



# Reaction to fire test report

Test standard: BS 8414-2:2015

Test sponsor: Cladding Safety Victoria

Product: [REDACTED] wall system

Job number: RTF230138

Test date: 7 May 2024 Revision: RR1.0

## Quality management

Revision	Date	Information about the report			
RR1.0	29 November 2024	Description	Initial issue		
		Name	Prepared by	Reviewed by	Authorised by

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## Executive summary

This report documents the findings of the reaction to fire test for a non-loadbearing external wall system performed on 7 May 2024 in general accordance with BS 8414-2:2015.

Warringtonfire performed the test at the request of Cladding Safety Victoria.

Table 1 provides details of the test assembly, and Table 2 provides a summary of the test specimen. A summary of the results is provided in Table 3.

**Table 1 Test assembly**

Item	Detail	
Nominal non-loadbearing wall system	Height	8000 mm
	Thickness	Curtain wall - 110 mm
		Panel – 75 mm
Nominated width of main wall finished face	3000 mm	
Nominated width of wing wall finished face	1700 mm	
Meeting point of main wall and wing wall	Internal corner	

**Table 2 Test specimen**

Item	Detail
Test specimen	The façade consisted of 75 mm thick panels secured to 0.75BMT top hats that were secured to the framing rig.

**Table 3 Test results**

Parameter	Results
$t_s$ , start time	3 minutes 58 seconds after ignition of crib
Peak temperature/time at Level 2, 50 mm external	664 °C at 16 minutes 34 seconds after $t_s$
Peak temperature/time at Level 1, 50 mm external	958 °C at 18 minutes 21 seconds after $t_s$
Peak temperature/time at 900 mm above lintel	75 °C at 30 minutes 5 seconds after $t_s$
Flaming on the unexposed side	No flaming
Openings to the unexposed side	No openings
Flame spread	No flame spread beyond specimen
Flaming debris	No flaming debris
Mass of measured debris	No discernible debris

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## 1. Introduction

This report documents the findings of the reaction to fire test for a non-loadbearing external wall system performed on 7 May 2024 in general accordance with BS 8414-2:2015.

Warringtonfire performed the test at the request of the test sponsor listed in Table 4.

**Table 4 Test sponsor details**

Test sponsor	Address
Cladding Safety Victoria	717 Bourke Street Fitzroy VIC 3008 Australia

## 2. Test specimen

### 2.1 Schedule of components

Table 5 describes the test specimen and lists the schedule of components. These were provided and surveyed by Warringtonfire.

All measurements were done by Warringtonfire – unless indicated otherwise.

Detailed drawings of the test specimen are provided in Appendix A.

**Table 5 Schedule of components**

Item	Description	
Cladding		
1.	Item name	AAC cladding
	Product name	[REDACTED]
	Material	Autoclaved aerated concrete (AAC)
	Reinforcement	Single mesh reo
	Size	3000 mm long × 600 mm wide × 75 mm thick 2400 mm long × 600 mm wide × 75 mm thick (cut to suit)
	Product code	[REDACTED]
	Panel mass	3000 mm – 62.5 kg 2400 mm – not measured
	Density	449 kg/m <sup>3</sup>
	Batch number	[REDACTED]
	Manufacturer	[REDACTED]
Framing		
2.	Item name	Top hat
	Product name	[REDACTED]
	Material	[REDACTED] G550 grade steel
	Size	50 mm face × 35 mm high × 19 mm flange × 3600 mm long (cut to length)
	Average thickness	0.86 mm TCT (0.75BMT)
	Product code	[REDACTED]



Item	Description	
	Batch number	[REDACTED]
	Manufacturer	[REDACTED]
3.	Item name	Top hat cleat
	Product name	[REDACTED]
	Material	[REDACTED] AM 150 G550 grade steel
	Size	100 mm long × 45 mm wide × 35 mm deep
	Average thickness	2.0 mm TCT (1.9BMT)
	Mass	155 g
	Product code	[REDACTED]
	Batch number	[REDACTED]
	Manufacturer	[REDACTED]
Sealant/Adhesive		
4.	Item name	Mortar
	Product name	[REDACTED]
	Product code	[REDACTED]
	Manufacturer	[REDACTED]
5.	Item name	Adhesive
	Product name	[REDACTED]
	Density	Not measured
	Product code	[REDACTED]
	Batch number	[REDACTED]
	Manufacturer	[REDACTED]
6.	Item name	Fire rated sealant
	Product name	[REDACTED]
	Base	Polyurethane
	Density	1009 kg/m <sup>3</sup>
	Product code	[REDACTED]
	Batch number	[REDACTED]
	Manufacturer	[REDACTED]
7.	Item name	Backing rod
	Product name	[REDACTED]
	Average thickness	13.5 mm
	Density	29 kg/m <sup>3</sup>
Fixings		
8.	Item name	Top hat screws
	Product details	12-24 × 50 mm SDS Hex head, fine thread
	Product code	[REDACTED]



Item	Description	
	Batch number	██████
	Manufacturer	██████
9.	Item name	Cleat screws
	Product details	10g × 16 mm Hex Head without seal, SDS, hex head
	Batch number	██████
	Manufacturer	██████
10.	Item name	Cladding screws
	Product details	14g × 100 mm Bugle Head, SDS, batten screw, type 17
	Batch number	██████
	Manufacturer	██████
Steel substrate		
11.	Item name	Steel substrate
	Size	The steel substrate was 9300 mm high × 3245 mm wide for the main wall and 9300 mm high × 2000 mm wide for the wing wall
	Description	The substrate consisted of structural steel sections and square hollow sections (SHS).
Installation method		
EW	Overall size	8000 mm high × 3120 mm wide (main wall)/1700 mm wide (wing wall) × 110 mm thick
	Installation	<p>Top hat cleats (item 3) were secured to the steel substrate (item 11) at 600 mm max centres with cleat screws (item 9).</p> <p>Top hats (item 2) were installed at 600 mm max centres and were secured to the top hat cleats (item 3) with top hat screws (item 8).</p> <p>AAC cladding panels (item 1) were then installed horizontally and were secured to the top hats (item 2) with cladding screws (item 10) at 250 mm max centres and 50 mm from the panel's edge.</p> <p>Adhesive (item 5) was installed between the cladding panels (item 1).</p> <p>At the corner between the main wall and the wing wall, backing rod (item 6) was installed on the gap at 10 mm depth followed by fire rated sealant (item 6), installed flush.</p> <p>5 mm thick (approximately) mortar (item 4) was applied at the bottom of the lower cladding panel (item 1), between the panel and the ground.</p> <p>See Appendix A for more details.</p>

## 2.2 Installation details

Table 6 lists the installation details for the test specimen.

**Table 6 Installation details**

Item	Detail
Start date for construction of the test specimen	30 April 2024
Completion date for construction of the test specimen	6 May 2024
External wall system constructed by	Representatives of Warringtonfire
Symmetry	<p>Asymmetrical:</p> <ul style="list-style-type: none"> <li>Exposed side of the external wall was clad with [REDACTED] wall.</li> <li>Sealant and backing rod detail only used on the exposed side.</li> </ul> <p>It was confirmed that the system was exposed from the side that would normally face the outside of the building.</p>

## 3. Test procedure

Table 7 details the test procedure for this reaction to fire test.

**Table 7 Test procedure**

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of BS 8414-2:2015+A1:2017 and AS 5113:2016+A1:2018 for a non-loadbearing external cladding system fixed to and supported by a structural steel frame.	
Variations	<ul style="list-style-type: none"> <li>The fuel source for the test was constructed from Pinus Radiata instead of Pinus Silvestris as prescribed under Annex A.1.1 of BS 8414-2:2015. The fuel source used for the test does however comply with Section 4.2 of AS 5113:2016.</li> <li>For the main wall, the panels were installed with no vertical joint.</li> <li>For both the main wall and wing wall, there was no internal instrumentation at Level 2.</li> <li>The timber strips used as part of the ignition source were comprised of medium density fibreboard (MDF) instead of the low-density fibreboard as prescribed under Annex A.1.2 of BS 8414-2:2015+A1:2017. This variation is not considered to have affected the outcome of the test.</li> <li>On some of the AAC cladding panels, material was mechanically removed to facilitate the inclusion of instrumentation.</li> <li>The moisture content of the ignition source crib was 1% above the limit prescribed by the BS 8414-2:2015.</li> </ul>	
Environmental conditions at the start of the test	Start of the test	23 °C
	Wind speed	0.0 - 0.9 m/s
Ignition source	Crib material	Softwood (radiata pine)
	Moisture content	16 %
	Crib density	0.49 kg/dm <sup>3</sup>
	Crib mass	366 kg
Sampling / specimen selection	All test materials were supplied and installed by representatives of Warringtonfire.	

