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BRE Global Summary Test Report

BS8414-2:2005 Test on Aluminium panels and Kingspan K15 insulation

Prepared for: **Kingspan Insulation Limited**

Report Number: **P100184-1002 Issue: 1**

BRE Global Ltd
Watford, Herts
WD25 9XX

Customer Services 0333 321 8811

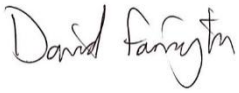
From outside the UK:
T + 44 (0) 1923 664000
E enquiries@bregroup.com
www.bregroup.com

Test Sponsor:
Kingspan Insulation Limited
Pembridge
Leominster
Herefordshire
UK
HR6 9LA

Prepared by

Name David Farrington

Position Fire Resistance and Large-Scale Commercial Projects Manager

Signature 

Authorised by

Name Tony Baker

Position Head of Passive

Date 07 April 2022

Signature 

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1 Introduction

The test method, BS8414-2:2005[1] describes a method of assessing the behaviour of non-loadbearing 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 was 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. Results apply to the sample as received and installed.

The validity of the results is conditional on the accuracy of the data. All measurements quoted in this report are nominal unless stated otherwise.

The information in this summary report is provided for the Test Sponsor's information only and should not be used to demonstrate performance against the standard nor compliance with a regulatory requirement. This summary test report is issued as a non-UKAS accredited report. At the time of the test it was determined that a test report was not required by the Test Sponsor, subsequently a report was requested 2 years after test at which time verification of some of the build details was not possible.

2 Details of Test Apparatus

The product was installed on to wall number 1 of the BRE Global test facility. This apparatus is representative of a structural steel framed building and consists of a structural steel test frame 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 11*. The main wall includes the combustion chamber.

3 Description of the System

Product names and system drawings were supplied by the Test Sponsor and were not independently verified by BRE Global. The validity of the test results is conditional on the accuracy of the system details, the component specification and the installation of the system components.

The information in sections 3.1, 3.2 and 3.2.1 relies heavily on the system drawings included in section 3.2.2. Where it has not been possible to visually verify a detail, an asterisk (*) has been used to mark the reliance on the system details supplied by the Test Sponsor.

3.1 Summary

Generic cladding type	Ventilated rainscreen
Relevant test method	BS 8414-2:2005
Substrate	Lightweight steel frame system
Insulation	Kingspan K15 (140mm-thick) Batch Nr 8100155308 dated 17 04 2015
Cavity depth	78mm* (111mm including panel return (33mm))*
Vertical cavity barriers	AIM stone wool cavity barrier (75mm-wide×265mm-deep)
Horizontal cavity barriers	AIM stone wool cavity barrier with intumescent strip (150mm-thick×227mm-deep)
External finish	CA Prime 7 rainscreen system (3mm-thick)*

3.2 Description of product

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

Item	Description
1	Plasterboard (12.5mm-thick, double layer)*
2	Kingspan SFS framework (154mm-deep)
3	Versapanel* sheathing board (12mm-thick).
4	Aluminium support bracket (179/23/7/121/7/23/179×3mm-thick).*
5	AIM stone wool horizontal cavity barrier with intumescent strip (150mm-thick×227mm-deep×1000mm-long)
6	AIM stone wool vertical cavity barrier (75mm-wide×265mm-deep×1000mm-long)
7	Kingspan K15 insulation (140mm-thick).
8	Aluminium hanging mullion (22/65/67/65/22×3mm-thick).*
9	CA Prime 7 rainscreen system (3mm-thick)*
10	Top hat support (50/31/103/31/75×3mm-thick)*
11	Top closure flashing (430/58/27/27×3mm-thick)*

3.2.1 Installation sequence

Figure 1. Installation of sheathing board and wing wall brackets

A Kingspan steel framing system (Item 2), with nominal 3m-high floors and 300mm* stud centres, was assembled and fixed back to the test rig. A double* layer of plasterboard (Item 1) was fixed to the rear/internal face of the partition. A single layer of sheathing board (Item 3), long edge horizontal was fixed to the front/external face of the partition. Joints were sealed.

Double-headed aluminium support brackets (Item 4) were fixed to the sheathing board so that there would be a bracket located at the top, middle and base of each rainscreen panel junction (1075mm-high)* in columns nominally 550mm-wide* on the main wall and 410mm-wide* on the wing wall. Two EJOT LS 5.5×25mm fixings were used per bracket.

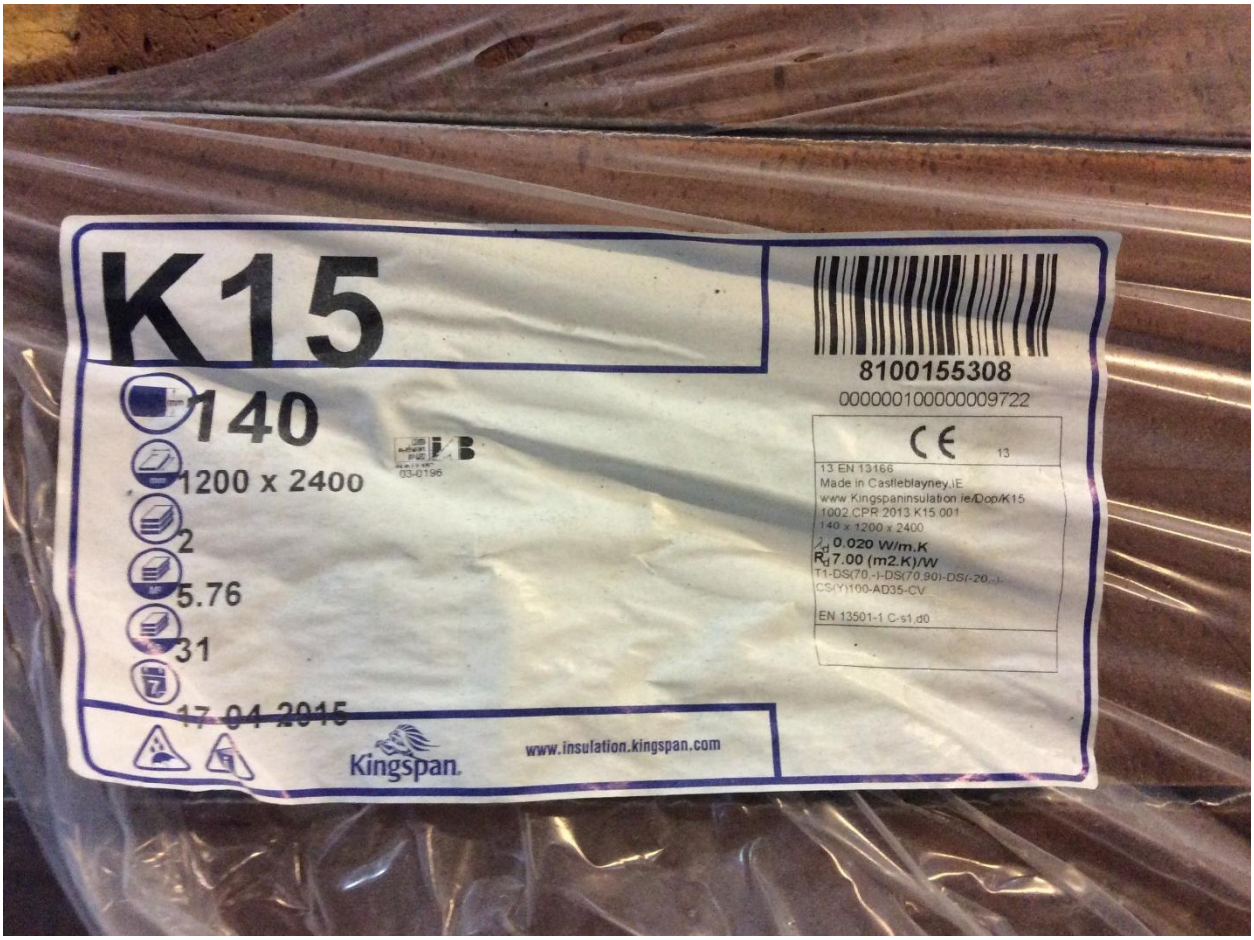

Figure 2. Photograph of insulation supplied for test

Figure 3. Installation of insulation, cavity barriers and panels to wing wall.

Horizontal cavity barriers (Item 6) were attached to the sheathing board via clips (5 per barrier)* in rows approximately: 1m, 4m and 6m above the combustion chamber opening. The ventilation gap was nominally 25mm*.

Vertical cavity barriers (Item 8) were attached to the sheathing board in columns approximately: 1.25m (wing wall), 0m and 2.5m (main wall) from the main-wing wall junction. Each column was interrupted by the horizontal cavity barriers which remained consistent across the test specimen.

Insulation boards (Item 9) were cut to size and installed vertically between the columns of aluminium support brackets typically with four EJOT SW8R 4.8×160 steel fixings in a diamond pattern (Ø50mm steel washer at the top and base, Ø65mm plastic washer at mid-height of each vertical edge). All joints were sealed with aluminium tape.

Aluminium mullions (Item 10) were slotted between the double-headed support brackets and fixed to each bracket with two EJOT LS 5.5×25mm (one on either side) so that the front face of the mullion protruded an additional 35mm from the bracket. There were nine columns of mullions (five on the main wall, four on the wing wall).

Figure 4. Panel fixing detail.

1075mm-high aluminium cassette panels (Item 11) were hooked onto the hanging mullions and secured through the top lip of the panel with two EJOT LS 5.5×25mm. The next row of panels overlapped the top lip of the row below so that the fixings were hidden. A nominal 20mm gap was left between adjacent panels.

Figure 5. Combustion chamber surround detail.

The combustion chamber surround was lined with a layer of stone wool and finished with aluminium panels (Item 11) that returned into the reveal.

Figure 6. Completed installation.

At the top of the system, top hat section (Item 12)* was fixed along the top face of the SFS frame and angled sections* fixed to the top of the mullions. This provided a platform for the top closure flashing (Item 13) that capped the top of the system.

