

BRE Global Test Report

BS 8414-1:2015 + A1:2017 Test on Eternit Equitone Natura panel ventilated rainscreen system with Kingspan K15 insulation.

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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:	P114679-1000
Date of test:	6 th June 2019
Method:	The test was carried out in accordance with BS 8414-1:2015 + A1:2017
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 90° 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	Kingspan K15 insulation (60mm-thick) Batch nr: 8100325903
Cavity depth	40mm
Vertical cavity barriers	Siderise RVG-090/030/100-102 vertical cavity barrier (75mm-wide×110mm-deep)
Horizontal cavity barriers	Siderise RH25G-090/30/098-102 horizontal open state cavity barrier with intumescent strip (75mm-high×75mm-deep)
External finish	Eternit Equitone Natura panels (8mm-thick)

4.2 Description of product

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

Item	Description
1	Aluminium 'L'-shaped bracket with thermal pad A. Single - (80mm-deep×50mm-wide×75mm-high×2mm-thick) B. Double - (80mm-deep×50mm-wide×150mm-high×2mm-thick)
2	Aluminium combustion chamber surround pod (107mm-deep×50mm-wide×5mm-thick)
3	Siderise B65 galvanised skewer (225mm-long×25mm-wide×1mm-thick)
4	Siderise RVG-090/030/100-102 vertical cavity barrier (75mm-wide×110mm-deep)
5	Siderise RS350G galvanised skewer (cut to 180mm-long×25mm-wide×1mm-thick)
6	Siderise RH25G-090/30/098-102 horizontal open state cavity barrier with intumescent strip (75mm-high×75mm-deep)



7	Kingspan K15 insulation (60mm-thick) Batch nr: 8100325903
8	Aluminium rails A. 'L'-shaped (60mm-deep×40mm-wide×2mm-thick) B. 'T'-shaped (40mm-deep×125mm-wide×2mm-thick)
9	Foam tape (9mm-wide×6mm-thick compressible)
10	Eternit Equitone Natura panels (8mm-thick)
11	Aluminium horizontal panel joint flashing (50mm-high×1mm-thick with 6mm 'bird beak' profile at mid-height)
12	Aluminium capping (130mm-deep×85mm-high×3mm-thick)

4.2.1 Installation sequence

Aluminium 'L'-shaped brackets with thermal pad (Item 1A & 1B) were fixed to the substrate with EJOT T40/SW13 SDF-KB 10V×60 E screws with plastic anchors. The brackets were fixed in sequence of a single, double, single vertically. *See Figure 3.*

Aluminium combustion chamber surround pod (Item 2) was fixed flush to the combustion chamber surround, with EJOT T40/SW13 SDF-KB 10V×60 E screws with plastic anchors at 480mm centres. *See Figure 3.*

Siderise B65 galvanised skewers (Item 3) were folded to 90mm-deep and fixed at nominal 500mm vertical centres with TuffFast HTF-SS-6.3×57mm screws, in three columns located at: 385mm (main wall), 2485mm (main wall) and 1250mm (wing wall) all measured from the main-wing wall junctions.

Siderise RVG-090/030/100-102 vertical cavity barrier (Item 4) was pressed onto skewers in three columns. The barriers were sized to allow 10mm compression fit. Aluminium tape was applied to the joints. *See Figure 4.*

Siderise RS350G galvanised skewers (Item 5) were cut to 180mm-long and folded to protrude from the wall 85mm. The skewers were fixed at nominal 500mm horizontal centres with TuffFast HTF-SS-6.3×57mm screws in 4 rows located: 2065mm, 4390mm, 6695mm and 8430mm from ground.

Siderise RH25G-090/30/098-102 horizontal open state cavity barriers with intumescent strip (Item 6) were pressed onto the skewers in four rows and were bisected by the vertical cavity barriers. Aluminium tape was applied to the joints over the foil face. *See Figure 4.*

Kingspan K15 insulation (Item 7) were fixed as horizontal boards between the aluminium 'L'-shaped brackets leaving a 5-10mm gap between boards. The insulation was fixed with two EJOT DH Ø9mm plastic discs and EJOT DH Ø60mm insulation support anchor and one EJOT Ø75mm metal disc and DMH 8×110 V metal insulation plug at centre of board at nominal 500mm horizontal and 1100mm vertical centres. Aluminium tape was applied over the fixings. *See Figure 5.*

Aluminium rails (Item 8A & 8B) were fixed to the aluminium brackets on the main wall in an alternating fashion with two or four AX Ø4.8mm×19mm-long self-drilling screws, depending on the size of the brackets. On the wing wall only 'L'-shaped rails (Item 8A) were used. 'L'-shaped rails (Item 8A) were fixed either side of the combustion chamber surround pod with Mainline SSSS Ø4mm×18mm-long rivets at



nominal 500mm vertical centres. Aluminium tape was applied to the joint between the aluminium rails and Kingspan K15 insulation. *See Figure 6.*

Foam tape (Item 9) was applied to the vertical faces of the aluminium rails, in line with the panel locations. *See Figure 7.*

Eternit Equitone Natura panels (Item 10) were fixed to the aluminium rails with Mainline SSSS Ø4mm×18mm-long rivets at 345-440mm vertical and 500-600mm horizontal centres. Aluminium horizontal panel joint flashings (Item 11) were placed between horizontal panel gaps. Panel gaps were measured to be 9-12mm vertical and 5-7mm horizontal. *See Figure 8 & 9.*

Aluminium capping (Item 12) was fixed at the top of the system with EJOT T40/SW13 SDF-KB 10V×60 E screws with plastic anchors at 400mm horizontal centres. *See Figure 10.*

The cladding system measured:

Requirement	Actual measurement
≥6000mm above the top of the combustion chamber	6510mm
≥2400mm width across the main wall	2650mm
≥1200mm width across the wing wall	1258mm
260mm (±100mm) wing wall-combustion chamber opening	350mm
2000mm×2000mm (±100mm) combustion chamber opening	1945mm-wide×1995mm-high
Horizontal joint (if present) placed 2400 (±100mm) above combustion chamber opening	2325mm
Vertical joint (if present) located on centre line of combustion chamber (±100mm)	On the centre line



5 Test Results

5.1 Test conditions

Test Date: 6th June 2019

Ambient Temperature: 18°C

Wind speed: <0.1 m/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 14-17 provide the temperature profiles recorded during the test. Figure 9 shows the system before the test.

Parameter	Result (whole test)	Result (t_s+15 mins)
T_s , Start Temperature	18°C	n/a
t_s , Start time (mm:ss)	01:40 after ignition of crib.	n/a
Peak temperature / time at Level 2, External	600°C ($t_s+11:00$).	600°C ($t_s+11:00$).
Peak temperature / time at Level 2, Cavity	217°C ($t_s+25:10$).	163°C ($t_s+10:40$).
Peak temperature / time at Level 2, Insulation	170°C ($t_s+28:20$).	146°C ($t_s+10:50$).



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.
01:20		Flame tips impeding cladding system.
01:40	00:00	Start time (t _s) criteria achieved: External temperature 2.5m above the top of the combustion chamber in excess of 218°C (=200°C+T _s).
01:55	00:15	Flame tips to level 1 thermocouples.
02:50	01:10	Flame tips to mid-height of panels 2C & 2D.
03:40	03:00	Flame tips to level 2 thermocouples.
05:40	04:00	Consumption to combustion chamber surround top edge.
06:30	04:50	Flame tips to mid-height of panels 2C & 2D.
07:30	05:50	Distortion to combustion chamber surround top edge.
07:40	06:00	Flame tips to top of panels 2C & 2D.
08:20	06:40	Cracking to surface of panels 1C & 1D.
09:30	07:50	Further distortion to combustion chamber surround top edge.
10:00	08:20	Flame tips to the top of system.
11:10	09:30	Further cracking to surface of panels 1C & 1D.
11:40	10:00	Cracking to surface of panel 2D.
11:55	10:15	Falling debris.
12:35	10:55	Flame tips to the top of system.
13:00	11:20	Flaming debris.
13:40	12:00	Detachment of panel 1D.



