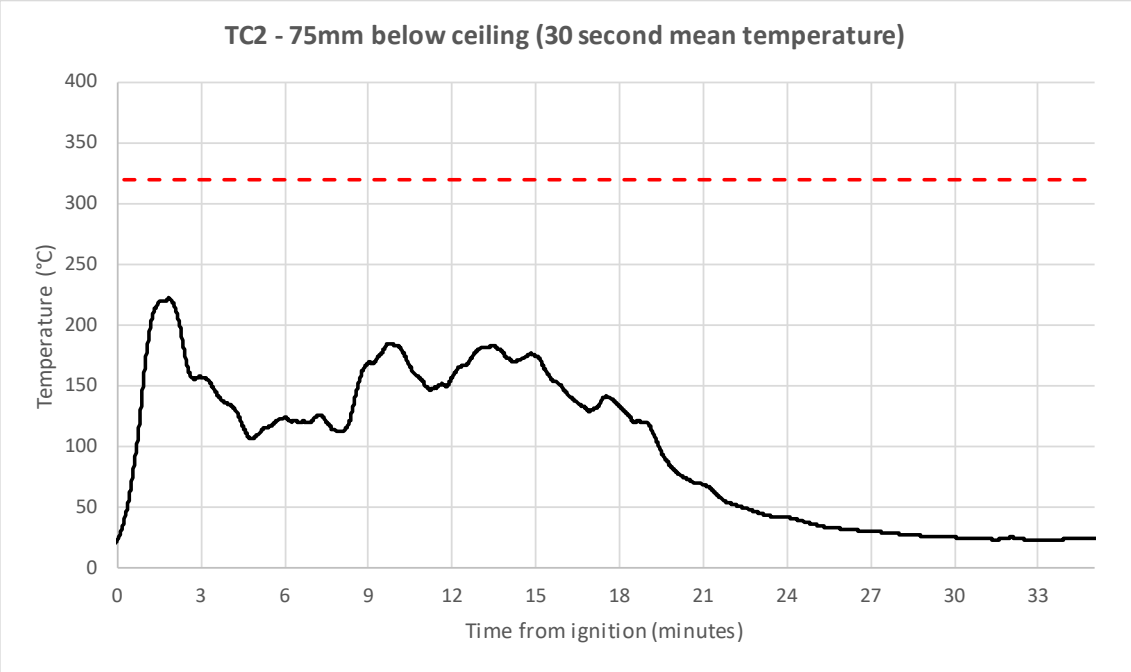

Figure 19: Test 2 – Temperature above the fire (TC 2, 75mm below the ceiling)

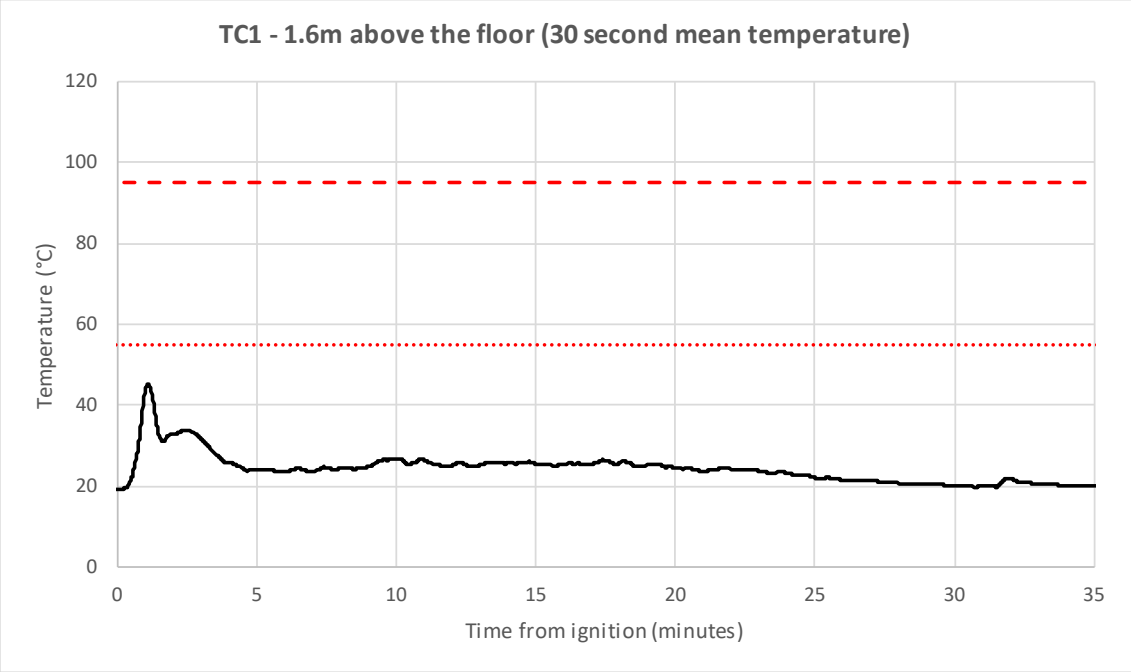

Figure 20: Test 2 – Temperature at TC1, 1.6m above the floor

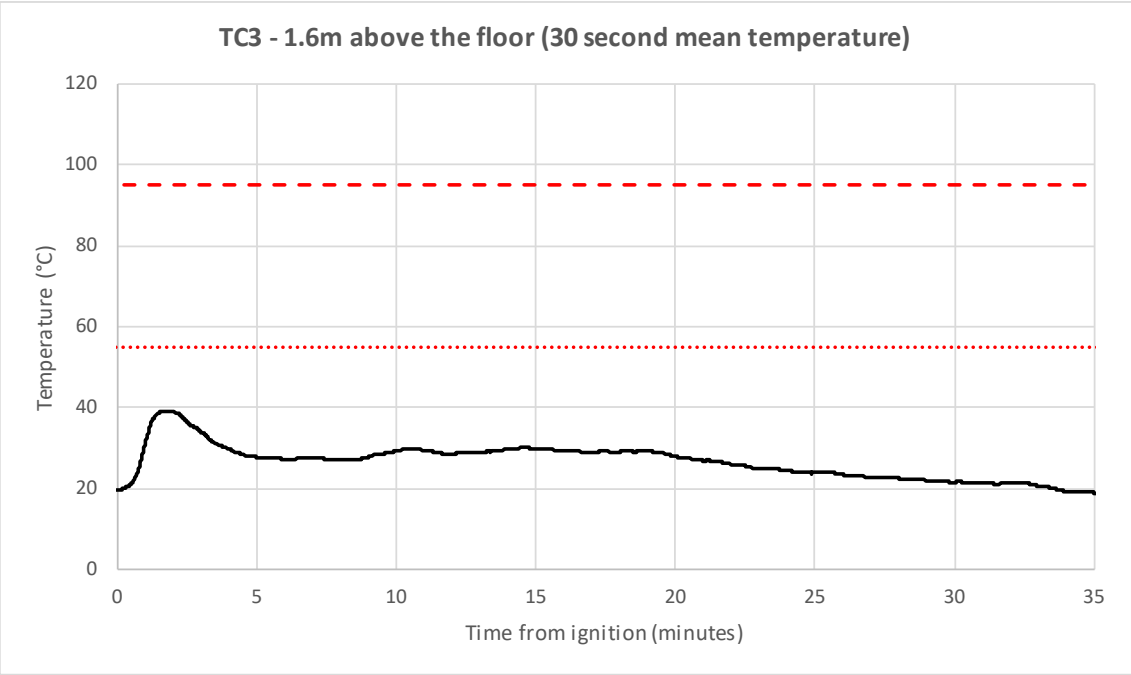

Figure 21: Test 2 – Temperature at TC3, 1.6m above the floor

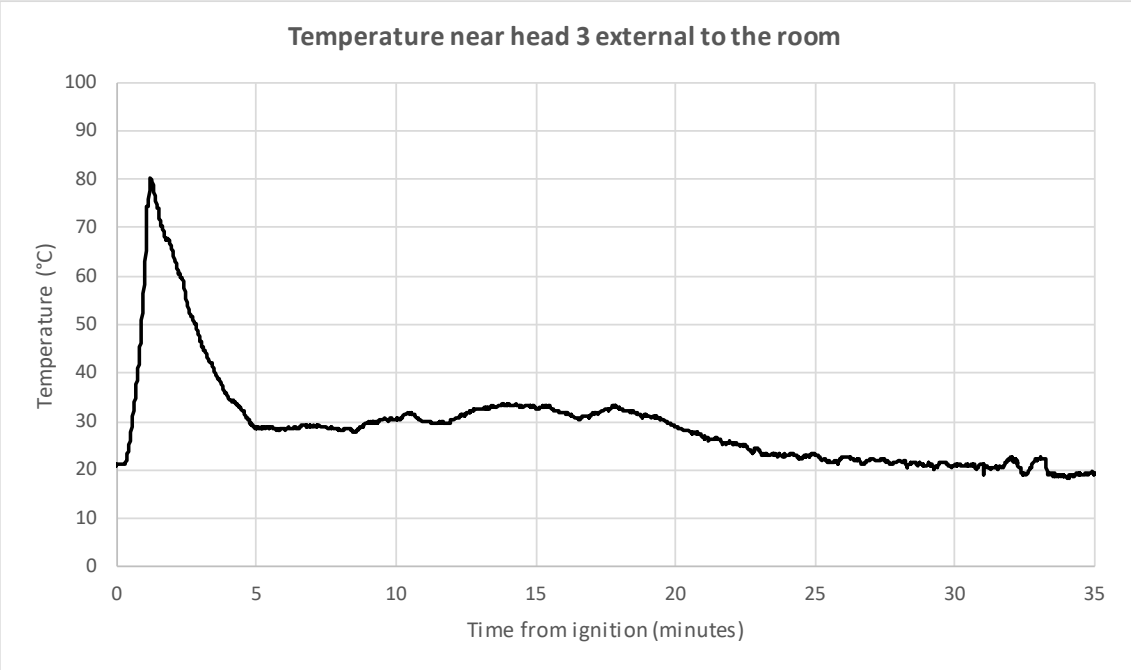

Figure 22: Test 2 – Temperature near head 3 external to the room (TC5)

