

BRE Global Client Report

BS 8414-1:2015 + A1:2017 test referred to as DCLG test 1.

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Version History

03/08/2017	Issue 1.1	Amendment to Figure 2.
12/09/2017	Issue 1.2	Amendment to Section 4.4.

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1 Introduction

This report is one of a series, commissioned by the Department for Communities and Local Government (DCLG) intended to establish how different types of Aluminium Composite Material (ACM) panels in combination with different types of insulation behave in a fire.

Following the fire at Grenfell Tower in London on 14 June 2017, the Government established an Independent Expert Advisory Panel to advise on immediate measures that should be put in place to help make buildings safe. On 6 July the Independent Expert Advisory Panel recommended a series of full scale BS 8414 tests be carried out in order to help building owners make decisions on any further measures that may need to be put in place.

This series of tests includes 6 combinations of cladding systems. The detailed design of each test specimen was carried out by a cladding company appointed by DCLG. The design of the cladding systems have been reviewed by the Independent Expert Advisory Panel and other industry bodies to ensure that they are representative of the systems that are in common use on buildings, including the way they are fixed. The cladding systems have been or will be installed by a Company appointed by DCLG and each one has been or will be independently assessed during the installation to ensure that it meets the design specification.

The six test specimens incorporate each of the three common types of ACM panel, with core filler materials of unmodified polyethylene, fire retardant polyethylene and limited combustibility mineral. The two insulation materials specified for use in the testing are rigid polyisocyanurate foam (PIR) or stone wool.

The test method, BS8414 Part 1:2015 + A1:2017^[1] 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 a building and exposed to an external fire under controlled conditions. The fire exposure is 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. It is important to check that the cladding system tested relates to the end use application when installed on a building. Such checks should be made by a suitably competent person.

All measurements quoted in this report are nominal unless stated otherwise.



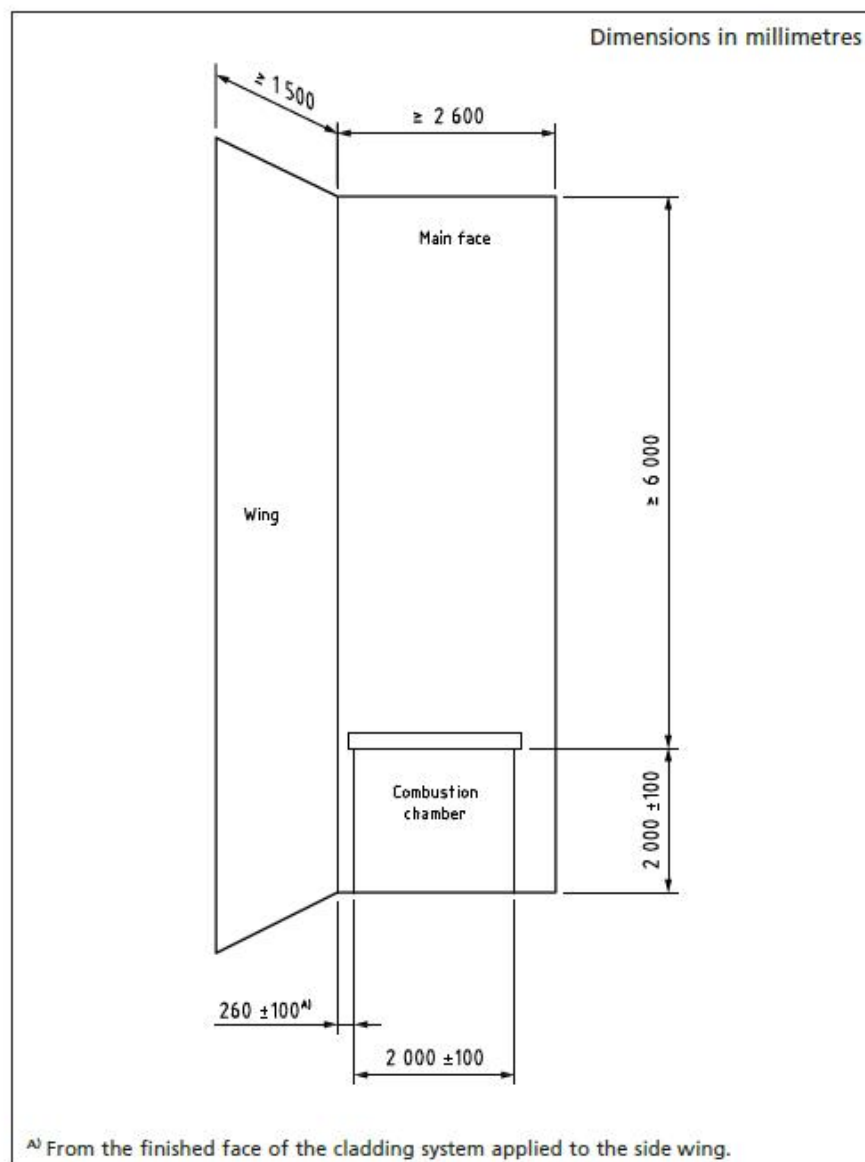
2 Details of test carried out

Name of Laboratory:	BRE Global Ltd.
Laboratory Address:	Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX.
Test reference:	DCLG test 1
Date of test:	23/07/2017
Sponsor:	Department for Communities and Local Government
Sponsor address:	2 Marsham Street, London, SW1P 4DF.
Method:	The test was carried out in accordance with BS 8414-1:2015 + A1:2017
Deviations:	None



3 Details of test apparatus used

The product was installed to wall number 1 of the BS 8414-1 BRE Global test facility. This apparatus is defined in the test Standard^[1] and consists of a masonry structure with a vertical main test wall and a vertical return wall at a 90° angle to and at one side of the main test wall. See *Schematic 1*. The main wall includes the combustion chamber.



Schematic 1. Test apparatus dimensions as specified by test Standard^[1].

Note: The test apparatus may be constructed left- or right-handed.



4 Description of the system

4.1 Installation of specimen

BRE was not involved in the design, installation, procurement or specification of the materials and cladding system that was submitted for testing. The tested system was defined by the Test Sponsor.

4.2 Description of substrate

The test specimen was installed to wall number 1 of the BRE Global Cladding Test Facility. This is a multi-faced test rig constructed from steel with a masonry finish onto which the cladding system was applied.

4.3 Description of product

Figures 12-16 were provided by the Test Sponsor to show the design and detailing of the installed system.

The tested cladding system build up is given in order from the masonry substrate to the external finish:

- 90mm-high×64mm-wide×113mm-deep×4mm-thick aluminum 'L'-shaped brackets fixed with a single 90mm-long× ϕ 8mm stainless steel screw anchor and plastic plug – see *Figures 7&8*;
- 100mm-thick rigid polyisocyanurate (PIR) foam insulation boards (supplied 2400mm×1200mm and cut to size) with Aluminium foil facings on both sides – see *Figure 6*;
- 100mm-wide×60mm-deep×2mm-thick aluminum 'T'-section framing and 40mm-wide×60mm-deep×2mm-thick aluminum 'L'-section framing – see *Figure 9*;
- 75mm-wide×160mm-deep stone wool vertical cavity barriers (stated integrity/insulation performance: 90/30mins), with 10mm compression – see *Figure 3*;
- 75mm-wide×125mm-deep stone wool with intumescent horizontal cavity barriers (stated integrity/insulation performance: 90/30mins) – see *Figure 5*;
- 4mm-thick front face Aluminum composite material (ACM) panels, with a white finish – see *Figure 11*.

The densities of the insulation and the cavity barriers have been determined and are reported in *Appendix A*.

The 4mm-thick ACM panels consisted of, from outward face in:

- 0.5mm-thick aluminium sheet;
- 3.0mm-thick polyethylene (PE) filler;
- 0.5mm-thick aluminium sheet.

The filler between the Aluminium sheets was screened using the BS EN ISO 1716:2010^[3] test methodology. The results are given in *Appendix B*.

4.4 Installation sequence

Onto the masonry support structure the 90mm-high×64mm-wide×113mm-deep×4mm-thick aluminium 'L'-shaped brackets were fixed in position with a single 90mm-long× ϕ 8mm stainless steel screw anchor and plastic plug. On the main face the horizontal spacing between the brackets varied between 340mm and 500mm. On the wing wall the horizontal spacing between the brackets was 645mm as specified in the manufacturer's details. The vertical spacing between the brackets was 960mm and where horizontal cavity barriers were present a spacing of 410mm was used - see *Figure 3*.



The system included vertical and horizontal cavity barriers. On the main face, two 75mm-wide × 160mm-deep stone wool vertical cavity barriers, with 10mm compression, were fixed in position with a clear distance of 1980mm between them. The vertical cavity barriers were skewered to $\frac{3}{4}$ -depth on steel brackets fixed into the masonry wall with one 70mm-long × ϕ 4mm anchor. Two steel brackets were used for each length of 1200mm of stone wool cavity barrier – see *Figure 3*.

On the wing wall, one 75mm-wide × 160mm-deep stone wool vertical cavity barrier, with 10mm compression, was fixed in position at the edge of the system, approximately 1500mm from the external face of the main wall. Once installed in position the stone wool vertical cavity barriers were compressed by the ACM panels to fully close the 50mm ventilated cavity. *Figure 3* demonstrates the installed 'L' brackets and vertical cavity barriers.

A pre-fabricated, welded window pod constructed from 5mm-thick aluminium was fixed into the combustion chamber opening with eight (two on top, three on both vertical edges) 90mm-long × ϕ 8mm stainless steel screw anchor and plastic plugs – see *Figure 4*. The window pod extended 180mm perpendicular to the masonry wall so that it extended approximately 30mm beyond the front face of the finished cladding system.

A set of four 75mm-wide × 125mm-deep intumescent horizontal cavity barriers were butted up to the continuous vertical barriers and fixed in rows at approximate heights of:

- 0m above the combustion chamber opening,
- 2395mm above the first cavity barrier,
- 2330mm above the second cavity barrier,
- and close to the top of the ventilated system (1635mm above the third cavity barrier, 6360mm above the combustion chamber opening).

