Reaction to fire test report

Test standard: Ad-hoc test based off ISO 13785-1:2002

Test sponsor: Cladding Safety Victoria (CSV)

System: A cassetted aluminium composite panel wall system

Job number: RTF230111

Test date: 6 September 2023 Revision: R1.0

Quality management

Revision	Date	Information about the report			
R1.0	18 October 2023	Description	Initial issue		
			Prepared by	Reviewed by	Authorised by
		Name	[redacted]	[redacted]	[redacted]
		Signature	[redacted]	[redacted]	[redacted]

Contents

1. Introduction

This report documents the findings of the first of three ad-hoc reaction to fire tests on a cassetted aluminium composite panel (ACP) external wall system - performed on 6 September 2023. The test was based on ISO 13785-1:2002.

Warringtonfire performed the test at the request of the test sponsor listed in Table 1.

Table 1 Test sponsor details

Test sponsor	Address
Cladding Safety Victoria	717 Bourke Street Docklands VIC 3808 Australia

2. Test specimen

2.1 Schedule of components

Table 2 describes the test specimen and lists the schedule of components. These were provided by the representatives of the test sponsor 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 2 Schedule of components

Item	Description	
Cladding		
1.	Item name	ACP Panelling - cassetted
	Product	Econ Panel™ - 3 mm Glossy White/Matte White (BC-03E) with 0.21 mm skin
	Manufacturer/Supplier	[redacted]
	Material	The material was nominated as panels consisting of two layers of aluminium sheets sandwiching a layer (core) with 45 % polyethylene (PE) with inorganic filler. Analysis conducted by the analytical centre of UNSW showed that the core consisted of polyethylene-vinyl acetate (PEVA) - found to be 49.8 % w/w - whilst the remainder of the material was found to be 40.2 % calcium carbonate, 7.9 % other inert material and 2.1 % magnesium hydroxide. Refer to Appendix C for more detailed results - Sample 23139-3, CSV #4.
	Size	As shown in Figure 7. Total thickness – 3.1 mm Skin thickness (both sides) – 0.2 mm Cassette depth – 150 mm
	Measured mass/unit area densities	Panel areal density – 4.8 kg/m²
2.	Item name	FR Plasterboard
	Product	[redacted] 13 mm Fyrchek
	Manufacturer/Supplier	[redacted]
	Size	Measured board: 3000 mm × 1200 mm × 13 mm
	Batch Date:	16/08/22
	Areal density (measured)	11.0 kg/m²
3.	Item name	Backpan

Item	Description	
	Product	0.9 mm thick Galvabond steel
	Supplier	[redacted]
	Size	Measured: 1160 mm wide × 3700 mm tall, 0.9 mm thick – in segments
Framing		
4.	Item name	Test rig frame - 90 × 90 SHS and 200 × 90 PFC frame
	Size	90 mm × 90 mm × 5 mm thick and 200 mm × 90 mm × 10 mm thick – refer to Figure 6.
5.	Item name	Aluminium curtain wall transom/mullions (rectangular hollow sections) - framing
	Size	65 mm wide × 120 mm deep × 3 mm thick Total frame size: 120 mm deep × 1165 mm wide × 3705 mm tall
	Manufacturer/Supplier	Capral Aluminium
6.	Item name	Aluminium angles - framing
	Size	20 mm wide × 30 mm deep × 3 mm thick
	Manufacturer/Supplier	Rapid Aluminium
7.	Item name	Aluminium stiffener - framing
	Size	3 mm thick
	Manufacturer/Supplier	Rapid Aluminium
8.	Item name	Internal side frame - steel
	Size	Studs and noggings: 90 mm deep × 36 mm wide × 0.55 BMT
	Installation	The steel framing members were riveted (item 17) to one another.
9.	Item name	Strap – 50 mm wide
	Size	Studs and noggings: 90 mm deep × 36 mm wide
	Installation	The steel framing members were riveted (item 17) to one another.
Smoke seal		
10.	Item name	Smoke seal
	Size	1 mm thick galvanised steel
	Manufacturer/Supplier	Atlas Steel
Insulation		
11.	Item name	90 mm thick polyethylene terephthalate (PET) insulation
	Density	10 kg/m³
	Manufacturer/Supplier	Pricewise Insulation
12.	Item name	50 mm thick aluminium - with fibre-glass mesh - foil faced rockwool insulation
	Density of core	40 kg/m³
	Manufacturer/Supplier	Rockwool Insulation Australia
Sealant/Adhesive		
13.	Item name	Weathering sealant
	Product type	Silicone sealant
	Product name	PROSIL 41lm
	Manufacturer/Supplier	Admil Adhesives

Item	Description	
	Usage	Placed at ACP edges and over screw and rivet locations.
Fixings		
14.	Item name	Wafer head screws – zinc coated steel
	Size	10g × 16 mm long
	Installation	Used to fix aluminium angles (item 6) to the aluminium frame (item 5) at 500 mm centres
15.	Item name	Wafer head screws – zinc coated steel
	Size	10g × 50 mm long
	Installation	Used to fix ACP (item 1) to the aluminium stiffener (item 7) – four per corner.
16.	Item name	Hex head tek screw – zinc coated steel
	Size	12g × 16 mm long
	Installation	Used to fix aluminium stiffeners (item 7) to themselves
17.	Item name	Steel rivets
	Size	Ø4 mm
18.	Item name	Plasterboard screws
	Size	6g × 32 mm long, bugle head, self-drilling screws
19.	Item name	Fast-fix washers and pin weld
	Size	115 mm × 3 mm pins and 25 mm × 25 mm fast fix washers.
Installation method		
Internal wall:	The test rig frame (item 4) was the main support for the test specimen, however, there were two C-purlin sections that acted as false slabs (200 mm tall). Steel stud framing (item 8) was installed between the C-purlins. PET insulation (item 11) was inserted within the steel framing (item 8) and was capped with 13 mm thick FR plasterboard (item 2) on the unexposed side and along the edges. The plasterboard was fixed with plasterboard screws (item 18) – max 300 mm centres on the periphery and 600 mm centres in-field.	
External wall:	The external section of the wall system largely consisted of an aluminium extrusion framing system (item 5), galvanised steel sheet backpan (item 3) and ACP cassette system (item 1). The external wall was screw fixed using angles. The ACP cassettes were 150 mm deep and were connected to the aluminium extrusion framing (item 5) using aluminium angles (item 6) and aluminium stiffeners (item 7). The angles (item 6) were screw fixed to the extrusions, the aluminium sheeting riveted to the angles, and the ACP cassettes riveted to the aluminium sheets. Sealant (item 13) was used to seal open ACP edges, screw fixings and rivet locations. The backpan (item 3) was screw fixed and riveted to the back of the aluminium extrusion framing (item 5). Foil faced insulation (item 12) was installed within the external wall. The insulation was held to the steel backpan (item 3) with the aid of fast-fix washers and pin combinations (item 19) – at ~600 mm centres - that were welded to the backpan. There was a 60 mm gap between the backpan and the internal wall studwork.	

3. Test procedure

Table 3 details the test procedure for this reaction to fire test.

