

## Fire Performance Testing of an External Cladding System BS 8414-2:2015 + A1:2017

### Test Report

Prepared for : Kingspan Insulation Ltd.  
Project : System Development  
Report No. : DLR1558 Rev.0  
Sample : 160mm Kingspan Kooltherm K15 - Alpolic A2 ACM -  
BML400



4559

September 2018

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# 1. Introduction

This report describes the fire performance test carried out at Al Futtaim Exova (AFE) laboratory in Dubai at the request of:

Kingspan Insulation Ltd,  
Pembroke, Leominster,  
Herefordshire,  
England.

Client contact: [highrisetechnical@kingspan.com](mailto:highrisetechnical@kingspan.com) Contact number: +44 1544 387 382

AFE Job/Sample Number: PD 106193 / C2753E

The test sample consisted of external wall cladding system (160mm Kingspan Kooltherm K15 - Alpollic A2 ACM - BML400) installed by European Aluminium Systems on behalf of Kingspan Insulation Ltd.

This test report is personal to the client, confidential, non-assignable and shall not be reproduced, except in full, without prior written approval of AFE.

## 1.1 Purpose of Testing

The test was carried out on 10<sup>th</sup> May 2018 to determine the fire performance of a cladding panel system fixed on to steel frame substrate when exposed to external fire under controlled conditions. The test method was in accordance with AFE test method statement DMC2753E/MSrev0, which was in accordance with the following standard:

- ▶ BS 8414-2: 2015 + A1:2017

This test report relates only to the actual sample as tested and described herein.

The tests were witnessed wholly or in part by:

Adrian Brazier - Kingspan Insulation Ltd.

The test was supervised and conducted by Arun Kumar Murugan of Al Futtaim Exova.

## 1.2 Terms and Definitions

### 1.2.1 Level 1 Height

2500mm above the top of the combustion chamber opening on the test apparatus.

Refer to section 4 for details.

### 1.2.2 Level 2 Height

5000mm above the top of the combustion chamber opening on the test apparatus.

Refer to section 4 for details.

### 1.2.3 Start Temperature, $T_s$

Mean temperature of the thermocouples at Level 1, five minutes prior to ignition of the heat source.

### 1.2.4 Start Time, $t_s$

Time when the temperature recorded by any external thermocouple at Level 1 equals or exceeds 200°C above  $T_s$  and remains above this value for at least 30 seconds.

## 2. Test Summary

The cladding system was tested in accordance with BS 8414-2:2015 + A1:2017 without any early termination of the test.

**Table 1 Observations**

See Figure 3 on page 13 and Figure 4 on page 4 for the thermocouple locations & numbers.

Parameters	Temperature Data / Observations
T <sub>s</sub> , start temperature	33°C
t <sub>s</sub> , start time	516 seconds after ignition of the crib (thermocouple 6)
Peak temperature & time at Level 2 (External)	369°C at 939 seconds from t <sub>s</sub> (thermocouple 15)
Peak temperature / time at Level 2 (Mid-depth of cavity)	389°C at 891 seconds from t <sub>s</sub> (thermocouple 24)
Peak temperature / time at Level 2 (Mid-depth of 100mm Kingspan Kooltherm K15 insulation)	233°C at 933 seconds from t <sub>s</sub> (thermocouple 32)
Peak temperature / time at Level 2 (Mid-depth of 60mm Kingspan Kooltherm K15 insulation)	182°C at 1035 seconds from t <sub>s</sub> (thermocouple 40)
Peak temperature / time at Level 2 (Mid-depth of 12mm Versapanel Cement Particle Board)	159°C at 1014 seconds from t <sub>s</sub> (thermocouple 48)
Peak temperature / time at Level 2 (Mid-depth of 100mm SFS)	83°C at 891 seconds from t <sub>s</sub> (thermocouple 56)
Peak temperature / time at Level 2 (Mid-depth of 2 layers of 12.5mm Plaster Board)	66°C at 732 seconds from t <sub>s</sub> (thermocouple 62)

For full details refer to Section 6.

The above results are valid only for the conditions under which the tests were conducted.

### 3. Description of the Test Sample

The test specimen build-up comprised of:

- ❖ 2 layers of 12.5mm plaster boards.
- ❖ Kingframe SFS (steel framing system)
- ❖ 12mm thick Versapanel cement particle board
- ❖ Siderise RH25G 90/30 horizontal open state cavity barrier.
- ❖ Siderise RSV-90/30 vertical cavity barrier.
- ❖ 160mm Kingspan Kooltherm K15 insulation built with layers of 100mm and 60mm.
- ❖ Horizontal aluminium Top hat 60mm deep, insulated with 60mm Kingspan Kooltherm K15 insulation
- ❖ ECF-B-S-220 Helping Hand bracket.
- ❖ Aluminium 'T' rail and 'L' rail.
- ❖ 4mm thick Alpolic A2 composite panel.

The sample dimensions were:

Main wall - 2845mm wide x 8515mm high.

Wing wall -1350mm wide x 8515mm high.

The top termination of the cladding system was closed with 2mm thick aluminium sheet. The main wall side was closed with aluminium composite panel. Wing wall side was left open. The interface between the cladding system and the combustion chamber was covered with 5mm thick aluminium pod. The distance of the finished face of the wing wall to the side opening of the combustion chamber was 245mm.

Photo DLP C2753E/6180 below shows an external view of the sample.

Figure 1 Photo DLP C2753E/6180 External View of the Test Sample



The system components are mentioned in Table 2. Refer to the drawings in Appendix B for sample construction details and dimensions.

Table 2 System Details

Component	Description	Installation Details
Internal wall board	2 layers of 12.5mm thick plaster board.	Plaster boards were fixed to the SFS with flat head screws.
Steel framing system (SFS)	Kingframe SFS (steel framing system) comprising Galvanized cold formed steel 'C' and 'U' sections with 100x50mm studs.	The tracks were fixed to the concrete beams with HTF-6.3 x 45mm carbon steel screws.  The studs were fixed to the tracks with DF3-SS-5.5x55mm carbon steel screws.
Sheathing board	12mm thick Versapanel cement particle board manufactured by Euroform.  See photo DLP C2753E/5990 in Appendix A.	Cement particle boards were fixed to the SFS with DF3-CF-5.5x22mm carbon steel screws.
Breather membrane	Nilvent breathable membrane.  See photo DLP C2753E/5990 in Appendix A.	Nilvent breathable membrane was provided to the face of the cement board.
Bracket and Railings	<b>Top Hat bracket:</b> Horizontal aluminium Top Hat, 60mm deep  <b>Helping Hand bracket:</b> ECS-B-S-115 Helping hand bracket with 100-HR25 Polypropylene isopad  <b>Railings:</b> 120x60x2mm aluminium vertical T-rail 60x40x2mm aluminium vertical L-rail  See photos DLP C2753E/5990 & DLP C2753E/6571 in Appendix A.	Horizontal 'aluminium Top Hat brackets were fixed to the SFS through the sheathing board with DF3-SS-5.5x35mm steel screws. Top hat brackets were insulated with 60mm Kingspan Kooltherm K15 insulation.  Helping Hand brackets were fixed to SFS through the sheathing board with DF3-SS-5.5x35mm steel screws.  Vertical railings were fixed to the Helping hand bracket with 4.8mm tek screws.
Cavity barrier	<b>Horizontal cavity barrier:</b> Siderise RH25G-90/30, open state cavity barrier  See photos DLP C2753E/6571 & DLP C2753E/6165 in Appendix A.	The horizontal cavity barriers were fixed to the concrete slab with HTF-6.3 x 45mm carbon steel screws and to the sheathing board with DF3-SS-5.5x35mm steel screws.  4 nos. of horizontal cavity barriers were installed on the main wall and wing wall at approximately 25mm, 2325mm 4725mm and 6395mm above the combustion chamber.

	<p><b>Vertical cavity barrier:</b> Siderise RSV-90/30 vertical cavity barrier</p> <p>See photos DLP C2753E/6571 &amp; DLP C2753E/6165 in Appendix A.</p>	<p>The vertical cavity barriers were fixed to the SFS through the sheathing board with DF3-SS-5.5x35mm steel screws.</p> <p>2 nos. of vertical cavity barrier were installed on the main wall and 1 no. of vertical cavity barrier was installed on the wing wall.</p>
Thermal Insulation	<p>160mm thick Kingspan Kooltherm K15 insulation built with a layer of 100mm and 60mm.</p> <p>See photo DLP C2753E/6571 in Appendix A.</p>	<p>Kingspan Kooltherm K15 insulation was fixed to the sheathing boards with plastic and steel pins.</p> <p>Self-adhesive foil tape was provided at the joints, perimeter of the insulation boards.</p>
Panels	<p>4mm thick Alpolic A2 composite panel.</p> <p>Top skin – Aluminium Core – Mineral filled Bottom skin – Aluminium</p> <p>See photo DLP C2753E/6157 in Appendix A.</p>	<p>Cladding panels were fixed to the vertical railings with R-SS-LF-4.8x16mm rivets.</p> <p>10mm joints were provided between the panels.</p>

Material information described in Table 2 is as supplied by Kingspan Insulation Ltd.

AFE was not involved in the design, procurement, installation, specification and verification of the materials / properties or system.

### **Sample installation**

AFE monitored the installation of the sample based on the drawings supplied by Kingspan Insulation Ltd. which are included in Appendix B of this report. Any deviation in the installation from these drawings were recorded and reported.

Date of installation: 5<sup>th</sup> to 8<sup>th</sup> May 2018

Ambient temperature range: 28 - 37°C

## 4. Test Apparatus

### 4.1 Test Rig

The test specimen was installed on a purpose-built test rig constructed by AFE as per the BS 8414-2:2015 + A1:2017 standard.

The test apparatus had a vertical structural steel test frame, with a vertical main test wall and a vertical return wall (wing) at a 90° angle to, and at one side of the main test wall. The main wall was provided with a combustion chamber with an opening of 2000mm x 2000mm. The test facility was capable of enduring the effects of the test procedure without itself suffering undue damage or distortion. The main wall had a width of 3800mm and the wing wall with a width of 2300mm. The total height of the test rig was 9300mm.

Refer to Figure 2 below for a schematic diagram of the test rig.

### 4.2 Heat Source

A timber crib, 1500mm x 1000mm in plane and 1000mm in height, was constructed using Pinus Silvestris softwood sticks as described in BS 8414-2:2015 + A1:2017 with a first layer consisting of 10 long sticks of 1500mm. The next layer consisted of 15 short sticks was evenly distributed to cover an area of 1500mm x 1000mm.

The process was repeated to give a total of 20 layers of sticks, giving a nominal height of 1000mm. The crib was constructed on a solid steel platform positioned 400mm above the floor of the combustion chamber and placed centrally and displaced 100mm from the back wall of the chamber.

The crib was ignited using 16 strips of low density fibreboard, soaked for 5 minutes in 5 litres of white spirit.

### 4.3 Thermocouples

All thermocouples used conformed to BS EN 60584-1:2013, Type K (Chromel / Alumel). The thermocouples were mineral insulated and had a nominal 1.5mm diameter with insulated junctions. Data acquisition was performed at 3 second intervals.

The locations of the thermocouples on the specimen were as shown in Figure 3.

#### 4.3.1 External thermocouples at Levels 1 and 2

Thermocouples were positioned in front of the main test wall face on the centre line and at 500 mm and 1000 mm each side of the centre line of the combustion chamber (five locations). Thermocouples were also positioned in front of the wing test wall face at 150 mm, 600 mm and 1 050 mm from the finished face of the main test wall face (three locations).