Time* (mm:ss)	t _s (mm:ss)	Description
13:45	12:05	Detachment from panel 1C.
14:00	12:20	Further detachment from panel 1D.
14:15	12:35	Further detachment from panel 1C.
14:50	13:10	Further detachment from panel 1C.
15:00	13:20	Further detachment from panel 1C & 1D.
15:50	14:10	Detachment from panel 2C.
16:00	14:20	Flaming debris.
16:20	14:40	Flame tips to the mid-height of panels 3C & 3D.
16:25	14:45	Falling debris.
18:40	17:00	Falling debris.
19:20	17:40	Further detachment from panel 2C.
19:50	18:10	Falling debris.
20:00	18:20	Cracking to surface of panel 1A.
20:30	18:50	Falling debris.
20:50	19:10	Detachment of 2D.
21:35	19:55	Flaming to mid-height of panel 1A wing wall.
22:00	20:20	Falling debris.
22:40	21:00	Flaming to base of panel 2A wing wall.
23:00	21:20	Further flaming of panels 1A & 2A wing wall.
23:30	21:50	Detachment from panel 1A wing wall.
24:00	22:20	Flaming of panels 2A & 2B main-wing wall junction.
24:30	22:50	Falling debris.



Time* (mm:ss)	t _s (mm:ss)	Description
24:45	23:05	Further detachment from panel 1A wing wall.
25:25	23:45	Further detachment from panel 1A wing wall.
26:50	25:10	Falling debris.
28:15	26:35	Falling debris.
30:00	28:20	Crib extinguished.
30:20	28:40	Continued flaming of panels 0A & 1A wing wall.
31:00	29:20	Insulation glowing up to panels 2C & 2D. Flaming of panel 2D.
32:00	30:20	Flame flickering directly above combustion chamber right-hand side.
33:15	31:35	Flaming reduced on the main wall.
34:00	32:20	Continued flaming wing wall. Falling debris.
36:45	35:05	Further detachment from panel 2D.
37:20	35:40	Flaming reduced on wing wall.
39:00	37:20	Further detachment from panel 2D.
39:45	38:05	Detachment from panel 0A wing wall.
46:00	44:20	Flaming continued main and wing wall.
46:25	44:45	Further detachment from panel 1A wing wall.
46:50	45:10	Falling debris.
53:45	52:05	Flaming behind 0A, 1A and 1D.
60:00	58:20	Flaming at 1A. Glowing at the base of 2C. End of test.

*Time from point of ignition.



6 Post-Test Damage Report

6.1 Mechanical performance

Cracking of the surface of the panels was observed at 08:20 (mm:ss) until 20:00 (mm:ss). Falling debris was observed from 11:55 (mm:ss) until 46:50 (mm:ss). Flaming debris was observed from 13:00 (mm:ss) until 16:00 (mm:ss).

Following extinguishing of the ignition source ongoing system combustion was observed until 60 minutes.

6.2 System damage

6.2.1 Panels

With reference to *Figure 2 & 19*, panel damage was as follows:

On the main wall, the panels had fallen/burnt away exposing an area of approx. 1.2m-wide×3.9m-high (approx. 4.7m²) above the combustion chamber opening. The surfaces of the panels were cracked up to 4.6m and discoloured up to 5.5m above the combustion chamber opening.

On the wing wall, the panels had fallen/burnt away exposing an area of approx. 0.9m-wide×4.4m-high (approx. 4.0m²) from ground. The panels were discoloured up to approx. 3.5m-high covering the full width of the panels from ground with panels discoloured further along the main-wing wall up to approx. 6.6m.

See *Figure 18*.

6.2.2 Capping & combustion chamber surround pod

On the main wall, the capping was discoloured to full width. On the wing wall, the capping was discoloured on main-wing junction. See *Figure 19*.

The combustion chamber surround pod top edge was consumed approx. 1.5m-wide. The vertical edges were distorted and discoloured.

6.2.3 Aluminium rails

On the main wall, the rail in line with the combustion chamber centre line was consumed to 6.7 from ground. The rails either side of the centre rail were consumed up to 5m and 4.m respectively. All rails up to 7m from ground were distorted between both vertical cavity barriers. The rails were discoloured between both vertical cavity barriers up to the top of the system.

On the wing wall, the central rail had consumed sections up to 2.8m. The rails were distorted to 4.4m and discoloured to 7m from ground.

See *Figure 20*.



6.2.4 Insulation

On the main wall, the insulation had burnt/fallen away to approx. 2m-wide \times 6.7m-high from ground, in a tapering fashion reducing to 0.5m-wide. The insulation was discoloured between the combustion chamber opening to top of system, to a width of 2.5m measured from the main-wing wall junction.

On the wing wall, the insulation had burnt/fallen away to approx. 1.2m-wide \times 4.8m-high. The insulation was discoloured to the top of the system.

See Figure 21.

6.2.5 Horizontal cavity barriers

On the main wall, a 1m-wide section of horizontal cavity barrier had detached from the horizontal cavity barriers located at 2065mm and 4390mm from ground. The intumescent strip on the remaining sections and horizontal cavity barriers located at 6695mm and 8430mm from ground had activated.

On the wing wall, the horizontal cavity barriers located at 2065mm and 4390mm from ground were intact and activated. The horizontal cavity barriers located at 6695mm and 8430mm from ground had not fully activated.

See Figure 22

6.2.6 Vertical cavity barriers

On the main wall, both vertical cavity barriers were intact and discoloured up to approx. 7m from ground. On the wing wall, the vertical cavity barrier surface had detached sections up to approx. 4m and discoloured up to 5.5m from ground. *See Figure 22.*

6.2.7 Aluminium brackets

On the main wall, the three central columns of brackets were consumed in line with the combustion chamber opening to approx. 4m. The brackets were discoloured to of system, measured from the main-wing wall junction to 2.5m-wide.

On the wing wall, the column of brackets located at centre and the main-wing wall junction were consumed between 1m-2m from ground. The brackets were distorted up 4m

See Figure 23.



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

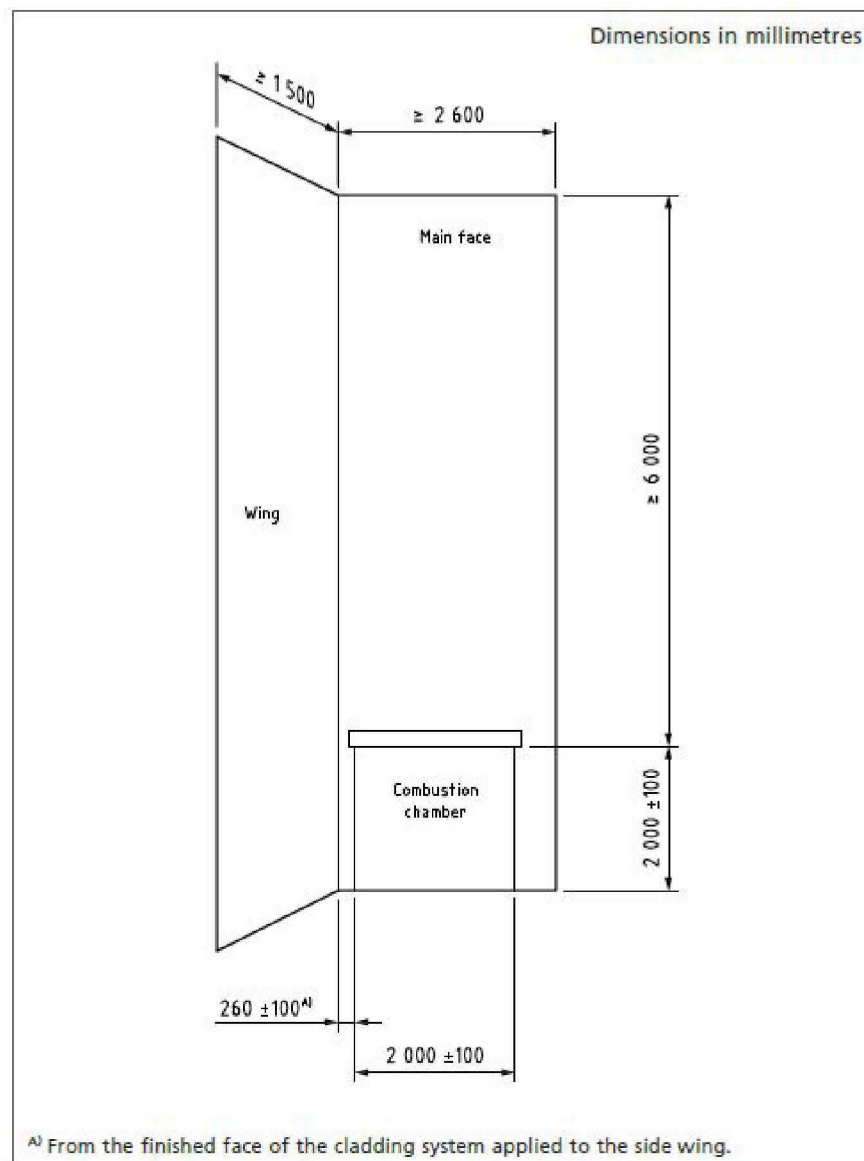


Figure 1. Test apparatus dimensions as specified by test Standard^[1].