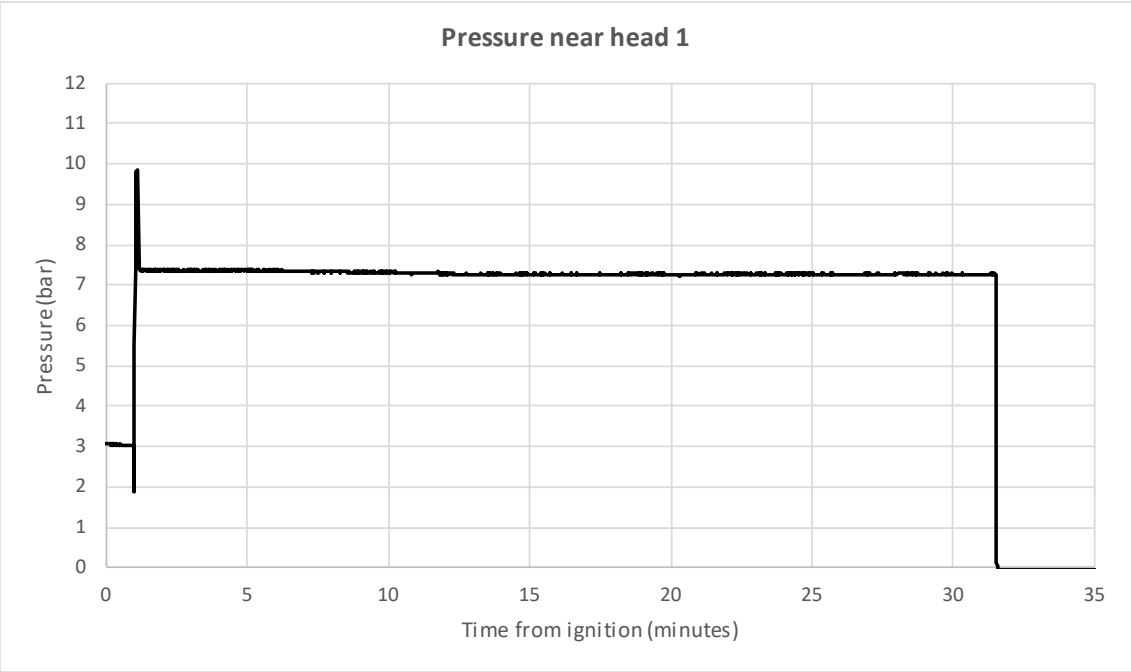

Figure 23: Test 2 – Pressure near head 1

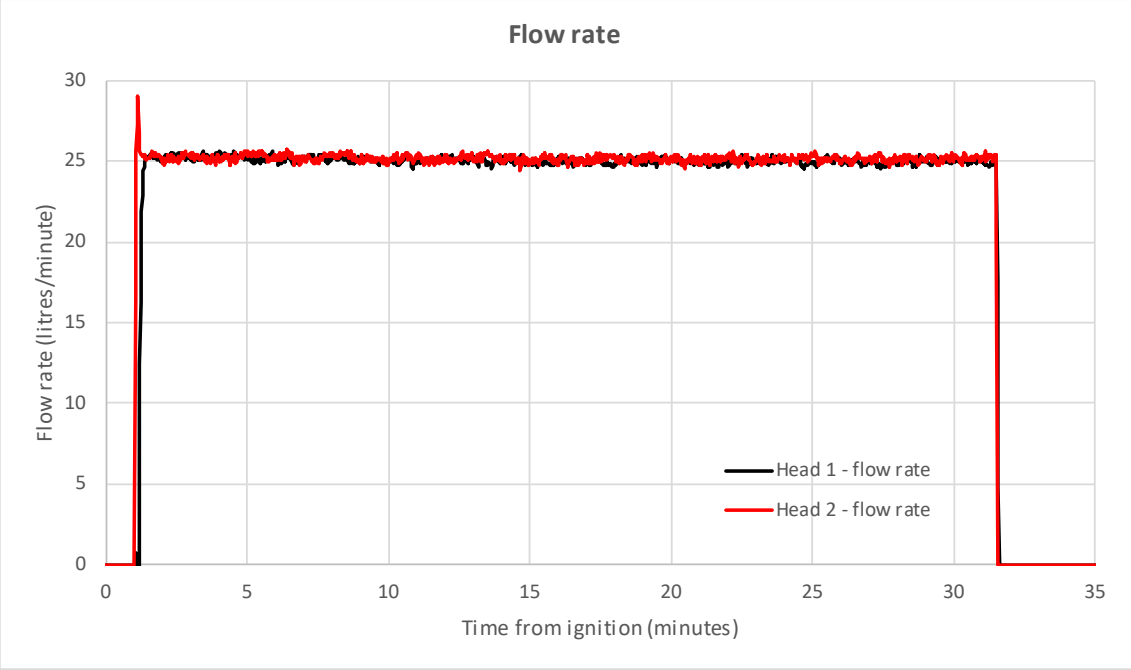

Figure 24: Test 2 – Water flow rate

Figure 25: Photographs of test 2 fire damage

B3 Test 3 – Fuel package beneath nozzle

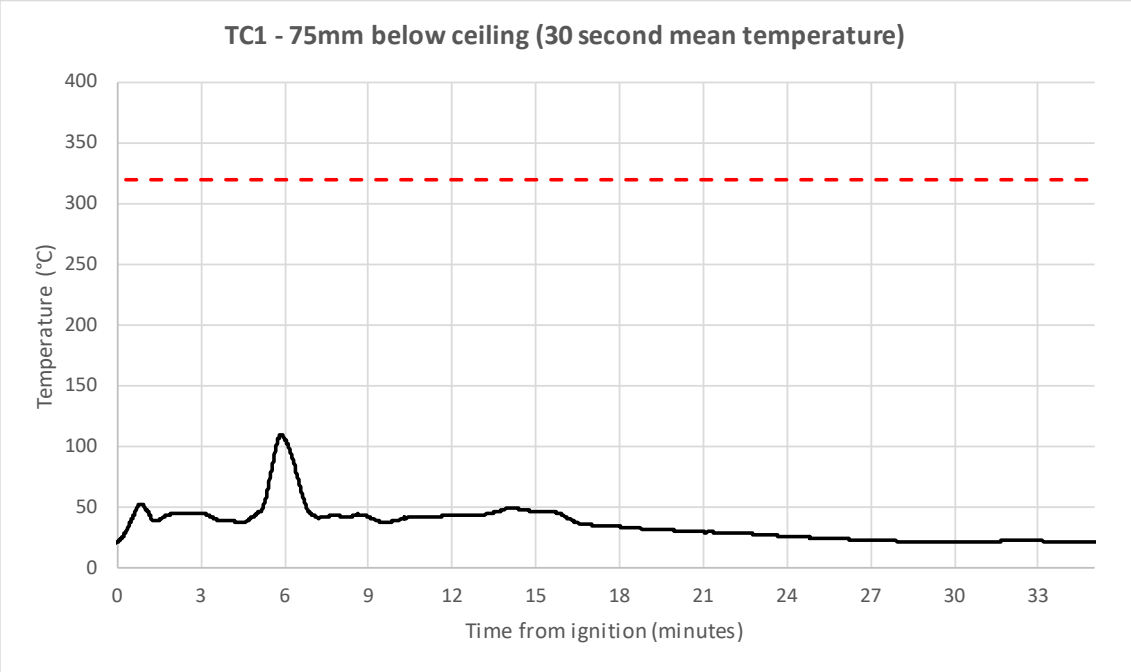

Figure 26: Test 3 – Temperature above the fire (TC 1, 75mm below the ceiling)

