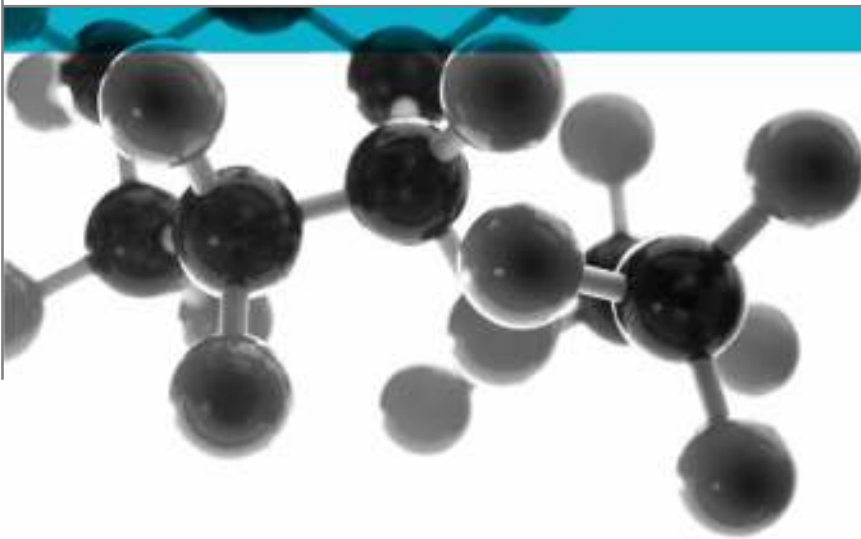


Test on a watermist system utilising the principles of the procedure defined in BS 9252: 2011: Annex S



**Specification and test methods for residential sprinklers:
Fire tests**

A Report To: Plumis

Document Reference: 347811

Date: 13th March 2015

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Page 1

**Testing
Advising
Assuring**

Executive Summary

Objective To demonstrate the capability of a water mist system to control a fire utilising the principles of the test procedure defined in BS 9252:2011: Annex S

Generic Description	Product reference	Thickness / diameter / angle	Weight per unit area or density
Automist "Plus" fire suppression system	"Automist Plus"	Not applicable	Not applicable
Individual components used to manufacture the system:			
Nozzle	"Production Intent Flat Spray Nozzle TTCC-6503 and Spray Head Sn1a"	65° (spray angle) 30° to 150° (head sweep angle)	Not applicable
Pipe	"Production High Pressure Hose 150bar Working Pressure"	Internal: Ø 6.3mm External: Ø 11.5mm	Unable to provide
Pump	"Production Pluvia Pump"	Not applicable	Not applicable
Heat alarm	"Ei164 Heat Alarm"	Not applicable	Not applicable
Please see page 5 of this test report for the full description of the system tested			

Test Sponsor Plumis, HMS President (1918), Victoria Embankment, London, EC4Y 0HJ

Test Results:

Thermocouple location	Maximum temperature °C			
	Corner Test 1	Corner Test 2	Centre Test 1	Centre Test 2
75mm below the underside of the ceiling, above centre of crib	100	114	90	159
Ceiling temperature (6.5mm above the underside of the ceiling), above centre of crib	42	41	40	52
1.6m above the floor, furthest from fire	46	57	49	59
1.6m above the floor, centre	N/A	N/A	51	76
1.6m above the floor, close to fire	40	52	55	39



Where the thermocouples were positioned at 1.6m above the floor, the temperatures did not exceed 55°C for any 120 second interval.

The maximum temperature measured during the tests for the replicated third sprinkler are below:

Thermocouple location	Maximum temperature °C			
	Corner Test 1	Corner Test 2	Centre Test 1	Centre Test 2
Replicated third sprinkler	49	60	49	94

Date of Test 15th and 16th December 2014

Signatories

	
Responsible Officer T. Kinder * Technical Officer	Authorised T. Mort * Senior Technical Officer

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 13th March 2015

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Test Details

Introduction

The sponsor, Plumis produce watermist systems, designed to control fires in similar situations to which sprinkler system would usually be used. The sponsor approached **Exova Warringtonfire** with such a watermist system and asked that its performance under fire conditions be assessed.

Purpose of test

To determine the performance of a watermist system when it is subjected to the conditions of the tests specified in BS 9252: 2011 “Components for residential sprinkler systems – Specification and test methods for residential sprinklers” Annex S “Fire tests”

The test was performed in accordance with the principles of the procedure specified in BS 9252: 2011: Annex S (please note the deviations from this as detailed in the ‘Deviation from test standard’ section below) and this report should be read in conjunction with that Standard.

Scope of test

BS 9252: 2011 specifies requirements for the fire performance of sprinklers which are operated by a change of state of an element or bursting of a glass bulb under the influence of heat. Annex S to this Standard details a test procedure for measuring the temperature within a test room, to determine if a system has the capabilities to control the test fires for a period of 10 min (measured from sprinkler operation) without the operation of a third sprinkler in the system. The temperature measurements recorded throughout the test are used to determine compliance with the criteria given in BS 9252: 2011 Table 5 and the requirements specified in this table are detailed in Appendix 2.

Deviation from test standard

BS 9252: 2011 is a specification which details the performance requirements for components of residential sprinkler systems. Annex S specifies the fire performance requirements of sprinklers which are operated by a change of state of an element or bursting of a glass bulb under the influence of heat.

The system under test and described in this report is a watermist system, and as such does not fall into the category of sprinkler system as covered by this test standard.