#### 4.3.2 Internal thermocouple locations at Level 2

Thermocouples were positioned within each layer (greater than 10mm thick) of the main test wall face on the centre line and at 500mm and 1000mm each side of the centre line of the combustion chamber (five locations). Thermocouples were also positioned within each layer (greater than 10mm thick) of the wing



**Figure 3 Thermocouple, Cavity Barrier Locations & Panel Numbering**

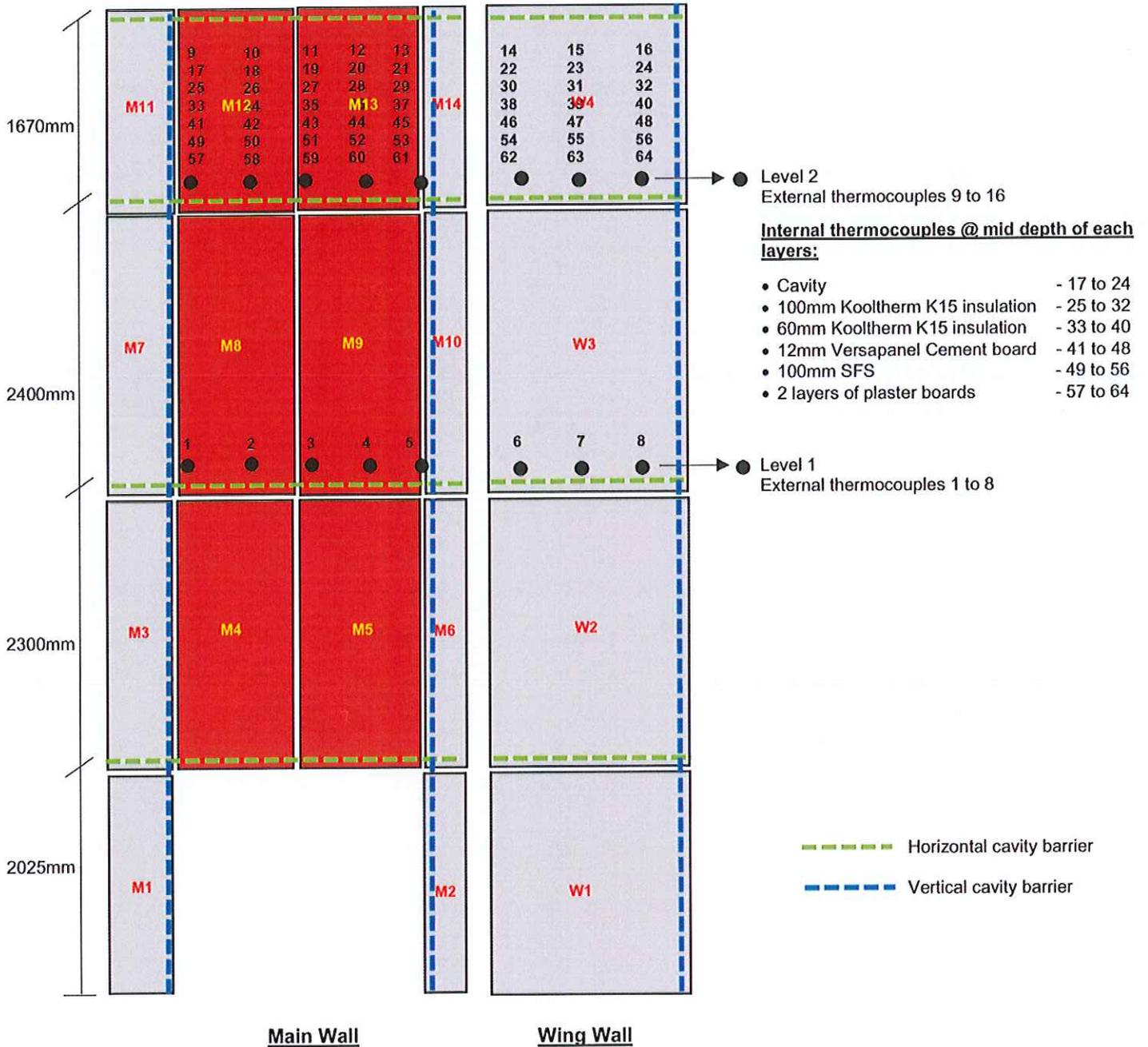
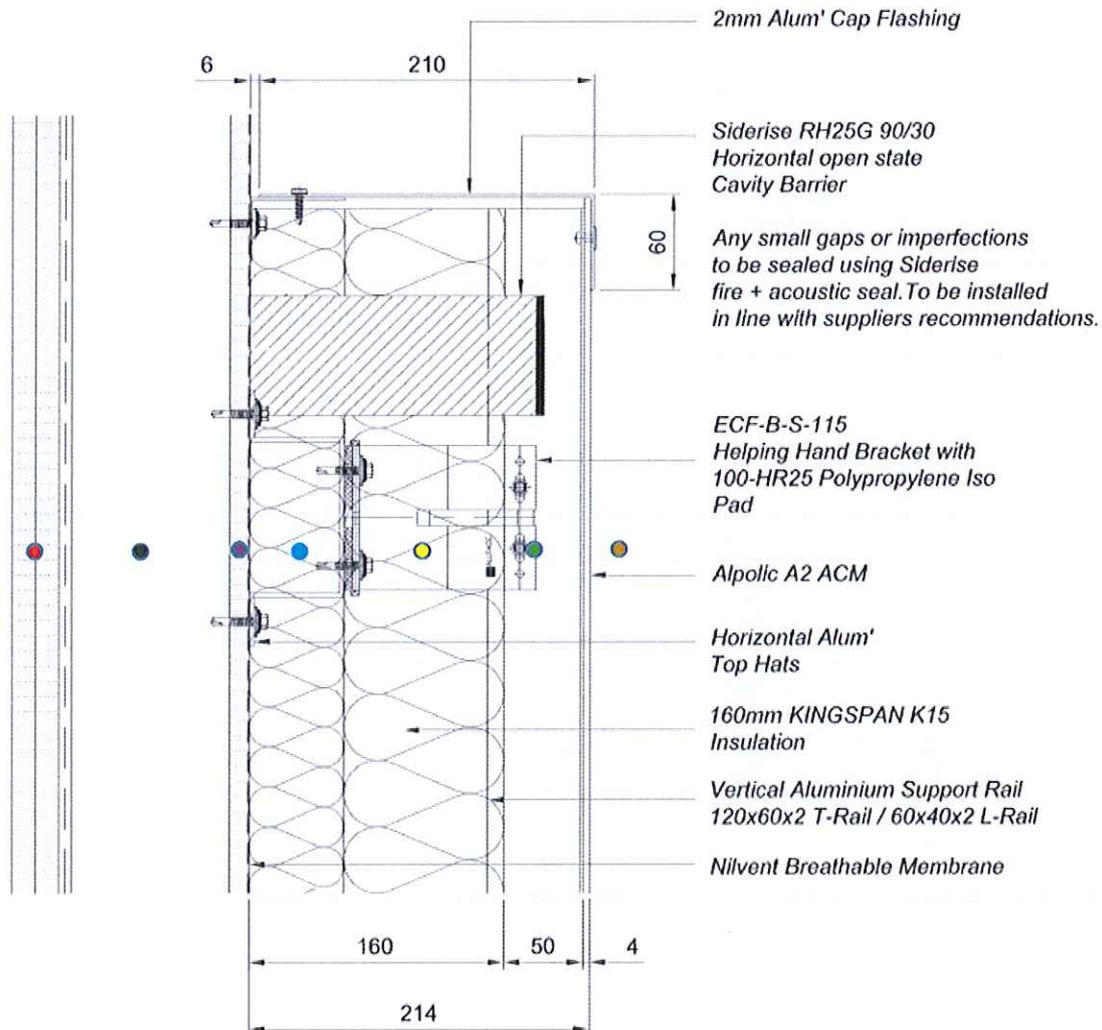


Figure 4 Level 2 Section Drawings Showing the Thermocouple Locations



- External thermocouples - 9 to 16
- Cavity - 17 to 24
- 100mm Kingspan Kooltherm K15 Insulation - 25 to 32
- 60mm Kingspan Kooltherm K15 Insulation - 33 to 40
- 12mm Versapanel cement particle board - 41 to 48
- 100mm Kingframe SFS - 49 to 56
- 2 layers of 12.5mm plaster boards - 57 to 64

## 5. Test Procedures

### 5.1 Testing

The environmental conditions were recorded.

The data acquisition and video recording was started 5 minutes prior to ignition of the fuel source. Then fuel source was ignited.

Significant events were recorded, including;

- changes in flaming conditions
- change in the mechanical behaviour of the cladding system
- the detachment of any part of the sample
- fire penetration through any fire stops in the cladding system

The heat source was extinguished 30 minutes after ignition. The data acquisition was continued to 60 minutes from ignition.

### 5.2 Post-test Examination

After the test was terminated, the sample was allowed to cool. The sample was then examined for damage, including the following.

- Spalling
- Melting
- Deformation
- Delamination
- The extent of flame spread over the surface of the cladding system
- The extent of flame spread and/or damage within intermediate layers
- An estimate of flame spread and/or damage within cavities
- The extent to which the external face of the cladding system has burnt away or become detached
- Details of any collapse or partial collapse

Smoke staining and discolouration were not considered damage in this context.

## 6. Test Data / Observations

The sample conditioning period was not specified. The ambient temperature was in the range 28°C - 37°C during installation.

Installation start date: 05 May '18

Date of testing: 10 May '18

Ambient temperature: 33°C

Wind speed recorded at the start of the test: 1m/s

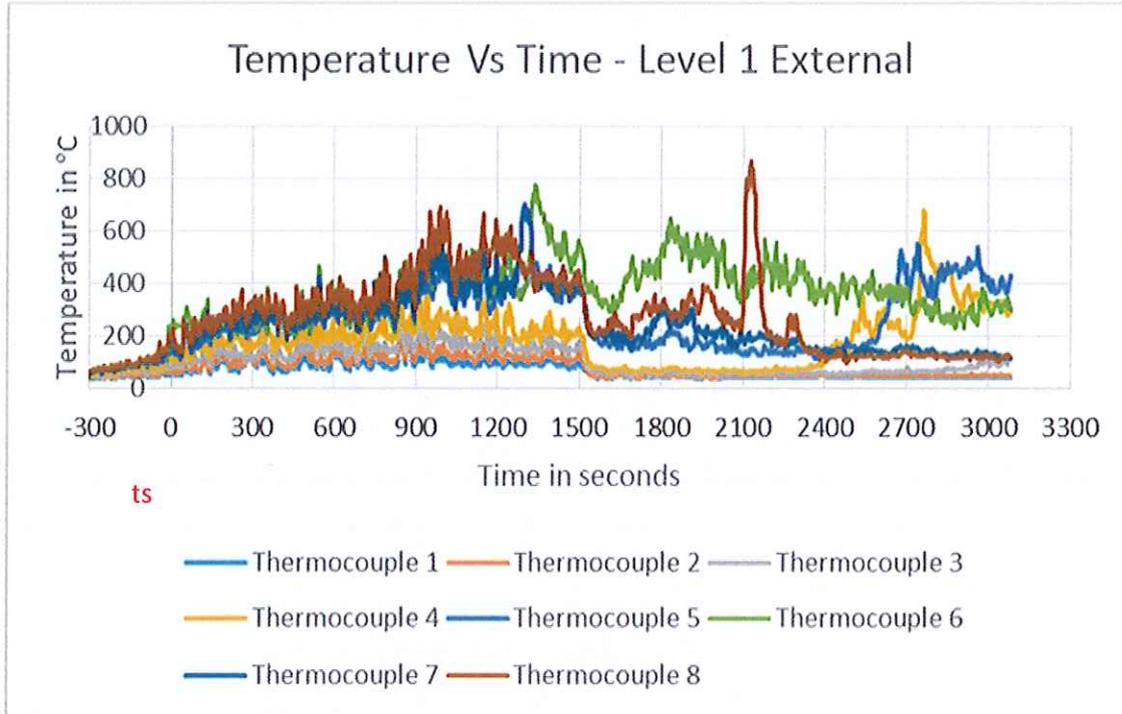
The table below summarises the observations during the test.

**Table 3 Visual Observations During the Test**

Time	Seconds	Observation	Photo Reference
06:37:36	N/A	Ignition of crib	-
06:39:53	N/A	Coating of panel W1 started to peel off.	-
06:40:57	N/A	Flame tip reached above the combustion chamber.	-
06:43:10	N/A	Self-sustained flames on the surface of panel W1.	-
06:43:56	N/A	Coating of panel W2 started to peel off.	DLP C2753E/0001
06:45:56	N/A	Coating of panel M5 started to peel off.	-
06:46:12	00	Start time $t_s$ , 241°C ( $\geq T_s + 200^\circ\text{C}$ ) at thermocouple 6, Level 1 (Wing wall).	-
06:46:19	07	Minor buckling on panels M4 & M5.	-
06:47:30	78	Minor buckling on panel W3.	-
06:48:15	123	Approximately 50% of coating of panels W1 & W2 peeled off.	-
06:51:10	298	Debris started falling off the wing wall.	-
06:52:20	368	Panel M5 partially melted	
06:53:16	424	Aluminium window pod above the combustion chamber buckled.	-
06:53:26	434	Aluminium skin of panel M5 started melting.	-
06:55:26	554	Debris of panel M5 fell off.	-
06:55:51	579	Panel M6 partially melted.	-
06:56:20	608	Self-sustained flames behind panel M5.	DLP C2753E/0002

