Fire test of 4mm Alpolic A2 cladding fixed to Aclad 4000 framing system in accordance with BS 8414.2-2015 (Amdt 1) as modified by AS 5113-2016

Test Report

Author: Brett Roddy
Report number: FNW 7936
Date: 4/6/2018

Client: Architectural Façade Cladding Solutions Pty Ltd

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Contents

1 Introduction

1.1 Identification of specimen

The sponsor identified the specimen as 4mm Alpolic A2 cladding fixed to Aclad 4000 framing system with the unexposed face of the wall system lined with fire grade plasterboard.

1.2 Sponsor

Architectural Façade Cladding Solutions Pty Ltd
21 Ingleston Road
Wakerly, QLD 4154

1.3 Manufacturer

Aclad 4000 system:
Architectural Façade Cladding Solutions Pty Ltd
21 Ingleston Road
Wakerly, QLD 4154

Alpolic cladding panels:
Mitsubishi Chemical Corporation
Alpolic Department
1-1-1, Marunouchi, Chiyoda-ku,
Tokyo 100-8251 JAPAN

Mitsubishi Chemical Corporation have provided permission in writing for CSIRO to undertake a test sponsored by Architectural Façade Cladding Solutions Pty Ltd.

1.4 Test standards

The testing was in accordance with BS 8414.2-2015 (Amdt 1) as appropriate for a non-loadbearing external cladding system fixed to and supported by a structural steel frame. The test was undertaken for the purpose of classification of the external wall in accordance with AS 5113-2016 Fire propagation testing and classification of external walls of buildings.

1.5 Test number

CSIRO Reference test number FNW 7936.

1.6 Test date

The fire-resistance test was conducted on 6th March 2018.

2 Description of specimen

2.1 Test Configuration

The test specimen is representative of a structural steel frame clad with an external wall panel.

2.2 Specimen Components

The test specimen comprised the following components:

Component reference	Manufac.	Material	Overall thickness	Density	Size (L x W x H)	Fixing method
CSR Fyrchek plasterboard	CSR Gyprock	Plasterboard	13-mm	10.5 kg/m^2	Various	Screwed to lightweight wall framing in accordance with manufacturer's specification.
Lightweight steel wall framing	Rondo	Steel	0.75bmt	N/A	90-mm studs	Fixed to the structure with 12g series 500 Tek screws.
Mineral wool insulation	Bradford	CSR Fibertex 450 Rockwool Board	50mm	72.4 kg/m^3	1200-mm x 600-mm x 50-mm thick	Friction fit into light weight wall frame cavity. The CSR Fibertex 450 Rockwool Board is not deemed combustible in accordance with AS 1530.1 (Refer test report FNC 9595).
12g series 500 Tek screw	ICONN	Steel	5.5mm		65-mm	
Galvabond air seal sheet	Metalcorp	Steel	1mm BMT	7.85 kg/m^2	2400mm x 1200mm	Fixed with 12g Tek screw onto lightweight wall framing at nom, 300-mm centres.
Stainless steel bolt set	ICONN	304 Stainless Steel	14 mm		90 mm	One bolt per framing bracket
Aclad 4000 aluminium framing bracket	Almax	T6 6106 aluminium	2.5mm		522-mm and 2300-mm vertical centres	Fixed through air seal sheet to structure with 12g series 500 Tek screws (4 Tek screws per bracket)
Aclad 4000 aluminium framing rail	Almax	T6 6106 aluminium	2.5mm		1213-mm centres	Fixed to frame bracket with single 14-mm stainless steel bolt set.
Aclad 4000 aluminium female	Almax	T6 6106 aluminium	2.5mm			Fixed to cladding panel using pop rivets at nom. 300-mm centres
Aclad 4000 aluminium male	Almax	T6 6106 aluminium	2.5mm			Fixed to frame rail using 12g Tek screws. Fixed to cladding panel using pop rivets at nom. 300-mm centres
Alpolic A2 Cladding Panel	Mitsubishi	Aluminium Composite Panel	4mm			Fixed to male and female extrusions using pop rivets at nom. 300-mm centres.
12g Tek screw	ICONN		5.5mm		35-mm	12-14 x 35 full thread
Pop rivets	Hobson	Aluminium/ steel				Rivet dome head open 73AS2 - aluminium and steel #54
Aluminium window subhead			3mm		150x50	Fixed to the structure with 12G Tek screws
Aluminium "F" extrusion	Almax	6106 T6 aluminium				Fixed to the structure with 12g Tek screws
Steel angle	Unknown	Mild Steel	3-mm		70-mm x70-mm	Fixed to steel cleats on test structure using two 12G series 500 Tek screws per wall cleat.

- Refer to drawings in Appendix A.

2.3 Specimen Overall Dimensions

The steel substructure was overall 9.237m high. The main wall was 3.24m wide and the wing wall was 2.0m wide.

The specimen face was overall 9.186m high. The main wall specimen face was 2.941m wide and the wing wall substructure face was 1.64m wide

2.4 Assembly and construction method

Steel supporting cleats were fitted to the structural steel test frame using M16 bolts. Lengths of 70-mm x 70-mm x 3-mm mild steel angle were then screw fixed to the wall cleats to support the lightweight steel wall framing panels. The 90mm deep lightweight steel wall framing panels were lined using 13mm thick Fyrechek plasterboard sheets on the unexposed face of the wall system. The wall frame cavity was then filled with 50mm thick non-combustible Fibretex 450 Rockwool insulation batts which were friction fitted between the wall studs and located hard against the plasterboard wall lining. The wall framing was then lined with a single layer 1mm thick Galvabond air seal sheets which were screw fixed to the exposed side of the wall framing using 12G x 35-mm Tek screws at nom. 300-mm centres.

Aclad 4000 system framing brackets were then screw fixed to the wall system at nom. vertical centres of 522-mm and 2300-mm using 4 off 12G series 500 Tek screws per bracket. The vertical Aclad 4000 system wall framing extrusions were then bolted to the Aclad 4000 framing brackets using a single 14-mm stainless steel bolt.

Mitsubishi Alpolic A2 cladding panels (4-mm thick) were rivet fixed at nom. 300-m centres to Aclad 4000 system male and female extrusions to form cladding panels nom. 1193-mm wide x 2400-mm high with a 20-mm deep panel return at the panel edges. The panels were attached to the Aclad 4000 system aluminium vertical framing rails using 12G x 35-mm Tek screws at nom. 300-mm centres through the Aclad 4000 system male extrusions used to form the panel framing. A 20-mm wide gap was maintained between cladding panels.

An aluminium window subhead channel was screw fixed at 400-mm centres using two 12G x35-mm Tek screws to an aluminium ‘F’ extrusion section located around the perimeter of the opening to the combustion chamber. The cladding panels were screw fixed to a 70-mm x 70-mm x 3-mm aluminium angle using 12G x 35-mm Tek screws at nom. 400-mm centres through the Aclad 4000 system aluminium male extrusions at both sides of the combustion chamber opening. The cladding panels were not fixed to the aluminium window subhead positioned above the opening of the combustion chamber.

2.5 Pre - conditioning

The external cladding was installed between the 28th February and the 3rd March 2018 in an internal laboratory location.

2.6 Sampling and specimen selection

All test materials were supplied and installed by the sponsor. The laboratory was not involved in the sampling or selection of the test specimen for the fire test.

3 Documentation

The following documents were supplied or referenced by the sponsor as a complete description of the specimen and should be read in conjunction with this report:

- Drawings titled Fire-101 to Fire-109 (inclusive), all dated 10 April 2018, issued by Aclad Architectural Façade Cladding Solutions Pty Ltd.

Confidential information about the test specimen has not been submitted to CSIRO Infrastructure Technologies.

4 Equipment

4.1 Ambient Temperature and Wind Speed

The specimen was tested under indoor laboratory conditions. The ambient temperature at the start of the test was 22°C and the wind speed at the start of the test was 0.0m/s when measured perpendicular and parallel to the main wall of the specimen at level 2.

4.2 Ignition source

The crib was constructed from softwood (Pinus Radiata) with a moisture content of between 10% and 15% and a density ranging between 480 kg/m^3 and 520 kg/m^3, in accordance with the requirements of AS 5113-2016 clause 4.2. The crib was otherwise constructed in accordance with BS 8414.2-2015 (amdt1).

4.3 Temperature

The instrumentation was provided in accordance with BS 8414.2- 2015 as detailed below.

All exposed and internal temperatures were measured by mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5mm with the measuring junction insulated from the sheath.

The non-fire side specimen temperatures were measured by Type K thermocouples with wire diameters less than 0.5mm soldered to 12mm diameter × 0.2mm thick copper discs covered by 30mm × 30mm × 2.0 mm inorganic insulating pads. The thermocouple positions are described in Appendix B.

4.4 Measurement system

The primary measurement system comprised multiple-channel data loggers, scanning at 10-second intervals during the test.

The data from all sensors were collected for at least 5 minutes prior to the ignition of the timber crib.

4.5 Audio Visual system

A continuous audio-visual record of the condition of the full height of the test faces was recorded for a minimum of 5 minutes prior to the ignition of the timber crib and throughout the 60 minute period of the test.

5 Departure from standard

The test was undertaken in accordance with BS 8414 Amdt 1 subject to the variations listed in AS 5113-2016.

6 Duration of the test

The test duration was 60 minutes.

7 Test results

7.1 Test observations

The following include observations of the significant behaviour of the specimen. Times are all in relation to crib ignition.

Time	Observation
0 minutes	Ignition of timber crib. Start temperature (Ts) of 22°C
01 minutes	Main wall façade surface damage observed.
02 minutes	Deformation of main wall façade lining observed.
03 minutes	Deformation of the exposed face of main wall façade.
03 minutes	Smoke emitted from the wall cavity at the top of specimen and mid-width of the main wall of the façade.
05 minutes	Deformation of the exposed face of wing wall façade.
07 minutes	Debris observed falling from main wall façade, flaming duration > 20sec of the fallen debris noted at this time.
07 minutes	Debris observed falling from main wall façade, no flaming noted.
08 minutes	Wing wall façade lining blistered.
08 minutes	Debris observed falling from main wall façade, duration of flaming > 20sec of fallen debris noted at this time.
08 minutes	The exposed lining of the main wall burnt through to 2.3m above furnace opening.
09 minutes	Main wall façade facing below TC 2:4 bowing out.
12 minutes	Debris observed falling from main wall façade, flaming duration > 20sec of the fallen debris noted at this time.
13 minutes	The exposed lining of the main wall façade burnt through exposing rain screen layer.
14 minutes	Large pieces of debris falling from main wall façade, no flaming observed.

Time	Observation
15 minutes	The exposed lining of main wall façade burnt through to 4m above combustion chamber opening.
17 minutes	Debris falling from main wall façade.
18 minutes	Debris falling from main wall façade.
19 minutes	Flaming observed above the main wall.
19 minutes	Wing wall façade surface damaged.
28 minutes	Flaming reduced on the head of combustion chamber opening.
30 minutes	Test terminated.

7.2 Post Test Observations

Time	Observation
Day following test	The exposed aluminium skin buckled from the core and melted, refer to Figure D1 and Figure D2 for more detail.
	The core dislodged and melted above the combustion chamber opening and along the central joint. Melting does not extend to the top of the specimen or beyond the minimum confines of the specimen on wing wall. Refer to Figure D3 and Figure D4 for more detail.
	Smoke staining and heat damage of Galvabond air seal sheet layer on the exposed side evident on the main wall above the combustion chamber. Molten aluminium also evident on the face of the air seal sheet. Refer to Figure D5 and Figure D6 for more detail.
	Smoke staining (not melting or charring) of Rockwool layer on the exposed side evident on the main wall above the combustion chamber. Refer to Figure D7 and Figure D8 for more detail.
	Localized smoke staining and charring on the exposed side of the plasterboard layer evident on the main wall above the combustion chamber. Refer to Figure D9 for more detail.
	No damage observed on the plasterboard on the unexposed side of the specimen. Refer to Figure D10 for more detail.

7.3 Mass of Debris fallen from Specimen

Debris	No. of fragments	Result (g)
Total mass of debris less than 100g	~710	11,353
Total mass of debris between 100g and 200g	12	1,521
Total mass of debris between 200g and 300g	3	731
Total mass of debris between 300g and 400g	0	0
Total mass of debris between 400g and 500g	1	402
Total mass of debris with a mass greater than 500g	5	32,433
The total mass of debris		46,440

Refer to Figures C10 to C12 for examples of debris collected at the conclusion of testing.