Item	Detail
Test duration	60 minutes
Instrumentation and equipment	<p>The instrumentation was provided in accordance with BS 8414-2:2015+A1:2017 as follows:</p> <ul style="list-style-type: none"> <li>• Exposed external temperatures were measured by mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5 mm with the measuring junction insulated from the sheath.</li> <li>• Specimen exposed face temperatures were measured by 100 mm × 100 mm × 0.7 mm plate thermocouples with mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5 mm and with the measuring junction electrically insulated from the sheath. The thermocouple hot junction was fixed to the geometric centre of the plate by a small steel strip made from the same material as the plate. The plate thermocouples included 97 mm × 97 mm × 10 mm inorganic insulation pads. Before the first use of the plate thermocouples, they were aged by being exposed to heat in a fire resistance test furnace for 90 minutes under the standard temperature/time curve. The plate thermometers were recessed into the face of the specimen such that the face of the thermometer was coplanar with the exposed face of the specimen.</li> <li>• Radiant heat flux measurements were taken using water cooled heat flux gauges which were embedded into the specimen and installed such that the measuring face of the gauge was coplanar with the exposed face of the specimen.</li> <li>• The unexposed side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5 mm soldered to 12 mm diameter × 0.2 mm thick copper discs covered by 30 mm × 30 mm × 2.0 mm thick inorganic insulating pads.</li> <li>• The thermocouple positions are shown in Figure 9 in Appendix D.</li> <li>• The wind speed was measured by an anemometer at Level 2, 1000 mm forward from the centre line of the combustion chamber.</li> <li>• Timber crib moisture was measured by a moisture meter.</li> </ul>

## 4. Test measurements and results

**Table 9** shows the peak temperatures the test specimen achieved as listed in BS 8414-2:2015+A1:2017.

The temperature measurements for the test specimen are included in Appendix D.

**Table 9** in Appendix B includes observations of any significant behaviour of the specimen and details the occurrence of the various performance criteria specified in BS 8414-2:2015+A1:2017.

Photographs of the specimen are included in Appendix E.

**Table 8 Test results**

Parameter	Results
$t_s$ , start time	3 minutes 58 seconds after ignition of crib
Peak temperature/time at Level 2, 50 mm external	664 °C at 16 minutes 34 seconds after $t_s$
Peak temperature/time at Level 1, 50 mm external	958 °C at 18 minutes 21 seconds after $t_s$
Peak temperature/time at 900 mm above lintel	75 °C at 30 minutes 5 seconds after $t_s$
Flaming on the unexposed side	No flaming
Openings to the unexposed side	No openings
Flame spread	No flame spread beyond specimen
Flaming debris	No flaming debris
Mass of measured debris	No discernible debris

## **5. Application of test results**

### **5.1 Test limitations**

The results of these fire tests may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all fire conditions.

These results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, and they do not necessarily reflect the actual behaviour in fires.

### **5.2 Variations from the tested specimen**

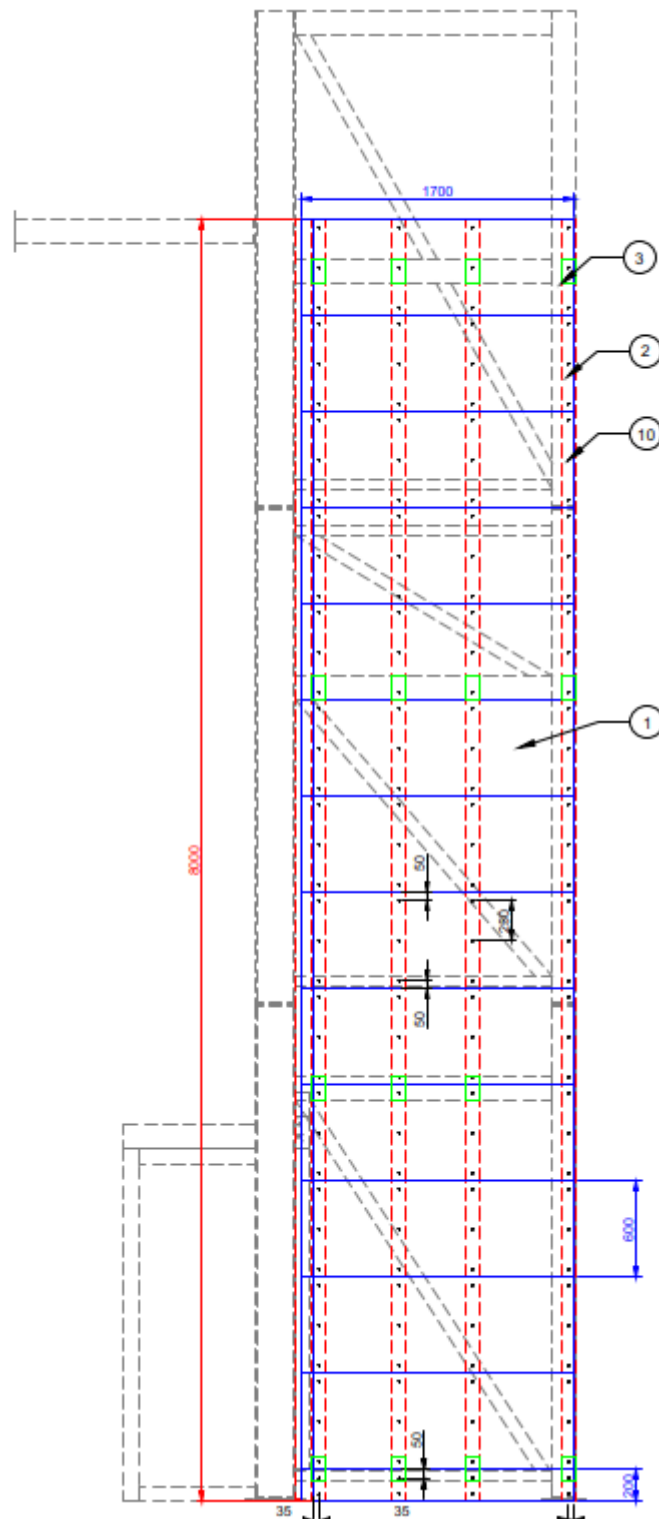
This report details methods of construction, the test conditions and the results obtained when the specific element of construction described here was tested following the procedure outlined in BS 8414-2:2015+A1:2017.

Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions, other than that allowed under the field of direct application in the relevant test method, is not covered by this report.

