SYSTEM BRIEF DETAIL

Report detailing the testing of an HPL rainscreen cladding system tested in accordance with the requirement as described in British Standard 8414

Ministry of Housing, Communities & Local Government

CUSTOMER TEST REPORT

BS 8414-1-2015+A1-2017 Test Report

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Review

Approval	Name	Date
Author	[REDACTED]	16/07/2019
Reviewed by	[REDACTED]	16/07/2019
Reviewers signature	[REDACTED]	

Distribution

Name	Company
[REDACTED]	**Ministry of Housing, Communities and Local Government**

Document version history

Version	Date	Superseded documents/description/details
1.0	16/07/2019	Initial issue
2.0	17/07/2019	Alteration to product description – Section 4.1 and Figure 36

Disclaimer

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- This report may only be distributed in its entirety, without amendment however the sponsor may redact names of those involved in the production of the report, product trade names and other material that they consider sensitive.
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- The report does not imply that FPA believe the BS8414 test regime alone is appropriate for the guarantee of end-use system performance.

Contents

1 Introduction

The test method, BS 8414-1-2015+A1-2017 describes a method of assessing the behaviour of non-load bearing external cladding systems, rain screen over cladding systems and external wall insulation systems when applied to the face of the building and exposed to an external fire under exposed conditions. The fire exposure is claimed to be representative of an external fire source or a fully developed (post-flashover) fire in a room, venting through an opening such as a window aperture that exposes the cladding to the effects of external flames.

This report applies to the cladding system as detailed. The report only covers the details as tested.

The test method does not cover the performance of glazed window openings or the detailing at such openings. It does not apply to curtain walling systems or systems that include glass panels.

Performance Criteria and Classification methodology of the external fire performance covered by this test can be found in report *BR 135: Fire performance of external thermal insulation for walls of multi - storey buildings.*

2 Details of the test carried out

Name of Laboratory:	Fire Protection Association Ltd
Laboratory Address:	London Road Moreton-in-Marsh Gloucestershire GL56 0RH
Test reference:	101856.002
Date of Test:	11/07/2019
Sponsor:	Ministry of Housing Communities and Local Government
Sponsor address:	2 Marsham Street London SW1P 4DF United Kingdom
Method:	Tested in accordance with BS 8414-1-2015+A1-2017
Deviations:	None

3 Details of test apparatus used (BS 8414-1-2015+A1-2017)

The apparatus is defined in the Test Standard and consists of a steel frame structure with masonry infill to form a vertical main test wall and a vertical return wall at a 90° angle at one end of the main test wall as shown in Figure 1. The main wall includes the combustion chamber.

Aside from apparatus described above, and the applied fuel, all additional items used to for the built up 'system' are considered part of the cladding system under test.

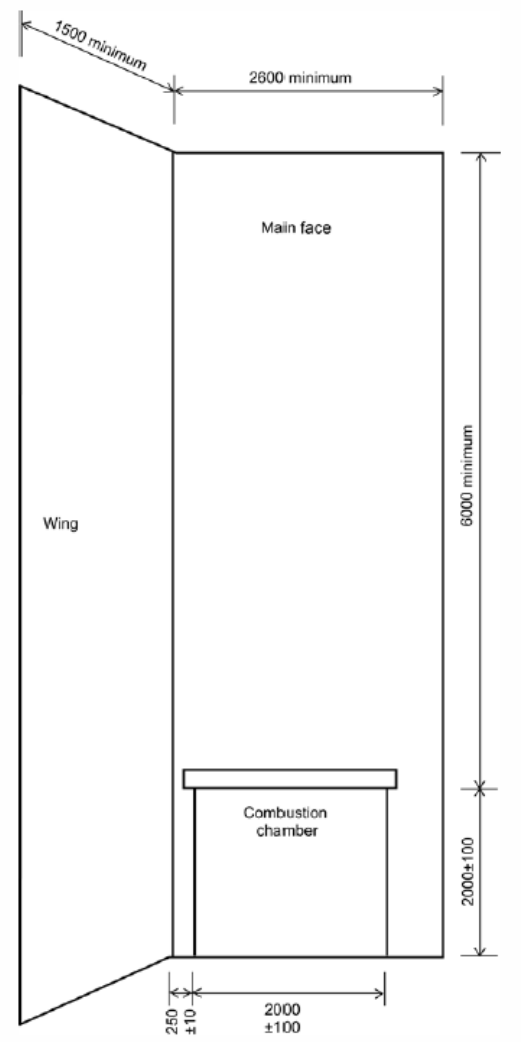

Figure 1 - Test apparatus dimensions [As specified by test standard figure 1]

4 Description of the system under test

Aside from apparatus described in Section 3, and the applied fuel, all additional items used to form the built-up 'system' are considered part of the cladding system under test with the potential to impact upon its overall performance. These include, but might not be limited to:

- Façade panels
- Insulation
- Cavity barriers and their rating
- Bracketry
- All fixtures and fittings

Similarly, many assumed design factors pertinent to the installation might also contribute to overall performance such as:

- The building substrate
- Method of panel attachment
- Form of panel
- Insulation thickness / rating
- Void size behind panel
- Panel spacing
- Distance between cavity barriers
- Cavity barrier locations
- Type of cavity barrier used
- Assumed window detailing

Some elements of a cladding system are not by default tested through this test regime which again have the potential to be important to overall performance such as the provision of breaches within the system (e.g. vents and ducts).

Expert consideration of all assumed test design factors will need to be made when using the test data to confirm end-use suitability where deviation in the material specification or design detailing from the as-tested design may exist.

4.1 Description of product

Rainscreen:

10mm High Pressure Laminate [REDACTED] Anthracite

- Manufacturer's stated reaction to fire classification in accordance with BS EN 13501: Euroclass B-s1, d0
- Large flange stainless steel rivets 5x16mm
- 10mm gap between horizontal and vertical joints

Insulation:

180mm [REDACTED] Insulation Board

- Manufacturer's stated reaction to fire classification in accordance with BS EN 13501: Euroclass A1
- 70mm stainless steel pressure plates and 230mm SDKBV10x Fasteners, no washer. (6no Fixings to every board)
- Vertical & Horizontal Joints sealed with UL723 FR Grade Aluminium 50mm wide foil tape

'Helping Hand' Brackets & Rainscreen Fixing Metalwork:

[REDACTED] 200mm Brackets

- Single Brackets – 2no SDF-KB-10Vx60E Fixings 32mm Long
- Double Brackets – 2no SDF-KB-10Vx60E Fixings 32mm Long

[REDACTED] T & L Bars

- Single brackets to bars -2no self-drilling stainless steel 4.2mm x 16mm, no washer
- Double brackets to bars – 4no self-drilling stainless steel 4.2mm x 16mm, no washer
- 10mm gap between T & L Bars

Cavity Barriers:

[REDACTED] E90 I30 Open State Cavity Barrier

- 2no galv brackets per 1200mm Barrier (300mm from ends and C/L) on verticals
- 3no galv brackets per 1200mm Barrier (200mm from ends and one in the centre) on horizontals
- 2no SDFKB10Vx60E, no washer per galv bracket
- [REDACTED] E90 I30 Solid/Fully Filled Cavity Barrier – 245mm Overall (10mm compression)
- [REDACTED] E90 I30 Open State Horizontal Cavity Barrier - 210mm overall to allow a 25mm air gap (expands an additional 44mm)

4.2 Installation of specimen

The specification of the materials of the cladding system were undertaken by the test sponsor. The system design, procurement and installation were undertaken on behalf of the FPA under the guidance of the test sponsor.

Figure 2 – Finished installation of cladding system under test

Following installation, the test wall was measured to have the following dimensions:

Table 1 – Measurements of system installed

Wall component	Requirement for BS8414-2	Actual measurement
Height of test wall	≥ 6000mm above the top of the combustion chamber opening	8540mm (6539mm above top of the combustion chamber opening)
Width of main wall	≥ 2600mm	2804mm
Width of return wall	≥ 1500mm	1528mm
Combustion chamber opening height	2000mm ±100mm	2001mm
Combustion chamber opening width	2000mm ±100mm	2025mm

4.3 Test conditions

Test date:	11th July 2019
Ambient temperature:	21 ˚C
Wind speed at start of test:	0.5 m/s
Frequency of measurement:	All temperature measurements recorded at 0.2 Hz
Fuel load	300m softwood pinus silvestris 50mm x 50mm sticks arranged in a stacked crib
Ignition package	16 strips of low density fibreboard, 25mm x 12mm x 1000mm. Uniformly soaked in 5 litres of white sprit.
Fuel load density (average of 4 randomly selected crib sticks)	0.57 kg/dm^3
Fuel load moisture content (average of 4 randomly selected crib sticks)	11%

5 Test results

5.1 Fire spread and start time

Test results for the evaluation of fire spread and start time are detailed in the tables below. Temperature profiles recorded during the test are shown in Figure 3 to Figure 7.