The horizontal cavity barriers were fixed through the entire depth on face turned steel brackets – see *Figure 5*. Two steel brackets were used for a length of 1200mm of stone wool cavity barrier fixed into the masonry wall with one 70mm-long × ϕ 4mm anchor, positioned above the cavity barrier. The horizontal intumescent cavity barriers were installed with a maximum gap of 25mm to the back face of the panel in accordance with the manufacturer's recommendation.

The 100mm-thick foil-faced PIR insulation panels (supplied in 2400mm × 1200mm panels and cut to fit) were installed in position through the substructure bracket fixing systems and fixed to the support structure with five 125mm-long × ϕ 8mm plastic anchors and four 140mm-long × ϕ 8mm stainless steel anchors per full size panel. All the gaps between the insulation panels and at the intersection with the cavity barriers were sealed with aluminium tape – see *Figure 6&14*.

After the insulation was fixed in position, the 100mm-wide × 60mm-deep × 2mm-thick aluminium 'T'-section and 'L'-section framing were installed at horizontal spacings of 480mm. The horizontal spacing between the two successive aluminium 'T'-section or 'L'-section framing was 970mm as shown in *Figure 9*. The aluminium vertical rails, with a typical length of 2300mm, were positioned 10mm inside the thermal insulation with each rail fixed to the brackets with 2 × 4.8 × 16mm self-tapping screws. The aluminium rails were installed with a 30mm gap at the floor levels to allow for thermal expansion with three brackets. The middle bracket was fixed while the top and bottom brackets were connected with movement holes – see *Figures 7&8*.

The external ACM panels of the system were installed on to the rail substructure with one fixed point (ϕ 6mm hole) in the middle and twenty oversize (ϕ 8.5mm holes) fixings into the rail substructure, at 450mm horizontal spacings and 375mm vertical spacings. A gap of 20mm was provided between the panels to maintain the ventilation of the cavity – see *Figure 10*. The measured gaps after installation varied between 18mm and 25mm. The full size ACM panel dimensions measured 950mm-wide × 2310mm-high.



In accordance with the requirements of the test Standard^[1], the cladding system measured:

Requirement	Actual measurement
≥6000mm above the top of the combustion chamber	6492mm
≥2400mm width across the main wall	2615mm
≥1200mm width across the wing wall	1340mm
260mm (±100mm) wing wall-combustion chamber opening	222mm
2000mm x 2000mm (±100mm) combustion chamber opening	2000mm × 1940mm

4.5 Test conditions

Test Date: 23/07/17

Ambient Temperature: 18.4°C

Wind speed: < 2 m/s

Frequency of measurement: Data records were taken at ten second intervals.

Thermocouple locations (*Figure 2*):

Level 1 – External (50mm in front of the finished face).

Level 2 – External (50mm in front of the finished face).

Level 2 – Midpoint of cavity between panel and insulation.

Level 2 – Midpoint of insulation layer.



5 Test results

5.1 Temperature profiles

Figures 17-20 provide the temperature profiles recorded during the test. Figure 11 shows the system before the test.

Parameter	Result
T _s , Start Temperature	18.4 °C
t _s , Start time	130 seconds after ignition of crib.
Peak temperature / time at Level 2, External	813.9 °C at 390 seconds after t _s .
Peak temperature / time at Level 2, Cavity	410.4 °C at 380 seconds after t _s .
Peak temperature / time at Level 2, Insulation	218.4 °C at 380 seconds after t _s .

Note: Test terminated after 395s.

5.2 Visual observations

Table 1: Visual Observations – refer to Figure 1.

Height measurements are given relative to the top of the combustion chamber.

Unless otherwise specified, observations refer to the centre line above the combustion chamber.

Time* (mins:secs)	t _s (seconds)	Description
00:00		Ignition of crib.
01:40		The flames from the combustion chamber are impinging on the cladding system.
02:00		Flame tips to mid-height of panels 1C&1D. A small amount of distortion at the base of 1D can be observed.
02:10	0	Start time (t _s) criteria achieved: External temperature 2.5m above the top of the combustion chamber in excess of 218.4 °C (=200 °C+T _s).
02:45	35	Flame tips to Level 1 thermocouples.
03:00	50	The colour of the panels has changed from white to a dark-grey.



Time* (mins:secs)	t _s (seconds)	Description
03:15	75	Distortion of panel 1D extends to mid-height. Distortion of panel 1C has started at the base.
03:45	95	Flame tips to mid-height of panels 2C&2D.
04:00	110	Full-width flame spill from the combustion chamber.
04:15	125	Black discolouration to the top of panels 1C&1D.
04:30	140	Intermittent flames can be observed behind panels 1C&1D, at the panel junction/ventilation gap.
05:00	170	Burning droplets from the system can be observed, with a self-sustained burning duration longer than 20 seconds.
05:30	200	Rate of flaming droplets is sufficient to fuel growth of pool fire at the base of the cladding.
06:00	230	Intermittent flames can be observed behind panels 2C&2D, at the base of the panel junction/ventilation gap.
06:20	250	Continuous flow of flaming material from the base of panels 1C&1D.
06:35	265	Flame tips remain at mid-height of panels 2C&2D but with increased intensity.
06:45	275	Flame tips at top of panels 2C&2D.
07:15	305	Sporadic flaming at the top of the rig.
07:20	310	Increased production of burning droplets, detachment and melting of aluminium at the base of panels 1C&1D.
07:40	330	Flaming from the top of the rig from the wing wall edge of panel 3C for a duration of approximately 10s. Flame emission from the 2C&2D panel junction/ventilation gap. Dark discolouration and distortion to mid-height of panels 2C&2D.
07:55	345	Flaming visible from underneath the base of panels 3C&3D. Frequent flaming at the top of the rig. Pool fire at base of rig approximately 1m-wide with flaming 300mm-high.
08:10	360	Flame emission from beneath base of panels 3C&3D.



Time* (mins:secs)	t _s (seconds)	Description
		Flame tips beyond the top of the rig.
08:20	370	Frequent flaming beyond the top of the rig.
08:30	380	Near continuous flaming beyond the top of the rig.
08:40	390	Flame emission from base of panel 3D across the full-width and right vertical edge. Flame emission from mid-height of 3C&3D panel junction/ventilation gap.
08:45	395	Flaming several metres beyond the top of the rig. Test terminated.

*Time from point of ignition.



6 Analysis of fire performance and classification

The primary concerns given in BR 135^[2] when setting the performance criteria for these systems are those of fire spread away from the initial fire source and the rate of fire spread.

In order for a classification to BR 135^[2] to be undertaken, the cladding system must have been tested to the full test duration requirements of BS 8414-1^[1] without any early termination of the test. The minimum test duration is 40 minutes. If the test criterion is met, then the performance of the system under investigation is evaluated against the following three criteria;

- External fire spread
- Internal fire spread
- Mechanical performance

Failure due to external fire spread is deemed to have occurred if the temperature rise above T_s (the mean temperature of the thermocouples at level 1 during the 5 minutes before ignition) of any of the external thermocouples at level 2 exceeds 600°C for a period of at least 30 seconds within 15 minutes of the start time (t_s).

Failure due to internal fire spread is deemed to have occurred if the temperature rise above T_s of any of the internal thermocouples at level 2 exceeds 600°C for a period of at least 30 seconds within 15 minutes of the start time (t_s).

No failure criteria are defined for mechanical performance. However, BR 135^[2] notes that ongoing system combustion following extinguishing of the ignition source shall be included in the test and classification reports together with details of any system collapse, spalling, delamination, flaming debris and pool fires. The nature of the mechanical performance should be considered as part of the overall risk assessment when specifying the system.

In accordance with BS 8414-1^[1] (and reported above in *Section 5*), the test of this cladding system was terminated after 8 minutes and 45 seconds from ignition of the fire load (timber crib) due to flame spread above the test apparatus. Therefore this cladding system failed to meet the minimum test duration as detailed in BS 8414-1^[1]. A classification to BR 135^[2] is therefore not possible for this cladding system.

In addition, *Figure 18* shows that the level 2 external thermocouples would have failed to meet the external fire spread criterion if classification had been possible as a measured temperature exceeded a 600°C temperature rise above T_s , for a minimum of 30s, within 15mins from test start time (t_s) at time 360s (6mins after t_s).



7 Post-test damage report

7.1 Summary

Figures 22&23 show the main damage areas spanned the majority of the combustion chamber opening (2000mm-width) tapering to a point 5000mm above. The extent of the damage increased from black discolouration at the edges of the damage zone to complete consumption of sections of the ACM panels, rail substructure and some charring of the insulation at the centre of the main wall – see *Figures 21-32*. Slight distortion of the ACM panel on the wing wall, immediately above the combustion chamber was the only external damage on this face of the cladding - see *Figures 21-25*.

7.1.1 ACM panel

Complete consumption of the ACM panel occurred in a 500mm-wide channel along the centre line of the combustion chamber up to a height of approximately 1000mm which narrowed to approximately 100mm at the top of the first panel exposing a total area of insulation of approximately 0.75m² - see *Figure 22*. At the base of the second row of panels (2300mm above the top of the combustion chamber), there was less consumption of the panels. A central 400mm-wide x 800mm-high section was damaged with approximately 0.05m² of the outer skin of the ACM panel melted exposing the core material – see *Figure 22*.

The surface finish of the panel was burnt away revealing a shiny metallic surface in a 300mm-wide strip adjacent to the consumed areas of the ACM panel which increased to approximately 1000mm at the tip of the flame impingement zone. Adjacent to the 'metallic' strip, a strip of dark discolouration, approximately 100mm-wide, which increased to approximately 1000mm at the tip of the flame impingement zone, extended to a height of 5000mm above the combustion chamber – see *Figure 21*.

Smaller areas of discolouration spanned the full-width at the base of the second and, to a lesser extent, third row panels where flaming had spread laterally – see *Figures 24&25*.