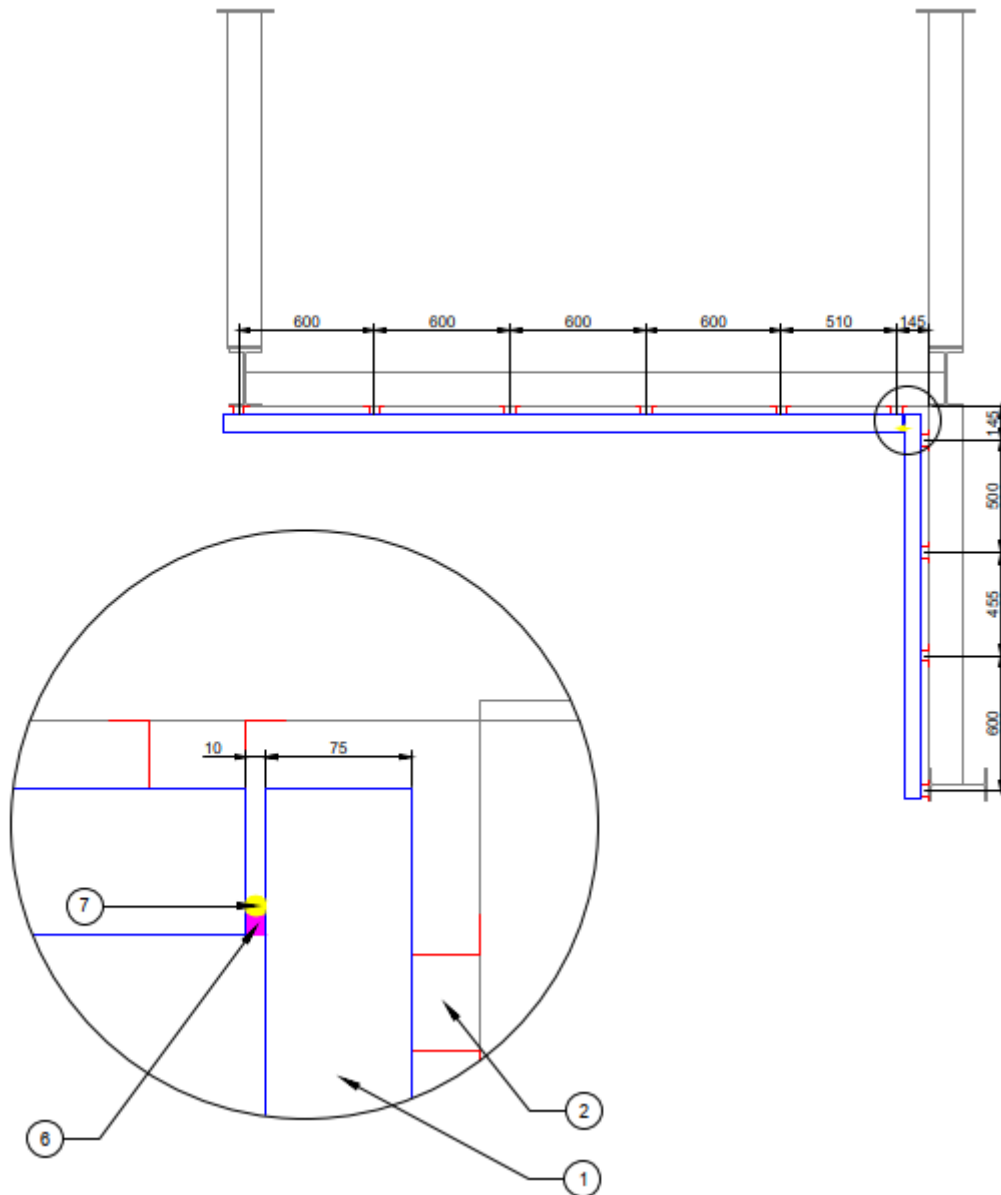
### **5.3 Uncertainty of measurements**

Because of the nature of reaction to fire testing and the consequent difficulty in quantifying the uncertainty of measurements obtained from a reaction to fire test, it is not possible to provide a stated degree of accuracy of result.





**Figure 2 Panel layout (elevation – wing wall)**



**Figure 3 Horizontal cross-section**

## Appendix B Test observations

### B.1 Visual observation

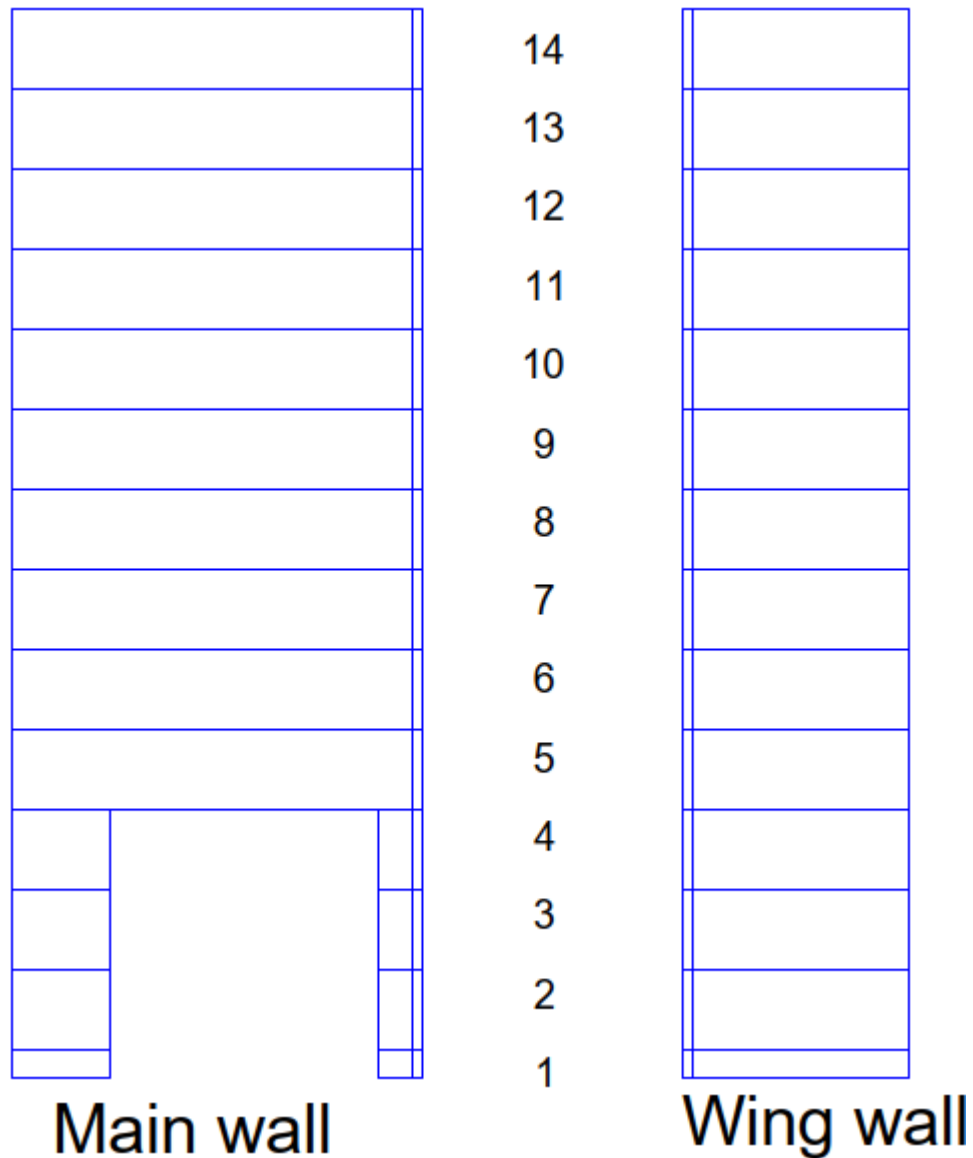


Figure 4 Panel designation (main and wing wall)

**Table 9** shows the observations of any significant behaviour of the specimen during the test.

Note: Time is relative from crib ignition.

**Table 9 Test observations**

Time		Observation
Min	Sec	
0	00	The crib was ignited, and the reaction of fire test was started.
3	10	Flames exited the combustion chamber.
3	47	Discolouration had appeared on section 5 on main wall.
3	58	Start time (ts). TC054 recorded a temperature of 222 °C and the temperature remained above 200 °C from start temperature continuously for a period longer than 30 seconds, in accordance with section 3.7 and 3.8 of BS 8414-2:2015.
4	40	Flames have reached section 6 on main wall.
5	02	Discolouration had appeared on section 6 on main wall.
5	29	Flames have reached section 7 on main wall.
6	04	Flames have reached Level 1 on main wall.
7	11	Discolouration had appeared on section 8 on main wall.
8	08	Flames have reached section 9 on main wall.
8	26	Intermittent flames have reached section 7 on wing wall.
11	49	Flames have reached section 11 on main wall.
12	08	Flames have reached Level 2 on main wall.
13	21	Discolouration appeared on the corner edge of section 5 and 6 of the wing wall.
14	48	Flames have reached section 10 on wing wall.
15	28	Flames have reached top of specimen on main wall.
17	30	Flame spread on the joint between the main and wing wall.
19	46	Flames have reached section 11 on wing wall.
28	17	Flames have reached the subside of Level 1 on main wall.
30	00	The crib was removed from the combustion chamber. The specimen was not flaming.
60	00	Test ended.