8 Test results

8.1 Peak Temperatures

Parameter	Temperature reached	Time Temperature Reached
Level 1 temperature	Average Exceeded 200°C	8 minute 59 seconds (t_s) then sustained above that temperature for > 30 seconds
Level 2, 50mm from the external face	Max 547°C	14 minutes 25 seconds
Level 2, in the cavity behind the Alpolic A2 cladding	Exceeded 250°C	At 9 minutes 29 seconds after ignition then sustained above that temperature for > 30 seconds
Level 2, within Rockwool layer	Exceeded 250°C	At 24 minutes 55 seconds after ignition then sustained above that temperature for > 30 seconds
Peak temperature/time on the unexposed side at 900mm above combustion chamber.	80°C	28 minutes 9 seconds

All times above are times after ignition of crib source and all temperature measurements are presented in Appendix E.

9 Classification

The AS 5113:2016 criteria for classification as appropriate for a BS 8414-2 testing are detailed below.

Classification Criteria	Related classification measure	Result in test	Pass/Fail
5.4.5(a) T_{w5m}	≤600°C	Max 547°C	Pass
5.4.5(b) $T_{layer5m - Cavity}$	≤250°C	Exceeded at 9 min 29 Sec	Fail
5.4.5(b) $T_{layer5m - Rockwool}$	≤250°C	Exceeded at 24 min 55 sec	Not applicable
5.4.5(c) $T_{unexposedside0.9m}$	≤180°C Rise	58°C Rise	Pass
5.4.5(d) flaming	No flaming	Did not occur	Pass
5.4.5(d) openings	No openings	Did not occur	Pass
5.4.5(e) spread	Spread beyond specimen	Did not occur	Pass
5.4.5(f) debris flaming	≤20 s	Flaming ≥ 20s occurred	Fail
5.4.5(g) debris mass	≤2 kg	≥ 46.440kg debris	Fail
		Classification	**Not classified**

10 Field of direct application of test results

The results of this test are applicable to the construction tested when exposed to fire from the external side as tested.

The result of 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.

This report details methods of construction, the test conditions and the results obtained when the specific element of the construction described herein was tested following the procedure outlined in AS 5113.

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

Because of the difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy of the result.

