

**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. : DLR1567 Rev.0**  
**Sample : 160mm Kingspan Kooltherm K15 - Alpolic A2 ACM**  
**Cassette Panel– BML100**



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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 / C2753I

The test sample consisted of external wall cladding system (160mm Kingspan Kooltherm K15 - Alpollic A2 ACM Cassette Panel – BML100) installed by European Aluminium Systems on behalf of Kingspan Insulation Ltd.

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## 1.1 Purpose of Testing

The test was carried out on 18<sup>th</sup> July 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 DMC2753I/MSrev0, which was in accordance with the following standards:

- 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 14 for the thermocouple locations & numbers.

Parameters	Temperature Data / Observations
T <sub>s</sub> , start temperature	29°C
t <sub>s</sub> , start time	81 seconds after ignition of the crib (thermocouple 3)
Peak temperature & time at Level 2 (External)	781°C at 978 seconds from t <sub>s</sub> (thermocouple 11)
Peak temperature / time at Level 2 (Mid-depth of cavity)	770°C at 3516 seconds from t <sub>s</sub> (thermocouple 22)
Peak temperature / time at Level 2 (Mid-depth of 100mm Kingspan Kooltherm K15 insulation)	803°C at 3048 seconds from t <sub>s</sub> (thermocouple 27)
Peak temperature / time at Level 2 (Mid-depth of 60mm Kingspan Kooltherm K15 insulation)	452°C at 3519 seconds from t <sub>s</sub> (thermocouple 35)
Peak temperature / time at Level 2 (Mid-depth of 12mm Versapanel Cement Particle Board)	199°C at 3519 seconds from t <sub>s</sub> (thermocouple 43)
Peak temperature / time at Level 2 (Mid-depth of 100mm SFS)	84°C at 3084 seconds from t <sub>s</sub> (thermocouple 54)
Peak temperature / time at Level 2 (Mid-depth of 2 layers of 12.5mm Plaster Board)	48°C at 1641 seconds from t <sub>s</sub> (thermocouple 61)

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.
- ❖ Siderise cassette insert
- ❖ 160mm Kingspan Kooltherm K15 insulation built with a layer of 100mm and 60mm.
- ❖ Horizontal aluminium Top hat
- ❖ ECF-B-S-220 Helping Hand bracket.
- ❖ Aluminium 'Y' rail
- ❖ 4mm thick Alpolic A2 composite panel.

The sample dimensions were:

Main wall – 2615mm wide x 8555mm high.

Wing wall -1315mm wide x 8555mm 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 220mm.

Photo DLP C27531/2258 below shows an external view of the sample.



Figure 1 Photo DLP C2753I/2258 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 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.  See photo DLP C2753I/1897 in Appendix A.	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 C2753I/1905 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 C2753I/2008 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  <b>Helping Hand bracket:</b> ECS-B-S-100 Helping hand bracket with 100-HR25 Polypropylene isopad  <b>Railings:</b> 97x79x2mm aluminium vertical Y-rail  See photos DLP C2753I/2008 & DLP C2753I/2019 in Appendix A.	Horizontal 'aluminium Top hat brackets were fixed to the SFS through the sheathing board with DF3-SS-5.5x35mm steel screws.  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 C2753I/2049 & DLP C2753I/2051 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 75mm, 2325mm 4670mm and 6320mm above combustion chamber.

	<b>Vertical cavity barrier:</b> Siderise RSV-90/30 vertical cavity barrier See photos DLP C2753I/2049 & DLP C2753I/2051 in Appendix A.	The vertical cavity barriers were fixed to the SFS through the sheathing board with DF3-SS-5.5x35mm steel screws.  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.
	<b>Cassette insert:</b> Siderise cassette insert 100x50mm See photo DLP C2753I/2082 in Appendix A.	Siderise inserts were placed at the folding of the ACM panels at cavity barrier locations.
Thermal Insulation	160mm thick Kingspan Kooltherm K15 insulation built with a layer of 100mm and 60mm.  See photos DLP C2753I/2049 & DLP C2753I/2051 in Appendix A	Kingspan Kooltherm K15 insulations were fixed to the sheathing boards with plastic and steel pins.  Self-adhesive foil tape was provided at the joints, perimeter of the insulation boards.
Panels	4mm thick Alpollic A2 composite panel. Top – Aluminium Skin Core – Mineral Filled Core Bottom – Aluminium Skin See photo DLP C2753I/2096 in Appendix A.	Cladding panels were hooked on to the vertical 'Y' railings with hook clips.  20mm joints were provided between the panels.

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: 08<sup>th</sup> to 16<sup>th</sup> July 2018

Ambient temperature range: 24 - 36°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 test wall at 150mm, 600mm and 1050mm from the finished face of the main test wall face (three locations).

#### 4.4 Audio Visual Equipment

A continuous audio-visual record of the condition of the full height of the test faces was taken throughout the period of the test. Both the external and internal faces of the test specimen was monitored.

**Figure 2 Schematic View of the Test Rig**

Note: All dimensions are in mm, the drawing is not to scale

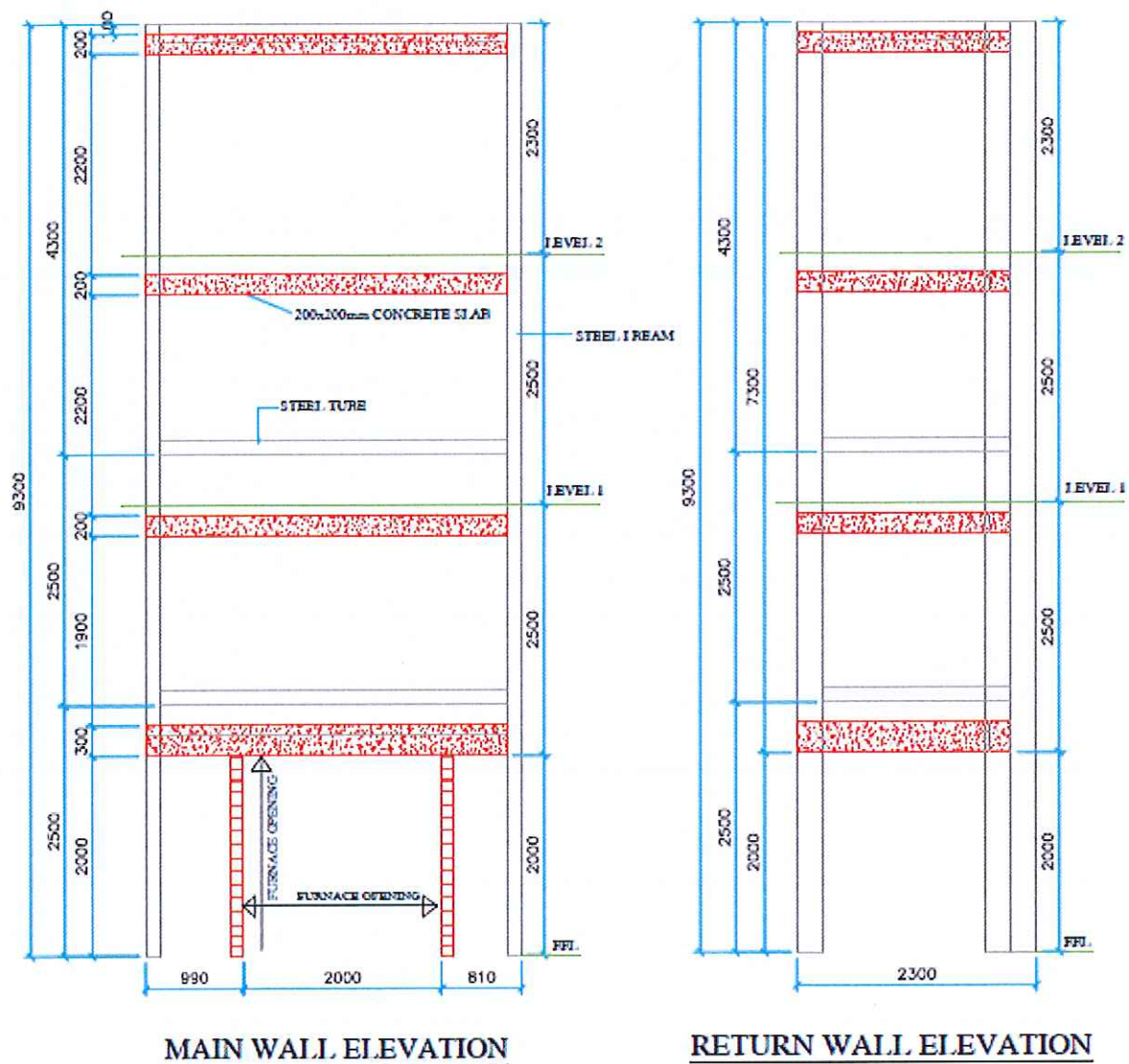




Figure 3 Thermocouple, Cavity Barrier Locations & Panel Numbering

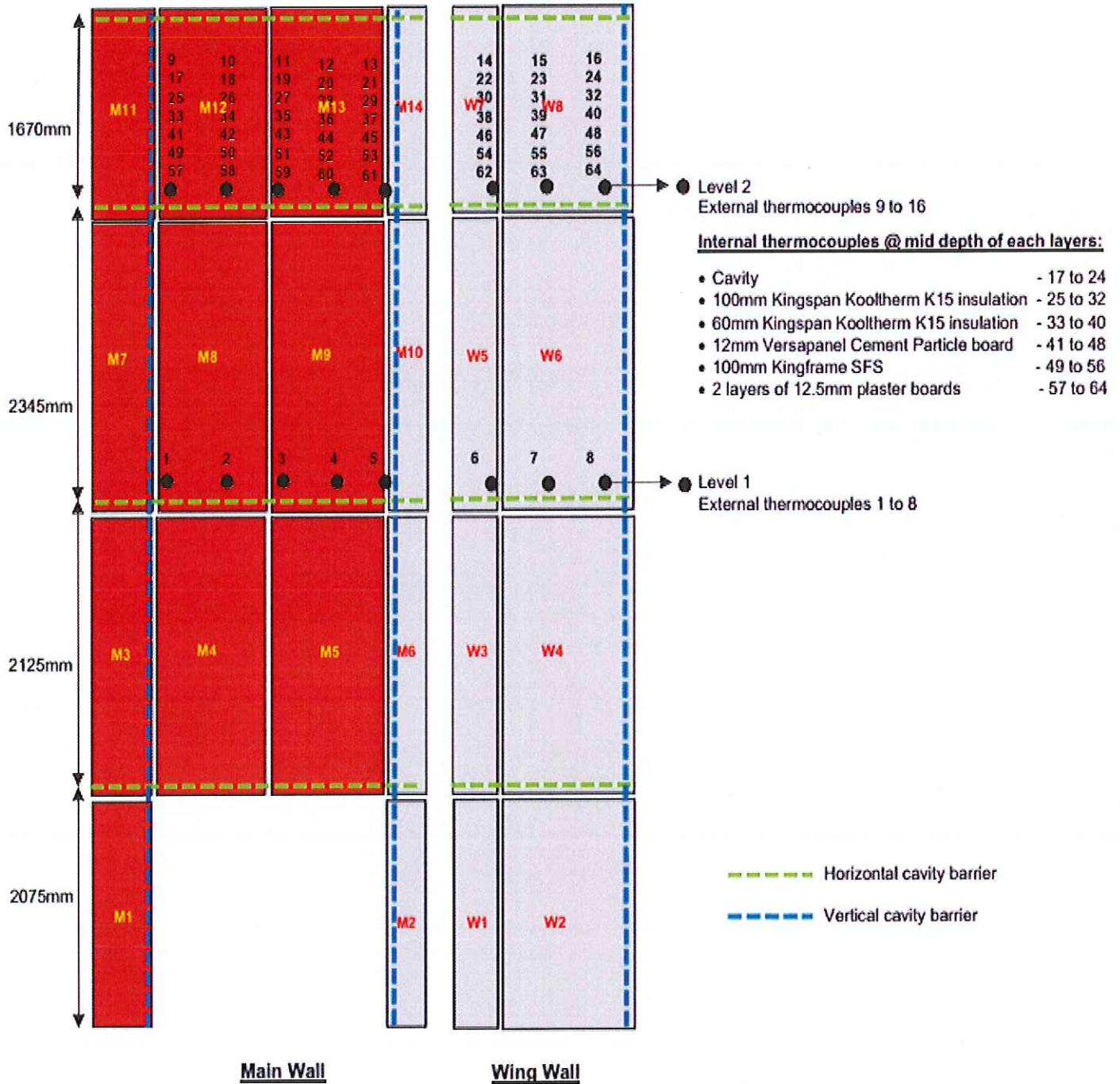
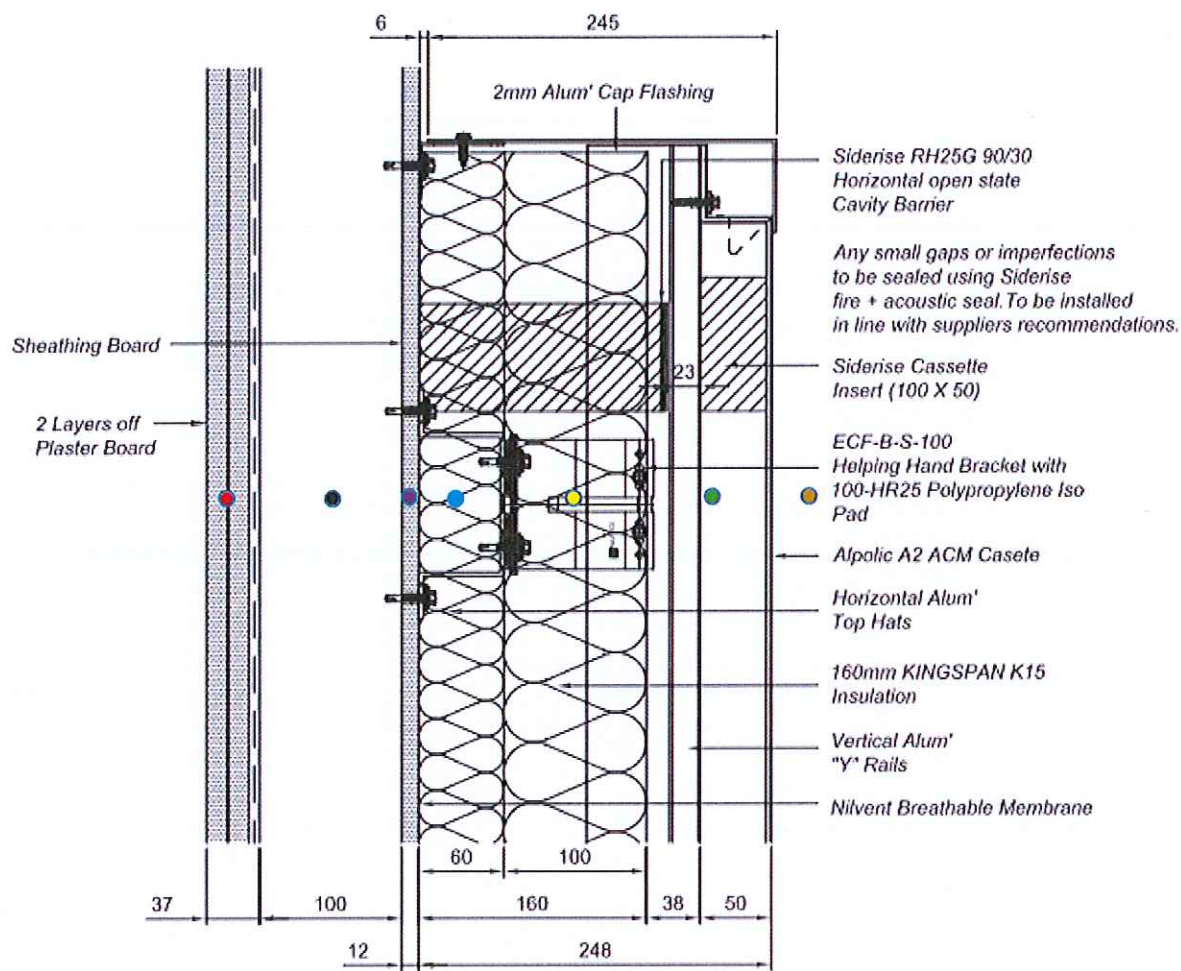