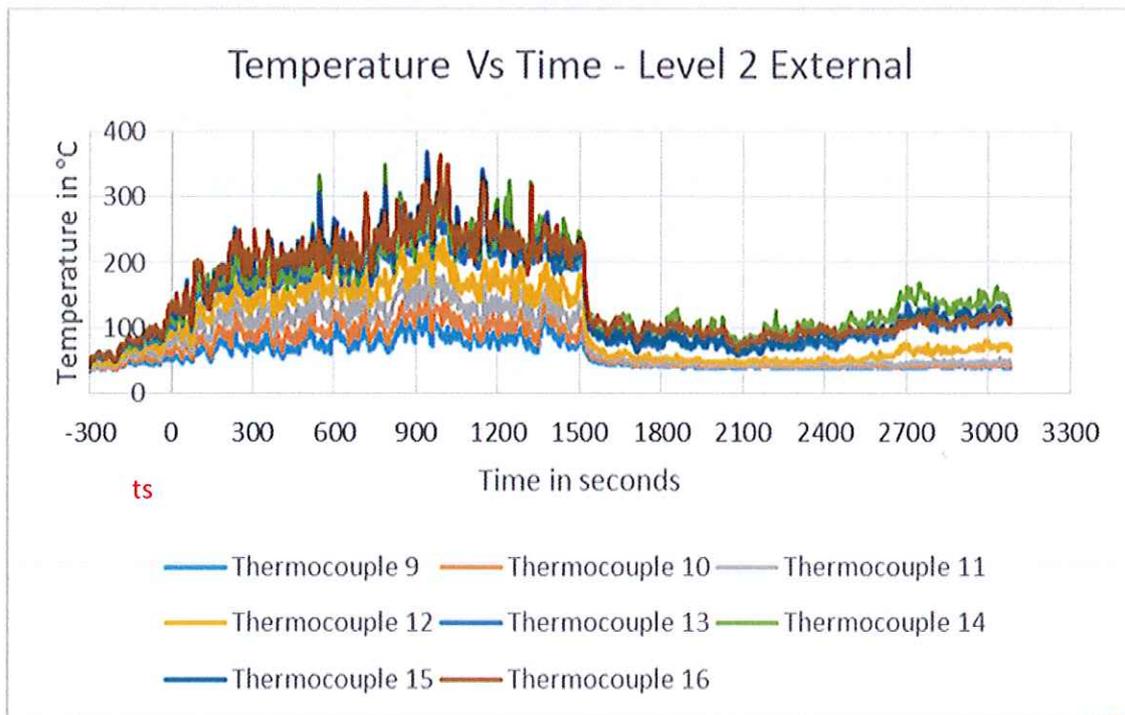
Time	Seconds	Observation	Photo Reference
06:56:27	615	Coating of panel W3 started to peel off.	-
06:56:31	619	Flaming debris fell off the main wall.	DLP C2753E/0003
06:57:07	655	Continuous falling of debris.	
06:57:17	665	Panel W2 partially melted.	DLP C2753E/0004
06:57:38	686	Aluminium debris of panel M5 fell off.	DLP C2753E/0005
06:58:01	709	Panel W2 partially melted and flames on the insulations behind the panel.	DLP C2753E/0006
06:58:22	730	Panels M5 & M6 partially melted and flames behind the panels.	DLP C2753E/0007
06:58:42	750	Self-sustained flames on the insulations behind panel W2.	-
06:58:47	755	Debris of insulation fell off the main wall.	-
06:58:54	762	Aluminium debris of panel W2 fell off.	
06:59:03	771	Sustained flames at panels M5 & M6 vertical joint.	-
06:59:15	783	Flaming debris observed on the floor.	DLP C2753E/0008
06:59:26	794	High intensity flames behind panels M5, M6 & W2.	
07:01:04	892	Continuous falling of flaming debris.	-
07:01:42	930	Railings behind panels M5, M6 & W2 melted.	-
07:01:55	943	Panel W3 started melting.	
07:02:28	976	Approximately 80% of panel W2 consumed.	DLP C2753E/0009
07:03:26	1034	Debris of panel M4 fell off.	-
07:03:38	1046	Flaming debris of panel M5 fell off.	-
07:03:52	1060	Self-sustained flames at panels M6 and W2 internal corner joint.	DLP C2753E/0010
07:04:52	1120	Debris of panel W2 detached and fell off.	-
07:07:36	1284	Heat source was extinguished. Observations continued for another 30 minutes.	-
07:12:35	1583	High intensity flames behind panels M5, W1 & W2.	DLP C2753E/0011
07:17:55	1903	Self-sustained flames behind panel W3.	-
07:27:38	2486	Sustained flames on the face of panel M9.	DLP C2753E/0012
07:37:36	3084	Test was terminated 60 minutes after the ignition.	-

**Figure 5 Thermocouple Readings on Level 1 - External**



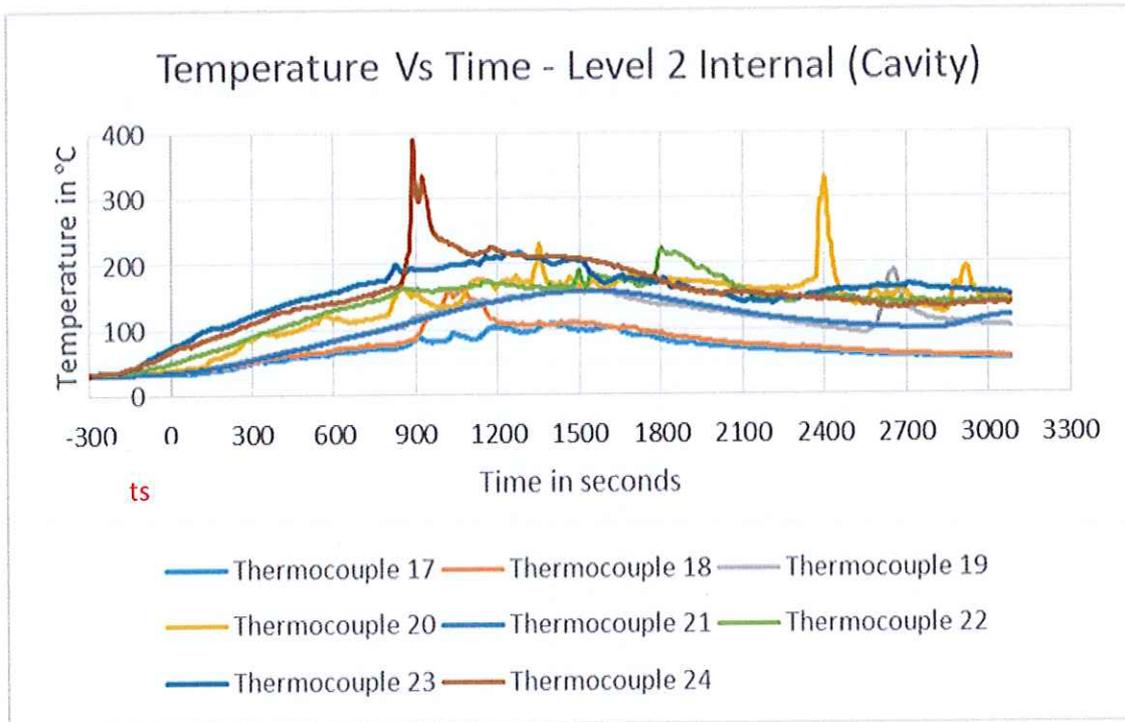
For thermocouple locations see Figure 3 & 4.

**Figure 6 Thermocouple Readings on Level 2 – External**



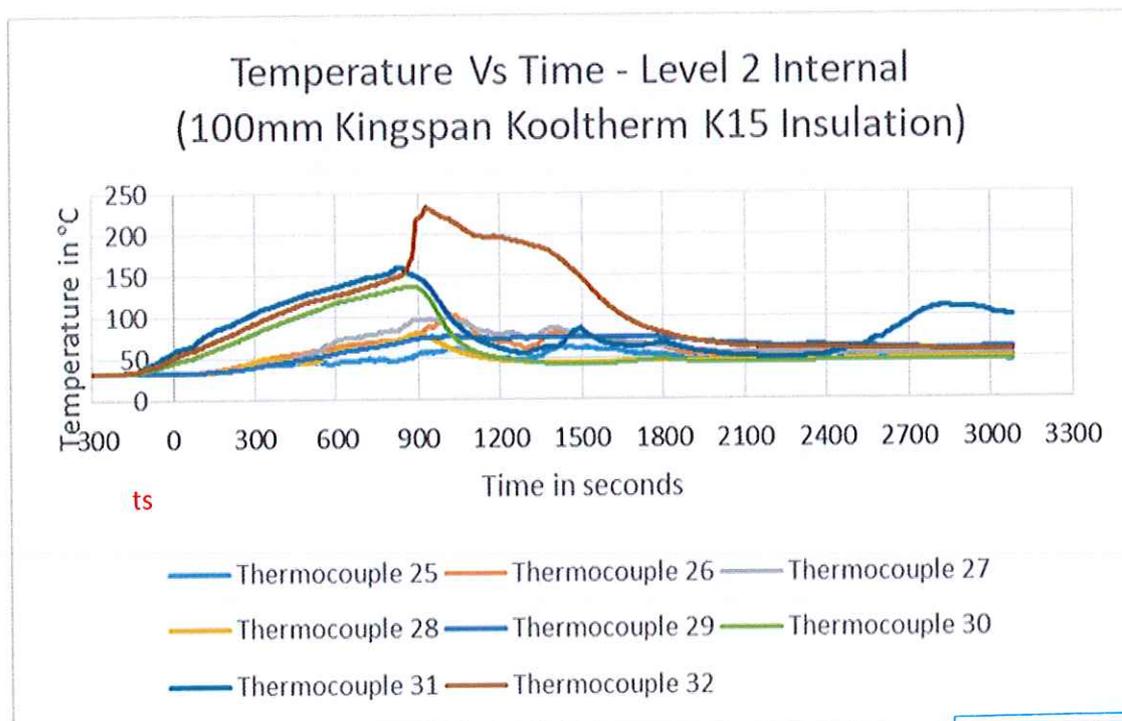
For thermocouple locations see Figure 3 & 4.

**Figure 7 Thermocouple Readings on Level 2 – Internal (Cavity)**



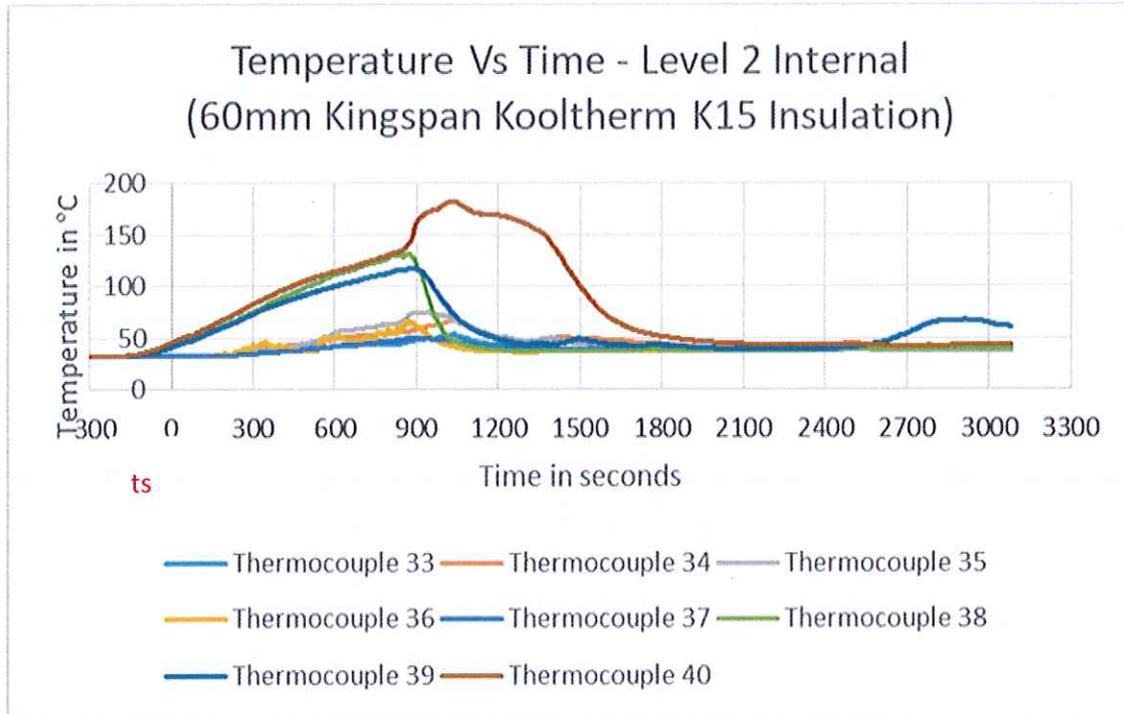
For thermocouple locations see Figure 3 & 4.

**Figure 8 Thermocouple Readings on Level 2 – Internal (Mid-depth of 100mm Kingspan Kooltherm K15 Insulation)**



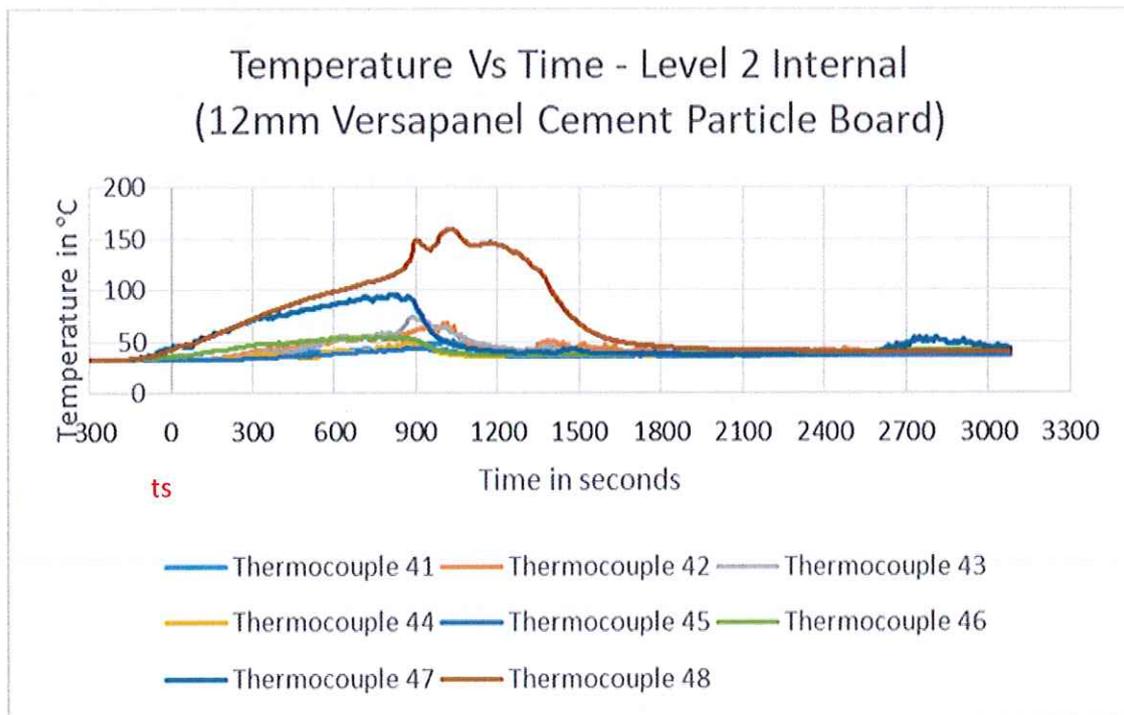
For thermocouple locations see Figure 3 & 4.

