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BRE Global Test Report

BS 8414-1:2015 + A1:2017 Test on aluminium hook-on cassette panel ventilated rainscreen system with Rockwool insulation.

Prepared for: d+b facades.

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1 Introduction

The test method, BS8414-1:2015+ A1:2017 [1] describes a method of assessing the behaviour of non-load bearing external cladding systems, rainscreen 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.

All materials and products used in the test were supplied and installed by the Test Sponsor. BRE Global were not involved in the sample selection process and therefore cannot comment upon the relationship between samples supplied for test and the samples supplied to market.

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

2 Test Details

Name of Laboratory:	BRE Global Ltd.
Laboratory Address:	Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX, UK.
Test reference:	P114006-1000
Date of test:	13th March 2019
Deviations:	None

3 Details of Test Apparatus

The product was installed on to wall number 3 of the BRE Global test facility. This apparatus is representative of the face of a building and consists of a masonry structure with a vertical main test wall and a vertical return wall at a 90º angle to and at one side of the main test wall - see *Figure 1*. The main wall includes the combustion chamber.

4 Description of the System

4.1 Summary

Generic cladding type	Ventilated rainscreen
Relevant test method	BS 8414-1:2015 + A1:2017
Substrate	Masonry
Insulation	Rockwool RWA45 insulation (120mm-thick)
Cavity depth	118.5mm (241.5mm system)
Vertical cavity barriers	Rockwool RW5 (100mm-wide×230mm-deep)
Horizontal cavity barriers	Rockwool RW5 (100mm-wide×195mmdeep)
External finish	Aluminium hook-on cassette panel (nominal panel size: 1685mm-high×1230mm-wide×3mm-thick)

4.2 Description of product

Table 1. List of component parts used in the construction of the system.

Item	Description
1	Aluminium brackets: A. 127mm-deep×67mm-wide×120mm-high×5.5mm-thick B. 117mm-deep×67mm-wide×120mm-high×5.5mm-thick
2	Aluminium rails with hook-on anchors (121mm-deep×55mm-wide×6.2mm-thick)
3	Galvanised steel skewer (300mm-long×30mm-wide×1.2mm-thick)
4	Rockwool RW5 (100mm-thick, cut to suit)
5	Rockwool RWA45 Insulation (1200mm-wide×600mm-high×120mm-thick)
6	Anti-rattle clip (28mm-high×18mm-deep×6mm-wide)
7	Aluminium hook-on cassette panel (nominal panel size: 1685mm-high×1230mm-wide×3mm-thick)

8	Aluminium 'L'-shaped combustion chamber surround flashing (200mm-deep×50mm-wide×3mm-thick)

4.2.1 Installation sequence

Holes were drilled into the masonry substrate, Hiliti HIT-HY 270 resins was injected into the holes and 110mm of the Ø12mm×150mm-long stainless-steel anchors/threaded rods were embedded. *See Figure 3.*

The system had four rows of aluminium brackets. Aluminium brackets (Item 1A) were fixed in two rows at nominal 2300mmin centres up to 3321mm from the ground. Aluminium brackets (Item 1B) were fixed in two rows at nominal 2300mmin centres, the first row was located 5411mm from ground. Both sets of brackets were fastened to the anchors/ threaded rods with M12 nuts with washers. *See Figure 4, 5 & 6.*

Aluminium rails with hook-on anchors (Item 2) were fixed to aluminium brackets (Item 1A) with Ø12mm×90mm-long M12 bolts and nuts. The aluminium rails were fixed to the aluminium brackets (Item 1B) with Ø8mm×90mm-long M8 bolts and nuts. *See Figure 7 & 8.*

Galvanised steel skewers (Item 3) were folded to 195mm-deep and fixed with Hilti DBZ 6/4.5×40mm-long wedge anchors at nominal 400mm horizontal centres in two rows located: 730mm and 4275mm above the combustion chamber on the main wall only.

Rockwool RW5 (Item 4) was cut to 195mm-deep and pressed onto the galvanised steel skewers (Item 3) as horizontal barriers to the two rows, intersected by the aluminium rails with hook-on anchors (Item 2). *See Figure 9.*

Galvanised steel skewers (Item 3) were folded to 195mm-deep and fixed with Hilti DBZ 6/4.5×40mm-long wedge anchors at nominal 400mm centres in one continuous column located at vertical left-hand side of the combustion chamber opening.

Rockwool RW5 (Item 4) was pressed onto the galvanised steel skewers (Item 3) as a vertical cavity barrier and was intersected by the horizontal cavity barriers. *See Figure 9.*

At the top and vertical right-hand side of the combustion chamber opening, galvanised steel skewers (Item 3) were folded to 195mm-deep and fixed with Hilti DBZ 6/4.5×40mm-long wedge anchors at nominal 400mm centres in line with the combustion chamber opening. Rockwool RW5 (Item 4) was cut to 230mm-deep and pressed onto to skewers as horizontal and vertical cavity barrier respectively. The Rockwool RW5 fixed directly above the combustion chamber extended from the vertical cavity barrier to edge of the system on the main wall.