Figure 4 Level 2 Section Drawings Showing the Thermocouple Locations



- 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 conditioned period was not specified. The ambient temperature was in the range 24°C - 36°C during installation.

Installation start date: 07 July '18

Date of testing: 18 July '18

Ambient temperature: 29°C

Wind speed recorded at the start of the test: 0.24m/s

The table below summarises the observations during the test.

**Table 3 Visual Observations During the Test**

Time	Seconds	Observation	Photo Reference
06:15:22	N/A	Ignition of crib	-
06:16:03	N/A	Flame tip reached above the combustion chamber.	-
06:16:43	00	Start time $t_s$ , 236°C ( $\geq T_s + 200^\circ\text{C}$ ) at thermocouple 3, Level 1 (Wing wall).	-
06:17:21	38	Minor buckling on panels M4 & M5.	-
06:17:51	68	Coating of panels M4 & M5 started to peel off.	-
06:18:22	99	Discoloration on panels M4 & M5.	DLP C2753I/0001
06:18:40	117	Flame tip at 4m above the combustion chamber.	-
06:19:05	142	Discoloration on panel M9.	-
06:20:10	207	Discoloration on panel M8.	-
06:20:30	227	Flame impinged on wing wall and coating of panel W4 started to peel off.	-
06:21:05	262	Self-sustained flames on the surface of panel W4.	DLP C2753I/0002
06:21:20	277	Coating of panel W6 started to peel off.	-
06:22:16	333	Aluminum skin of panels M4 & M5 started melting.	-
06:22:19	336	Flaming debris fell off the main wall.	-
06:22:25	342	Debris of mineral core of panel M5 fell off.	DLP C2753I/0003
06:23:08	385	Continuous falling of aluminium debris of panels M4 & M5.	-
06:23:28	405	Panels M4 & M5 partially melted and insulations exposed.	DLP C2753I/0004
06:23:48	425	Coating of panel W2 started to peel off.	

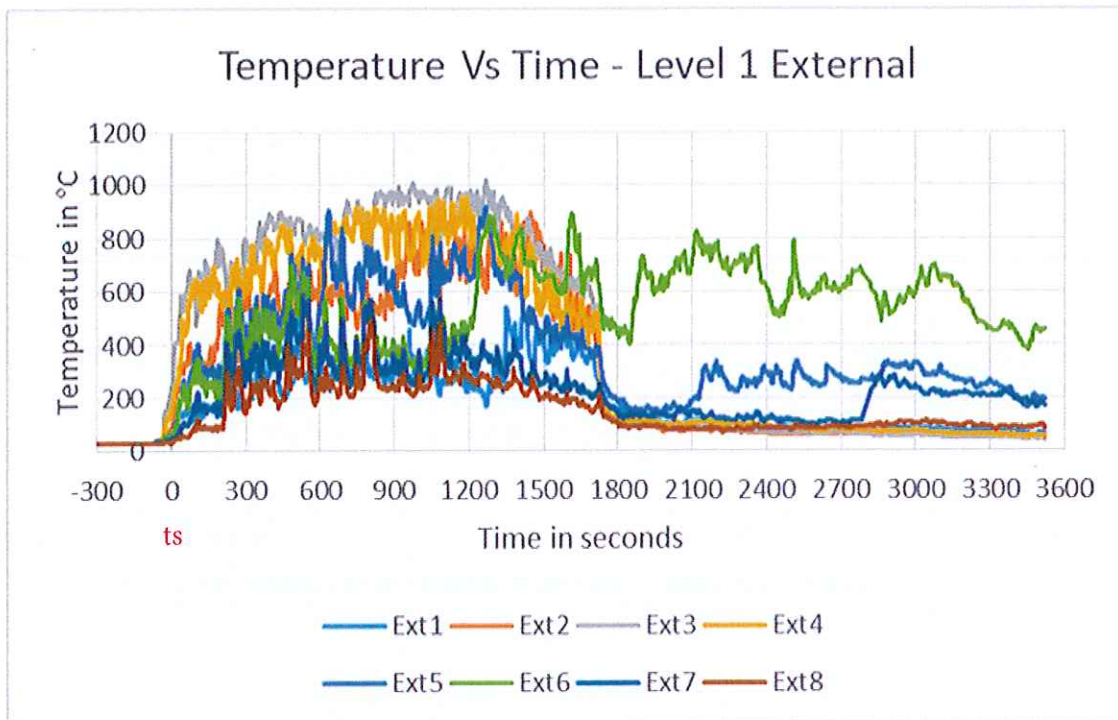


Time	Seconds	Observation	Photo Reference
06:23:56	433	Flaming debris of panel M5 fell off.	DLP C2753I/0005
06:24:04	441	High intensity flames behind the panels M4 & M5.	-
06:24:12	449	Minor buckling on panels M12 & M13.	-
06:24:32	469	Self-sustained flames on the insulations behind the panels M4 & M5.	DLP C2753I/0006
06:25:03	500	Railings behind the panels M4 & M5 melting.	-
06:25:36	533	Continuous falling of debris of insulation.	-
06:25:58	555	Coating of panel W8 started to peel off.	-
06:26:21	578	Flaming debris observed on the floor.	-
06:26:52	609	Aluminium skin of panel M9 melting.	-
06:27:20	637	Approximately 50% of panel M4 consumed.	-
06:27:40	657	Panel M9 partially melted and flames on insulations behind the panel.	DLP C2753I/0007
06:28:52	729	Debris of insulation behind the panel M9 fell off.	DLP C2753I/0008
06:29:03	740	Aluminium skin of panel M8 melting.	-
06:29:16	753	Continuous falling of flaming debris.	-
06:30:02	799	Railings behind the panels M8 & M9 partially melted.	DLP C2753I/0009
06:30:24	821	Flaming debris of insulation behind the panel M5 fell off.	-
06:30:54	851	High intensity flaming debris observed on the floor.	DLP C2753I/0010
06:31:19	876	Self-sustained flames at internal corner.	-
06:32:41	958	Continuous falling of debris of aluminium and insulation.	-
06:34:06	1043	Self-sustained flames behind the panel M8.	-
06:35:07	1104	Panels W2, W3, W4, W5 & W6 discoloured.	-
06:35:40	1137	Aluminium skin of panel M13 melting.	-
06:36:13	1170	100% of panels M5 & M9 consumed.	-
06:37:06	1223	Self-sustained flames on the surface of panel W3.	DLP C2753I/0011
06:38:04	1281	Aluminium debris of panel W3 fell off.	-
06:38:31	1308	Panel W3 consumed and flames on the insulation behind the panel.	-
06:39:15	1352	Aluminium skin of panels W4 & W5 melting.	-
06:40:24	1421	Panel W5 partially consumed and insulation behind the panel burning.	-

Time	Seconds	Observation	Photo Reference
06:41:06	1463	Flaming debris of insulation behind the panel M9 fell off.	DLP C2753I/0012
06:41:40	1497	Flaming debris of insulation behind the panel M8 fell off.	-
06:42:12	1529	Self-sustained flames behind the panel M13.	-
06:43:22	1599	Panel M13 partially consumed.	-
06:45:22	1719	Heat source was extinguished. Observations continued for another 30 minutes.	-
06:46:04	1761	High intensity flames behind the panel W5.	-
06:47:03	1820	Self-sustained flames at panels M12 & M13 vertical joint.	-
06:51:29	2086	Self-Sustained flames on the insulations behind the panels W3, W4 & W5.	DLP C2753I/0013
06:52:19	2136	Self-sustained flames at panels M13 & M14 vertical joint.	-
06:52:27	2144	Debris of insulation behind the panel M8 fell off.	-
06:55:04	2301	High intensity flames on the insulations behind the panels W3 & W5.	-
06:58:40	2517	Debris of insulation behind the panels W3 & W5 falling.	-
06:59:02	2539	Flaming debris on the floor.	-
07:03:03	2780	Self-sustained flames behind the panel W4.	-
07:03:53	2830	Discoloration on panel M14.	-
07:09:16	3153	Self-sustained flames on face of panel M14 and aluminium skin of panel melting.	DLP C2753I/0014
07:11:09	3266	Panel M14 partially consumed and insulation behind the panel burning.	-
07:13:15	3392	Self-Sustained flames on the insulations behind the panels W4, W6 & W7.	-
07:15:22	3519	Test was terminated 60 minutes after the ignition.	-