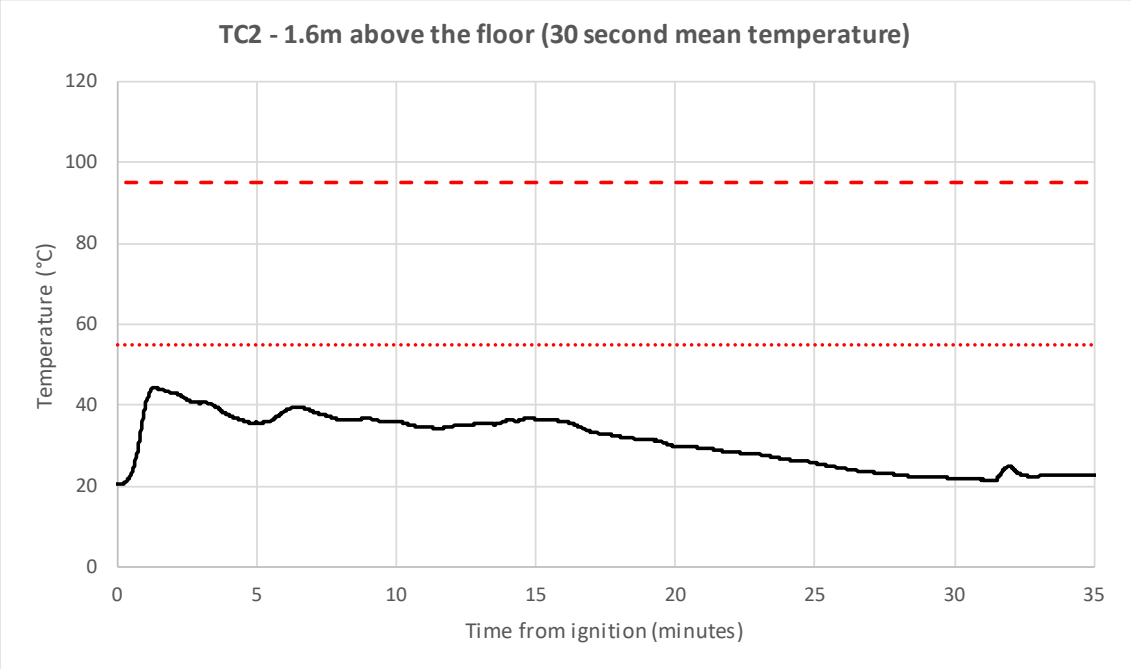

Figure 27: Test 3 – Temperature at TC2, 1.6m above the floor

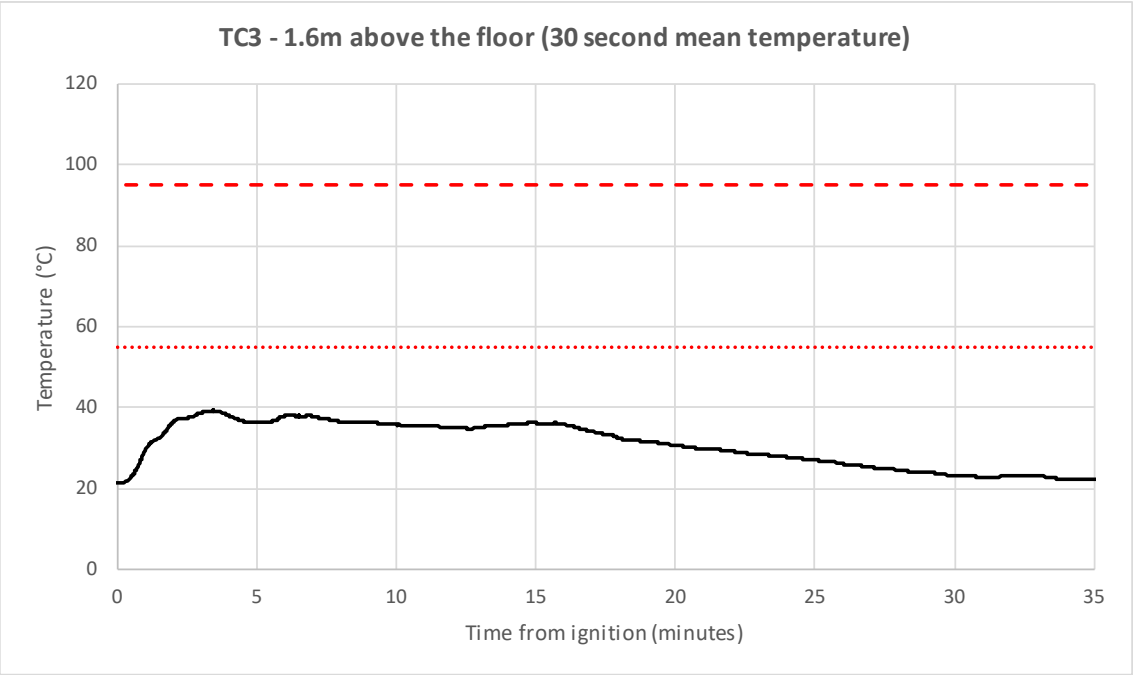

Figure 28: Test 3 – Temperature at TC3, 1.6m above the floor

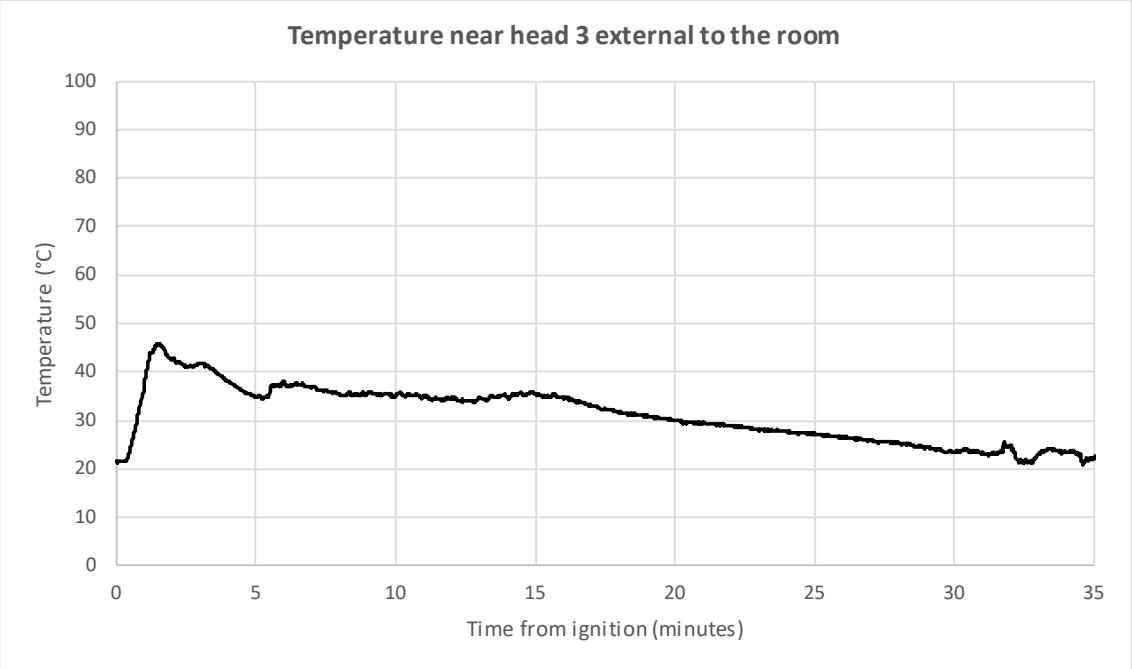

Figure 29: Test 3 – Temperature near head 3 external to the room (TC5)

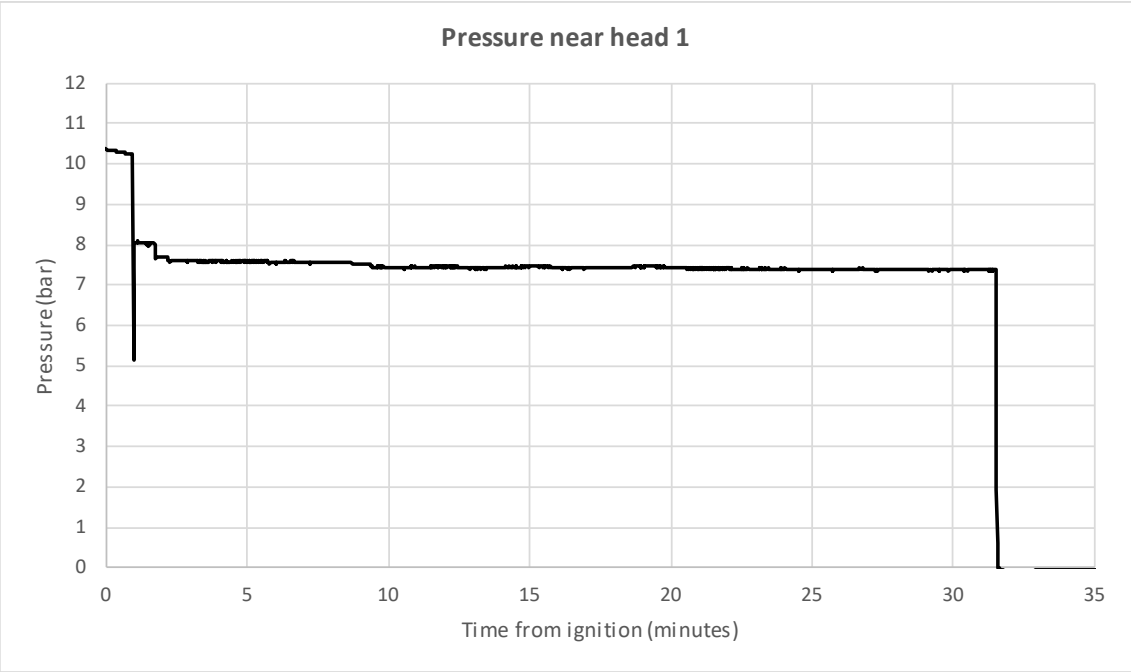

Figure 30: Test 3 – Pressure near head 1

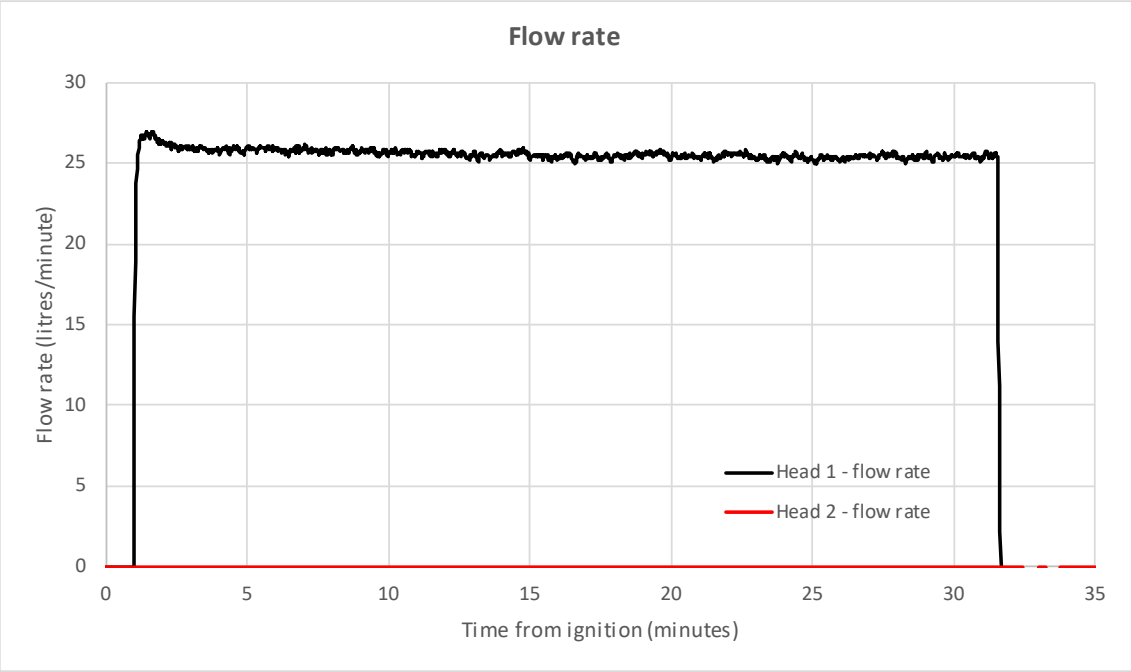

Figure 31: Test 3 – Water flow rate

Figure 32: Photographs of test 3 fire damage

B4 Test 4 – Ventilation test, fuel package between two nozzles

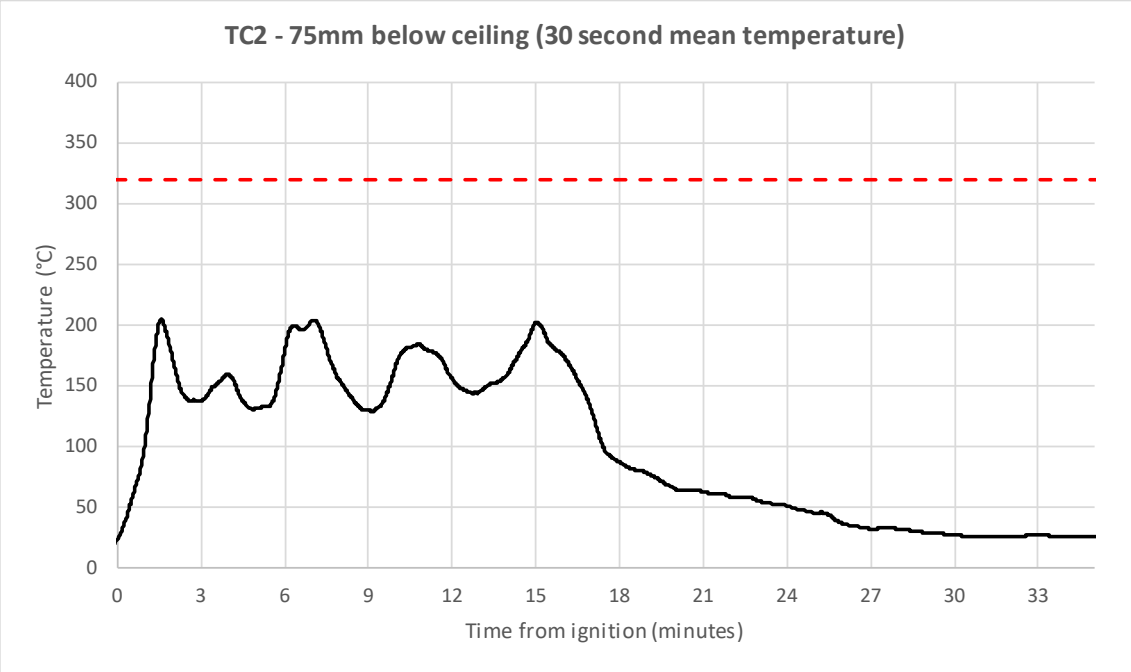

Figure 33: Test 4 – Temperature above the fire (TC 2, 75mm below the ceiling)

