warringtonfire

# 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: RTF230139

Test date: 27 November 2023 Revision: R1.0

# Quality management

| Revision | Date | Information about the report | | | |
|---|---|---|---|---|---|
| R1.0 | 21 December 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 27 November 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<br>Docklands VIC 3808<br>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 | Vitrabond FR* Aluminium Composite Panel - 4 mm Dark Oak/Matte White with 0.5 mm skin.<br>*Sample sheets were taken from older manufactured quarantined stock with a higher polyethylene content that is no longer in circulation which was received marked as 'Testing Only'. |
| | 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) and inorganic filler.<br>Analysis conducted by the analytical centre of UNSW showed that the core consisted of polyethylene-vinyl acetate (PEVA) - found to be 43.9 % w/w - whilst the remainder of the material was found to be 45.3 % magnesium hydroxide, 6.1 % calcium carbonate and 4.8 % other inert material.<br>Refer to Appendix C for more detailed results - Sample 23197-1, Oak. |
| | Size | As shown in Figure 8.<br>Total thickness – 4.1 mm<br>Skin thickness (both sides) – 0.5 mm<br>Cassette depth – 150 mm |
| | Batch number | 1609418 |
| | Measured mass/unit area densities | Panel areal density – 6.9 kg/m² |
| 2. | Item name | FR Plasterboard |
| | Product | [redacted] 13 mm Fyrchek |
| | Manufacturer/supplier | [redacted] |
| | Size | Measured board: 3000 mm × 1200 mm × 13 mm |

| Item | Description | |
|---|---|---|
| | Batch date | 16/08/22 |
| | Areal density (measured) | 11.0 kg/m$^2$ |
| 3. | Item name | Backpan |
| | 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 7. |
| 5. | Item name | Aluminium curtain wall transom/mullions (rectangular hollow sections) - framing |
| | Size | 65 mm wide × 120 mm deep × 3 mm thick<br>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/m$^3$ |
| | Manufacturer/supplier | Pricewise Insulation |
| 12. | Item name | 50 mm thick aluminium - with fibre-glass mesh - foil faced rockwool insulation |
| | Density of core | 40 kg/m$^3$ |
| | Manufacturer/supplier | Rockwool Insulation Australia |
| **Sealant/Adhesive** | | |
| 13. | Item name | Weathering sealant |

| Item | Description | |
|---|---|---|
| | Product type | Silicone sealant |
| | Product name | PROSIL 41lm |
| | Manufacturer/supplier | Admil Adhesives |
| | 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.<br><br>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.<br>The results obtained during the test only apply to the test samples as received and tested by Warringtonfire. | |
| Test duration | 60 minutes | |
| Ambient laboratory temperature | Start of the test | 18 °C |
| | Minimum temperature | 18 °C |
| | Maximum temperature | 25 °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.<br>• 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.<br>• 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 $kW/m^2$.<br>• 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.<br>• 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 following 29 minutes of the test. After the burner was then turned off, the specimen was monitored for the remainder of the test. | |
| Test number | Test one of four. | |
| Variation between tests | The test was based off RTF220104 R1.0, RTF220104 R2.0, RTF220104 R3.0 and RTF230111 R1.0. 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 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.