The system under test is manually activated 10 seconds after a separate heat alarm is triggered. In this manner the system cannot be considered to operate in the way required by the scope of the standard (the triggering device is remote from the site of water application).

BS 9252 requires that the width and length of the test room are determined using the maximum sprinkler spacing. At the specific request of the sponsor, the width and length were set to 3.7 and 7.4m respectively.

In all other respects, the procedures defined in the test standards (fire loads, positions etc) were applicable.

The deviations from test standard as detailed here along should be considered carefully when assessing the results obtained against specific requirements.

Instruction to test	The test was conducted on the 15 th and 16 th December 2014 at the request of Plumis, the sponsor of the test.
Provision of the system to test	The system was supplied by the sponsor of the test on the 15 th December 2014. Exova Warringtonfire was not involved in any selection or sampling procedure.
Conditioning of ignition and fuel packages	<p>The plywood sheets, sacrificial boards, wooden frames, foam sheets and wood crib sticks were conditioned to constant mass at a temperature of $23 \pm 2^{\circ}\text{C}$ and a relative humidity of $50 \pm 5\%$ prior to testing.</p> <p>The cribs were conditioned, such that the moisture content was $10 \pm 2\%$ at 3mm below the wood stick surface prior to testing.</p>
Ignition package	Ignition packages as detailed in Annex S.1.3 were used.
Fuel package	Fuel packages as detailed in Annex S.1.4 were used.
Test room	The test room was constructed such that the dimensions detailed in S.1.1., were complied with, with the exception of the length and width of the test room (7.4m x 3.7m respectively) which were as specified by the sponsor of the test.
Operating pressure	The system's operating pressure was 80 bar.
Water flow rate	The system's water flow rate at operation was 5.6 l/min.

Description of system

The description of the system given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

General description		Automist "Plus" fire suppression system
System reference		"Automist Plus"
Name of manufacturer		Plumis
Detailed description		Automist "Plus" pre-engineered active watermist fire suppression system
Nozzle	Product reference	"Production Intent Flat Spray Nozzle TTCC-6503 and Spray Head Sn1a"
	General description	Flat spray nozzle for moving spray head. 11mm external diameter, M10x1.0mm thread. 65° fan angle. 0.63 K factor
	Name of manufacturer	Plumis supply chain
	Angle	65° degrees spray angle. 30° to 150° head sweep angle.
	Colour reference	"316 stainless steel" "Silver" (observed by Exova Warringtonfire)
Pipe	Product reference	"Production High Pressure Hose 150bar Working Pressure"
	Generic type	PE (Polyethylene) core, Polyester braid, PVC (Polyvinylchloride) outer
	Name of manufacturer	Plumis supply chain
	Diameter	Internal: Ø 6.3mm External: Ø 11.5mm
	Wall thickness	2.6mm
	Length	4000mm
	Density	See Note 1 below
	Colour reference	"Black"
	Flame retardant details	See Note 2 below
Pump	Product reference	"Production Pluvia Pump"
	General description	Automist Pluvia high pressure pump. 5.6 l/min, 80bar working pressure, 120bar pressure limit.
	Name of manufacturer	Plumis supply chain
Heat alarm	Product reference	"Ei164 Heat Alarm"
	General description	Aico 57° fixed point heat alarm
	Name of manufacturer	Ei Electronics
	Colour reference	"White"
Brief description of manufacturing process		See Note 1 below

Note 1. The sponsor was unable to provide this information.

Note 2. The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

Test Results

Applicability of test results

The test results relate only to the behaviour of the system under the particular conditions of test, they are not intended to be the sole criterion for assessing the potential fire hazard of the system in use.

The test results relate only to the system in the form in which it was tested. Small differences in the composition of the system may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any system which is supplied or used is fully represented by the system which was tested.

Test results

BS 9252: 2011 requires that testing is conducted in both a 'corner' configuration and a 'centre' configuration and readings are taken throughout the test by thermocouples sited at fixed positions such that the maximum temperature reached at each position can be determined. The maximum temperatures recorded at each of the positions are as detailed in the table below:

Thermocouple location	Maximum temperature °C			
	Corner Test 1	Corner Test 2	Centre Test 1	Centre Test 2
75mm below the underside of the ceiling, above centre of crib	100	114	90	159
Ceiling temperature (6.5mm above the underside of the ceiling), above centre of crib	42	41	40	52
1.6m above the floor, furthest from fire	46	57	49	59
1.6m above the floor, centre (if applicable)	N/A	N/A	51	76
1.6m above the floor, close to fire	40	52	55	39

Where the thermocouples were positioned at 1.6m above the floor, the temperatures did not exceed 55°C for any 120 s interval.

During a formal BS 9252: 2011: Annex S test using a sprinkler system a third sprinkler would usually be fitted as per the requirements of BS 9252: 2011: Annex S.2. As a result of the being carried out using a watermist system and the deviations previously identified within this report, the sponsor of the test requested that an extra thermocouple be situated where the third sprinkler would have been fitted. This would allow for a temperature reading to be recorded and documented that subsequently could provide an indication as to whether or not a sprinkler in its position would activate.