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



9.2 Diagrams of finished face of the cladding system

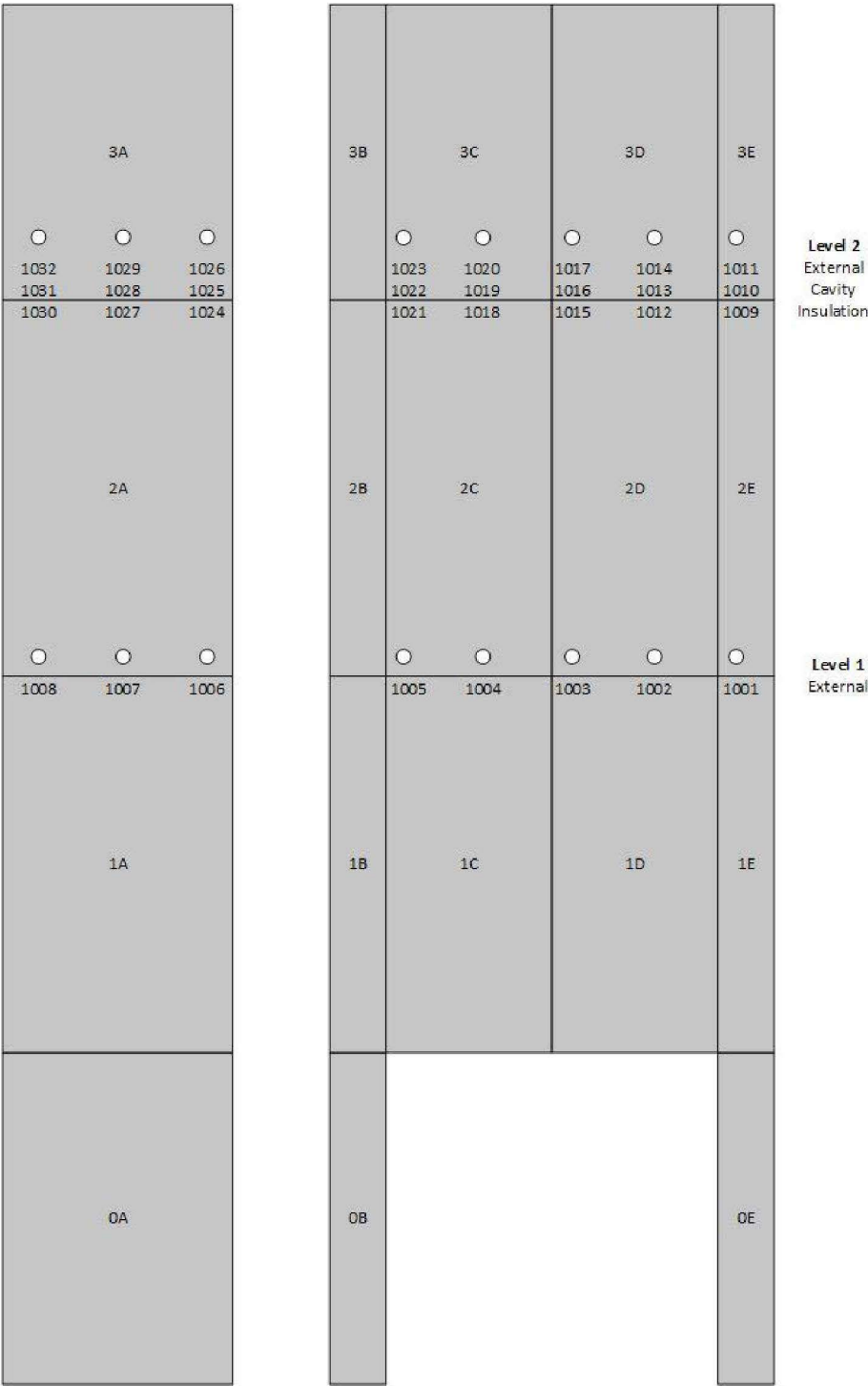


Figure 2. Layout of panels, TC positions and panel numbering (0A – 3E). Not to scale.



9.3 Installation photographs



Figure 3. Installation of 'L'-shaped brackets and combustion chamber surround pod.

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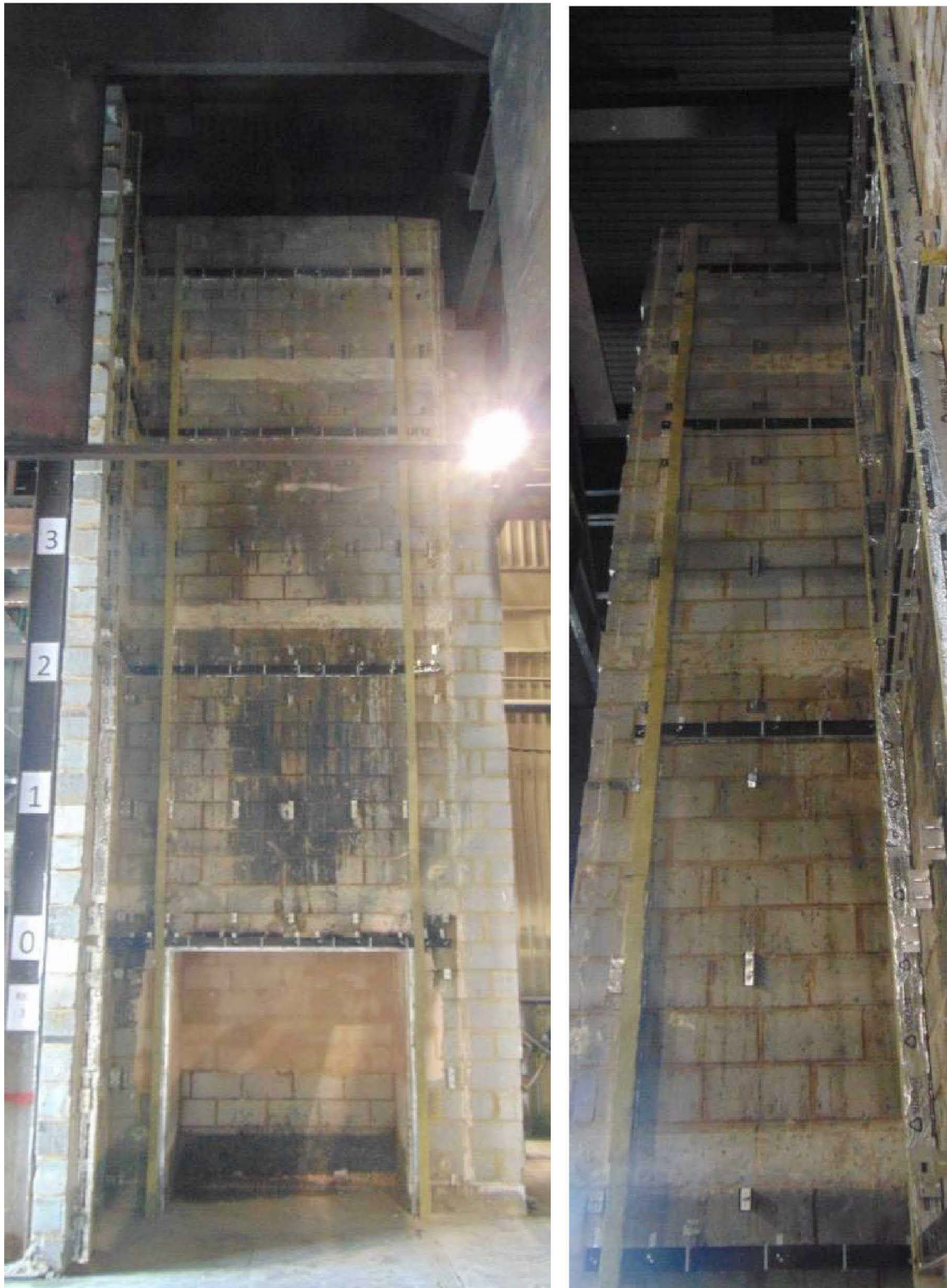


Figure 4. Installation of horizontal and vertical cavity barriers.