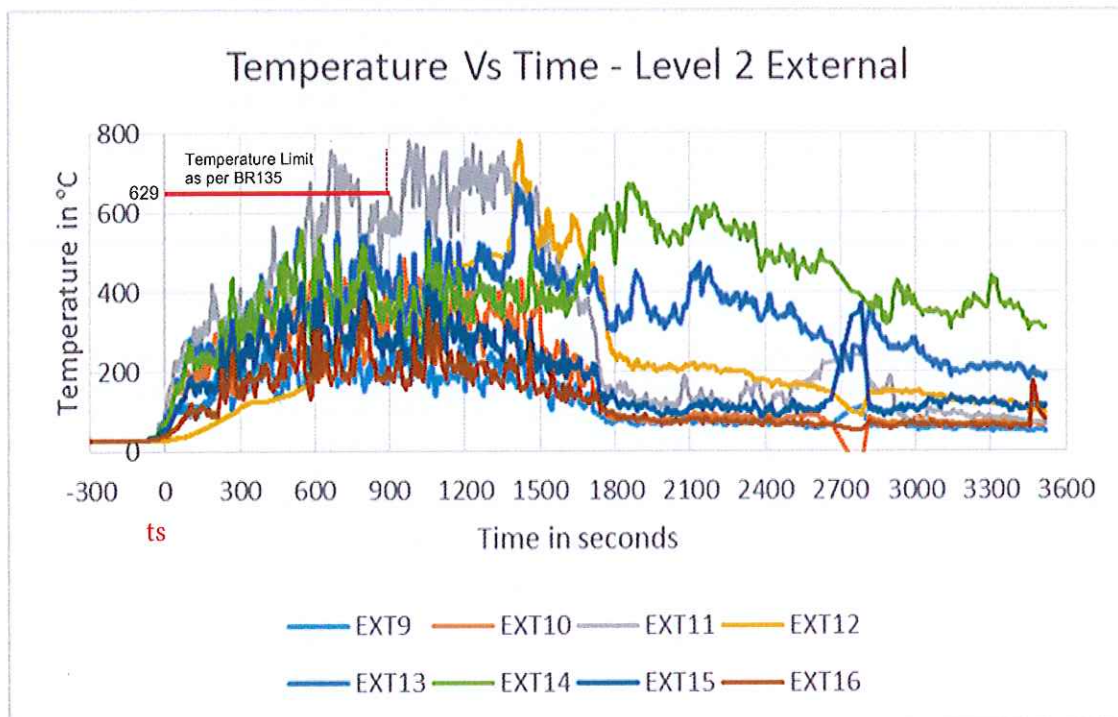


Figure 5 Thermocouple Readings on Level 1 - External



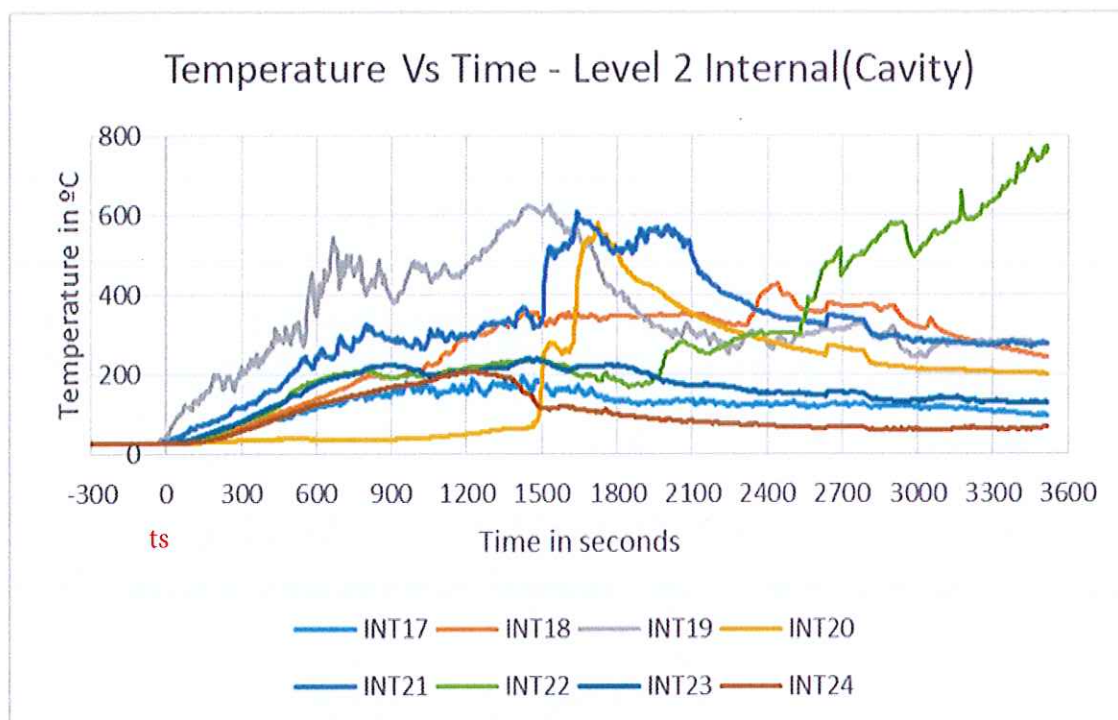
For thermocouple locations see Figure 3 & 4.

Figure 6 Thermocouple Readings on Level 2 – External



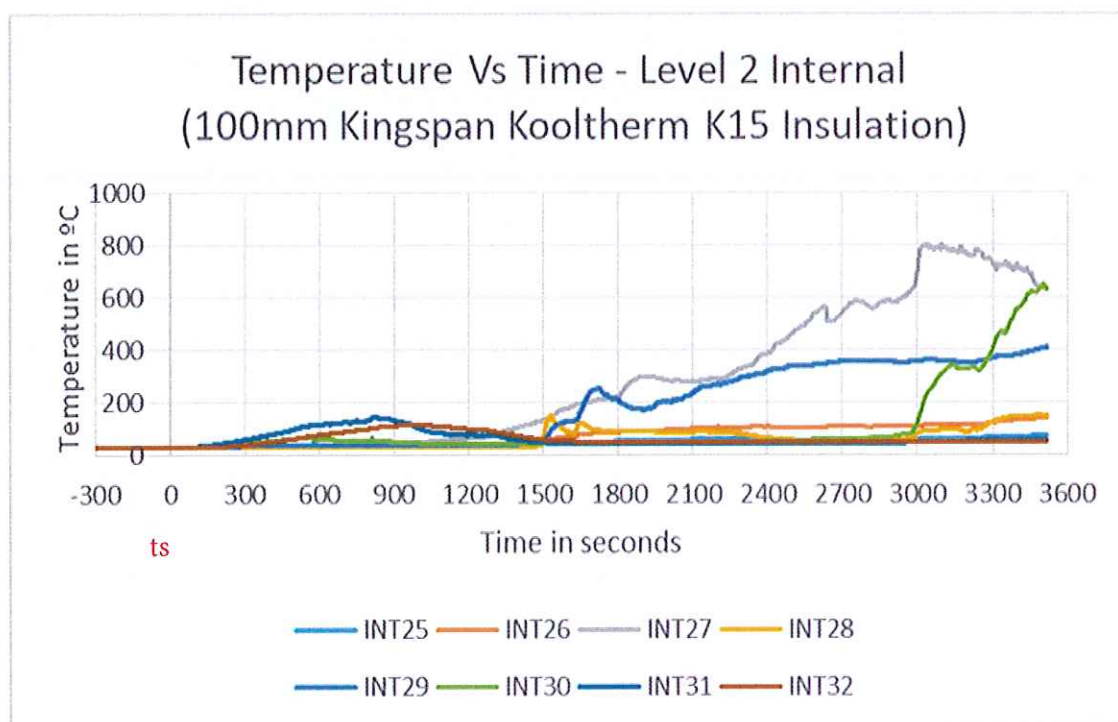
For thermocouple locations see Figure 3 & 4.

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



For thermocouple locations see Figure 3 &4.

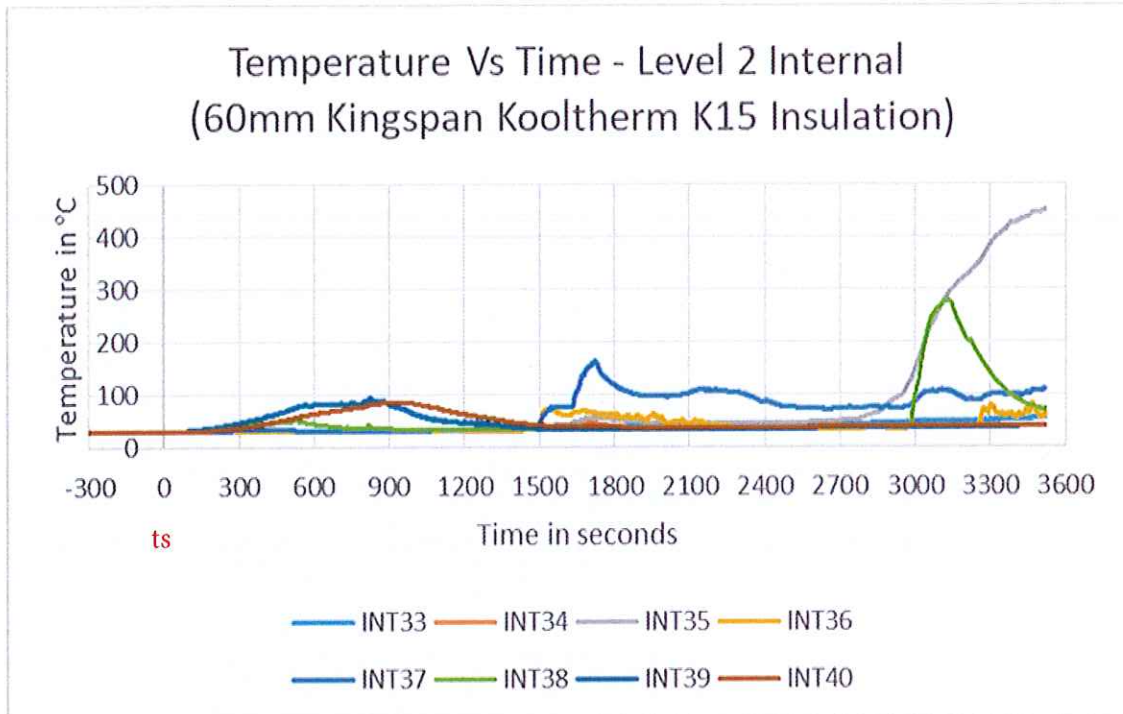
**Figure 8 Thermocouple Readings on Level 2 – Internal (Mid-depth of 100mm Kingspan Kooltherm K15 Insulation)**



For thermocouple locations see Figure 3 & 4.

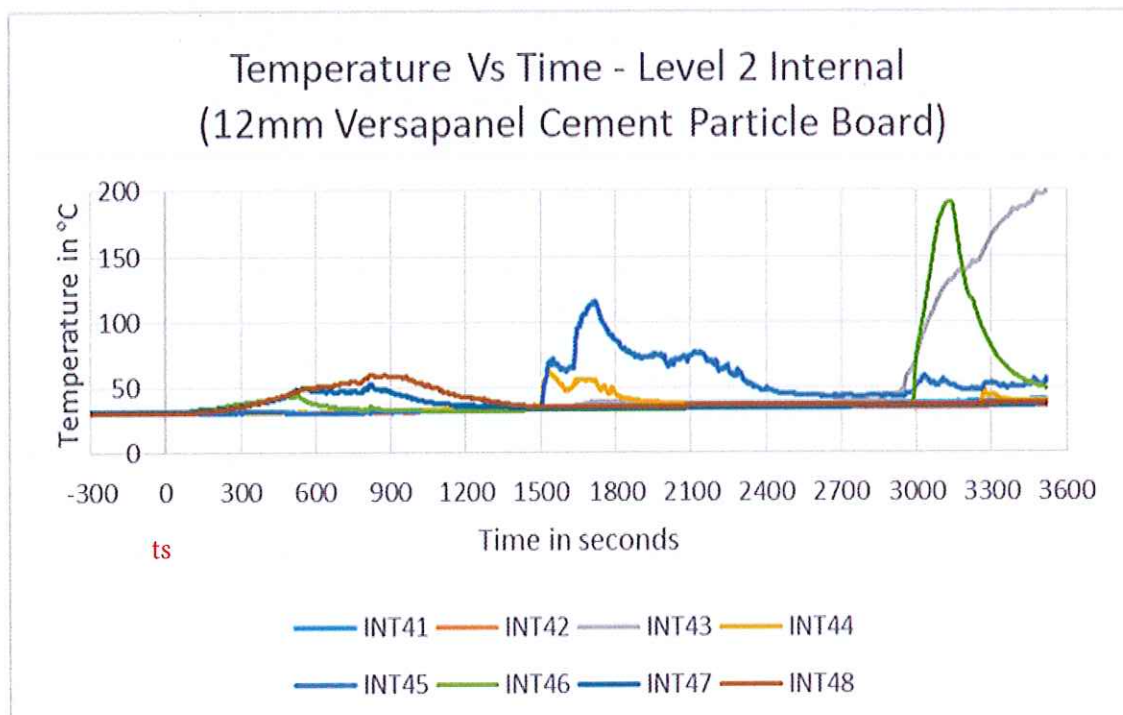


**Figure 9 Thermocouple Readings on Level 2 – Internal (Mid-depth of 60mm Kingspan Kooltherm K15 Insulation)**



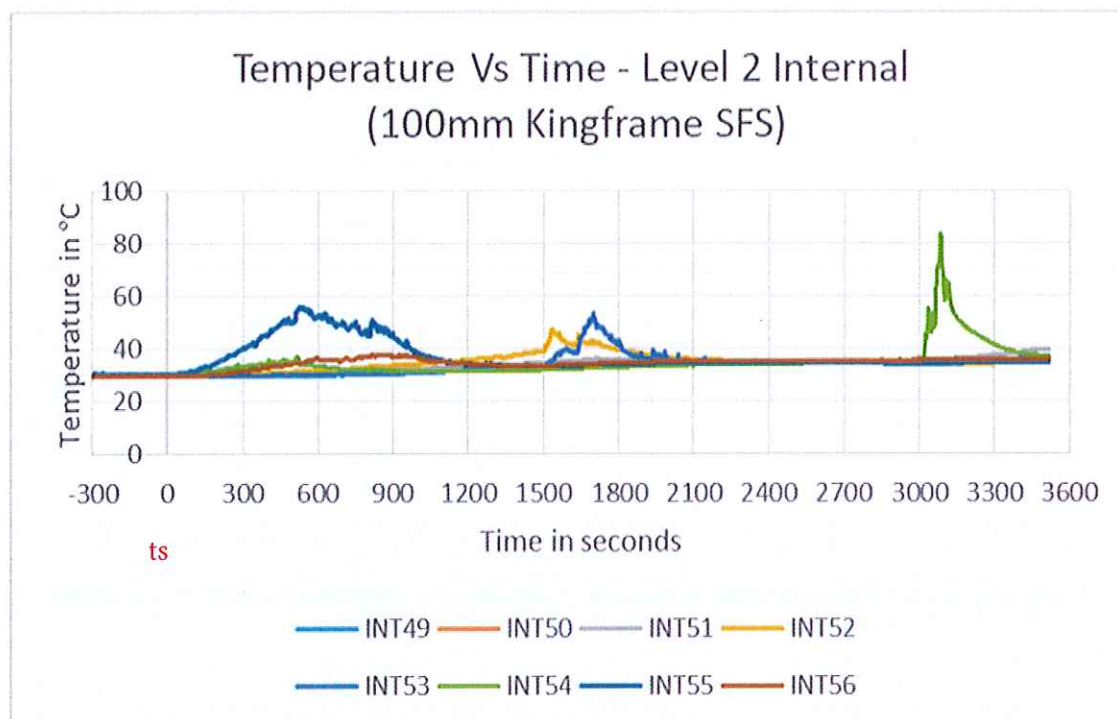
For thermocouple locations see Figure 3 & 4.