The maximum temperatures measured during the tests for the replicated third sprinkler are below:

Thermocouple location	Maximum temperature °C			
	Corner Test 1	Corner Test 2	Centre Test 1	Centre Test 2
Replicated third sprinkler	49	60	49	94

- Observations** The visual observations taken during the tests are shown in Appendix 1.
- Temperatures** The temperatures logged during the tests are presented in Figures 1, 2, 3 and 4.
- Fire test layout** Diagrams detailing the fire test layouts are presented in Figures 5, 6, 7 and 8.
- Validity** The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

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Appendix 1

Observations during test of Corner Test 1

00:01 Test start, the fire loads were ignited.
02:20 Heat alarm sounded.
02:30 System manually activated.
12:30 Test terminated.

Observations during test of Corner Test 2

00:01 Test start, the fire loads were ignited.
01:05 Heat alarm sounded.
01:15 System manually activated.
11:15 Test terminated.

Observations during test of Centre Test 1

00:01 Test start, the fire loads were ignited.
01:00 Heat alarm sounded.
01:10 System manually activated.
11:10 Test terminated.

Observations during test of Centre Test 2

00:01 Test start, the fire loads were ignited.
00:48 Heat alarm sounded.
00:58 System manually activated.
10:58 Test terminated.

Appendix 2

Table 5 **Fire test maximum temperatures**

Thermocouple location	Maximum allowable temperature °C
75mm below the underside of the ceiling, above centre of crib	320
Ceiling temperature (6.5mm above the underside of the ceiling), above centre of crib	260
1.6m above the floor, directly beneath sprinklers ^{A)}	95
1.6m 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).