It was observed that there was no PE 'filler' material between the aluminium sheets on the remaining ACM panels directly above the combustion chamber - significant melting had been observed during the test. Some residual solidified material was observed at the base of the panels in the top row (5000mm above the top of the combustion chamber) – see *Figure 26*.

7.1.2 'T' and 'L' rail substructure

The outermost face of the central 'T' rail was absent in the region approximately 400-900mm above the top of the combustion chamber – see *Figures 27&28*. This was the only structural damage observed to the rail substructure.

Dark discolouration occurred to the 'L' rails either side and, to a lesser extent, the remaining section of 'T' rail, up to the level of the 2nd horizontal cavity barrier (2500mm above the top of the combustion chamber) – see *Figure 29*. Lighter discolouration occurred, almost exclusively to those three central sections of railing, up to the height of the third cavity barrier (5000mm above the top of the combustion chamber) – see *Figure 30*.

The rail substructure on the wing wall appeared to be almost completely undamaged – see *Figure 31*.



7.1.3 PIR Insulation

The foil face on the insulation was burnt away and the insulation charred in a rectangular section approximately 600mm-wide and 1000mm-high (0.6m²) centrally located approximately 300mm above the top of the combustion chamber – see *Figure 28*.

With the exception of the lower right corner (approximately 500mm-wide x 1000mm-high) which was mostly undamaged, discolouration and blistering affected the foil face of the panels, across the full width of the combustion chamber, up to the height of the second horizontal cavity barrier – see *Figure 28*. Between the second and third horizontal cavity barriers, light brown discolouration with occasional blistering affected approximately 50% of the area in line with the combustion chamber opening – see *Figure 29*. Black discolouration (approximately 0.5m²) was observed above and below the third horizontal cavity barrier in the section contained by the central 'T' rail and the 'L' rail to the left (direction of wing wall) – see *Figure 30*. A small section (approximately 0.1m²) of dark discolouration was noted directly below the third horizontal cavity barrier to the right of the central 'T' section.

The insulation on the wing wall appeared to be almost completely undamaged – see *Figure 31*.

7.1.4 Horizontal (intumescent) cavity barriers

The first row of horizontal intumescent cavity barriers directly above the combustion chamber expanded on exposure to the heat to fill the void along the majority of the combustion chamber width – see *Figure 28*.

At the second row of horizontal cavity barriers (approximately 2400mm above the combustion chamber) there was evidence of intumescent activation across the full width of the combustion chamber – see *Figure 28*. On the wing wall, directly adjacent to the main wall, a 500mm-width of the intumescent strip had partially activated – no smoke damage was visible above or below this section of cavity barrier – see *Figure 32*.

At the third row of horizontal cavity barriers (approximately 4700mm above the combustion chamber, there was again evidence of some intumescent activation on the main wall – see *Figure 30*.

Partial activation of the fourth row horizontal cavity barrier occurred at the top of the cladding system in line with the combustion chamber.

7.1.5 Vertical (compression) cavity barriers

The fire damage to the ACM panels and the PIR insulation was within the bounds of the vertical cavity barriers contained within the width of the combustion chamber – see *Figure 28*. The cavity barriers suffered discolouration along the inside edges running parallel to the vertical edges of the combustion chamber.



8 Reference

1. BS 8414-1:2015 + A1:2017, 'Fire performance of external cladding systems – Part 1: Test method for non-load bearing external cladding systems applied to the masonry face of the building', British Standards Institution, London, 2015.
2. Colwell, S and Baker, T. BR 135, "Fire performance of external thermal insulation for walls of multistorey buildings", Third Edition, published by IHS BRE press, 2013.
3. BS EN ISO 1716:2010 ("*Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)*"), British Standards Institution, London, 2010.



9 Figures

9.1 Diagrams of finished face of the cladding system

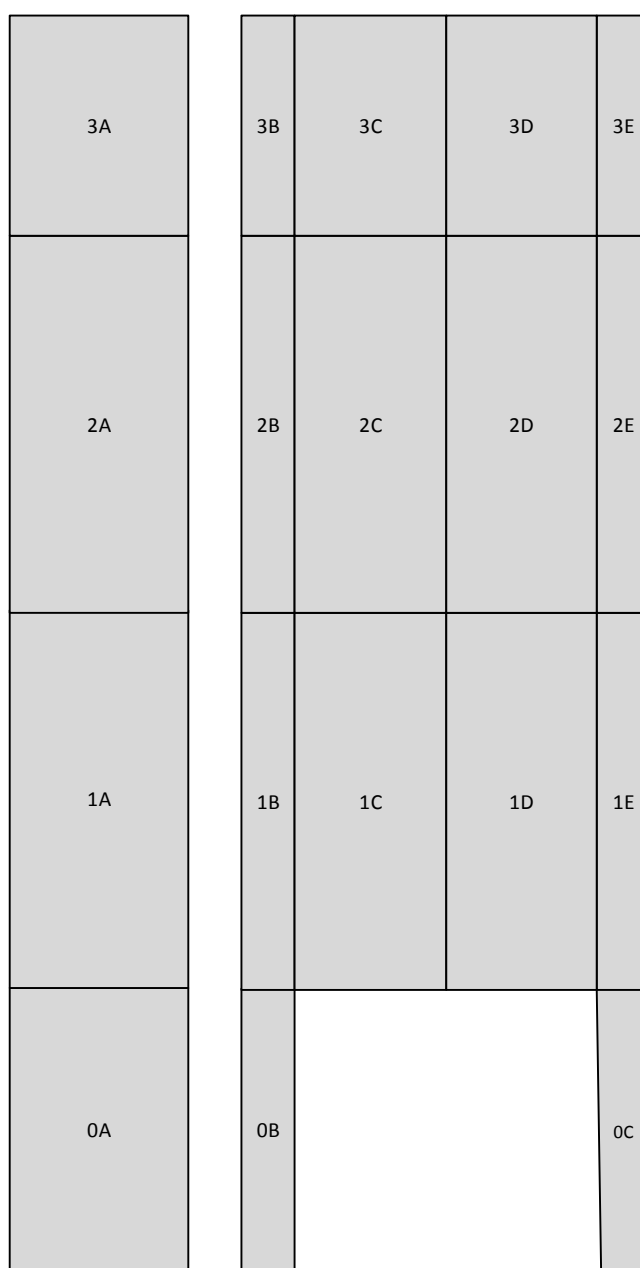


Figure 1. Layout of panels and labelling system used for reporting purposes. Not to scale.

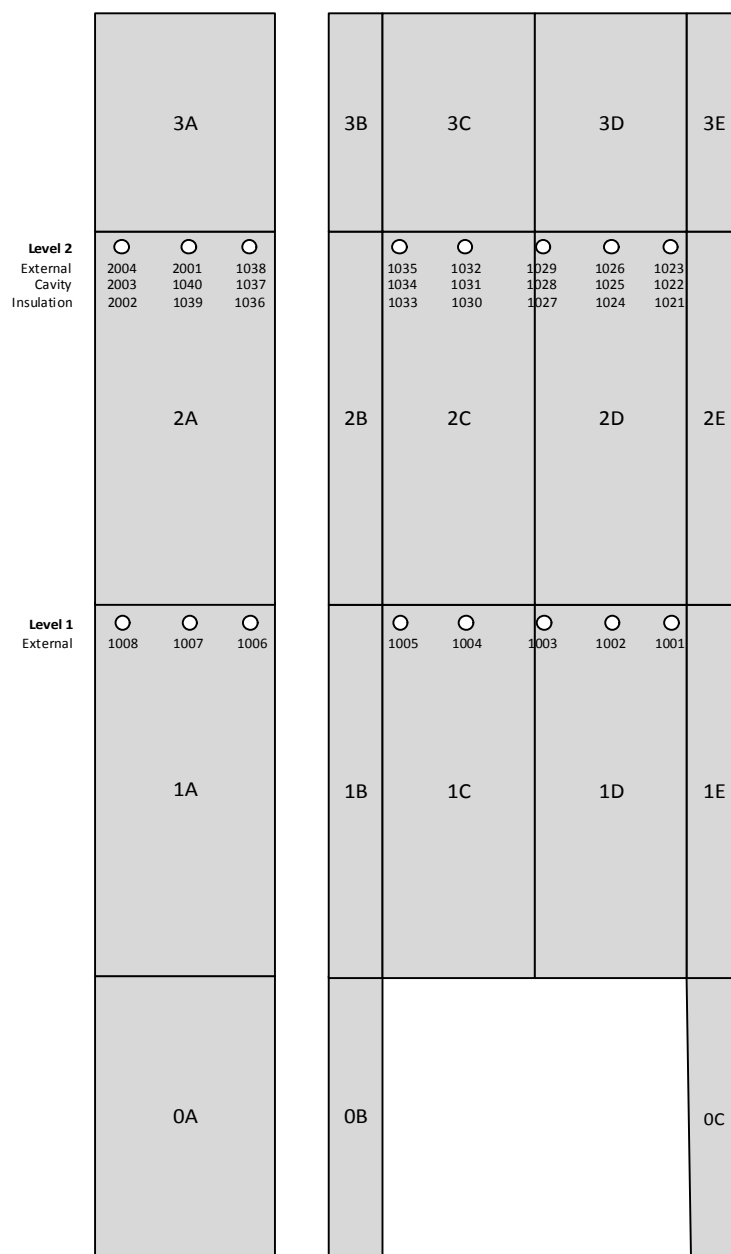


Figure 2. TC positions and panel labelling system (0A – 3E). Not to scale.



9.2 Installation photographs



Figure 3. Location of 'L' brackets and vertical cavity barriers.

Note: 'L' brackets on the main wall were later reattached to match orientation specified in *Figure 13*.

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Figure 4. Installed window pod lining combustion chamber.

Note: Horizontal cavity barrier above window pod has yet to be fixed.