## B.2 Post-test observations

### External wall system

The damaged area of the cladding system is described as follows;

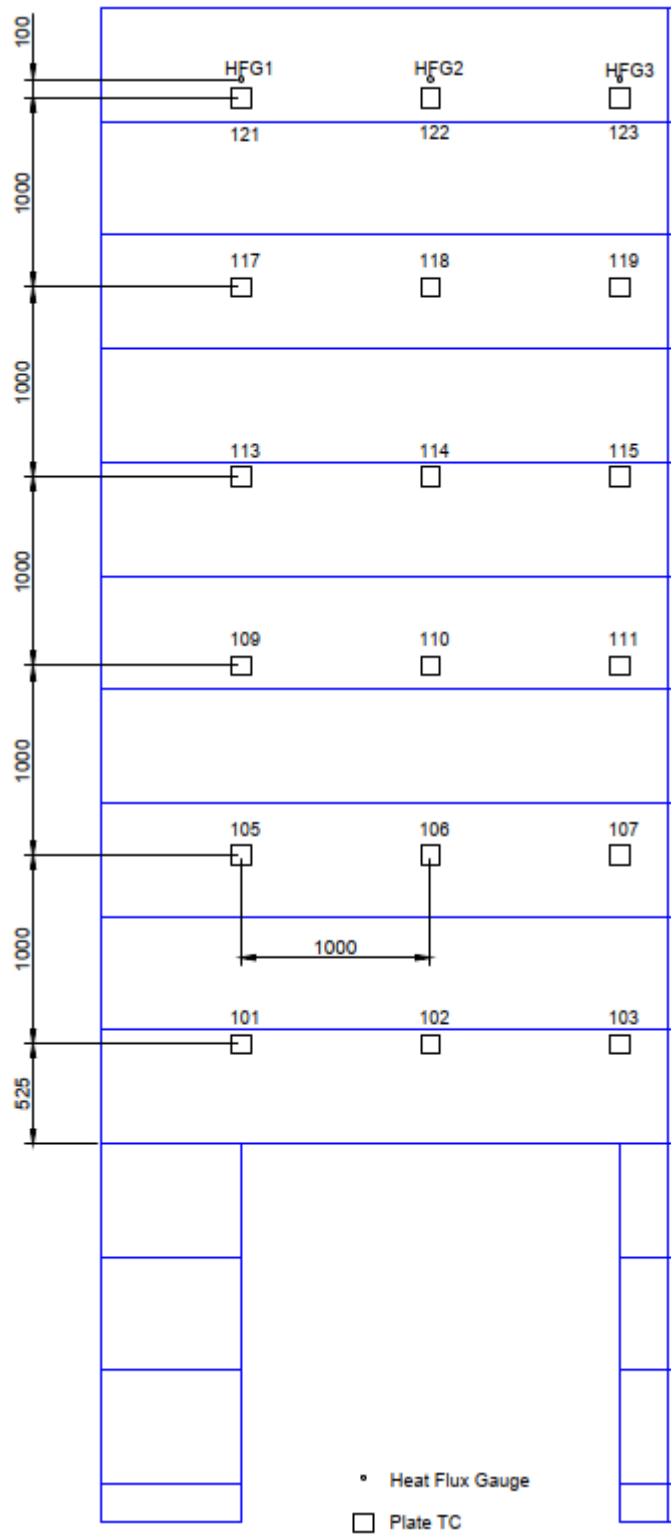
Approximately 5.2 m<sup>2</sup> of panels had visible discolouration, exposed side:

- Approximately 1.6 m<sup>2</sup> of panels were exposed to severe heat.
- Approximately 1.4 m<sup>2</sup> of panels were exposed to high heat.
- Approximately 3.8 m<sup>2</sup> of panels had visible discolouration

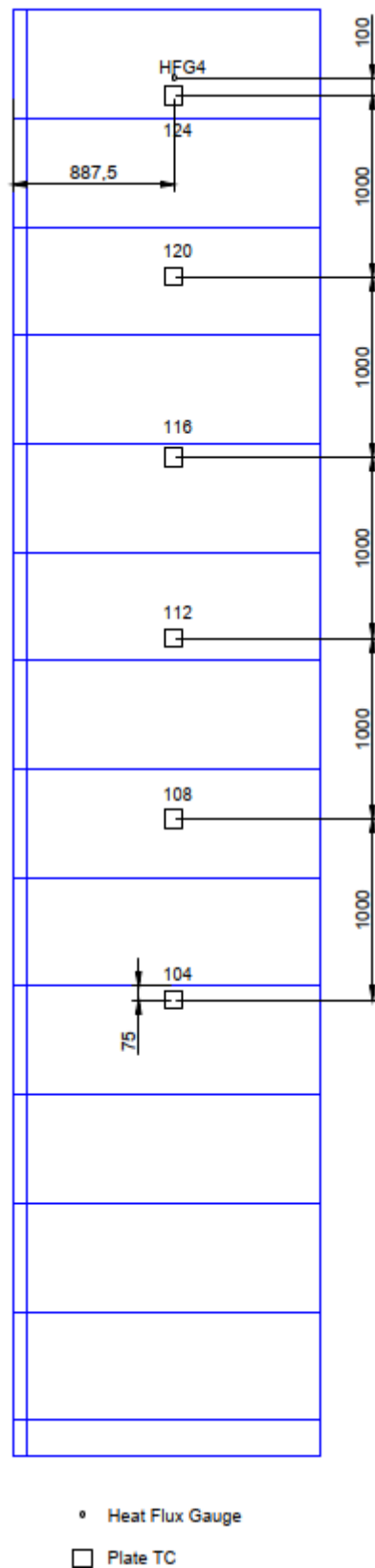
There was no post-test debris, therefore no post-test debris measurements were taken.

See Figure 26 for more details.