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



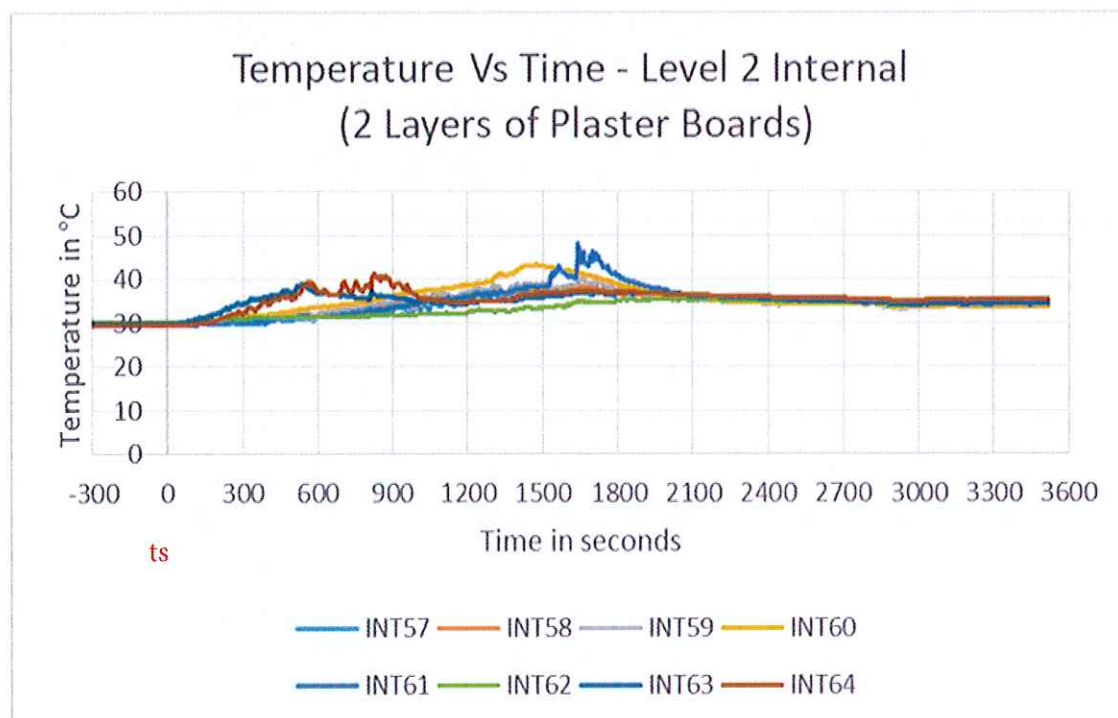
For thermocouple locations see Figure 3 & 4.

**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 &amp; M11 - No changes on the panels.</p> <p>Panels M2, M3, M7 – Minor discoloration and buckling on the panels.</p> <p>Panels M4, M6, M8 &amp; M10– Approximately 90% material loss on the panels. Remaining area was discoloured and buckled.</p> <p>Panels M5 &amp; M9 – 100% material loss on the panels.</p> <p>Panel M12 - Approximately 40% of the panel discoloured.</p> <p>Panels M13 &amp; M14 – Approximately 30% material loss on the panels. Remaining area was discoloured and buckled.</p> <p>Panels W1, W2, W6 &amp; W8 – 100% discoloration on the panels.</p> <p>Panels W3 – Approximately 75% material loss on the panels. Remaining area was discoloured and buckled.</p> <p>Panels W4 &amp; W7 – Approximately 25% material loss on the panels. Remaining areas were buckled and discoloured.</p> <p>Panels W5 - 100% material loss on the panels.</p>	DLP C2753I / 0015.
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 200mm above the combustion chamber was activated except the cavity barrier behind the 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 the panel M7. Intumescent layer was not 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 the panel M11. Intumescent layer was partially present during dismantling. No material loss observed.</p>	DLP C2753I / 0016, DLP C2753I / 0020 & DLP C2753I / 0021.

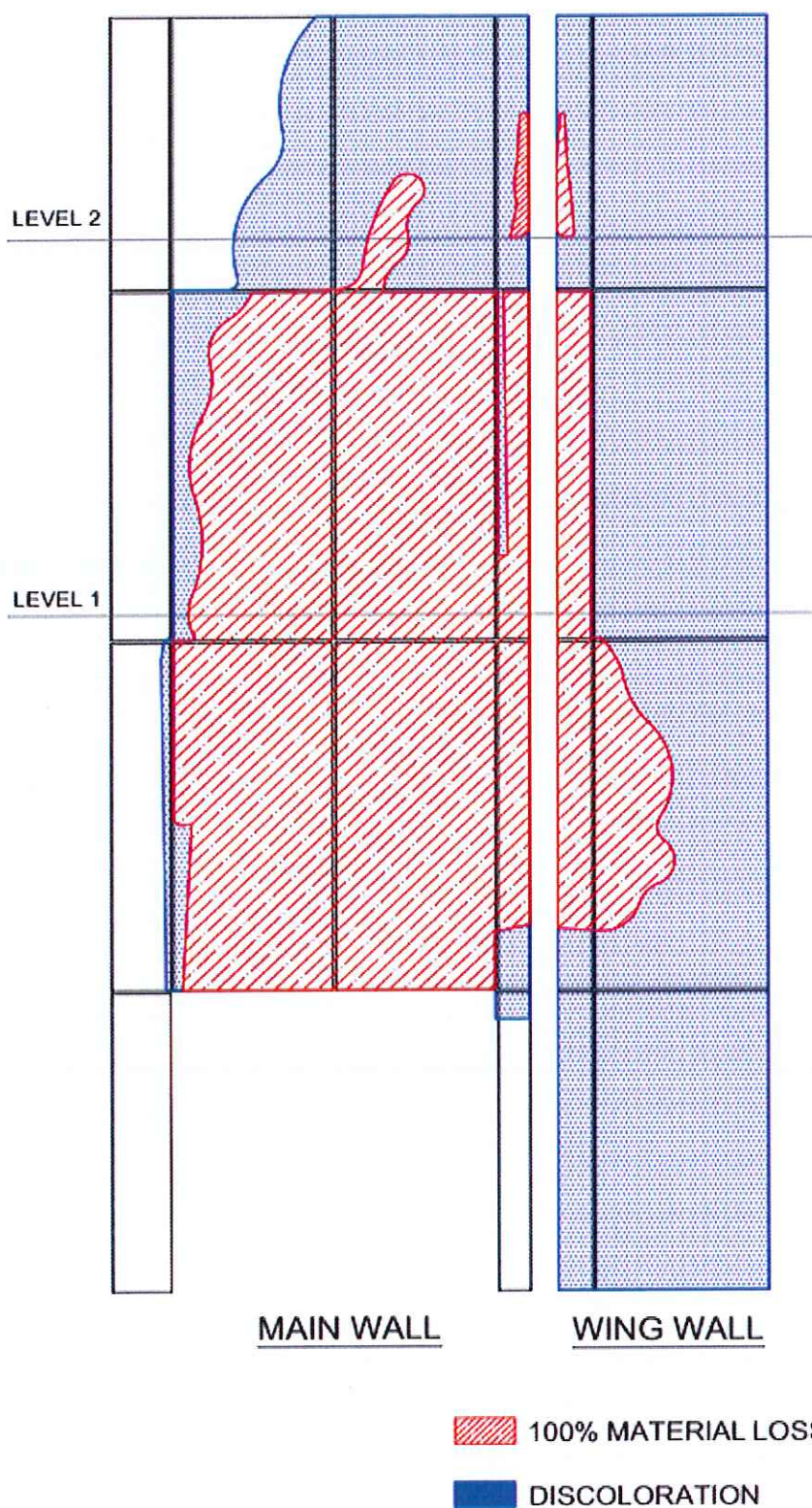


Sl. No.	Components	Observation	Photo Reference
		<p>The 4<sup>th</sup> horizontal cavity barrier at 6395mm above the combustion chamber was activated except the cavity barrier behind the panel M11. Intumescent layer was resented during dismantling. No material loss observed.</p> <p>Wing wall:</p> <p>The 1<sup>st</sup> horizontal cavity barrier at 2200mm above the ground level was activated. Intumescent layer was partially 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 partially 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 activated. Intumescent layer was present during dismantling. No material loss observed.</p> <p><b>Vertical Cavity barrier:</b></p> <p>Buckling and discoloration on the vertical cavity barriers. Minor material loss observed.</p>	
3	Kingspan Kooltherm K15 insulation	<p>Insulations behind the panels M4, M5, M6, M8, M9, M10, M13, M14, W3, W4, W5, W6 &amp; W7 panels were burned. Approximately 60% of the burned insulations fell off and remaining left as char.</p> <p>Minor discoloration on the insulations behind the panels M12 &amp; W8.</p> <p>All other insulations were in place and no significant changes observed.</p>	DLP C27531 / 0016, DLP C27531 / 0020 & DLP C27531 / 0021.
4	Carrier railings	<p>Railings behind the panels M4, M5, M6, M8, M9, M10, W3, W4 &amp; W5 were melted.</p> <p>Railings behind the panels M12, M13, M14, W6, W7 &amp; W8 were discoloured.</p> <p>All other railings were in place and no damage was observed.</p>	DLP C27531 / 0016 & DLP C27531 / 0021.

Sl. No.	Components	Observation	Photo Reference
5	Brackets and Nilvent breather membrane	<p>Top Hat bracket:</p> <p>Discoloration on the brackets behind the panels M4, M5, M8, M9, W3, W4 &amp; W5. No significant changes on the remaining brackets.</p> <p>Helping hand bracket:</p> <p>Approximately 10% 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 C2753I / 0017 & DLP C2753I / 0022.
6	12mm Versapanel cement particle board	Minor discolouration on the cement particle boards behind the panels M4, M5, M8, M9, W3 & W5. No significant changes on the remaining boards.	DLP C2753I / 0018.
7	SFS and plaster boards	No significant changes.	DLP C2753I / 0019.



Figure 13 Area Map Showing the Condition of the ACM Panels After the Test



- Approximately 11.5m<sup>2</sup> of the total external visible area was completely consumed.
- Approximately 13m<sup>2</sup> of the total external visible area was discoloured.