Table 1 – Start temperature and start time

Parameter	Result
T_s, Start temperature – the mean temperature of the thermocouples at level 1 during the 5 minutes before ignition	21 °C
t_s, Start time – the time when the temperature of any external thermocouple at level 1 equals or exceeds a 200 °C temperature rise above T_s, and remains above this value for at least 30 seconds	110 seconds after ignition of the crib

Table 2 – Peak temperatures measured by level 2 thermocouples within 15 minutes of start time (t_s) (See *Appendix A – Location of thermocouples on test wall*)

External fire spread								
Level 2, external thermocouples								
Thermocouple ID	1A	2A	3A	4A	5A	6A	7A	8A
Peak temperature (°C)	220	344	462	368	236	200	161	137
Internal fire spread								
Level 2, thermocouples in tile façade								
Thermocouple ID	1B	2B	3B	4B	5B	6B	7B	8B
Peak temperature (°C)	106	159	177	194	115	107	91	86
Level 2, thermocouples in cavity								
Thermocouple ID	1C	2C	3C	4C	5C	6C	7C	8C
Peak temperature (°C)	104	129	160	171	97	91	68	76
Level 2, thermocouples in insulation								
Thermocouple ID	1D	2D	3D	4D	5D	6D	7D	8D
Peak temperature (°C)	22	24	27	25	26	23	21	22