Table 3 Test procedure

Item	Detail	
Statement of compliance	The ad-hoc test – which was based off ISO 13785-1:2002 - was performed to determine the reaction to fire performance of an external wall cladding when exposed to heat from a simulated external fire with flames impinging directly upon a façade. The test utilises a burner used in ISO 13785-1:2002 with the specimen mimicking the as-built construction of the façade.	
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for the reaction to fire test. The results obtained during the test only apply to the test samples as received and tested by Warringtonfire.	
Test duration	18 minutes	
Ambient laboratory temperature	Start of the test	17 °C
	Minimum temperature	17 °C
	Maximum temperature	18 °C
Instrumentation and equipment	• Eight mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5 mm with the measuring junction insulated from the sheath were positioned 60 mm in front of the face of the test specimen. Refer to Figure 1 (TC011 – TC018) for details on positioning. • Ten mineral insulated metal sheathed (MIMS) Type K thermocouples with an overall diameter of 1.5 mm with the measuring junction insulated from the sheath were positioned inside the specimen at the centre of the cavity. Refer to Figure 1 (TC001 – TC010) for details on positioning. • The incident heat flux on the top of the specimen in line with the front face of test specimen was measured using one Schmidt-Boelter type heat flux gauge with a range of 0-50 kW/m^2. • The fire source was a propane (95% purity) gas burner 1.2 m long × 0.1 m deep × 0.15 m tall. The burner was placed on the floor below the specimen with approximately 10 mm overlap with the ACP.	
Test procedure	• At least two minutes of baseline data was collected prior to burner ignition. Temperature and heat flux data was collected at 5 s intervals. • The heat output from the burner was held at 100 kW for the first 15 minutes of the test followed by 300 kW for the remainder of the test. The burner was then turned off and the specimen sprayed with water when excessive flaming was observed.	
Test number	Test one of three.	
Variation between tests	The test was based off RTF220104 R1.0, RTF220104 R2.0 and RTF220104 R3.0. The test specimens for those tests were considered a representation of an in-situ wall located at the listed location. The tested specimen in this test was considered a replica of those tests with the only variation being the ACP used, i.e., variation to the percentage of polyethylene in the core, absence of fire-retarding materials in the core and the thickness of panel and panel skin.	

4. Test measurements and results

The results from the tests are summarised below. Photographs of the specimen are included in Appendix B.