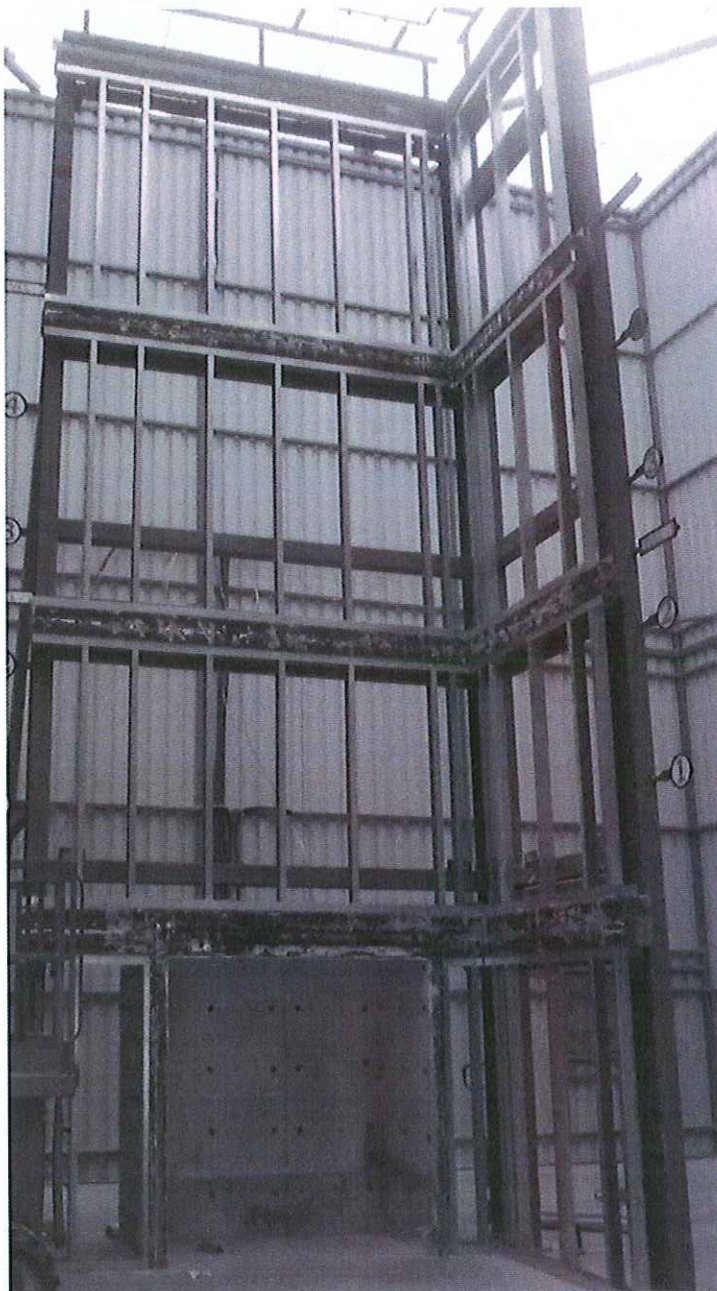


## Appendix A

# Photographs

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

## Pre-test Phase



DLP C2753I/1897 Kingframe SFS



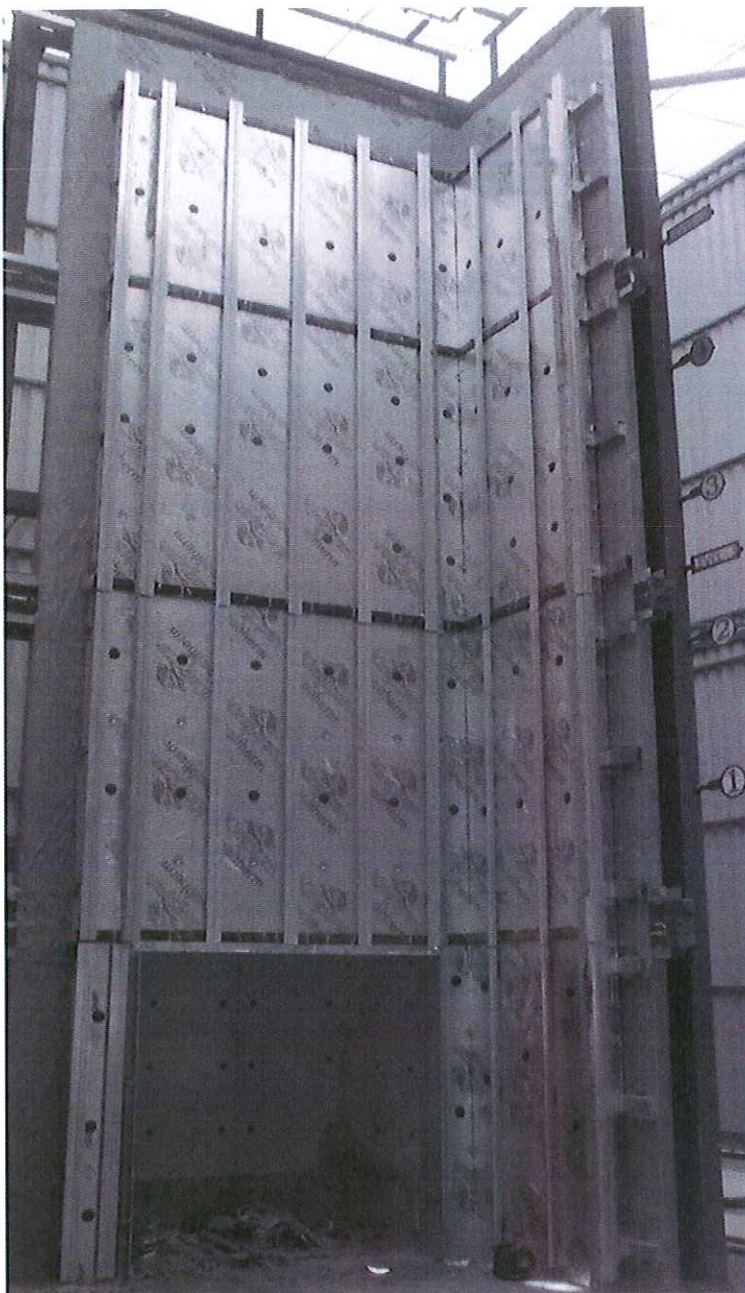
DLP C2753I/1905      Versapanel cement particle board





DLP C2753I/2008 Nilvent breather membrane, Top hat and Helping hand brackets





DLP C2753I/2049 Cavity barrier, Kingspan K15 insulation and carrier railings

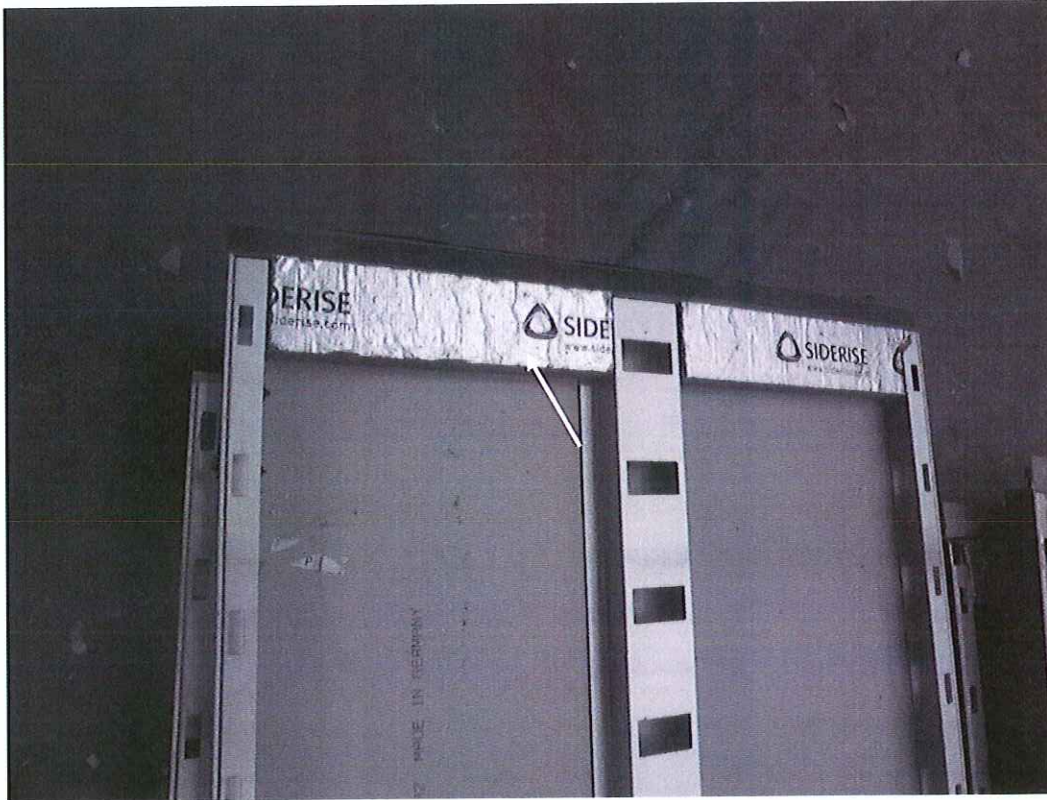


DLP C2753I/2019 Top hat and Helping hand brackets



DLP C2753I/2051 Cavity barriers, railings and Kooltherm K15 insulation





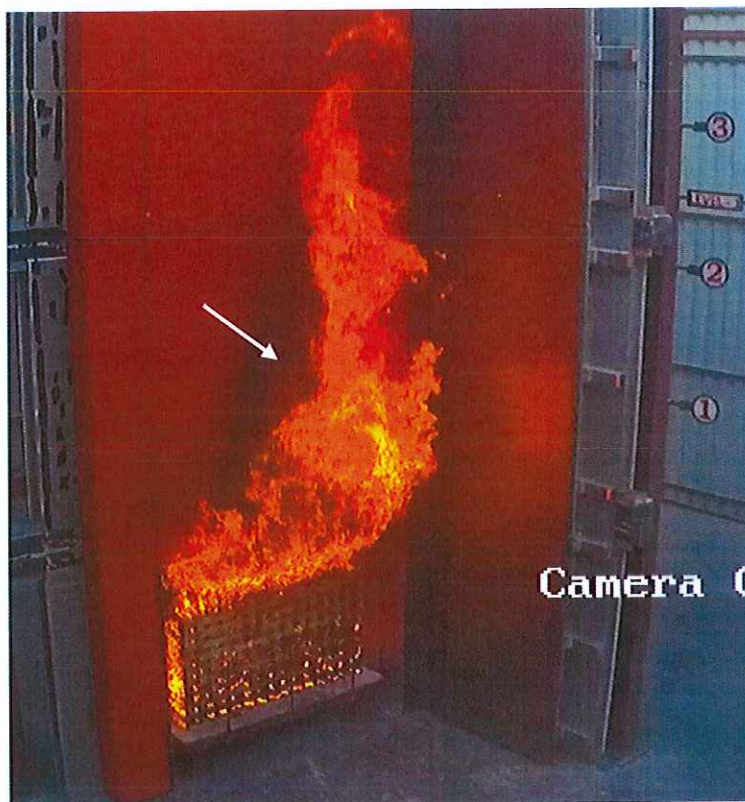
DLP C2753I/2082 Siderise cassette insert



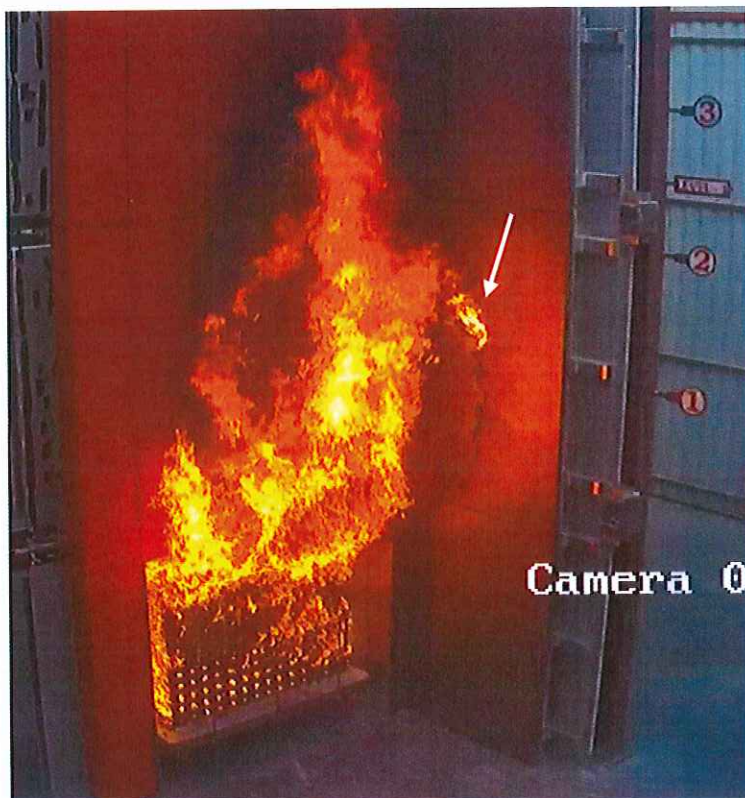
DLP C2753I/2096 ACM panel fixing



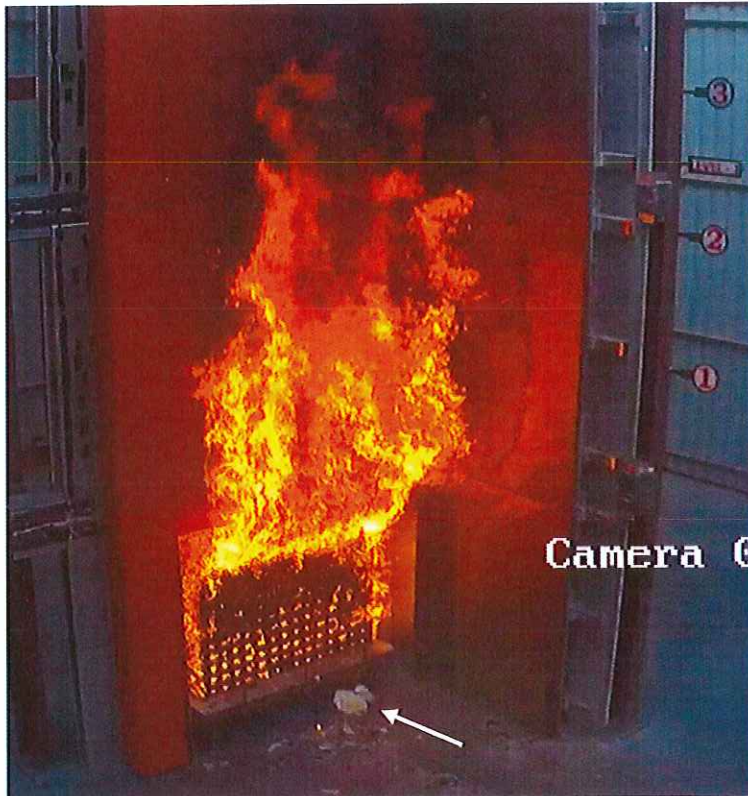
## Testing Phase



DLP C2753I/0001 Discoloration on panels M4 & M5.



DLP C2753I/0002 Self-sustained flames on the surface of panel W4.

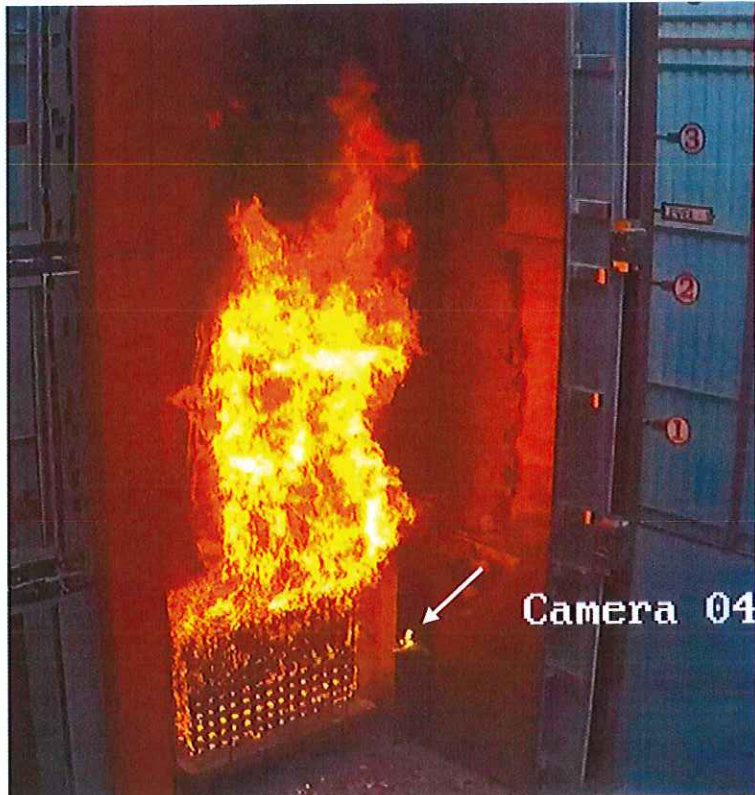


DLP C2753I/0003 Debris of mineral core of panel M5 fell off.