3.2.2 System drawings

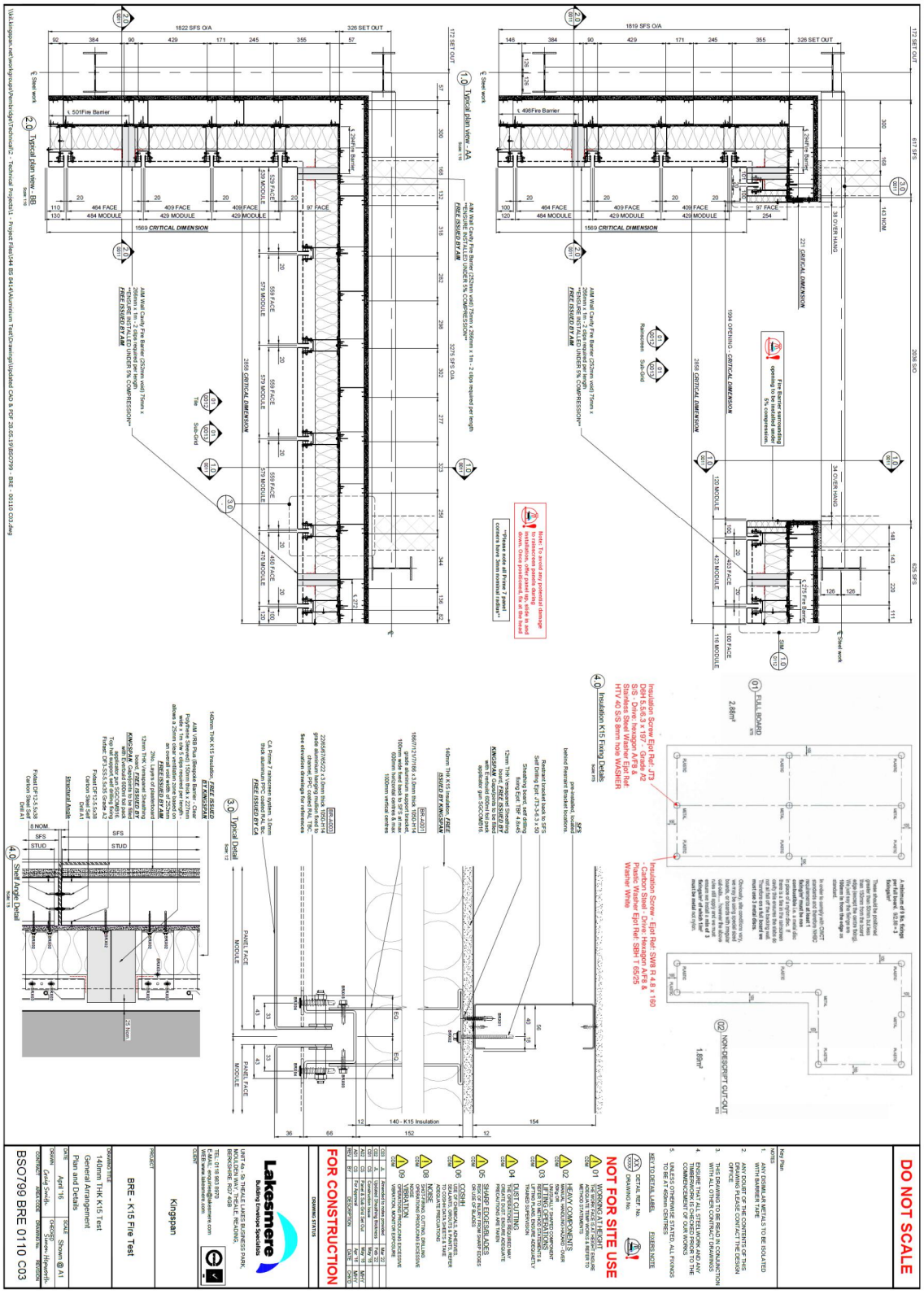

Figure 7. Plan and details (supplied by Test Sponsor, BSO799 BRE 0110 C03).

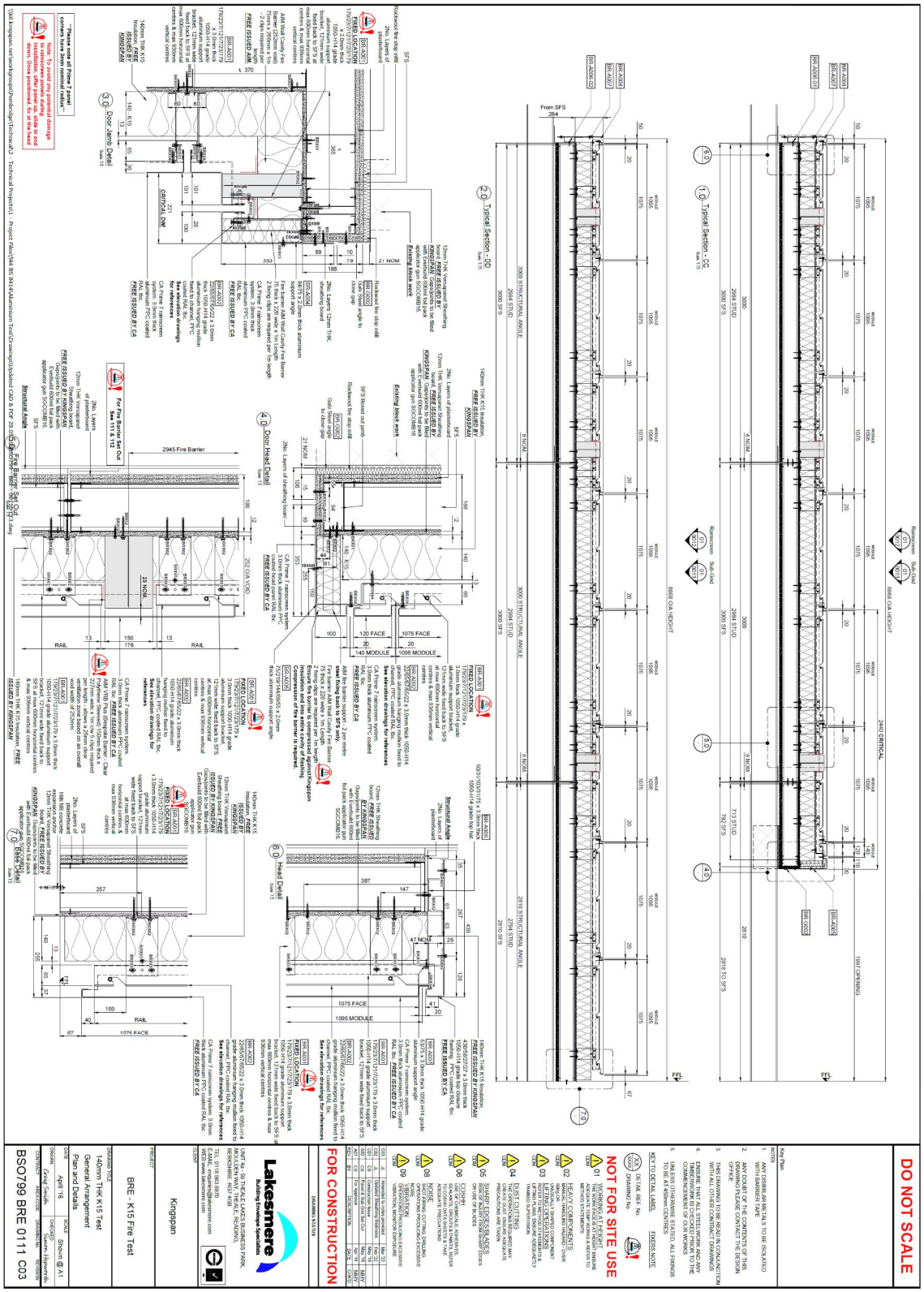

Figure 8. Plan and details2 (supplied by Test Sponsor, BSO799 BRE 0111 C03).

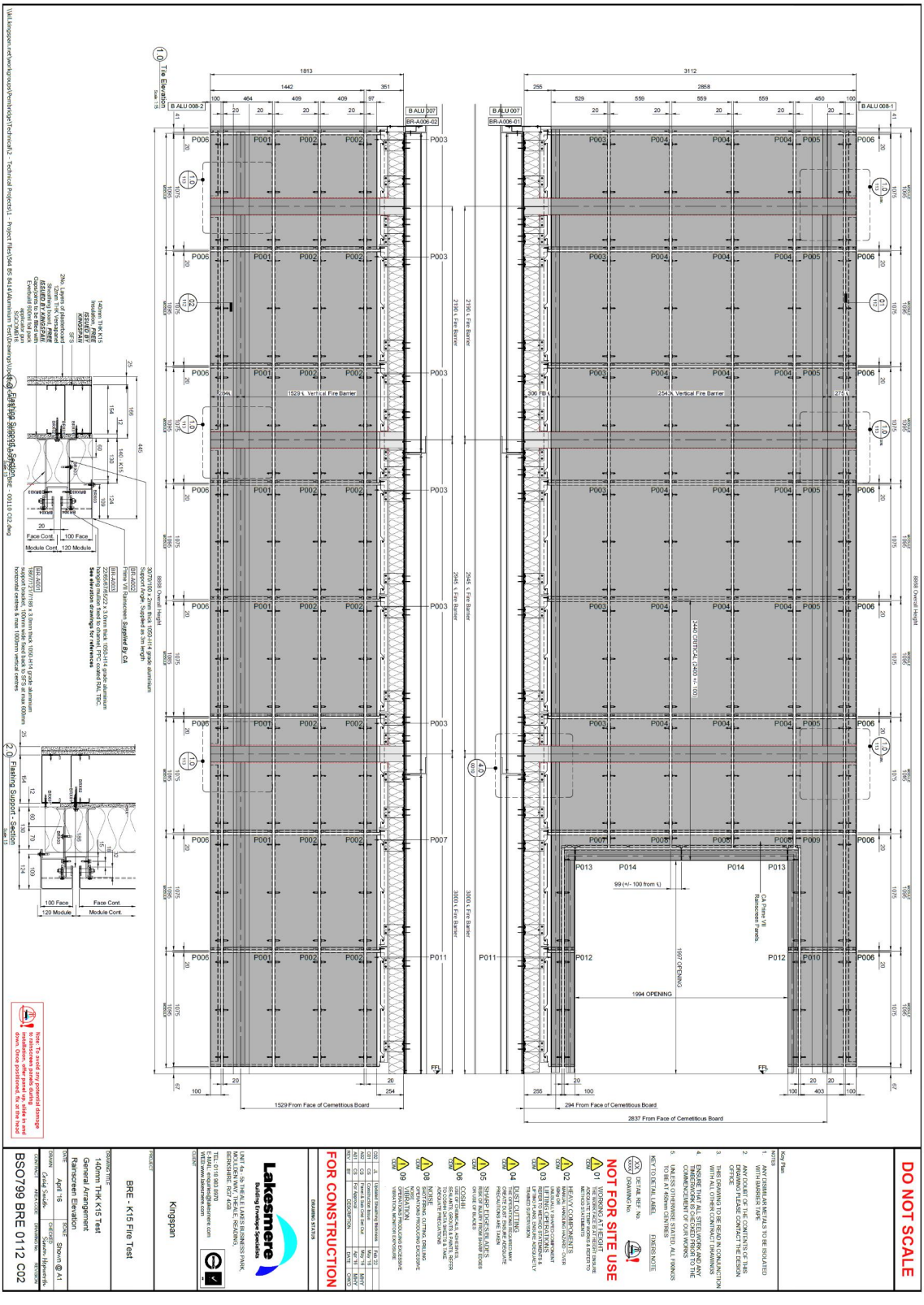

Figure 9. Rainscreen elevation (supplied by Test Sponsor, BSO799 BRE 0112 C02).