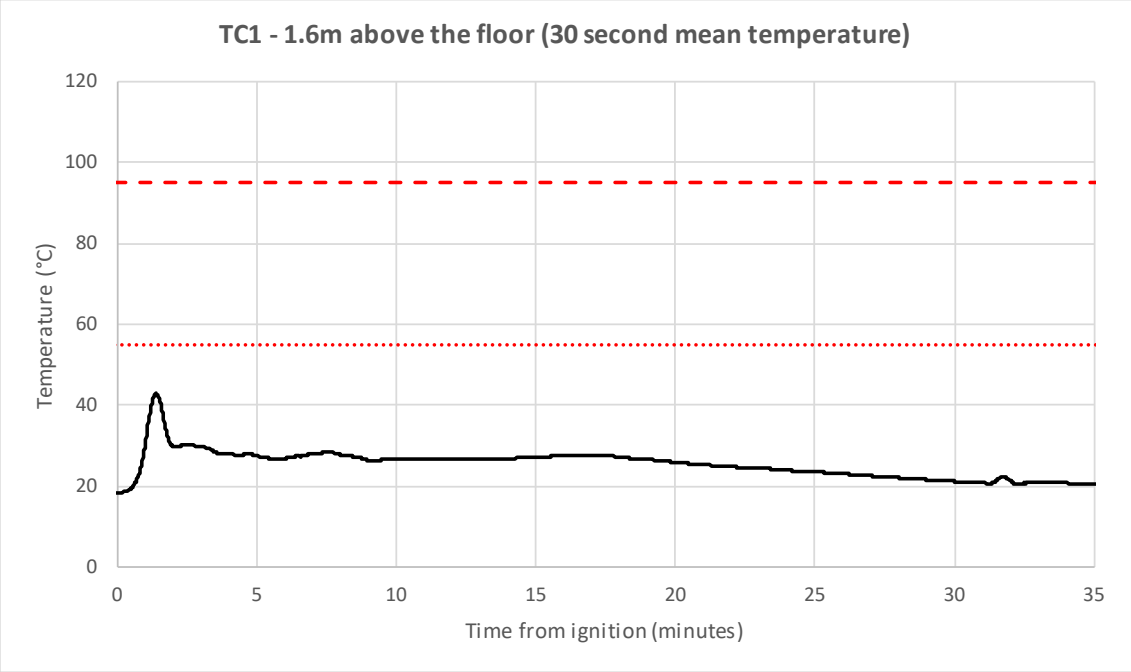

Figure 34: Test 4 – Temperature at TC1, 1.6m above the floor

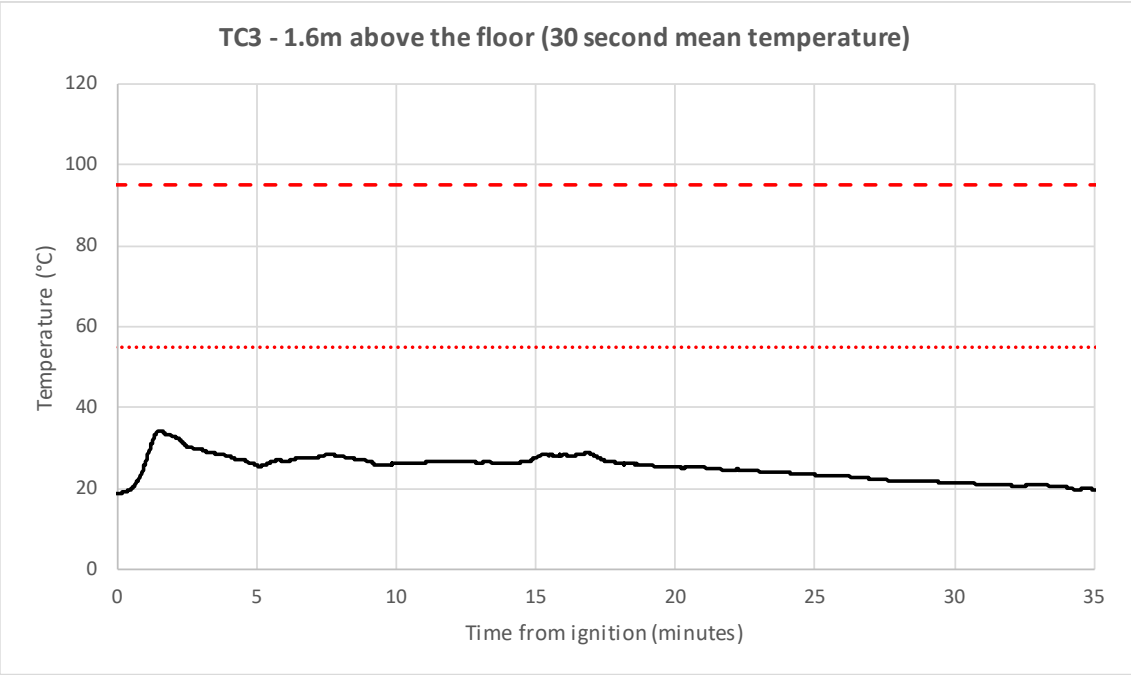

Figure 35: Test 4 – Temperature at TC3, 1.6m above the floor

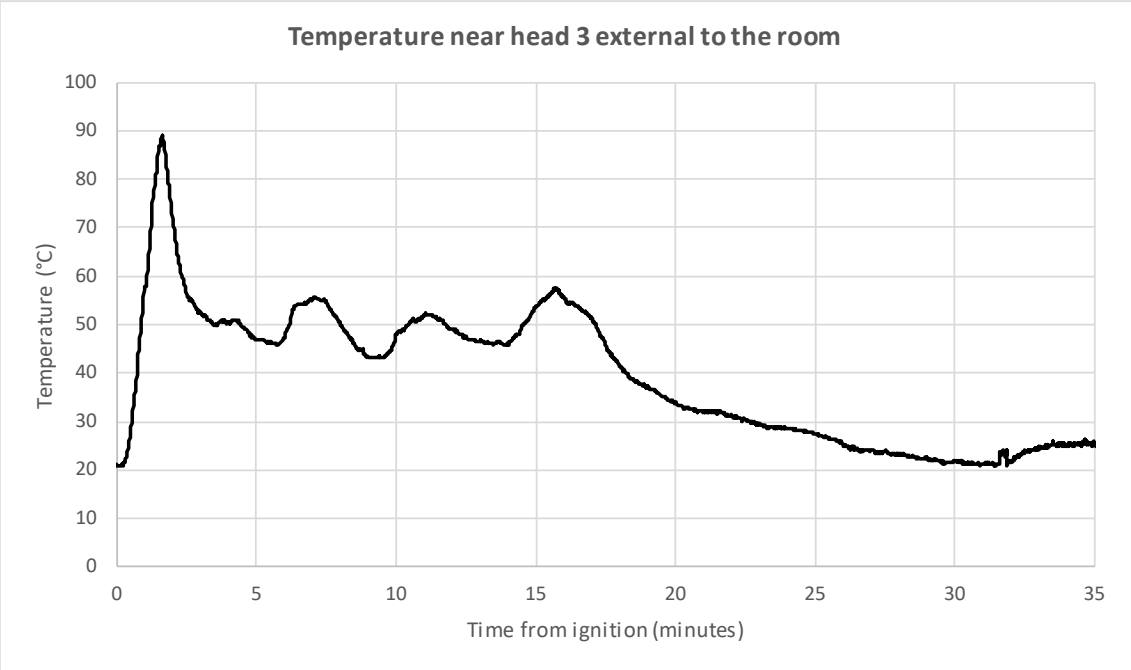

Figure 36: Test 4 – Temperature near head 3 external to the room (TC5)