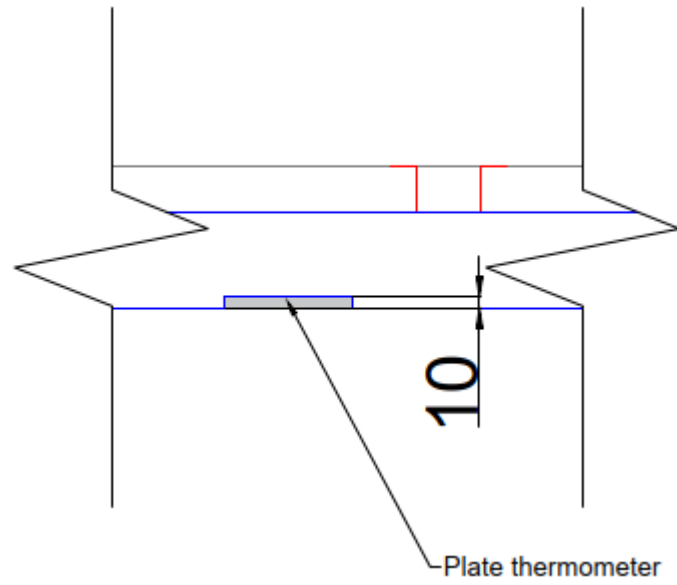
## Appendix C Instrumentation locations



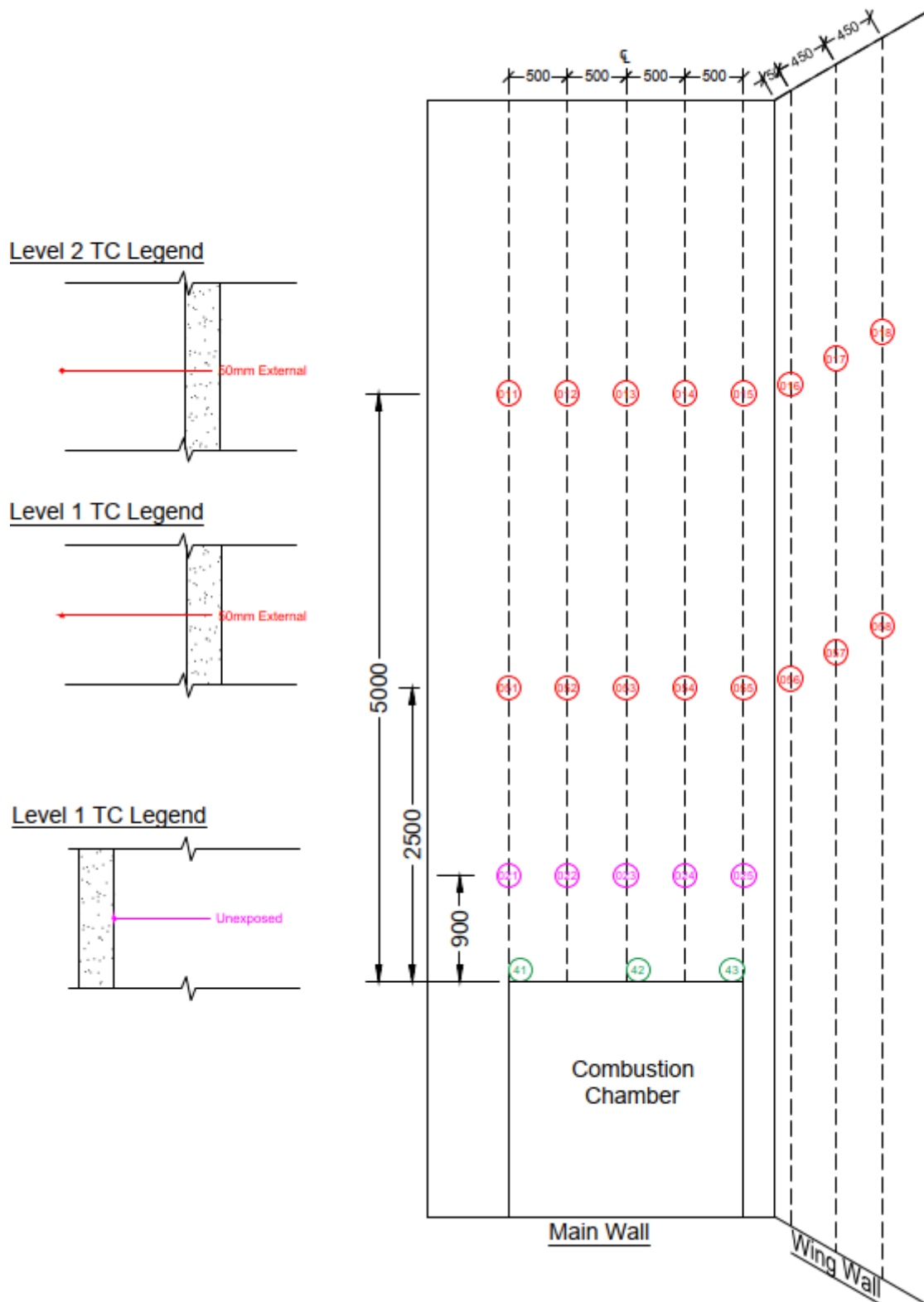
**Figure 5 Main wall – surface instrumentation**



**Figure 6 Wing wall – surface instrumentation**



**Figure 7 Horizontal cross section detail – plate thermometer**

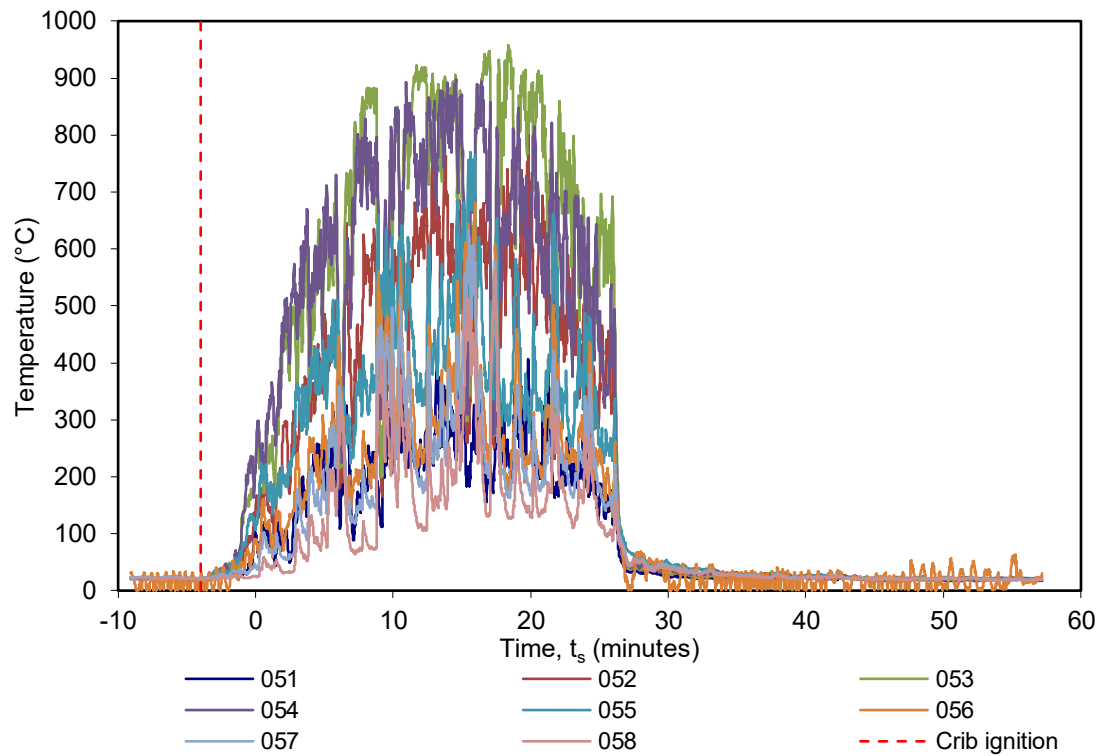


**Figure 8 Instrumentation locations - other (main and wing wall)**

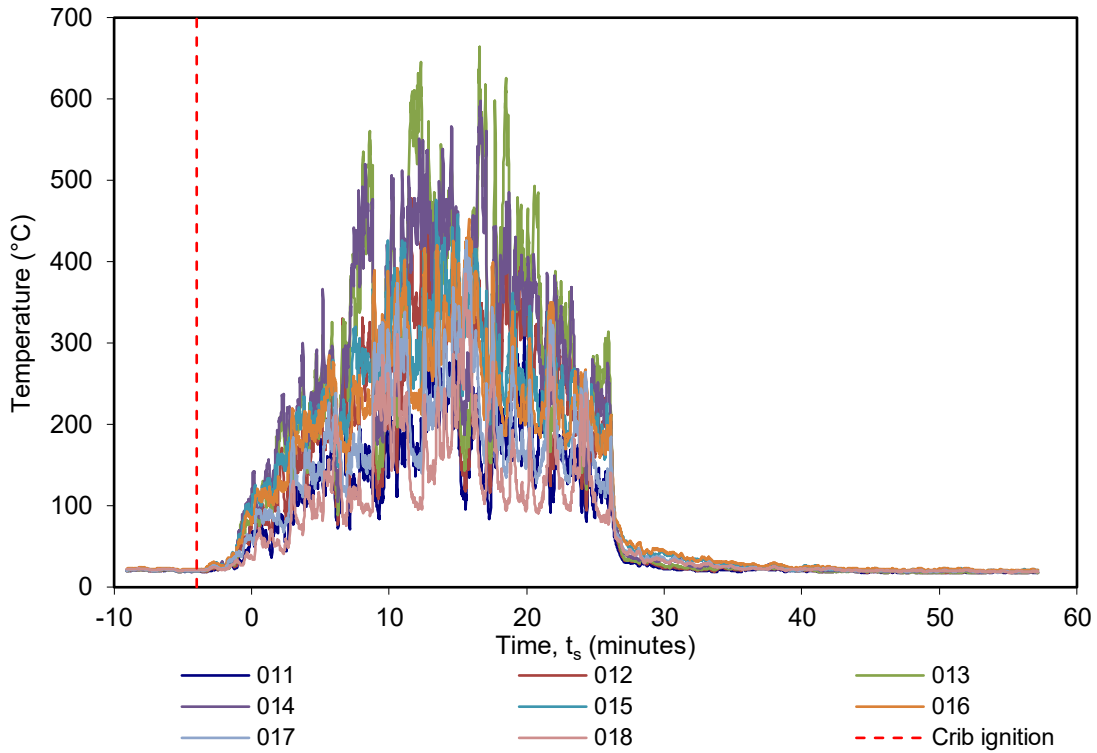
## Appendix D Test data

Note: Time is relative from  $t_s$ .