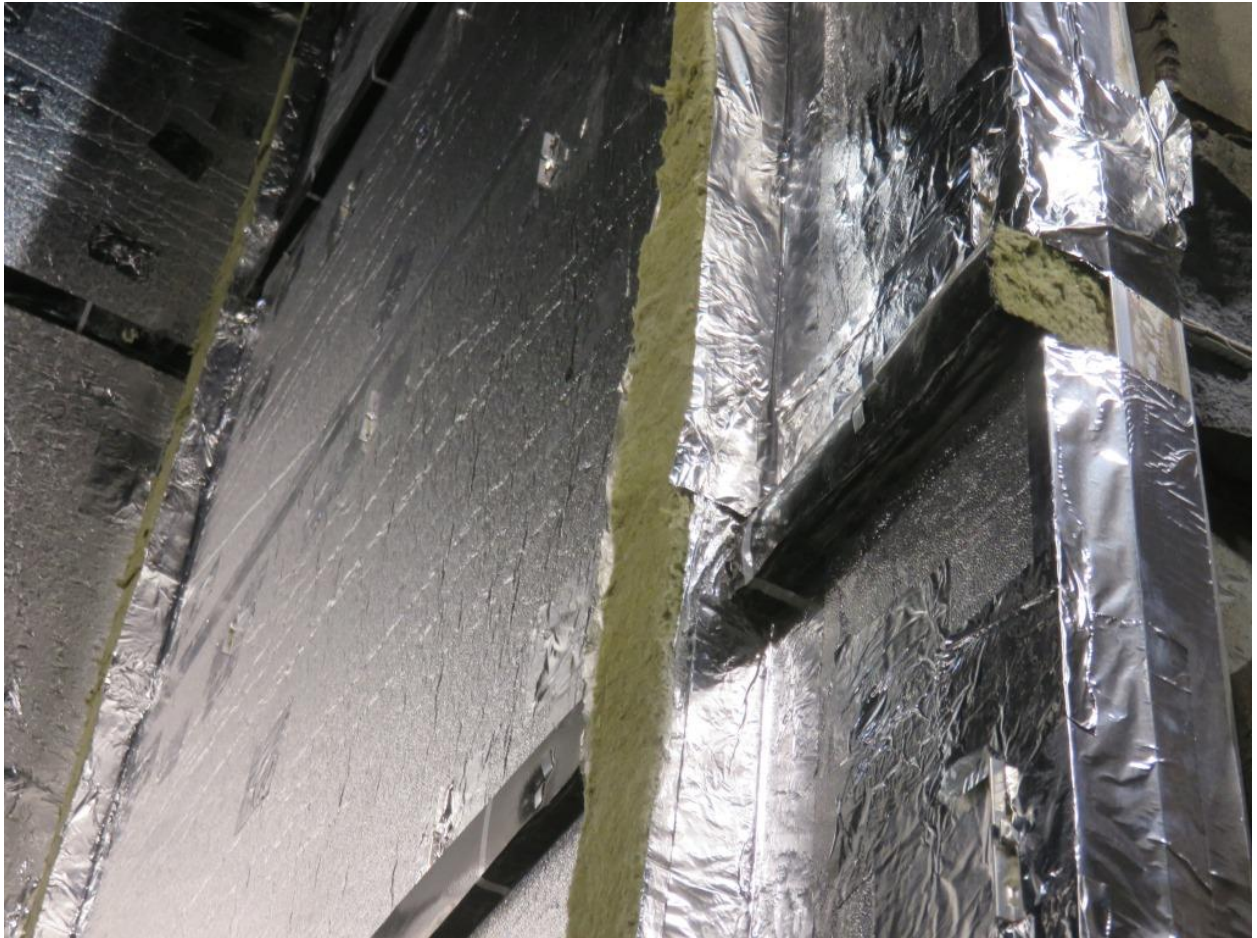


Figure 5. Horizontal intumescent cavity barriers fixed through the entire depth on face turned steel brackets, fitted between vertical cavity barriers.

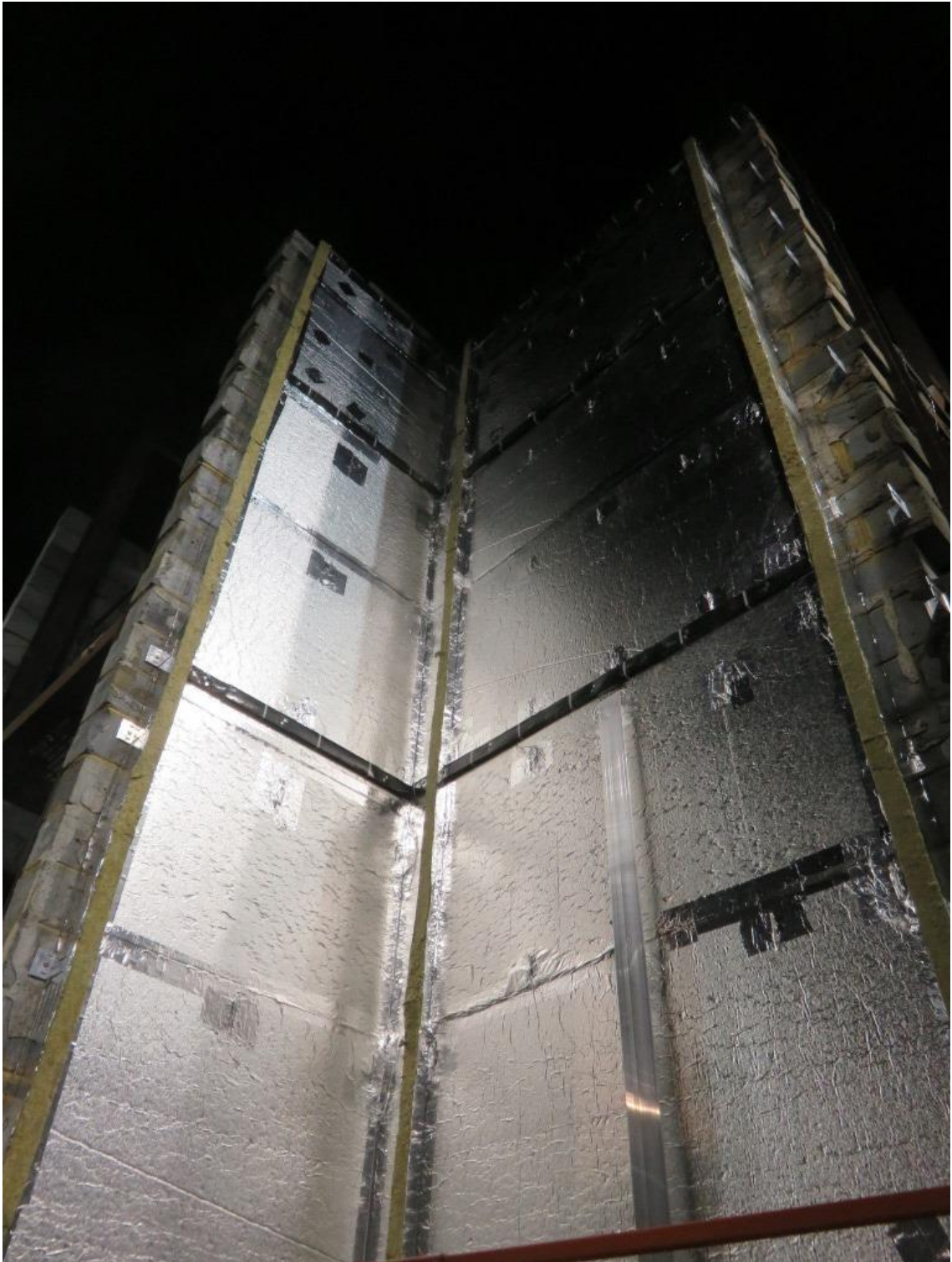


Figure 6. Installed cavity barriers, PIR insulation panels cut to fit and joints taped.

Note: Insulation panels have not yet been fixed to masonry.

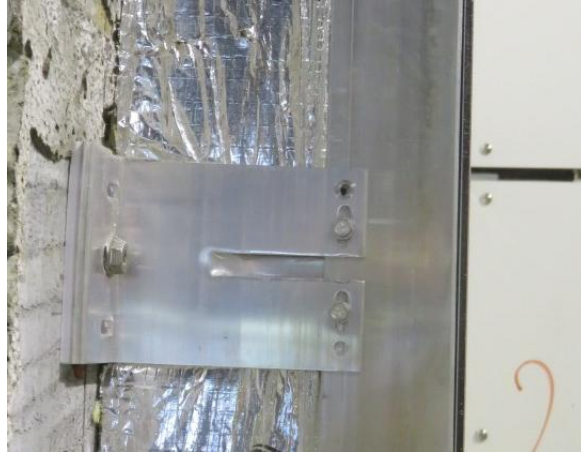


Figure 7. Example of aluminium rail fixed to 'L' bracket through movement holes.



Figure 8. Example of aluminium rail fixed to 'L' bracket through fixed holes.



Figure 9. Completed installation of railing substructure visible on main wall.

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Figure 10. Detail at corner of combustion chamber opening. Panels riveted in place and 20mm vertical gap left for ventilation purposes.



Figure 11. Completed installation prior to test.