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Figure 5. Installation of insulation.

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Figure 6. Installation of 'L'-shaped rails.

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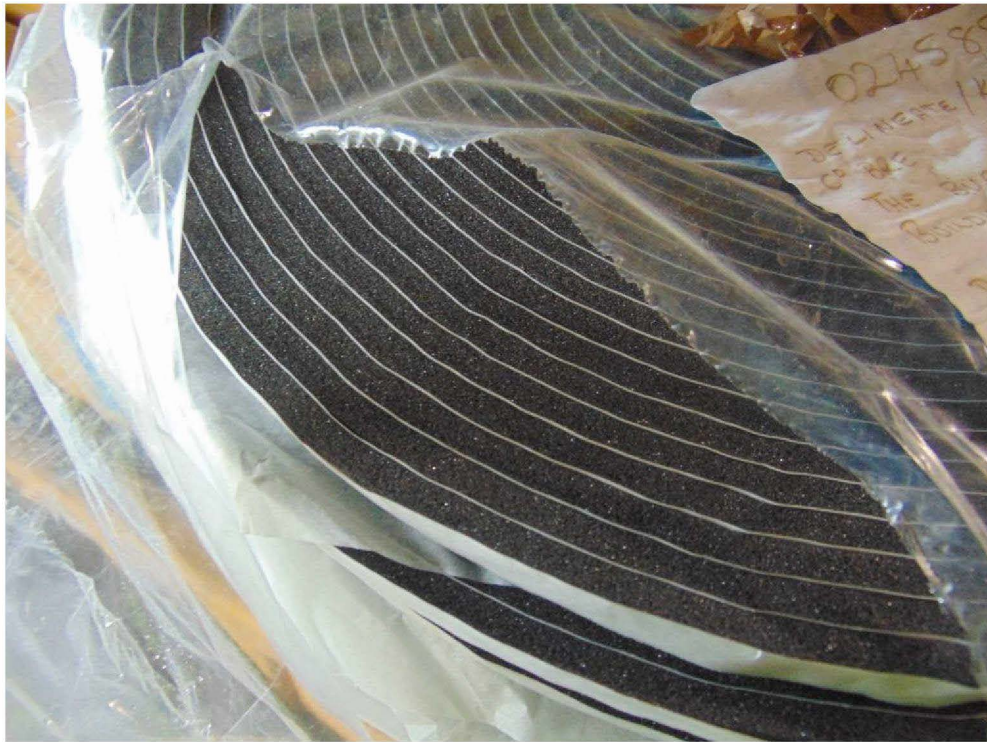


Figure 7. Foam tape installed on the rails.



Figure 8. Horizontal panel joint flashing.

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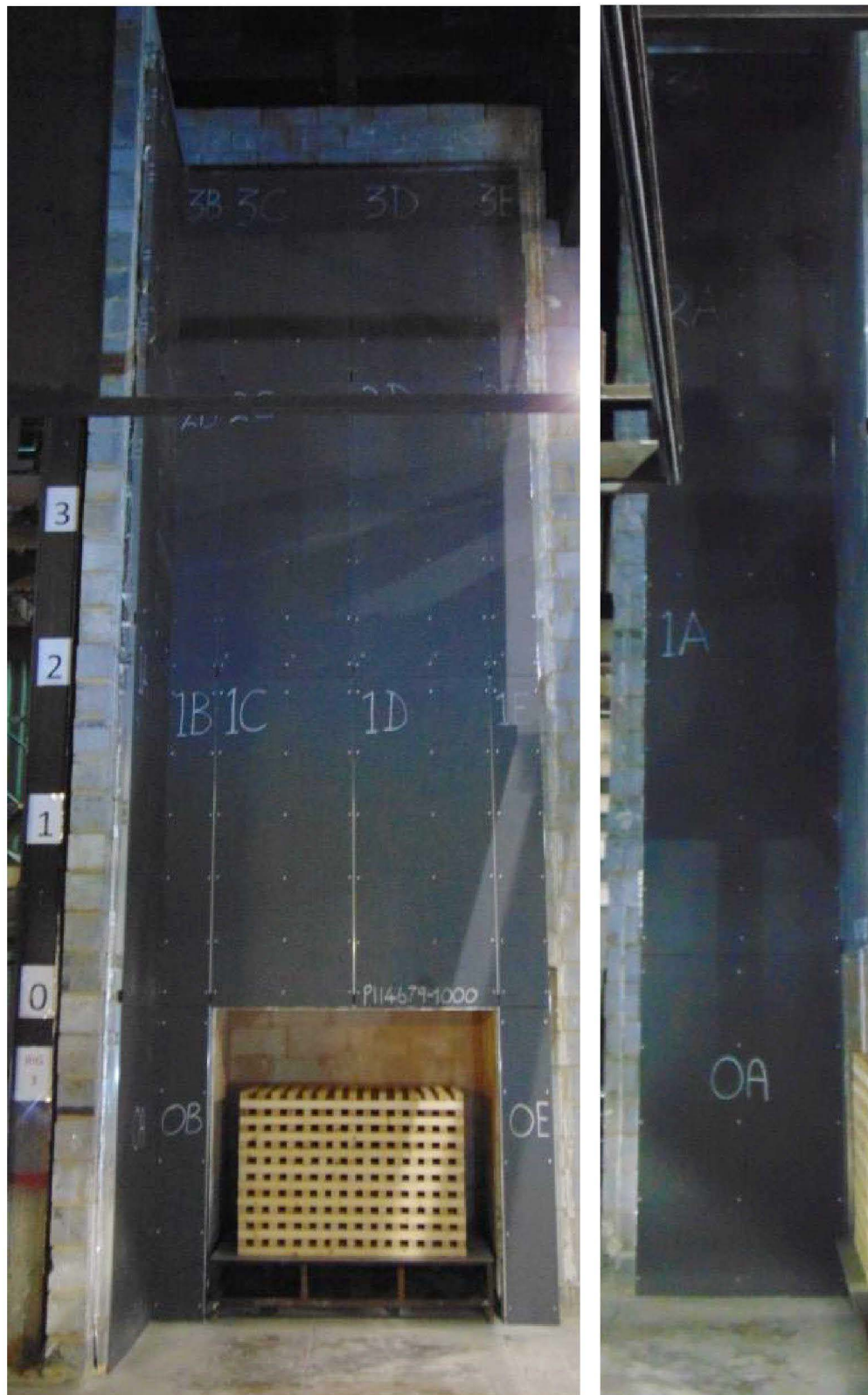


Figure 9. Completed installation prior to test.

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Figure 10. Close up of the capping.



9.4 System drawing

Product names and system drawings were supplied by the customer and were not independently verified by BRE. The validity of the results is conditional on the accuracy of the data.