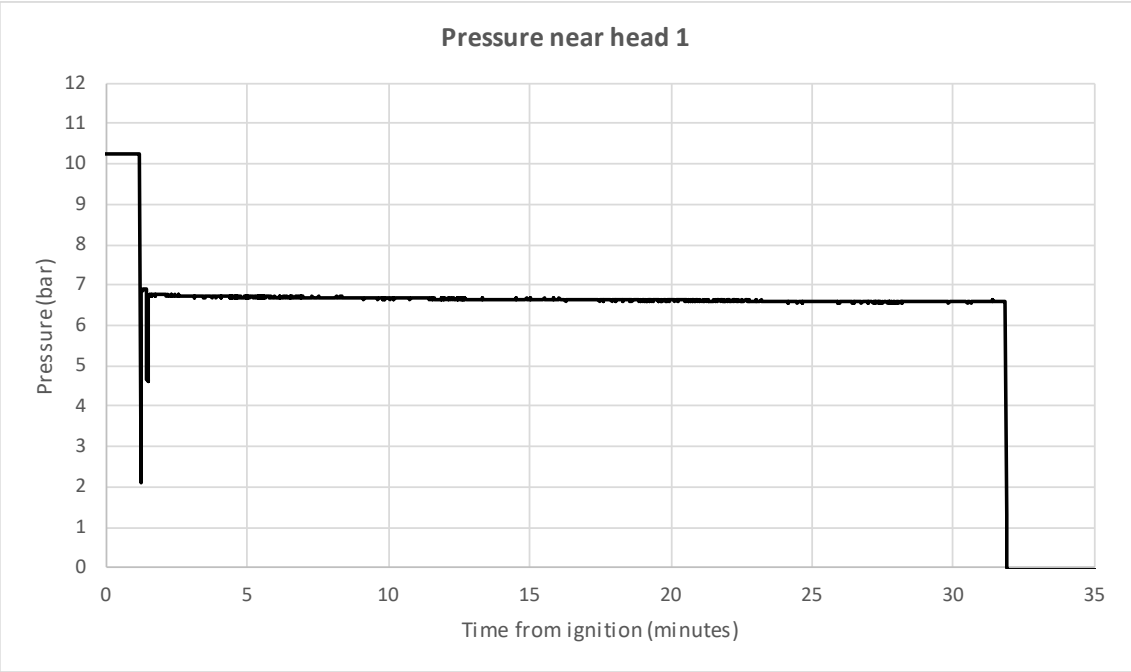

Figure 37: Test 4 – Pressure near head 1

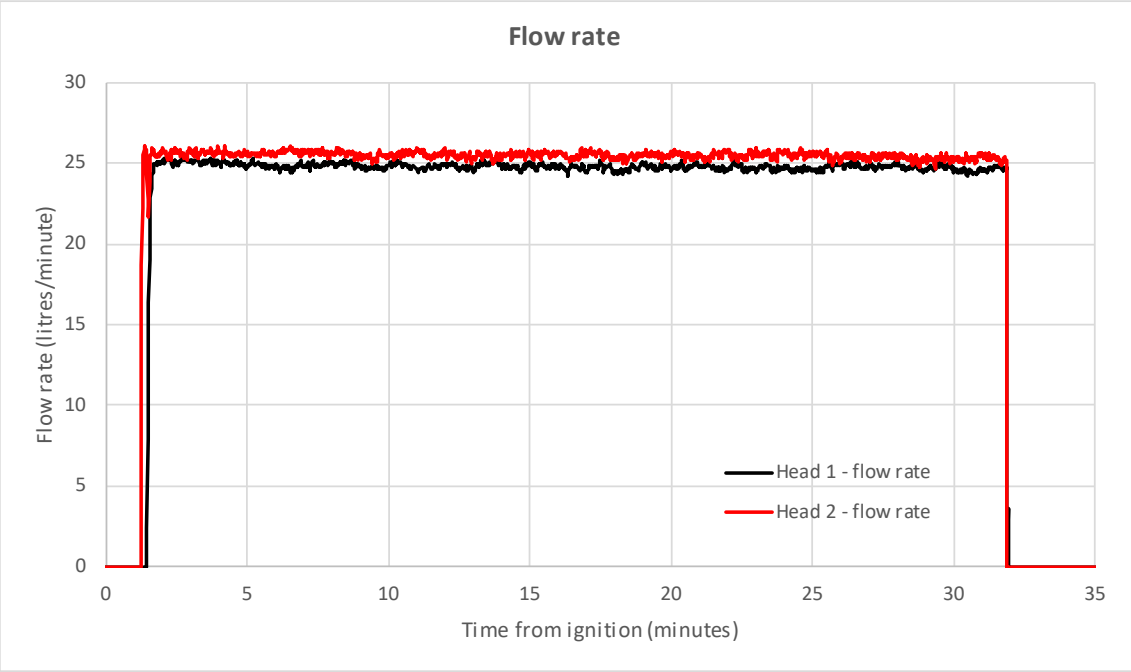

Figure 38: Test 4 – Water flow rate

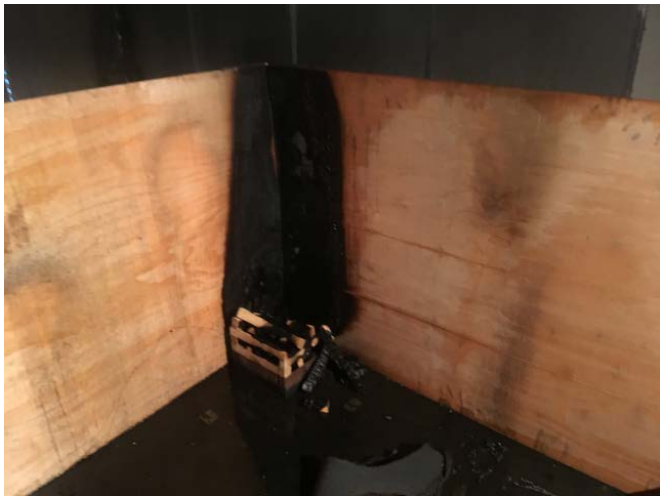

Figure 39: Photographs of test 4 fire damage

B5 Test 5 – Open room 1, fuel package in corner

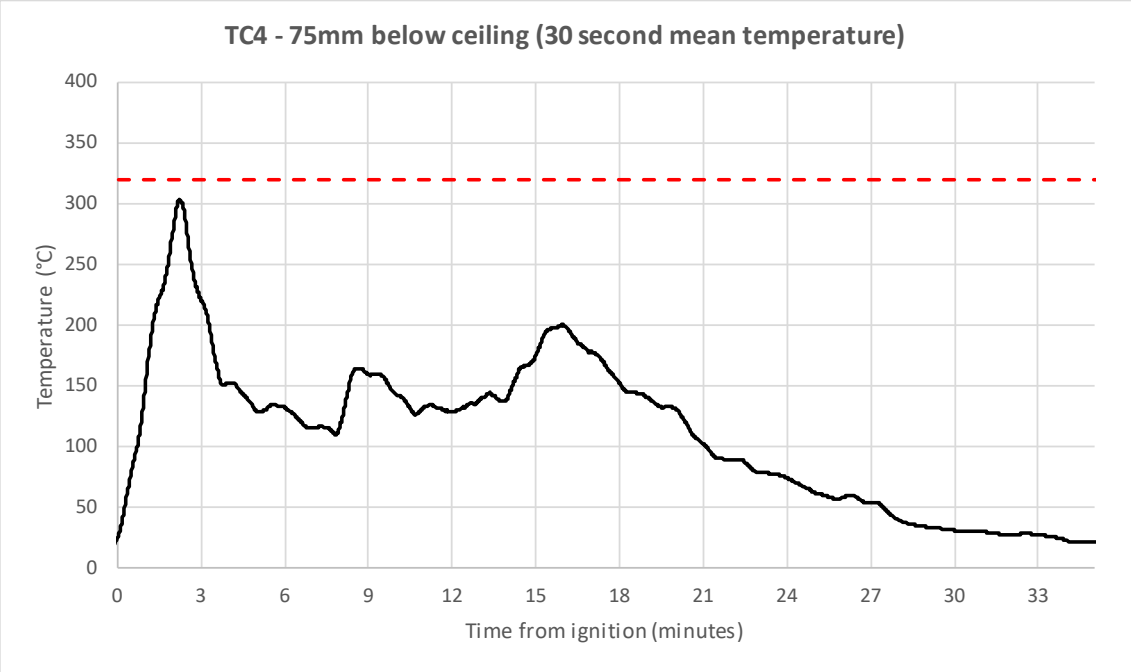

Figure 40: Test 5 – Temperature above the fire (TC 4, 75mm below the ceiling)