9.3 System drawings

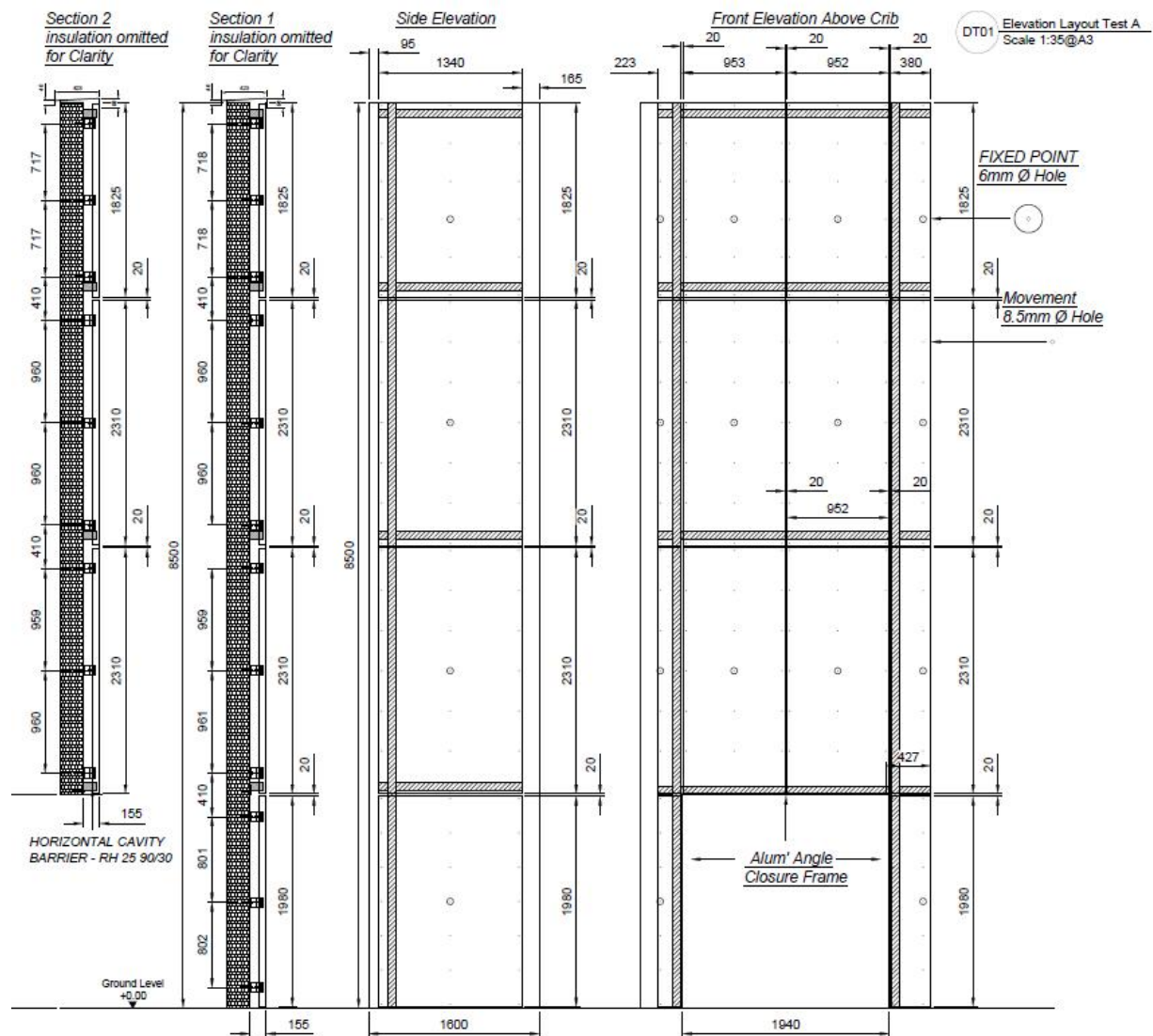


Figure 12. Front elevation, side elevation and vertical sections for the system (supplied by the Test Sponsor).

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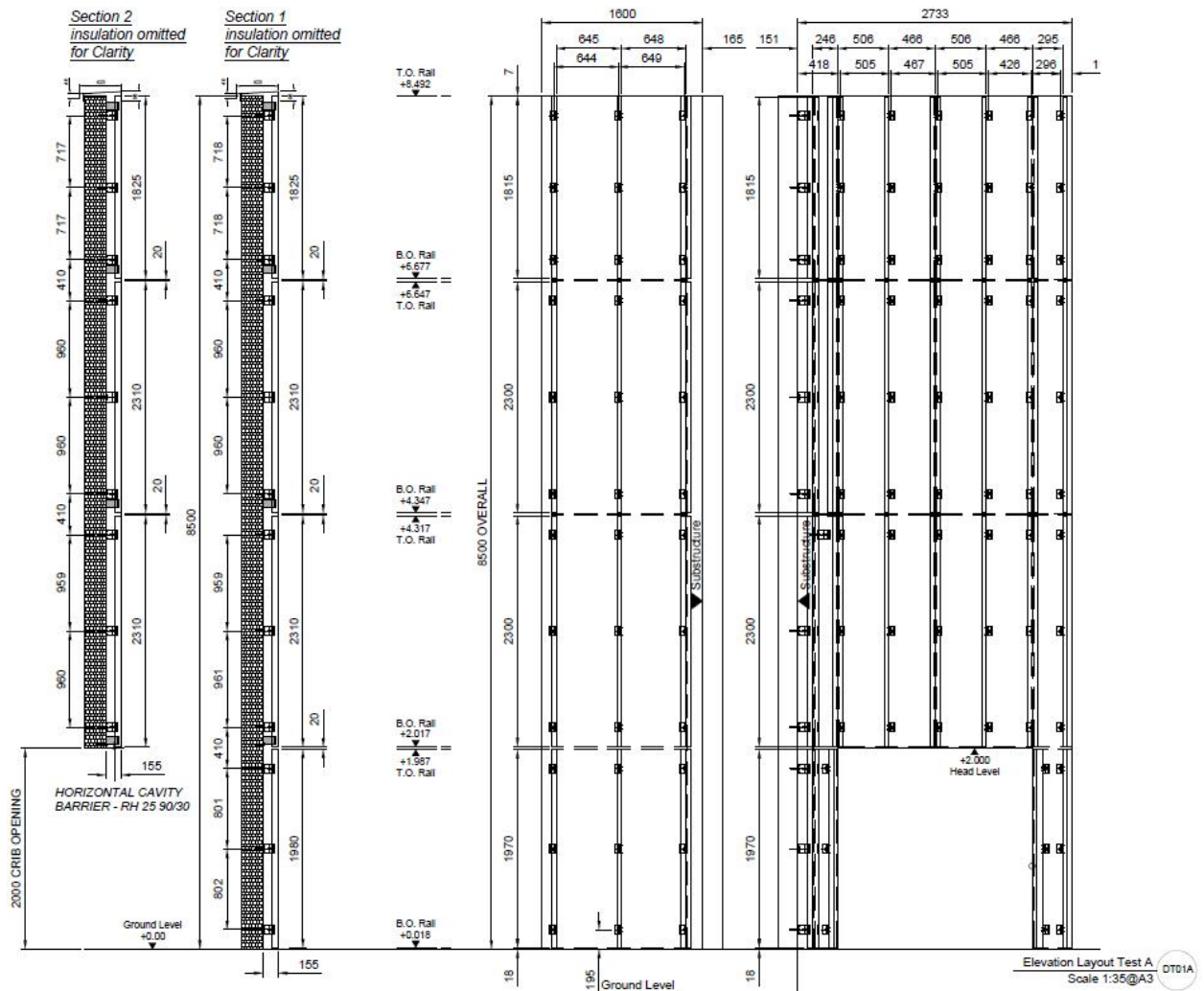


Figure 13. Front elevation, side elevation and vertical sections for the substructure system (supplied by the Test Sponsor).

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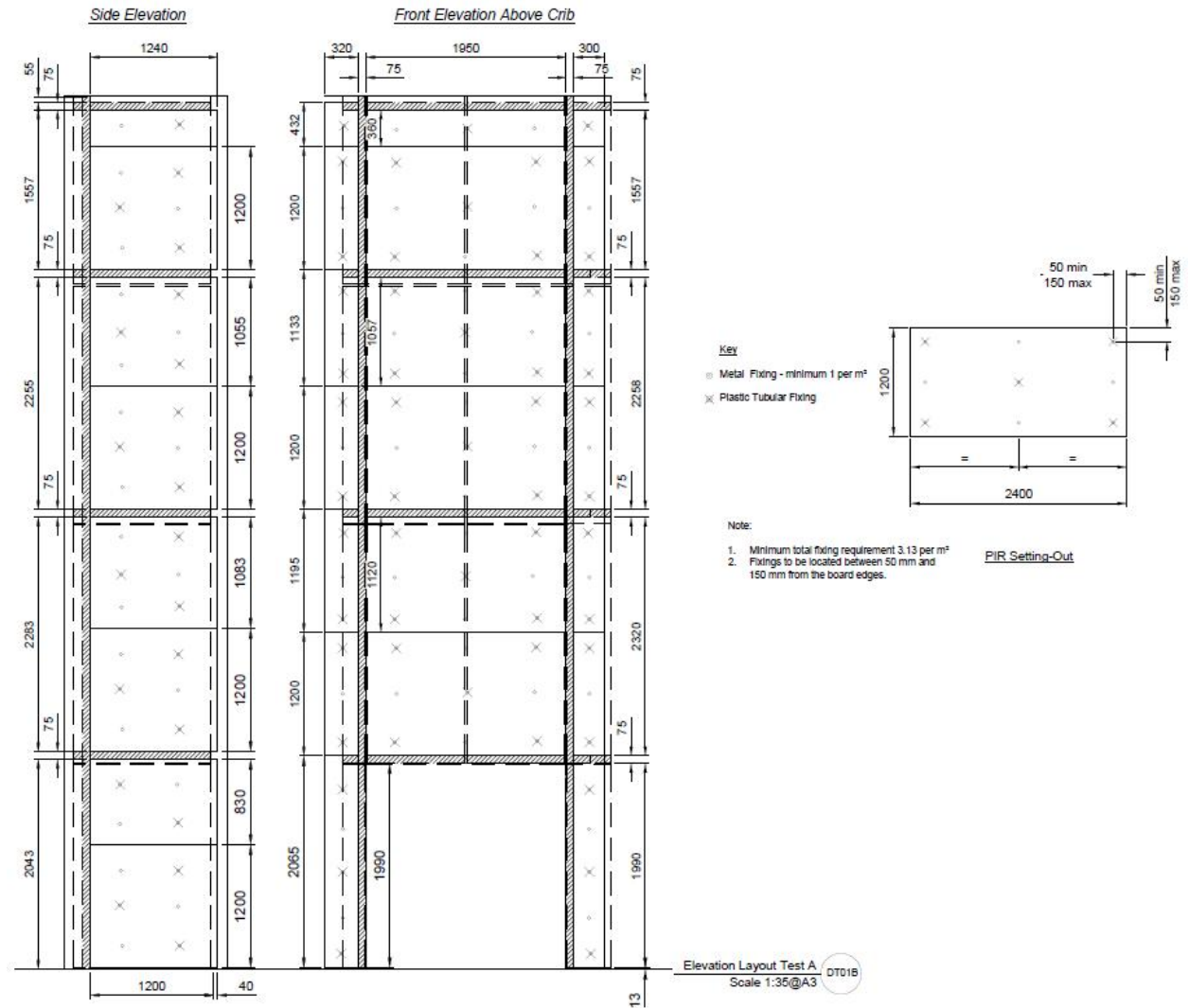


Figure 14. Front elevation, side elevation for the insulation panels installation (supplied by the Test Sponsor).