Figure 1

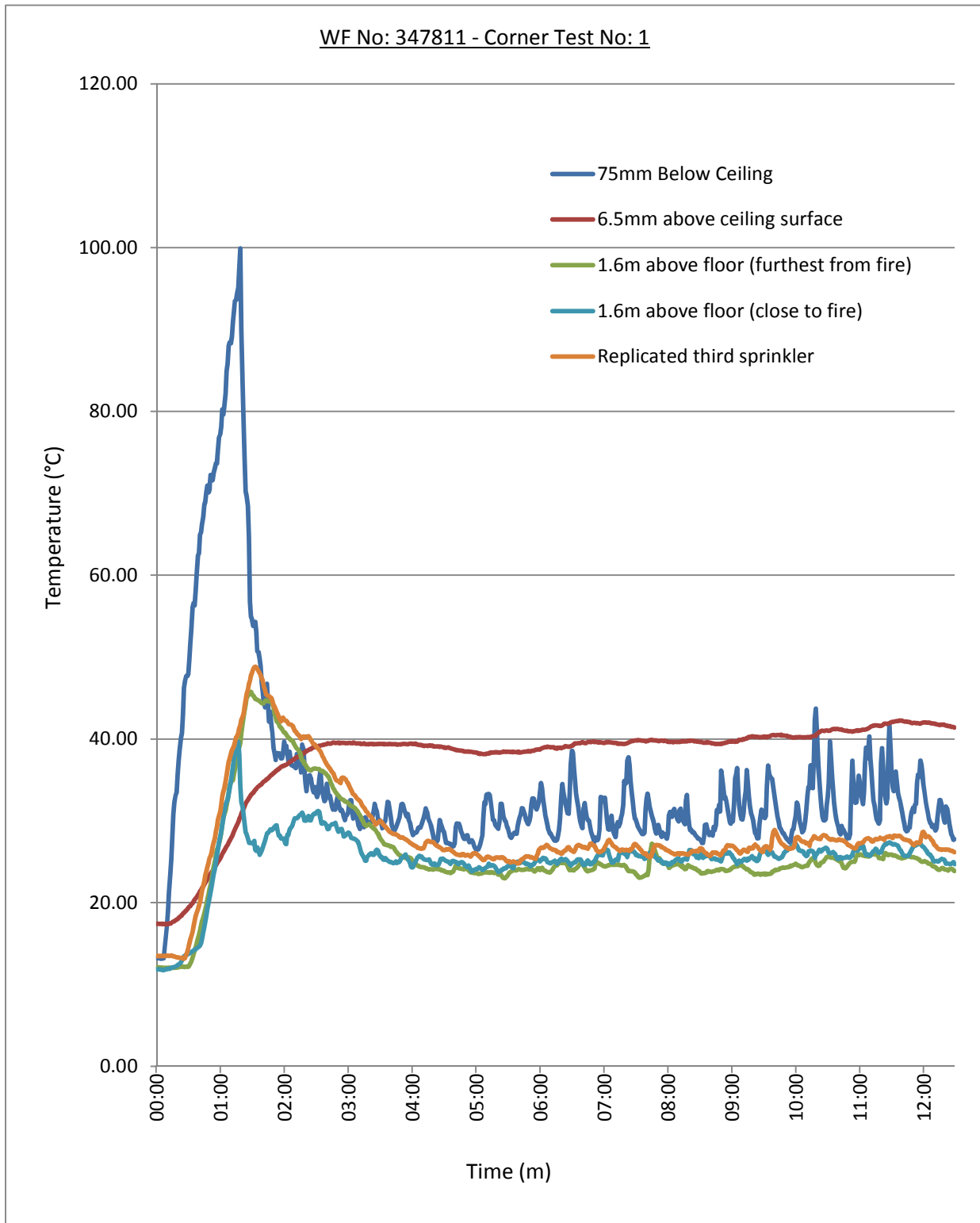


Figure 2