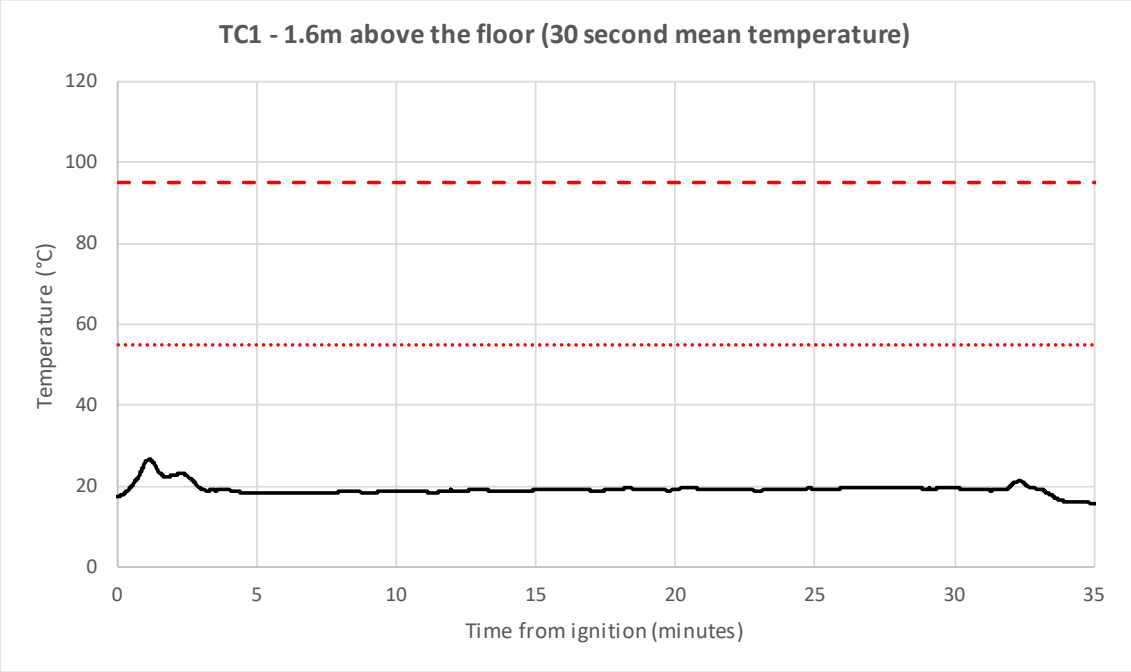

Figure 41: Test 5 – Temperature at TC1, 1.6m above the floor

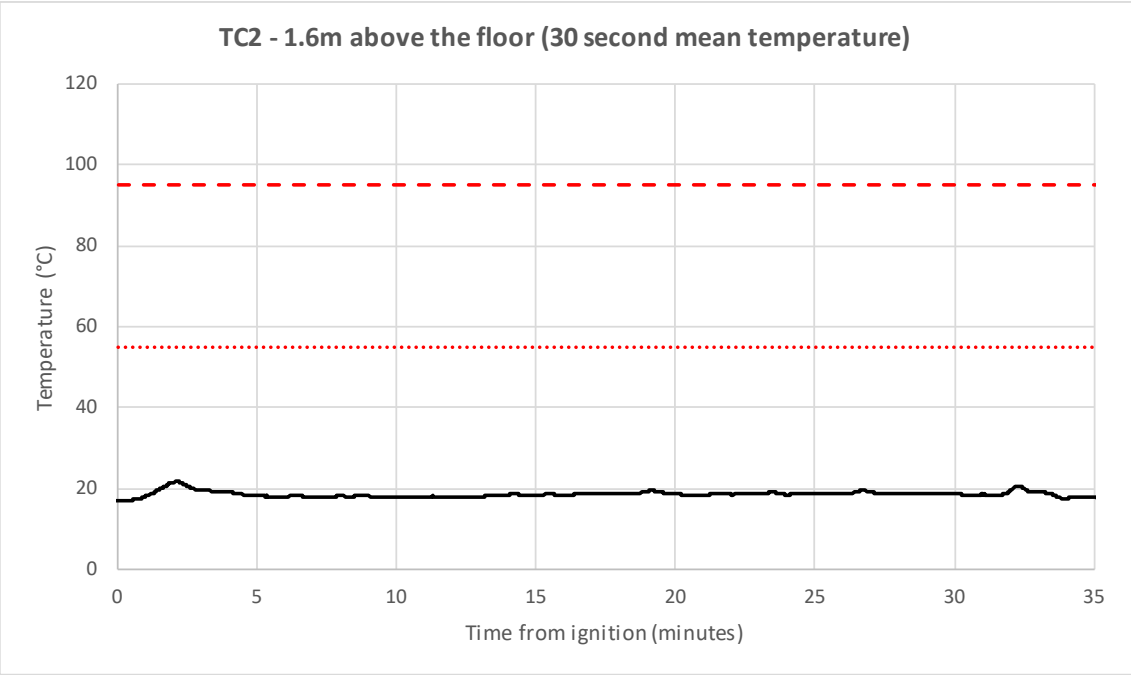

Figure 42: Test 5 – Temperature at TC2, 1.6m above the floor

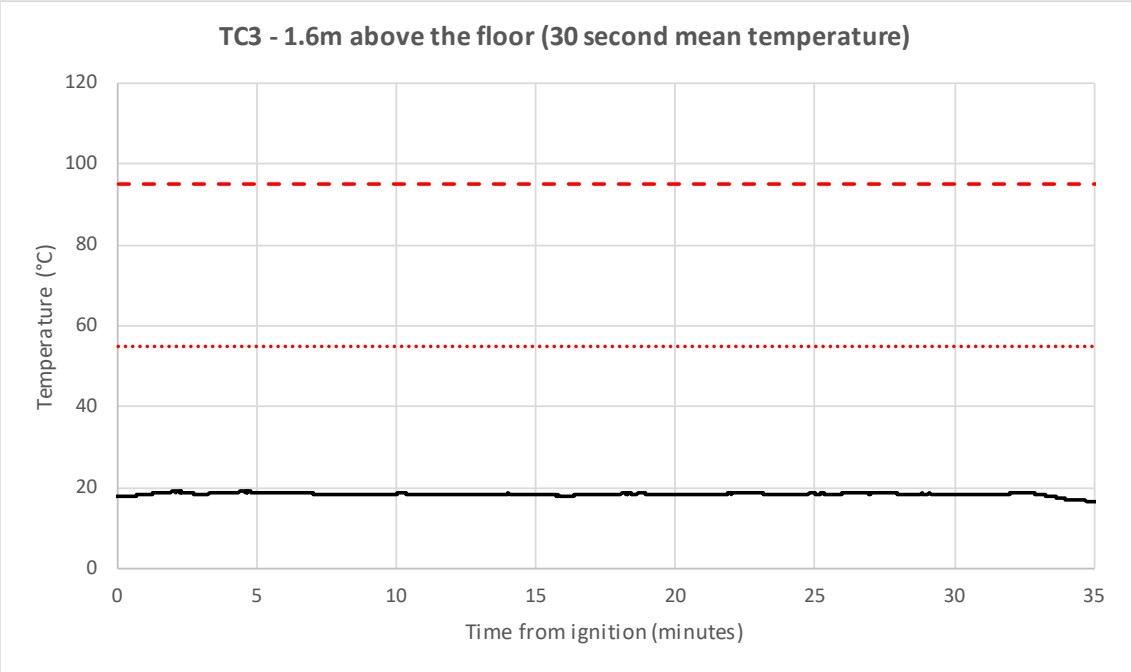

Figure 43: Test 5 – Temperature at TC3, 1.6m above the floor

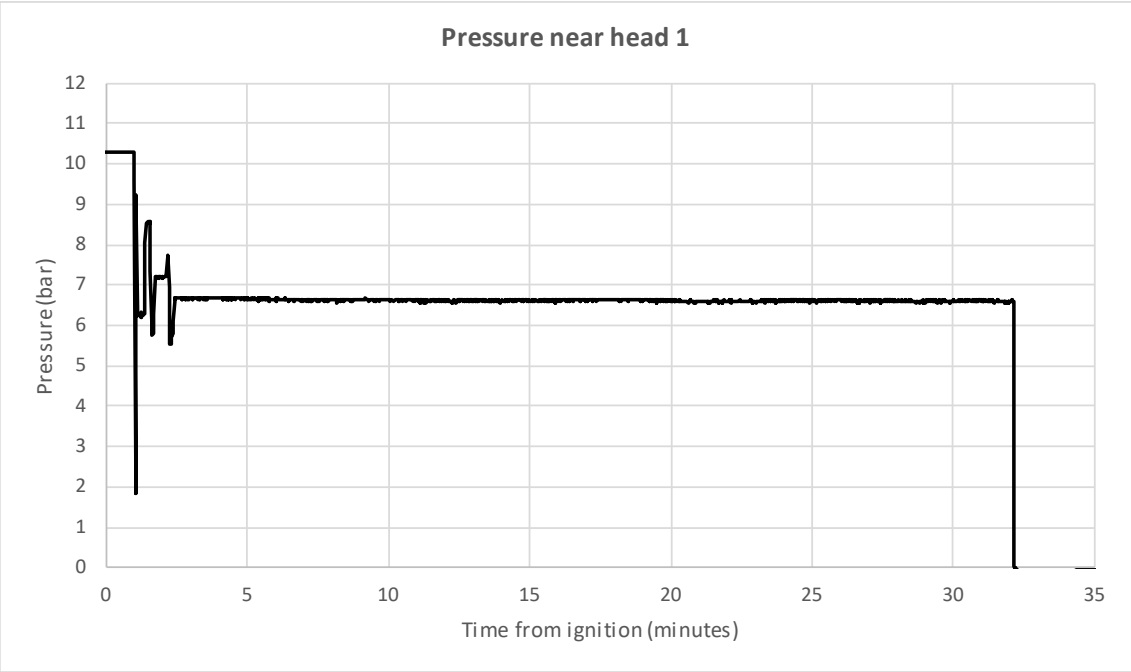

Figure 44: Test 5 – Pressure near head 1

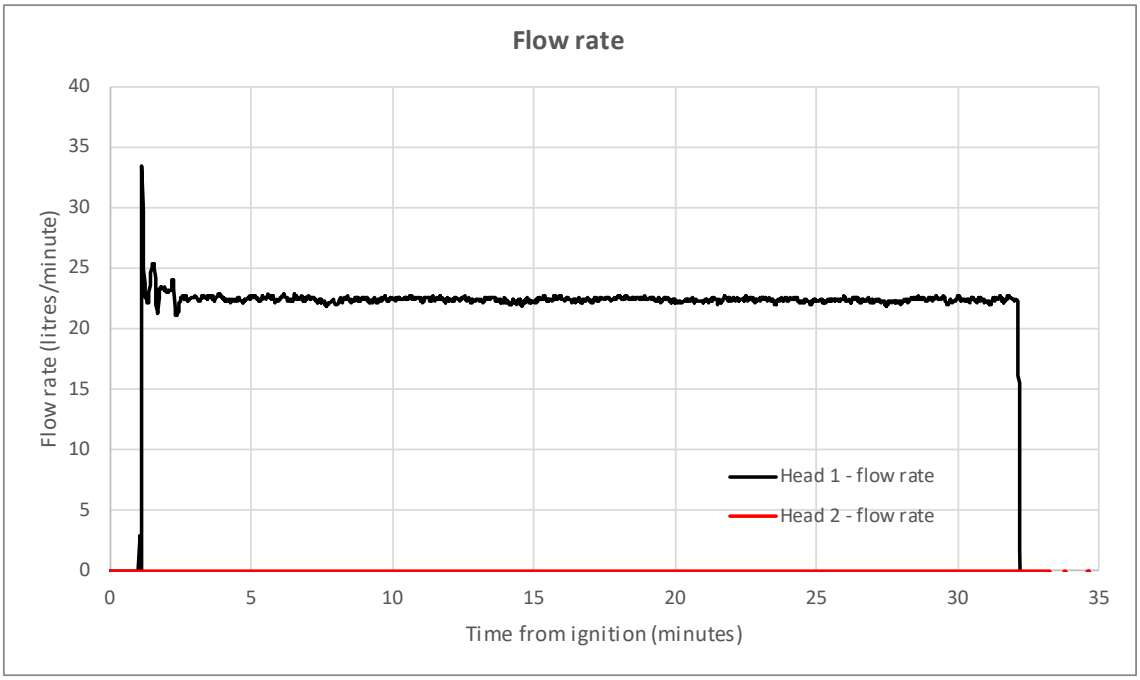

Figure 45: Test 5 – Water flow rate

Figure 46: Photographs of test 5 fire damage

B6 Test 6 – Open room 2, fuel package between two nozzles

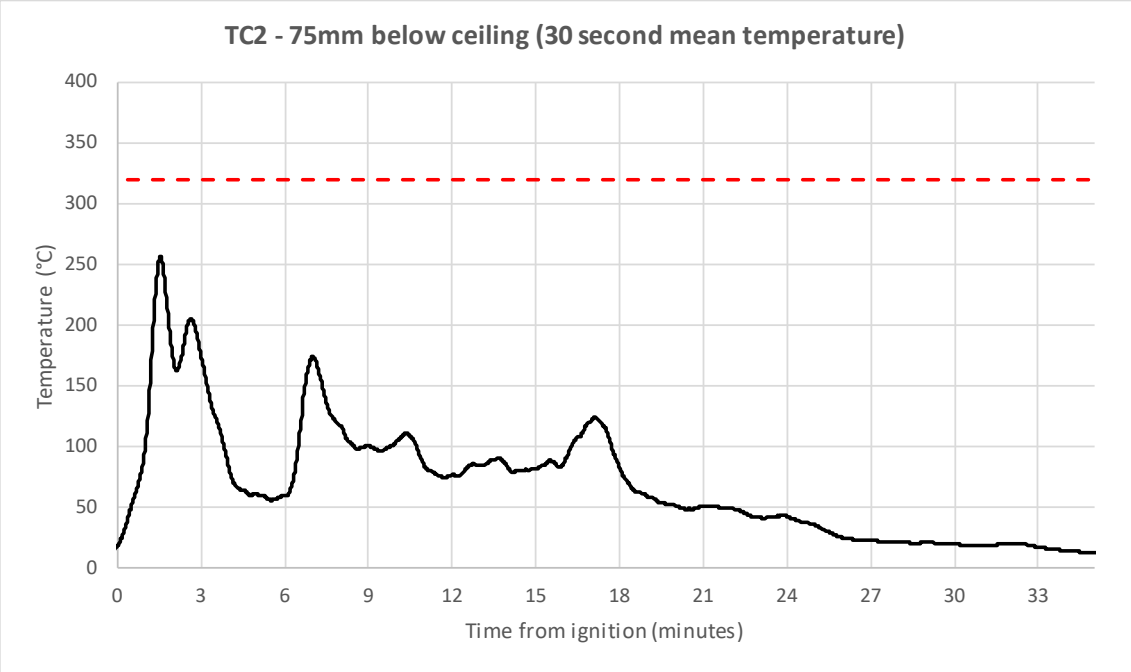

Figure 47: Test 6 – Temperature above the fire (TC 2, 75mm below the ceiling)