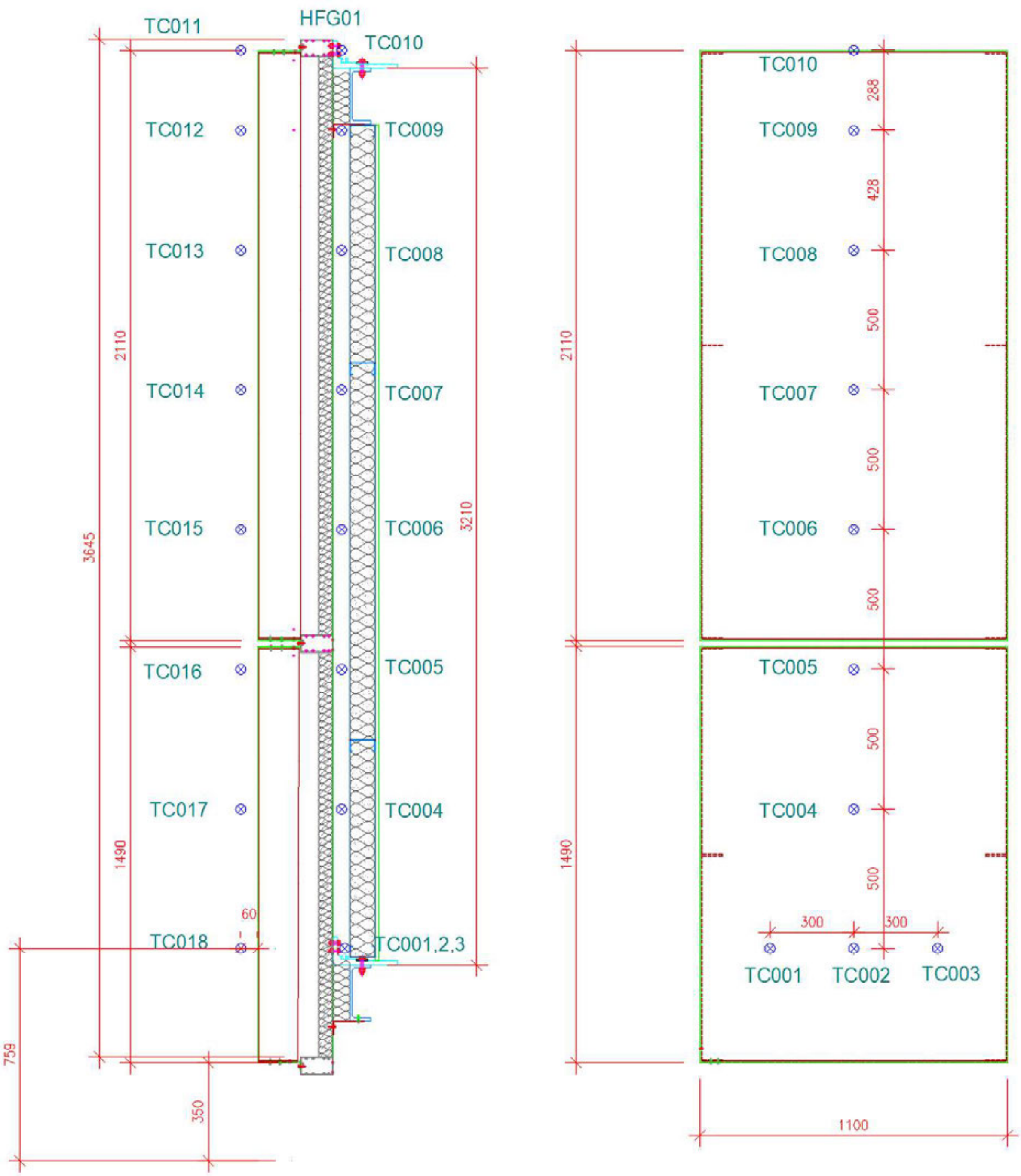

Figure 1 Instrumentation location

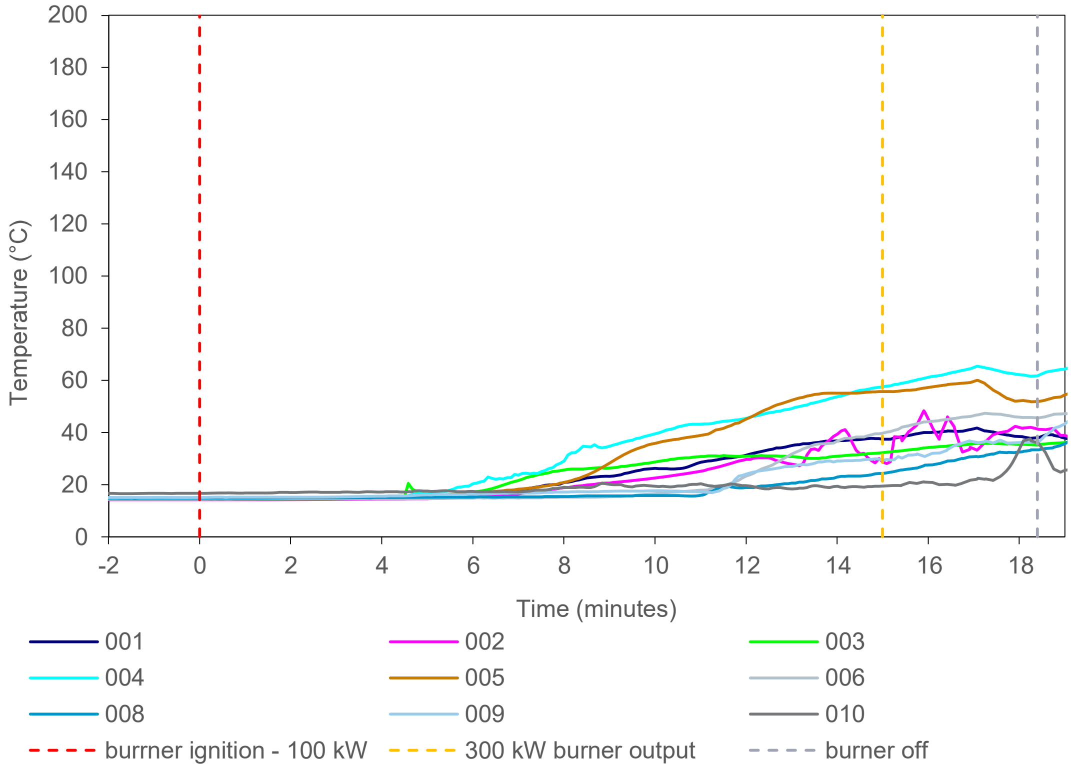

Figure 2 **Internal temperature data collected by thermocouples placed within the cavity – between the internal and external segments of the specimen.**

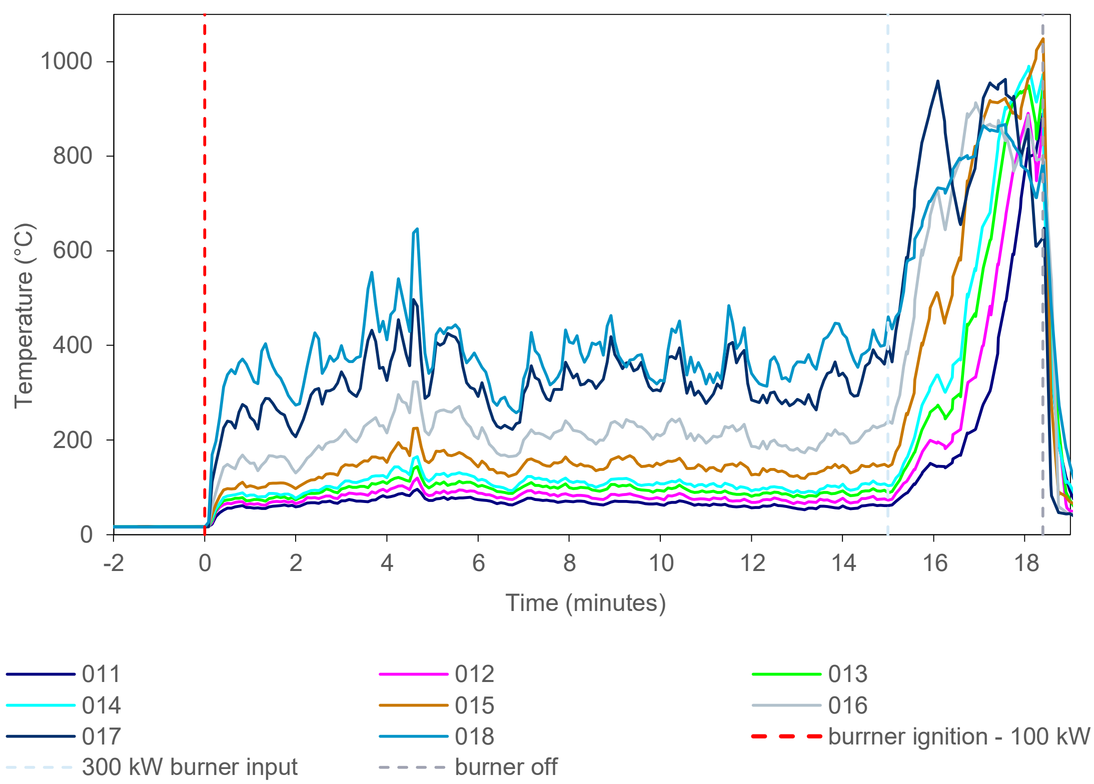

Figure 3 **External temperature data collected by thermocouples placed 60 mm from the front face of the specimen.**

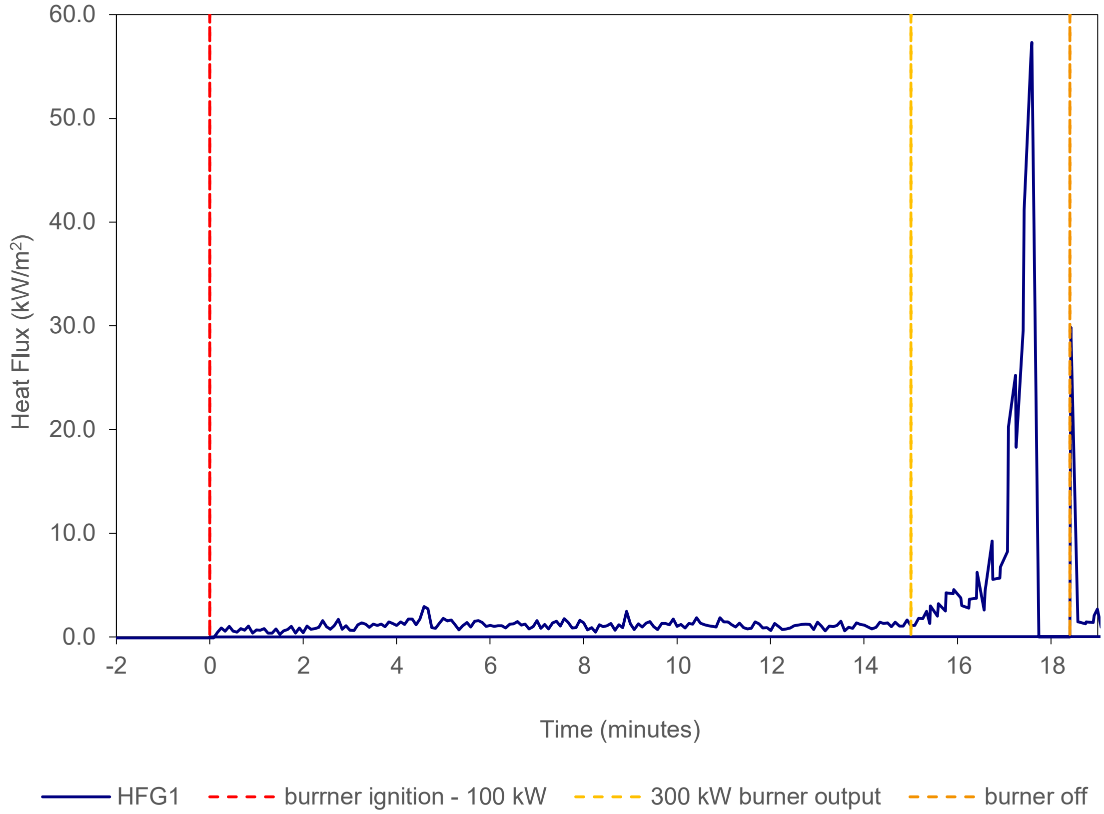

Figure 4 Heat flux data collected by heat flux gauges.