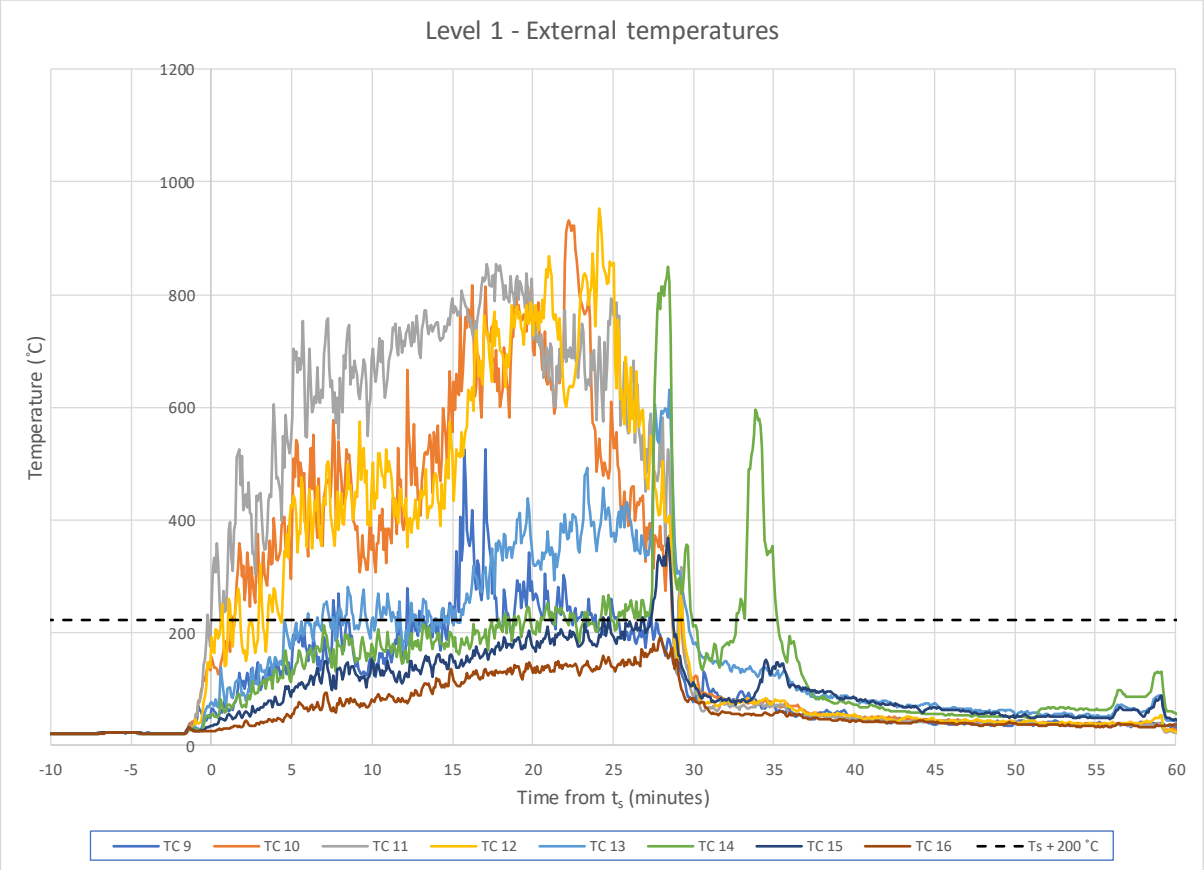

Figure 3 – External temperatures at level 1

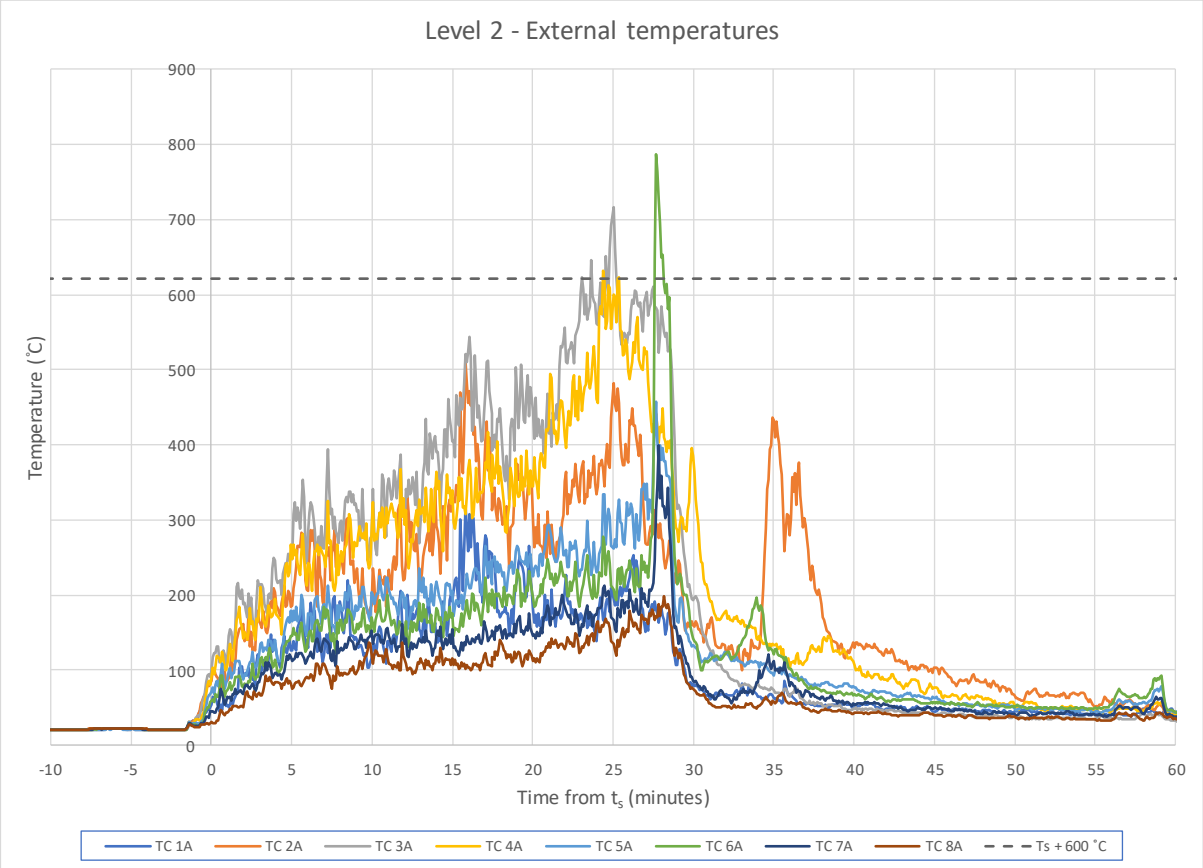

Figure 4 – External temperatures at level 2

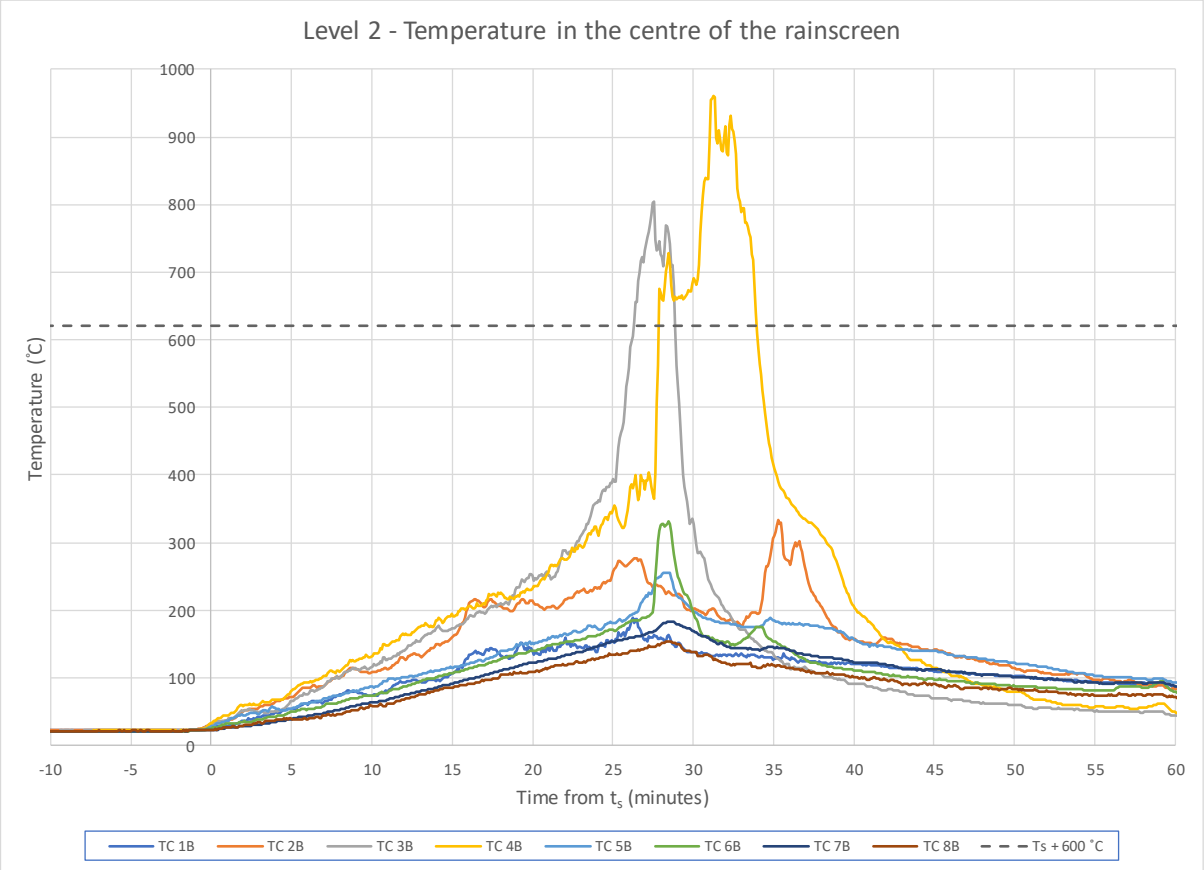

Figure 5 – Rainscreen internal temperatures at level 2

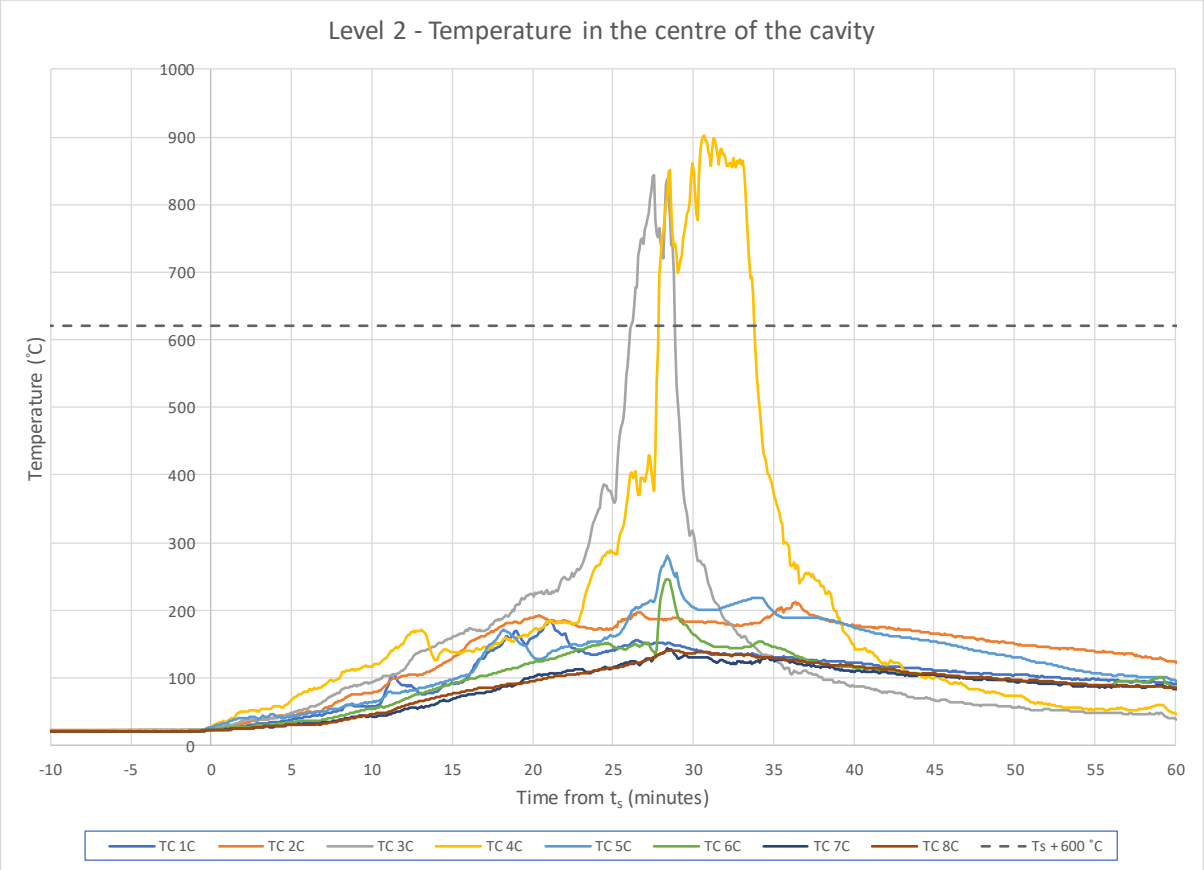

Figure 6 – Cavity internal temperatures at level 2

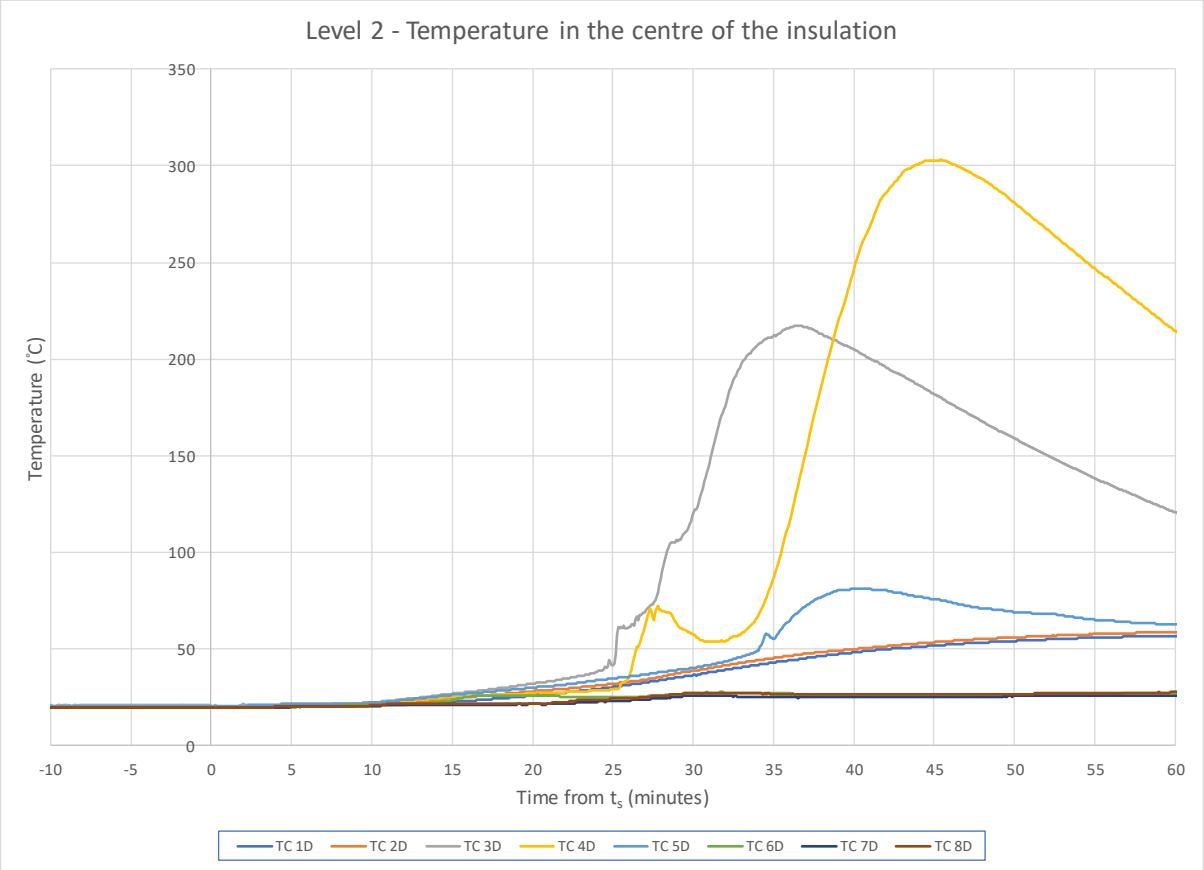

Figure 7 – Insulation internal temperatures at level 2

5.2 Visual observations

Visual observations from direct observation are detailed in the table below.
(Where direct observation was unsafe and to augment direct observations, visual observation of test video was also used).

Details of the panel numbering system used in the table below are shown in Figure 8.

Table 3 – Key tests times and visual observations.

Time from ignition (mins.secs)	Description
-11.00	Datalogger and videos started
-10.00	Fibreboard sticks begin soaking in white spirit
-04:00	Fibreboard sticks inserted into crib
00.00	Crib lighting commences
00.30	Flames reach top of combustion chamber.
01.30	Visible flames extended out of combustion chamber over front face of panels 7 and 8.
3.30	Aluminium frame around combustion chamber begins to warp.
4.10	Flame tips reach the bottom edge of panels 2 and 3.
5.30	Smoke seen issuing from gap between panels 1 and 6, and 2 and 7.
6.58	Smoke seen issuing from top of system behind panels 2 and 3.
7.00	Damage to surface of panels 7 & 8.
8.10	Aluminium frame around combustion chamber spits open.
10.50	Damage to surface of panels 2 & 3.
11.30	Damage to surface of panels 10 & 13.
12.00	Bottom edge of panels 7 and 8 starts to curve up. (See Figure 9)
15.20	Right hand edge of panels 10 and 13 starts to curve inwards toward the fire. (See Figure 10)
15.50	Bottom edge Panels 7 and 8 damaged/fallen away so the insulation is visible from front face.
18.20	Pieces of smouldering debris falling from panels 7 and 8. (Approximately 100 to 300 mm in diameter)
19.30	Approximately 50% of panels 7 and 8 fallen away.
20.50	Bottom edge of panels 2 and 3 start to curve upwards.
21.20	Flames visible in cavity through gap between panels 2 and 7.
24.40	Bottom edge Panels 2 and 3 damaged/fallen away.
26.00	Panel 2 and 3 burning independently. (See Figure 11)
26.50	Panel 10 starts to split apart near base. (See Figure 12)
27.50	Panel 10 burning independently.

30.30	Crib extinguished by applying water from remote monitor and in-chamber suppression system.
Post crib extinguishment	Flames continue to burn on panels 2, 3 and 10. (See Figure 14)
41.20	Open flaming on panel 10 appears to have ceased, although some smouldering continues.
41.50	Open flaming on panel 2 appears to have ceased, although some smouldering continues.
48.50	Open flaming on panel 3 appears to have ceased, although some smouldering continues.
58.20	Flames become visible from behind panel 13. (See Figure 15)
60.00	Test ended, residual burning near panel 13 extinguished. Face of test wall doused down as smoke was still issuing from top of test wall.