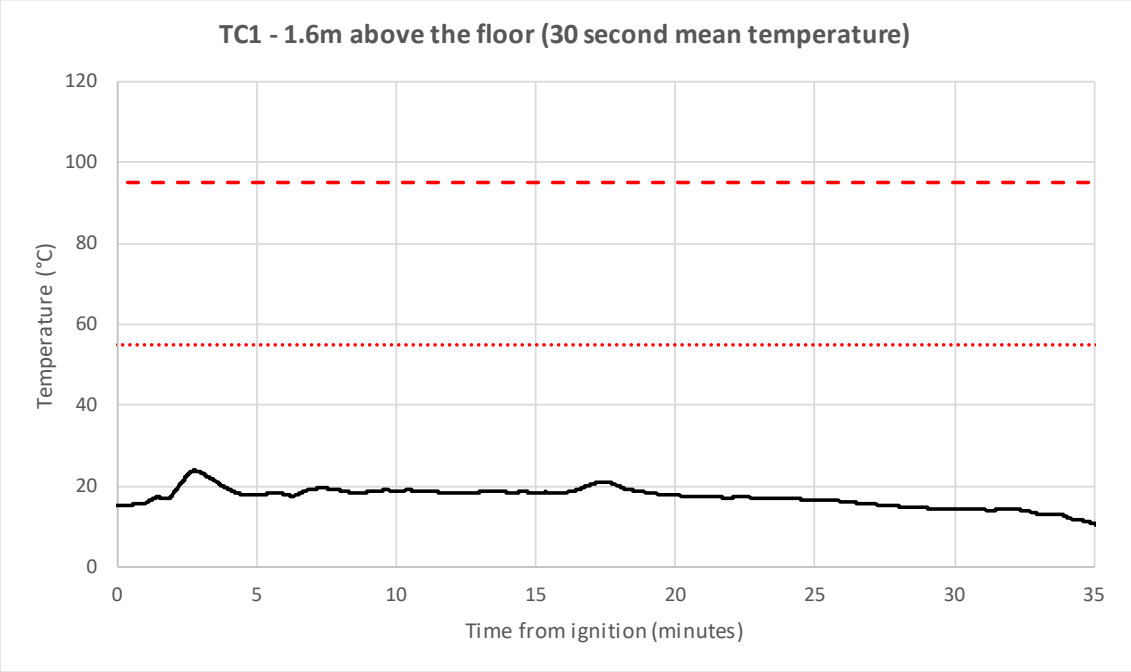

Figure 48: Test 6 – Temperature at TC1, 1.6m above the floor

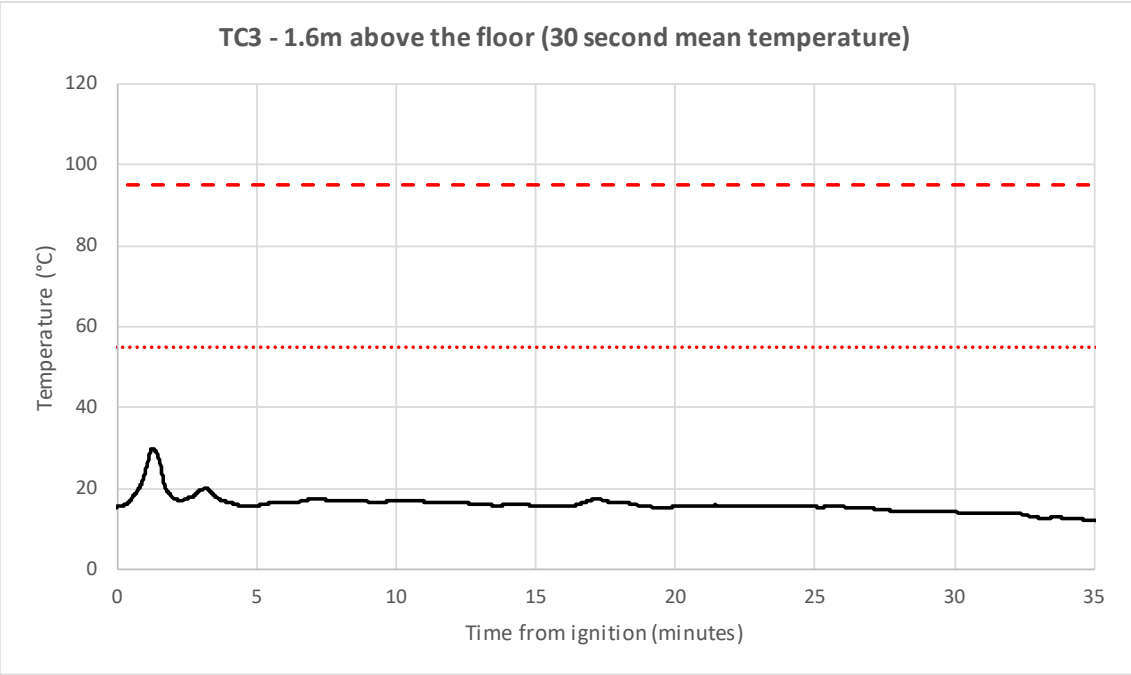

Figure 49: Test 6 – Temperature at TC3, 1.6m above the floor

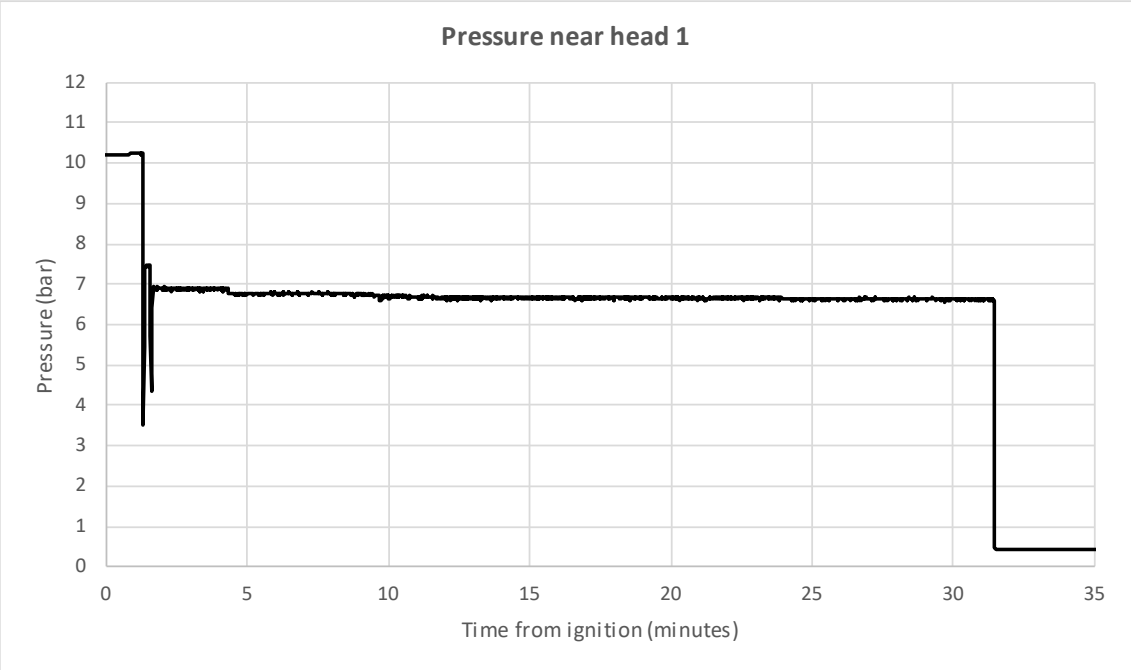

Figure 50: Test 6 – Pressure near head 1

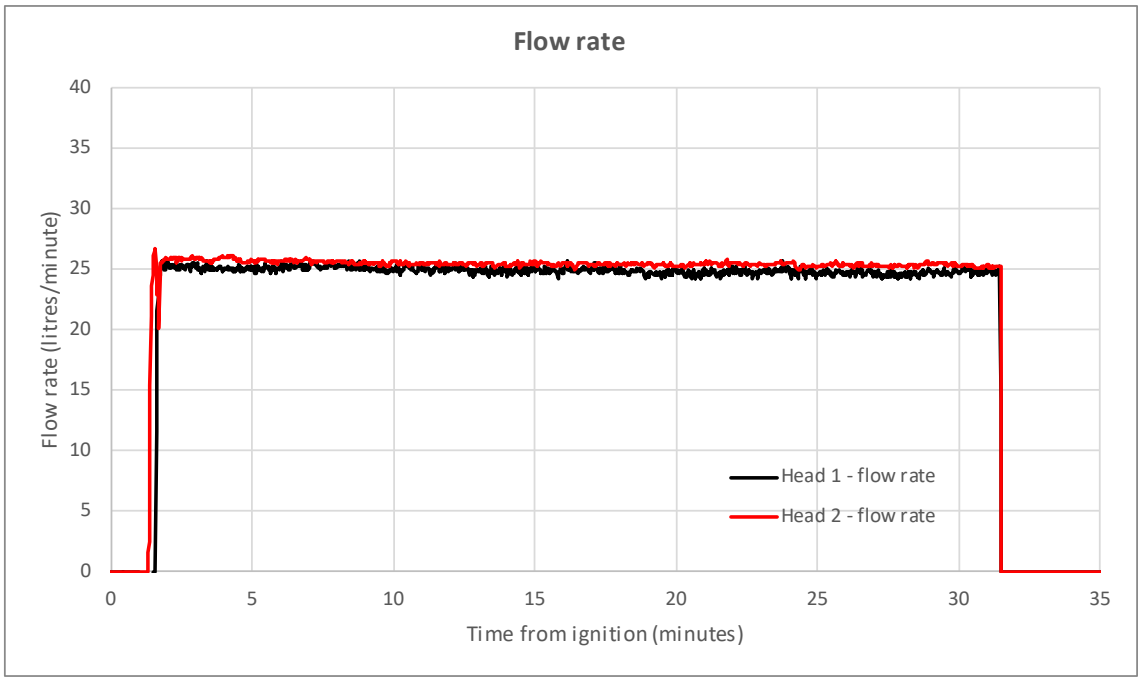

Figure 51: Test 6 – Water flow rate

Figure 52: Photographs of test 6 fire damage

Fire Protection Association

Annex C BSI FSH/18/5_17_0033 BS 8458 sub group comments and recommendations

BS 8458 Sub group review: comments and draft texts

Number	Standard reference	Pre meeting comments	BS 8458 Sub group review: comments and draft texts
1	Clause 6.1(a)(2) within 2 min from the operation of the first nozzle, the mean recorded temperatures 75 mm below the underside of the ceiling should remain steady or decrease	This is down to interpretation at the moment, as with most of our test runs we tend to see a 2nd peak of heat release from the crib at approximately 8 minutes and this is regardless of how good the system is (We don't see any reason why a system should fail, providing it continues to meet the temperature criteria of Table 2)	After some discussion, it was agreed that this recommendation could be deleted and that pass/fail criteria could be based upon "maximum allowable temperatures", provided that there was some clarification of how these should be used. **Recommendation: Delete 6.1 a 2**

2	Table 2 Fire test maximum temperatures Thermocouple location / Maximum allowable temperature °C 75 mm below the underside of the ceiling — 320 1.6 m above the floor — 95 1.6 m above the floor — 55 (for not more than any 120 s interval) Table 5 **Fire test maximum temperatures** **Thermocouple location** / **Maximum allowable temperature °C** 75 mm below the underside of the ceiling, above centre of crib — 320 Ceiling temperature (6.5 mm above the underside of the ceiling), above centre of crib — 260 1.6 m above the floor, directly beneath sprinklers A) — 95 1.6 m above the floor, directly beneath sprinklers A) — 55 (for not more than any 120 s interval) A) For sidewall sprinklers the thermocouple locations remain as if standard sprinkler heads were used (see Figures S.7 and S.8).	This is also down to interpretation as it doesn't specify where the certain thermocouples should go? At the time of testing to the DD we discussed this and decided on the locations due to the max temperatures (320C above crib, 95C/55C down the centres of the room/beneath the nozzles) We believe this was the intended interpretation of the BS 8458 as when we came to do a BS 9252 test we seen the below table that states the positions: Although questions could be asked about the statement "directly below the sprinklers" for the BS 8458, as may use 4 nozzles for example but I suggest we keep the thermocouples in the same position (centre of room) for consistency and as BS 9252 only shows the two nozzle arrangement which isn't a suggestion as BS 8458 is	The locations and heights of the relevant thermocouples needs to be clarified. **Recommendation: Amend table 2 as follows: Also amend labelling in figures C1, C2, C3, C6, & C7** **Table 2 – Fire test maximum temperatures** **Fire test** / **Thermocouple location/s and height/s** / **Maximum allowable mean temperature °C** Corner test (a) — TC4 75mm below ceiling — 320 TC1, TC2, TC3 1.6 m above the floor — 95 55 (for not more than a total of 120s) Note 1 Fuel between two nozzles (b) — TC2 75mm below ceiling — 320 TC1, TC3 1.6 m above the floor — 95 55 (for not more than a total of 120s) Note 1 Fuel beneath a nozzle (c) — TC1 75mm below ceiling — 320 TC2, TC3 1.6 m above the floor — 95 55 (for not more than a total of 120s) Note 1 Note 1: i.e. Not more than 60 cumulative individual mean temperatures throughout the duration of the test (corresponding to cumulative 120s at ½ Hz).