Rockwool RWA45 Insulation (Item 5) was fixed as vertical slabs onto masonry substrate with four Hilti 250 IDP 10/12 plastic plugs (one at each corner) and two Hilti 150 IDMR 9/12 77846 metal plugs (towards the centre), per full slab. *See Figure 9.*

Anti-rattle clips (Item 6) were friction fitted to the hook-on slots of the aluminium hook-on cassette panels (Item 7) to restrict movement. *See Figure 10.*

Aluminium hook-on cassette panels (Item 7) were hooked onto the aluminium rails with hook-on anchors (Item 2). The panels were secured to the rails with Hilti S-MD 53 S Ø5.5×38mm-long self-drilling screws with Ø12mm washer at each corner of the panel. Panel gaps were approximately 20mm. *See Figure 11, 12 & 13.*

'L'-shaped combustion chamber surround flashings (Item 8) were fixed to the panels at the combustion chamber surround with Hilti S-MD 53 S Ø5.5×38mm-long self-drilling screws with Ø15mm washer at nominal 550mm centres.

The cladding system measured:

Requirement	Actual measurement
≥6000mm above the top of the combustion chamber	7006mm
≥2400mm width across the main wall	2425mm
≥1200mm width across the wing wall	1247mm
260mm (±100mm) wing wall-combustion chamber opening	193mm
2000mm×2000mm (±100mm) combustion chamber opening	1970mm-wide×2008mm-high

5 Test Results

5.1 Test conditions

Test Date: 13th March 2019

Ambient Temperature: 11°C

Wind speed: <0.1m/s (test undertaken indoors).

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

Thermocouple locations:

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

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

Level 2 – Midpoint of cavity.

Level 2 – Midpoint of insulation.

5.2 Temperature profiles

Figures 15-18 provide the temperature profiles recorded during the test. *Figures 12 & 13* show the system before the test.

Parameter	Result (whole test)	Result (t_s+15mins)
T_s, Start Temperature	11˚C	n/a
t_s, Start time	02:10 after ignition of crib.	n/a
Peak temperature / time at Level 2, External	467˚C (t_s+15:00).	467˚C (t_s+15:00).
Peak temperature / time at Level 2, Cavity	704˚C (t_s+23:20).	405˚C (t_s+15:00).
Peak temperature / time at Level 2, Insulation	54°C (t_s+39:50).	23°C (t_s+15:00).

5.3 Visual observations

Table 2. Visual Observations – Refer to *Figure 2* for system schematic. Height measurements are approximate and given relative to a zero at the top of the combustion chamber. Unless otherwise specified, observations refer to the centre line above the combustion chamber on the main wall.

Time* (mm:ss)	t_s (mm:ss)	Description
00:00		Ignition of crib.
00:30		Flame tips to top of crib.
01:30		Flame tips impinging on cladding system.
01:45		Flame tips to 1m.
02:10	00:00	Start time (t_s) criteria achieved: External temperature 2.5m above the top of the combustion chamber in excess of 211˚C (=200˚C+T_s).
02:15	00:05	Flame tips to 2m.
02:50	00:40	Flame tips to 3m.
03:45	01:35	Flame tips to 4m.
05:31	03:21	Flame tips to 5m.
07:46	05:36	Flame movement to wing wall.
08:30	06:20	Combustion chamber surround flashing distorted.
09:17	07:07	Aluminium droplets from panel 1B.
09:30	07:20	Detachment from top of combustion chamber surround.
10:22	08:12	Further aluminium droplets.
10:55	08:45	Surface flaming on panel 1B, panels melted up to panel 2B.
11:42	09:32	Detachment from top of combustion chamber surround.
12:22	10:12	Detachment from panel 0C.
13:35	11:25	Falling debris.
14:01	11:51	Further aluminium droplets from system.

Time* (mm:ss)	t_s (mm:ss)	Description
14:30	12:20	Smoke emitting from panel 0A
16:35	14:25	Further aluminium droplets from system.
20:00	17:50	Further aluminium droplets from system.
23:39	21:29	Partial crib collapse.
28:00	25:50	Panels melted to base of panel 3B.
30:00	27:50	Crib extinguished.
60:00	57:50	Test terminated.

*Time from point of ignition.

6 Post-Test Damage Report

6.1 Mechanical performance

Falling debris was observed between 9 minutes and 17 second to 20 minutes. Consumption to panels were observed till 28 minutes. There was no flaming debris, pool fire, system collapse or spalling.

There was no ongoing combustion following extinguish of timber crib.

6.2 System damage

6.2.1 Aluminium panels

With reference to *Figure 2,* the damage observed to the aluminium panels was as follows:

On the main wall the aluminium panels were consumed in an area approx. 1.5m-wide×4.1m-high in a triangular fashion (approx. 3.1m^2) that tapered from max width of the combustion chamber opening. The panels were distorted and discoloured up to the base of panels 4B & 4C. On the wing wall the panels were distorted and discoloured up to panel 3A. *See Figure 19.*

6.2.2 Combustion chamber flashing

The combustion chamber flashing on the top edge was consumed to approx. 1.7m-wide. The right-hand side flashing had a 400mm section consumed with the remaining section distorted and discoloured. The left-hand side was distorted and discoloured.