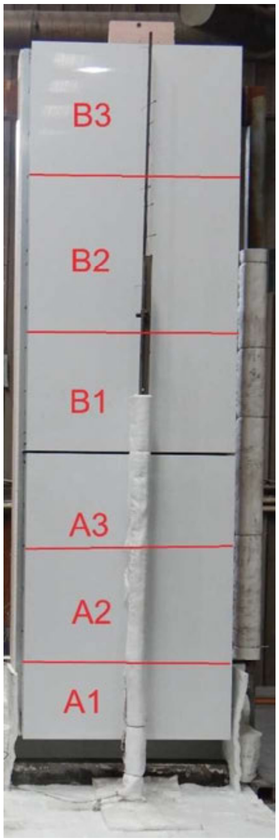

Figure 5 Designation for test specimen observations.

Table 4 shows the observations of any significant behaviour of the specimen during the test.

Video recordings were also taken of the test. A copy of the video recording is available upon request from the test sponsor or by contacting Cladding Safety Victoria. The video of the test should be viewed in conjunction the contents of this report.

Table 4 Test observations

Time		Section	Observation
Min	Sec		
-2	00	All	Data collection started.
0	00	All	The reaction to fire test was started with the burner ignited with a heat output set at 100 kW.
0	25	A1	There was discolouration of the panel skin.
0	58	A1	There was discolouration of the panel skin on the right side.
2	21	A1	There was flaming molten material (core) dripping from the bottom left corner.
3	11	A1	There amount of was flaming molten material (core) dripping has increased.
3	53	A1	There was discolouration and flaming at the bottom left side.
4	31	A1	Flaming increased intermittently.
6	03	All	There was a large amount of smoke being produced by the specimen,
6	53	A2/A3	The panel sections had begun to discolour.
8	29	A1	The specimen started to emit a significant amount of smoke from the back.
10	10	A1	The skin started to deform.
12	15	A	A popping sound had emanated from the specimen.
13	33	A2	Flaming bit of sealant fell from the left side of the specimen.
15	00	All	The burner output was increased to 300 kW.
15	14	A & B	Flaming had reached the second joint.
15	36	B1	The panel had started to discolour.
15	55	B2	Flames reached the middle section of the panel.
16	53	B3	Flames reached the top section of the panel.
17	09	B3	Flames reached the top of the specimen.
18	12	B3	It was observed that the cavity had opened up.
18	**20**	**All**	**Flaming of the specimen was excessive. The power to the burner was cut and specimen was sprayed with water. The test ended.**

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 Table 3. Any significant variation with respect to size, construction details, loads, stresses, edge or end conditions is not addressed by this report.

It is recommended that any proposed variation to the tested configuration should be referred to the test sponsor. They should then obtain appropriate documentary evidence of compliance from Warringtonfire or another accredited testing authority.

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.

Appendix A Drawings of test assembly

The drawings of the test assembly in Figure 6 to Figure 9 were provided representatives of Warringtonfire. Dimensions, unless specified, are in mm.

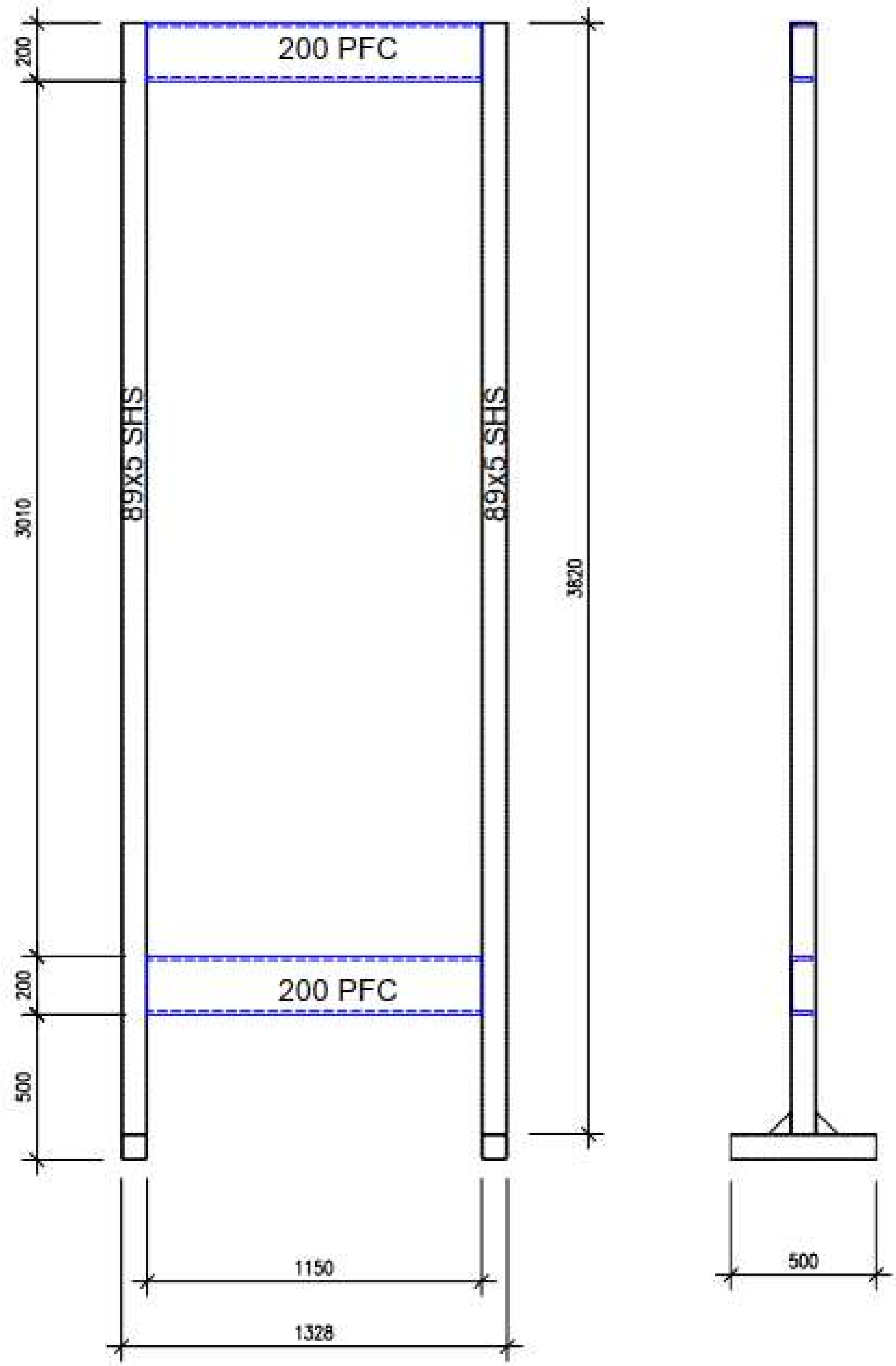

Figure 6 Elevation of rig support.