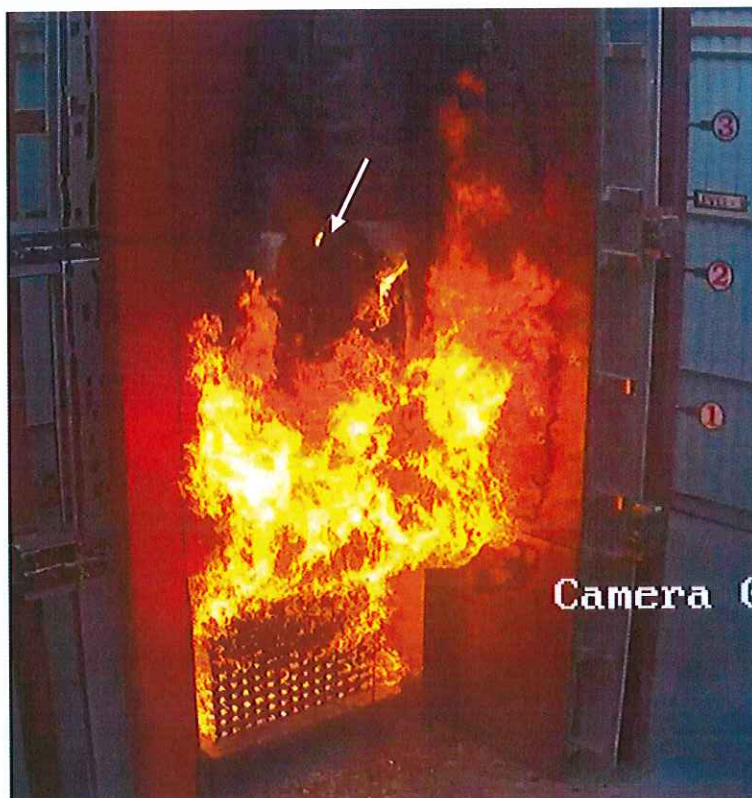


DLP C2753I/0004 Panels M4 & M5 partially melted and insulations exposed.



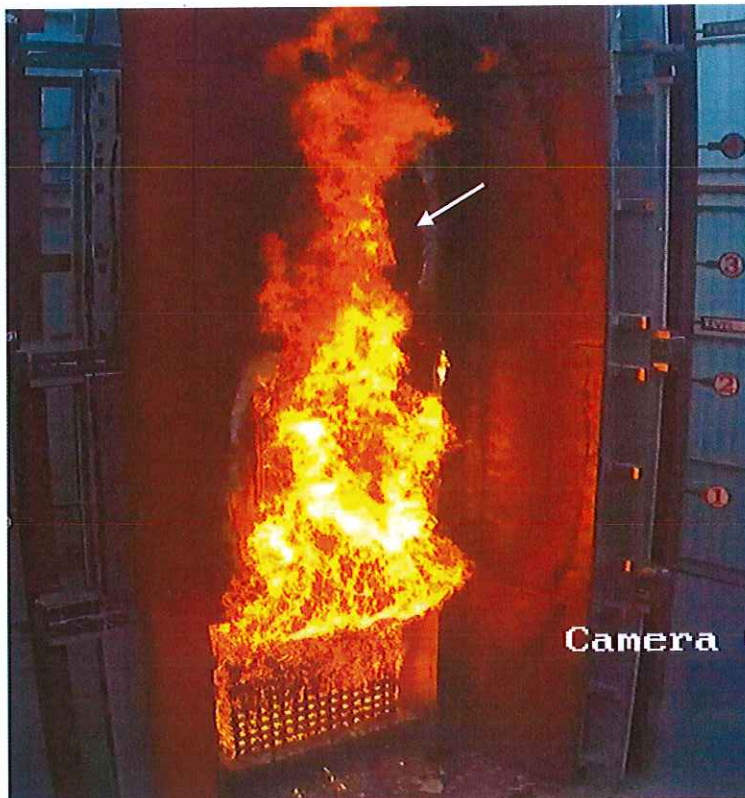


DLP C2753I/0005 Flaming debris of panel M5 fell off.

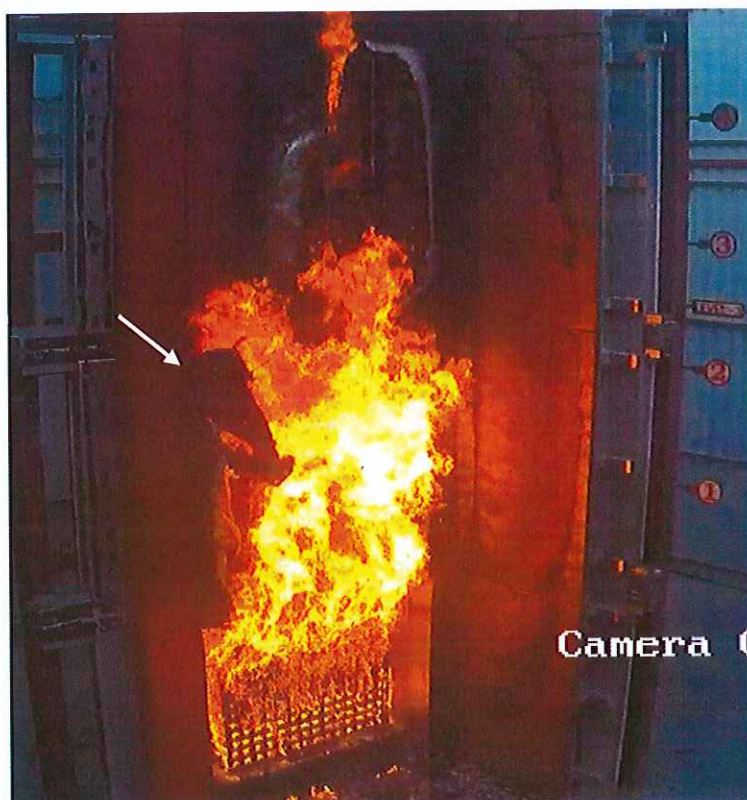


DLP C2753I/0006 Self-sustained flames on the insulations behind the panels M4 & M5.

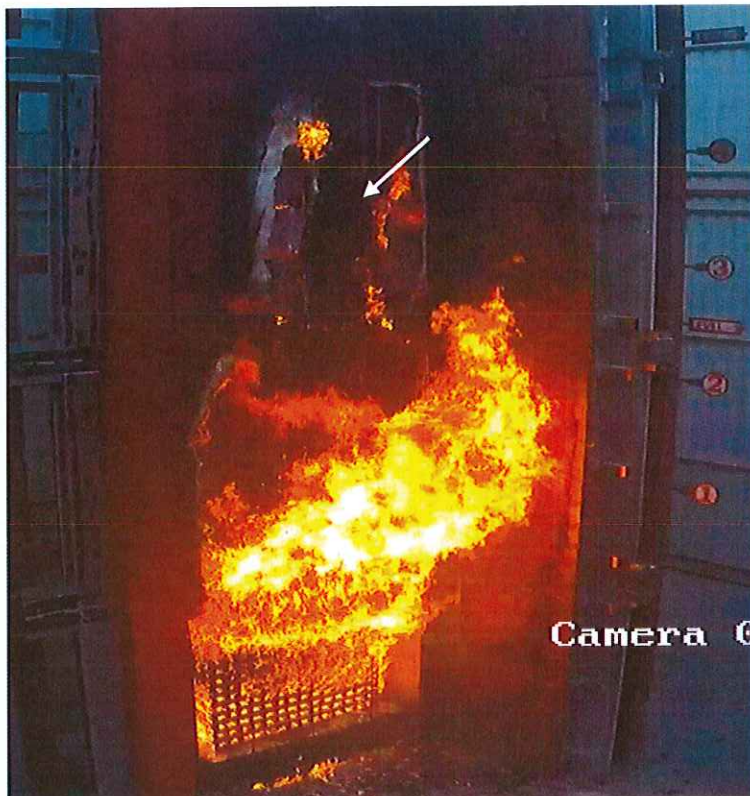




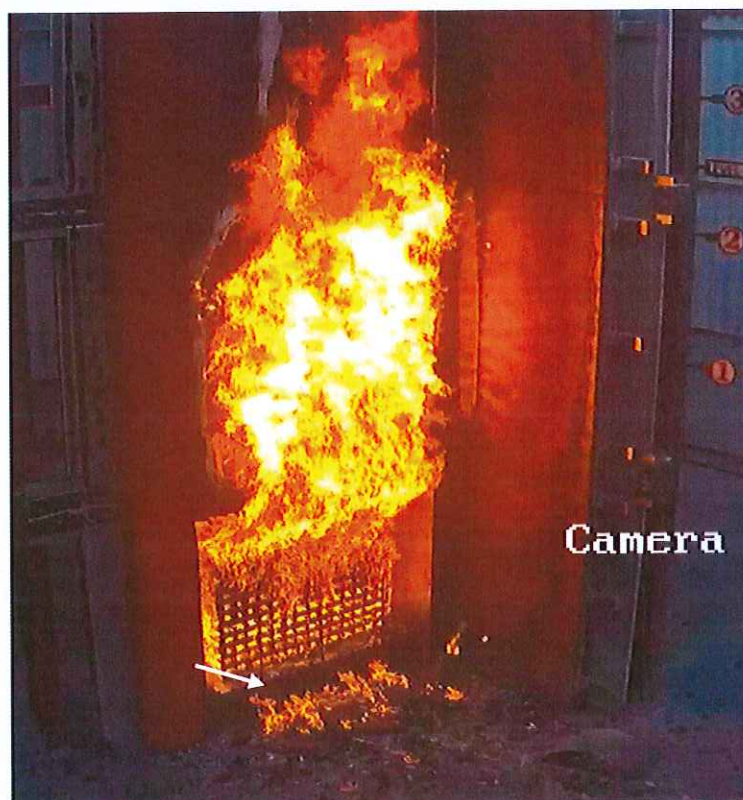
DLP C2753I/0007 Panel M9 partially melted and flames on insulations behind the panel.



DLP C2753I/0008 Debris of insulation behind the panel M9 fell off.

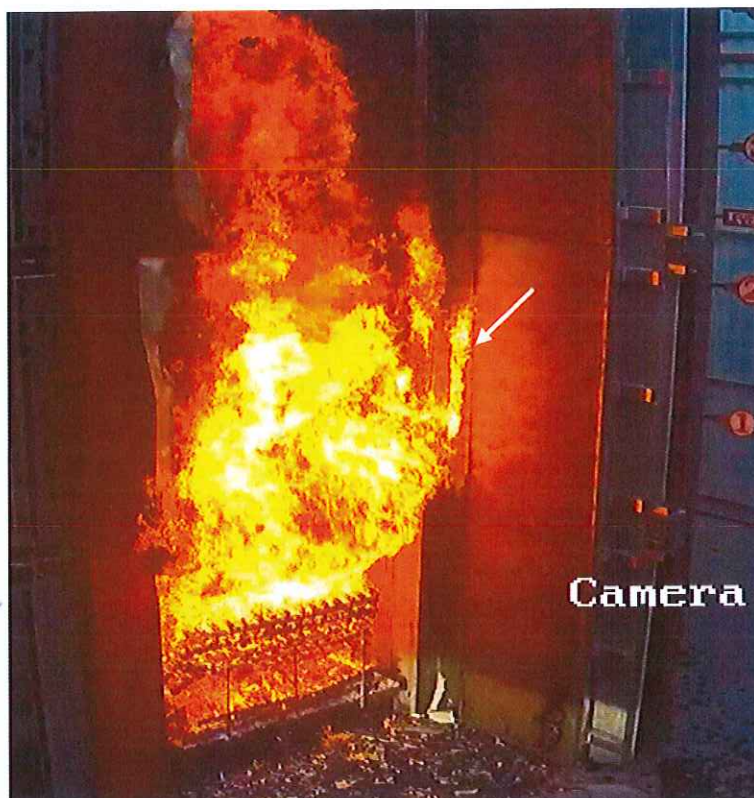


DLP C2753I/0009 Railings behind the panels M8 & M9 partially melted.

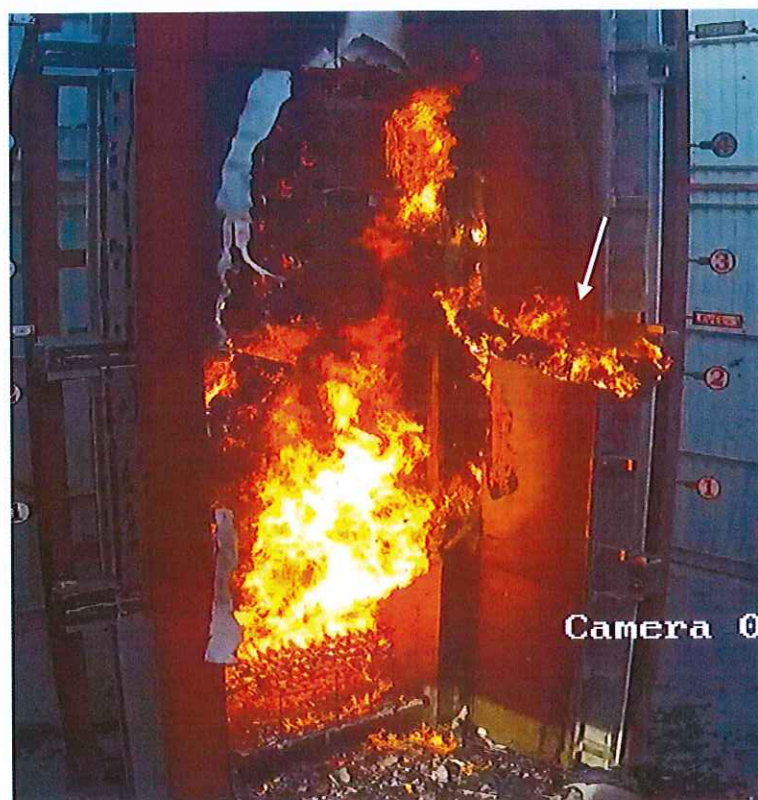


DLP C2753I/0010 High intensity flaming debris observed on the floor.





DLP C2753I/0011 Self-sustained flames on the surface of panel W3.