6.2.3 Stone wool insulation

On the main wall, the insulation was discoloured up to the top of the system. On the wing wall the insulation had sections discoloured along the main-wing wall junction up to the top of the system from above the combustion chamber opening. *See Figure 20 & 21.*

6.2.4 Horizontal & vertical cavity barriers

All horizontal cavity barriers were intact and discoloured to full width. *See Figure 22 & 23.*

The vertical cavity barrier located on the left-hand side of the combustion chamber opening was intact and discoloured to full-height. The vertical cavity barrier located on the right hand-side was intact and discoloured from mid-height to the top of barrier in line the combustion chamber opening. *See Figure 22 & 23.*

6.2.5 Aluminium rails & brackets

On the main wall, the central rail and brackets in line with the combustion chamber centre line, were consumed up 4300mm and discoloured up to 5200mm above the combustion chamber opening. The rail located at the outer edge of the main wall was distorted from 800mm to 4000mm and discoloured up to 4300mm above the combustion chamber opening. The rail located at the main-wing wall junction had patches of discolouration up to 4300mm above the combustion chamber opening.

On the wing wall, the rail and brackets located at the outer edge of the wall was intact with no visible damage.

See Figure 24 & 26.

7 Conclusion

BS8414-1:2015 + A1:2017 [1] does not contain acceptance criteria and therefore this test report does not indicate a pass or fail of the product.

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.

9 Figures

9.1 Dimensions of test apparatus

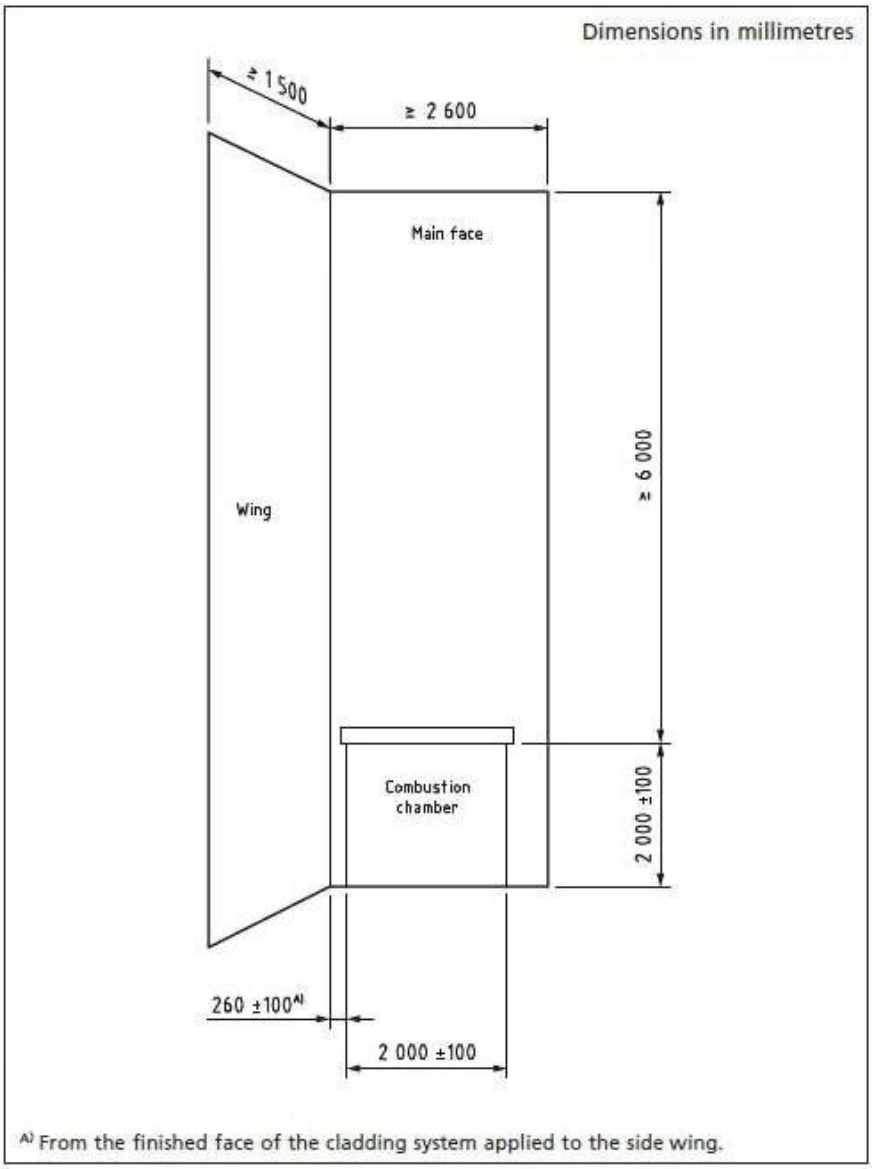

Figure 1. Test apparatus dimensions as specified by test Standard[1].