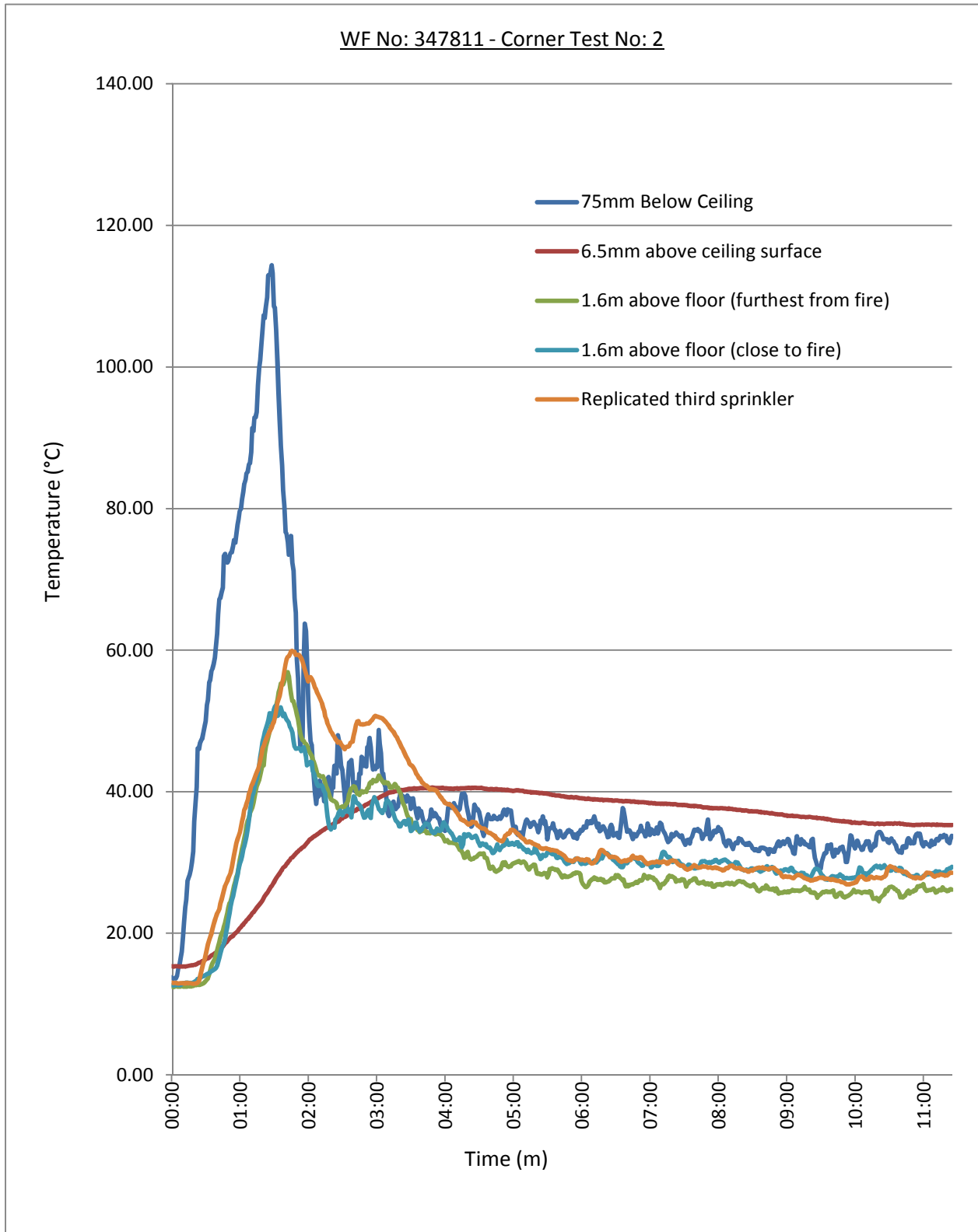


Figure 3

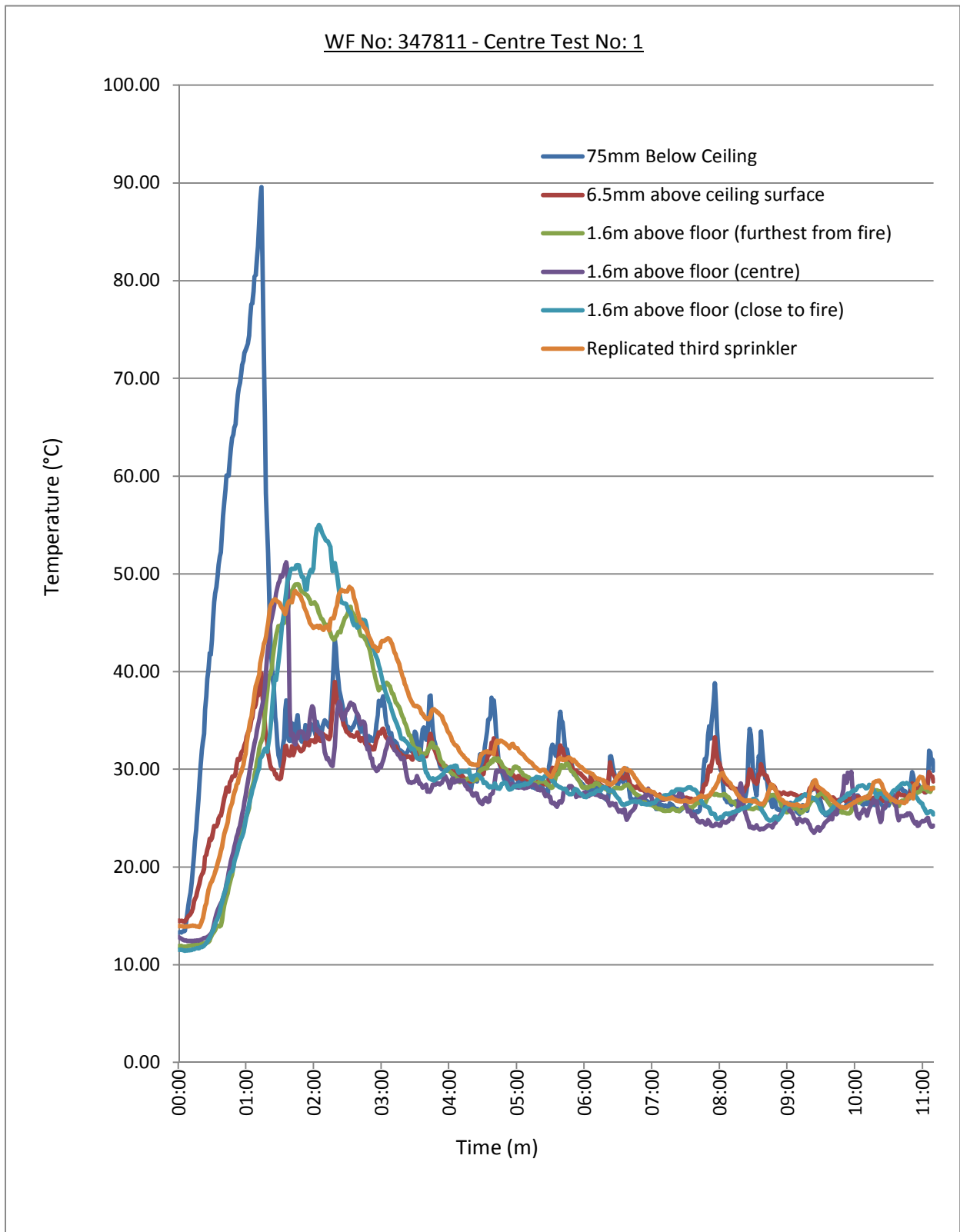