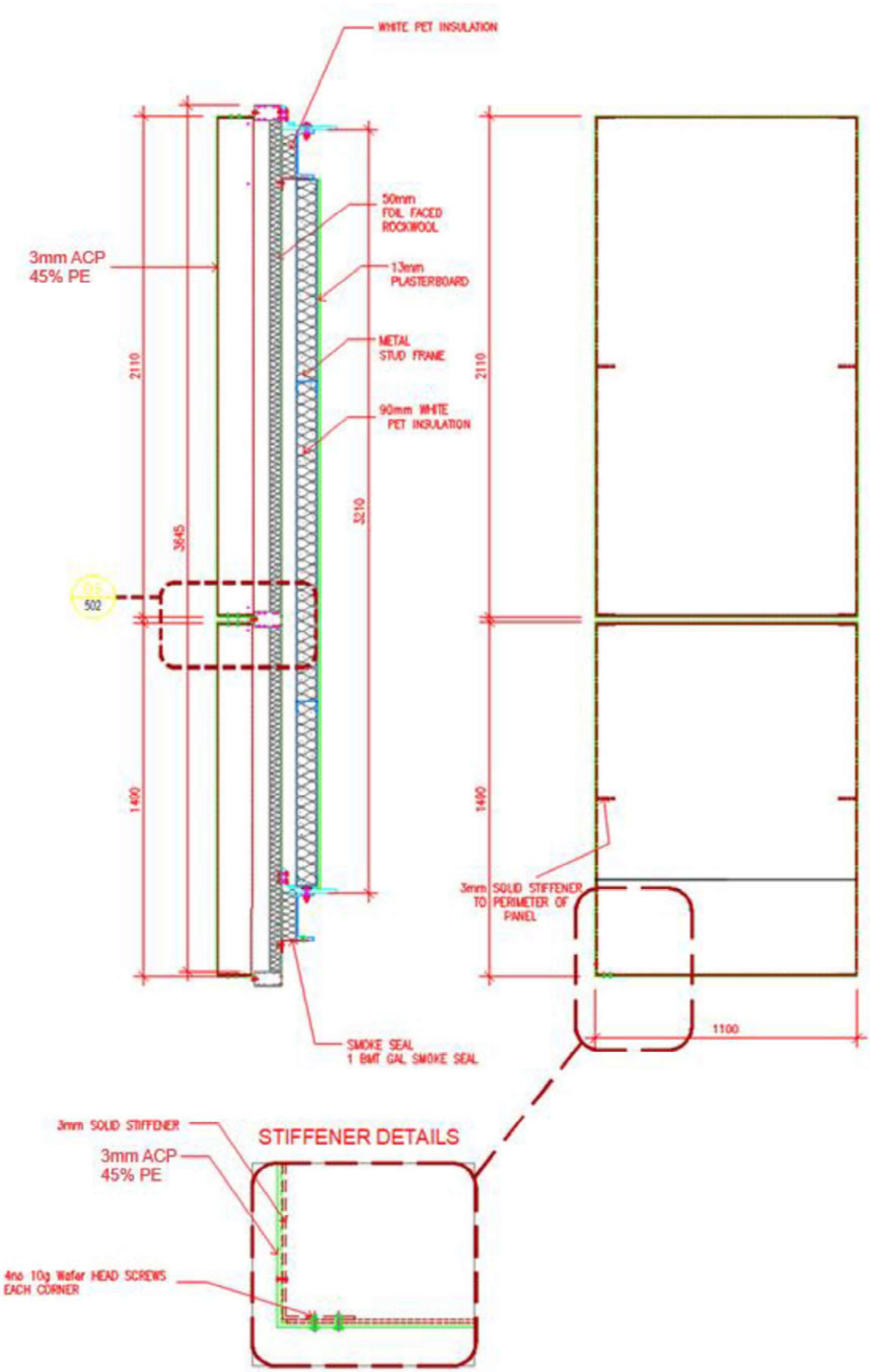
WHITE PET INSULATION
50mm FOIL FACED ROCKWOOL
3mm ACP 45% PE
13mm PLASTERBOARD
METAL STUD FRAME
90mm WHITE PET INSULATION
2110
3645
3210
1400
502
3mm SOLID STIFFENER TO PERIMETER OF PANEL
1100
SMOKE SEAL 1 BMT GAL SMOKE SEAL
3mm SOLID STIFFENER
STIFFENER DETAILS
3mm ACP 45% PE
4no 10g Wafer HEAD SCREWS EACH CORNER