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

9.2 Diagrams of finished face of the cladding system

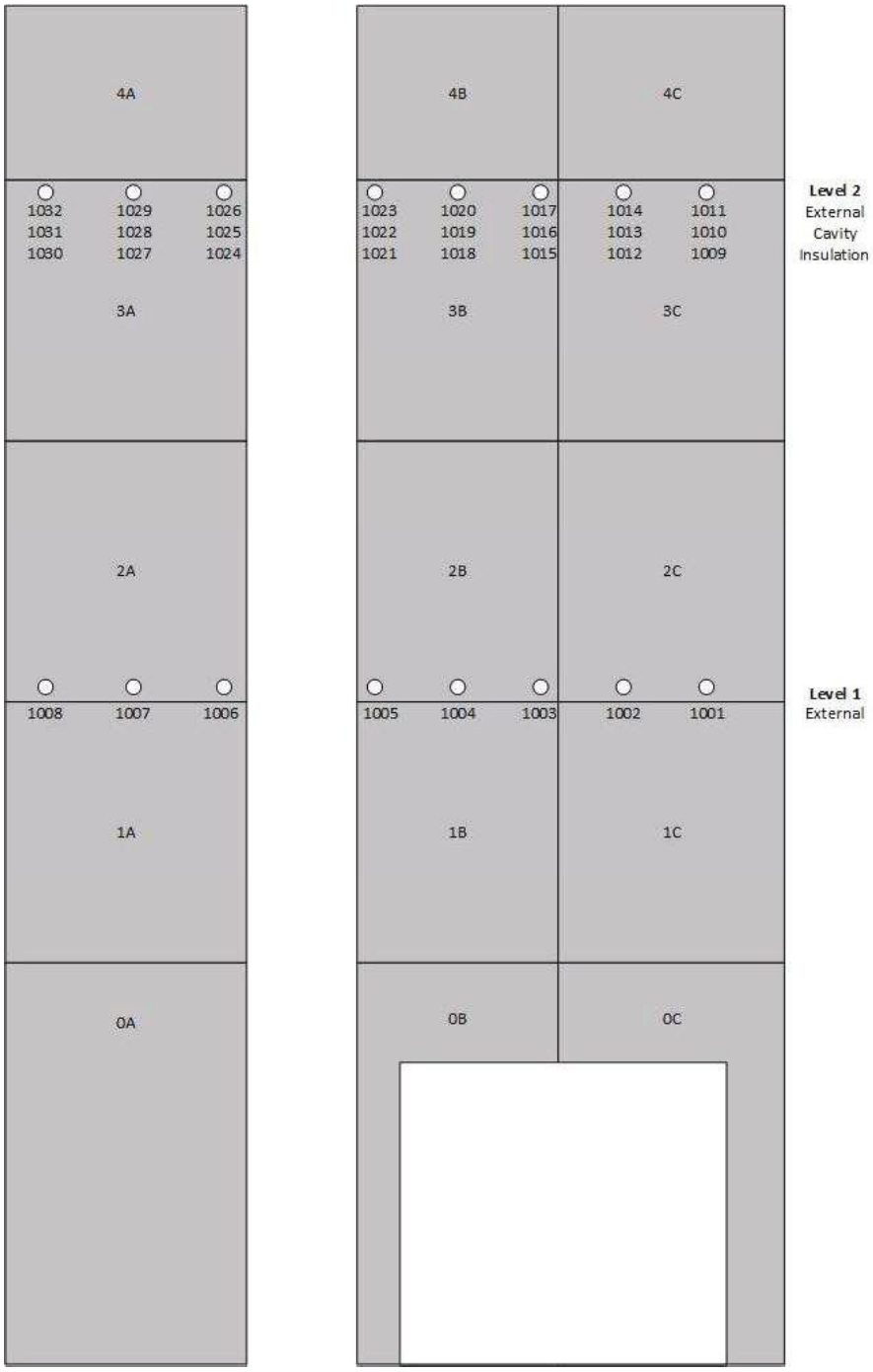

Figure 2. Layout of panels, TC positions and panel numbering used for reporting (0A – 4C). Not to scale.

Figure 5. Installation of the aluminium brackets up to mid-height.

Figure 6. Installation of the aluminium brackets up to top of system.

Figure 7. Installation of the aluminium rails up to mid-height.

Figure 8. Installation of the aluminium rails up to top of system.

Figure 9. Installation of the insulation, horizontal and vertical cavity barriers.

Figure 12. Photographs of completed build prior to test up to mid-height.