**Figure 9 Thermocouple Readings on Level 2 – Internal (Mid-depth of 60mm Kingspan Kooltherm K15 Insulation)**



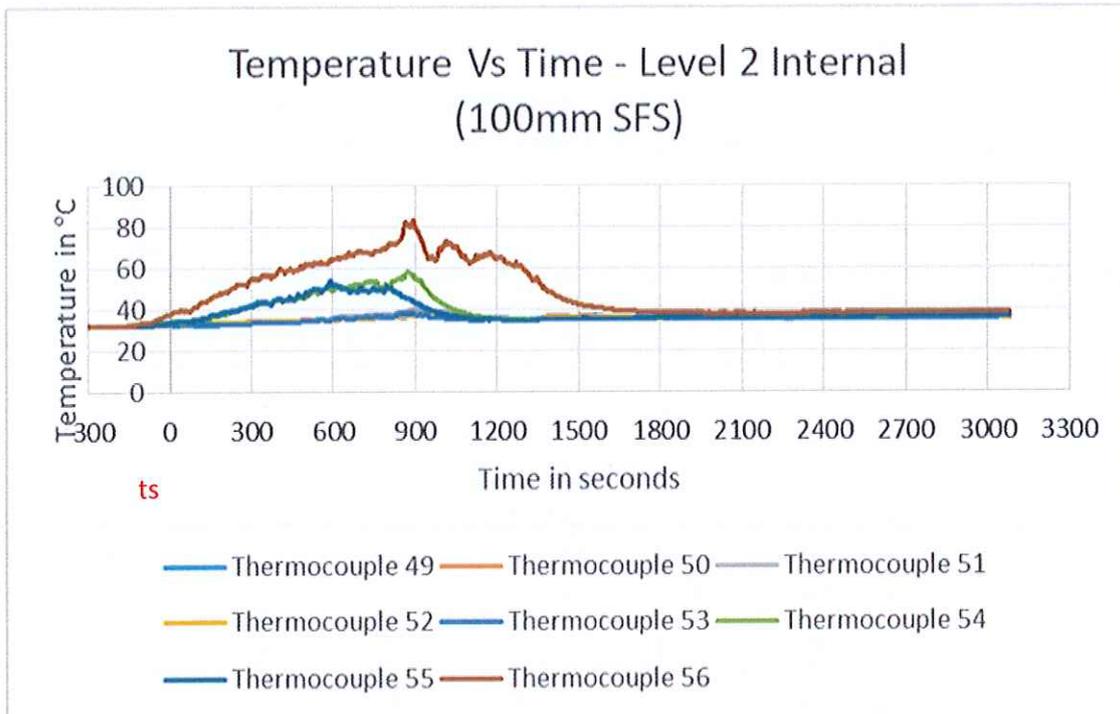
For thermocouple locations see Figure 3 & 4.

**Figure 10 Thermocouple Readings on Level 2 – Internal (Mid-depth of 12mm Versapanel Cement Particle Board)**



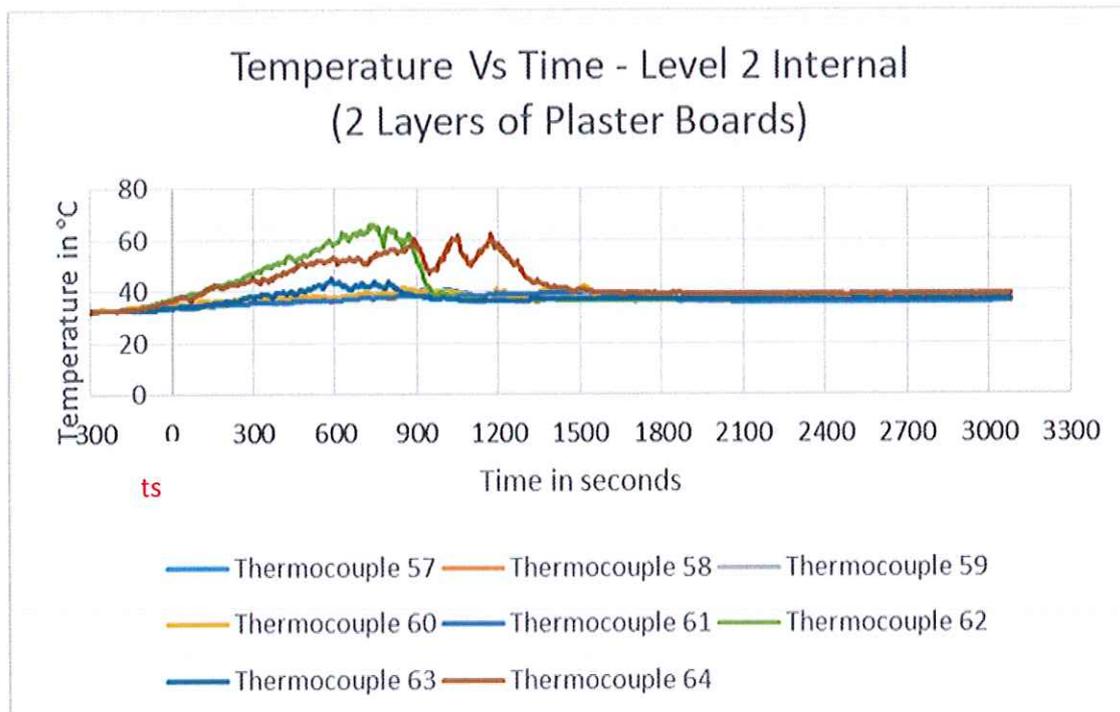
For thermocouple locations see Figure 3 & 4.

**Figure 11 Thermocouple Readings on Level 2 – Internal (Mid-depth of 100mm SFS)**



For thermocouple locations see Figure 3 & 4.

**Figure 12 Thermocouple Readings on Level 2 – Internal (Mid-depth of 2 layers of 12.5mm Plaster Boards)**



For thermocouple locations see Figure 3 & 4.

## 6.1 Post-test Examination

Table 4 below summarises the post-test observations.

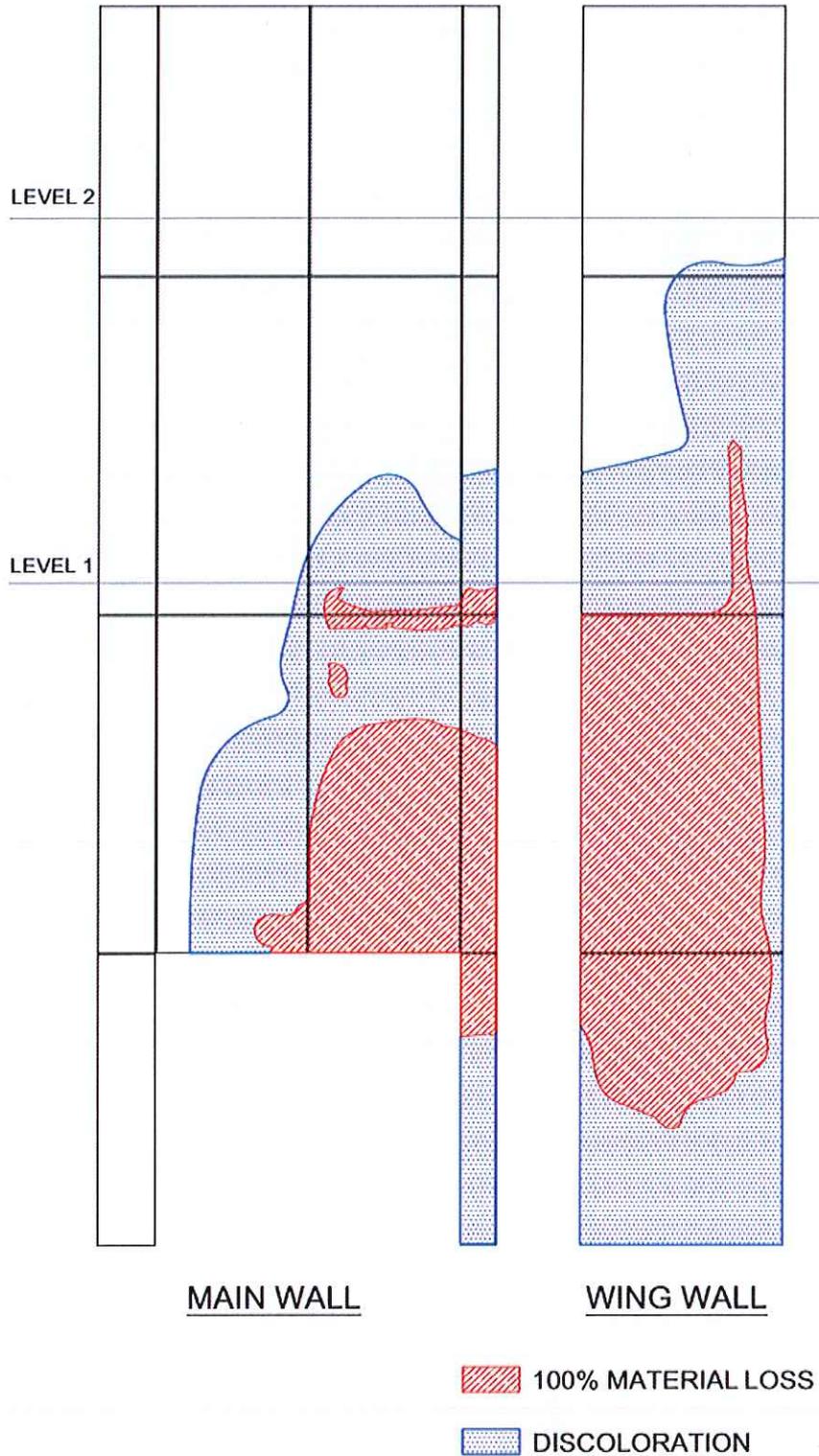
**Table 4 Post-test Observations**

Sl. No.	Components	Observation	Photo Reference
1	ACM panels	<p>Panels M1, M3, M7, M11 &amp; M12 - No changes on the panels.</p> <p>Panels M2, M5 &amp; M6- Approximately 60% material loss on the panels. Remaining areas were buckled and discoloured.</p> <p>Panels M4, M9 &amp; M10– Approximately 10% material loss on the panels. Approximately 30% of the panel discoloured. Remaining areas were buckled.</p> <p>Panels M8, M13 &amp; M14 – Minor discoloration on the panels.</p> <p>Panel W1 - Approximately 40% material loss on the panel. Remaining area was buckled and discoloured.</p> <p>Panel W2 – 100% material loss observed.</p> <p>Panel W3 – Approximately 20% material loss on the panel. Remaining area was buckled and discoloured.</p> <p>Panel W4 - Minor discoloration on the panel.</p>	<p>DLP C2753E/0013.</p> <p>See figure 13 in this section for damaged areas.</p>
2	Cavity barrier	<p><b>Horizontal intumescent cavity barrier:</b></p> <p>Main wall:</p> <p>The 1<sup>st</sup> horizontal cavity barrier at 25mm above the combustion chamber was activated except the cavity barrier behind panel M3. Intumescent layer was not present during dismantling. Material loss observed.</p> <p>The 2<sup>nd</sup> horizontal cavity barrier at 2325mm above the combustion chamber was activated except the cavity barrier behind panel M7 intumescent layer was partially present during dismantling. Material loss observed.</p> <p>The 3<sup>rd</sup> horizontal cavity barrier at 4725mm above the combustion chamber was activated except the cavity barrier behind panels M11 and M12. Intumescent layer was present during dismantling. No material loss observed.</p>	<p>DLP C2753E/0014, DLP C2753E/0017 &amp; DLP C2753E/0018.</p>

Sl. No.	Components	Observation	Photo Reference
		<p>The 4<sup>th</sup> horizontal cavity barrier at 6395mm above the combustion chamber was not activated. The cavity barrier was intact and no material loss observed.</p> <p>Wing wall:</p> <p>The 1<sup>st</sup> horizontal cavity barrier at 2025mm above the ground level was activated. Intumescent layer was not present during dismantling. Material loss observed.</p> <p>The 2<sup>nd</sup> horizontal cavity barrier at 4325mm above the ground level was activated. Intumescent layer was not present during dismantling. Material loss observed.</p> <p>The 3<sup>rd</sup> horizontal cavity barrier at 6725mm above the ground level was activated. Intumescent layer was present during dismantling. No material loss observed.</p> <p>The 4<sup>th</sup> horizontal cavity barrier at 8395mm above the ground level was not activated. The cavity barrier was intact and no material loss observed.</p> <p><b>Vertical cavity barrier:</b></p> <p>Buckling and discoloration on the vertical cavity barriers. Material loss observed.</p>	
3	Kingspan Kooltherm K15 insulation	<p>Insulation behind panels M4, M5, M6, M9, M10, W1, W2 &amp; W3 was burned and left as char.</p> <p>Minor discoloration on the insulation behind panels M8, M13, M14 &amp; W4.</p> <p>All other insulation was in place and no significant changes observed.</p>	DLP C2753E/0014 & DLP C2753E/0018.
4	Vertical railings	<p>Main wall:</p> <p>Railings behind panels M4, M5, M6 &amp; M9 were partially melted.</p> <p>Minor discoloration on the railings behind panels M10 &amp; M14.</p> <p>All other railings on the main wall were in place and no damage was observed.</p> <p>Wing wall:</p> <p>Railings behind panels W1, W2 &amp; W3 were partially melted.</p> <p>Minor discoloration was observed on the remaining railings on the wing wall.</p>	DLP C2753E/0014 & DLP C2753E/0018.