Figure 7 System assembly – Front and side view

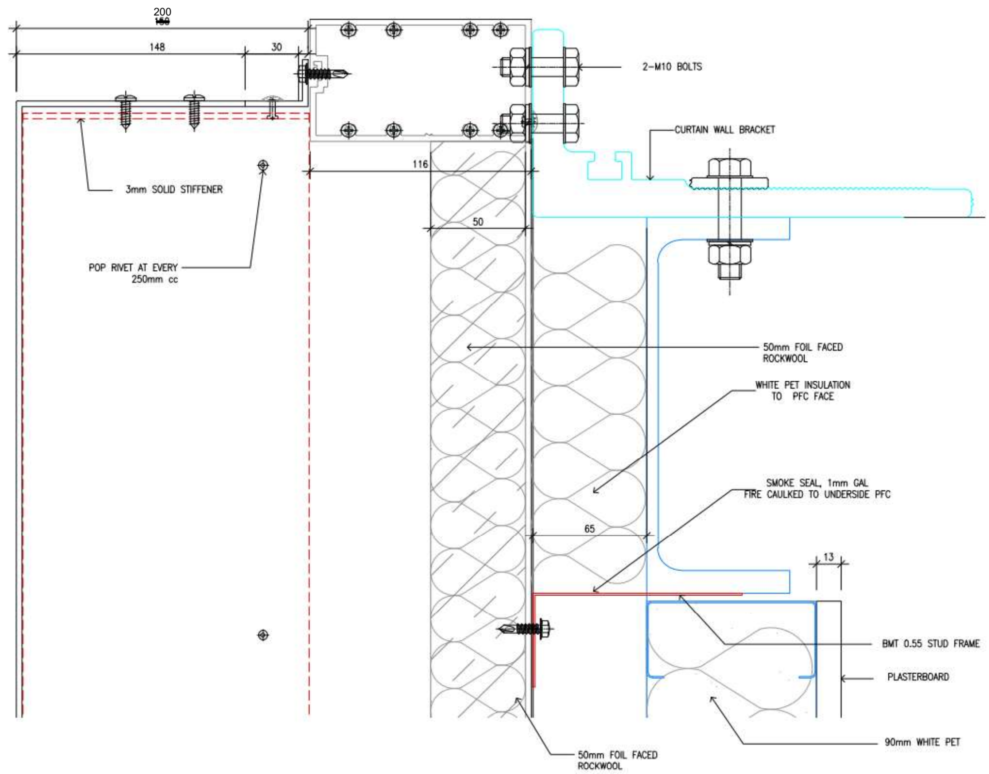

Figure 8 System assembly – top edge detail

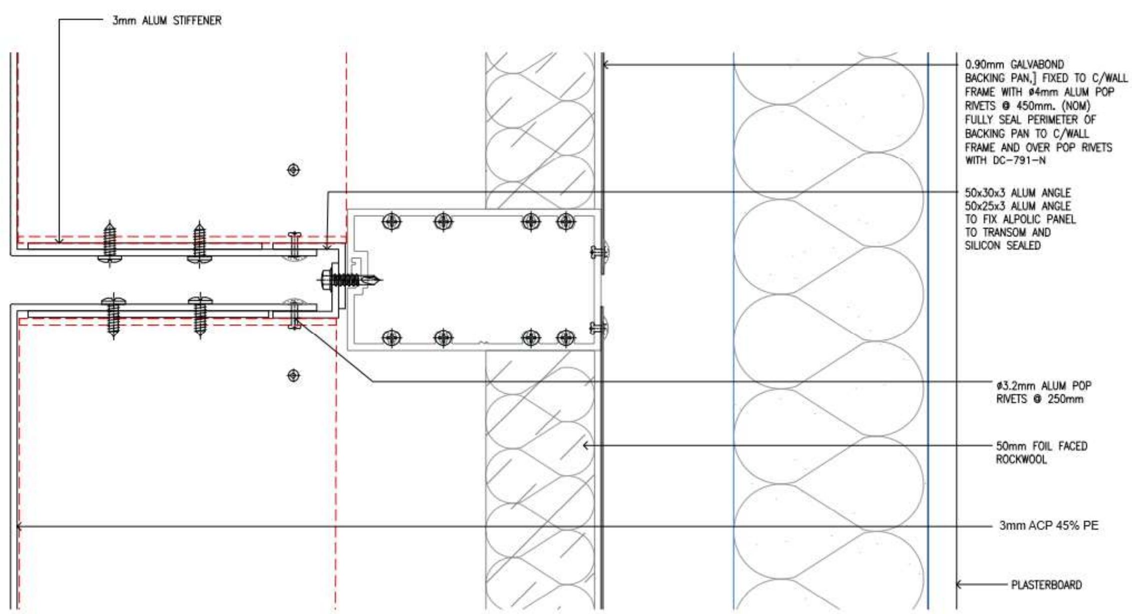

Figure 9 System assembly – middle join detail (D05)

Appendix B Photographs

Figure 10 The specimen before the reaction to fire test

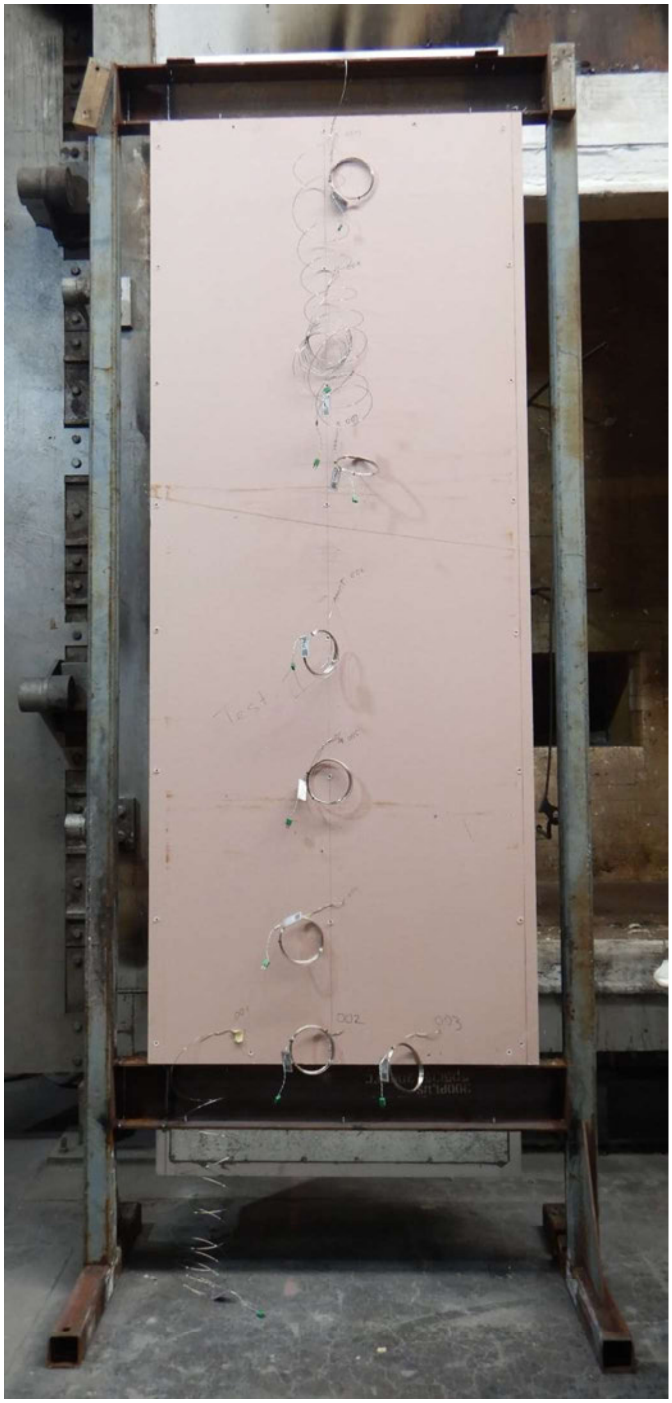

Figure 11 The specimen before the reaction to fire test – unexposed side

Figure 12 The specimen 1 minute 42 seconds into the test (burner output at 100 kW)

Figure 13 The specimen 3 minutes 11 seconds into the test (burner output at 100 kW)

Figure 14 The specimen 4 minutes 53 seconds into the test (burner output at 100 kW)

Figure 15 The specimen 9 minutes 53 seconds into the test (burner output at 100 kW)

Figure 16 The specimen 13 minutes 14 seconds into the test (burner output at 100 kW)

Figure 17 The specimen 14 minutes 45 seconds into the test (burner output at 100 kW)

Figure 18 The specimen 15 minutes 2 seconds into the test (2 seconds after burner output was changed to 300 kW)

Figure 19 The specimen 15 minutes 41 seconds into the test (41 seconds after burner output was changed to 300 kW)

Figure 20 **The specimen 15 minutes 56 seconds into the test (56 seconds after burner output was changed to 300 kW)**

Figure 21 The specimen 16 minutes 55 seconds into the test (1 minute 55 seconds after burner output was changed to 300 kW)