11 Tested by

Brett Roddy
Testing Officer

Appendices

Appendix A – Specimen drawings

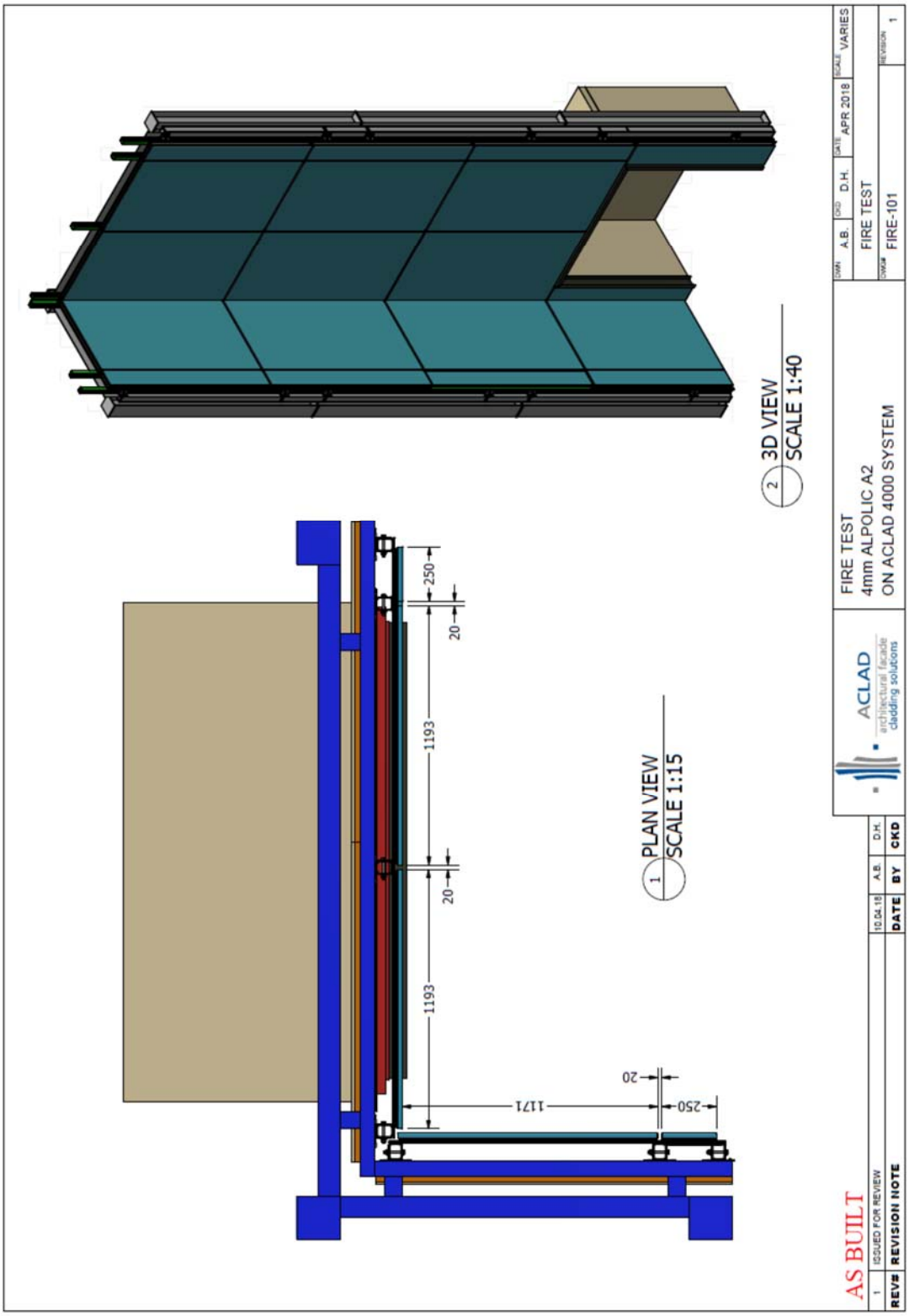


Figure A1 – Drawing titled FIRE-101, dated 10 April 2018

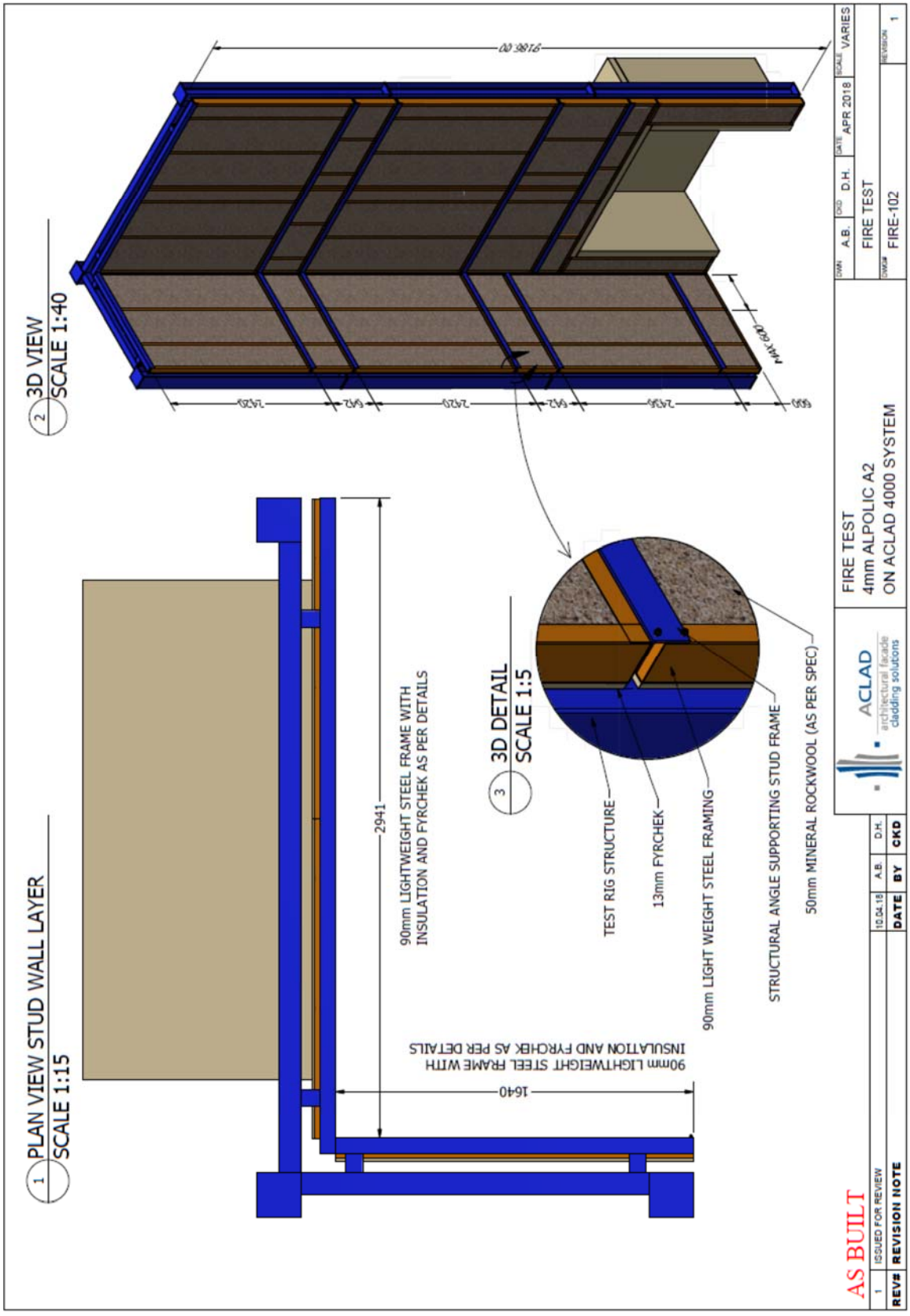


FIGURE A2 – Drawing titled FIRE-102, dated 10 April 2018

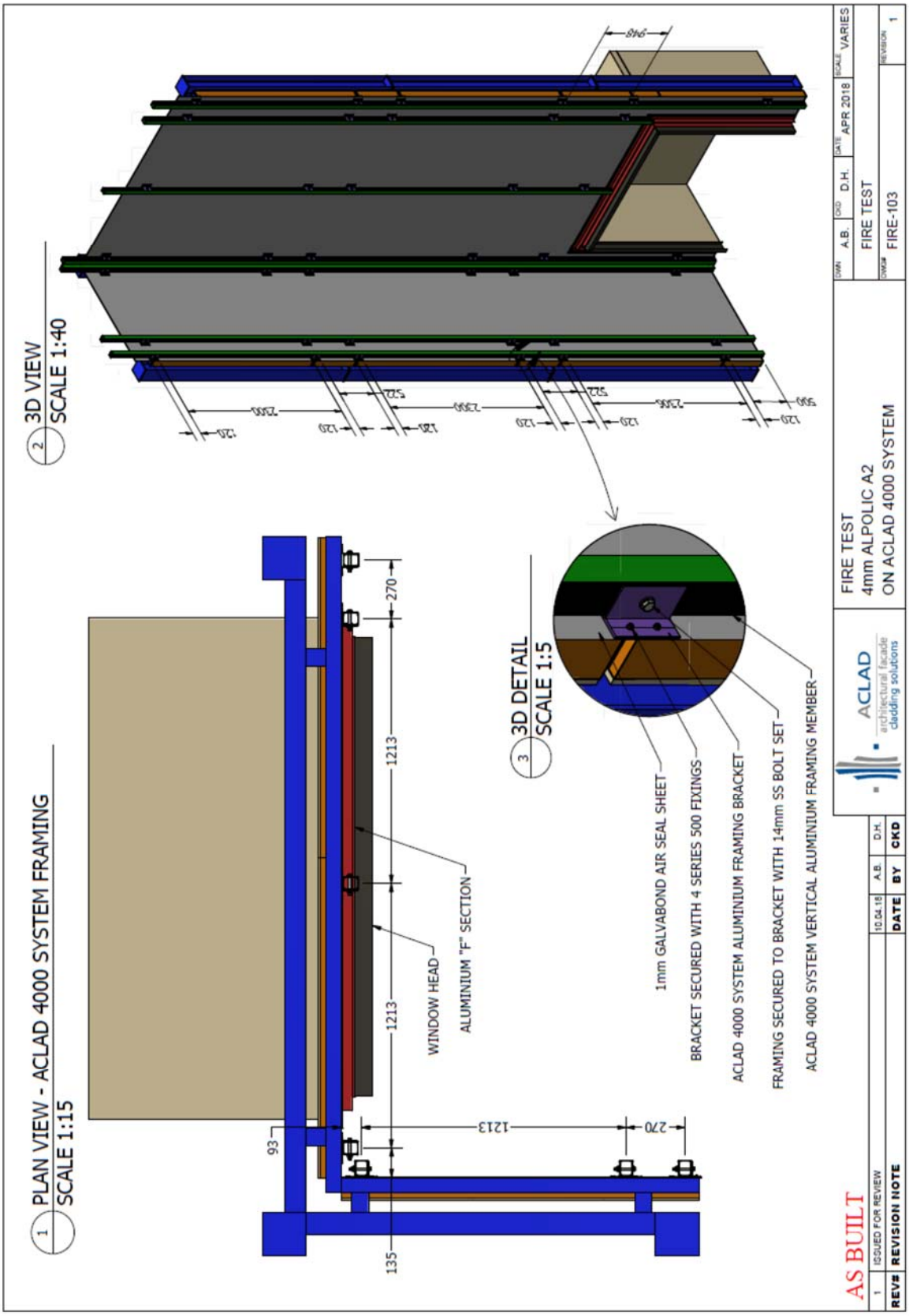


Figure A3 – Drawing titled FIRE-103, dated 10 April 2018

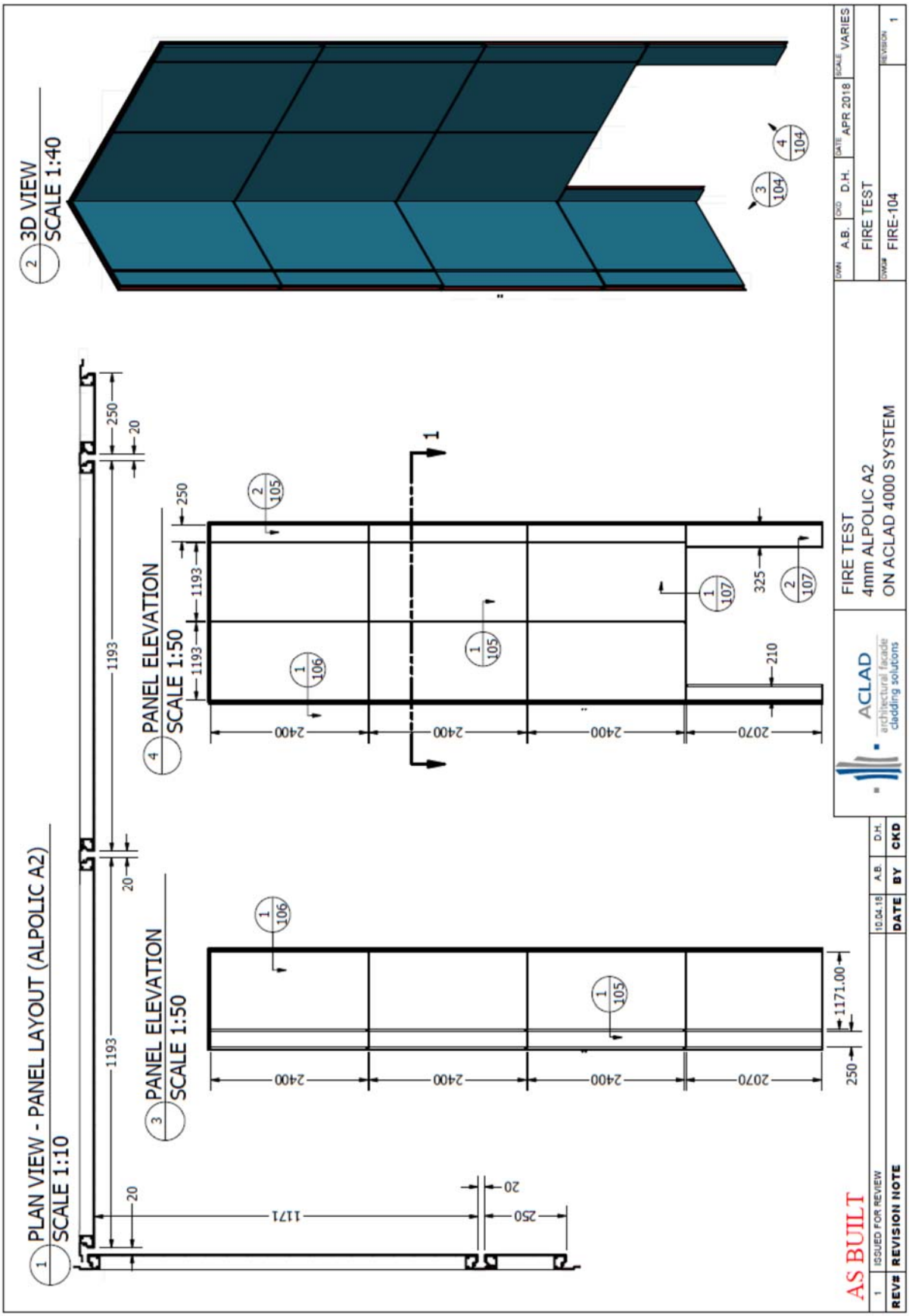


Figure A4 – Drawing titled FIRE-104, dated 10 April 2018

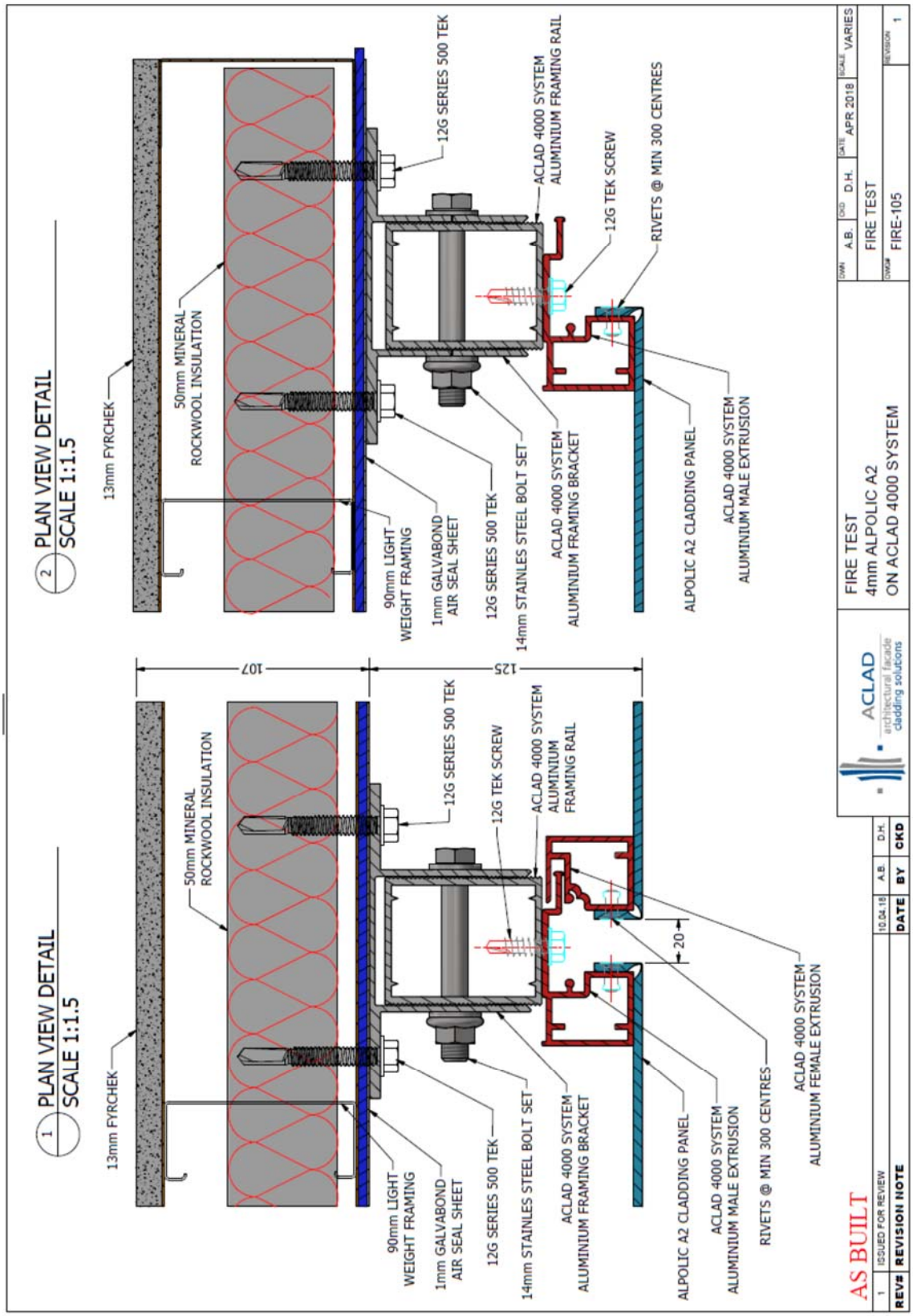


Figure A5 – Drawing titled FIRE-105, dated 10 April 2018

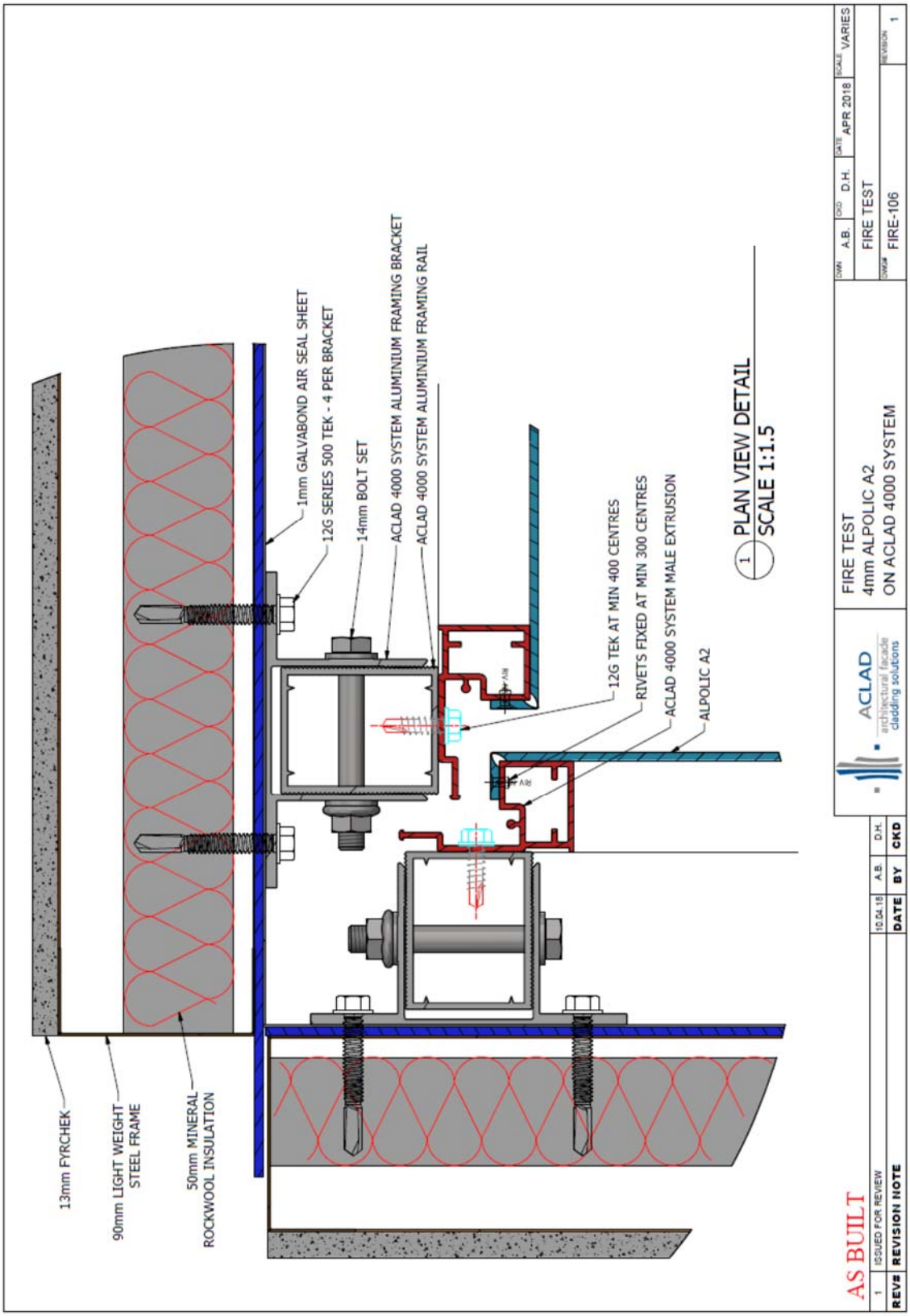


Figure A6 – Drawing titled FIRE-106, dated 10 April 2018

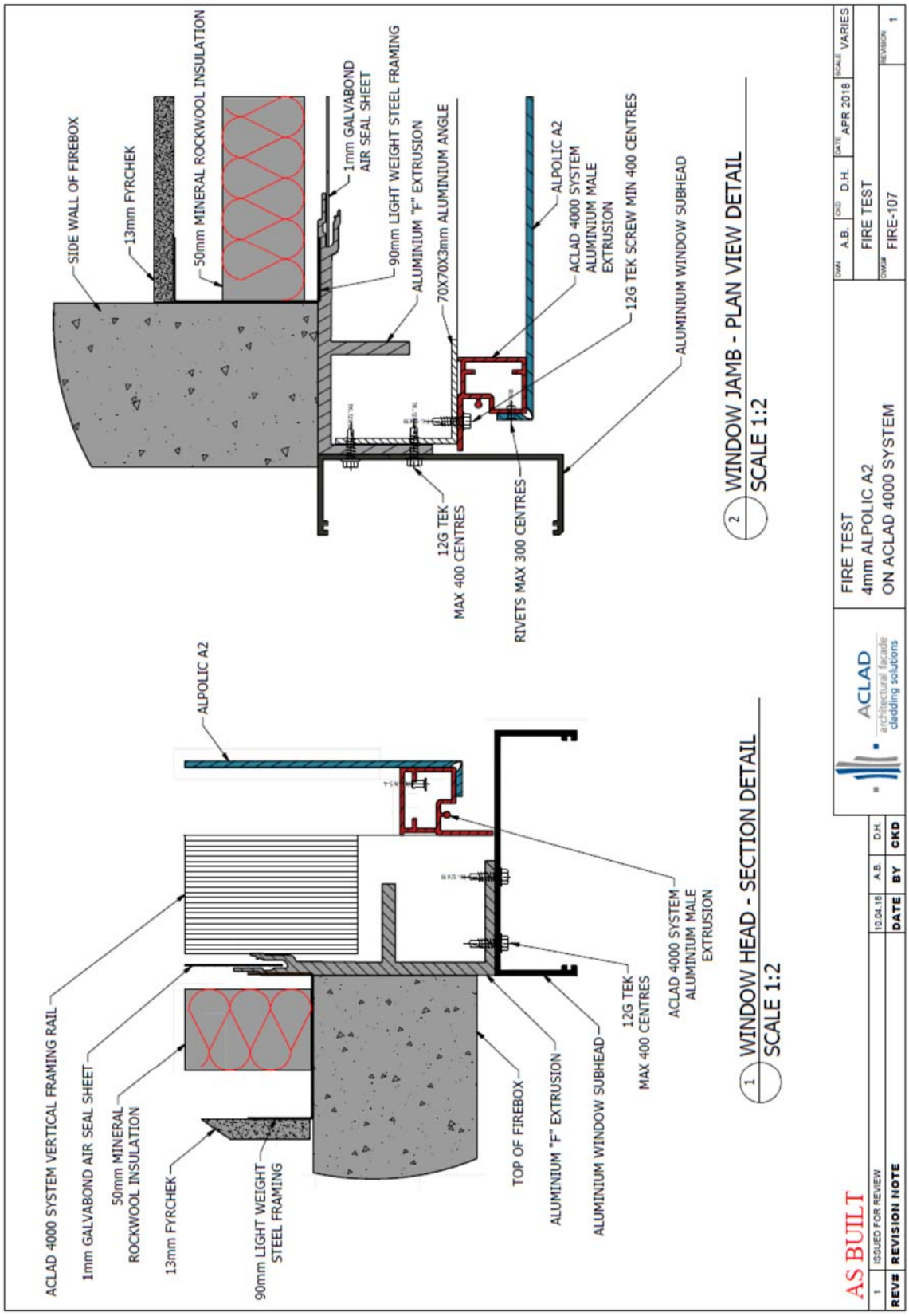


Figure A7 – Drawing titled FIRE-107, dated 10 April 2018

FIGURE A7 – DRAWING TITLED FIRE-108, DATED 10 APRIL 2018

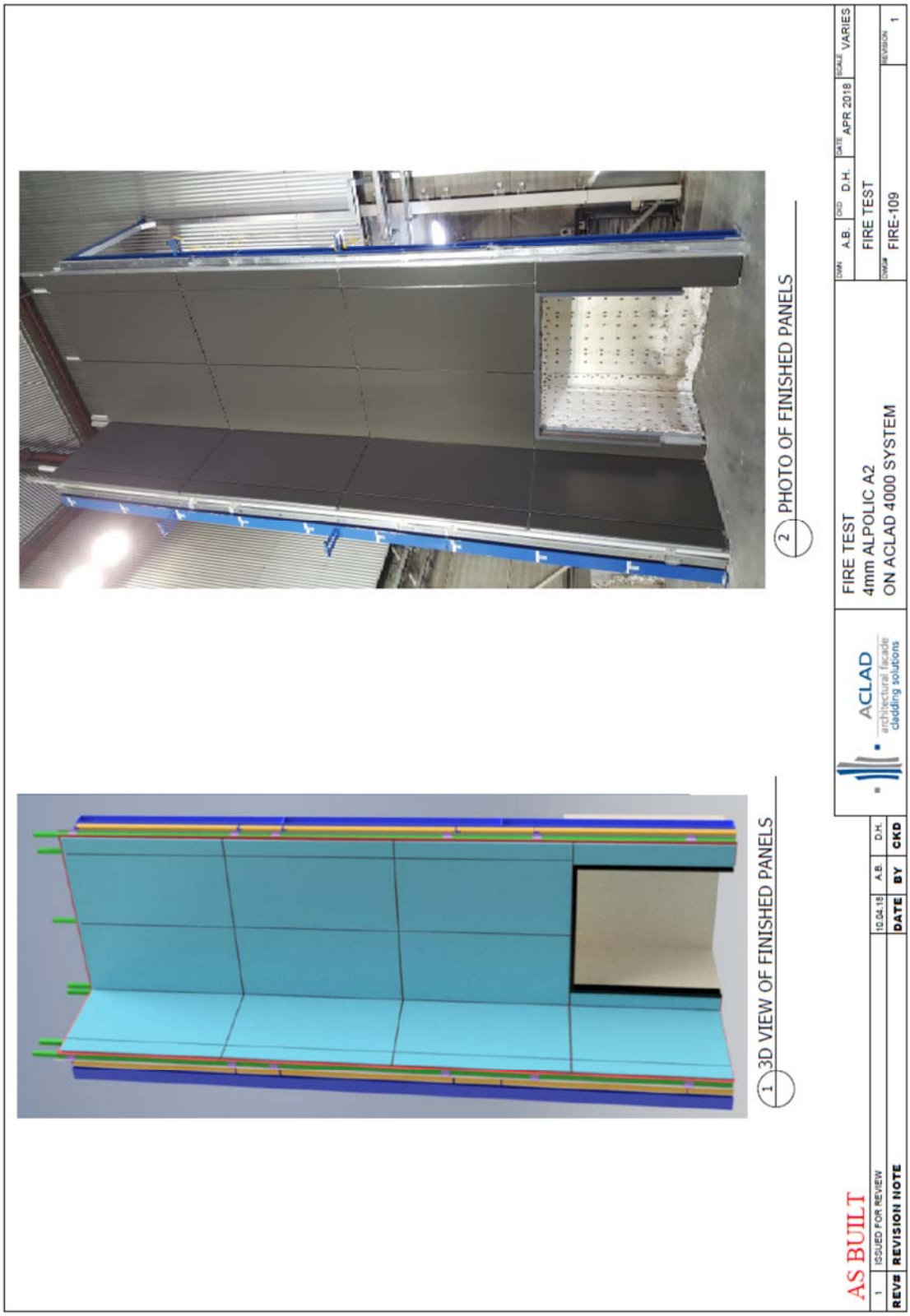


FIGURE A7 – DRAWING TITLED FIRE-109, DATED 10 APRIL 2018