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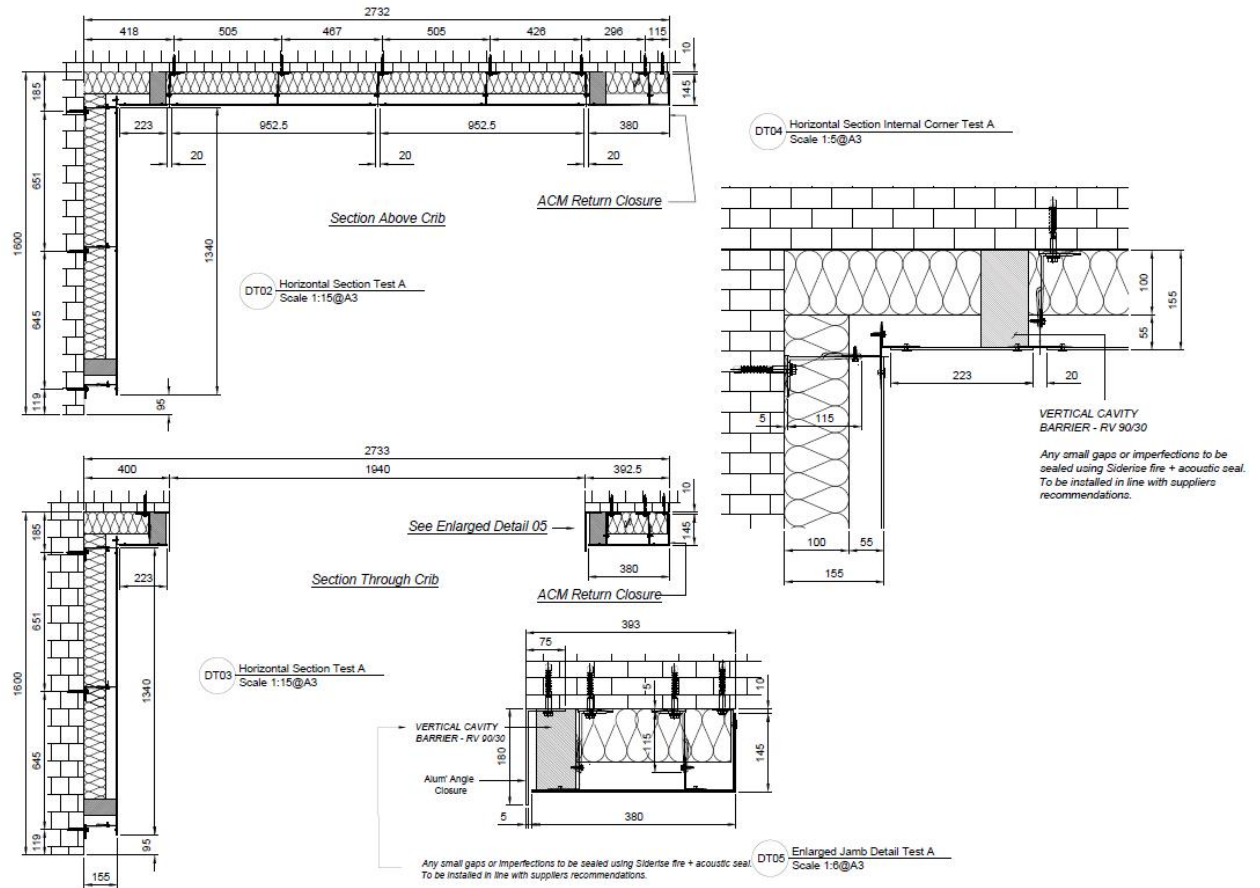


Figure 15. Horizontal section through and above the combustion chamber, and installation details for the system (supplied by the Test Sponsor).

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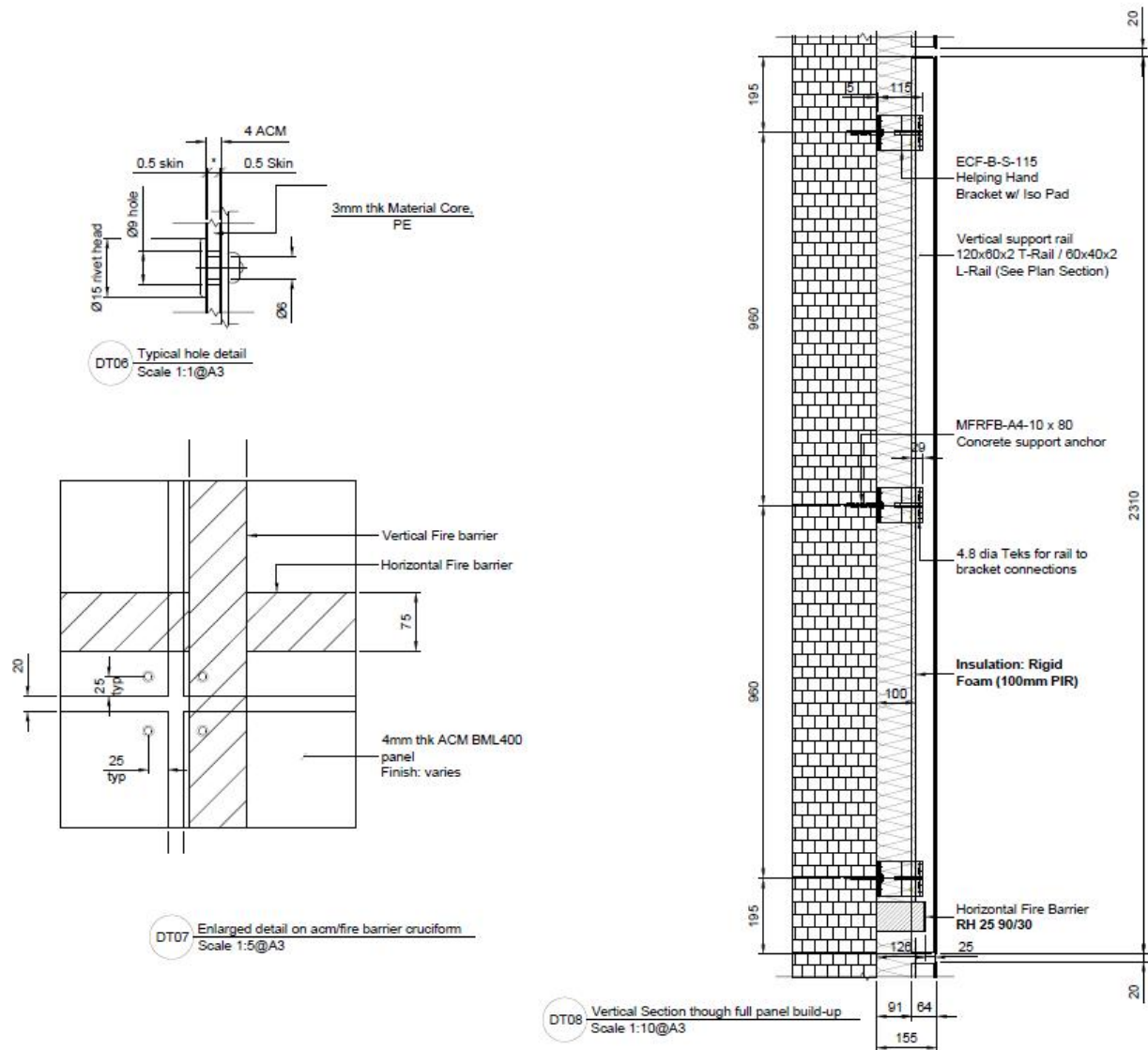


Figure 16. Vertical section through the cladding system, ACM panel detail and vertical and horizontal fire barriers intersection (supplied by the Test Sponsor).