Figure 8 – Panel labelling system used in test visual observations

Figure 9 – Panel 7 curing upwards (approximately 18 minutes after ignition)

Figure 10 – Panel 10 and 13 curing inwards (approximately 22 minutes after ignition)

Figure 11 – Panels 2 and 3 independently burning (approximately 26 minutes after ignition)

Figure 12 – Split in panel 10 (approximately 27 minutes after ignition)

Figure 13 – Test wall and debris in front of wall prior to extinguishment of the crib. (29 minutes 50 seconds from ignition)

Figure 14 – Residual burning on panels 2, 3 and 10 following extinguishment of the crib

Figure 15 – Flames on panel 13 immediately before test end

6 Post-test damage report

Post-test, the system was inspected to determine the amount of damage to system components. The result are as follows.

Rainscreen

- All panels were damaged or partially damaged. See Figure 20, Figure 21 and Figure 22.
- On the main wall the worst damaged area was directly above the combustion chamber. Approximately 50% (by area) of the panels had been consumed or become detached from the system.
- On the return wall the worst damaged areas were adjacent to and directly above the combustion chamber. Approximately 15% by area of the panels had been consumed or become detached from the system.
- On the return wall near the base, the panels had warped, resulting in the outside edge curling in towards the combustion chamber.

Insulation

- The insulation had smoke deposits on the front surface, but otherwise it was generally in good condition. See Figure 23.

Rainscreen Fixing Metalwork:

- Where the rainscreen had been consumed/fallen away from the system, the majority of exposed aluminium rails were missing. See Figure 20.
- In areas where the rainscreen was still present, the rails remained intact although slightly warped in places.

Helping had brackets

- Where the rainscreen had been consumed/fallen away from the wall, the section of the helping hand brackets that extended out past the front of the insulation were melted or partially melted. Within the insulation the brackets were in generally good condition.
- In areas where the rainscreen were still present, the helping hand brackets were generally in good condition.

Horizontal intumescent cavity barriers

- 1st cavity barrier (directly above combustion chamber). See Figure 24 and Figure 25.
    - Above the combustion chamber, the barrier was partially detached from the wall and the intumescent strip was not present.
    - On the return wall the intumescent strip had fully activated.
- 2nd cavity barrier. See Figure 26 and Figure 27.
    - The barrier was intact.
    - On the section between the vertical cavity barriers, directly above the combustion chamber, the intumescent strip was not present.
    - Outside this area on the main wall and on the return wall the intumescent strips had fully activated.
- 3rd cavity barrier. See Figure 28 and Figure 29.
    - The barrier was intact.
    - On the section between the vertical cavity barriers, directly above the combustion chamber, the intumescent strip had fully activated.

- Outside this area on the main wall and on the return wall the intumescent strips had partially activated.

- 4th barrier (near top of wall). See Figure 30 and Figure 31.
  - The barrier was intact.
  - On the section between the vertical cavity barriers, directly above the combustion chamber, the intumescent strip had partially activated.
  - Outside this area on the main wall and on the return wall the intumescent strips had partially activated.

Vertical compression cavity barriers

- The 3 vertical barriers appeared to be in good condition. See Figure 23.

7 Disclaimers

- The FPA is responsible for all the information provided in this report, except when information is provided by the customer.
- The FPA is not responsible for the validity of results that rely on information supplied by the customer.
- The contracted cladding supplier is responsible for providing the installed system for test (‘the sample’). Therefore, the results contained within this report apply to the sample as received.

8 References

[1] British Standards Institute, “BS 8414-1:2015+A1:2017, Fire performance or external cladding systems - Part 1: Test method for non loadbearing external cladding systems applied to the masonry face of a building,” British Standards Institute, London, 2017.

[2] S. Colewell and T. Baker, “BR135 Fire performance of external thermal insulation for walls of multistorey buildings, Third Edition,” IHS BRE Press, Watford, 2013.

9 Appendix A – Location of thermocouples on test wall

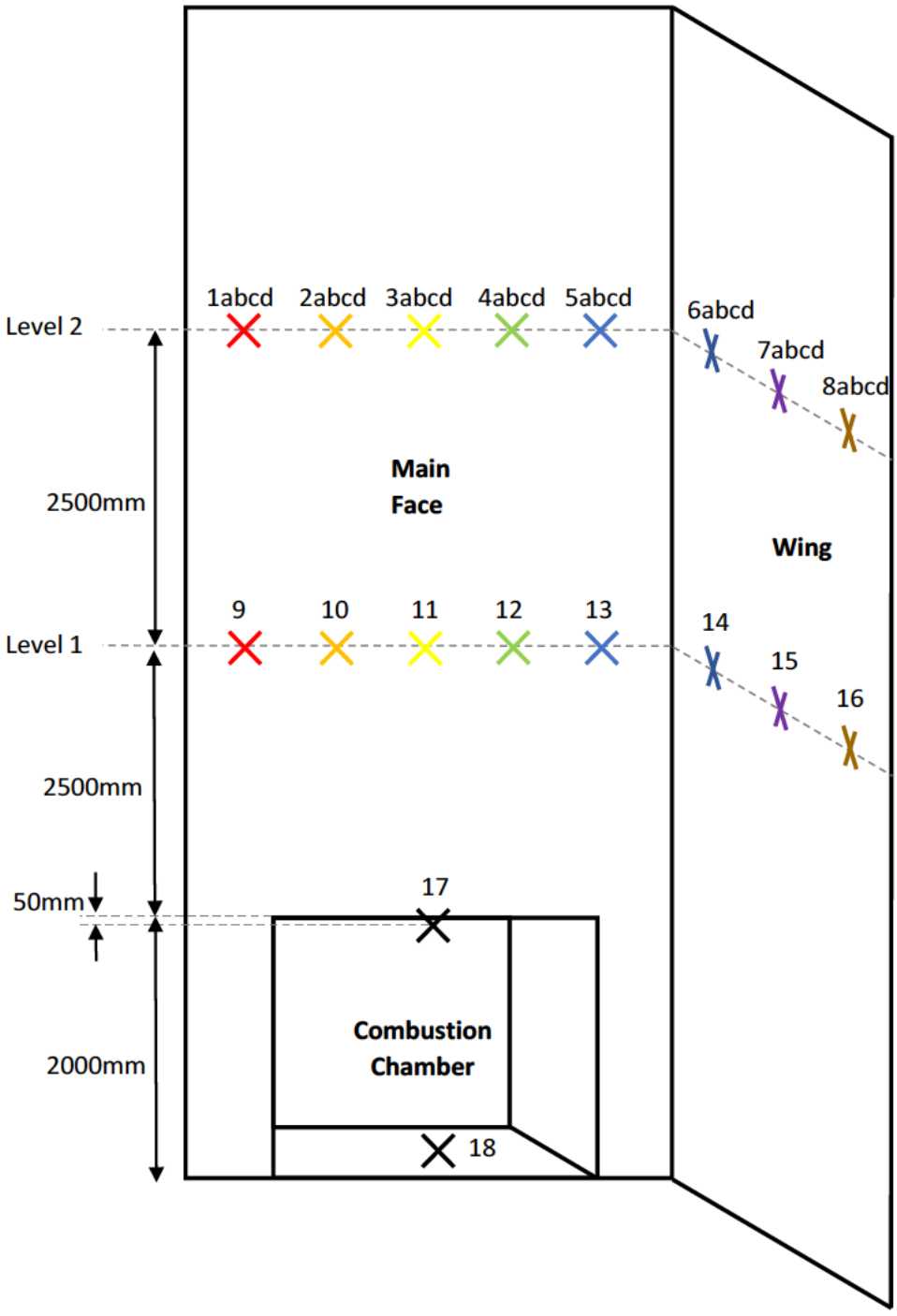

Figure 16 -Test wall thermocouple locations (not to scale)

10 Appendix B – Installation process

Figure 17 – Masonry wall with helping hand brackets installed

Figure 18 – Insulation and cavity barriers prior to installation of support rails and rainscreen

Figure 19 – Complete installation prior to test

Appendix C – Post-test photographs

Figure 20 – Front face of system post test

Figure 21 – Area directly above combustion chamber post test

Figure 22 – Return wall above combustion chamber post test

Figure 23 – Insulation and cavity barriers following removal of the rainscreen and support rails

Figure 24 – 1st cavity barrier (directly above combustion chamber) from main wall following removal of the rainscreen

Figure 25 – 1st cavity barrier (directly above combustion chamber) from return wall following removal of the rainscreen

Figure 26 – 2nd cavity barrier from main wall following removal of the rainscreen

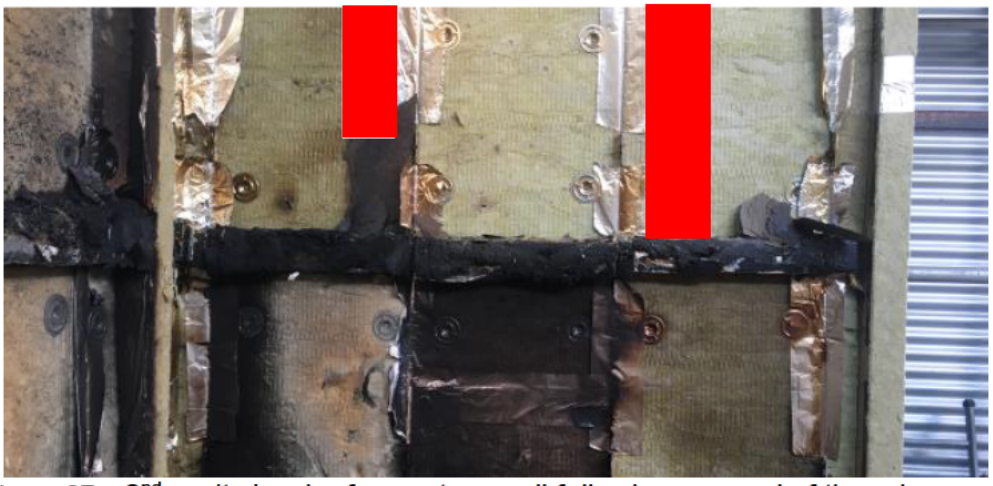

Figure 27 – 2nd cavity barrier from return wall following removal of the rainscreen