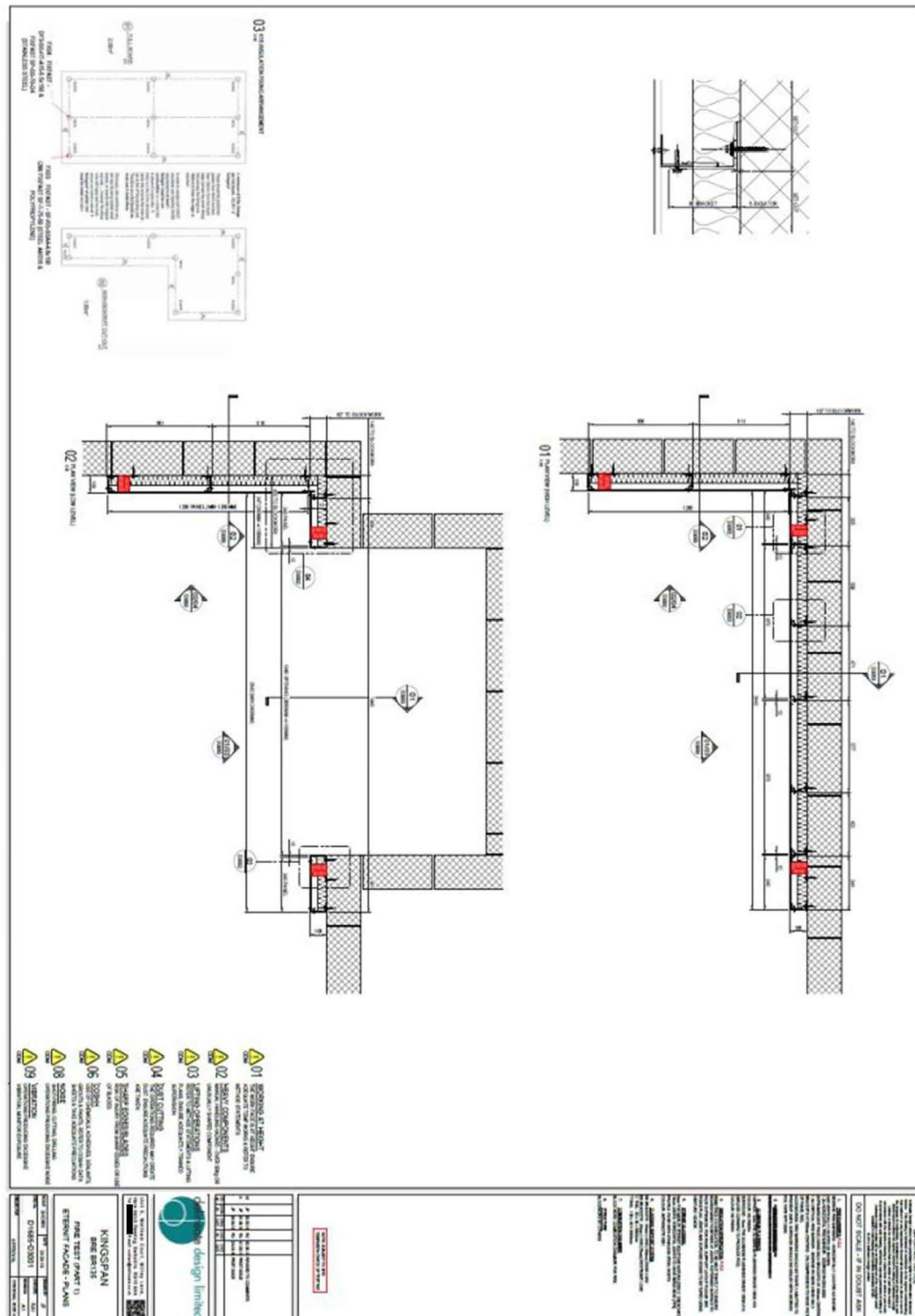


Figure 11. System plan view (supplied by Test Sponsor).

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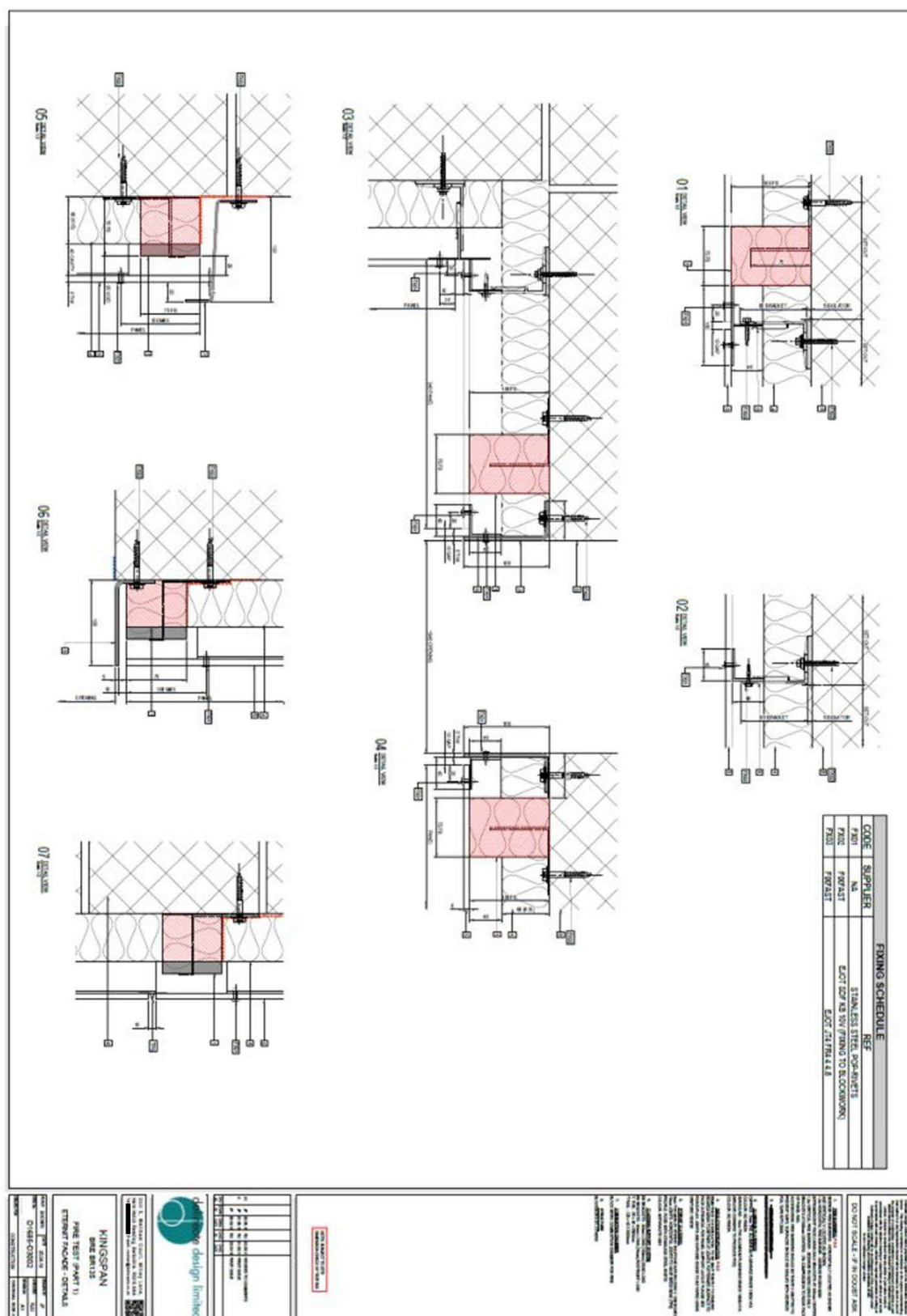


Figure 12. System details (supplied by Test Sponsor).