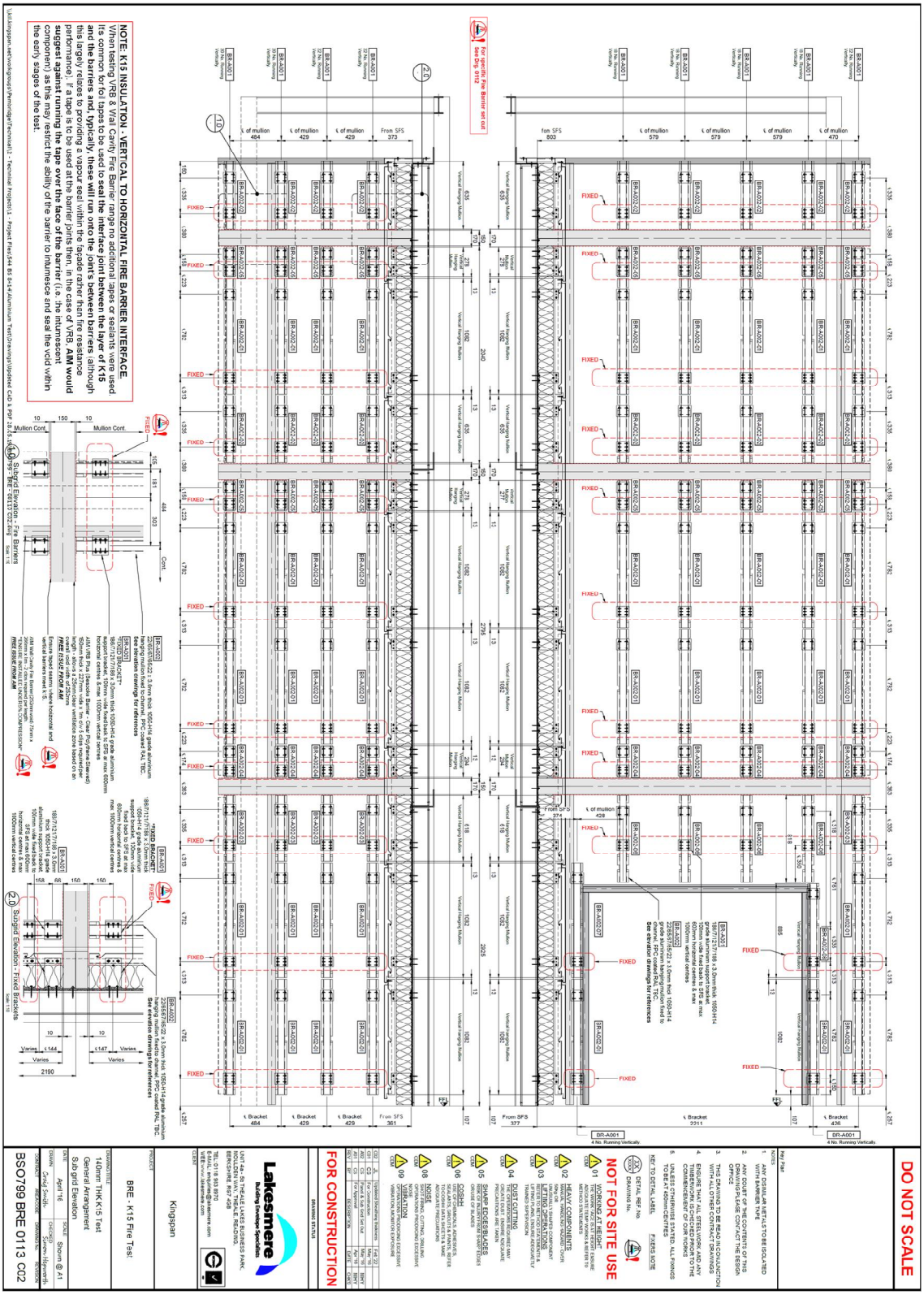

Figure 10. Sub grid elevation (supplied by Test Sponsor, BSO799 BRE 0113 C02).

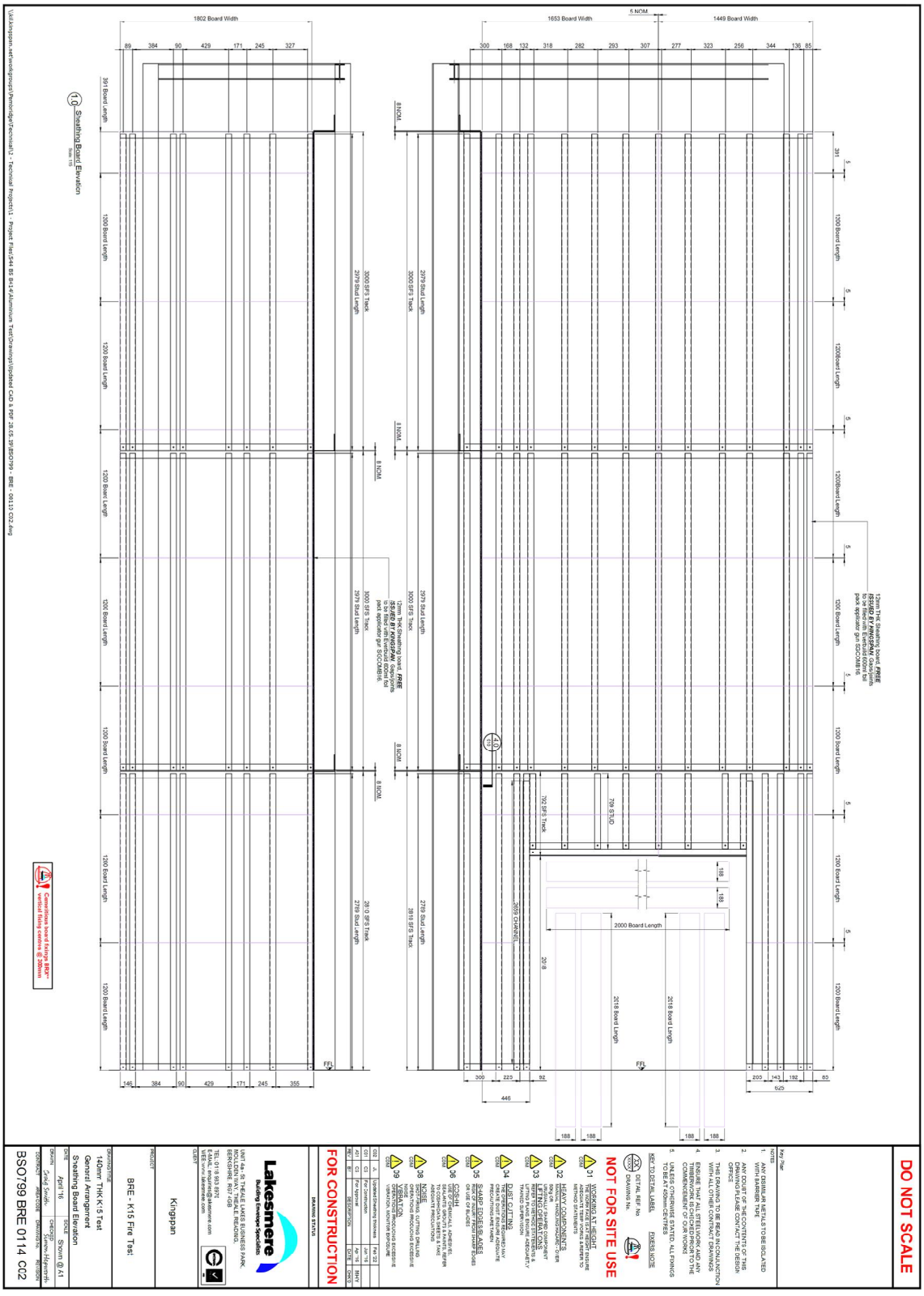

Figure 11. Sheathing board elevation (supplied by Test Sponsor, BSO799 BRE 0114 C02).