Appendix B – Measurement locations

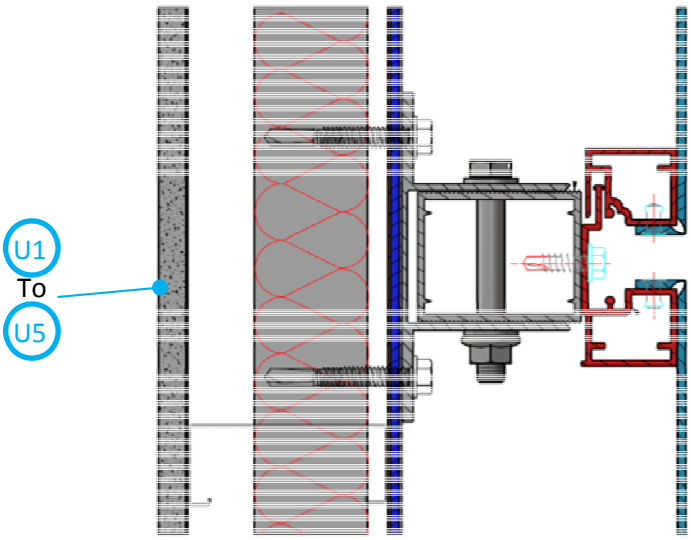


Figure B1: On unexposed face 900mm above combustion chamber opening, plan view

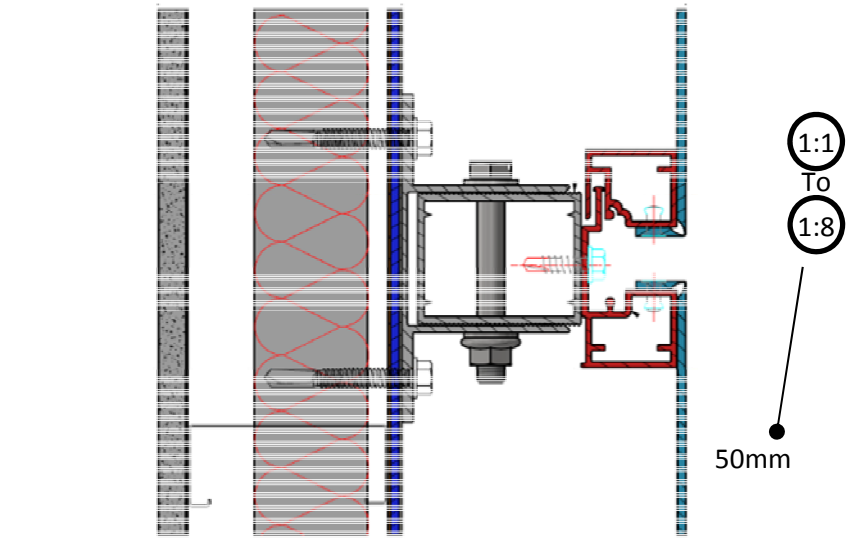


Figure B2: Level 1 - 2.5m above combustion chamber opening, plan view

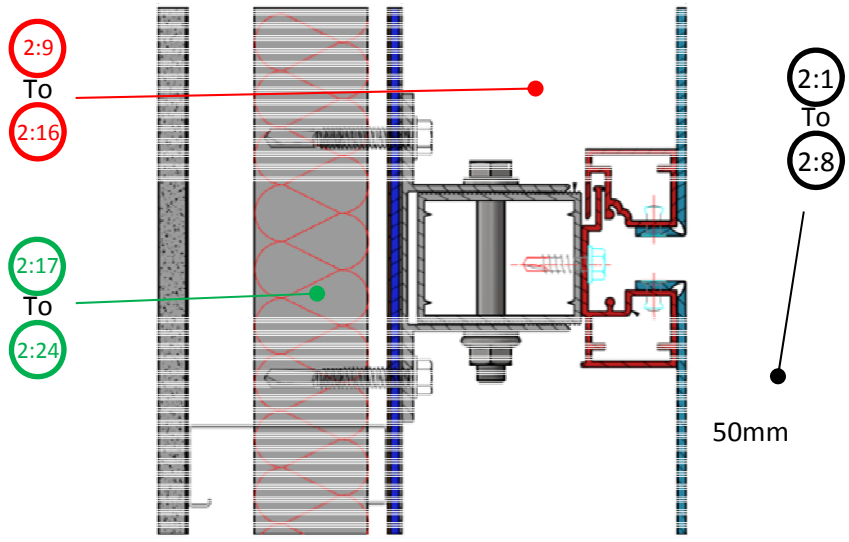


Figure B3: Level 2 - 5m above combustion chamber opening, plan view

Figure B4: Thermocouple locations, elevation view

Appendix C – Test photographs

Figure C1 – Exposed face of the specimen prior to testing

Figure C2 – Unexposed face of the specimen prior to testing

Figure C2 – Exposed face of the specimen at crib ignition

Figure C3 – Exposed face of the specimen at 3 minutes after crib ignition

Figure C4 – Exposed face of the specimen at 7 minutes after crib ignition

Figure C5 – Exposed face of the specimen at 11 minutes after crib ignition