Sl. No.	Components	Observation	Photo Reference
5	Brackets and Nilvent breather membrane	<p>Top Hat bracket:</p> <p>Discoloration on the brackets behind panels M4, M5, M6, W1 &amp; W2. No significant changes on the remaining brackets.</p> <p>Helping Hand bracket:</p> <p>Approximately 5% of the Helping Hand brackets were partially melted. All other brackets were in place and no significant changes observed.</p> <p>Breather membrane:</p> <p>Minor material loss and discoloration on the Nilvent breather membrane observed.</p>	DLP C2753E/0015 & DLP C2753E/0019.
6	12mm Versapanel cement particle board	Minor discolouration on the cement particle board behind panels M5, M6, M14 & W2. No significant changes on the remaining boards.	DLP C2753E/0016.
7	SFS and plaster boards	No significant changes.	

Figure 13 Area Map Showing the Condition of the Sample After the Test



- Approximately 6m<sup>2</sup> of the total external visible area was completely consumed.
- Approximately 7m<sup>2</sup> of the total external visible area was discoloured.

## Appendix A

# Photographs

*Note: Any warp in the images is due to the fish eye effect of the camera.*

### Pre-test Phase

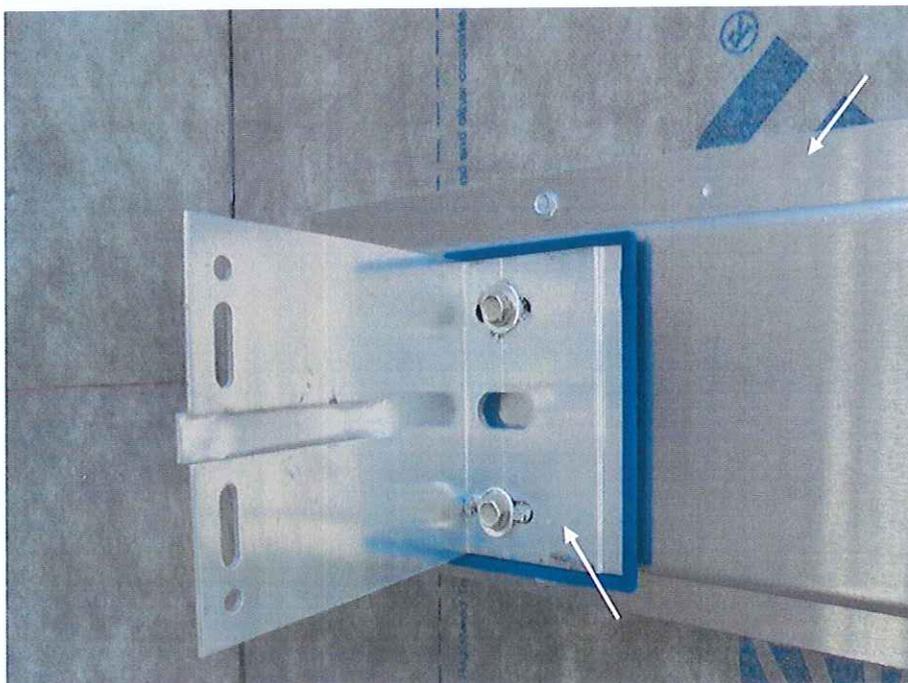


DLP C2753E/5990

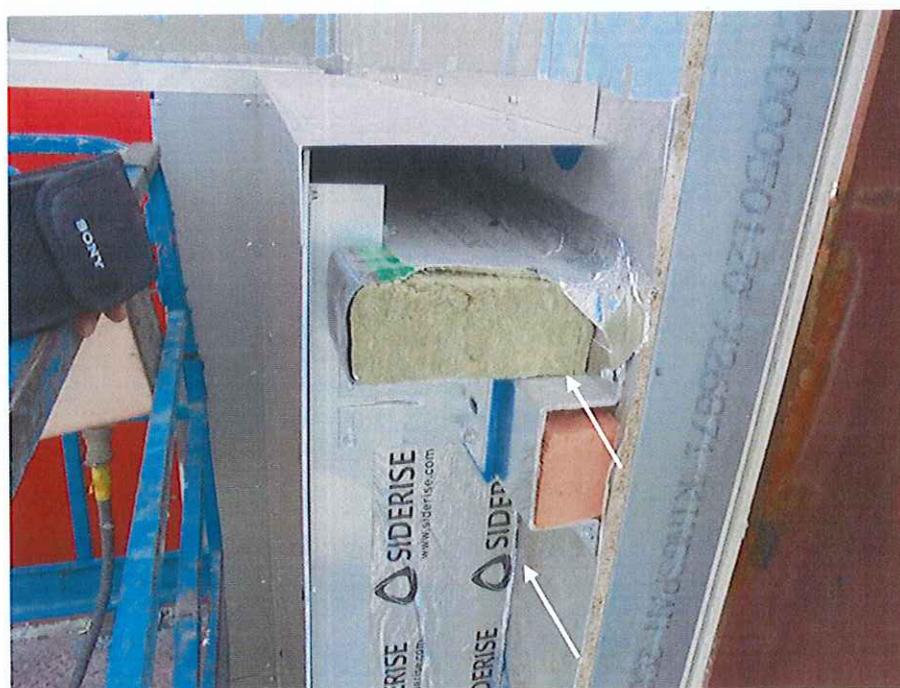
Versapanel cement particle board with Nilvent breather membrane, Top Hat and Helping Hand brackets



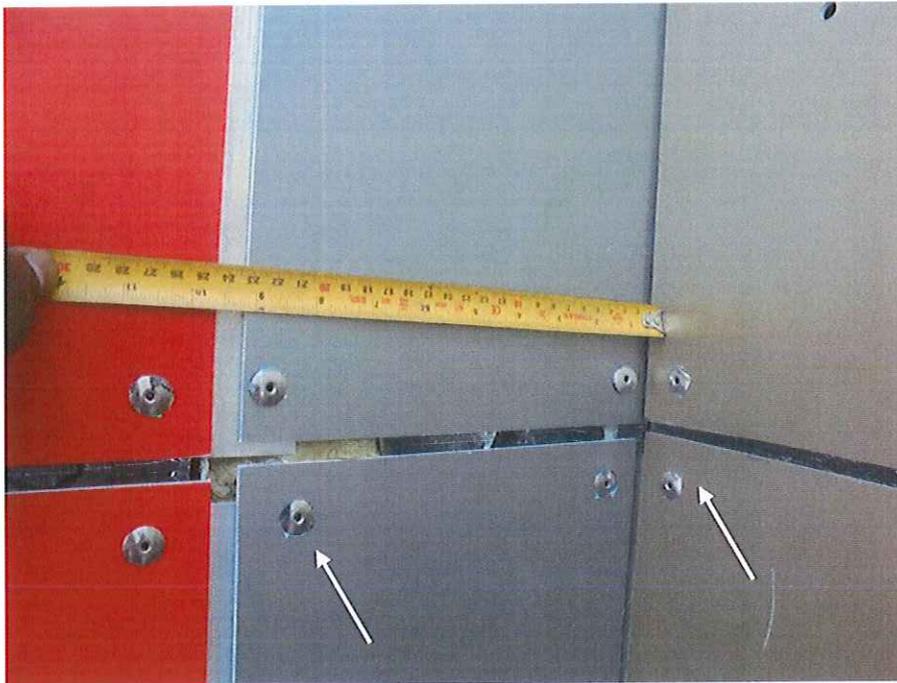
DLP C2753E/6571 Cavity barriers, Kingspan K15 insulation and carrier railings



DLP C2753E/6014 Top Hat and Helping Hand brackets

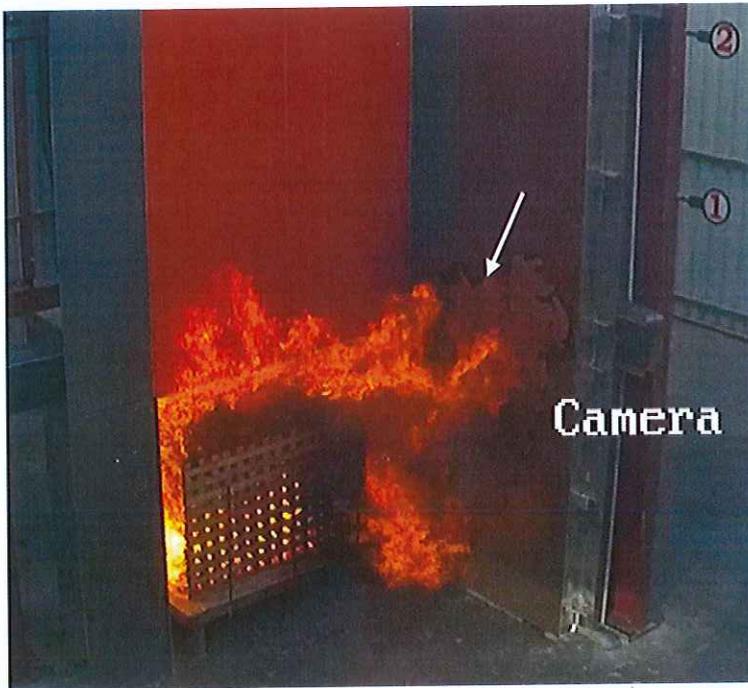


DLP C2753E/6165 Horizontal and vertical cavity barriers

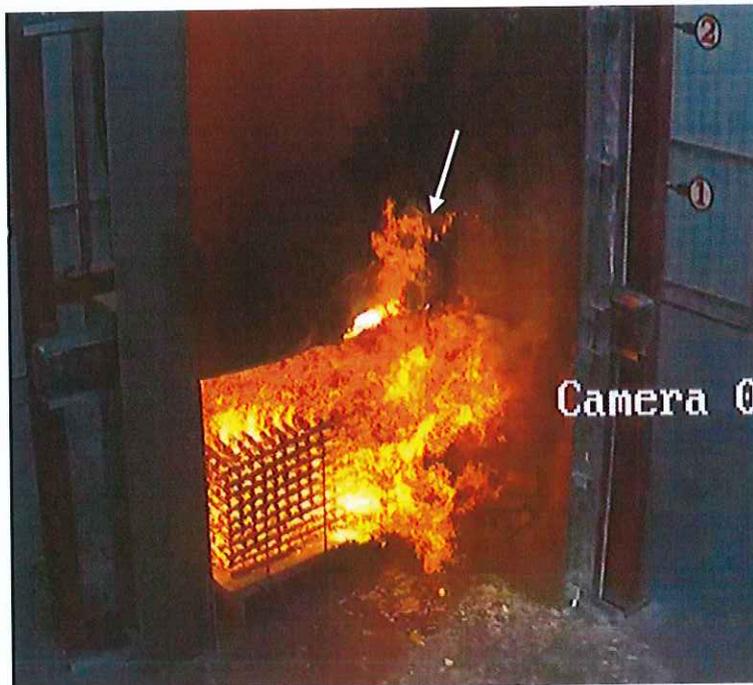


DLP C2753E/6157 ACM panel fixing

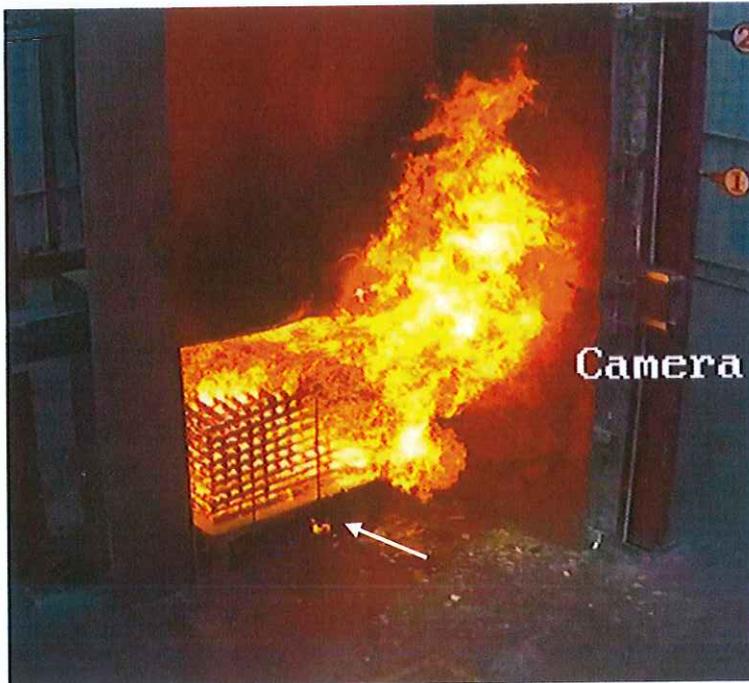
Testing Phase



DLP C2753E/0001 Coating of panel W2 started to peel off.



DLP C2753E/0002 Self-sustained flames behind panel M5.