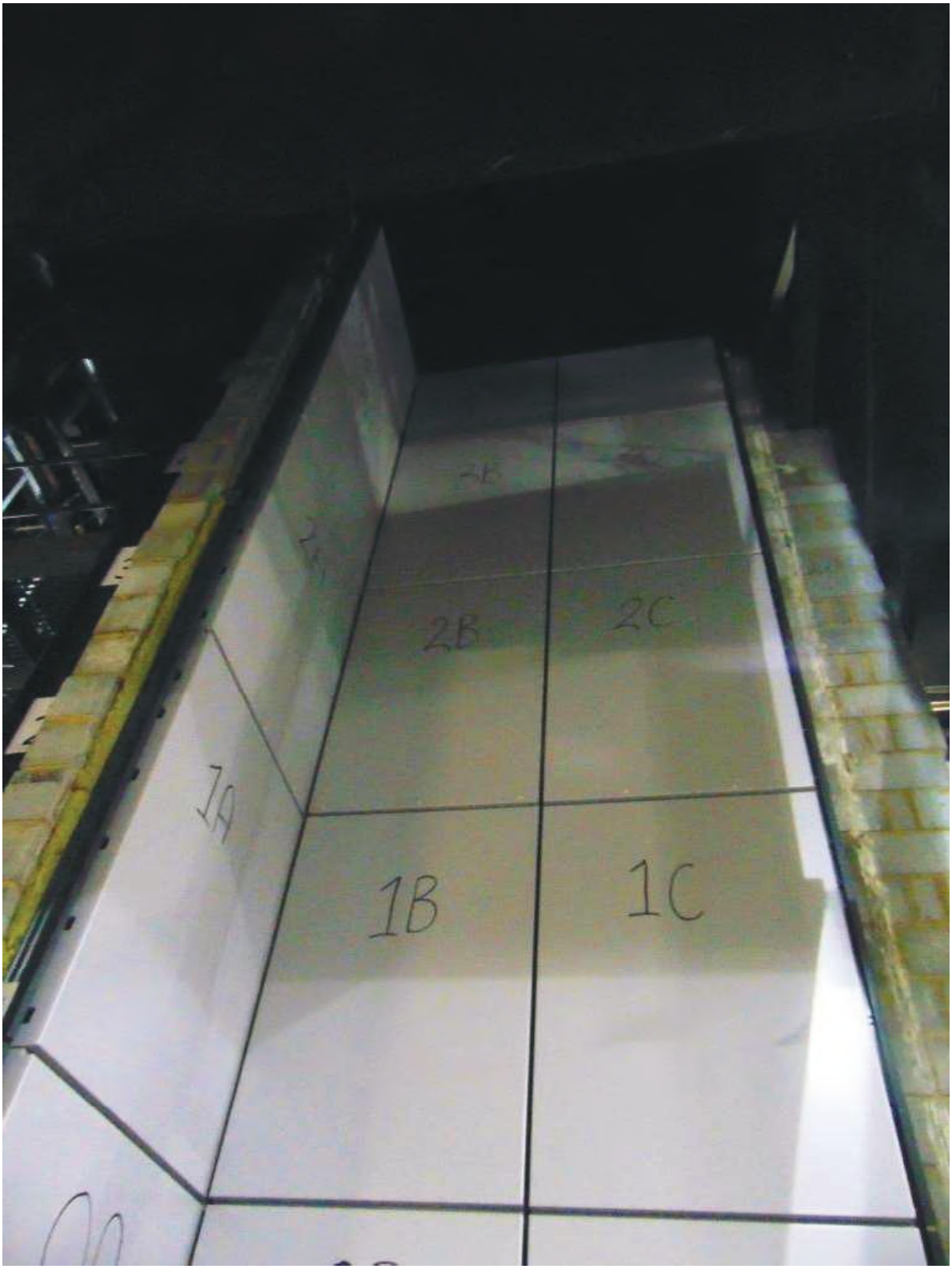

Figure 13. Photograph of completed build prior to test up to top of system.