Figure C6 – Exposed face of the specimen at 17minutes after crib ignition

Figure C7 – Exposed face of the specimen at 19 minutes after crib ignition

Figure C8 – Exposed face of the specimen at 30 minutes into the test

Figure C9 – Exposed face of the specimen at the conclusion of the test

Figure C10 –Debris collected at the conclusion of the test

Figure C11 – Debris collected at the conclusion of the test

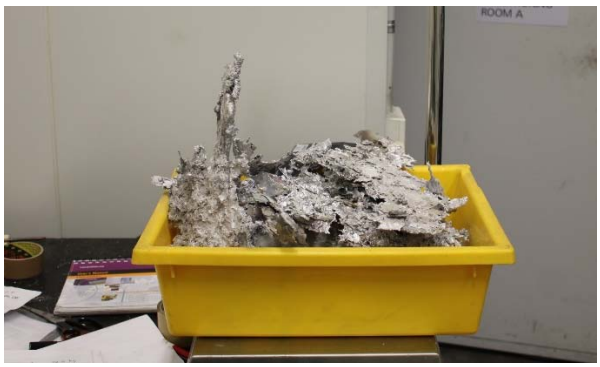
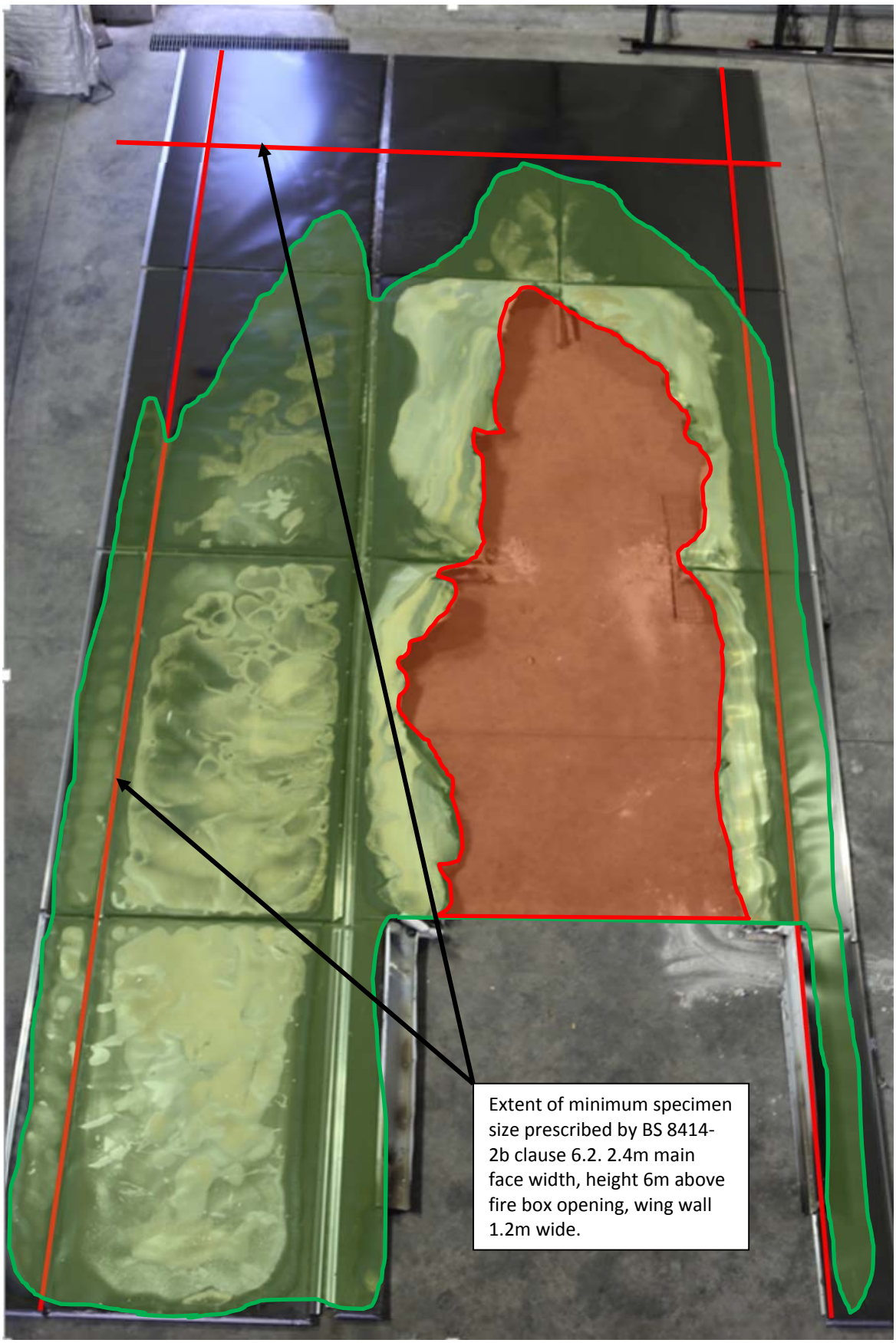





Figure C12 – Debris collected at the conclusion of the test

Appendix D – Extent of Spread

Figure D1 – Damage to the exposed aluminium skin at the conclusion of testing



Approximate extent of the aluminium skin melted from the core

Approximate extent of the aluminium skin buckled from the core

Figure D2 – Damage of the exposed aluminium skin at the conclusion of testing

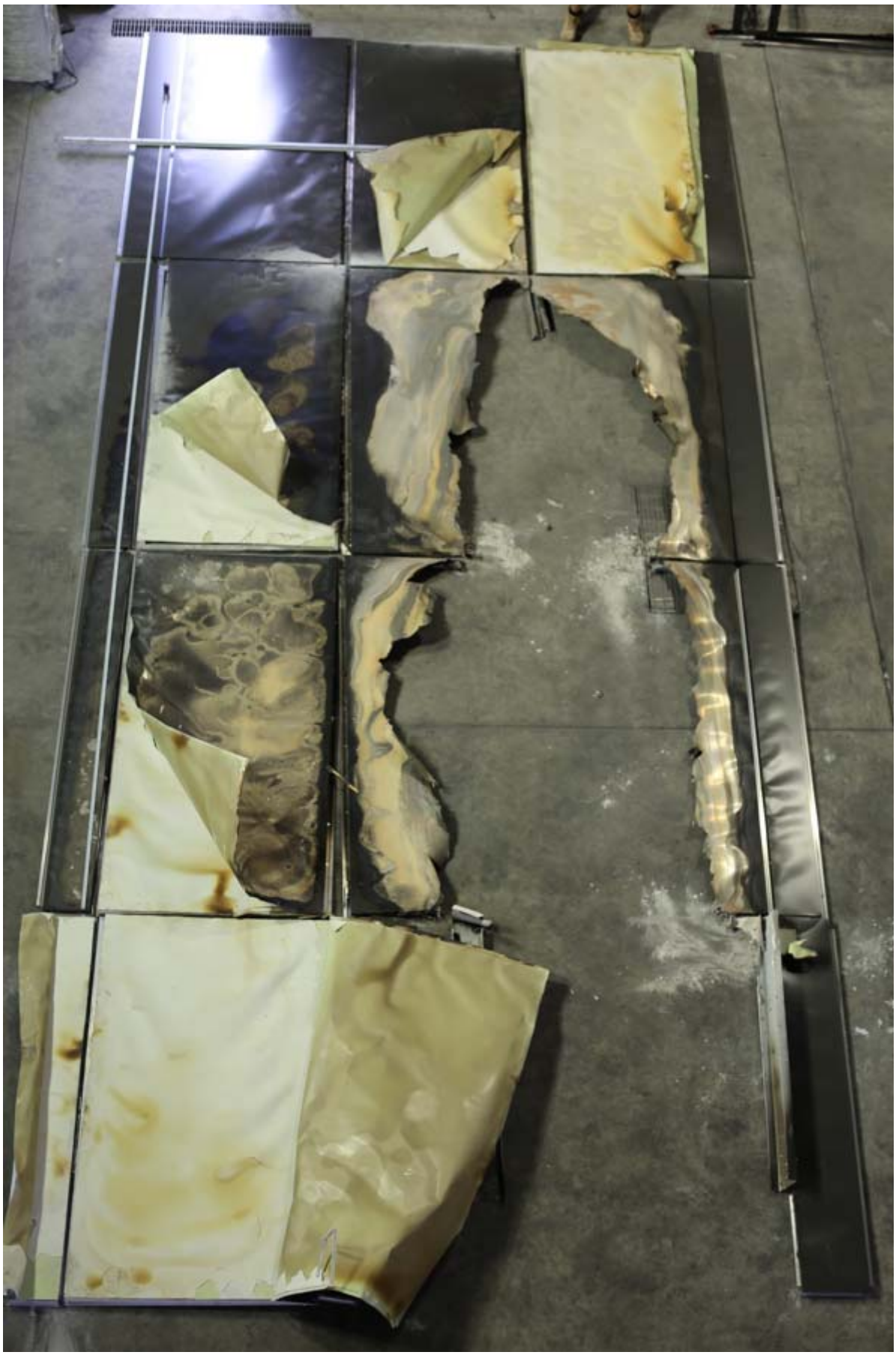
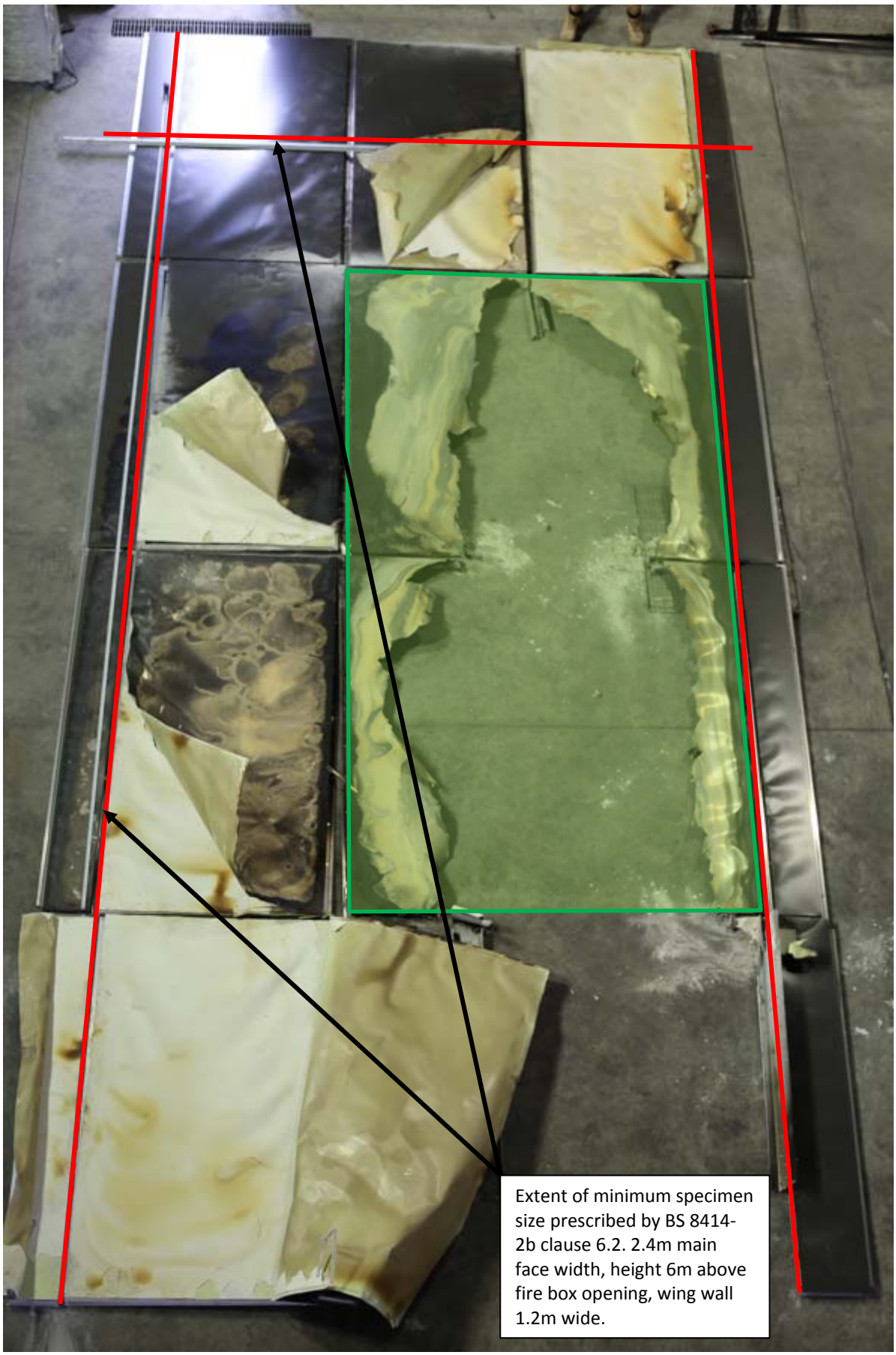