Figure 28 – 3rd cavity barrier from main wall following removal of the rainscreen

Figure 29 – 3rd cavity barrier from return wall following removal of the rainscreen

Figure 30 – 4th cavity barrier (top) from main wall following removal of the rainscreen

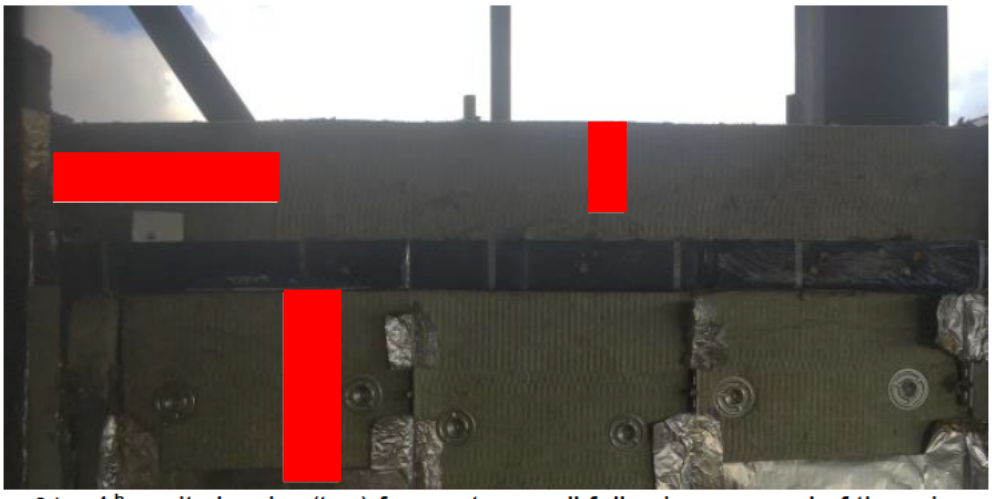

Figure 31 – 4 h cavity barrier (top) from return wall following removal of the rainscreen