9.4 Temperature data

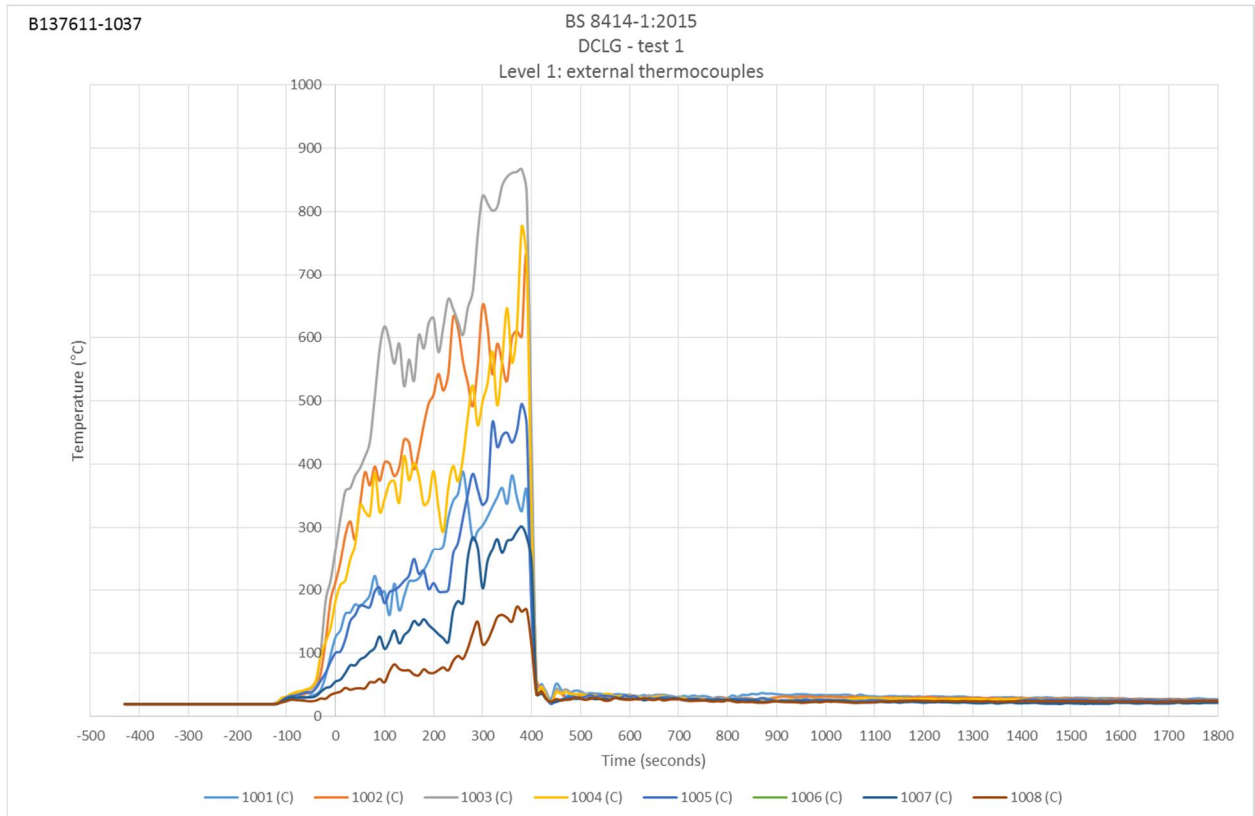


Figure 17. Level 1 external thermocouples.

$t_s=130s$ after ignition of the crib.

Note: Test terminated after 395s.

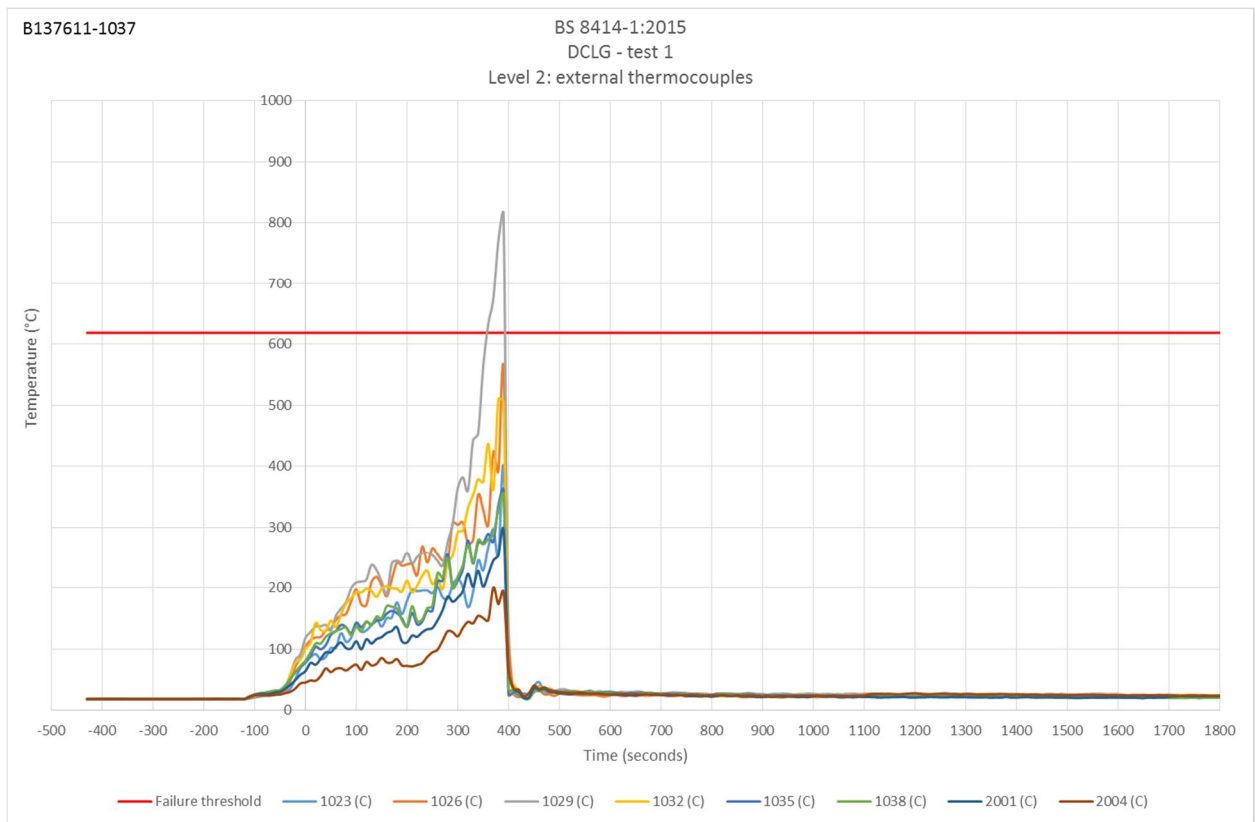


Figure 18. Level 2 external thermocouples.

$t_s=130s$ after ignition of the crib.

Note: Test terminated after 395s.

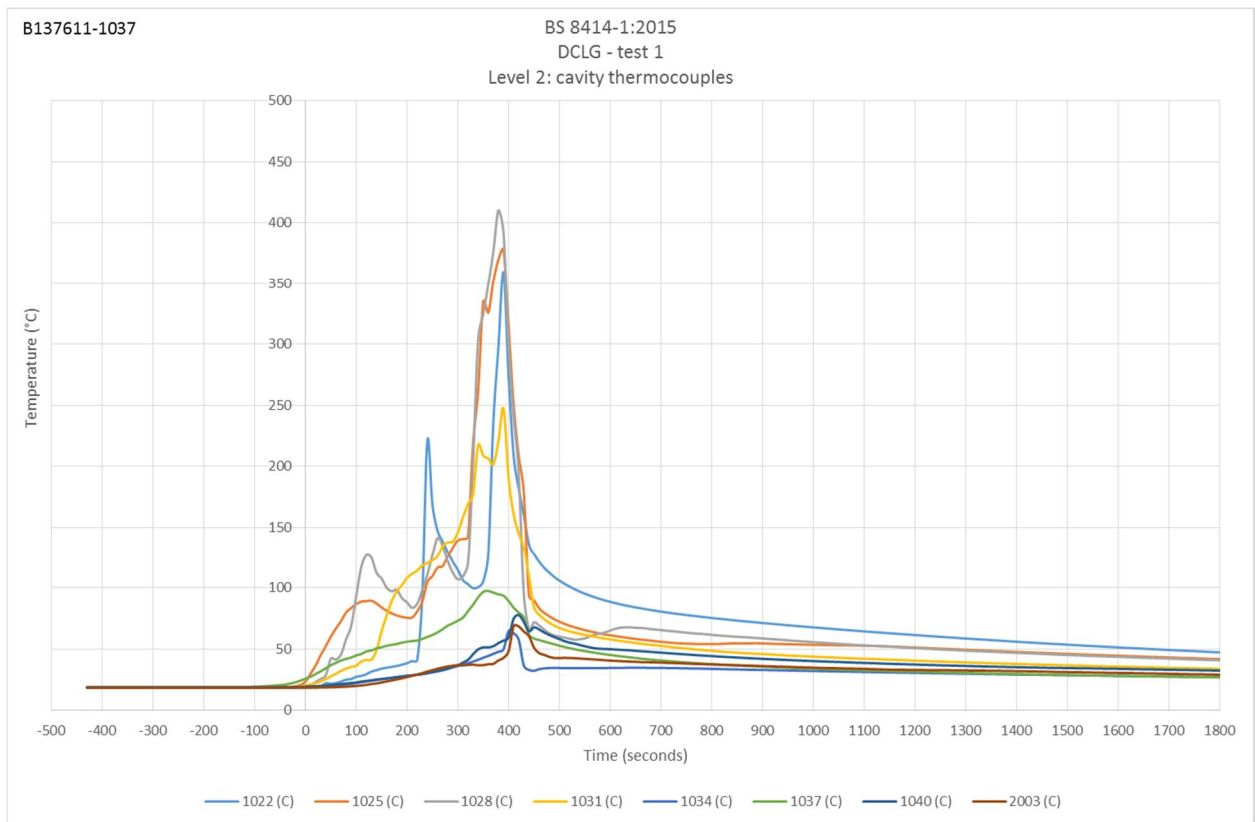


Figure 19. Level 2 cavity thermocouples.

$t_s=130s$ after ignition of the crib.

Note: Test terminated after 395s.