3.3 Critical dimensions

3.3.1 Test Standard requirements

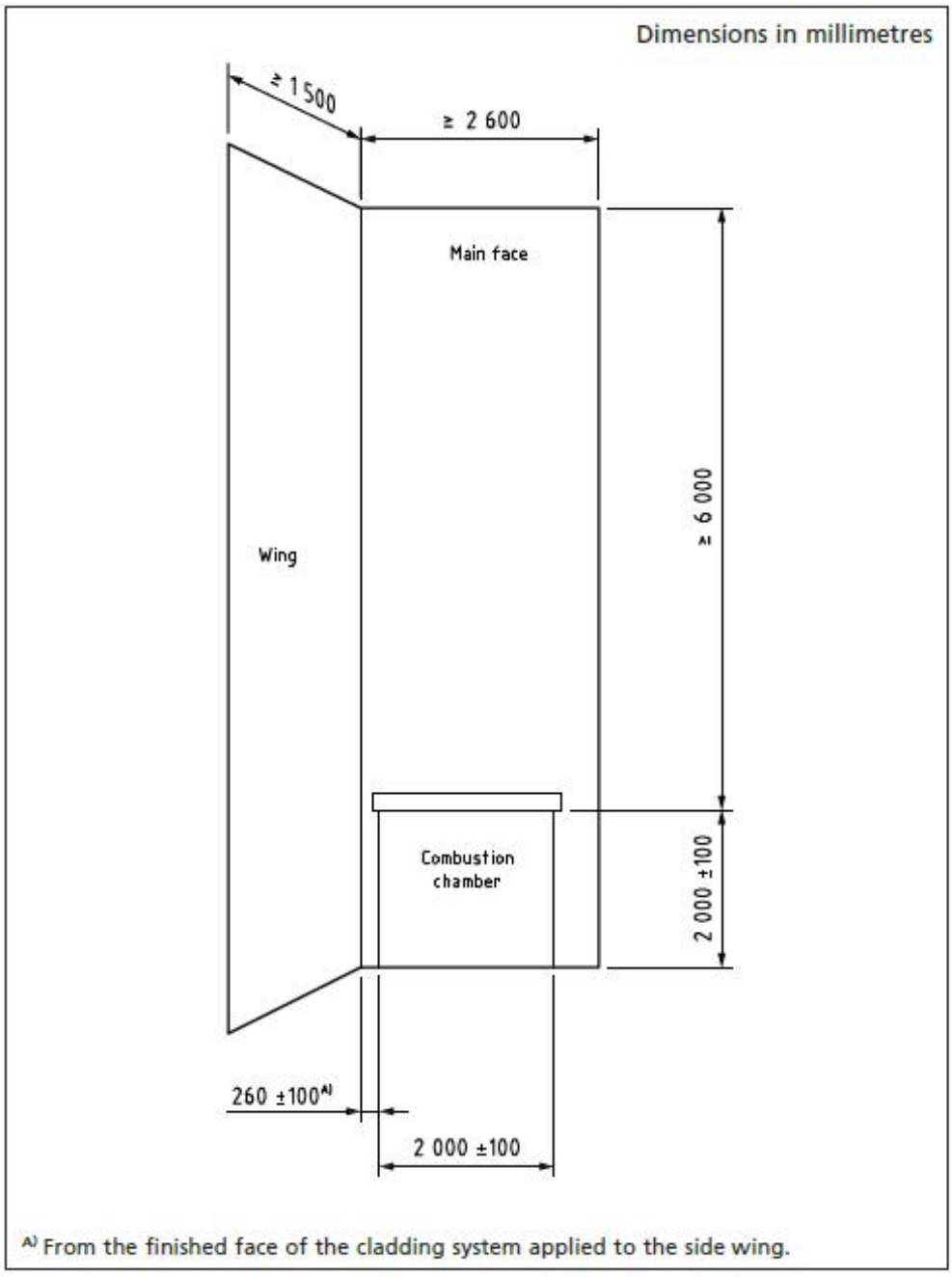

Figure 12. Test apparatus dimensions as specified by test Standard[1].

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

3.3.2 Measured dimensions of cladding system

BS 8414 requirement	Actual measurement	Criteria achieved?
≥6000mm above the top of the combustion chamber	Not recorded	
≥2400mm width across the main wall	2825mm	✓
≥1200mm width across the wing wall	1569mm	✓
260mm (±100mm) wing wall-combustion chamber opening	220mm	✓
2000mm×2000mm (±100mm) combustion chamber opening	1994mm-wide× 1997mm-high	✓
Horizontal joint (if present) placed 2400 (±100mm) above combustion chamber opening.	Not recorded	
Vertical joint (if present) located on centre line of combustion chamber (±100mm).	Not recorded	

4 Test Information

4.1 Test details

Name of Laboratory: BRE Global Ltd.

Laboratory Address: Bucknalls Lane, Garston, Watford, Hertfordshire, WD25 9XX, UK.

Test reference: P100184-1002

Date of test: 26th August 2016

Sponsor: Kingspan Insulation Limited

Sponsor address: Pembridge, Leominster, Herefordshire, HR6 9LA, UK

Method: The test was carried out in accordance with BS8414-2:2005

Deviations: None

4.2 Deviations from Test Standard

No deviations recorded.

4.3 Temperature data

Figures 30-37 provide the temperature profiles recorded during the test. *Figure 5* shows the system before the test.

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

Parameter	Result (whole test)	Result (t_s+15mins)
T_s, Start Temperature	21˚C	n/a
t_s, Start time	01:55 after ignition of crib.	n/a
Peak temperature / time at Level 2, External	914˚C (t_s+37:15).	770˚C (t_s+14:35).
Peak temperature / time at Level 2, Cavity	1023˚C (t_s+36:00).	628˚C (t_s+14:55).**
Peak temperature / time at Level 2, Insulation	997°C (t_s+37:10).	346°C (t_s+12:55).
Peak temperature / time at Level 2, Sheathing board	110˚C (t_s+50:25).	38˚C (t_s+14:55).
Peak temperature / time at Level 2, Partition	84°C (t_s+54:40).	33°C (t_s+14:55).
Peak temperature / time at Level 2, Plasterboard	85˚C (t_s+26:40).	35˚C (t_s+14:30).

**600°C temperature rise above T_s was recorded within 15 min of the start time.

4.4 Thermocouple location and panel layout

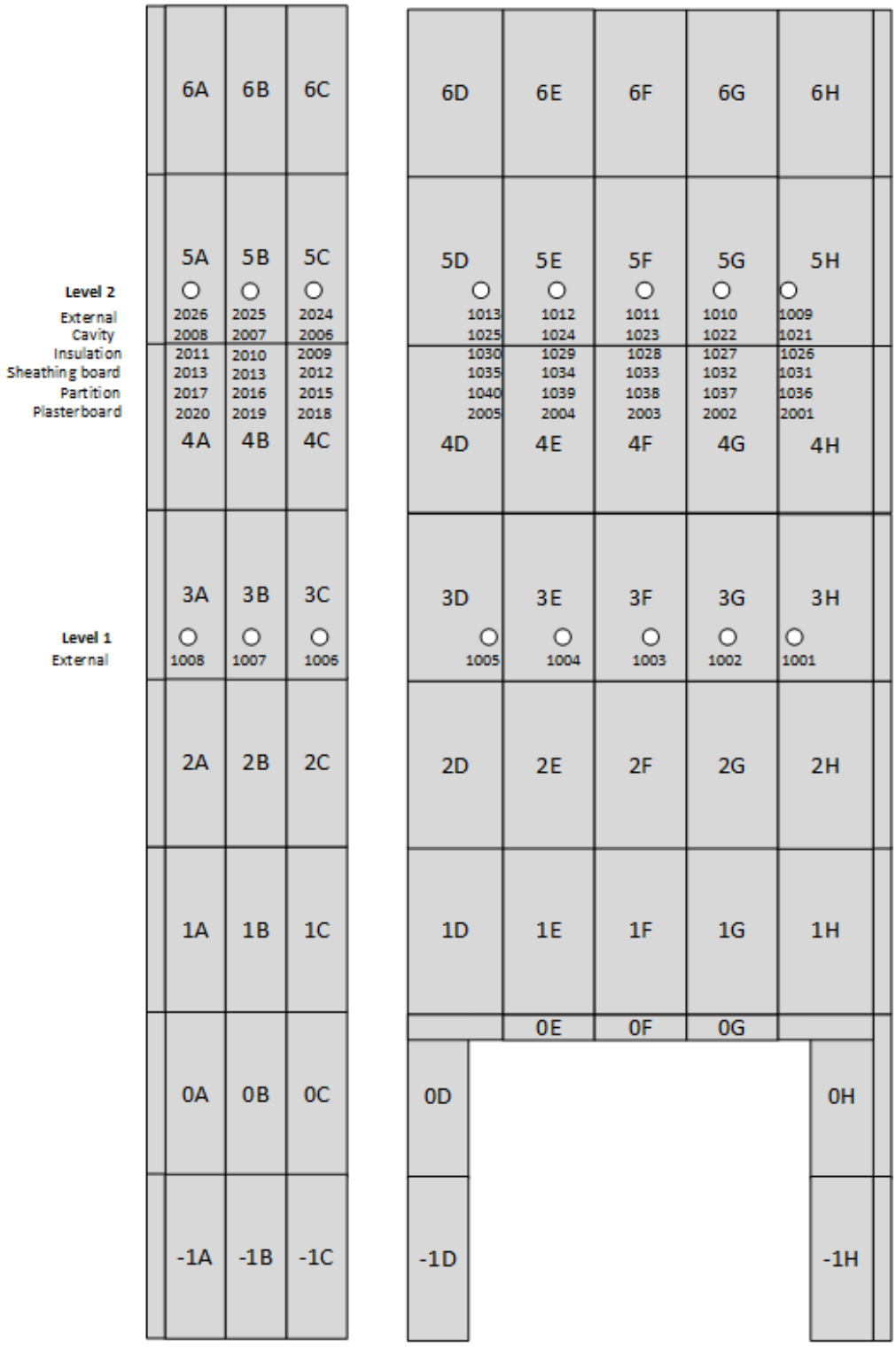

Figure 13. TC positions and panel numbering (-1A – 6H). Not to scale.