Figure 4

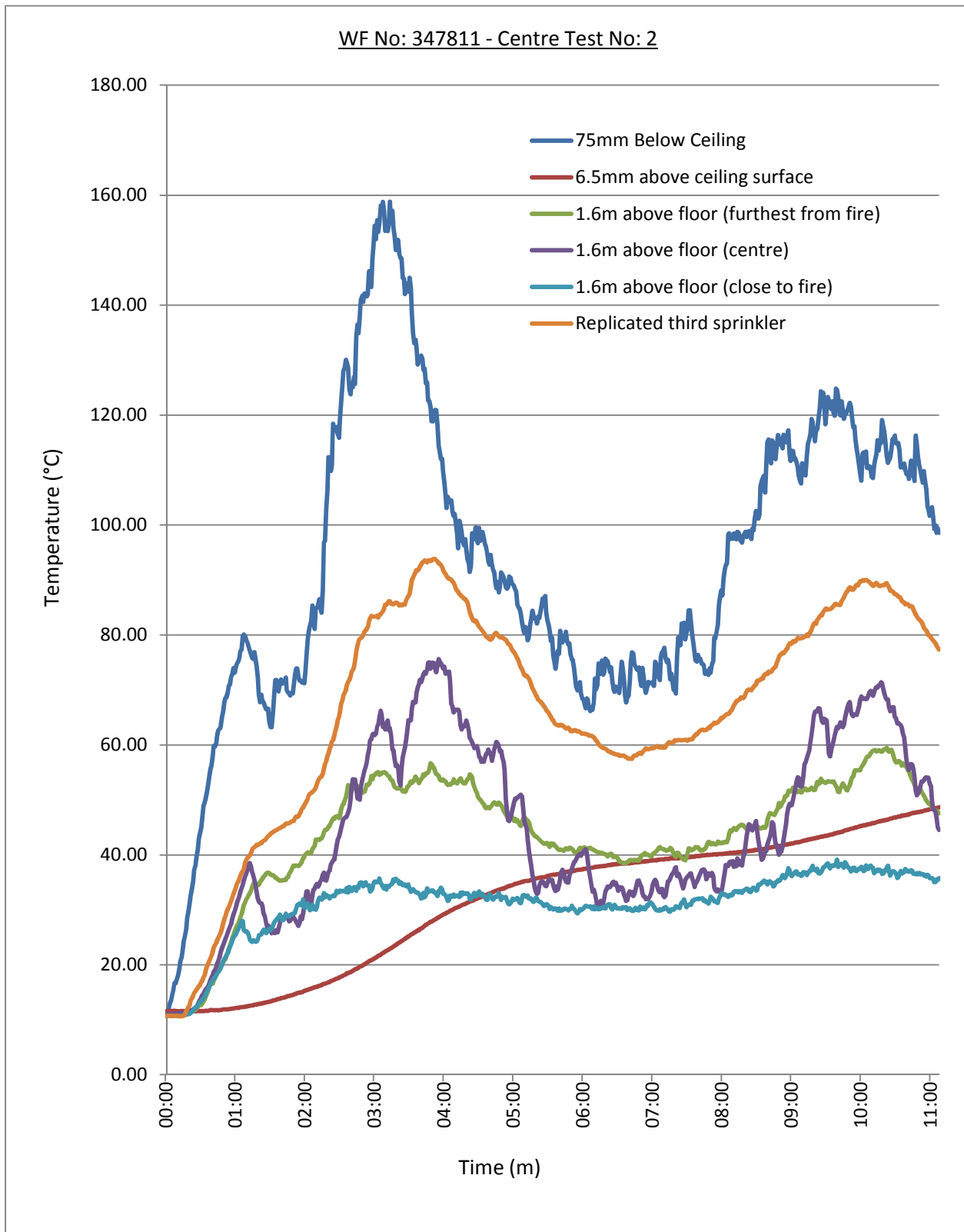