9.4 System drawings

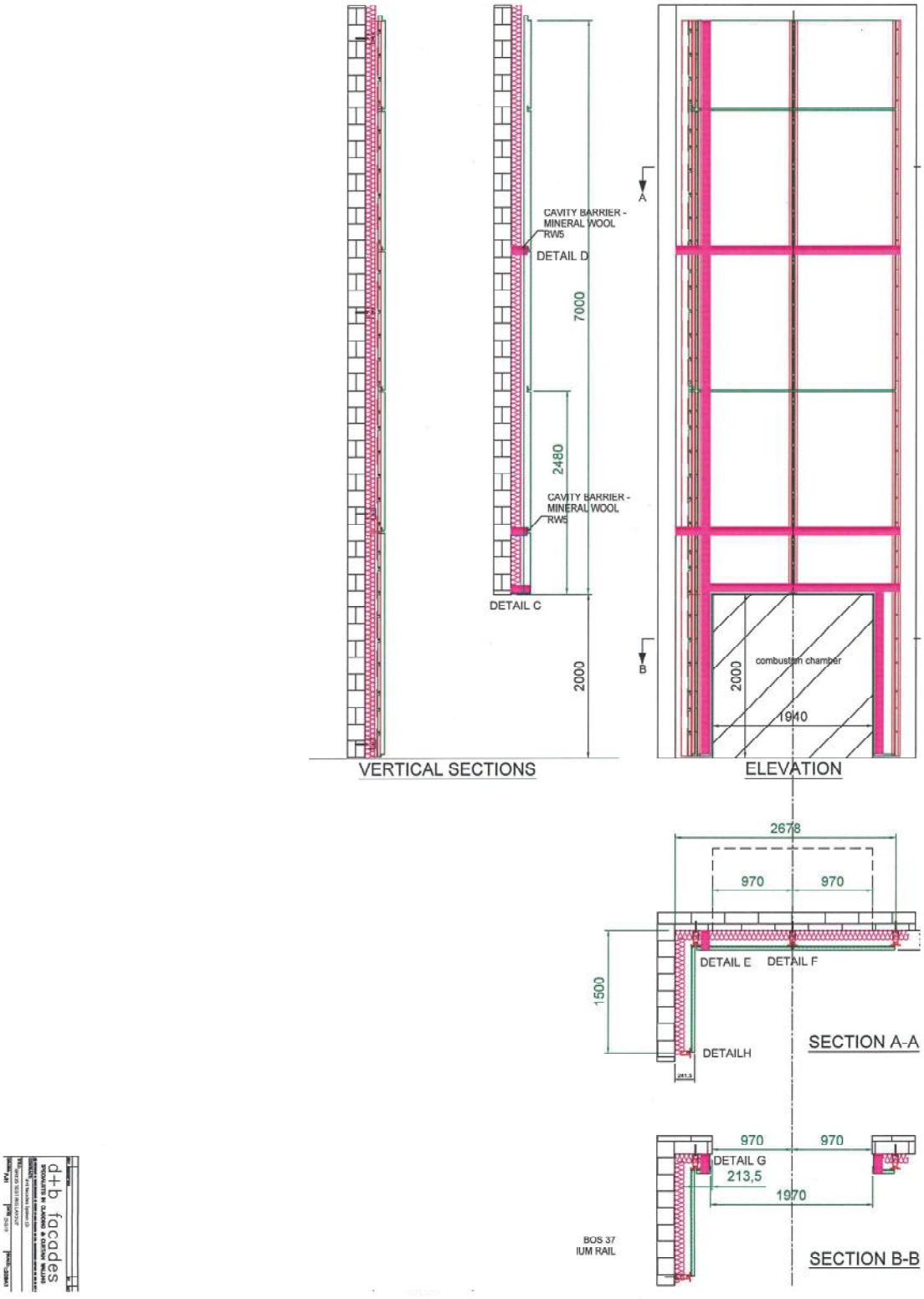

Figure 14. System overview (supplied by Test Sponsor).

9.5 Temperature data

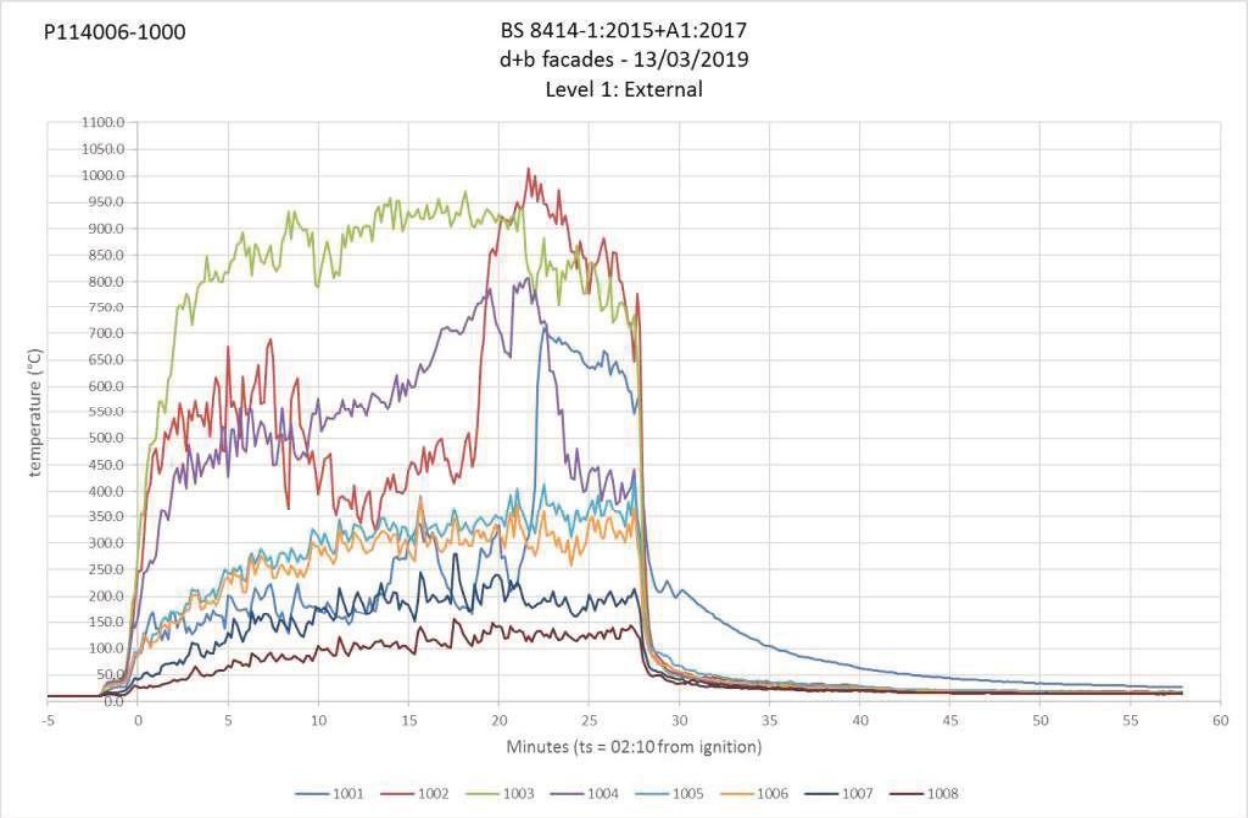

Figure 15. Level 1 external thermocouples.

t_s= 2mins 10secs after ignition of the crib.