Figure D3 – Damage to the core at the conclusion of testing



Approximate extent of the core dislodged and melted

Figure D4 – Damage to the core at the conclusion of testing

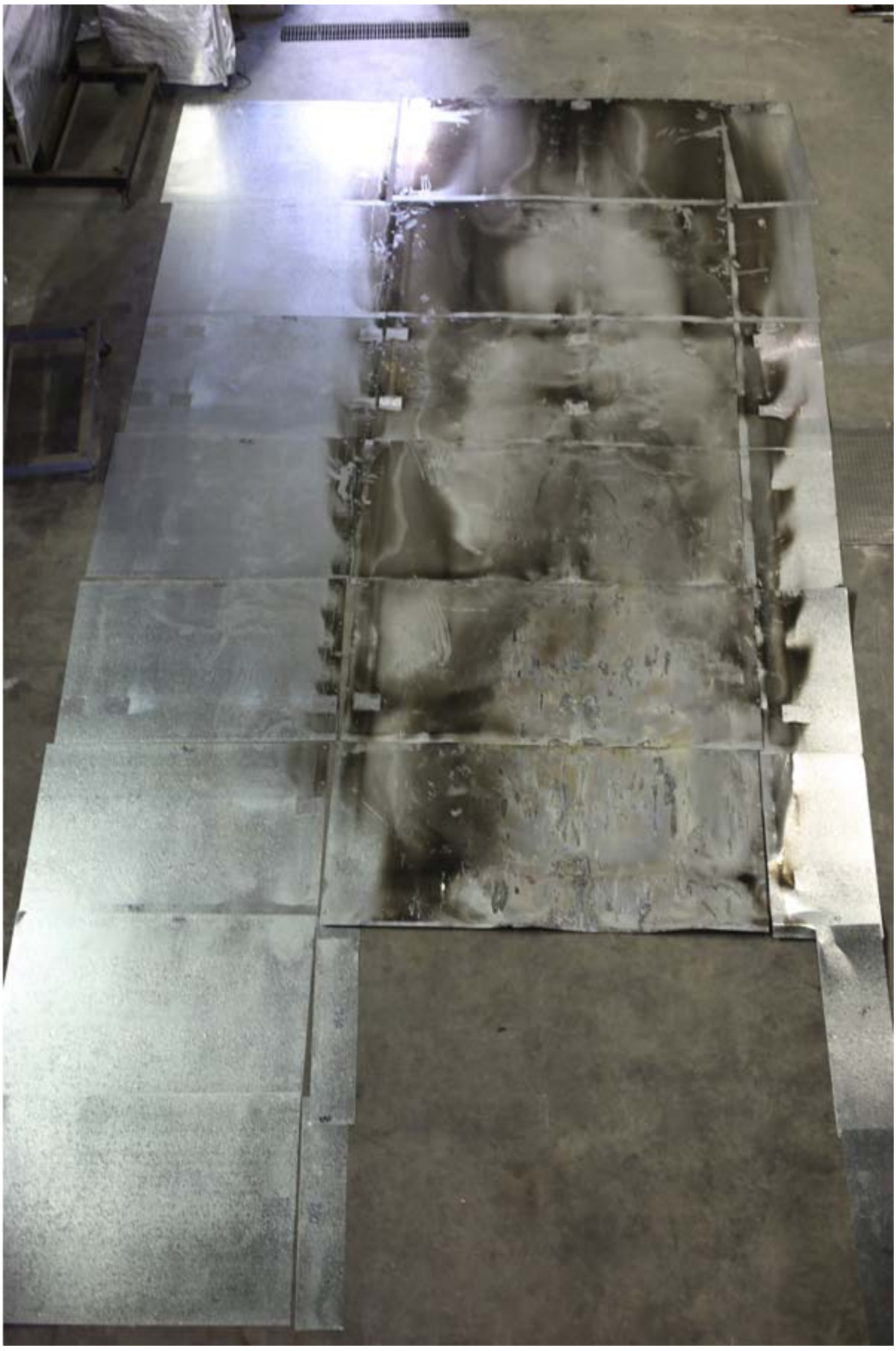
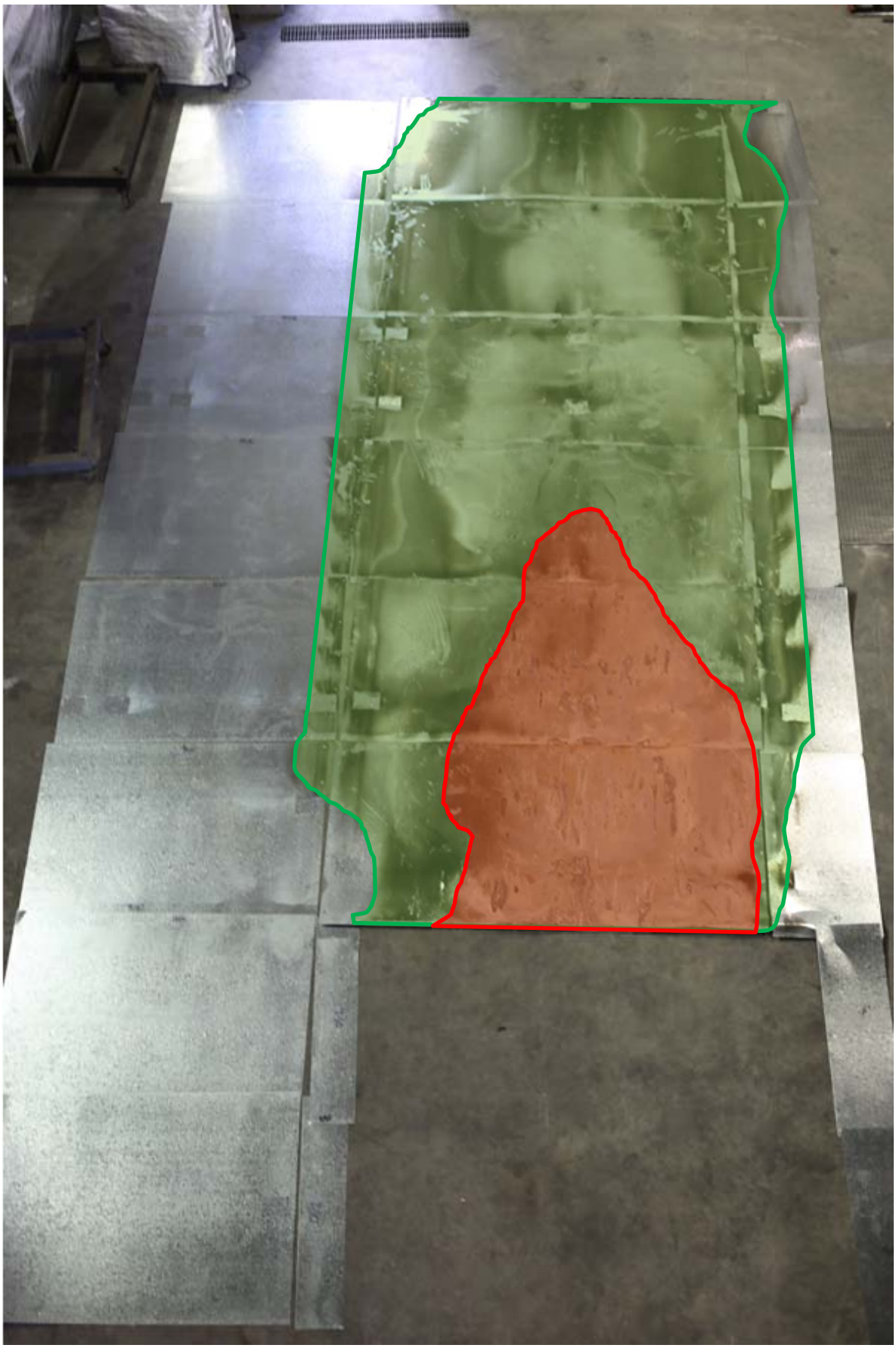


Figure D5 – Damage to the Galvabond air seal sheet layer at the conclusion of testing



Approximate extent of the smoke staining to Galvabond air seal sheet

Approximate extent of heat damage to Galvabond air seal sheet

Figure D6 – Damage to the Galvabond air seal sheet layer at the conclusion of testing

Figure D7 – Damage to the Rockwool layer at the conclusion of testing

Approximate extent of smoke staining to the Rockwool layer

Figure D8 – Damage to the Rockwool layer at the conclusion of testing

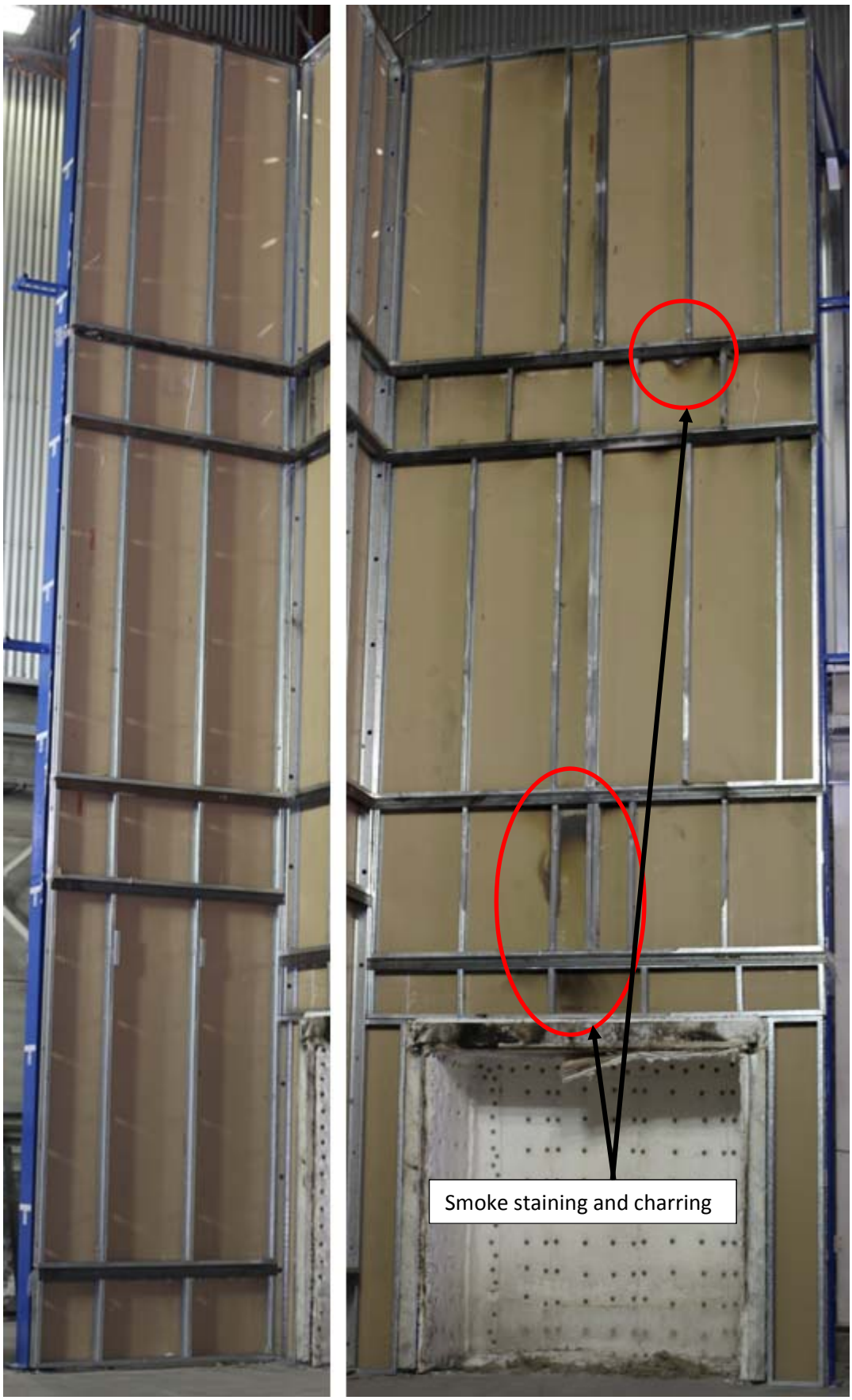


Figure D9 – Damage to the exposed side of plasterboard layer at the conclusion of testing