4.5 Visual observations

Figure 14. Flames escaping combustion chamber (00:01:32 from ignition)

Figure 15. Flame tips to approx. 2.5m above combustion chamber (00:05:13 from ignition)

Figure 16. Main wall panels melted to approx. 2m above chamber, falling debris (00:09:56 from ignition)

Figure 17. Main wall panels melted/detached to approx. 3.5m above combustion chamber, flaming at main-wing wall junction (00:13:56 from ignition)

Figure 18. Increased melting/detachment of main wall panels, flaming from wing wall at approx. 3.5m above combustion chamber (00:16:34 from ignition)

Figure 19. Increased melting/detachment of main wall panels up to approx. 6m above combustion chamber, flaming from main and wing wall at this height (00:18:42 from ignition)

Figure 20. Increased flaming from main wall at approx. 6m above combustion chamber, increased debris (00:19:13 from ignition)

Figure 21. Increased melting/detachment of panels on main wall at approx. 6m above combustion chamber, increased debris (00:21:12 from igntion)

Figure 22. Melting of wing wall panel at approx. 3m above combustion chamber (00:25:47 from ignition)

Figure 23. Melting of panels and insulation smouldering to top row of main wall panels, increased flaming from wing wall (00:27:08 from ignition)

Figure 24. Flaming from top row main wall panel to top of test specimen (00:29:49 from ignition)

Figure 25. Crib extinguished at 30 minutes from ignition, flaming from top of test specimen (approx. 32mins)

Figure 26. Crib extinguished at 30mins, flaming from insulation continues. Possible flaming at top of wing wall (00:33:31)

Figure 27. Increased flaming from behind main wall panels at approx. 6m above combustion chamber (00:37:39)

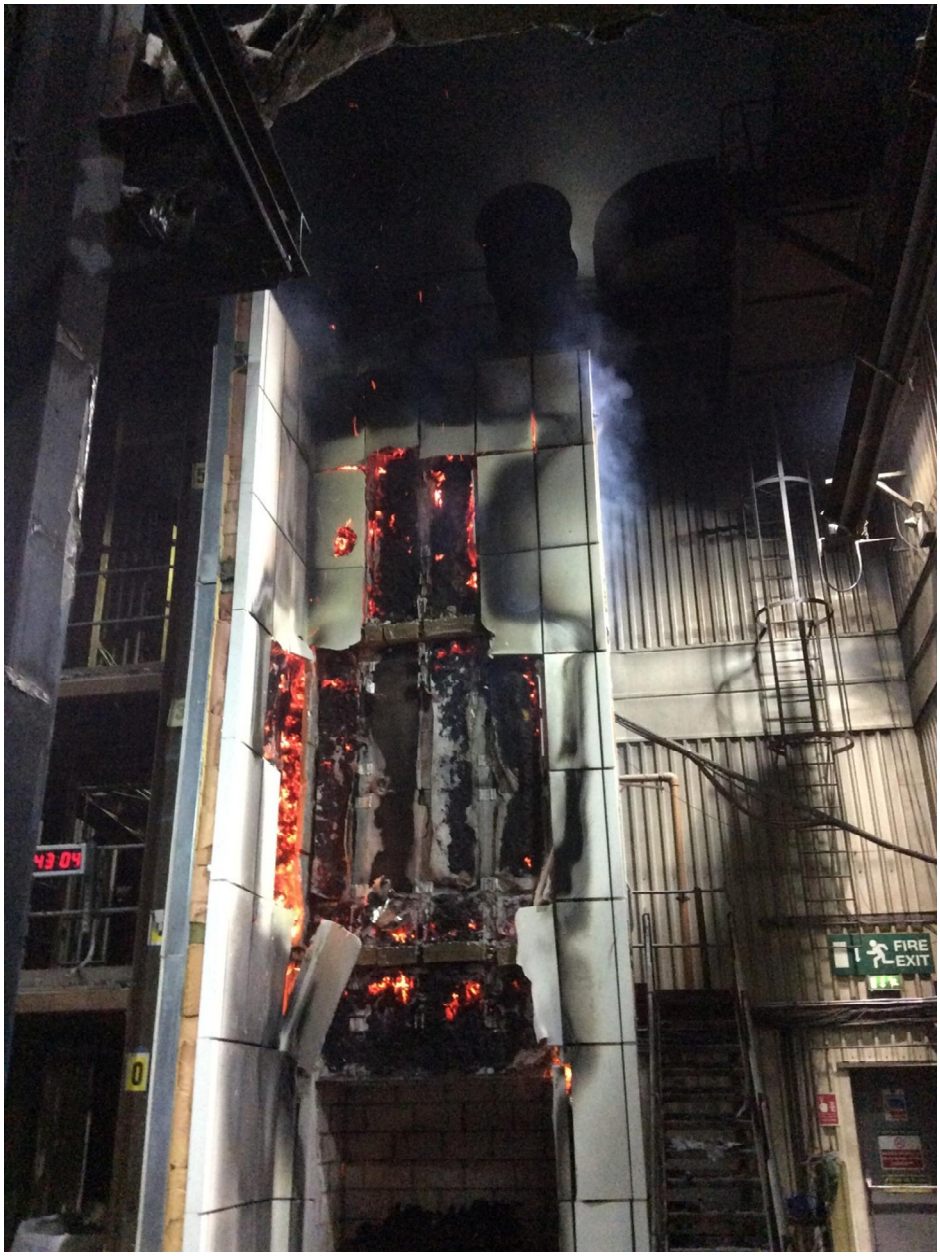

Figure 28. Flaming continues but has reduced in intensity (00:43:04)

Figure 29. Significant reduction in flaming except at outside edge of main wall, 6m above combustion chamber (00:55:56)

4.6 Mechanical performance

Time references given from point of ignition in the format mm:ss.

Observation	Details***
Ongoing system combustion following extinguishing of the ignition source	Until test end at 60:00
System collapse	Falling debris from 09:56
Spalling	Not recorded
Delamination	Panel detachment from 13:52
Flaming debris	Not recorded
Pool fire	Not observed

***with reference to *Table 2*.

4.7 Temperature profiles

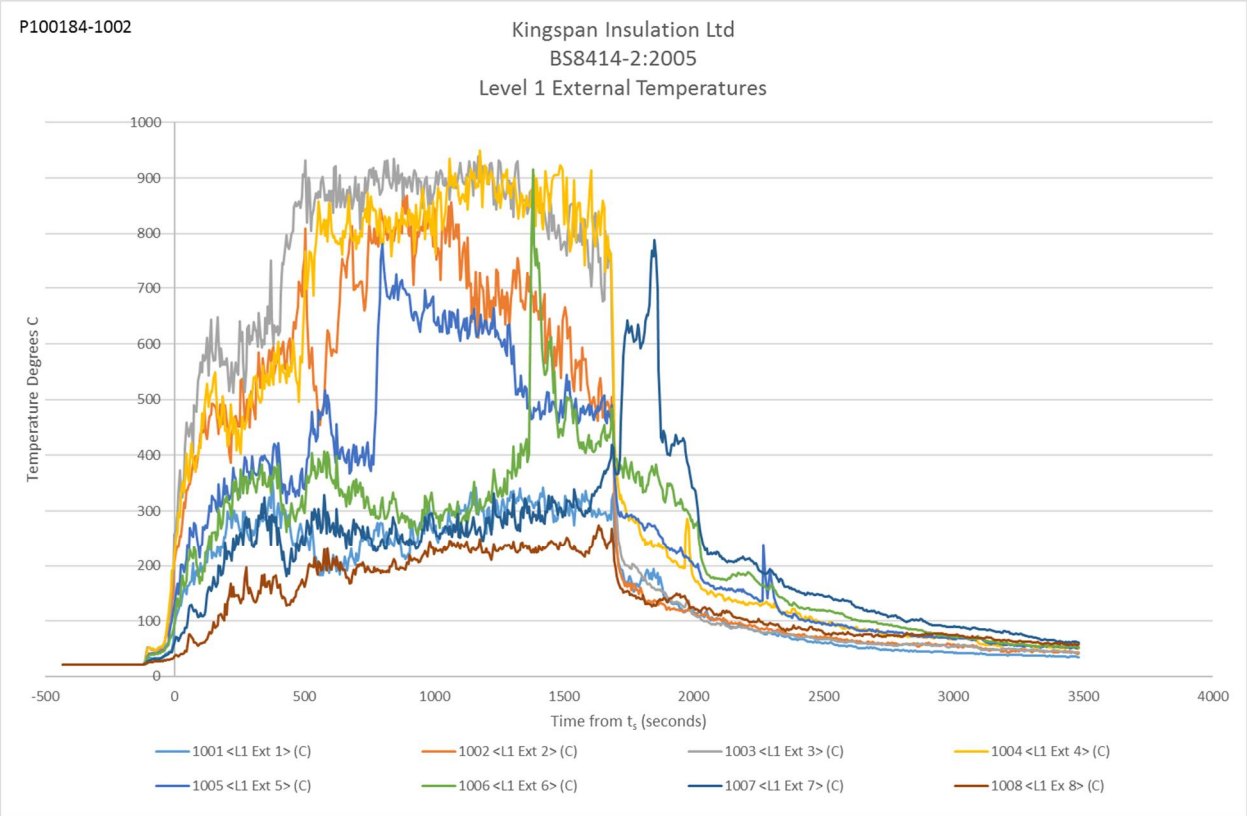

Figure 30. Level 1 external thermocouples.

t_s=01mins 55secs after ignition of the crib.