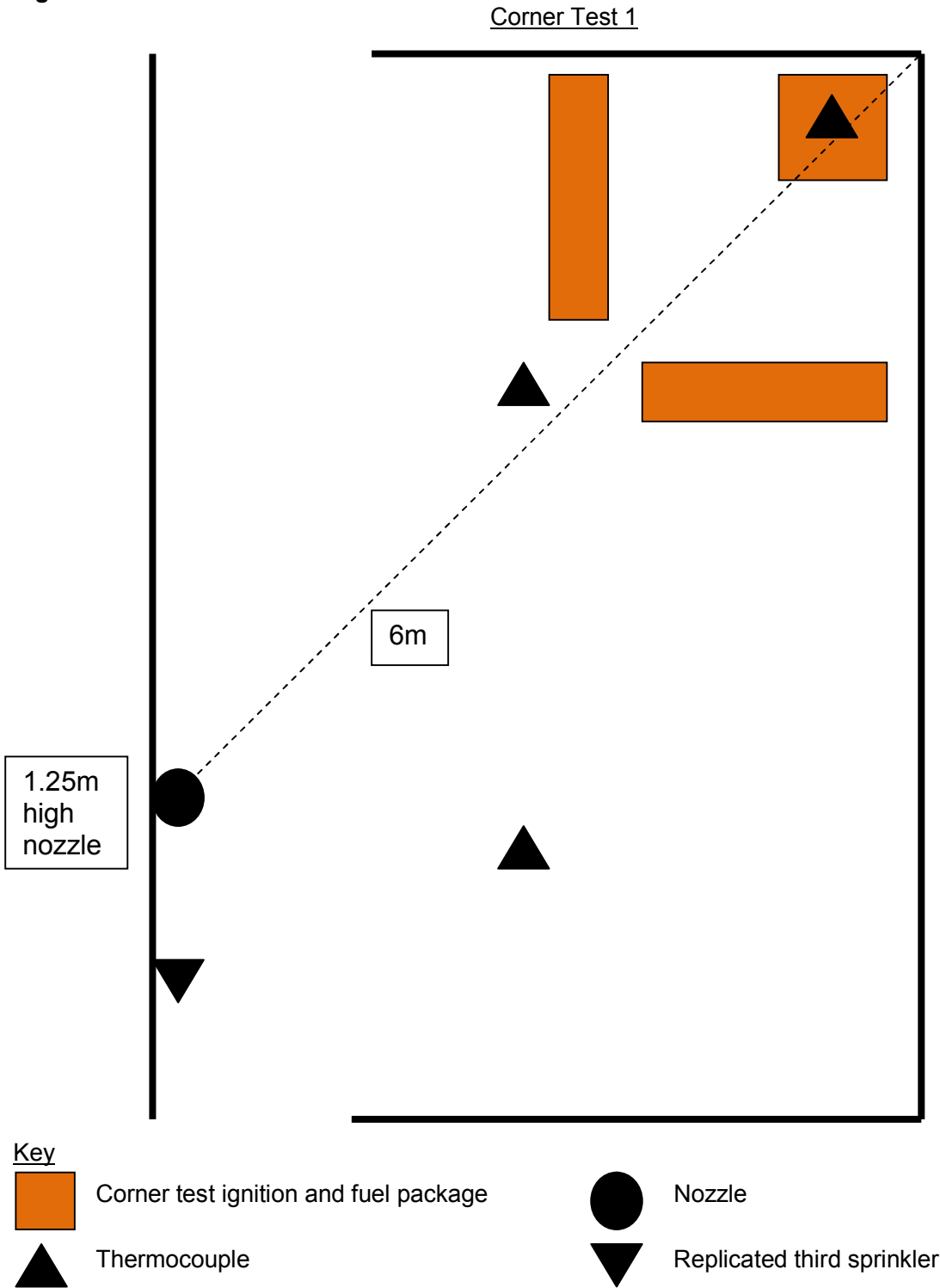
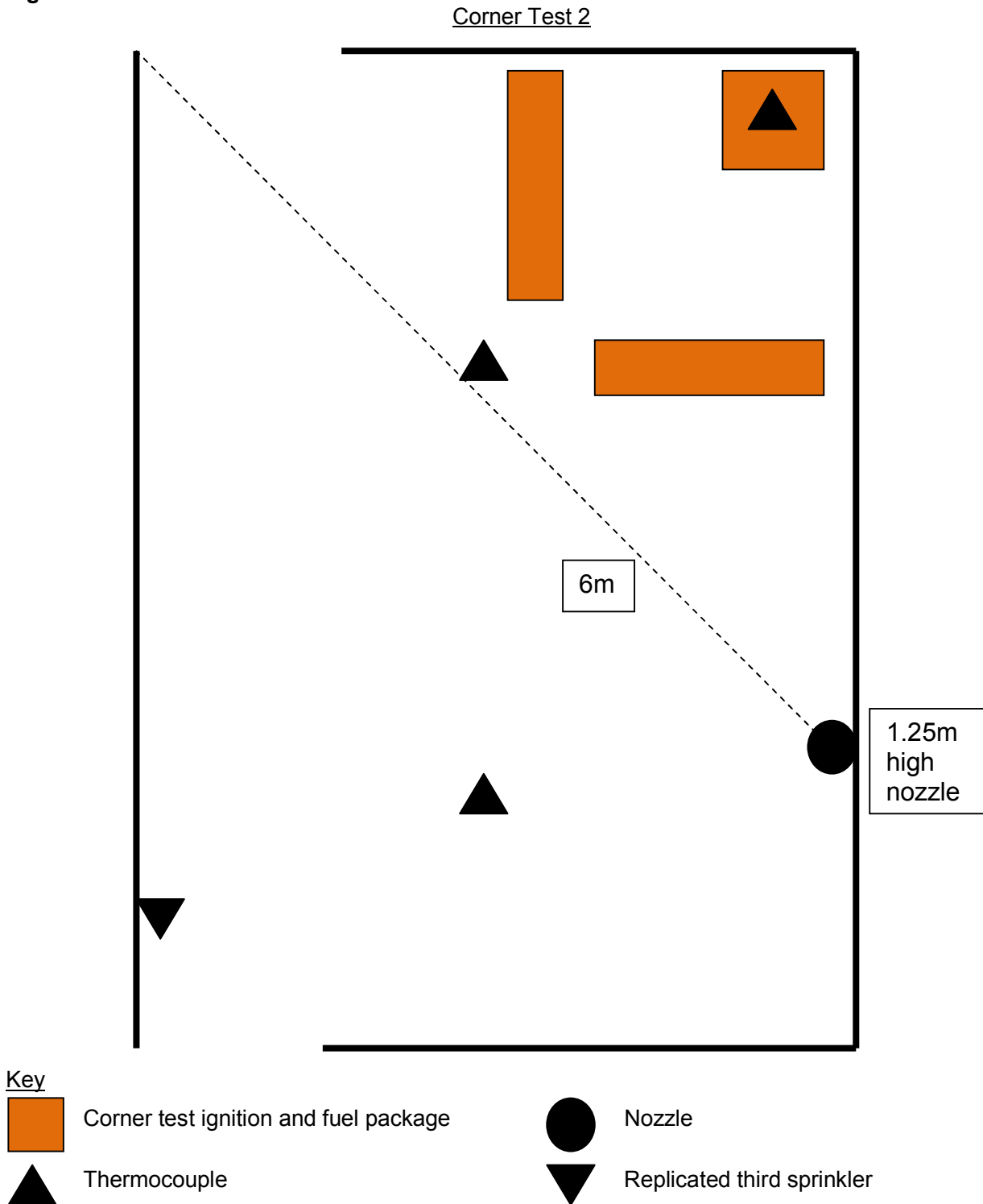