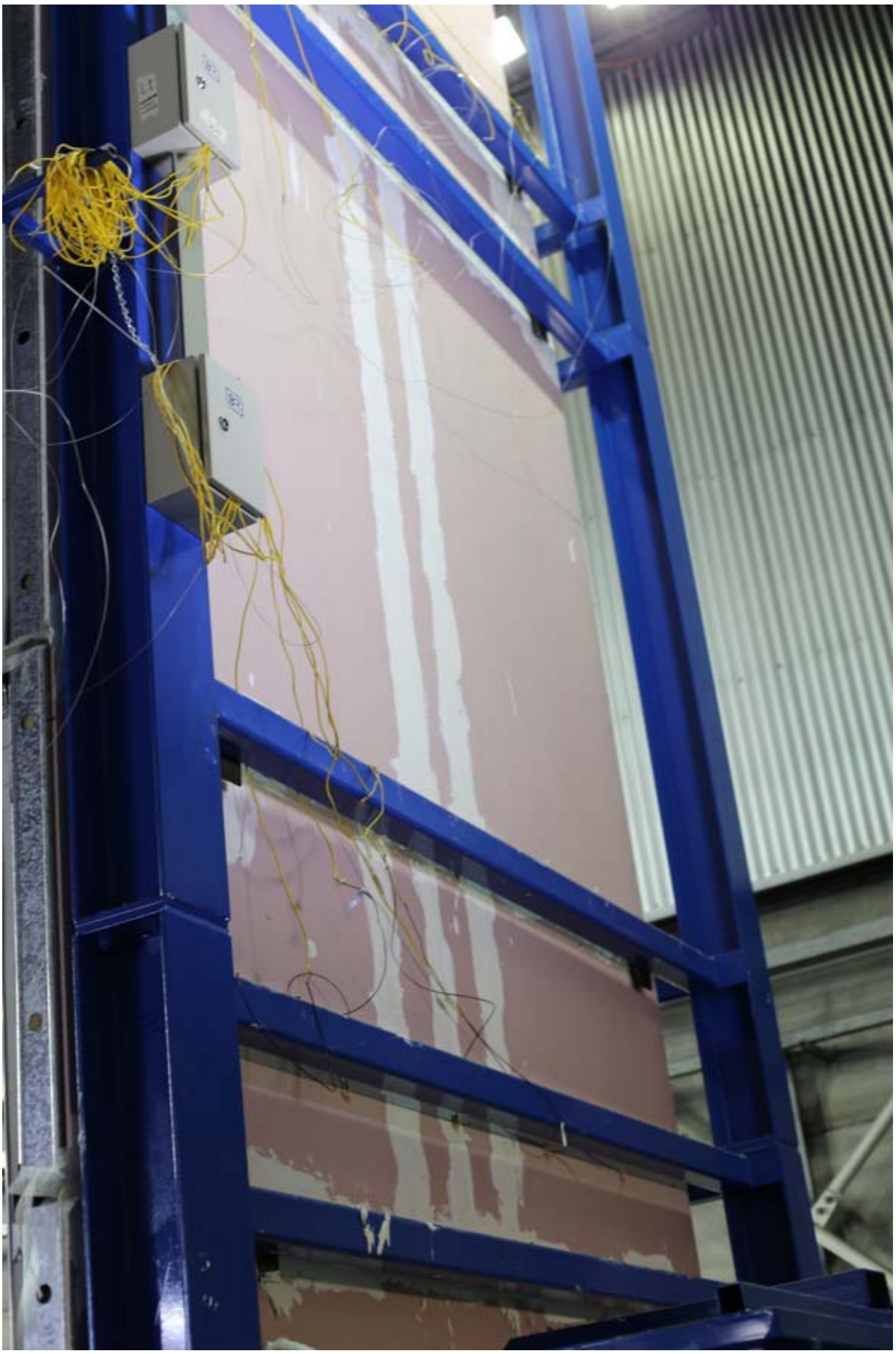


Figure D10 – Undamaged state of the unexposed side of plasterboard layer at the conclusion of testing