11 Appendix D – System Drawings

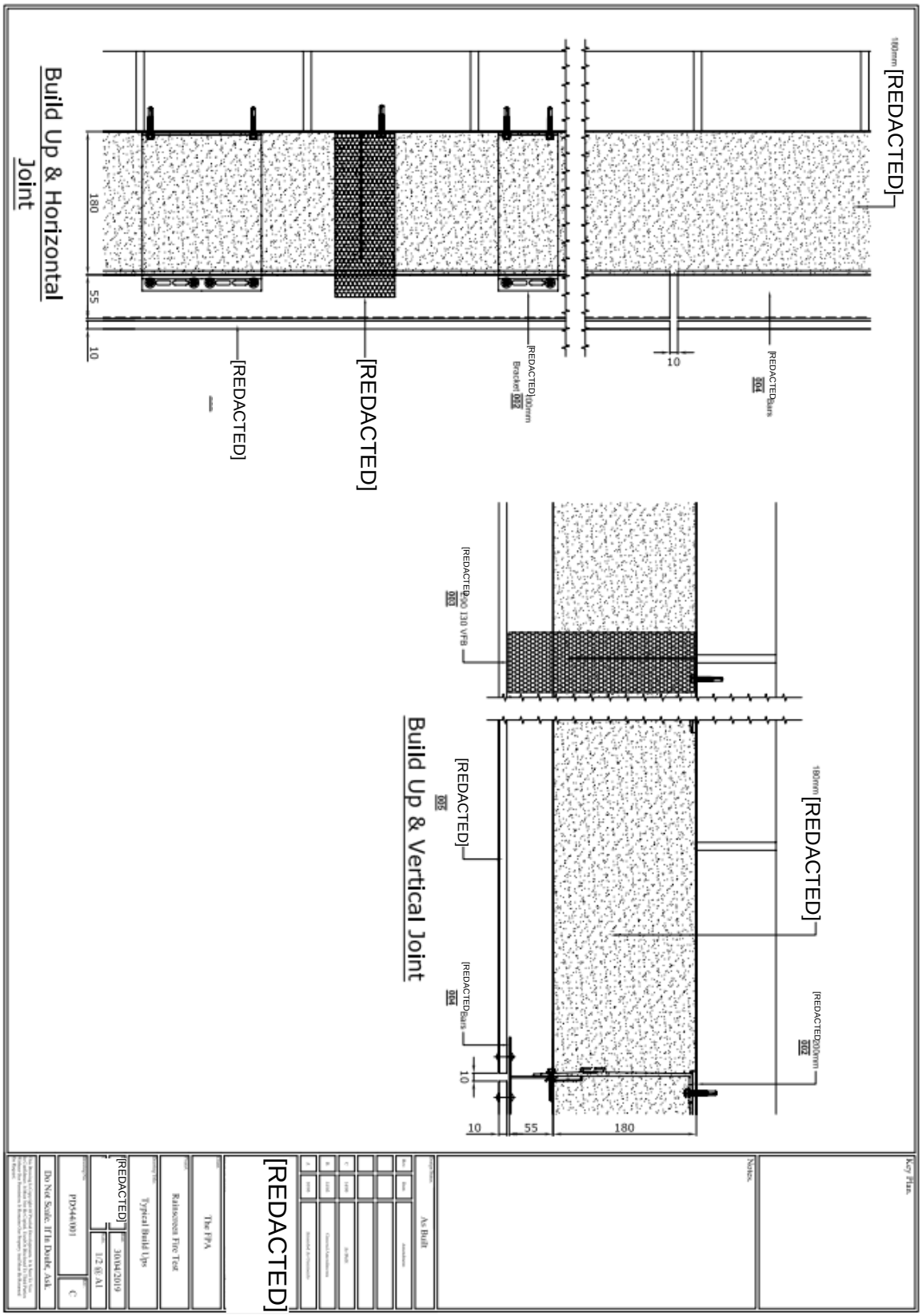

Figure 32 – Typical build ups

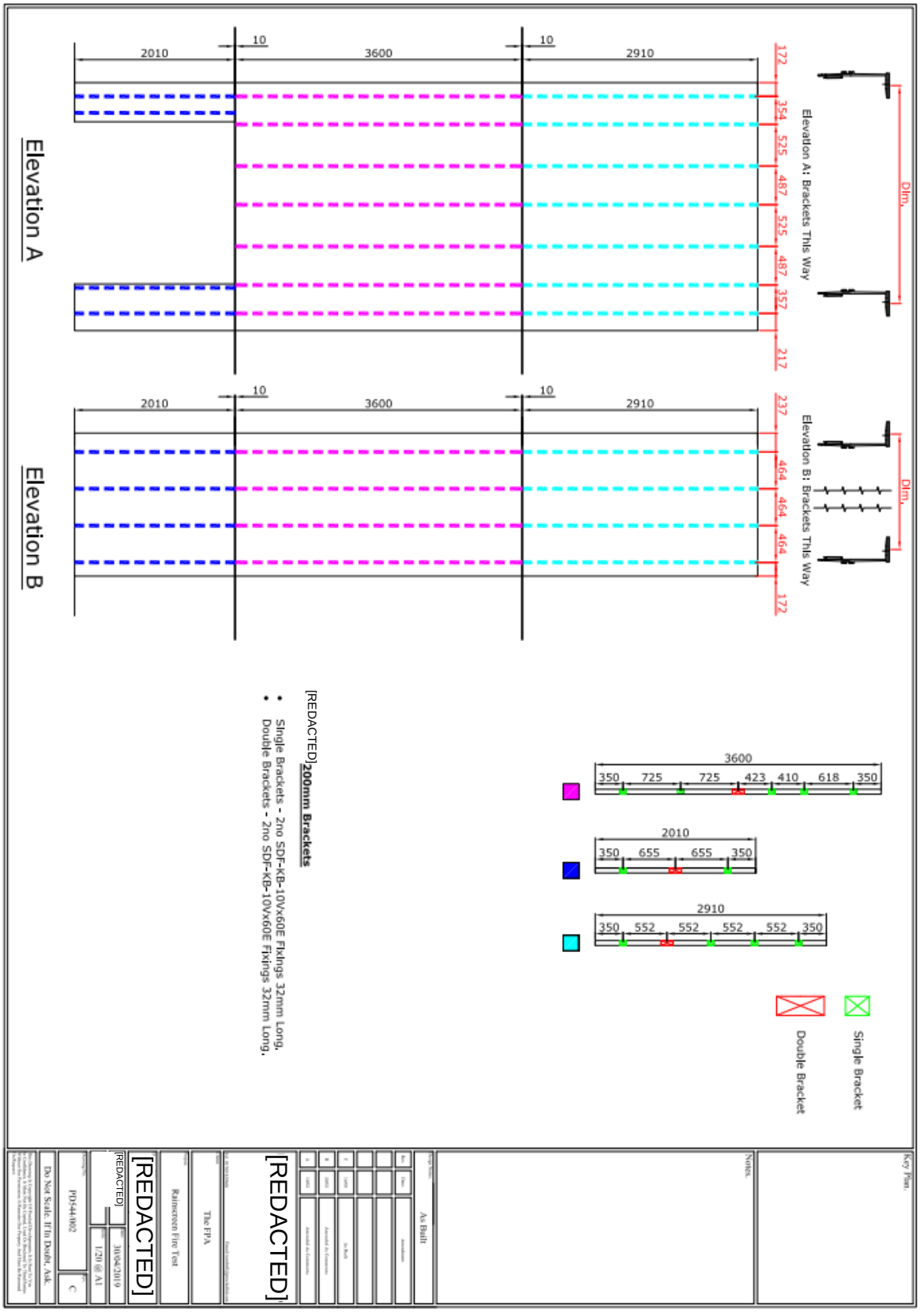

Figure 33 – [REDACTED] brackets layout and specification

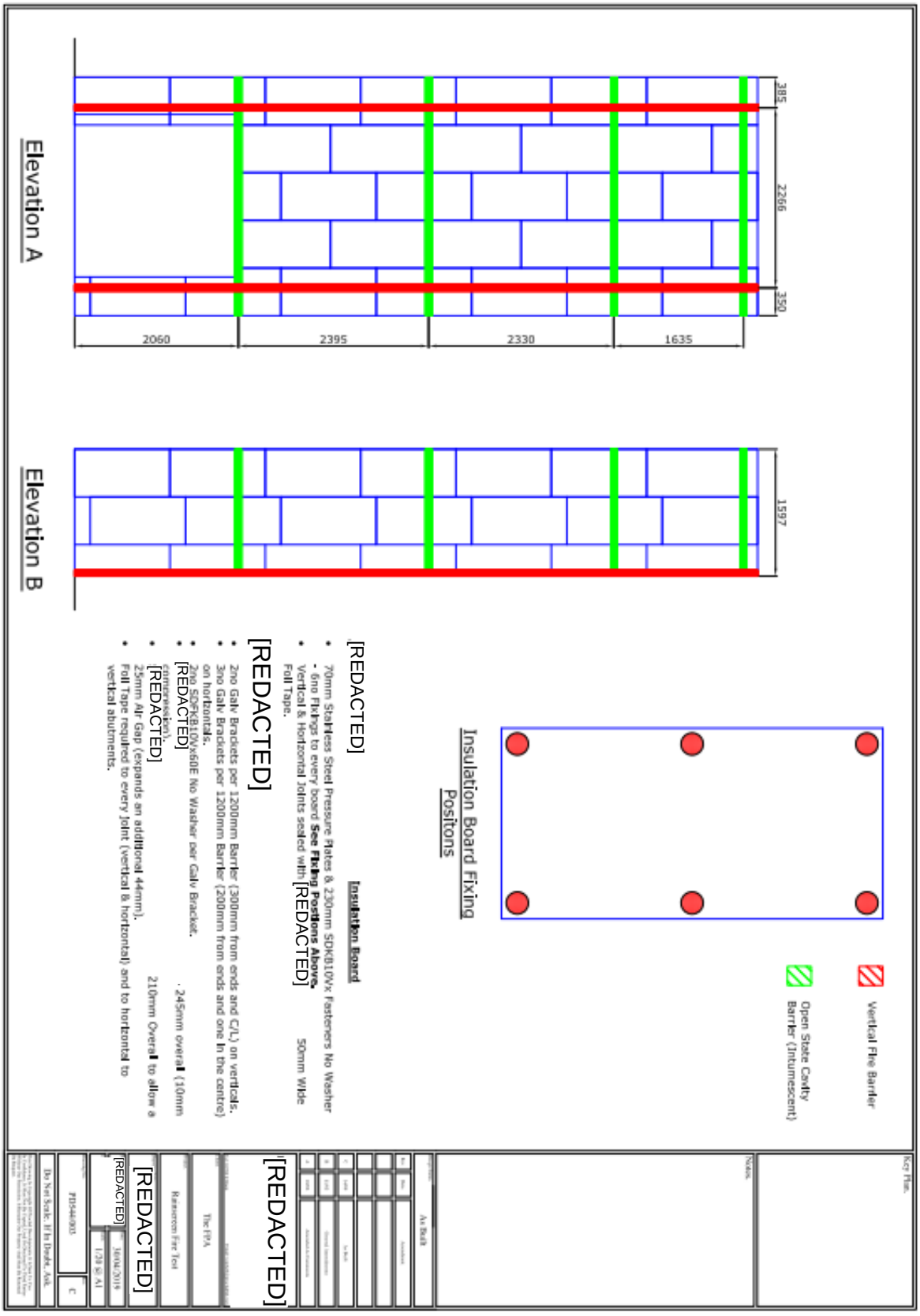

Figure 34 – Insulation board/fire barrier layout and specification

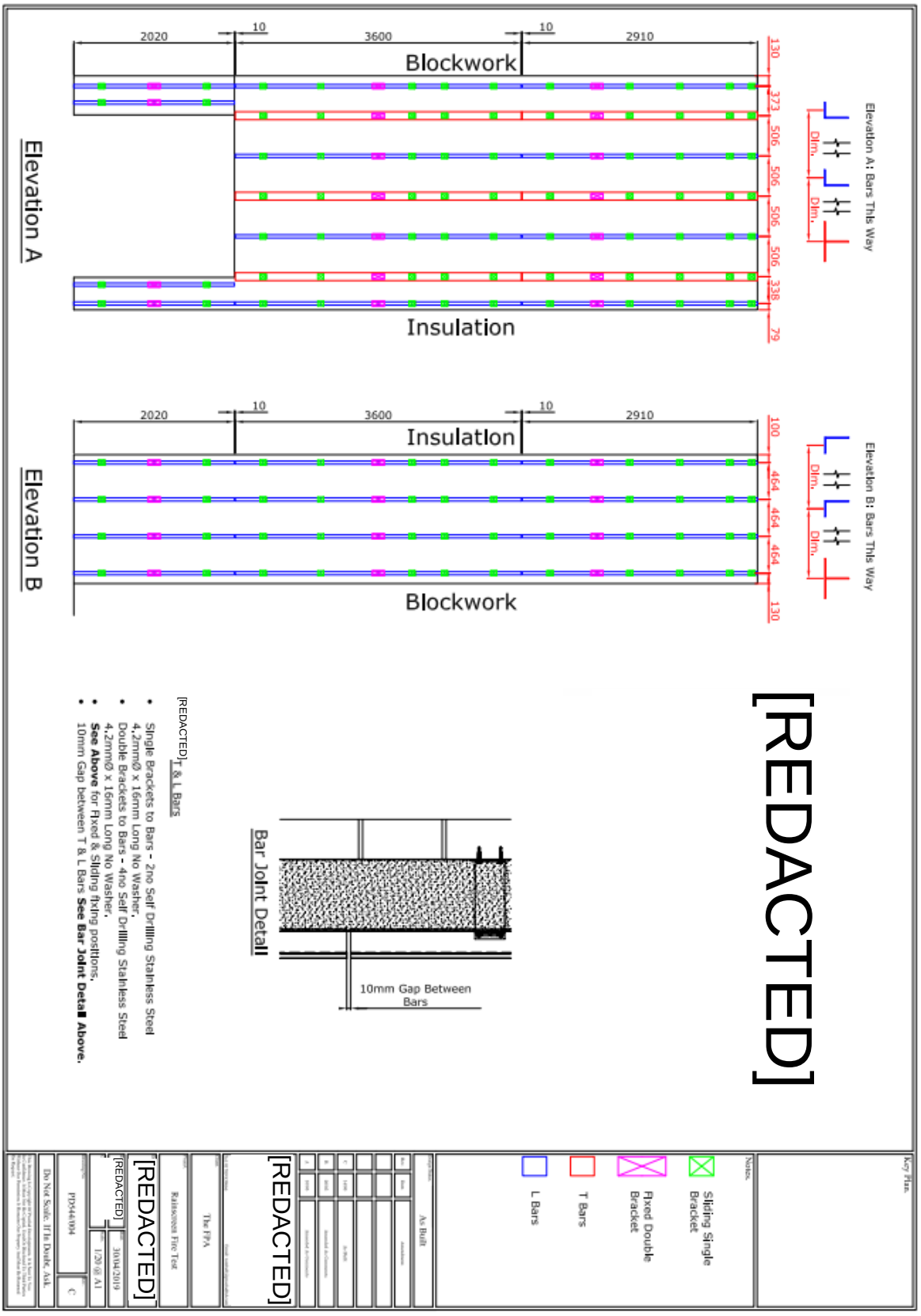

Figure 35 – [REDACTED] bars layout and specification

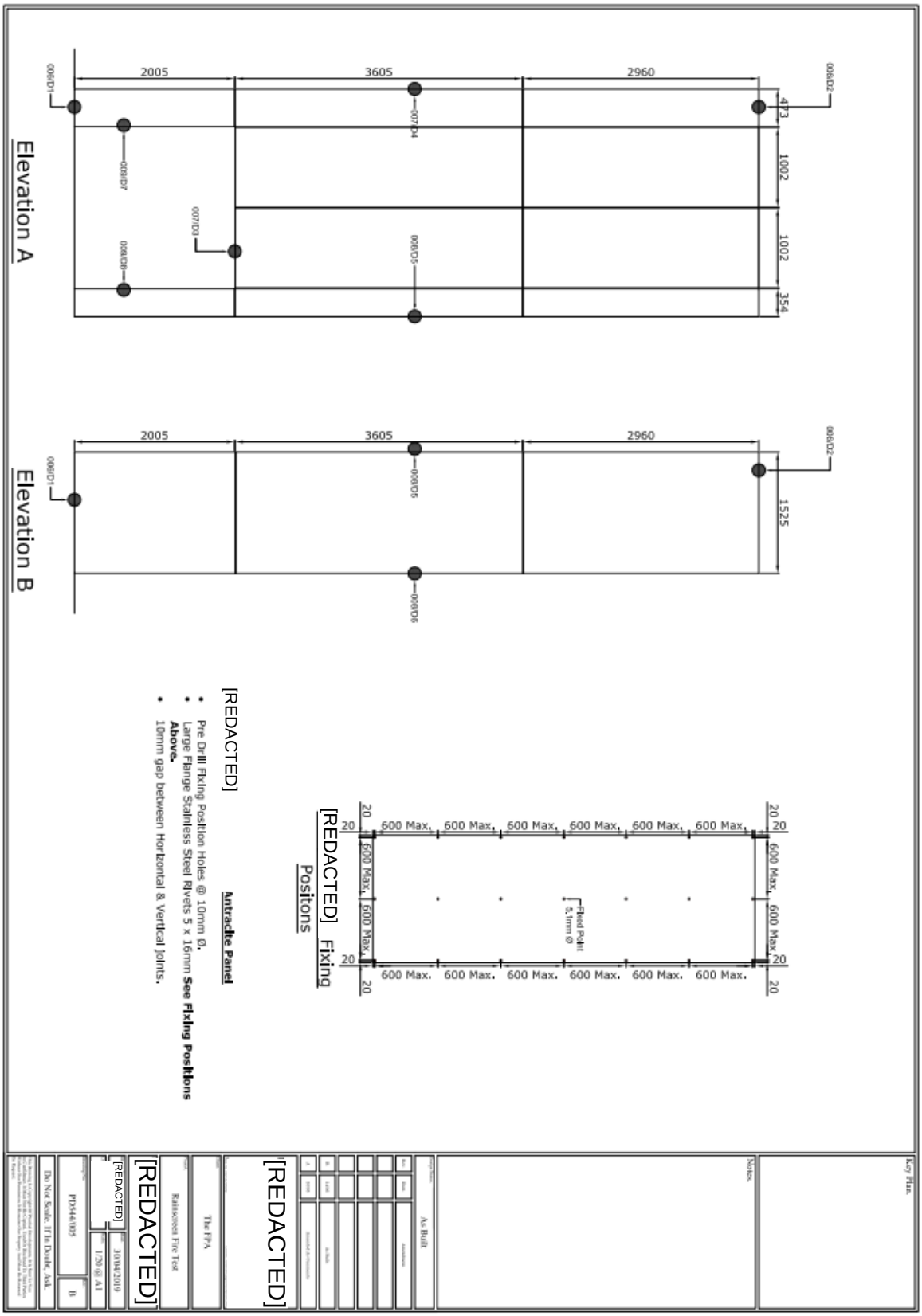

Figure 36 – High Pressure Laminate [REDACTED] layout and specification

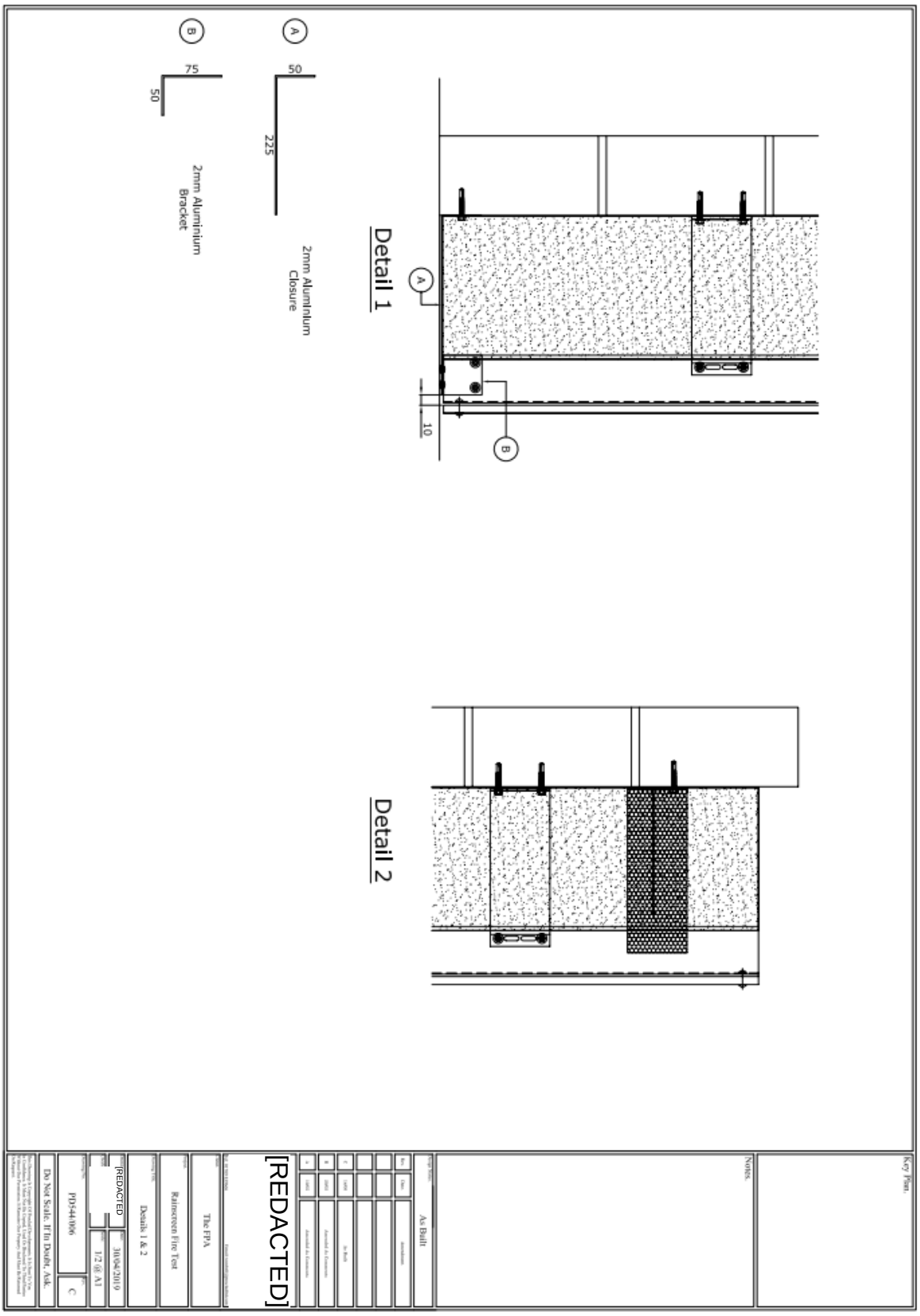

Figure 37 – Details 1 & 2

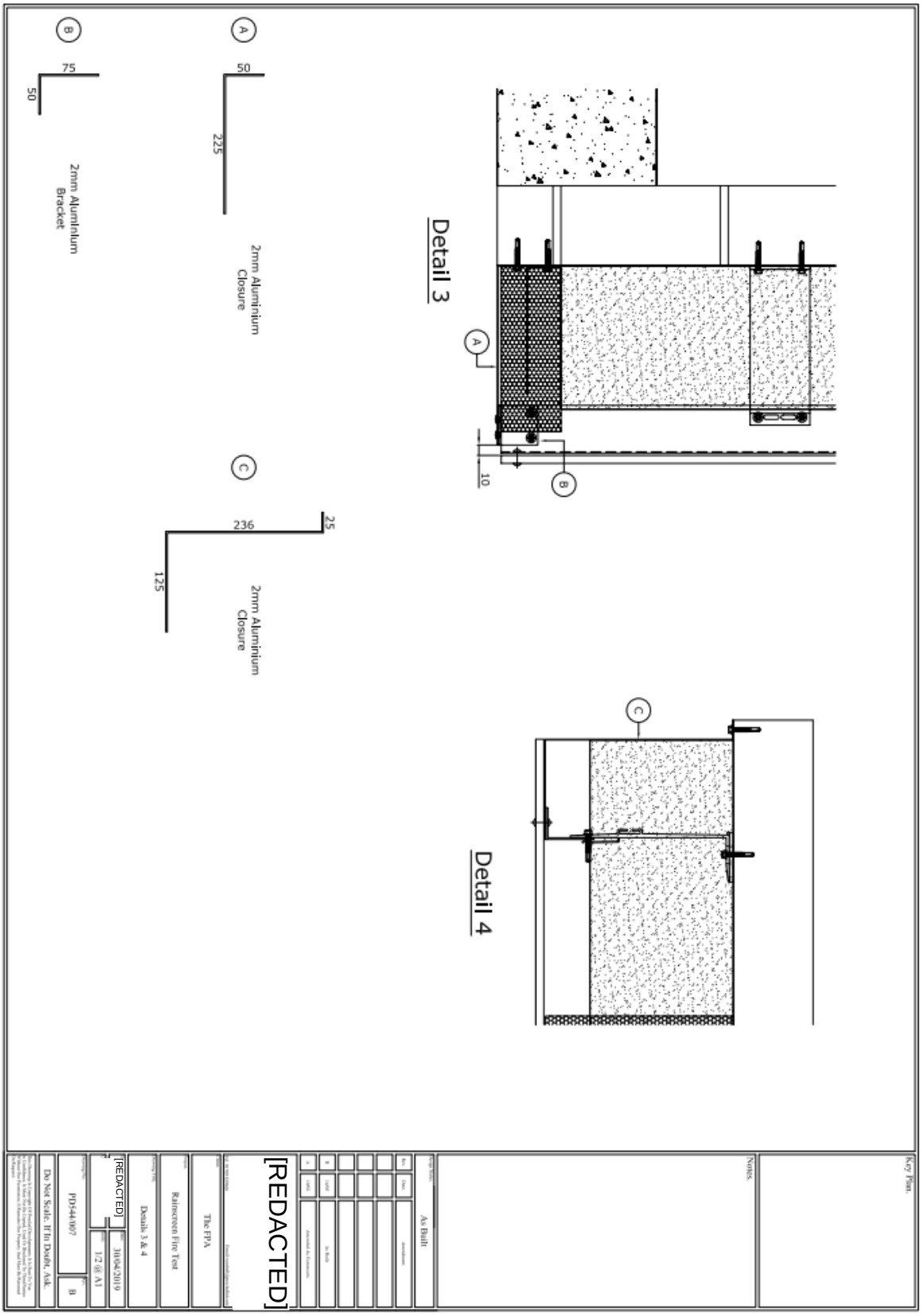

Figure 38 – Details 3 & 4

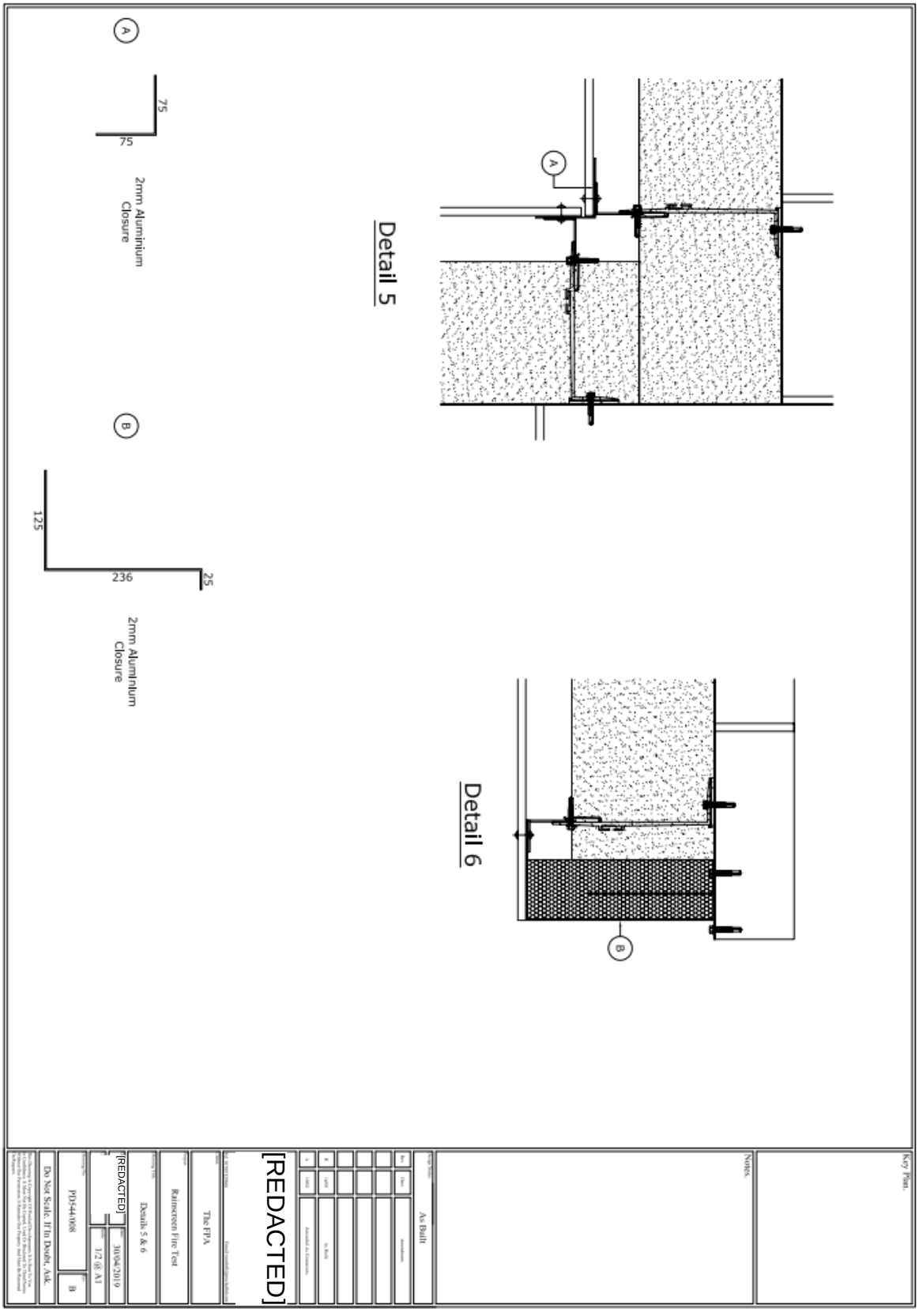

Figure 39 – Details 5 & 6

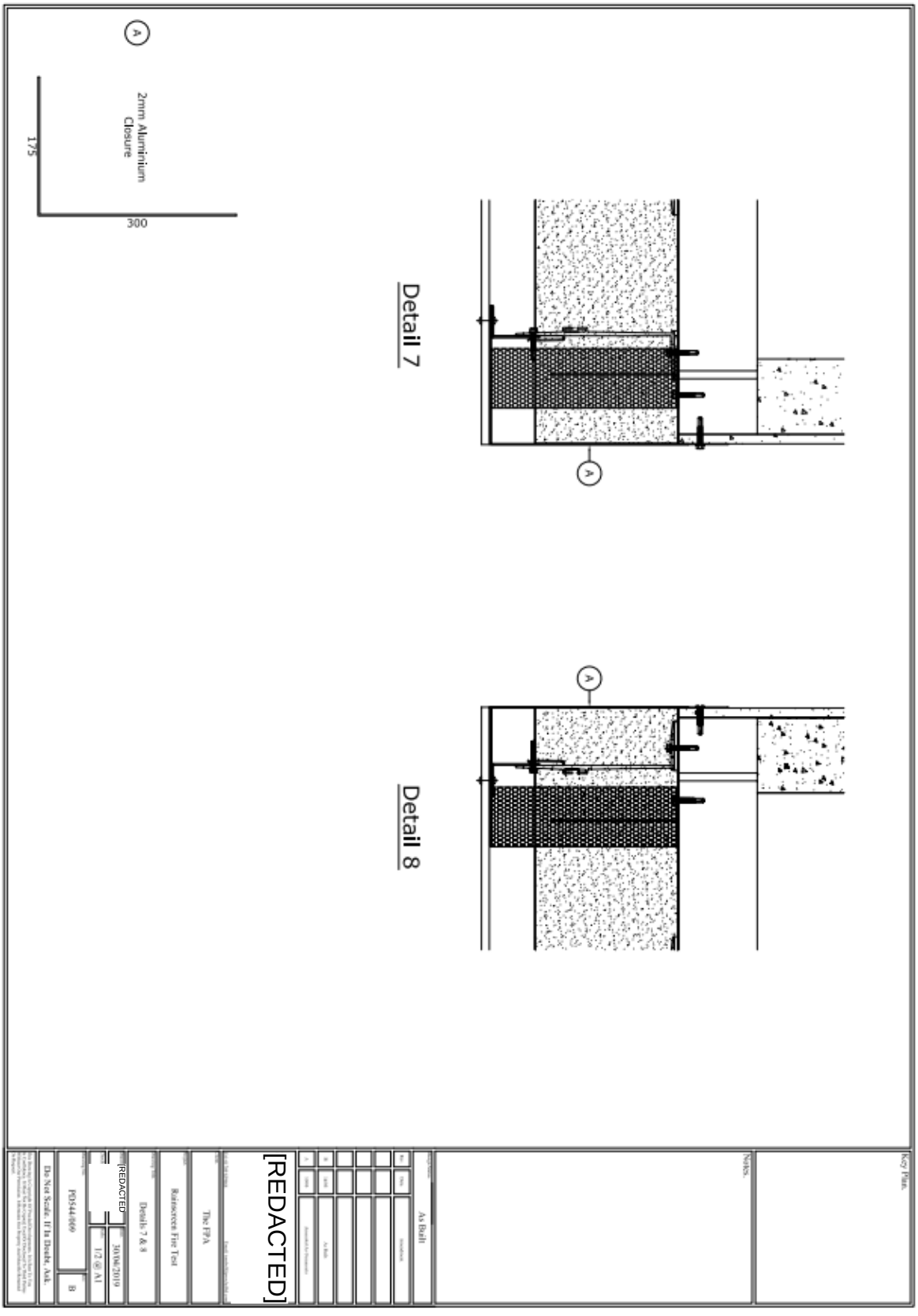

Figure 40 – Details 7 & 8

12 Appendix F - Equipment Calibration details

12.1 Time

Two timers were used during the test and data analysis, details of equipment used, and verification tests are as follows:

Procedure and reference equipment	
FPA procedure	MEOP-08: Management and use of chronometers, Version 1.0
Reference equipment	FPA's calibrated digital timer, Asset ID: 9004
Test equipment	