3	When a successful set of test results is obtained [see a) to c) above], those results should be used to determine the design parameters for the systems to be installed. The system should then be designed using those parameters and in accordance with this British Standard. All design and installation parameters determined by the fire tests and any other system constraints crucial to the required performance of the system should be specified in the manufacturer's design and installation manual. Sufficient and relevant design and installation information should be provided to enable the replication of the system as tested. The manufacturer should describe and/or specify the procedure for the installation of the system.	Does this mean once we have a pass at certain pressures/flows etc. this can then be used to determine the design for a system to be used in different sized rooms etc. so the client can change the pump etc. in practice to meet those pressures/flows for all nozzles? With all tests we suggest that only the tested product/system can be used in practice	**Discussed: Recommendation: No change**
4	6.5 Hydraulic calculations System piping should be hydraulically designed to deliver the required water flow and pressures as determined by the fire tests in Annex C. Hydraulic calculations should be carried out to determine the hydraulically most unfavourable area for the system based on the maximum number of heads assumed operating, the pipe configuration, head selection and classification of risk.	Does this mean that once the flow and pressures are determined by Annex C that when you fit the system into larger areas, a calculation can be done and therefore a larger pump would be needed to meet the flow and pressures should a said number of nozzles activate (most of the time only 2 nozzles are used in the test, connected to one pump)	**Discussed: Recommendation: No change**

5	6.6 Discharge performance 6.6.1 Domestic occupancies For domestic occupancies, the system should be capable of providing pressures and flow rates to permit all the watermist nozzles in the fire test room or largest compartment, whichever is the greater, up to a maximum area of operation (AMAO) of 64 m2, to operate simultaneously at not less than the greater of: a) the nozzle pressure given by the pass criteria determined by the test in Annex C; or b) the approval listed discharge performance.	As above (Number 4)	This is beyond the scope of the sub group but was discussed: FSH 18/2 to consider if text changes are necessary: By way of clarification: *" Domestic systems should be designed with an AMAO of 64m2, unless the largest risk area within the home is smaller than this. In which case the design AMAO can be reduced to the largest risk area, subject to a an absolute minimum of 32m2 (or the area of the fire test room if greater than 32m2)."*
6	6.6.2 Residential occupancies For residential occupancies, the system should be capable of providing pressures and flow rates to permit all the watermist nozzles in an assumed maximum area of operation (AMAO) of 64 m2 to operate simultaneously at not less than the nozzle pressure given by the pass criteria determined by the test in Annex C, or their approval listed discharge performance, whichever is the greater. Any flow for alarm purposes should be added to the system flow.	As above	This is beyond the scope of the sub group but was discussed: FSH 18/2 to consider if text changes are necessary: By way of clarification: *" Residential systems should be designed with an AMAO of 64m2."*
7	What is AMAO of 64m2 when we test at 32m2 for nozzles spaces of 2-4m and there is option to test to 50m2 for nozzle spacing's of	Understood from the answer sent to all by email, however I am still looking for more information if possible on how the 64m2 has	As above

	4-5m, plus the open space test option for 80m2?	been worked out when we have a maximum size of 80m2 therefore un-protected area?	
8	C.1.1 and C.1.2 The test room ceiling should be covered by 12.5 mm Type F fire-rated plasterboard conforming to BS EN 520:2004	Doesn't state how often this should be changed, we change the boards after a formal test has been completed/10 test runs/or when there is visible reason to do so.	**Discussed: Recommendation: No change**
9	C.1.3 Ignition package The wood sticks should be 38 mm × 38 mm cross-section by 305 mm long (actual) and plane finish	Is there a reason why they have to be 38x38mm as you can't actually buy this from a timber merchants at that size, as finish thickness (PAR) is approx. 33x33mm. We have to purchase thicker timber and plane it down	**Discussed: Recommendation: No change**
10	C.1.4 Fuel package, consisting of two sheets of polyether foam	Should state Non FR foam	**Discussed: Recommendation: Amend text as follows:** C.1.4 Fuel package, consisting of two sheets of **non fire resisting** polyether foam 775 mm × 865 mm × 75 mm having a density of 20 kg/m3. Each sheet should be glued to a sacrificial backing board, 775 mm × 865 mm × 12 mm, which is attached to a wooden supporting frame (see Figure C.4 and Figure C.5). The foam sheets should be flush with the top and sides of the sacrificial board and frame.
11	C.1.5 Plywood panels b) For the centre tests, a partition arrangement of plywood panels should be used, made from two 12 mm thick plywood panels each (2.2 ±0.1) m in length and 1.2 m in height (see Figure C.2 and Figure C.3).	Doesn't state if these are just screwed together (which we do) or have supports (we chose to have no support as the standard suggests when you look at figures C.2 and C.3 which don't show any support and support is shown for the sacrificial boards)	**Discussed: Recommendation: Amend text as follows:** b) For the centre tests, a partition arrangement of plywood panels should be used, made from two 12 mm thick plywood panels each (2.2 ±0.1) m in length and 1.2 m in height (see Figure C.2 and Figure C.3). **The panels should be constructed so that there is no air gap**

			between them. The distance of the ignition and fuel package from the plywood partitions should be controlled to (50 ±5) mm (see Figure C.5).
12	C.2 Watermist system set-up The watermist manufacturer should declare the following for the set-up of the tests: • water delivery system including nozzles, fire pumps, cylinders, pipework and filters/strainers, as intended to be used in a real installation.	States that the client should use what fire pump is to be used in real installation, but some other points such as the calculations suggest they would change the pump to achieve the pressures/flows?	**Discussed: Recommendation: No change**
13	C.4 Procedure For every 15 temperature measurements (30 s), the 15 results should be added together and the total divided by fifteen to obtain the mean value. The highest mean values should then be taken as the maximum temperature recorded during the test. Measure and record any flow of water to the room nozzles at intervals not exceeding 1 Hz to ensure that it does not fall below the minimum recommended design flow and that the most remote nozzles operate at the minimum recommended design pressure.	Is this "rolling" average or "block" average for every 30 seconds temp measurements (we "block" average this for every 30 second temperature measurement intervals due to the word for "every" 30s temp measurements) We don't do this as it is believed that the client should use their flow meter that they use in practice and if we were to add ours to the pipework this could affect the flow they get and wouldn't be a true flow as they would get in the real installation	**Discussed: Recommendation: Amend text as follows:** C.4 Procedure Ignite the heptane in the steel tray and the cotton wicks simultaneously. Record ~~thermocouple~~ temperatures **using 1.5mm type K thermocouples** at least every 2 s, throughout the tests and nozzle operating time(s) from ignition to 30 min after the operation of the first nozzle. For every 15 temperature measurements (30 s), the 15 results should be added together and the total divided by fifteen to obtain the mean **"rolling average"** value. **For example: SUM(T1 to T15)/15, SUM(T2 to T16)/15, SUM(T3 to T17)/15, etc.** The highest mean values **of each thermocouple** should then be taken as the maximum temperature recorded during the test. **Thermocouple values should be treated individually and not averaged together.**

			Needs explaining if that is correct and how it would be recorded?

Comparison to BS 9252: 2011

Standard reference	**Comments**	
4.21 Fire test When tested in accordance with Annex S, sprinklers shall be capable of controlling the test fires for a period of 10 min, measured from sprinkler operation. Temperatures shall be limited to the values indicated in Table 5. The third sprinkler shall not operate	Is there any reason why we can't keep it simple like this criteria from sprinkler standard BS 9252? After all watermist is compared to sprinklers and our BS standard for sprinklers only has this criteria to meet?	**Discussed and agreed, amendment in item 1 brings 8458 in alignment with 9252**

Questions from BSI to the committee	**Comments**	

1) Reference clause “6.1, a), 2)” – a. Is it the temperatures from 1st nozzle operation to 2 minutes later or 2 minutes following first nozzle operation until the end of the test which are of interest? b. Should mean temperatures be derived by taking a ‘rolling average’ or ‘block’ average (refer also clause C.4)? When should the averaging start from (t0 or 1st nozzle operation)?	From standard: "within 2 min from the operation of the first nozzle, the mean recorded temperatures 75 mm below the underside of the ceiling should remain steady or decrease"	**Discussed: Recommendation: Amend text as follows**: 6.1 b) From **ignition until the end of the test** ~~the start of the test~~, the recorded temperatures should not exceed the values indicated in Table 2. see 13 above
2) Reference clause “6.1, b)” – should the temperatures of table 2 be considered against instantaneous peaks measured or mean temperatures (clause C.4 says “The highest mean values should then be taken as the maximum temperature recorded during the test”)?	From standard: "b) From the start of the test, the recorded temperatures should not exceed the values indicated in Table 2"	see 13 above
3) Thermocouple types and diameters are not specified and probably should be. What should be used?	We use 1mm Type K	see 13 above
4) Reference clause “6.1, a), 2)” “…the mean recorded temperatures 75 mm below the underside of the ceiling…” – does this mean a time-averaged mean (see C.4) or mean of the three locations 75 mm below the ceiling?	Again using interpretation as per number 1 above, this was discussed to be underside of ceiling, above the crib (which was more evident when reading BS 9252 as being the intended interpretation) C.4 is clear that "The highest mean values should then be taken as the **maximum temperature** recorded during the test" and	See 2 and 13 above

	table 2 states "Fire test **maximum temperatures**"	
5) In a Domestic or Residential scenario, where the AMAO is 64m2 and as a result of maximum nozzle coverage area this determines that a system would have three (or more) nozzles operating; is it intended that the operation of the porch head (i.e. the third head; within the capability of such a system) still be considered a failure?	As 3 and 4 above	**Discussed: Recommendation: No change**

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