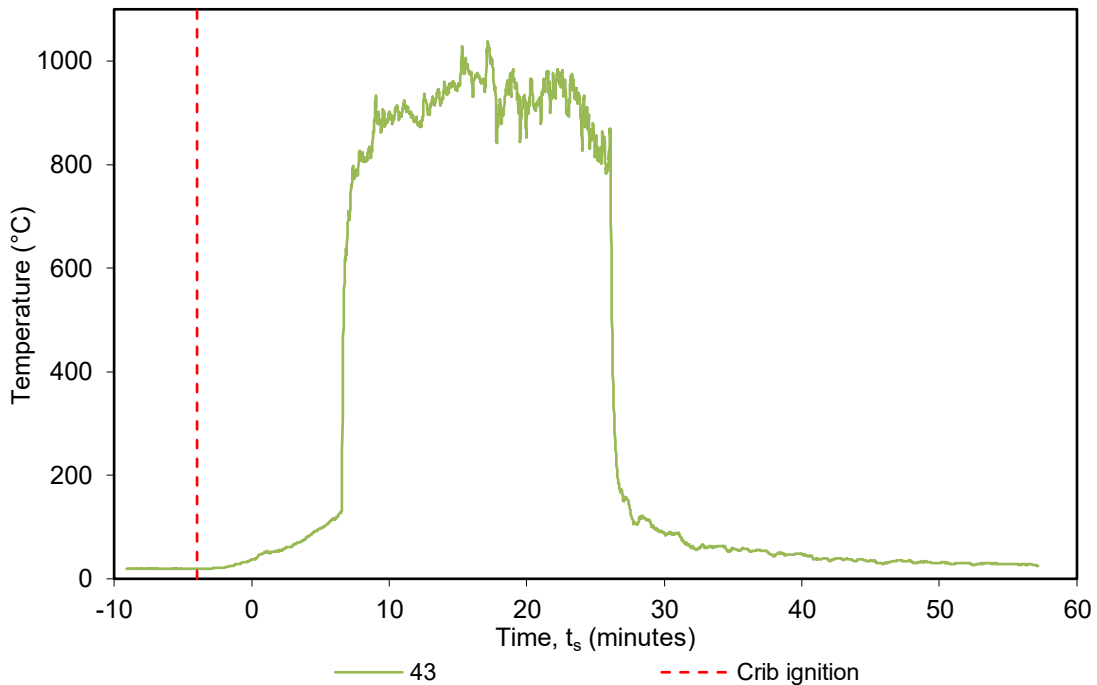
### D.1 Specimen temperatures



**Figure 9 Level 1, external – temperature vs time**

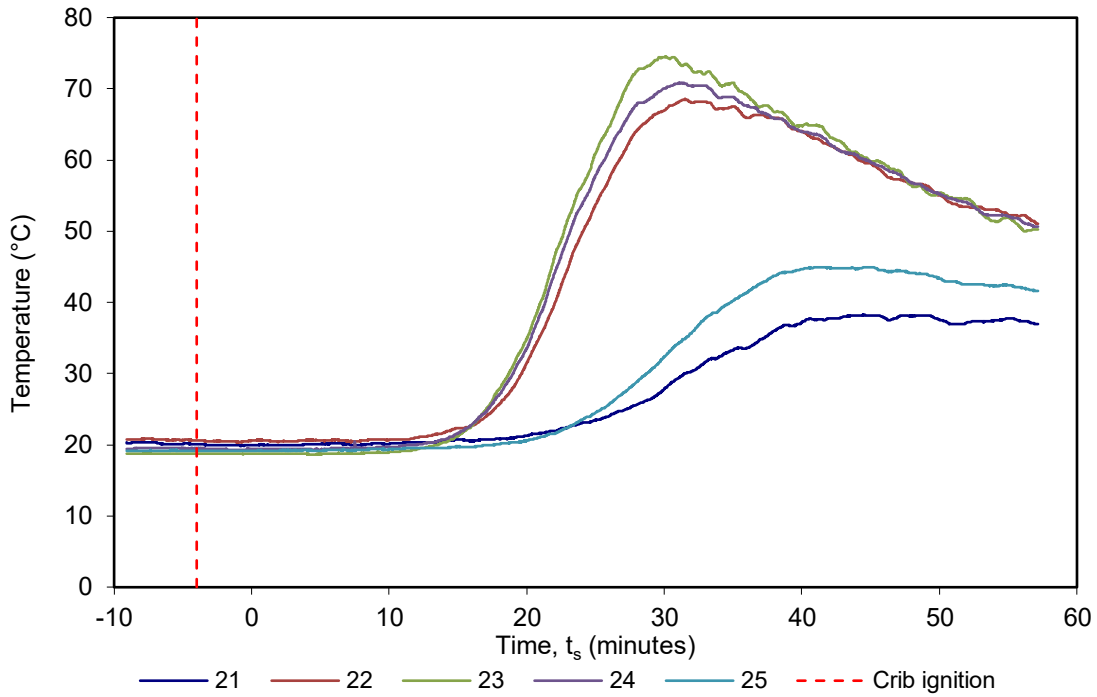


**Figure 10** Level 2, external – temperature vs time

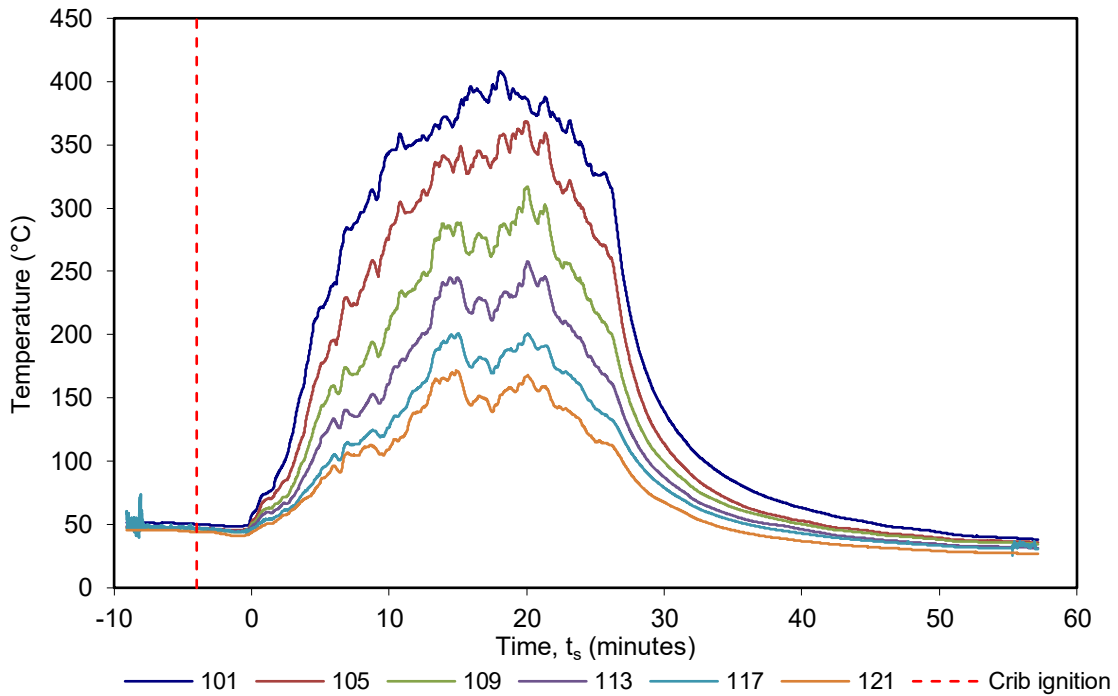


**Figure 11** Underside of chamber lintel – temperature vs time

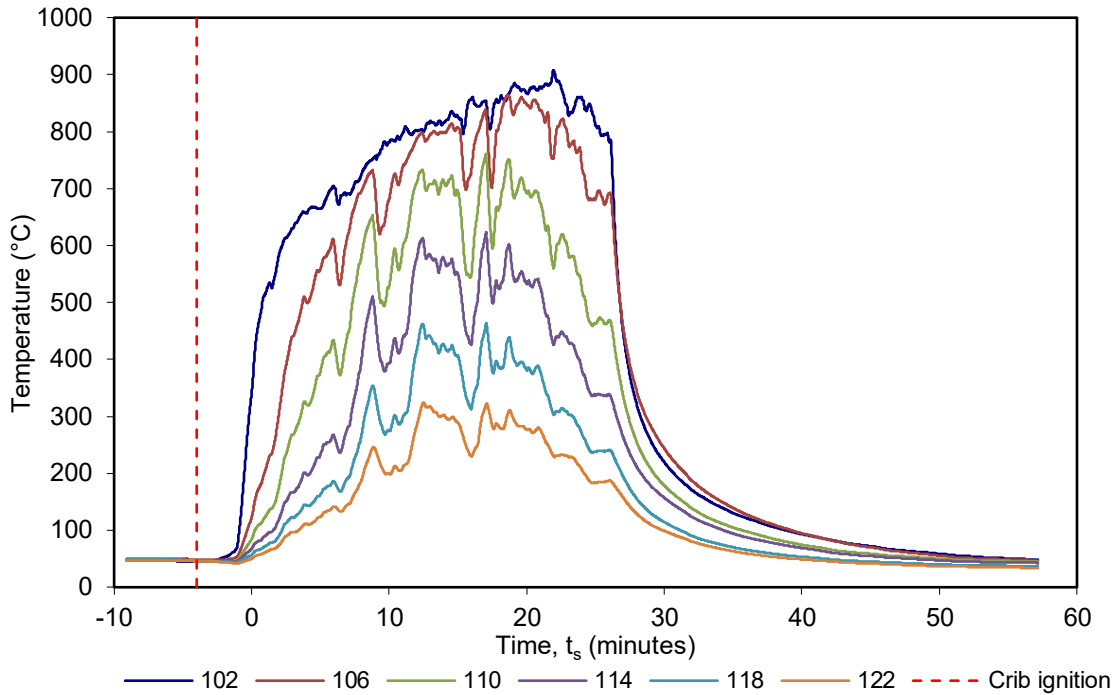