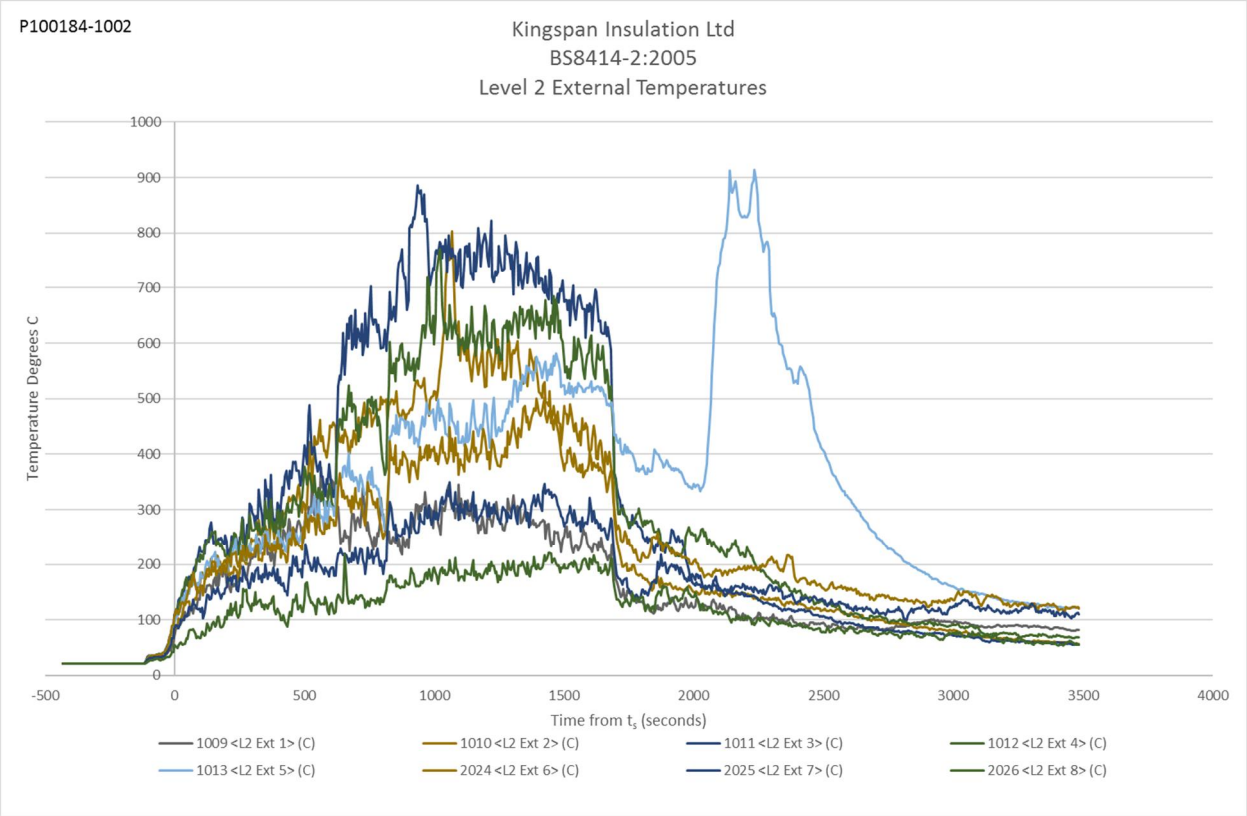

Figure 31. Level 2 external thermocouples.

t_s=01mins 55secs after ignition of the crib.

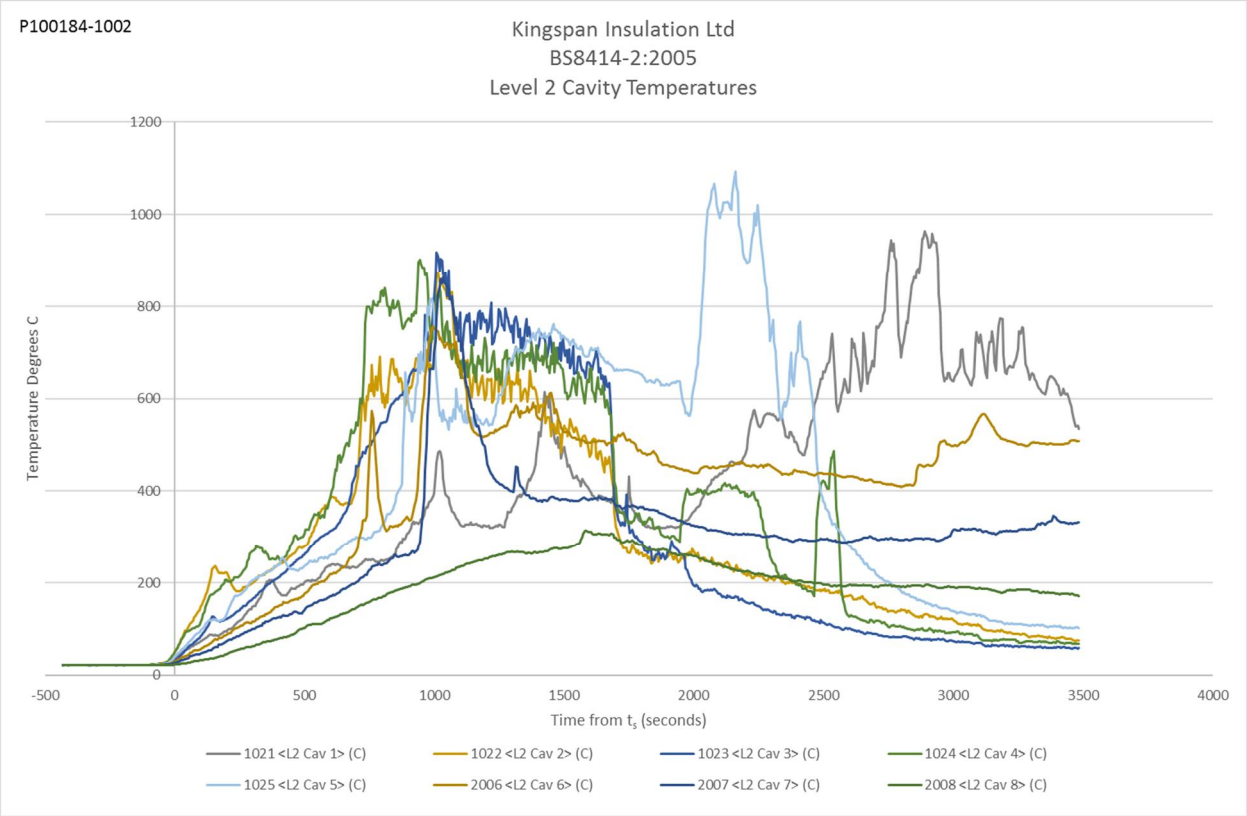

Figure 32. Level 2 cavity layer thermocouples.

t_s=01mins 55secs after ignition of the crib.

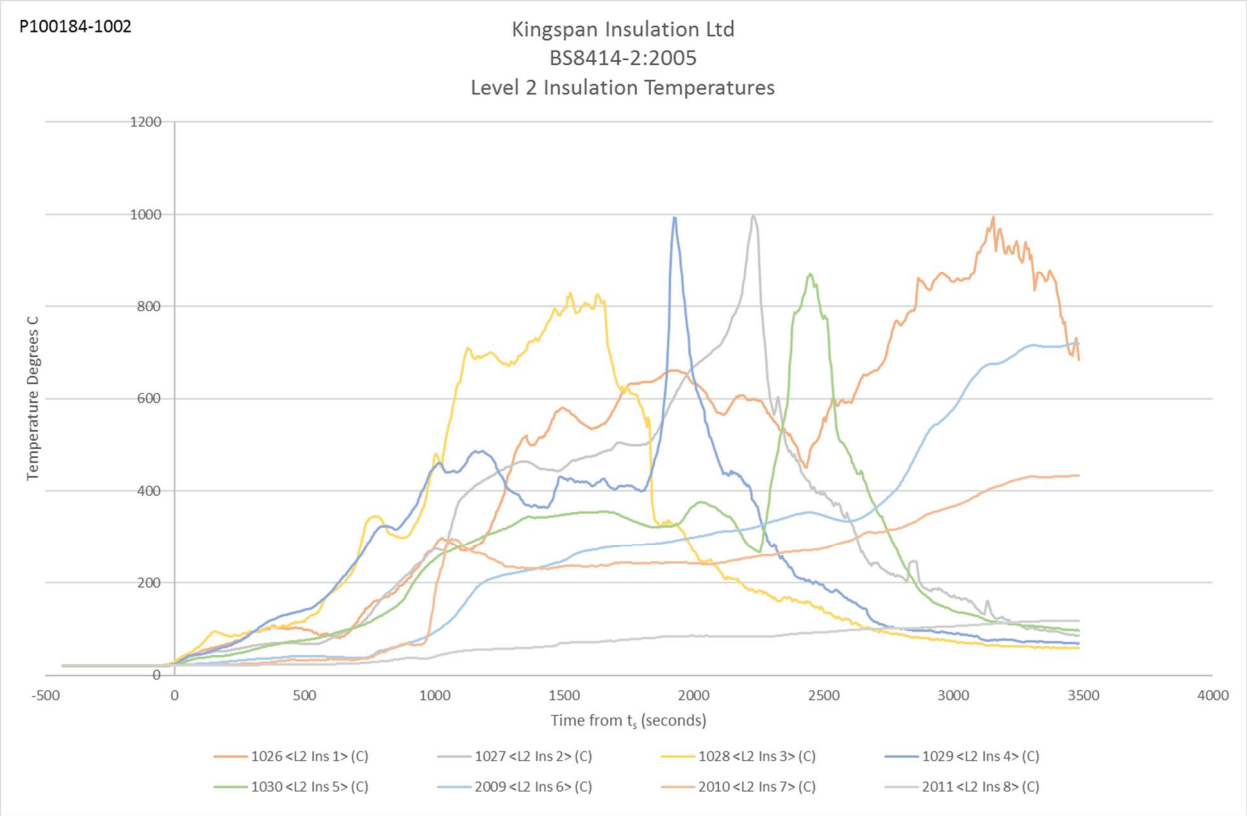

Figure 33. Level 2 insulation layer thermocouples.

t_s=01mins 55secs after ignition of the crib.