Figure 5



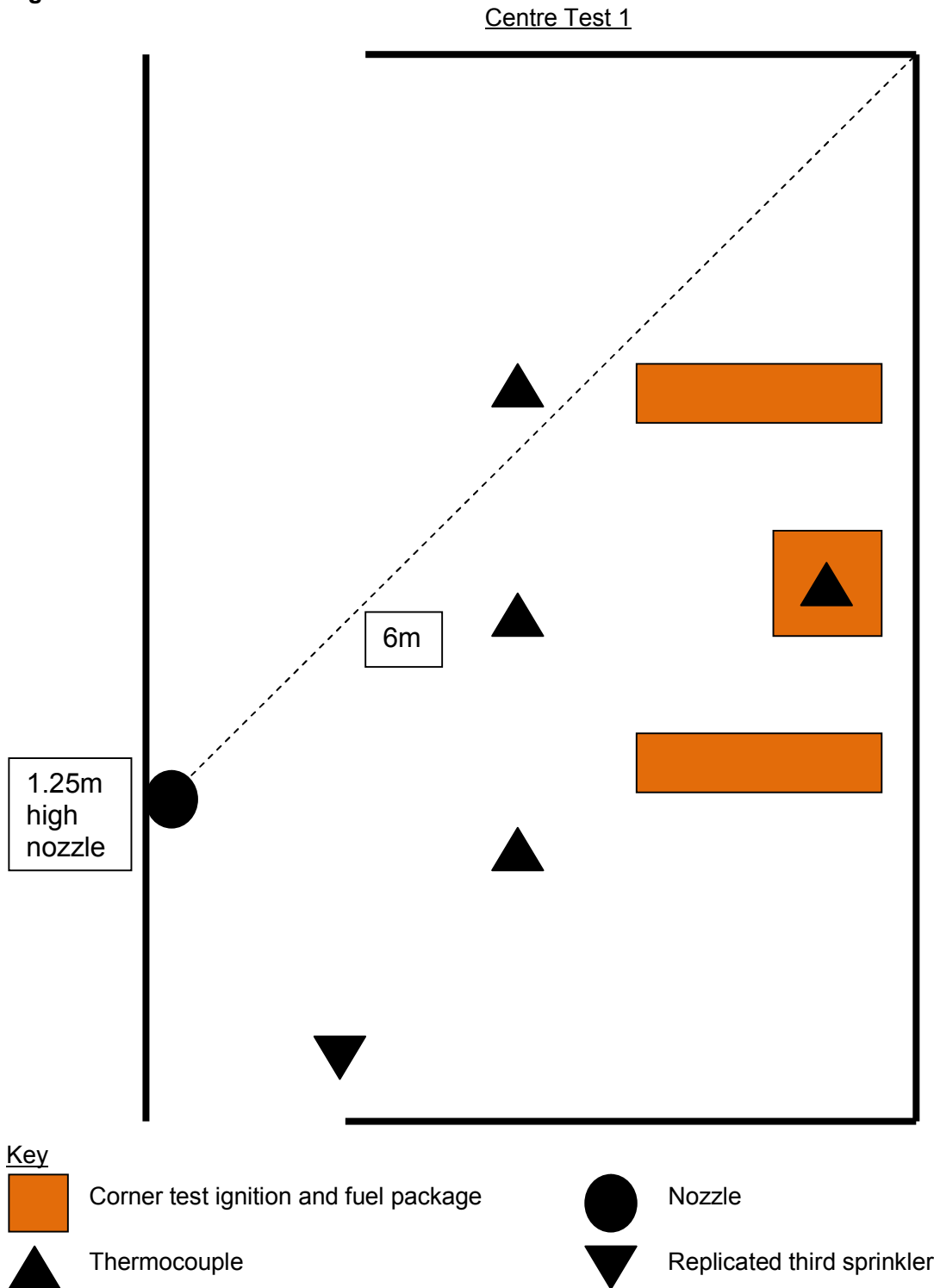
Drawing not to scale

Figure 6



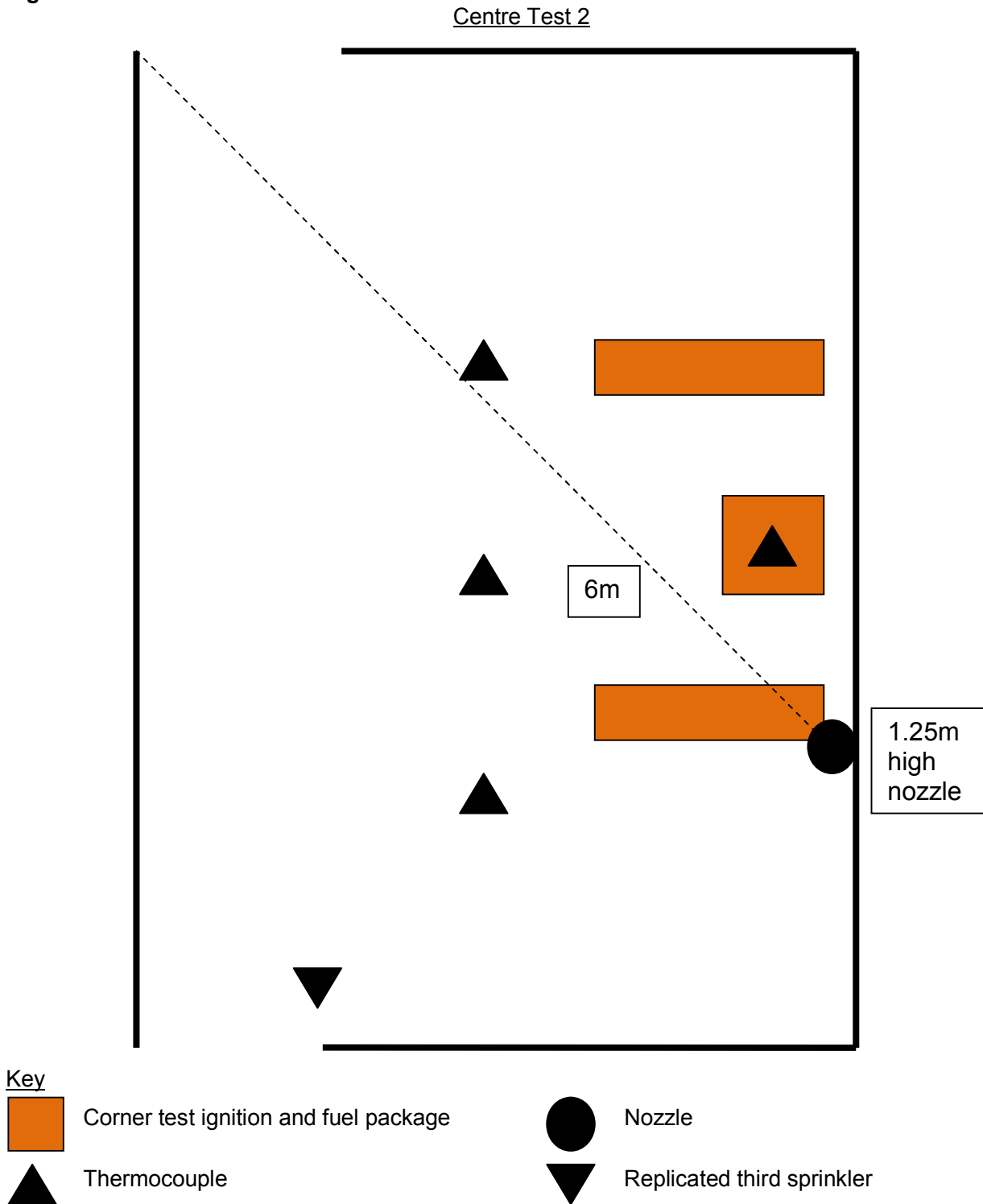
Drawing not to scale

Figure 7



Drawing not to scale

Figure 8



Drawing not to scale

Photographs



Photographs of ignition and fuel package before a test



Photographs of nozzle system before a test



Photographs during a test



Photograph after a test

Revision History

Issue No :	Issue Date:
Revised By:	Approved By:
Reason for Revision:	

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