Stopwatch A	
Description	[REDACTED]
Asset tag ID	9031
Date of last verification test	13th June 2019
Stopwatch B	
Description	[REDACTED]
Asset tag ID	9032
Date of last verification test	13th June 2019

12.2 Distance

Measurements of length were taken using an EU Class 1 retractable tape measure, details as follows:

Procedure and test equipment	
FPA procedure	MEOP-07: Management and use of linear distance measuring devices, Version 2.0
Description of equipment	[REDACTED]
Asset tag ID	9002

12.3 Temperature

42 thermocouples were used in the test. Details of equipment used, and verification test conducted are as follows:

Procedure and reference equipment					
FPA procedure	MEOP-03: Management and use of thermocouples, Version 2.0				
Test equipment					
Datalogger	DT85, Asset ID: 9020				
Laptop	[REDACTED]				
Thermocouples	1.5mm type k mineral insulated thermocouples, Asset ID numbers: FPA TC0001 to FPA TC0036 *(TC Set FPA 8414-03)* FPA TC0S01 to FPA TC0S05 *(TC Set FPA SPARE-01)*				
Date of last verification tests	25th April 2019				
Thermocouple locations on test wall, see					
Test location	Asset ID	Test location	Asset ID	Test location	Asset ID
1A	FPA TC0001	5A	FPA TC0018	9	FPA TC0010
1B	FPA TC0002	5B	FPA TC0019	10	FPA TC0011
1C	FPA TC0003	5C	FPA TC0020	11	FPA TC0012
1D	FPA TC0S37	5D	FPA TC0S05	12	FPA TC0013
2A	FPA TC0004	6A	FPA TC0021	13	FPA TC0014
2B	FPA TC0005	6B	FPA TC0022	14	FPA TC0030
2C	FPA TC0006	6C	FPA TC0023	15	FPA TC0031
2D	FPA TC0S02	6D	FPA TC0033	16	FPA TC0032
3A	FPA TC0007	7A	FPA TC0024	17	FPA TC0037
3B	FPA TC0008	7B	FPA TC0025	18	FPA TC0036
3C	FPA TC0009	7C	FPA TC0026		
3D	FPA TC0S03	7D	FPA TC0034		
4A	FPA TC0015	8A	FPA TC0027		
4B	FPA TC0016	8B	FPA TC0028		
4C	FPA TC0017	8C	FPA TC0029		
4D	FPA TC0S04	8D	FPA TC0035		

12.4 Moisture Content

The fuel load moisture content was measured using a conductivity moisture meter for use with wood, details as follows:

Procedure and test equipment	
FPA procedure	MEOP-10: Management and use of wood moisture sensors, Version 1.0
Description of equipment	[REDACTED]
Asset tag ID	9005

12.5 Wind Speed Measurement

Wind speed was measured using a hot wire anemometer, details as follows:

Procedure and test equipment	
FPA procedure	MEOP-11: Management and use of anemometers, Version 1.0
Description of equipment	[REDACTED]
Asset tag ID	9001