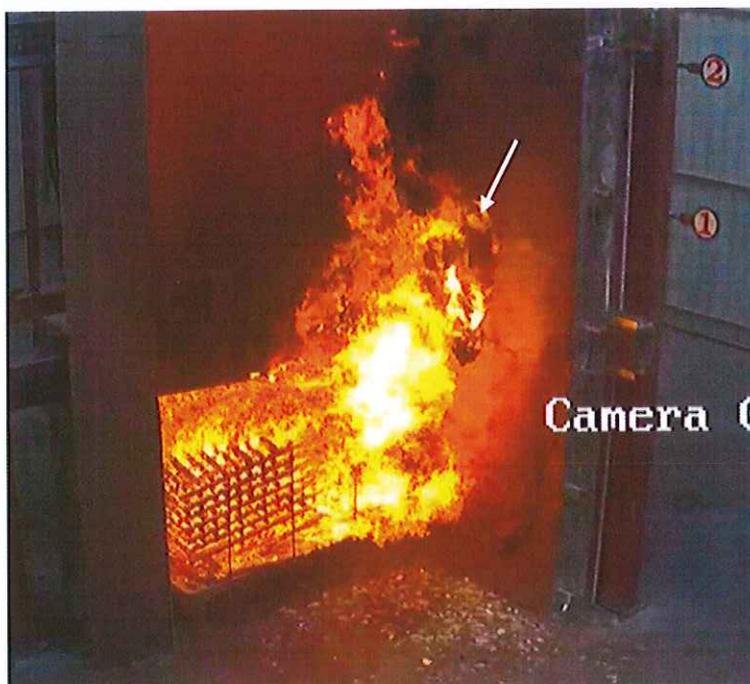
DLP C2753E/0003 Flaming debris fell off the main wall.



DLP C2753E/0004 Panel W2 partially melted.



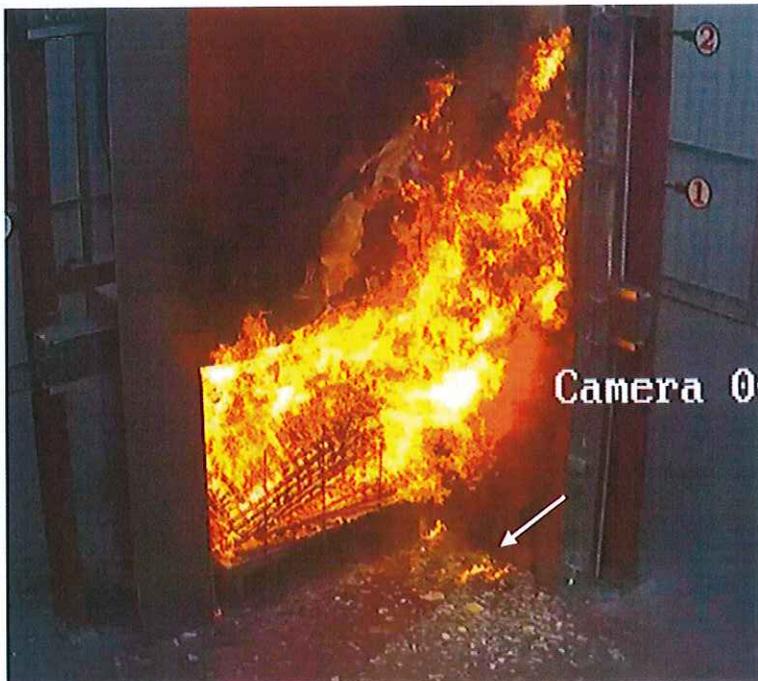
DLP C2753E/0005 Aluminium debris of panel M5 fell off.



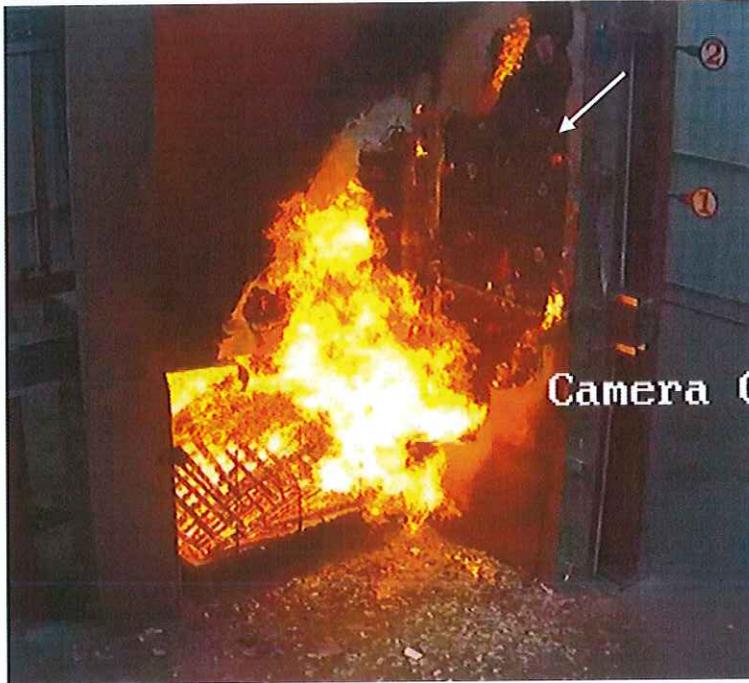
DLP C2753E/0006 Panel W2 partially melted and flames on the insulation behind the panel.



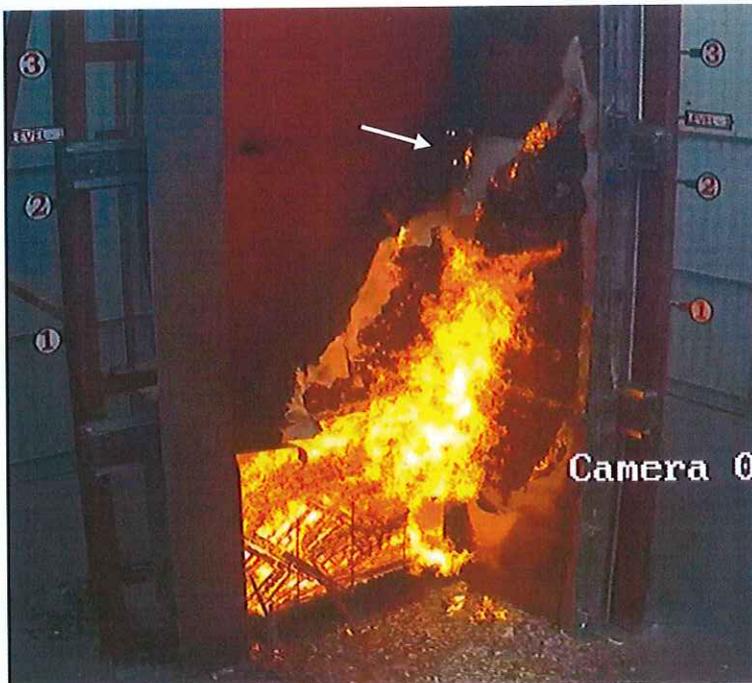
DLP C2753E/0007 Panels M5 & M6 partially melted and flames behind the panels.



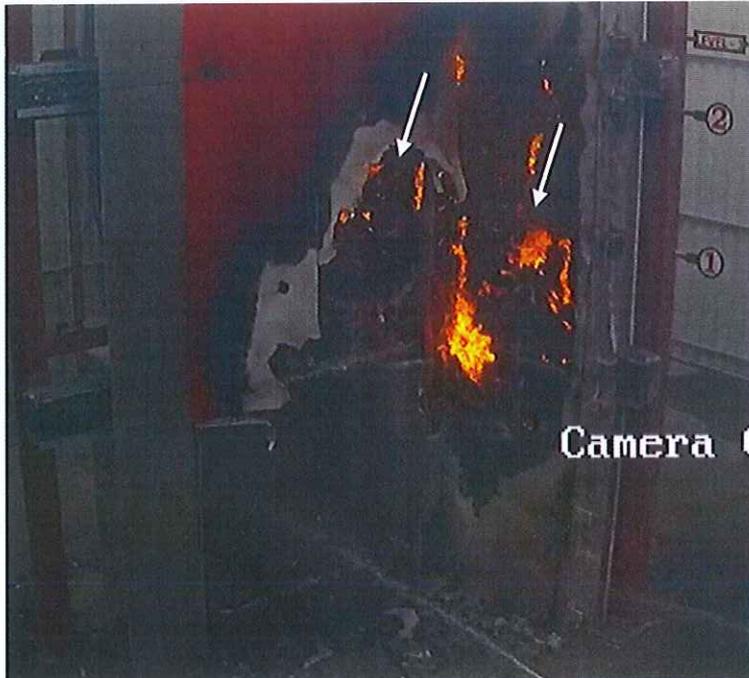
DLP C2753E/0008 Flaming debris observed on the floor.



DLP C2753E/0009      Approximately 80% of panel W2 consumed.



DLP C2753E/0010      Self-sustained flames at panels M6 and W2 internal corner joint.



DLP C2753E/0011 High intensity flames behind panels M5, W1 & W2.



DLP C2753E/0012 Sustained flames on the face of panel M9.

## Post-Test Phase



DLP C2753E/0013 View of the sample after the test

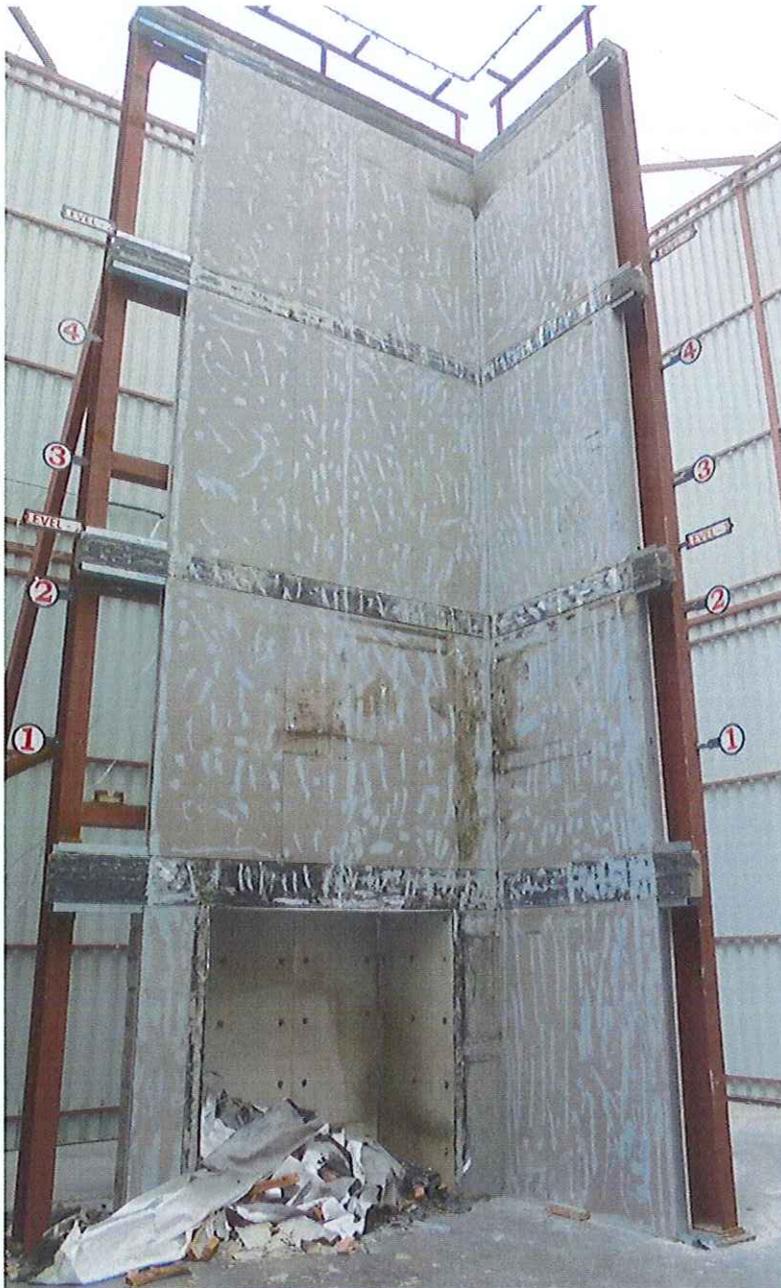


DLP C2753E/0014

Cavity barriers, Kingspan insulation and carrier railings

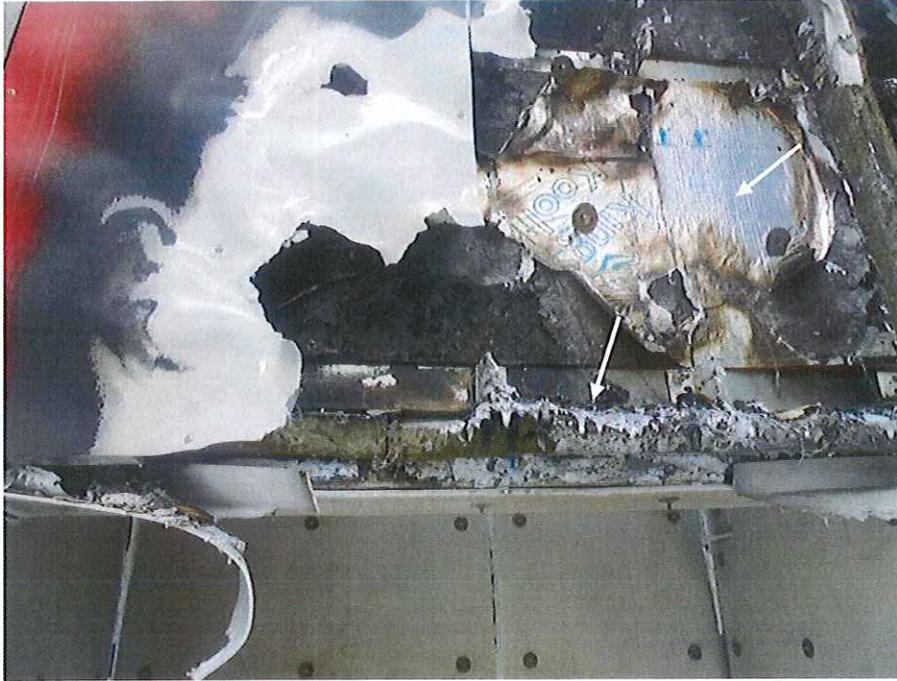


DLP C2753E/0015 Brackets and Nilvent breather membrane



DLP C2753E/0016

Versapanel cement particle board



DLP C2753E/0017 Cavity barrier and insulation above the combustion chamber



DLP C2753E/0018 Cavity barriers, Kingspan insulation and carrier rails on wing wall