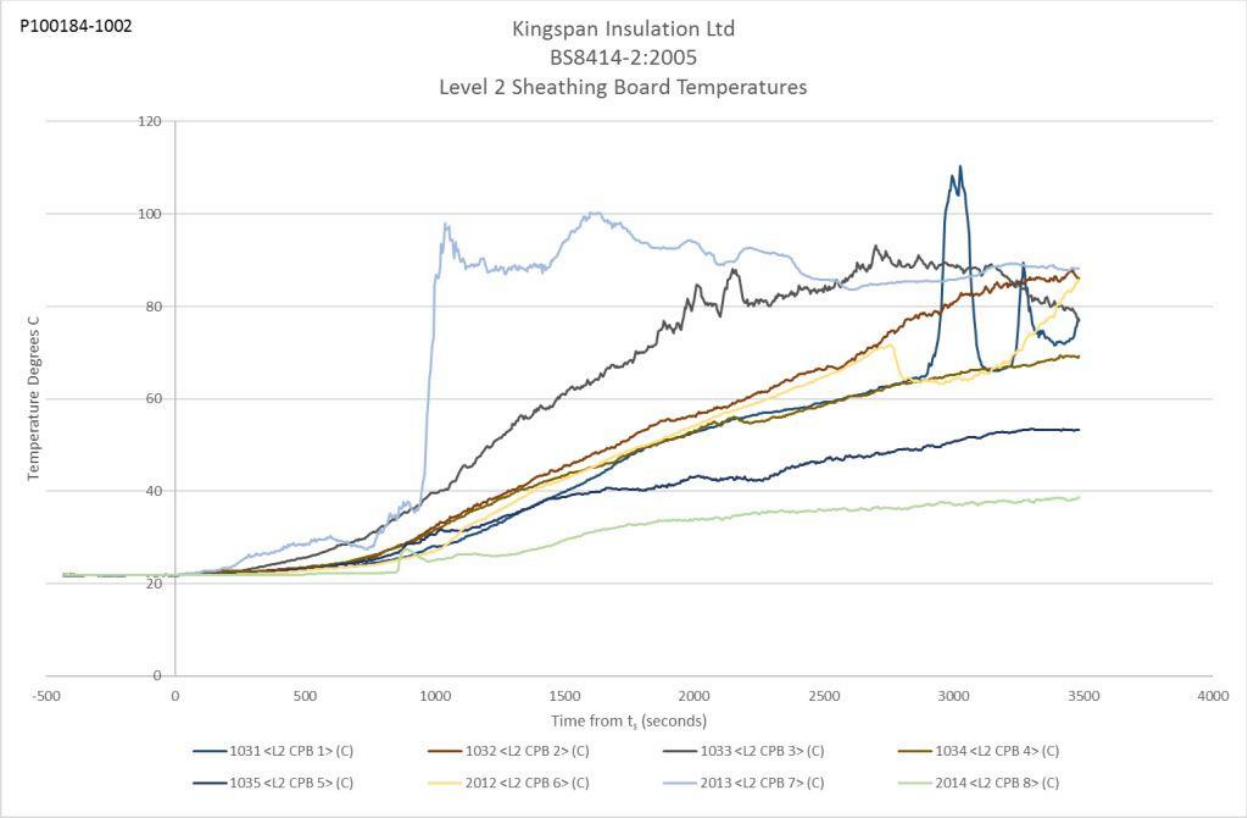

Figure 34. Level 2 sheathing board layer thermocouples.

t_s=01mins 55secs after ignition of the crib.

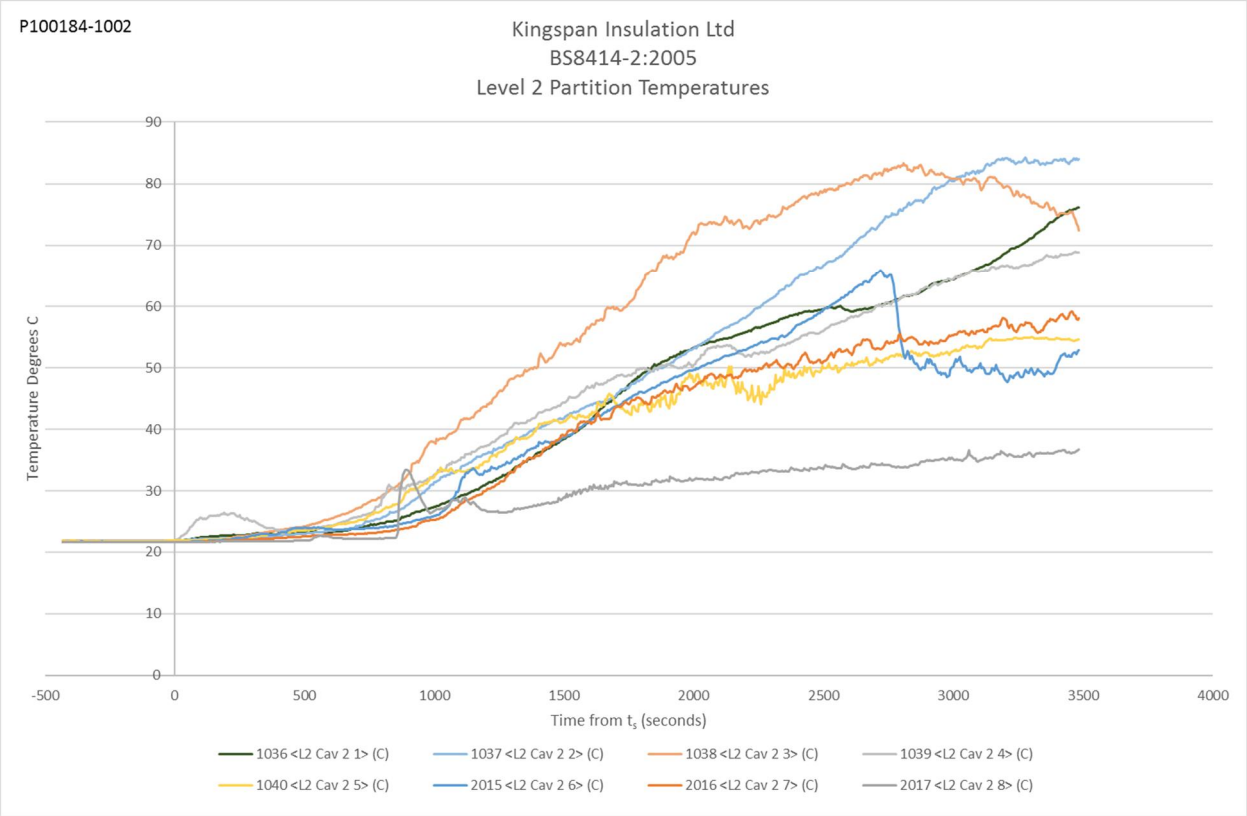

Figure 35. Level 2 partition layer thermocouples.

t_s=01mins 55secs after ignition of the crib.

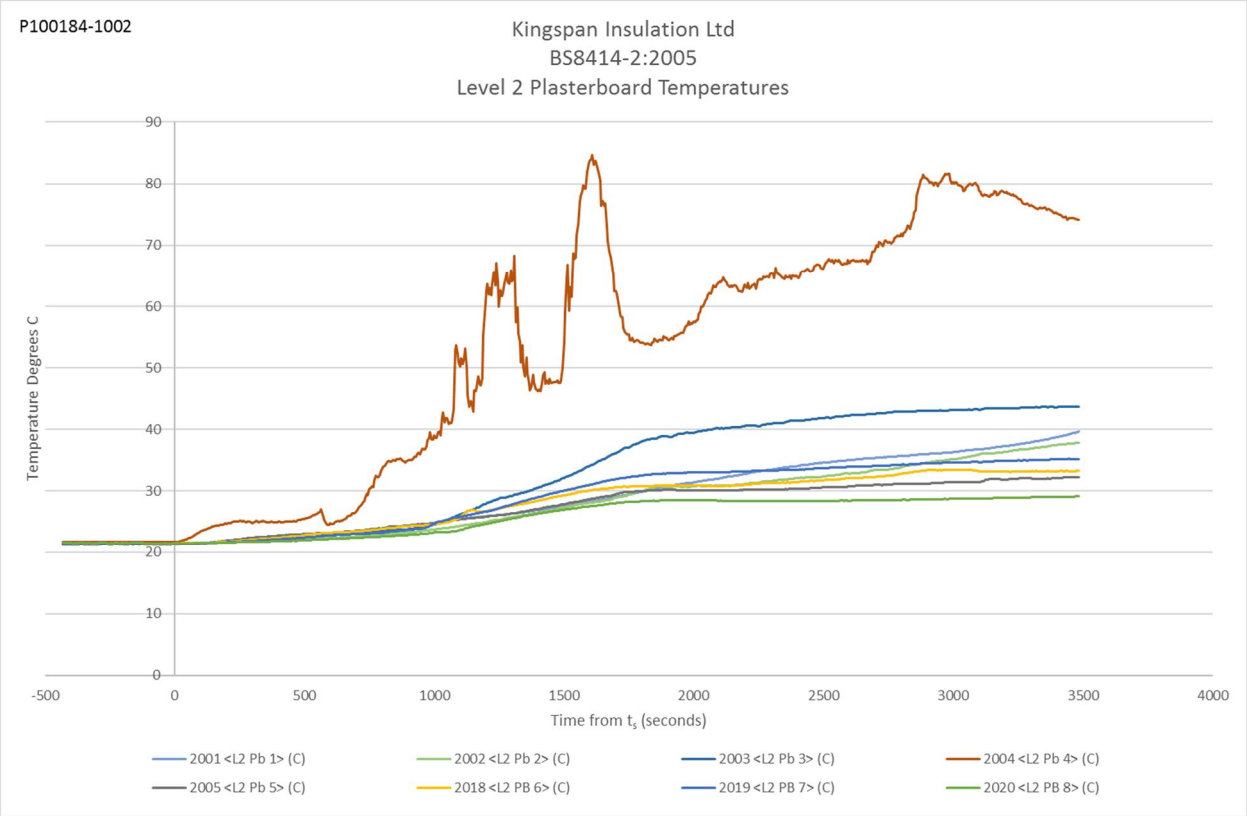

Figure 36. Level 2 plasterboard layer thermocouples.

t_s=01mins 55secs after ignition of the crib.

5 System Damage

5.1 Aluminium panels

Figure 38. Full-height photograph of cladding system following post-test dousing.

With reference to *Figure 13,* the damage observed to the aluminium panels was as follows.

Fully melted/detached panels:

0E, 0F, 0G,

1E, 1F,

2C, 2C, 2D, 2E, 2F, 2G,

3B, 3C, 3D, 3E, 3F, 3G,

4E, 4F,

5E, 5F

Partially melted/detached panels:

1C (15%), 1D (60%), 1G (40%), 4D (15%), 6E (15%)

The panels were discoloured and distorted adjacent to the main area of damage.

5.2 Aluminium hanging mullions

Figure 39. Post-test photograph of main wall following panels removal.