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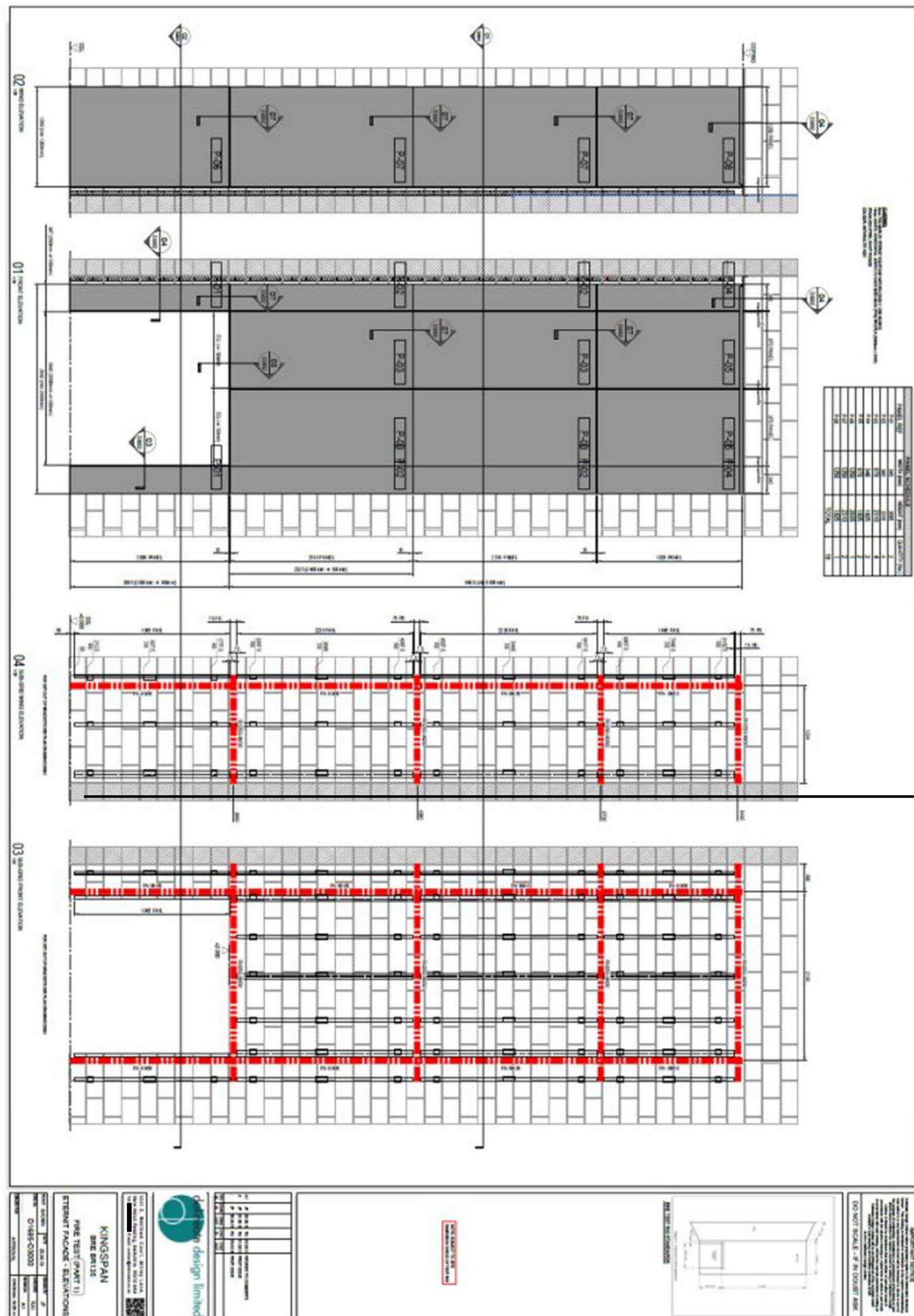


Figure 13 System overview (supplied by Test Sponsor).



9.5 Temperature data

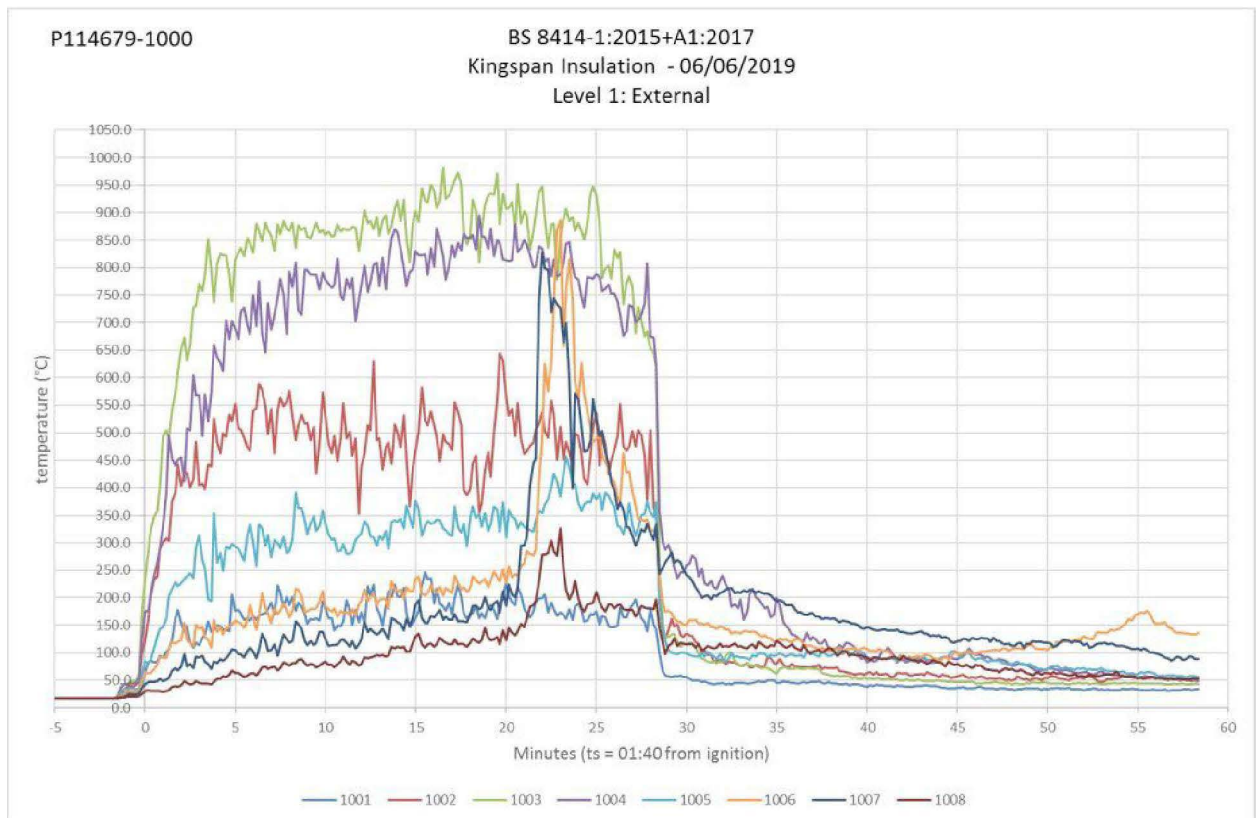


Figure 14. Level 1 external thermocouples.