Figure 22 The specimen 17 minutes 45 seconds into the test (2 minutes 45 seconds after burner output was changed to 300 kW)

Figure 23 The specimen 17 minutes 52 seconds into the test (2 minutes 52 seconds after burner output was changed to 300 kW)

Figure 24 The specimen shortly after being sprayed with water

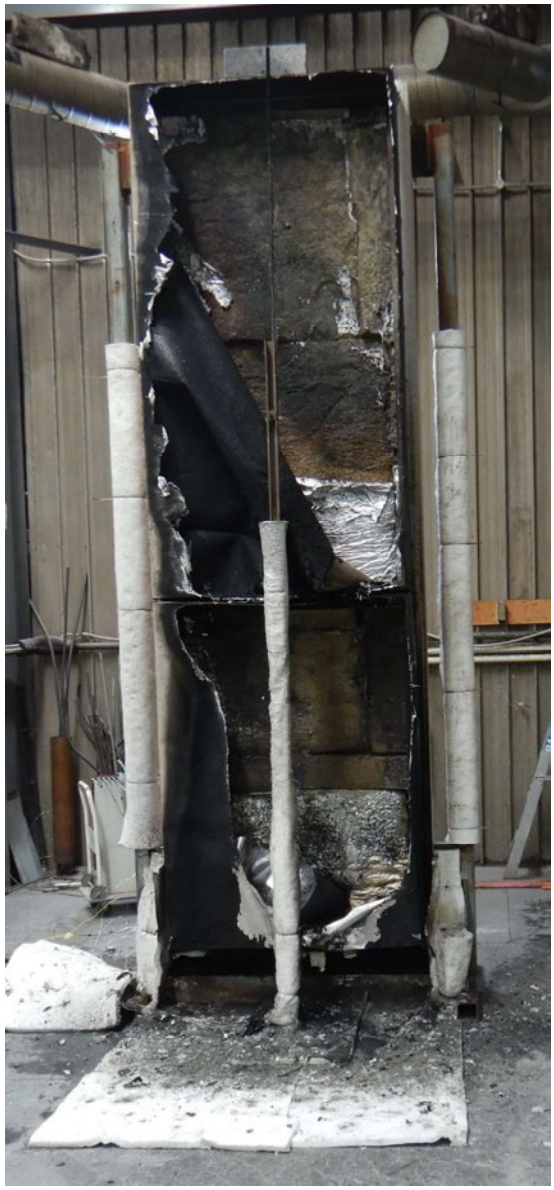

Figure 25 The specimen after the test.

Figure 26 The specimen after the test – unexposed side.

Appendix C Chemical analysis results

UNSW SYDNEY

UNSW RESEARCH INFRASTRUCTURE

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Test Report

Prepared by:

ANALYSIS OF CLADDING SAMPLES

REF: CSV Sample Collection

For

Company: Nevermind Facades Pty Ltd

Contact: [redacted]

Date: 22 August 2023

Project No: 23139

Prepared by: [redacted]

Approved by: [redacted]

COMMERCIAL-IN-CONFIDENCE

UNSW SYDNEY

Analysis of Cladding Samples, CSV Sample Collection

1. SAMPLES

One box containing five ACP cores was received for analysis. The samples were identified as follows:

CCL sample coding	Client sample coding
23139-1	CSV #02
23139-2	CSV #03
23139-3	CSV #04
23139-4	CSV #08
23139-5	CSV #09

CCL has been asked to identify the polymer and the filler (s) in the sample by FT/IR, quantitate and identify the mineral filler in the sample and classify them in accordance with the ICA cladding scheme.

2. METHODOLOGY AND RESULTS

The aluminium metals were removed from the ACPs cladding polymers, and the flat surface of the polymer samples was abraded to remove any surface adhesive. The surface of each sample was analysed directly by FTIR. The FT-IR spectra are presented in Figures 1-5.

The core of each sample was then ashed to determine its percentage mineral content (Table 1). If sufficient (>0.5 g) ash had been produced it would have been analysed for elemental composition by X ray fluorescence spectroscopy. Results are presented in Table 2.

Table 1 Ash content of 23139-1 to 23139-5

Sample coding	Ash content (w/w%)
23139-1	19.1
23139-2	21.9
23139-3	31.9
23139-4	38.3
23139-5	18.9

Table 2 Elemental composition of 23139-3 (CSV-04) and 23139-4 (CSV-08)

Element Oxide wt.%	23139-3	23139-4
Na_2O	0.46	0.50
MgO	4.59	6.80
Al_2O_3	1.08	0.96
SiO_2	7.09	6.63
P_2O_5	0.06	0.07
SO_3	1.43	2.71
K_2O	0.17	0.16
CaO	70.53	59.61
TiO_2	1.17	1.80
V_2O_5	<0.01	0.01
Cr_2O_3	<0.01	<0.01
Mn_3O_4	<0.01	<0.01
Fe_2O_3	0.90	0.90
NiO	<0.01	<0.01
CuO	0.14	0.10
ZnO	2.48	2.47
SrO	0.10	0.17
ZrO_2	<0.01	<0.01
BaO	3.02	6.15
HfO_2	<0.01	<0.01
PbO	<0.01	<0.01
L.O.I.	ND	ND

NOTE: (i) L.O.I.= loss on ignition at 1,050 °C.
(ii) ND = not determined

2. CONCLUSIONS

The cladding CSV #02 consisted of 80.9% poly(ethylene-vinyl acetate) (PEVA) polymer and 19.1% other inert material.

The cladding sample #1, CSV #02 is classified as ICA category A.

The cladding CSV #03 consisted of 78.1% poly(ethylene-vinyl acetate) (PEVA) polymer and 21.9% other inert material.

The cladding sample #2, CSV #03 is classified as ICA category A.

The cladding CSV #04 consisted of 2.1% magnesium hydroxide, 40.2% calcium carbonate, 7.9% other inert material and approximately 49.8% poly(ethylene-vinyl acetate) (PEVA) polymer.

The cladding sample 3, CSV #04 is classified as ICA category A.

The cladding CSV #08 consisted of 3.8% magnesium hydroxide, 40.7% calcium carbonate, 12.9% other inert material and approximately 42.6% poly(ethylene-vinyl acetate) (PEVA) polymer.

The cladding sample 4, CSV #08 is classified as ICA category A.

The cladding CSV #09 consisted of 81.1% poly(ethylene-vinyl acetate) (PEVA) polymer and 18.9% other inert material.

The cladding sample 5, CSV #09 is classified as ICA category A.

The ICA Classification assigned is correct as per the September 2020 revision of the ICA Guidelines.

The calculation for magnesium hydroxide content assumes that all magnesium found is present as the hydroxide. The calculation for calcium carbonate content assumes that all calcium found is present as calcium carbonate.

The reader is reminded that we can only analyse and classify the content of samples actually presented to us. We can offer no guarantee that this composition or classification is valid for cladding as a whole, because some types of cladding can be inhomogeneous, and a sample may not be representative of the cladding as a whole. Anyone using our results should consider these sampling issues and uncertainties before they generalise the results we present to anybody of cladding as a whole.