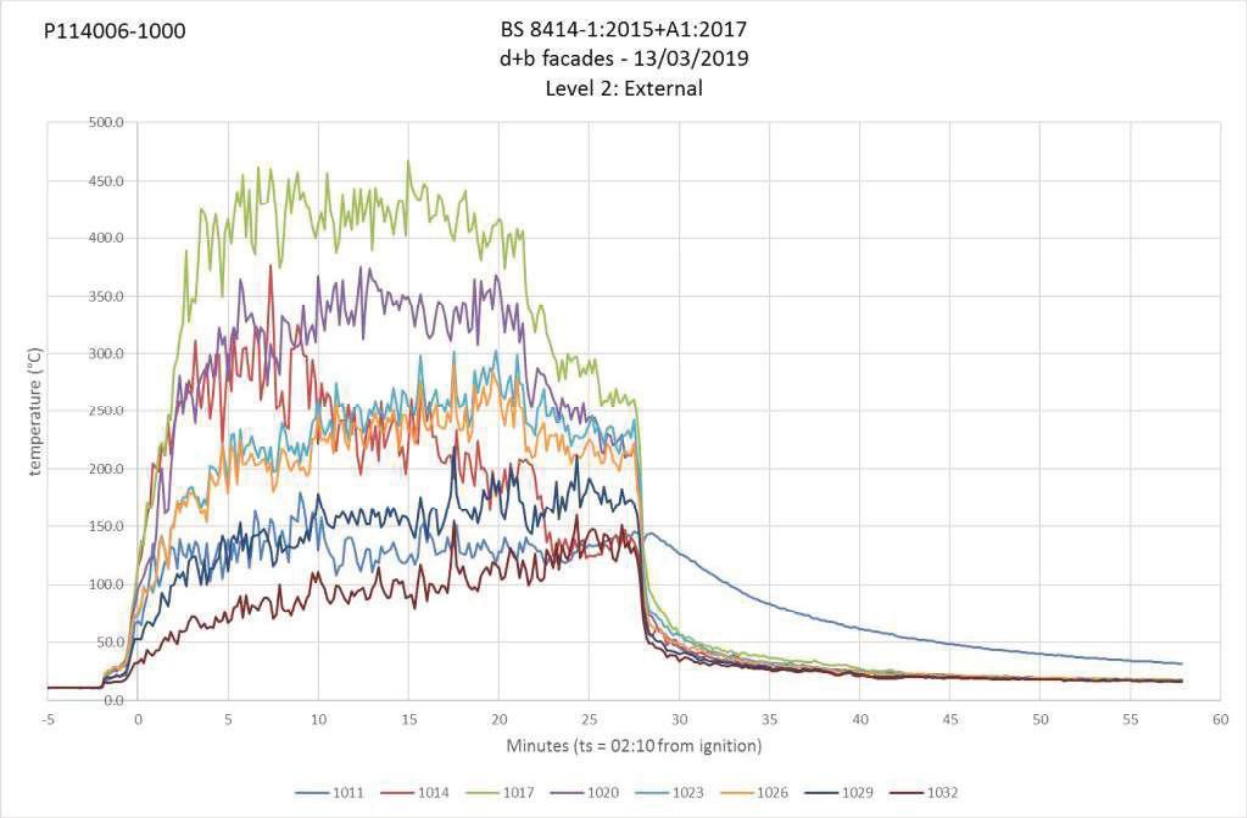

Figure 16. Level 2 external thermocouples.

t_s= 2mins 10secs after ignition of the crib.