**Note:** TC 041 and 042 malfunction throughout the test period.



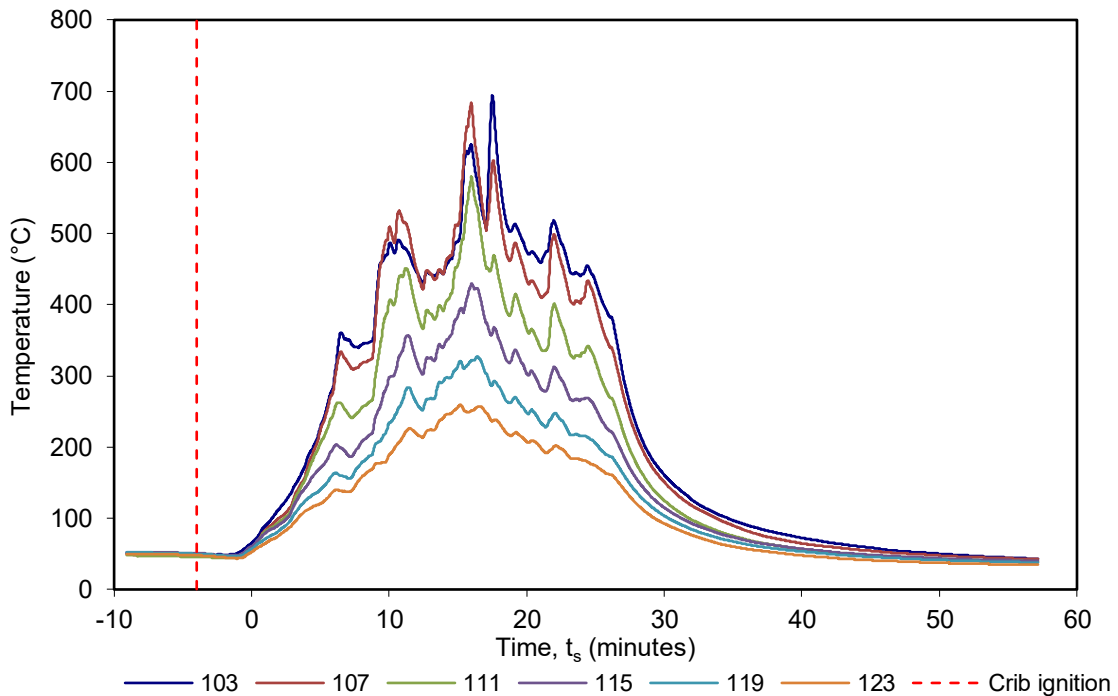
**Figure 12 900mm above chamber opening – temperature vs time**



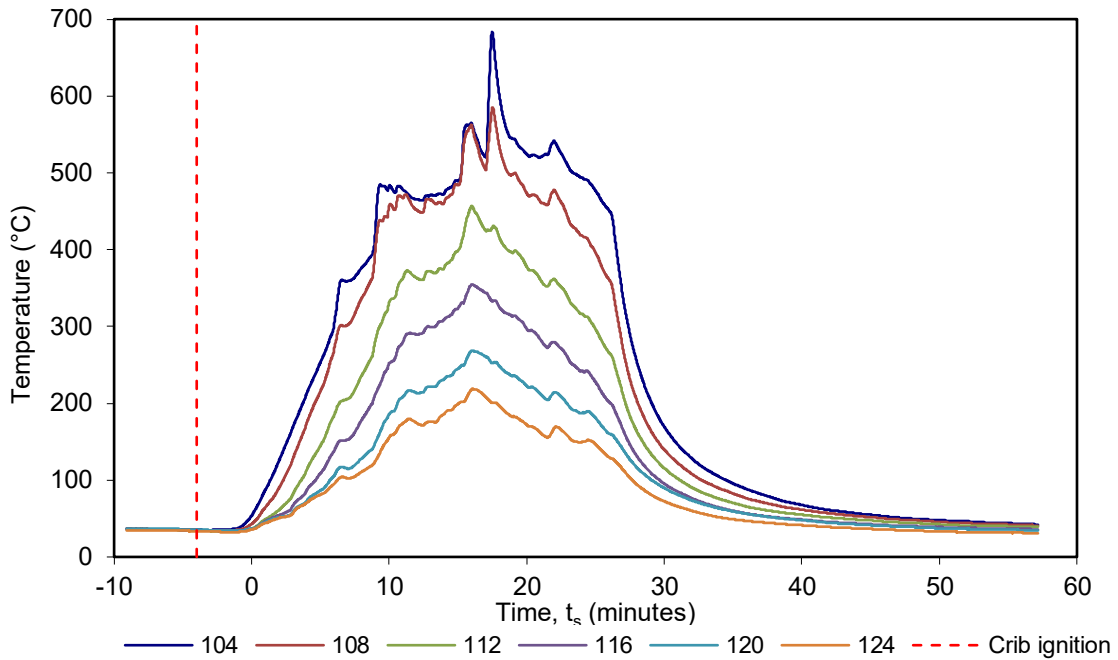
**Figure 13 Plate thermometers at 500 mm vertical centres, left-edge of chamber – temperature vs time**