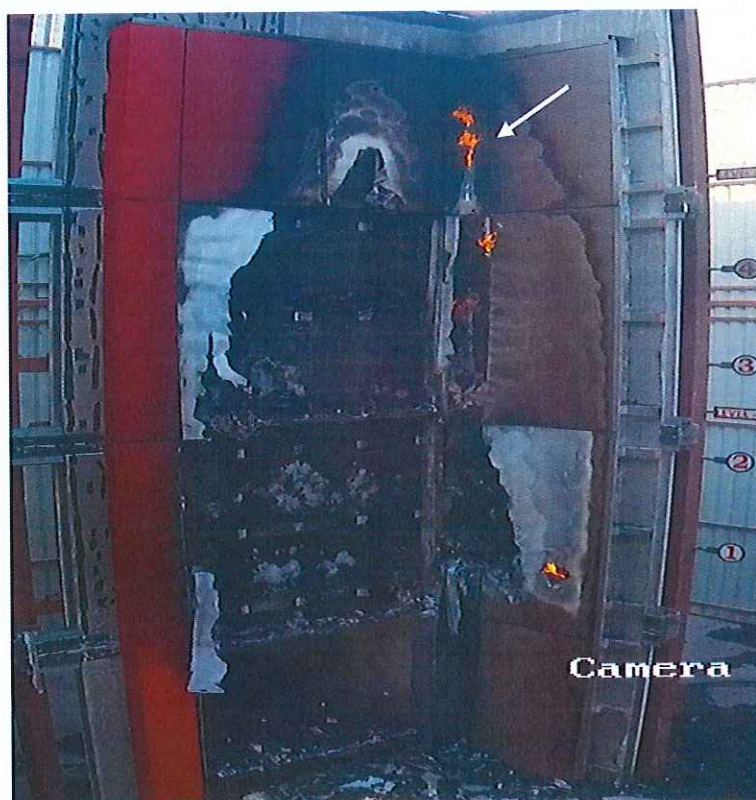


DLP C2753I/0012 Flaming debris of insulation behind the panel M9 fell off.





DLP C2753I/0013 Self-Sustained flames on the insulations behind the panels W3, W4 & W5.



DLP C2753I/0014 Self-sustained flames on face of panel M14



## Post-Test Phase



DLP C2753I/0015

View of the sample after the test



DLP C2753I/0016

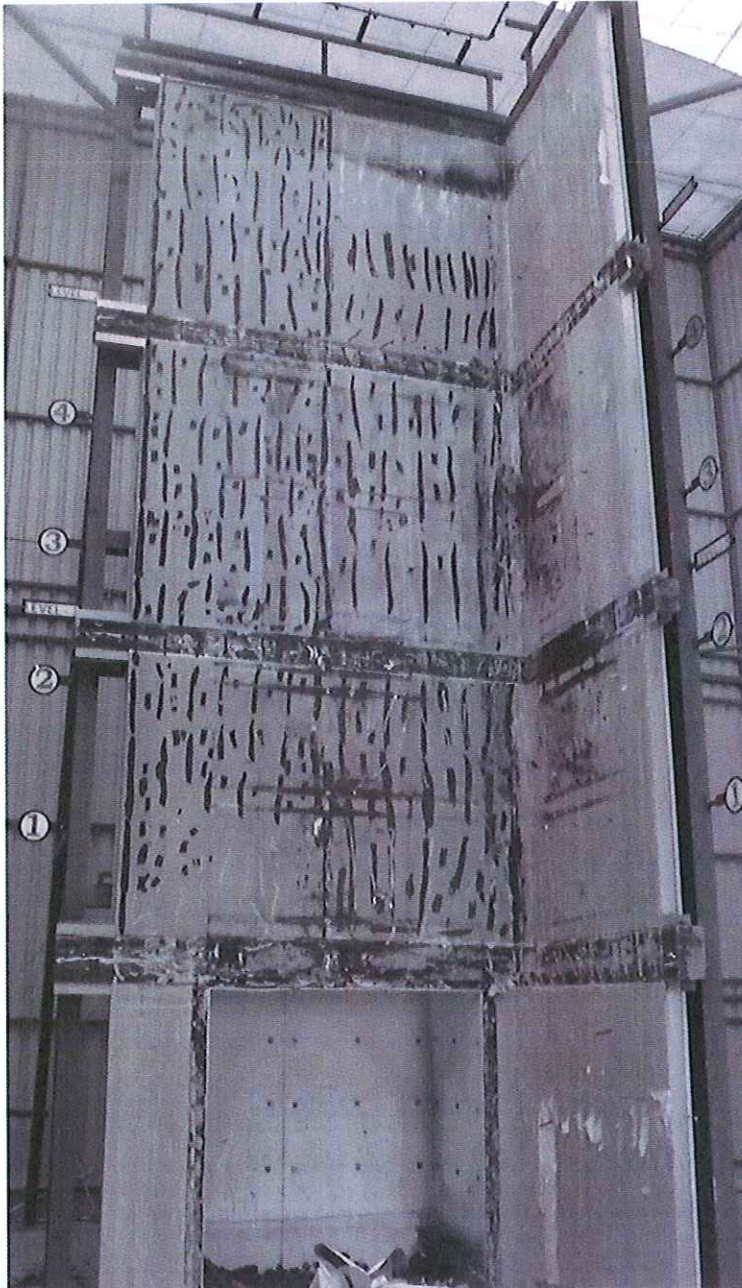
Cavity barrier, Kingspan insulation and carrier railings





DLP C2753I/0017

Brackets and Nilvent breather membrane



DLP C2753I/0018

Brackets





DLP C2753I/0019

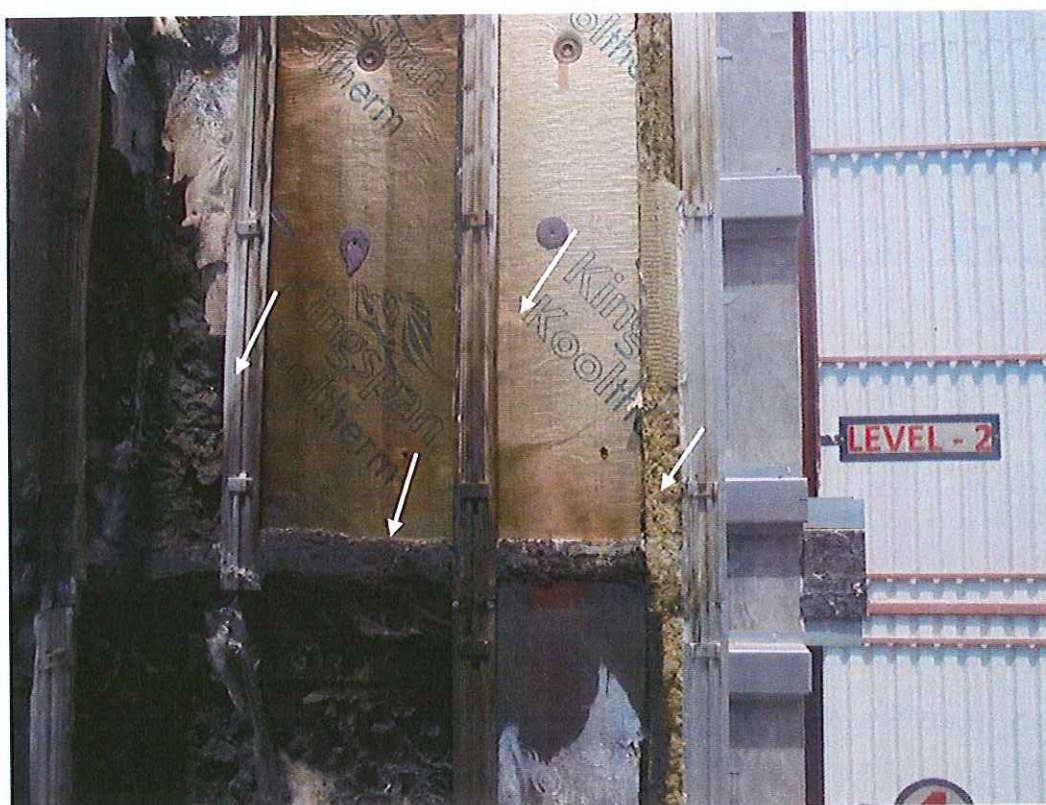
SFS and plaster board





DLP C2753I/0020

Cavity barrier and insulation above the combustion chamber



DLP C2753I/0021

Cavity barriers, Kingspan insulations and carrier rails on wing wall





DLP C2753I/0022

Breather membrane, Top hat and Helping hand brackets

## Appendix B

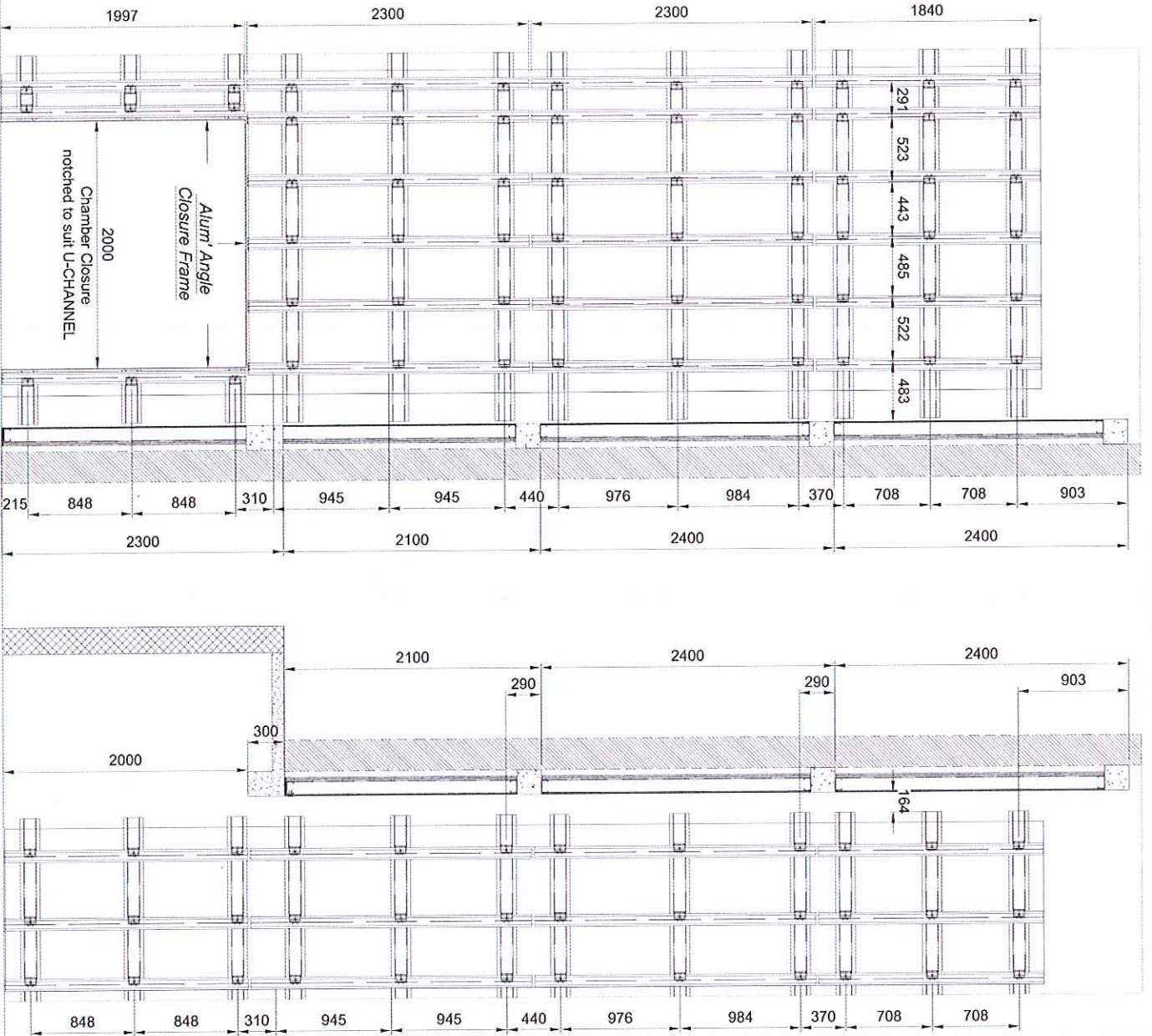
# Drawings

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

- L6 Rev. 04
- L7A Rev. 04
- DT6 Rev. 04
- DT6\_2 Rev. 04





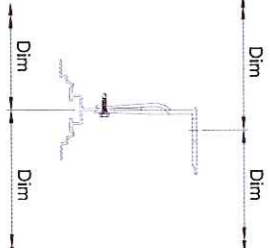


**Important Notes**

Panel: 4mm THK Apollo ACM  
 System: BML400  
 Finish: Anodized Look C31

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

**REFERENCE DRAWINGS**



**SET OUT POINTS RAIL/BRACKETS**

This Drawing to be read in conjunction with DT-L6 + DT6



Elevation Layout Test 7 SFS DT01A  
 Scale 1:35@A3

04 27.04.18 Updated as per Comments 03 13.03.18 Detail Annotated 02 13.11.17 Updated as per comments 01 13.07.17 First Issue	CI CI CI CI
<b>Revised</b> Date Attention	Initial
<b>boothmuir</b> Architectural Cladding Systems Calder House South Calderston Road, Coatbridge Midlothian EH17 9JG T: 01236 345 500 F: 01236 345 515 W: www.boothmuir.co.uk	<b>A euroCAD COMPANY</b> Client: KINGSFARM Project: 100mm Koolthym K15 - Apollo A2 - BML100 Title: Sub-Grid Layouts Drawn By: CI Scale: 1:35@A3 Date: Oct 2017 Job No: 17087 SFS Draw No: 1/1 CAD Ref: Total 08.dwg A3