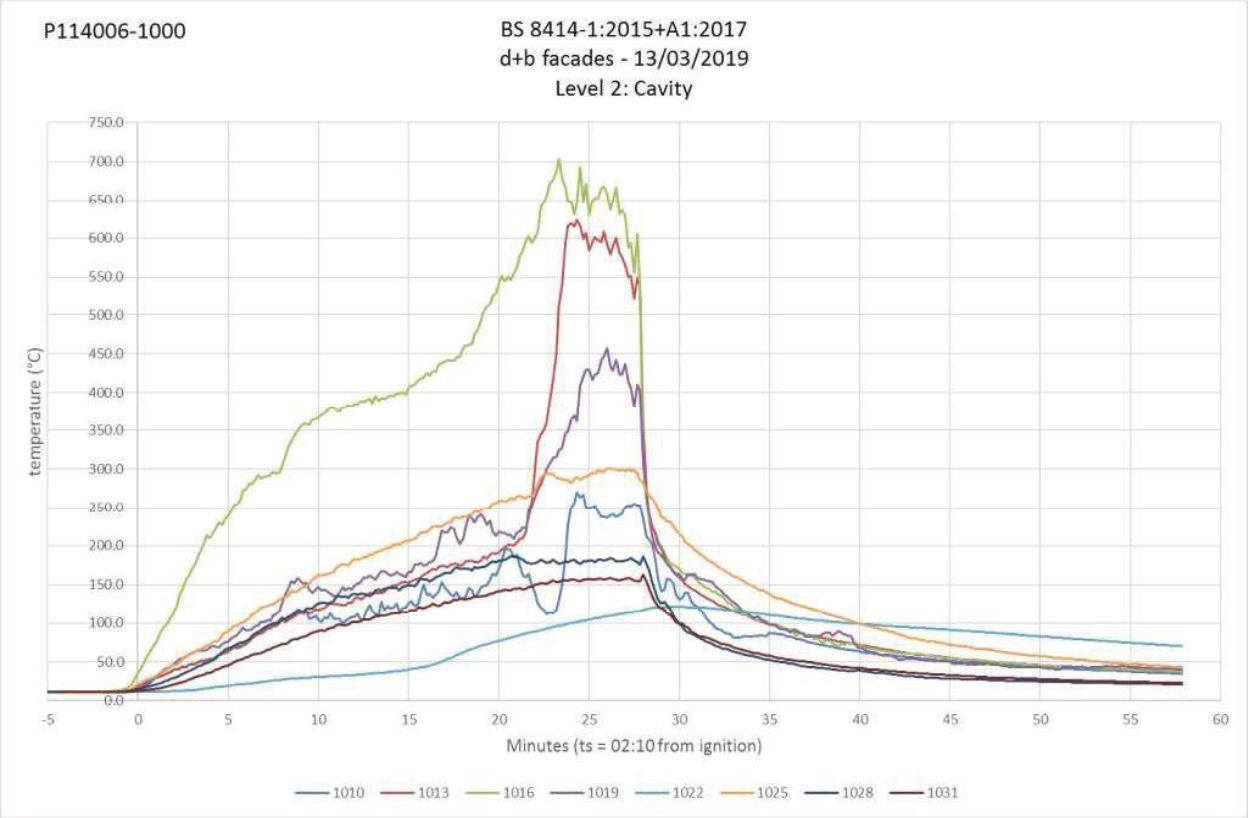

Figure 17. Level 2 insulation layer thermocouples.

t_s= 2mins 10secs after ignition of the crib.

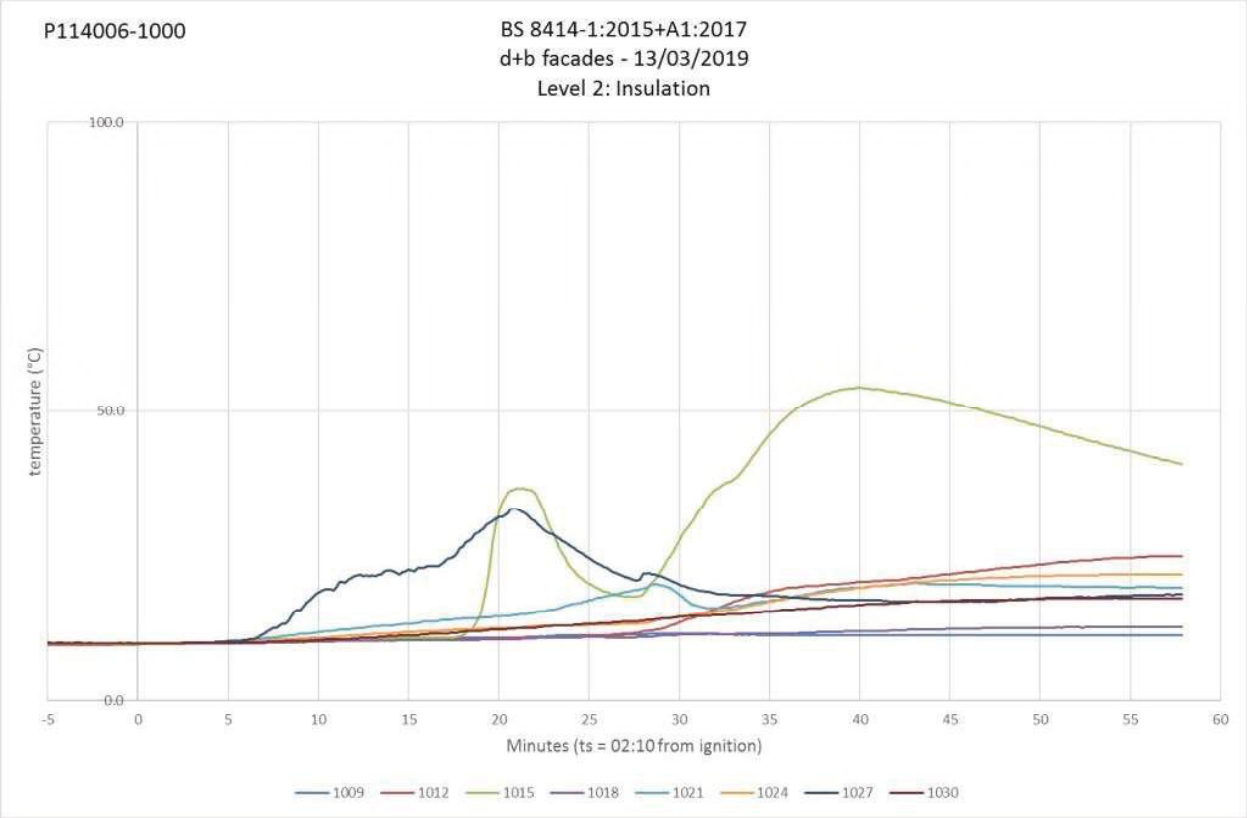

Figure 18. Level 2 plasterboard layer thermocouples.

t_s= 2mins 10secs after ignition of the crib.

9.6 Post-test photograph

Figure 19. Full-height photograph of cladding system immediately after test.

Figure 20. Full-height photograph of the insulation.

Figure 21. Close up of insulation.

Figure 22. Full-height photograph of the horizontal and vertical cavity barriers.

Figure 23. Close up of the horizontal and vertical cavity barriers up to mid-height.

Figure 24. Photograph of the aluminium rails up to mid-height.

Figure 25. Photograph of the aluminium rails up to top of system.

Figure 26. Photograph of the aluminium brackets.

Report Ends