**Figure 14 Plate thermometers at 500 mm vertical centres, centre of chamber – temperature vs time**

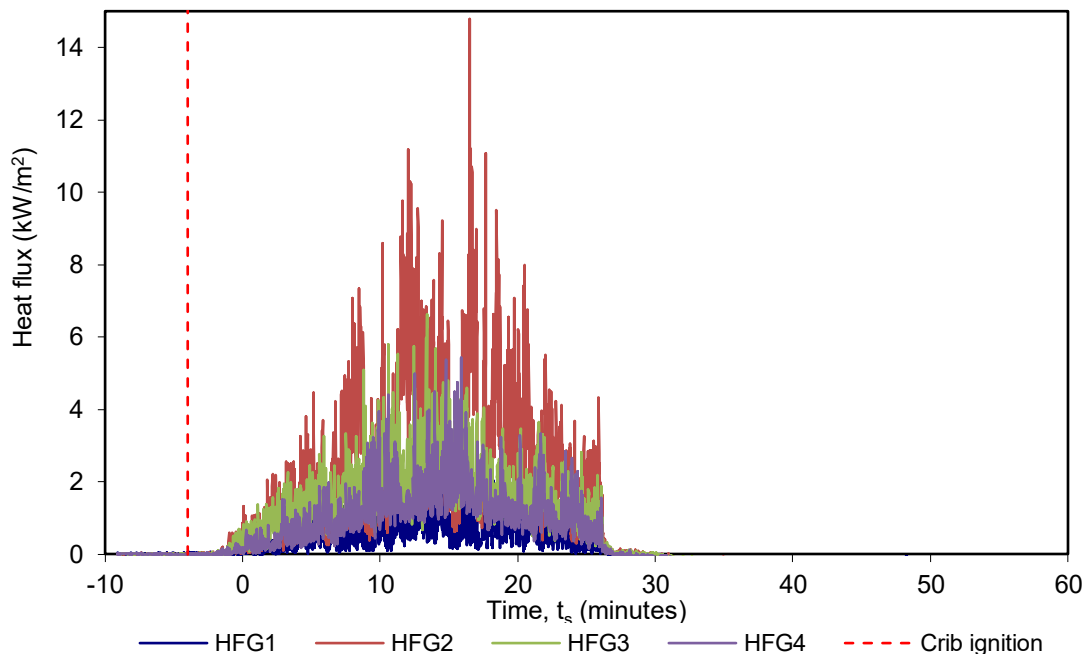


**Figure 15 Plate thermometers at 500 mm vertical centres, right-edge of chamber – temperature vs time**



**Figure 16** Plate thermometers at 500 mm vertical centres, mid-width of wing wall – temperature vs time

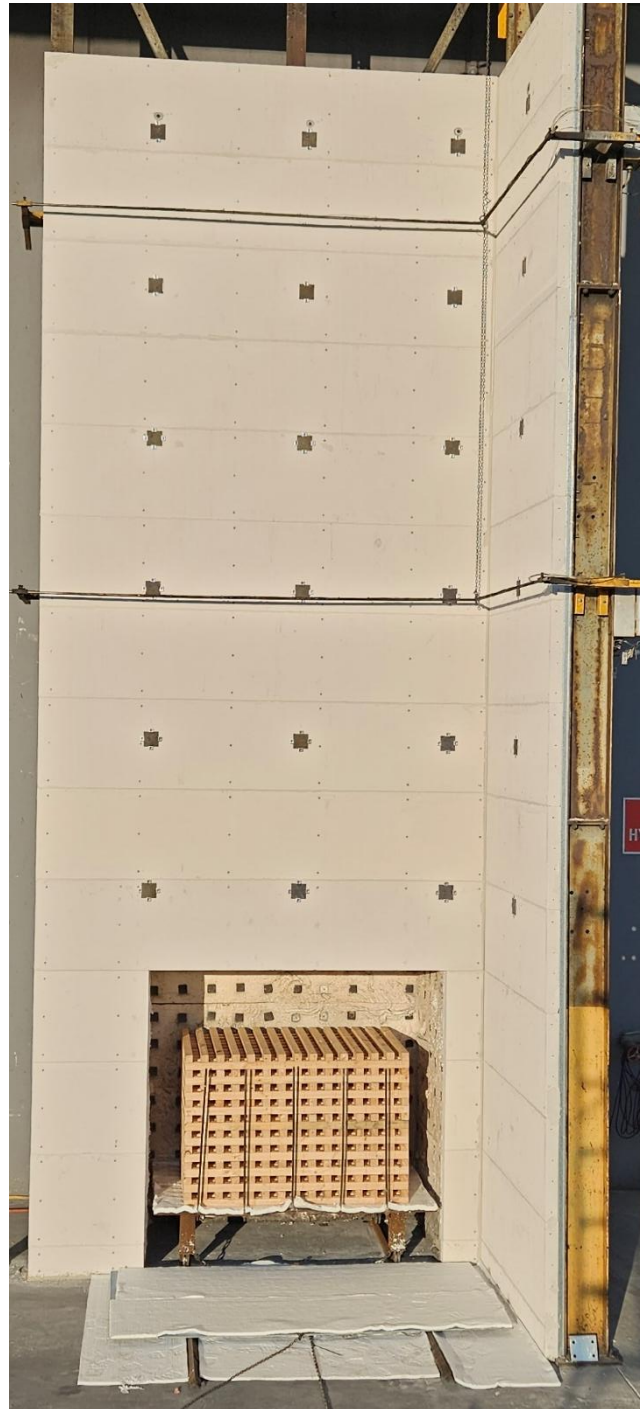
## D.2 Heat flux measurements



**Figure 17** Exposed face incident heat flux – heat flux vs time

**Note:** The heat flux measurements were located 5625 mm above the chamber opening.

## Appendix E Photographs



**Figure 18** The external cladding system before the start of the test – main wall



**Figure 19** The external cladding system before the start of the test – wing wall

Note: Picture taken prior instrumentation installation.



**Figure 20 The external wall system during the test – 7 minutes after crib ignition**



**Figure 21** The external wall system during the test – 22 minutes after crib ignition



**Figure 22** The external wall system during the test – specimen during removal of the crib, 30 minutes after ignition of crib



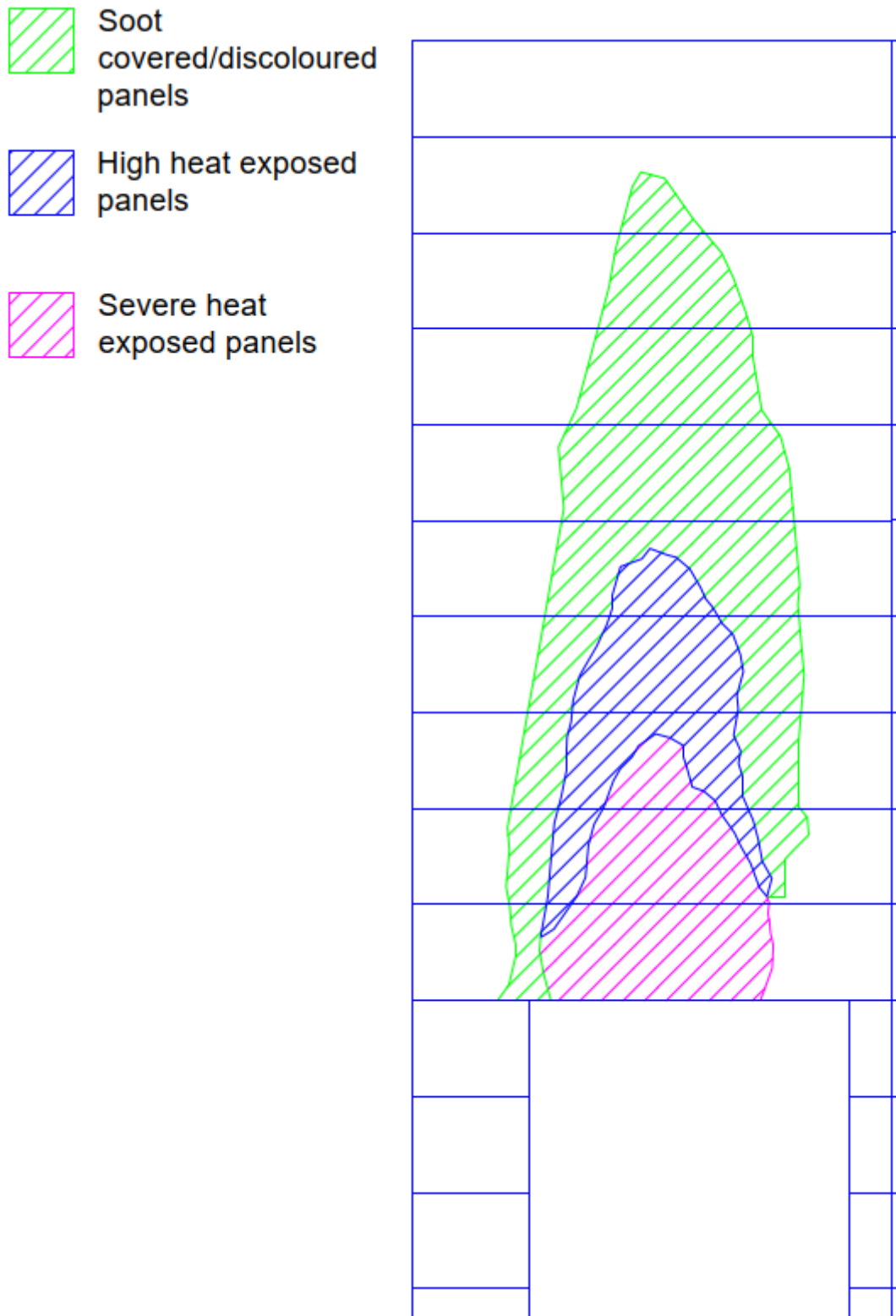
**Figure 23** The external wall system during the test – 37 minutes after crib ignition



**Figure 24 The external wall system on completion of the test – main wall**



**Figure 25** The external wall system on completion of the test – wing wall



**Figure 26 The post-test external wall system – exposed side**



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