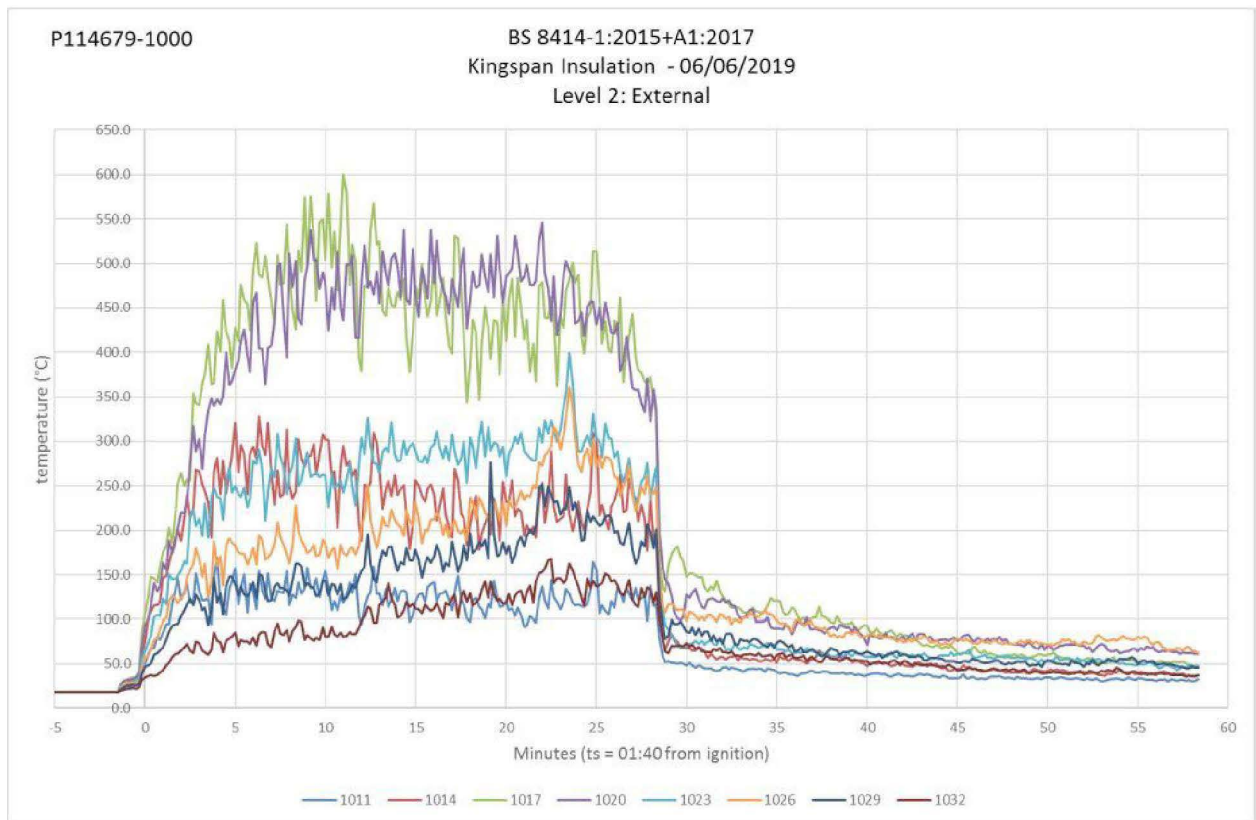


Figure 15. Level 2 external thermocouples.

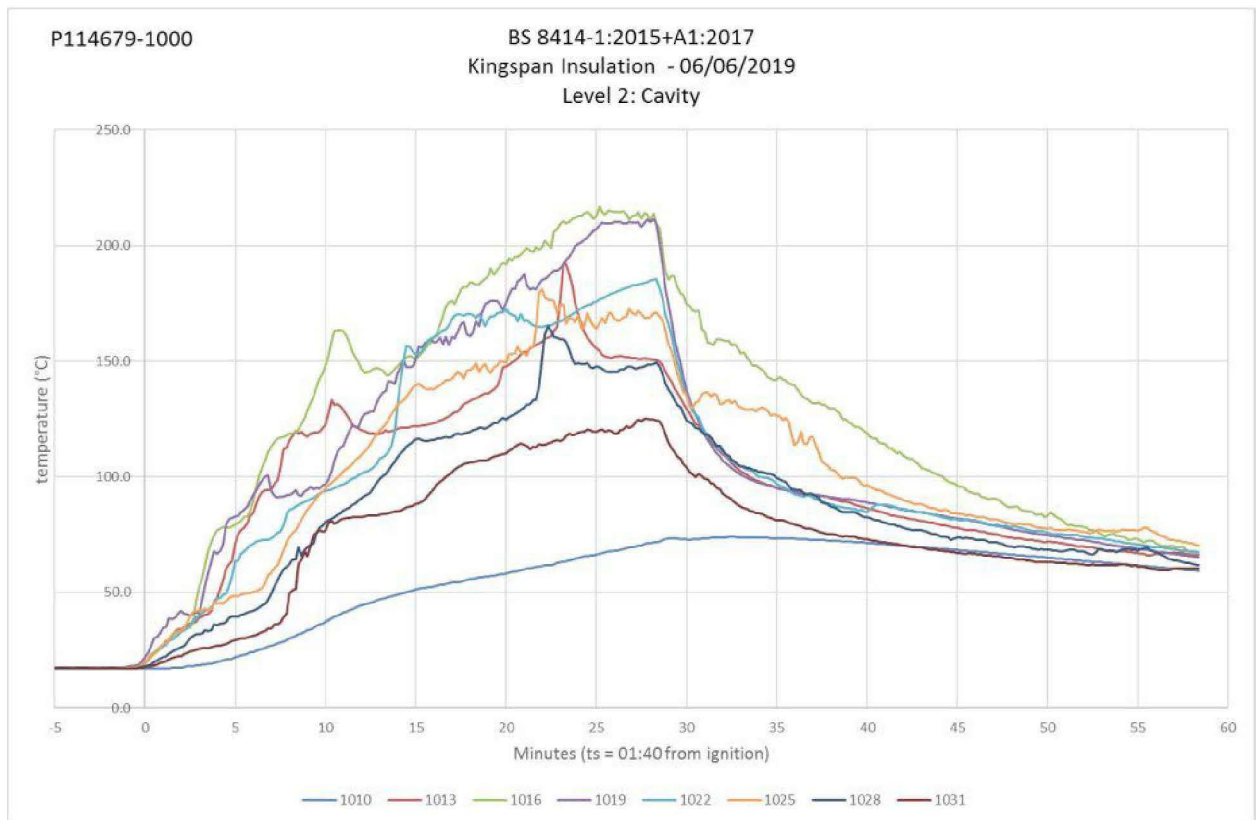


Figure 16. Level 2 cavity layer thermocouples.

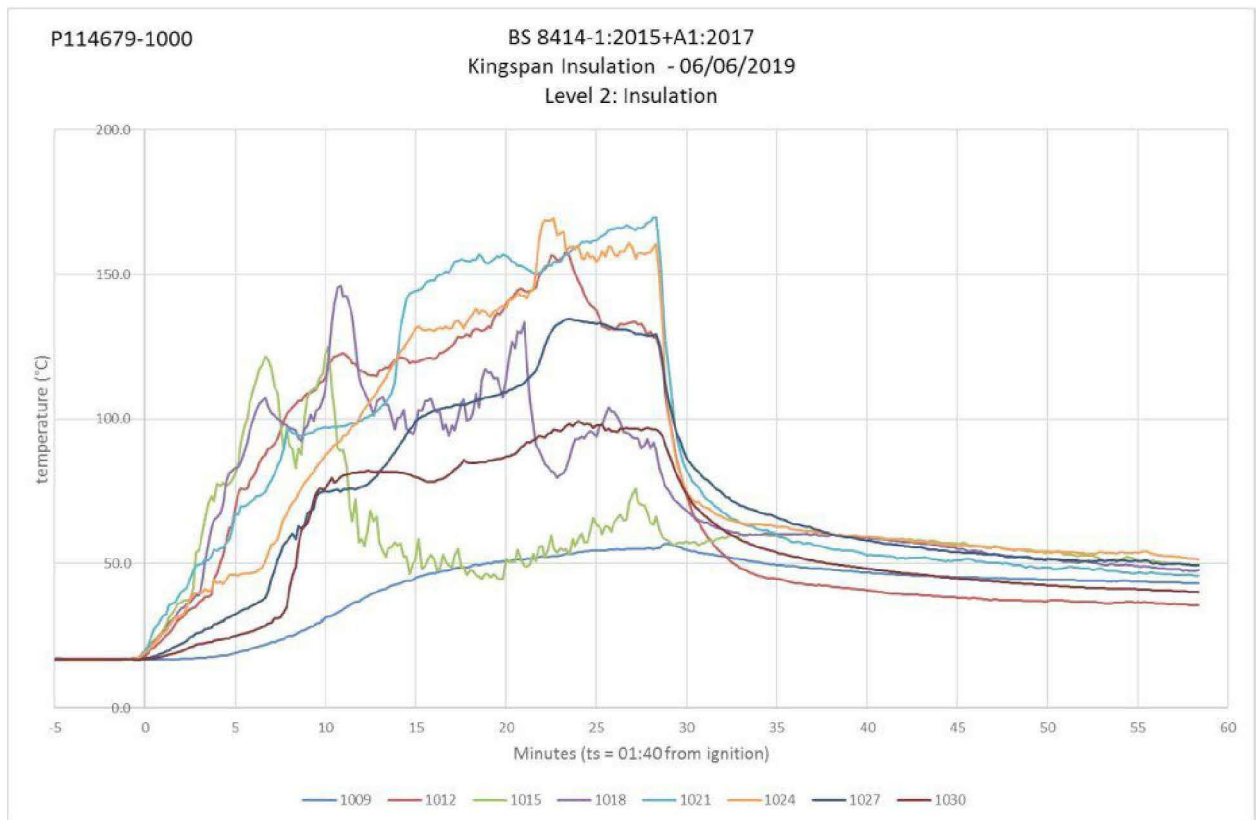


Figure 17. Level 2 insulation layer thermocouples.