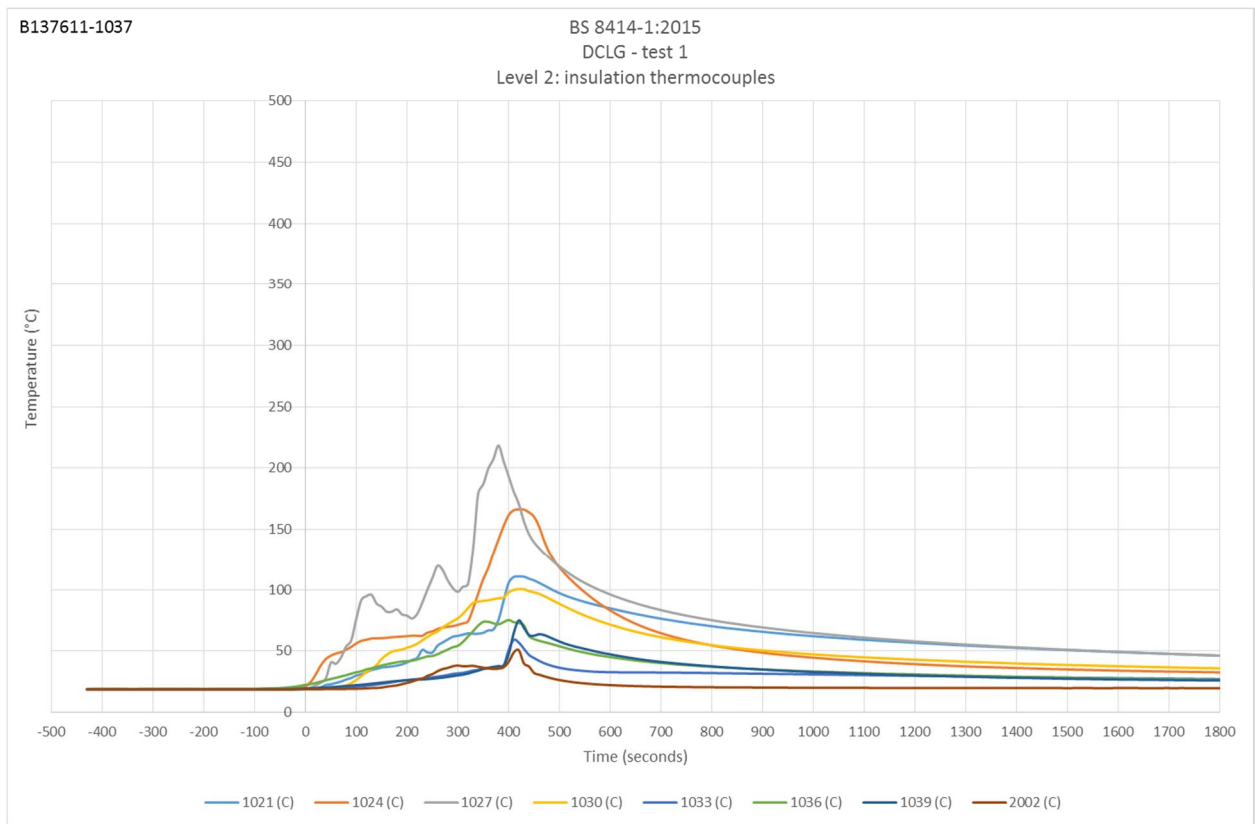


Figure 20. Level 2 insulation thermocouples.

$t_s=130s$ after ignition of the crib.

Note: Test terminated after 395s.



9.5 Post-test photographs



Figure 21. Full height photograph of system soon after test termination.

Note: Test terminated after 395s.



Figure 22. First row ACM panels (directly above combustion chamber).



Figure 23. Second row ACM panels (approximately 2300mm-4600mm above combustion chamber).

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Figure 24. Zoomed view of discolouration on base of second row panels.



Figure 25. Zoomed of discolouration on base of third row panels.

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Figure 26. Rear side of panel 3C (approximately 4600mm above the top of the combustion chamber) showing re-solidified PE core material.



Figure 27. Full height photograph of system following removal of ACM panels.



Figure 28. Damage to cladding system beneath ACM panels directly above the combustion chamber.



Figure 29. Damage to cladding system beneath ACM panels between the second and third horizontal cavity barrier (approximately 2400-4700mm above combustion chamber).



Figure 30. Damage to cladding system beneath ACM panels between the third and fourth horizontal cavity barrier (approximately 4700-6360mm above the combustion chamber).

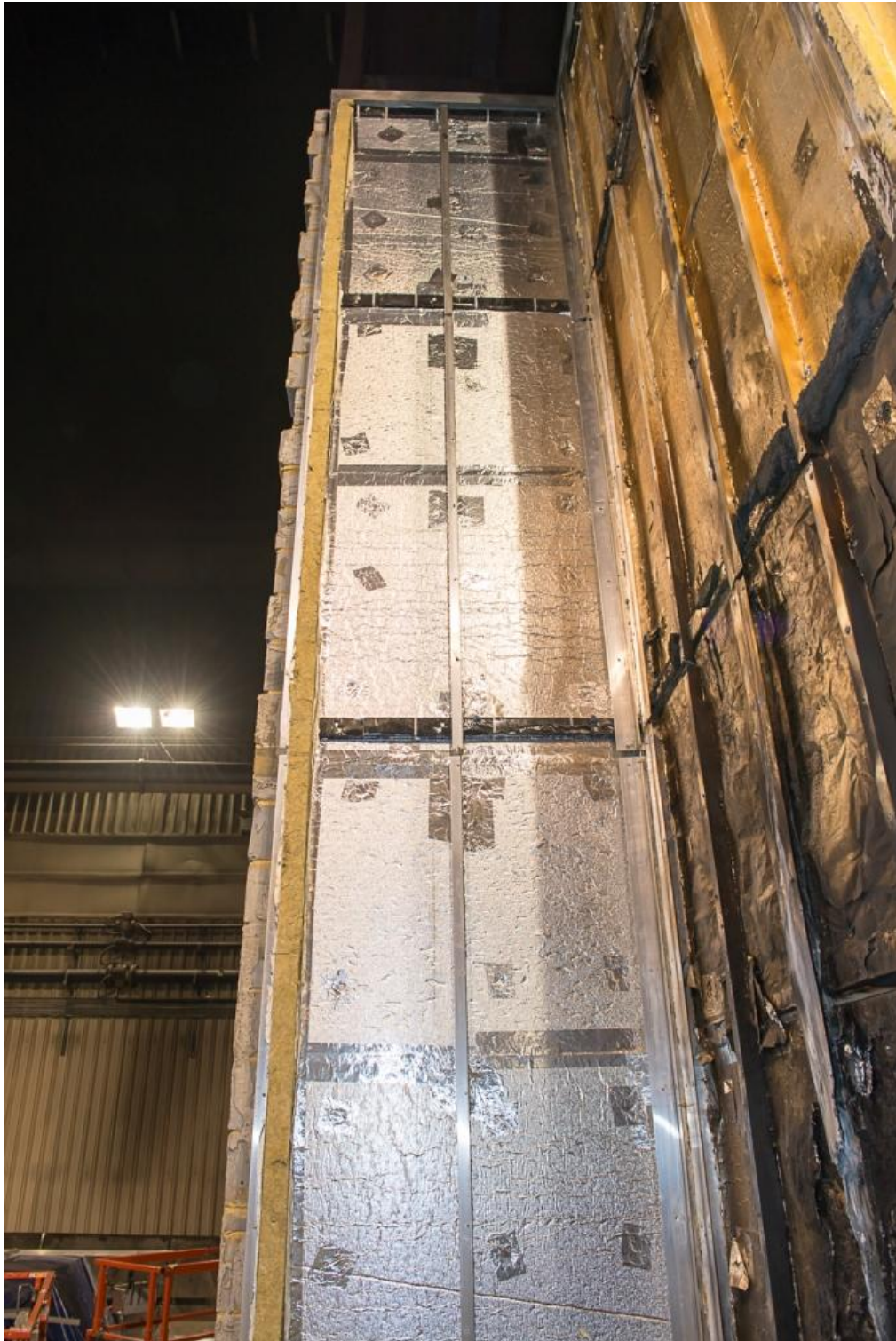


Figure 31. Post-test view of wing wall following removal of ACM panels.

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Figure 32. Zoomed view of partially activated horizontal cavity barrier at an approximate height of 2400mm above the combustion chamber, on the wing wall.



Appendix A – Material densities

Representative samples of the construction materials were taken during construction.

The free moisture content ($W_1 - W_2$) of the samples expressed as a percentage of the dried weights (W_2), and density (kg/m^3) are given in *Table 2*.

Table 2: Conditioning and material information.

Sample Material	Oven drying temperature	Moisture content by dry weight (%)	Density (kg/m^3)
PIR insulation	$105 \pm 5^\circ\text{C}$	2.4	31.2
Vertical cavity barrier	$105 \pm 5^\circ\text{C}$	0.4	80.3
Horizontal cavity barrier	$105 \pm 5^\circ\text{C}$	0.4	80.1



Appendix B – ACM panel screening test results

The screening test indicates whether the core or filler of the ACM panel used as part of the cladding system has properties which indicate flame retardant properties based on testing in BS EN ISO 1716:2010^[3]. As the purpose of this testing was to quickly and reliably screen the core material, the full procedures set out in the BS EN ISO 1716:2010 (“*Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value)*”) test standard have not been followed as they are unnecessary to confirm which type of panel has been used. These results should therefore be considered to provide a high degree of certainty as to the type of panel screened.

The result indicates the performance achieved for the core in terms of a category

- **Category 1** means that the result is in line with the requirements for a material of limited combustibility (Calorific potential ≤ 3 MJ/kg)
- **Category 2** means that the result does not achieve the requirements of category 1 but that it does have some limited flame retardant properties (Calorific potential > 3 MJ/kg and ≤ 35 MJ/kg)
- **Category 3** means that the result does not achieve the requirements of Category 1 or 2 and that it has no flame retardant properties (Calorific potential > 35 MJ/kg)

DCLG Advice - The Department’s view is that cladding material found to be in either Category 2 or Category 3 in the screening test would not meet the requirements for limited combustibility set out in Approved Document B guidance.

The samples were taken from aluminium composite material panels that were part of the cladding system tested and they had the following characteristics:

Overall dimensions (H×W mm)	Total thickness including Al facings (mm)	Code
2310×953	4.0	CT001-01 CT001-02 CT001-03

The ambient conditions in the testing room, prior to the test, were:

Ambient temperature (°C)	Relative humidity of the air (%)
23.2	45.8

Test results:

Test No.	Calorific value (MJ/kg)	Category	Standard deviation (%)
1	46.3149	CAT 3	0.03
2	46.3398	CAT 3	
3	46.3808	CAT 3	