Appendix E – Test data charts

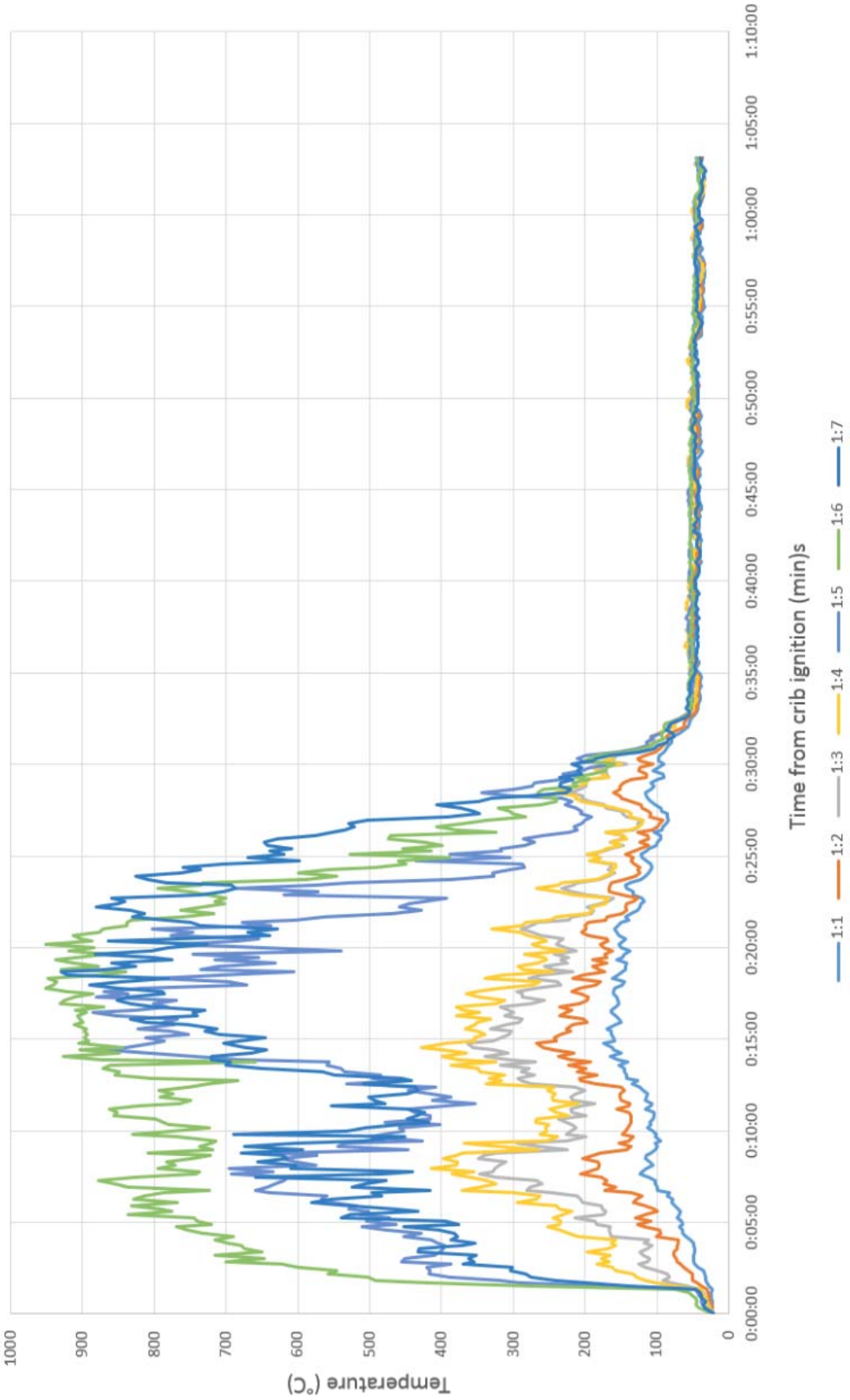


Figure E1 – Level 1, external temperatures vs. time

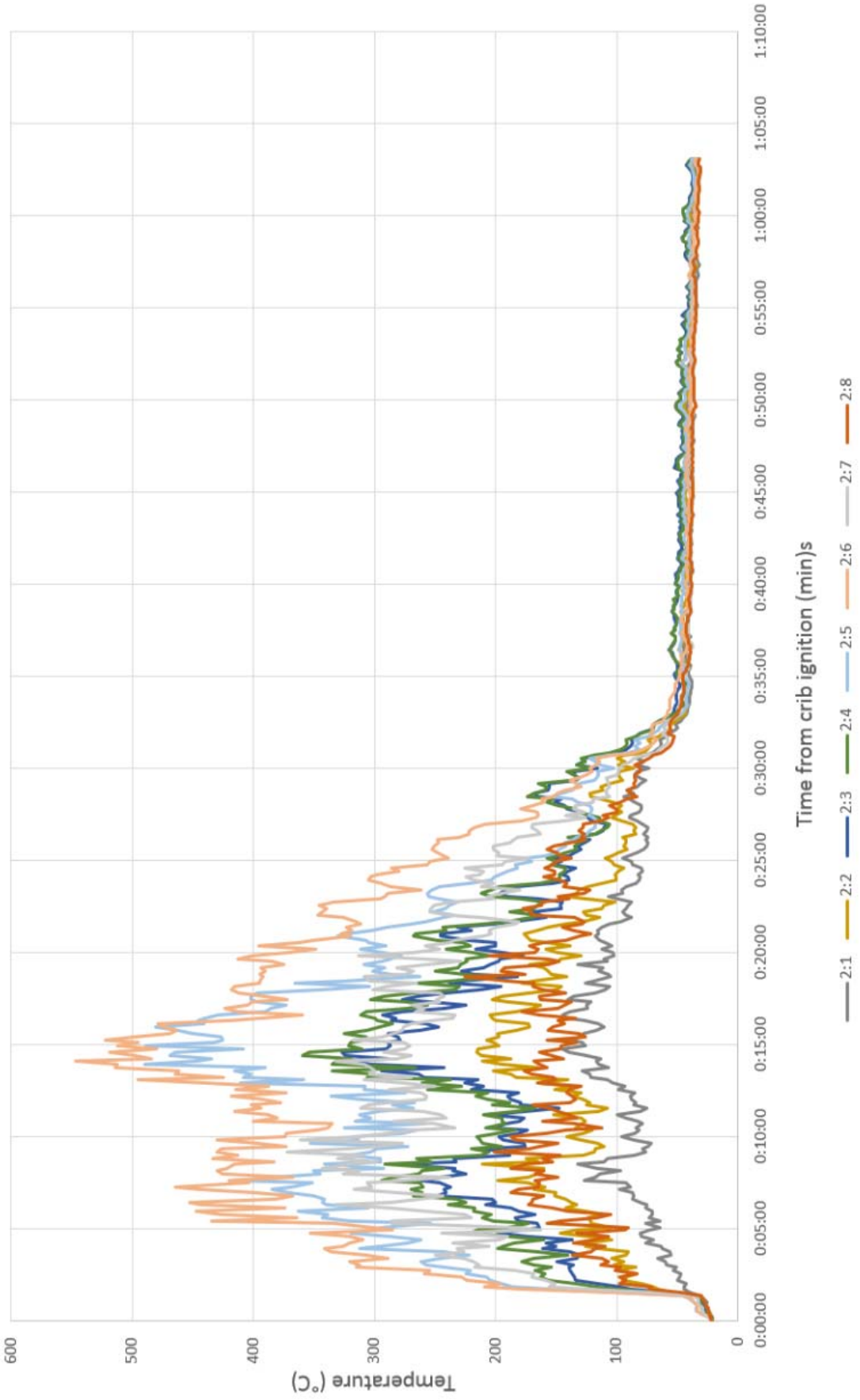


Figure E2 – Level 2, external temperatures vs. time

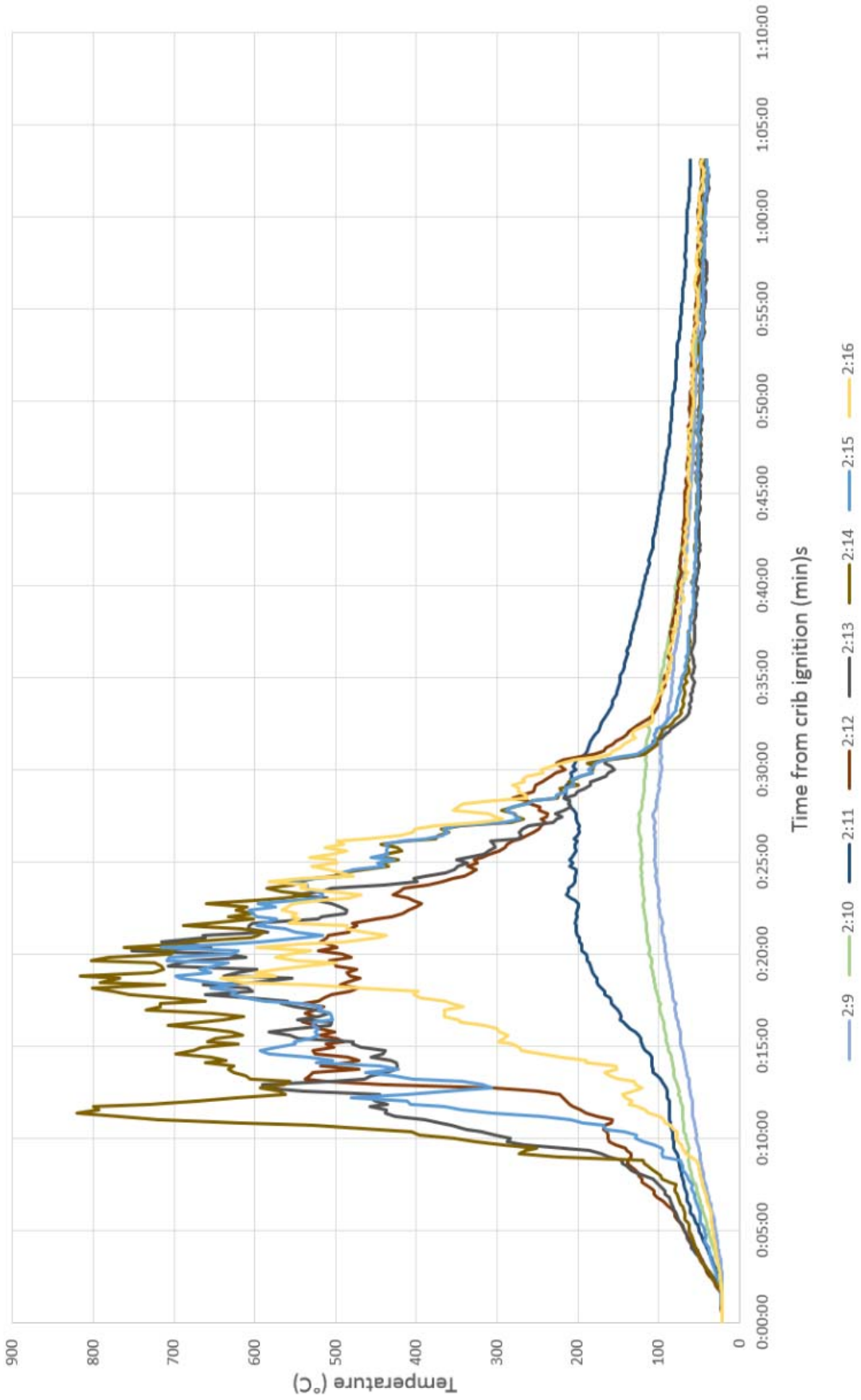


Figure E3 – Level 2, cavity behind Alpolic A2 cladding panel, temperatures vs. time

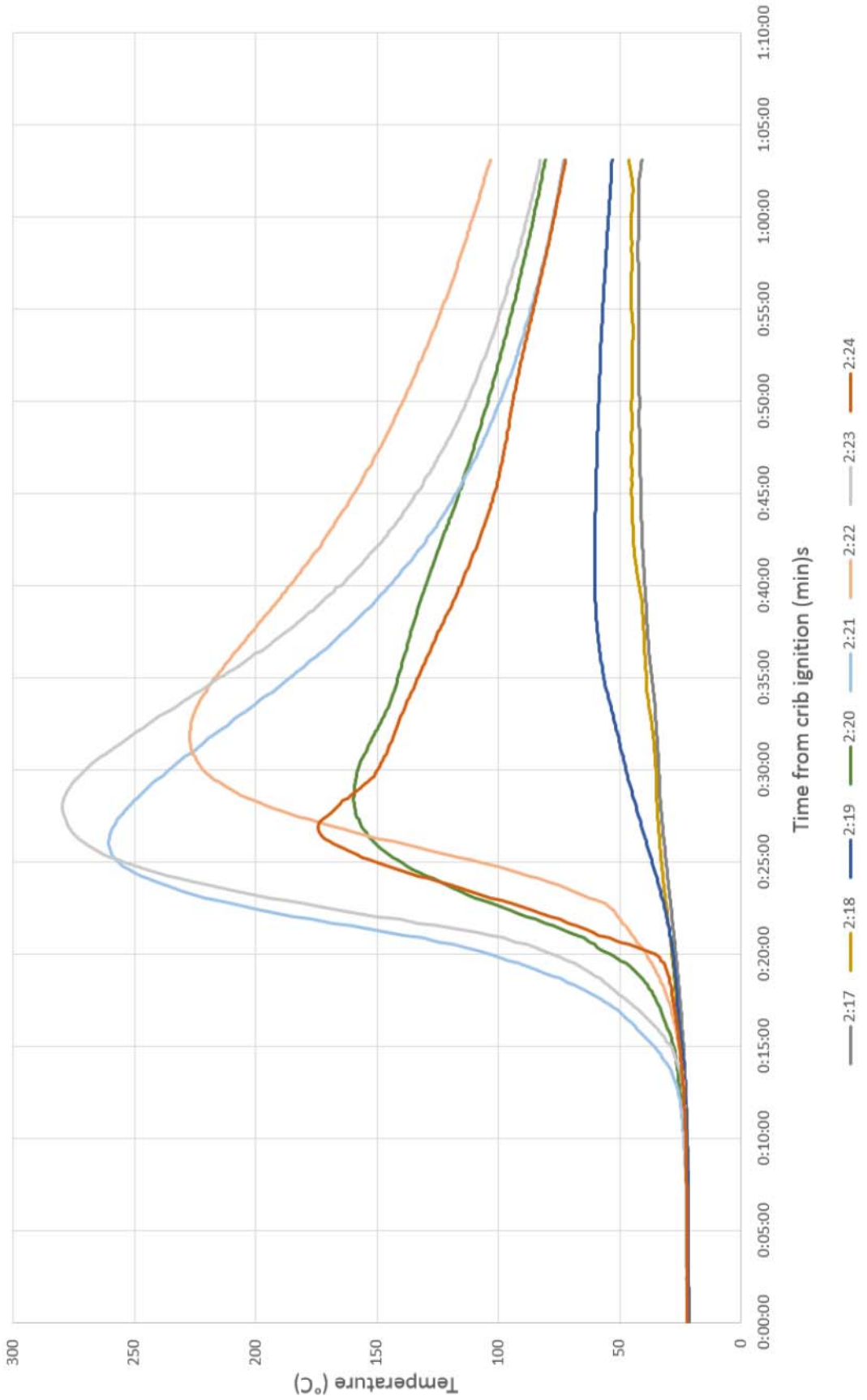


Figure E4 – Level 2, Mid depth of Rockwool layer, temperatures vs. time

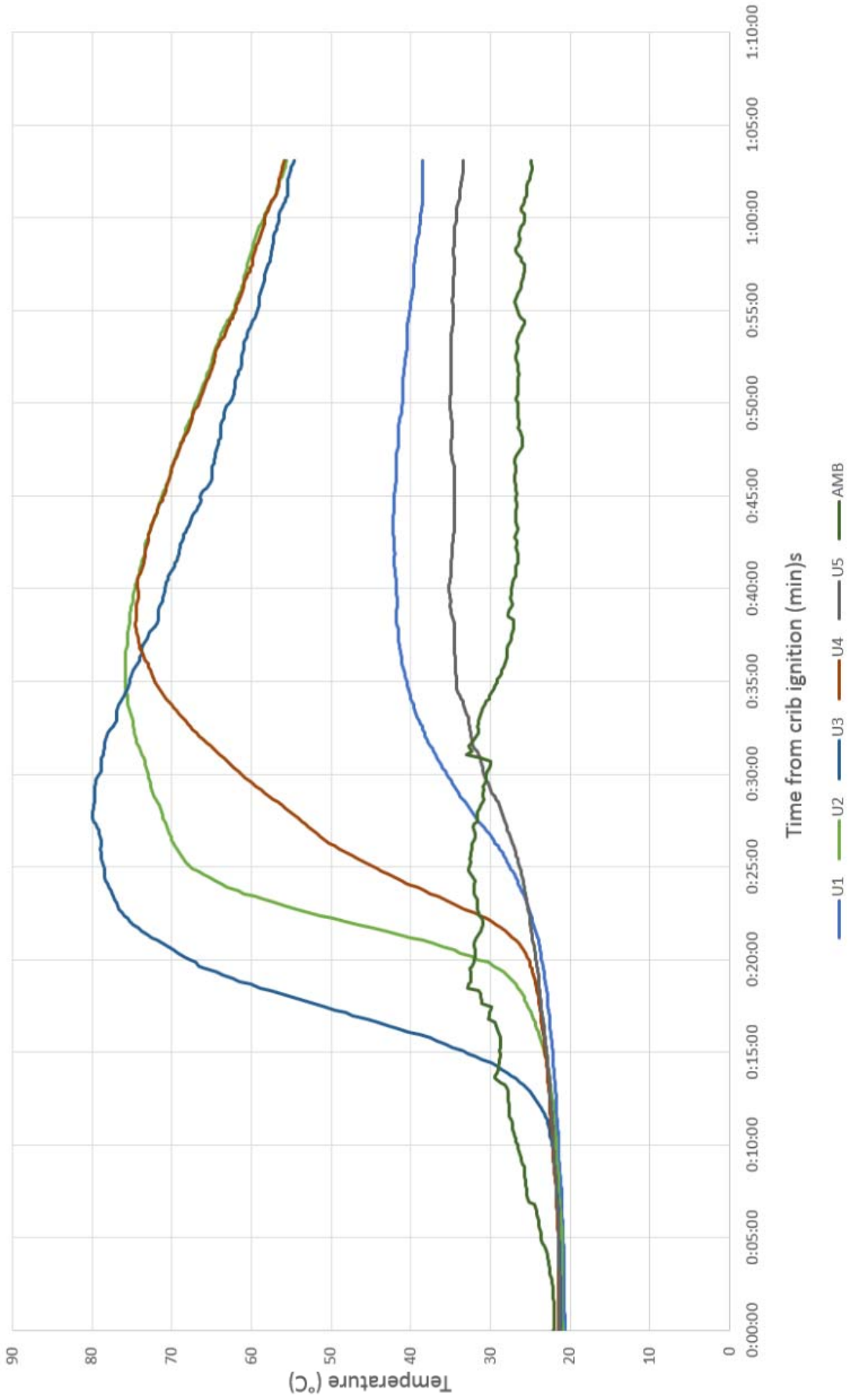


Figure E5 – 900mm above chamber opening, on unexposed face, temperatures vs. time

References

The following informative documents are referred to in this Report:

AS 5113:2016	Fire propagation testing and classification of external walls of buildings.
BS 8414-2	Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

END OF REPORT

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