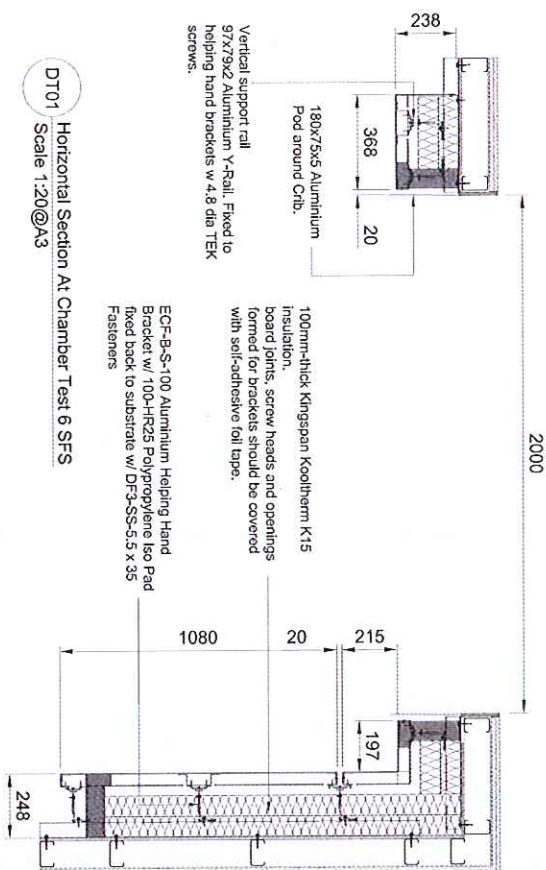
AS BUILT



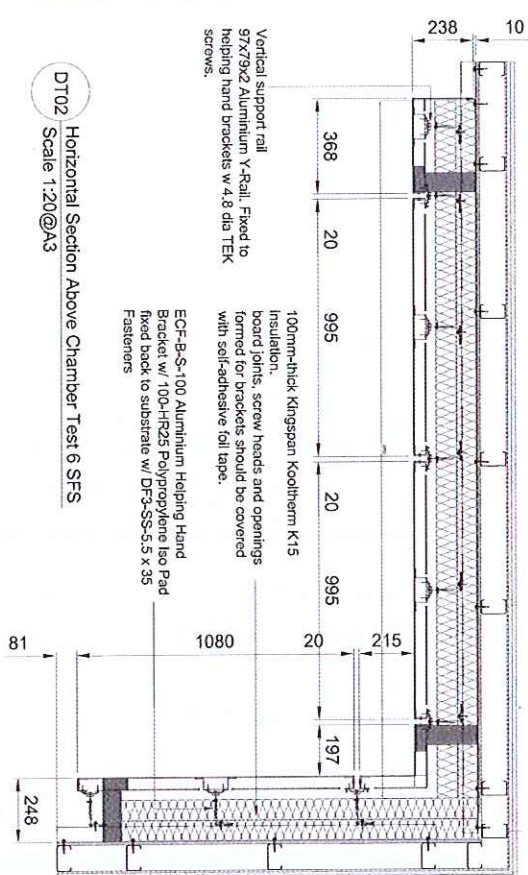
**Panels:** 4mm THK Alpolic A2 ACM  
**System:** BML100  
**Finish:** - Silver Met

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

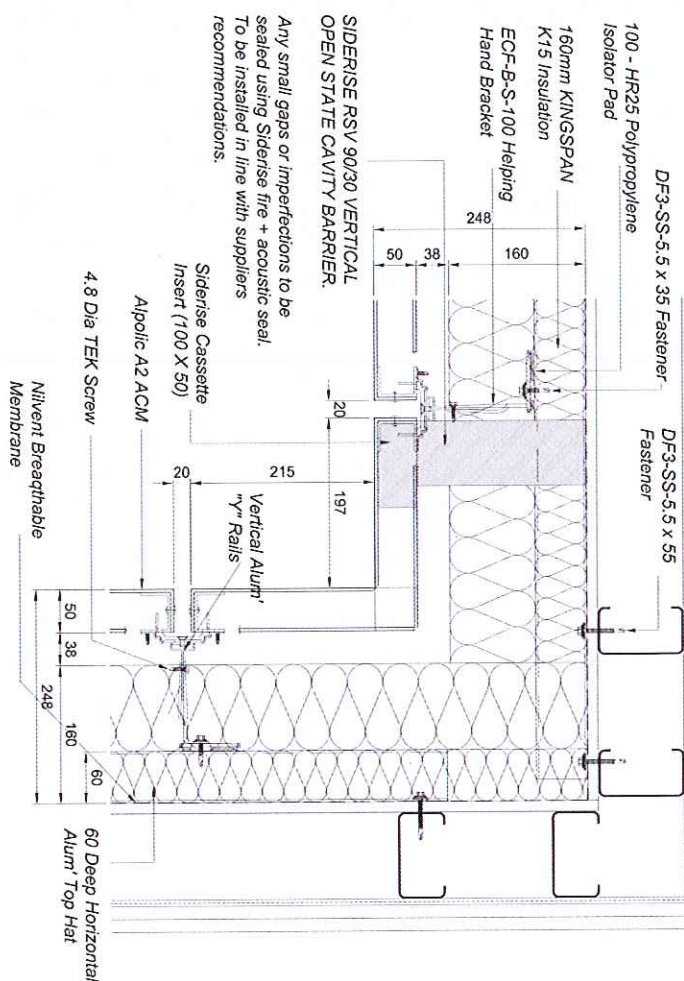
2000



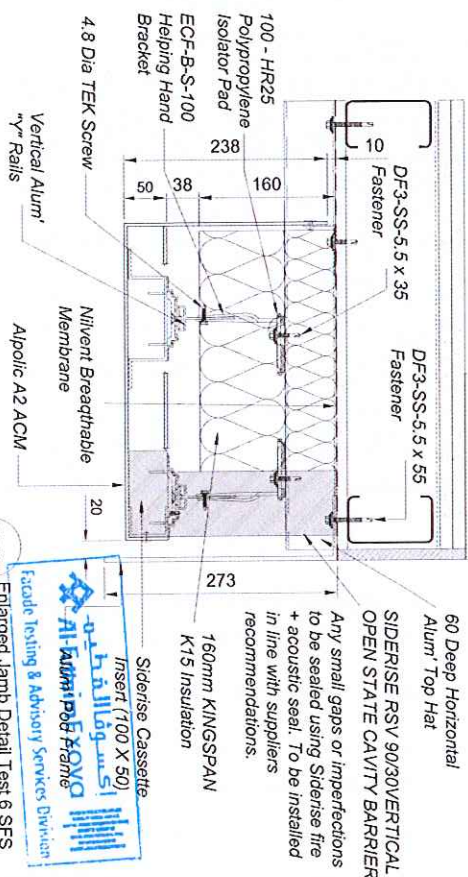
DT01 Horizontal Section At Chamber Test 6 SFS  
Scale 1:20@A3



DT02 Horizontal Section Above Chamber Test 6 SFS  
Scale 1:20 @ A3



DT04  
Enlarged Jamb  
Scale 1:6@A3



DT04  
Enlarged Jamb  
Scale 1:6@A3

Rev	Date	Alteration	Initials
04	13.02.19	Updated as per Comments.	GI
03	27.04.18	Updated as per Comments	GI
02	13.03.18	Detail Amended	GI
01	31.01.18	First Issue	GI

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**A EUROCLAD COMPANY**

KINGSPAN

160mm Kooltherm K15 - Alpollic A2 - BML100

Details 1 - 0

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By: G1  
1: A3  
Date:

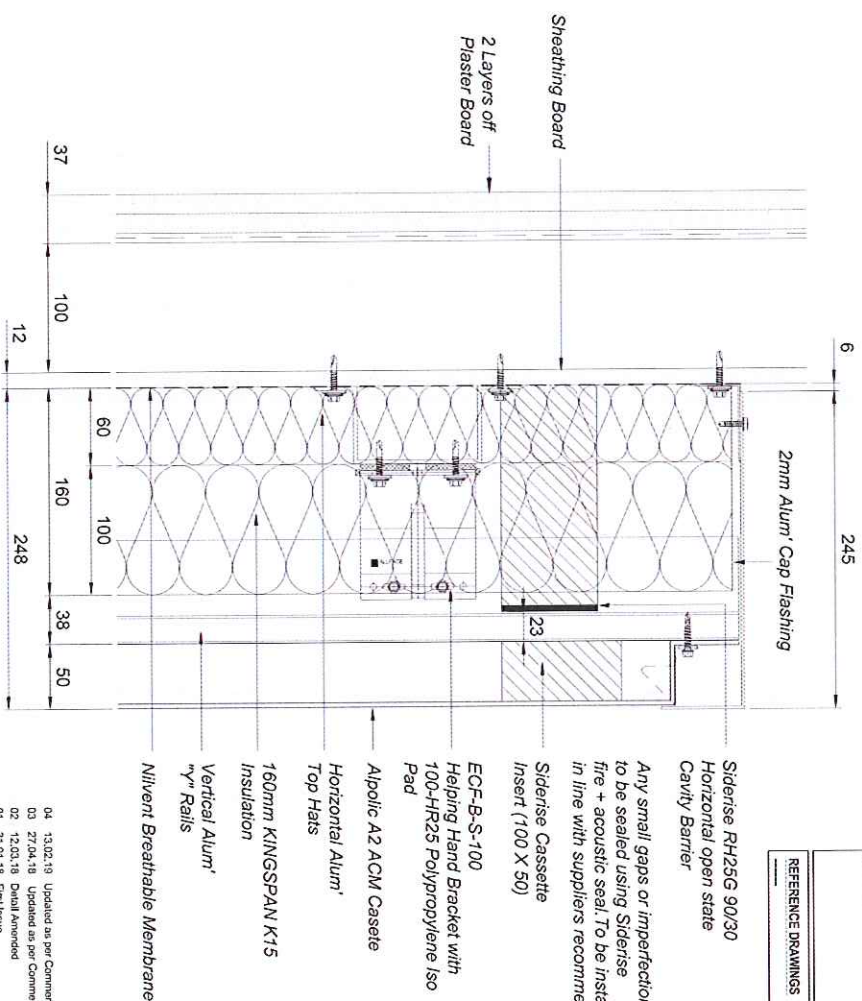
No:	Total 6 SFS	Dwg No
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Ref: Test 6B.dwg

AS BUILT

AS BUILT

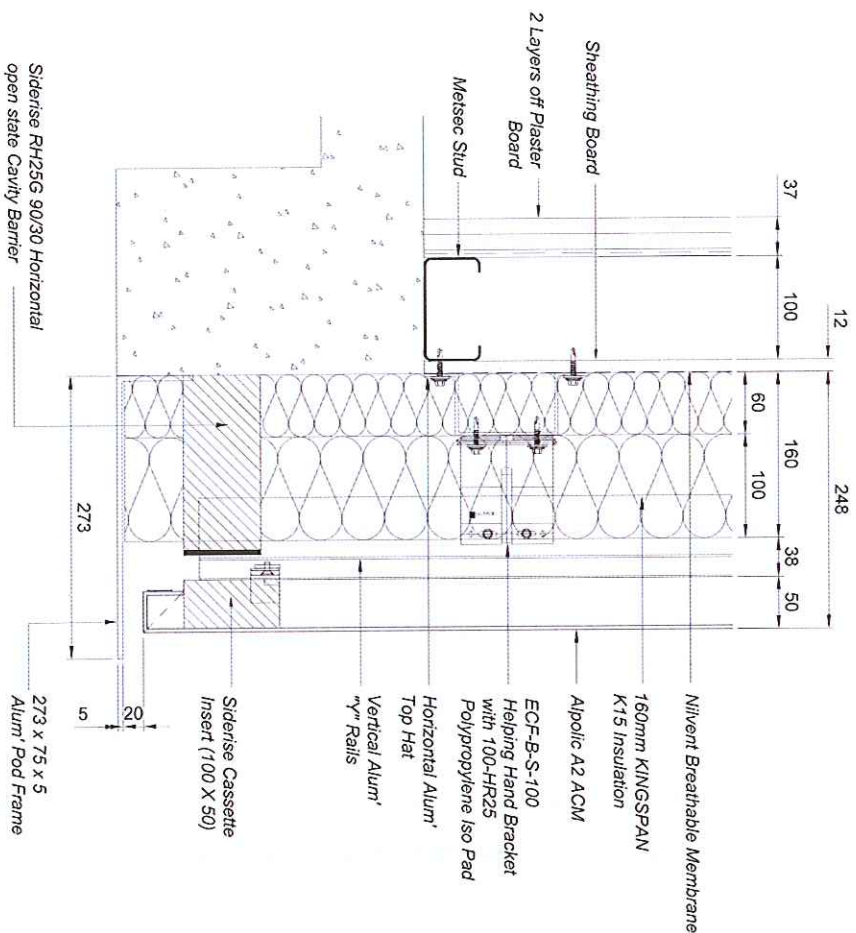
DT06 Vertical Section At Head of Rig Test 6 SFS  
Scale 1:4@A3



**Important Notes**  
Panels: 4mm THK Alpolic A2 ACM  
System: BML100  
Finish: Silver Met  
All dimensions are theoretical and should be checked and verified prior to instruction to manufacture.

**REFERENCE DRAWINGS**

DT05 Vertical Section At Head of Chamber Test 6 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.



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Client: KINGSPAN  
Project: 160mm Koolthum K15 - Alpolic A2 - BML100  
Title: Details 5 & 6  
Drawn By: GI  
Scale: 1: @ A3  
Date: Jun 2018  
Job No: Test 6 SFS  
Dwg No: DT6\_2  
Rev: 04  
CAD Ref: Test 05.dwg  
AS BUILT

AS BUILT



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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		21/08/19.