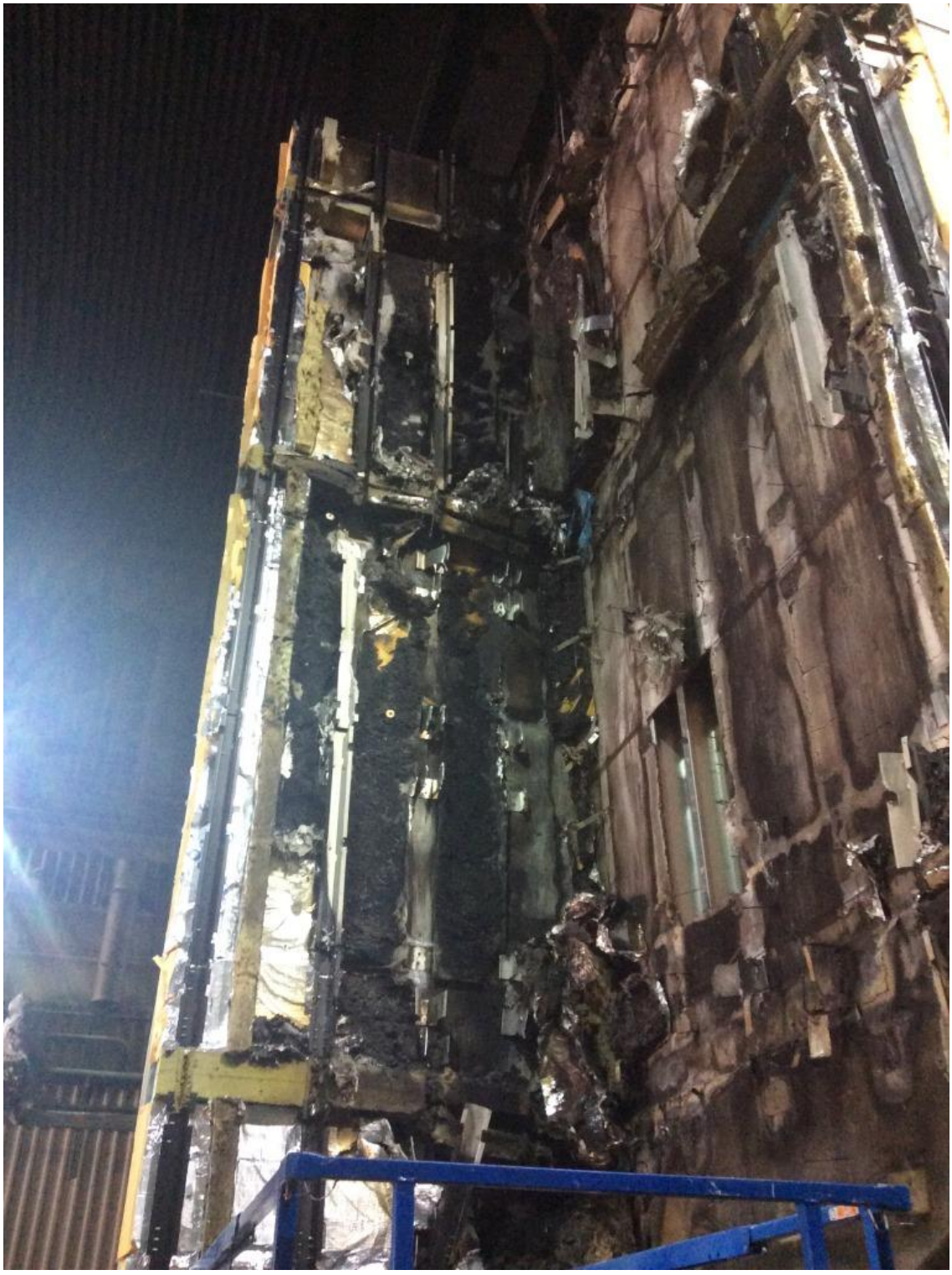

Figure 40. Post-test photograph of wing wall following panel removal.

The majority of the four mullions located in line with the combustion chamber opening had melted up to the height of the 3rd horizontal cavity barrier. The centre left mullion had melted to the top of the test specimen. The mullion at the outside edge of the main wall appeared to have no significant damage.

From the main-wing wall junction to the outside edge of wing wall:

- The first mullion had melted from the height of the combustion chamber opening to the third horizontal cavity barrier.
- The second mullion had melted between the first and second horizontal cavity barrier. Immediately below the first cavity barrier a section of mullion had partially detached. Between the second and third cavity barrier the mullion was distorted.
- The third mullion had partially melted between the first and second horizontal cavity barrier. Elsewhere the mullion remained intact and in place.
- The fourth mullion appeared to have no significant damage.

On the main wall, the majority of the aluminium brackets supporting the four central mullions had also melted. On the wing wall, the brackets had partially melted in the locations where the mullions had melted.

5.3 Phenolic insulation

On the main wall, the majority of the insulation had been consumed during test, some detached during post-test dousing of the system. Some insulation remained towards the top of the test specimen, adjacent to the wing wall, but was significantly charred. The insulation at the outside edge of the main wall remained intact and in place. See *Figure 39*.

On the wing wall, between the first and second horizontal cavity barrier, the insulation had been consumed between the first mullion and the main wall. The insulation was significantly charred adjacent to the first mullion with depth of char decreasing towards the vertical cavity barrier towards the outside edge. The foil face of the insulation remained intact at the junction between the vertical cavity barrier and first horizontal cavity barrier. A similar, though less severe, pattern of damage was observed between the second and third horizontal cavity barrier. Some charred insulation remained adjacent to the main wall. The foil face remained intact at the top of the test specimen with some fire damage. See *Figure 40*.

5.3.1 Horizontal cavity barriers

The horizontal cavity barriers remained intact and in place during the test. Where the aluminium panels had melted, the intumescent strip was no longer visible. There was some detachment of the cavity barriers during post-test dousing of the test specimen. See *Figure 39-40*.

5.3.2 Vertical cavity barriers

The vertical cavity barriers remained intact and in place during the test. There was some detachment of the cavity barriers during post-test dousing of the test specimen. Some sections of the vertical cavity barriers had fire damage on the inside edge (facing the combustion chamber). See *Figure 39-40*.

5.4 Sheathing board

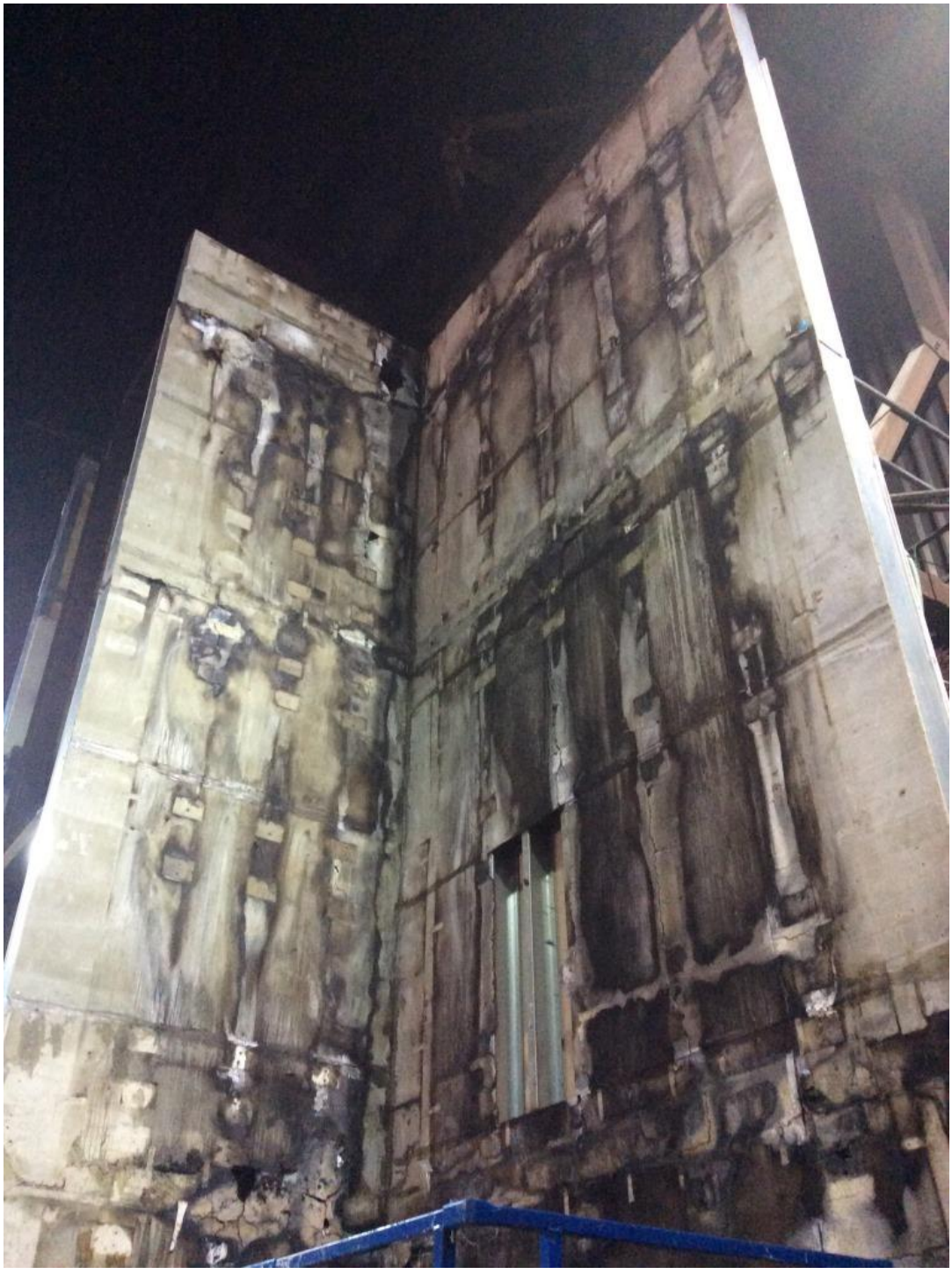

Figure 41. Post-test photograph of sheathing board layer.

The sheathing board appeared to remain intact and in place during the test, however; there was some detachment during post-test dousing. The sheathing board was cracked on the main wall and was charred to full-width and full-height across both main and wing wall.

6 Conclusion

BS8414-2: 2005 [1] does not contain acceptance criteria and therefore this test report does not indicate a pass or fail of the product.

7 Limitations

Because of the nature of fire testing and the consequent difficulty in quantifying the uncertainty of measurement of fire testing, it is not possible to provide a stated degree of accuracy of the results.

8 Reference

1. BS 8414-2:2005, 'Fire performance of external cladding systems – Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame', British Standards Institution, London, 2005.

Report Ends