DLP C2753E/0019

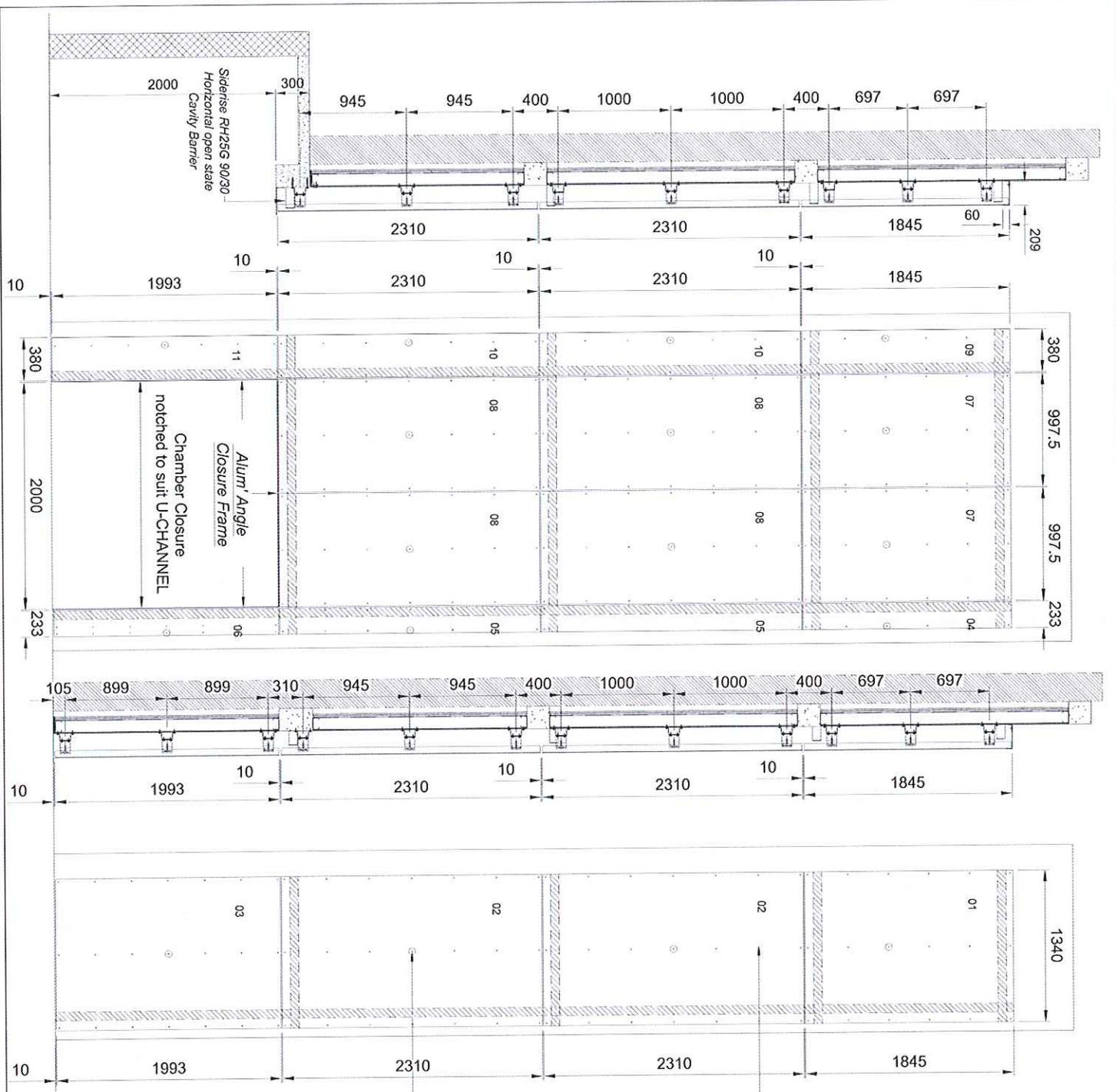
Helping Hand bracket

## Appendix B

# Drawings

The following four un-paginated sheets are copies of Kingspan Insulation Ltd. drawings numbered:

- L5 Rev. 05
- L5A Rev. 05
- DT5 Rev. 05
- DT5\_2 Rev. 05



**Important Notes**

Panel: 4mm THK Alpoic A2 ACM  
 System: BML400  
 Finish: - Traffic Red & Medium Bronze

All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

**REFERENCE DRAWINGS**

SYSTEM: BOOTH MUIRE BML400 RIVET FIXED-10MM JOINT			
INSULATION: 160mm Kingspan K15			
CAVITY BARRIER: SIDERISE RSV 90/30 & RH25G 90/30			
TEST	ACM	Classification - EN 13501	Screening Results Finish/Colour
5	Alpoic A2	A2, s1,d0	TBC Anodized Look C31

**FIXED POINT**  
 6mm Ø Hole

**DT01** Elevation Layout Test 5 SFS  
 Scale 1:40@A3



05 08.01.19 Updated as per Comments  
 04 27.04.18 Updated as per Comments  
 03 12.03.18 Changes/Revised  
 02 13.02.18 Subcontractor revised  
 01 17.01.18 Final Issue

Rev# Date Alteration Initial

**boothmuire**  
 Architectural Cladding Systems

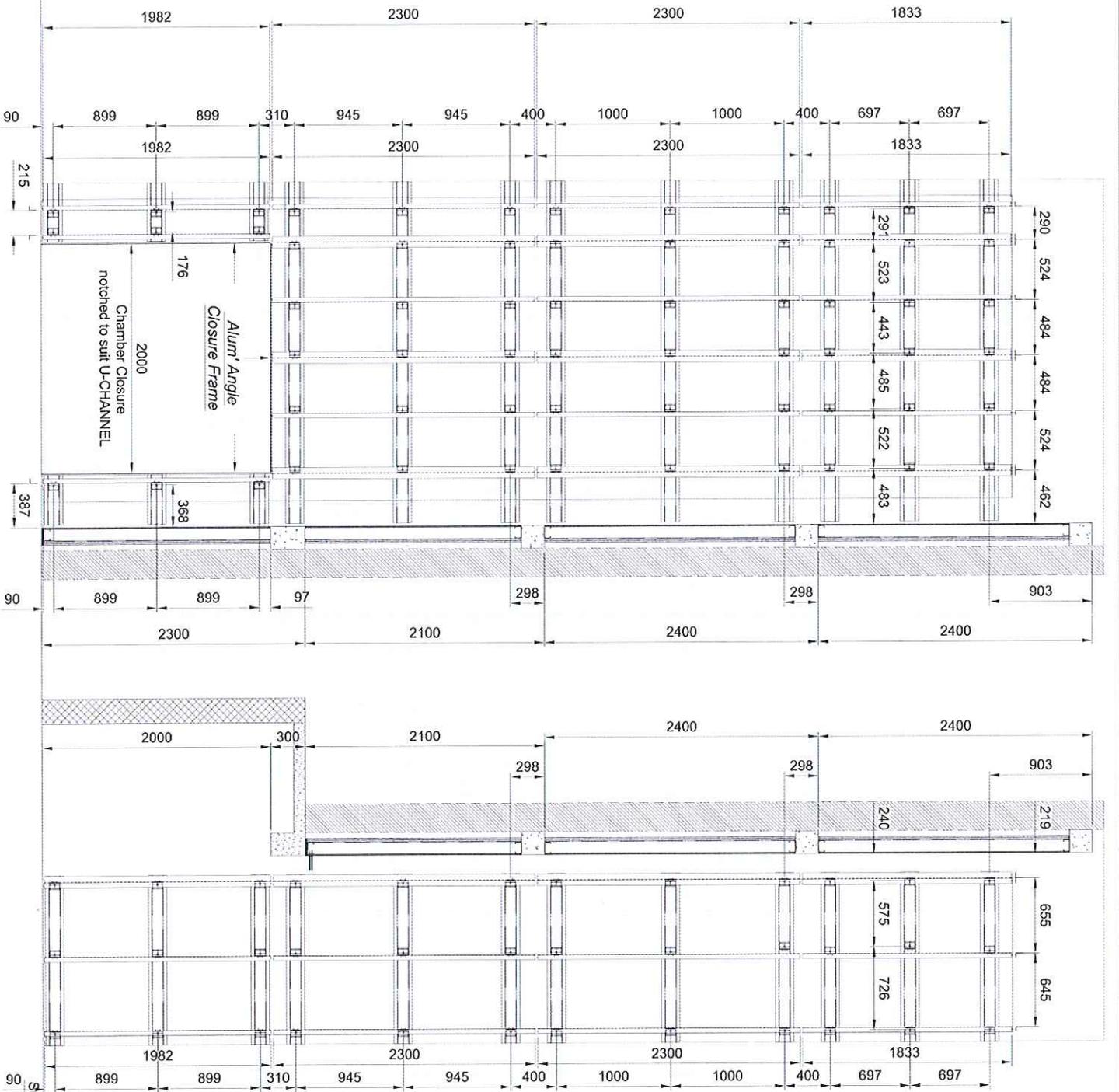
Calder House  
 500m  
 Market Street  
 T: 01236 345 500  
 F: 01236 345 515  
 W: www.boothmuire.co.uk

**A EUROCAD COMPANY**

Client: KINGSPAN  
 Project: 160mm Kingspan K15 - Alpoic A2 ACM - BML400  
 Title: Panel Elevations

Drawn By: GI  
 Scale: 1:40 @ A3  
 Date: 08/01/19  
 Job No: Trel 5 SFS  
 Draw No: 15 Rev/05  
 CAD Date: Trel 5 SFS.dwg

**FOR APPROVAL**

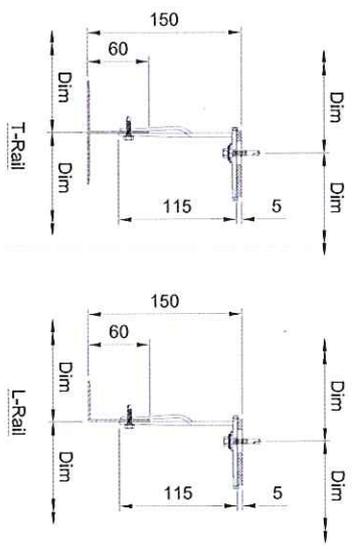


Support Elevation Layout Test 5 SFS DT01A  
Scale 1:35@A3



This Drawing to be read in conjunction with DT-L5 + DT5 & 5\_2

SET OUT POINTS RAILS/BRACKETS



**Important Notes**  
 Panels: 4mm THK Alpolic A2 ACM  
 System: BML400  
 Finish: - Traffic Red & Medium Bronze  
 All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

**REFERENCE DRAWINGS**

Rev	Date	Author	Initial
05	08.01.19	Updated as per Comments	GI
04	27.04.18	Updated as per Comments	GI
03	12.03.18	Detail Amended	SC
02	13.02.18	Substructure revised	SC
01	23.02.18	Final Issue	GI