9.6 Post-test photographs

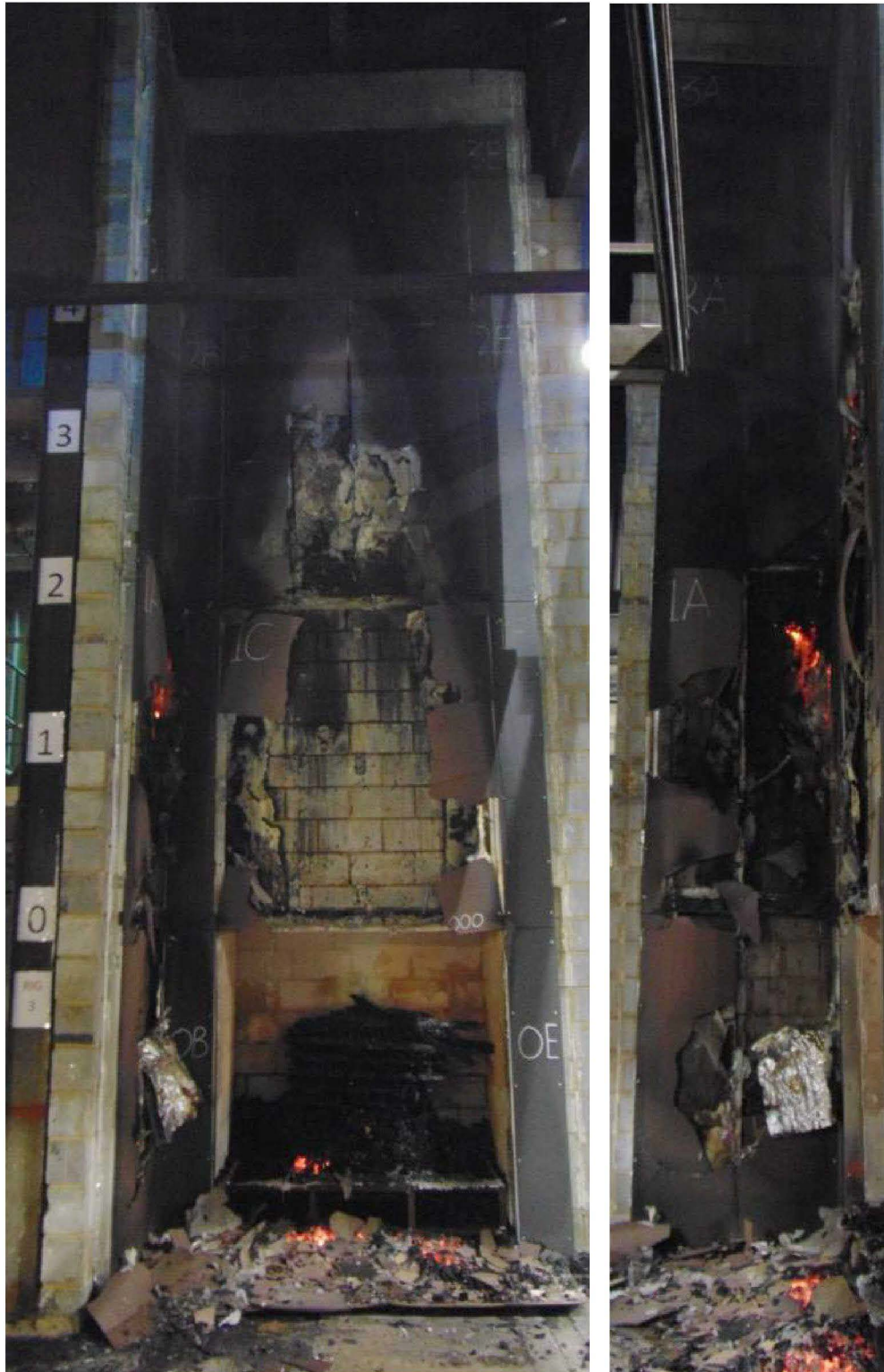


Figure 18. Full-height photograph of cladding system immediately after test.

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Figure 19. Capping at the top of the system.

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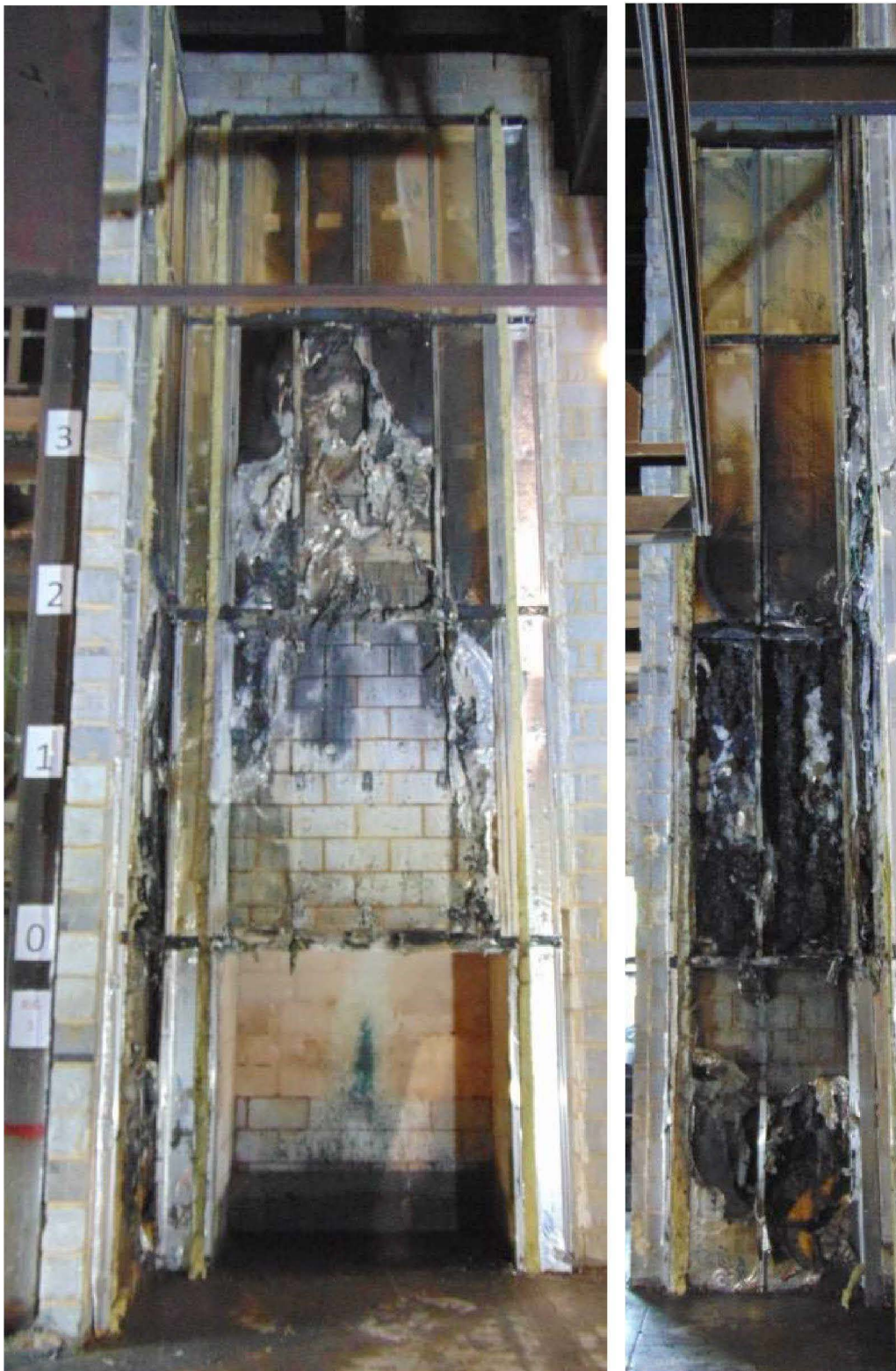


Figure 20. Post-test photograph following removal of panels.

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Figure 21. Post-test photograph following removal of rails.

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Figure 22. Post-test photograph of the horizontal and vertical cavity barriers

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Figure 23. Post-test photograph of the 'L'-shaped brackets.