[redacted]

Technical Officer

Chemical Consulting Laboratory

Mark Wainwright Analytical Centre, UNSW

22 August 2023

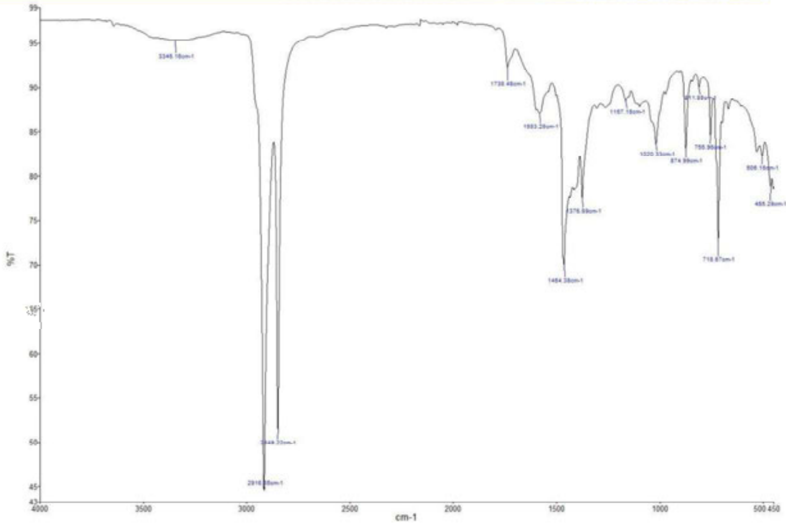

Figure 1. FT-IR spectrum of CSV #02

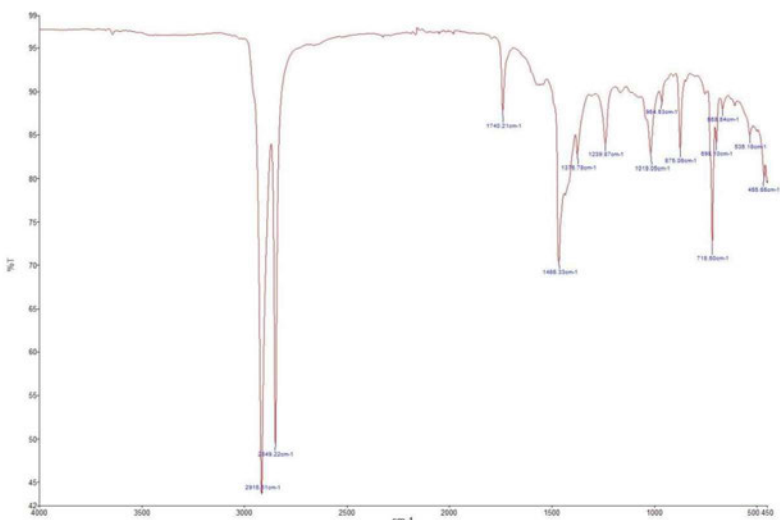

Figure 2 FT-IR spectrum of CSV #03

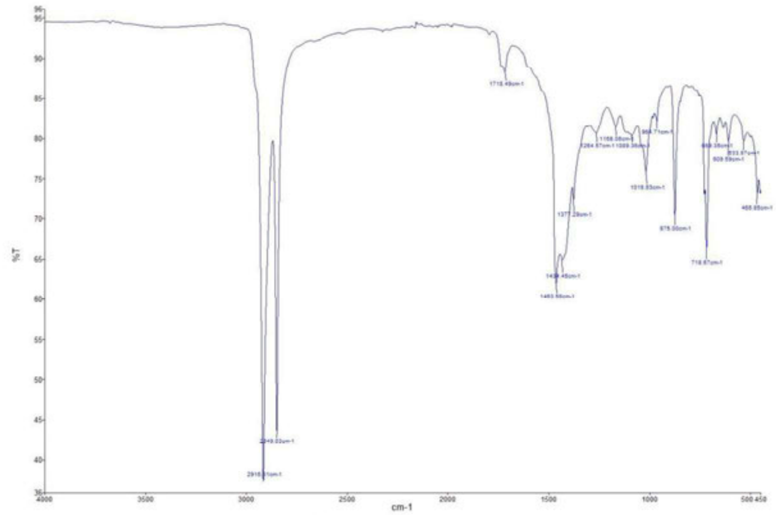

Figure 3 FT-IR spectrum of CSV #04

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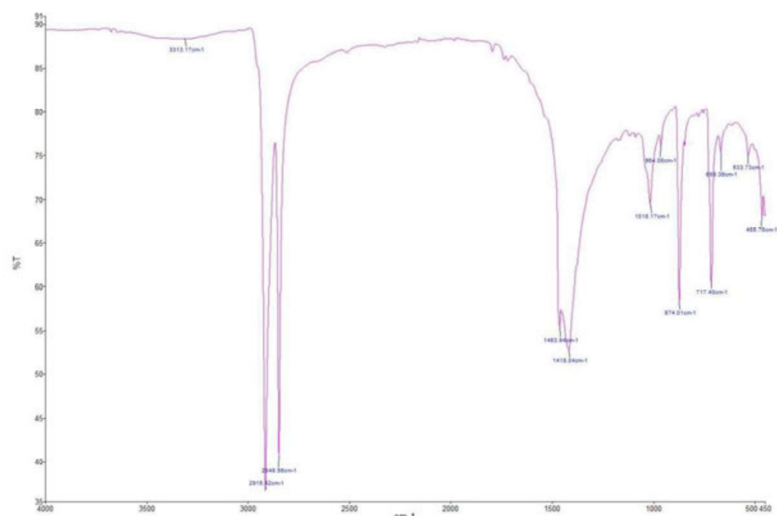

Figure 4 FT-IR spectrum of CSV #08

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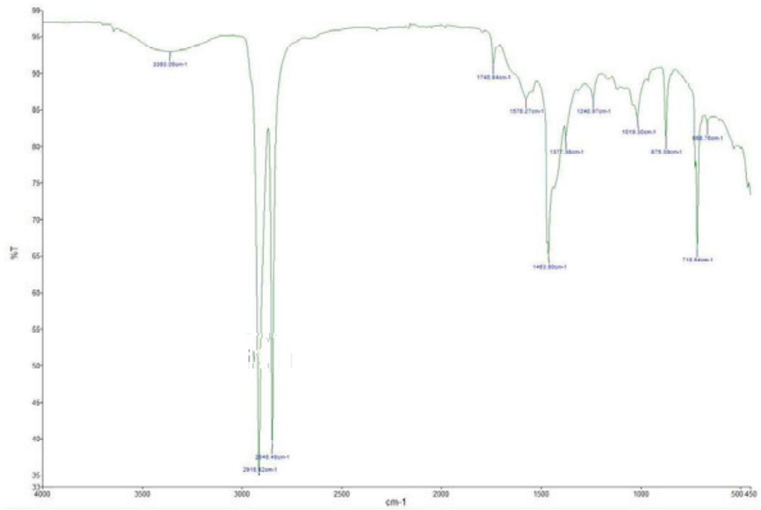

Figure 5 FT-IR spectrum of CSV #09

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