**boothmurie**  
 Architectural Cladding Systems

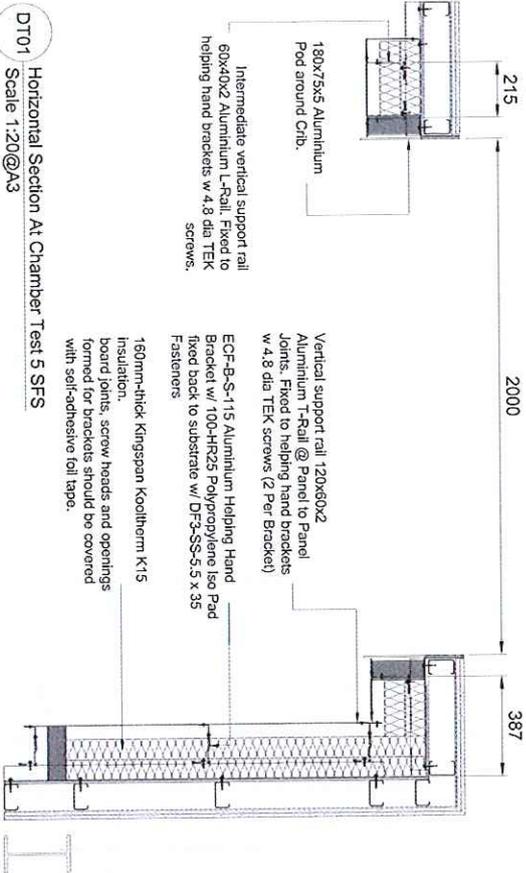
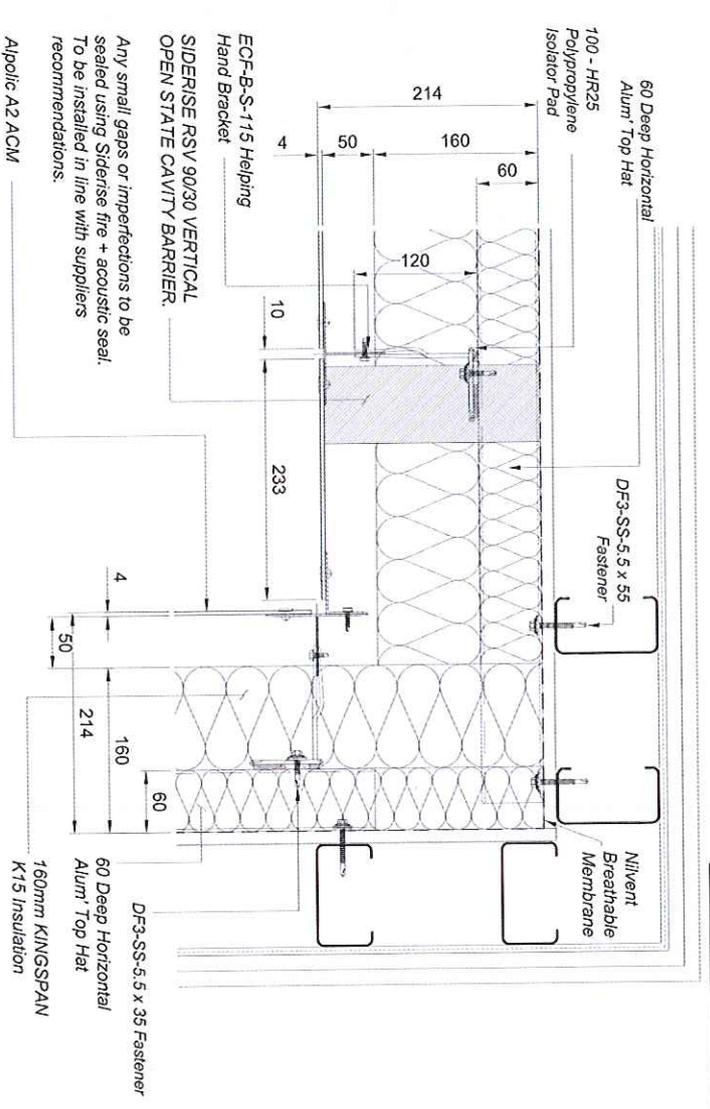
Callier House  
 South Colindale Road, Colindale  
 M.L.S 4EG  
 T: 01208 345 390  
 F: 01208 345 344  
 W: www.boothmurie.co.uk

**A EUROCLAD COMPANY**  
 KINOSPAN  
 Project: 100mm Kinobeam K15 - Alpolic A2 ACM - BML400  
 Title: Sub-Card Layouts  
 Drawn By: GI  
 Checked By: Nick Jenkins  
 Scale: 1: @ A3  
 Date: Feb 2018  
 Job No: Test 5 SFS  
 Draw No: L5A  
 Rev: 05  
 CAD Ref: Test 5S.dwg  
 FOR APPROVAL

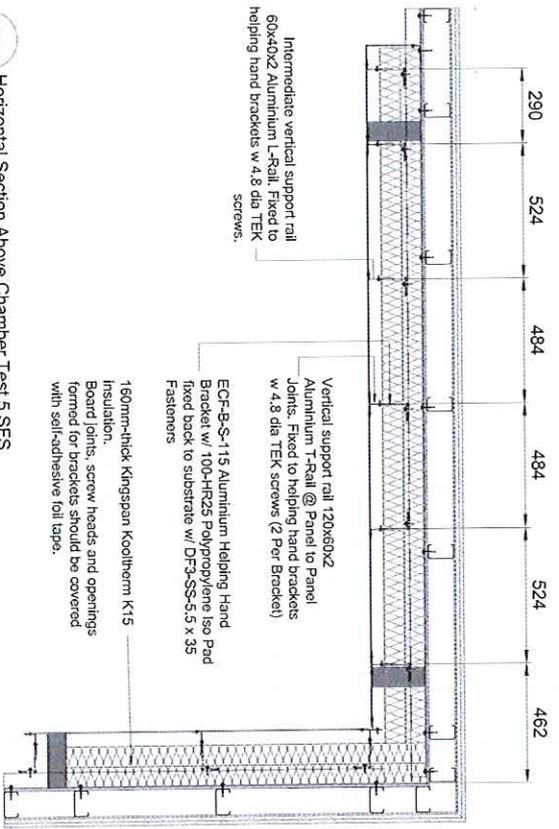
REFERENCE DRAWINGS

**Important Notes**  
 Panels: 4mm THK Alpolic A2 ACM  
 System: BML400  
 Finish: - Traffic Red & Medium Bronze  
 All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

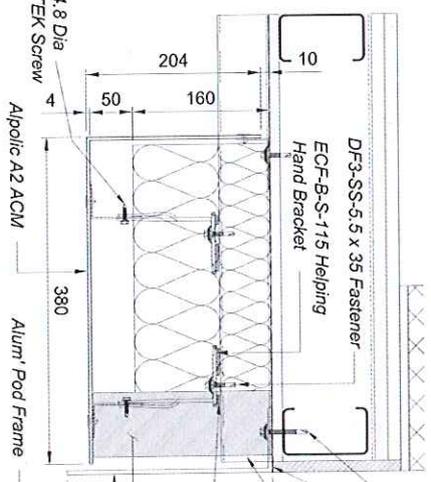
DT03 Horizontal Section Internal Corner Test 5 SFS  
 Scale 1:5@A3



DT01 Horizontal Section At Chamber Test 5 SFS  
 Scale 1:20@A3



DT02 Horizontal Section Above Chamber Test 5 SFS  
 Scale 1:20@A3



DT04 Enlarged Jamb Detail Test 5 SFS  
 Scale 1:6@A3

Rev.	Date	Author	Initial
05	08.01.19	Updated as per Comments	GI
04	27.04.18	Updated as per Comments	GI
03	12.03.18	Detail amended	SC
02	12.02.18	Substitution invited	SC
01	07.01.18	Final Issue	GI

**boothmire**  
 Architectural Cladding Systems

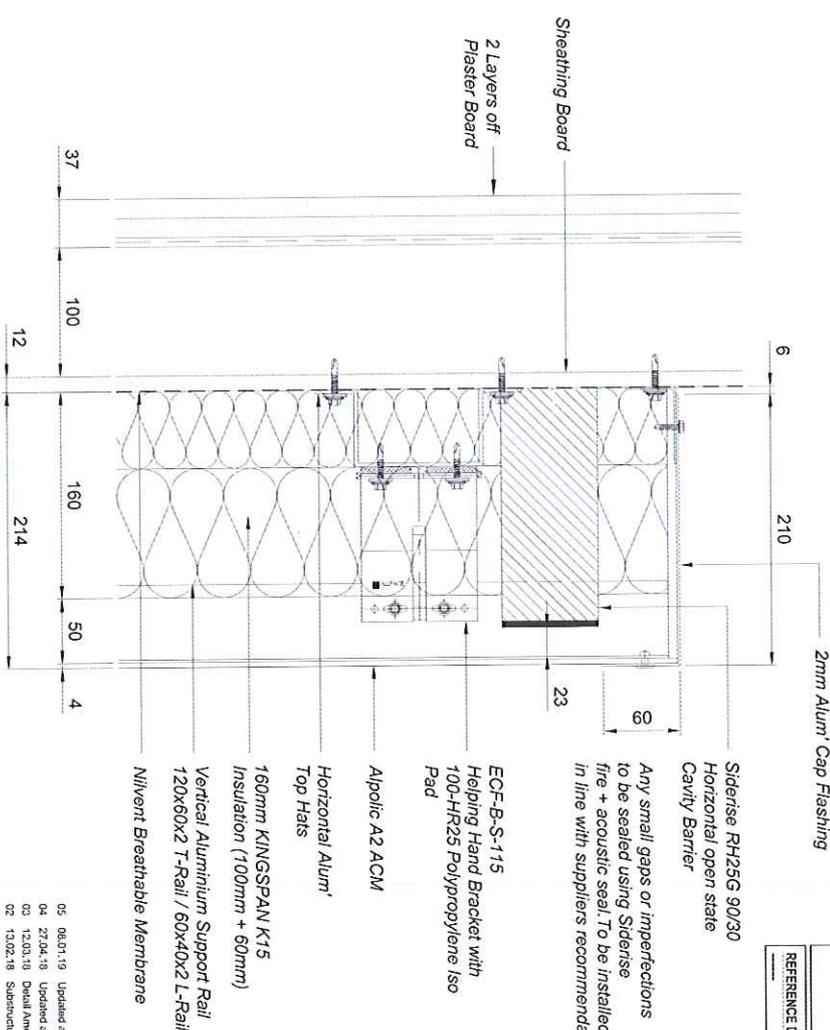
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 Project: 160mm Kingspan K15 - Alpolic A2 ACM - BML400  
 Title: Details 1 - 4

Drawn By: GI  
 Scale: 1: @ A3  
 Date: Jan 2018  
 Job No: Test 5 SFS  
 DWG No: DT5  
 Rev: 05  
 CADD Ref: Test 08/2018

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**DT06** Vertical Section At Head of Rig Test 5 SFS  
Scale 1:4@A3

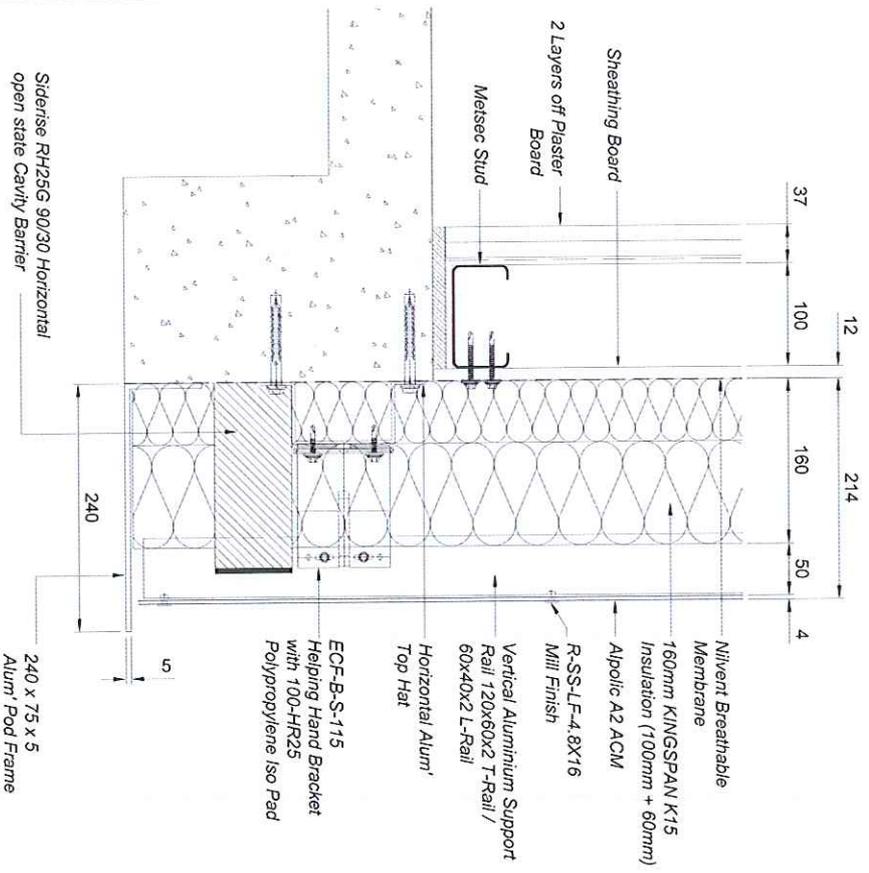


**Important Notes**  
 Panels: 4mm THK Alpicolic A2 ACM  
 System: BML400  
 Finish: - Traffic Red & Medium Bronze  
 All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

**REFERENCE DRAWINGS**

Any small gaps or imperfections to be sealed using Siderise fire + acoustic seal. To be installed in line with suppliers recommendations.

**DT05** Vertical Section At Head of Chamber Test 5 SFS  
Scale 1:5@A3



Any small gaps or imperfections to be sealed using Siderise fire + acoustic seal. To be installed in line with suppliers recommendations.

Rev	Date	Alteration	Initials
05	08.01.19	Updated as per Comments	GI
04	27.04.18	Updated as per Comments	GI
03	13.03.18	Detail Amended	SC
02	13.02.18	Substructure revised	SC
01	17.01.18	Final Issue	GI

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**A EUROCAD COMPANY**  
 Client: KINGSPAN  
 Project: 160mm Keelbeam K15 - Alpicolic A2 ACM - BML400  
 Title: Details 5 & 6  
 Drawn By: GI  
 Scale: 1:5@A3  
 Date: Jan 2018  
 App No: Trial 5 SFS  
 Draw No: DT5\_2\_Rev05  
 CAD Ref: Trial 50.dwg  
 AS



**FOR APPROVAL**

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**Table 5 Document Status**

Rev No.	Author	Reviewed & Approved for Issue		
		Name	Signature	Date
0	Arun Kumar M	Manoj Kumar Lab. Manager		14/01/2019