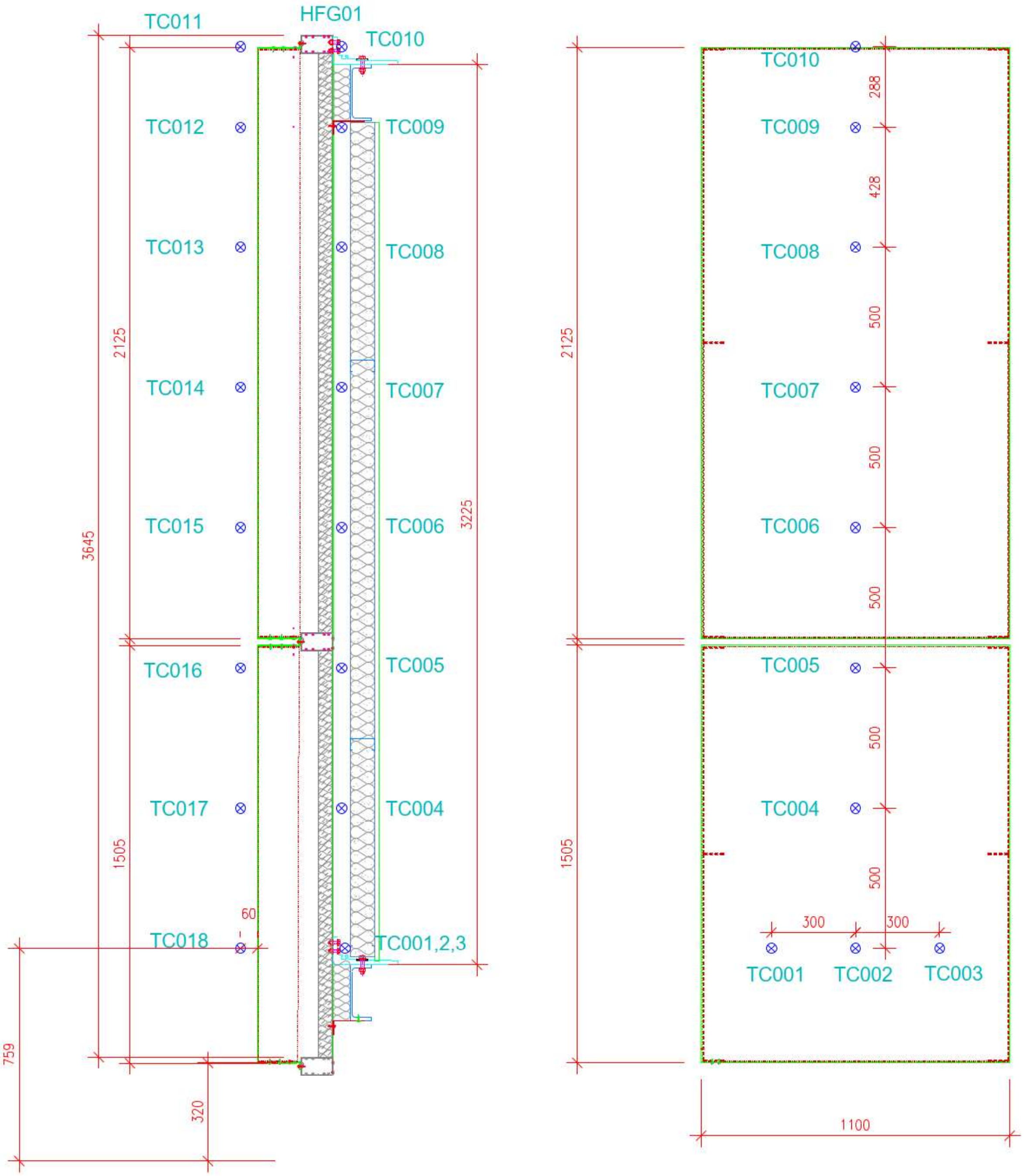


**Figure 1 Instrumentation location**

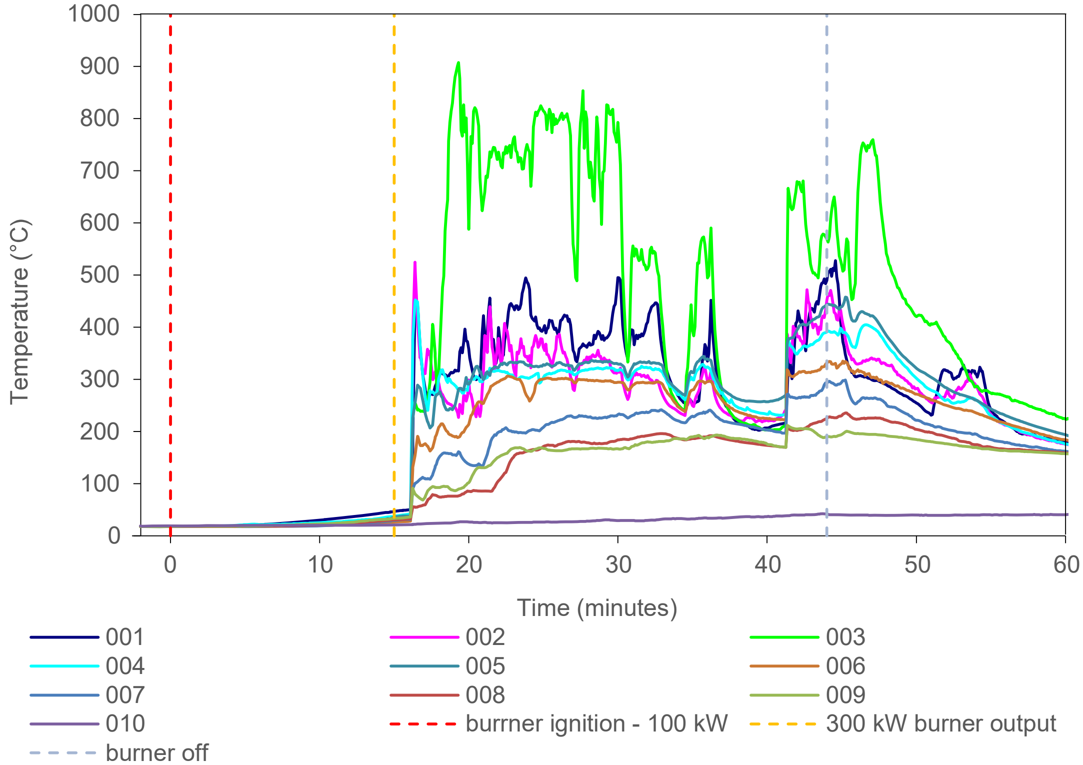


**Figure 2** **Internal temperature data collected by thermocouples placed within the cavity – between the internal and external segments of the specimen.**

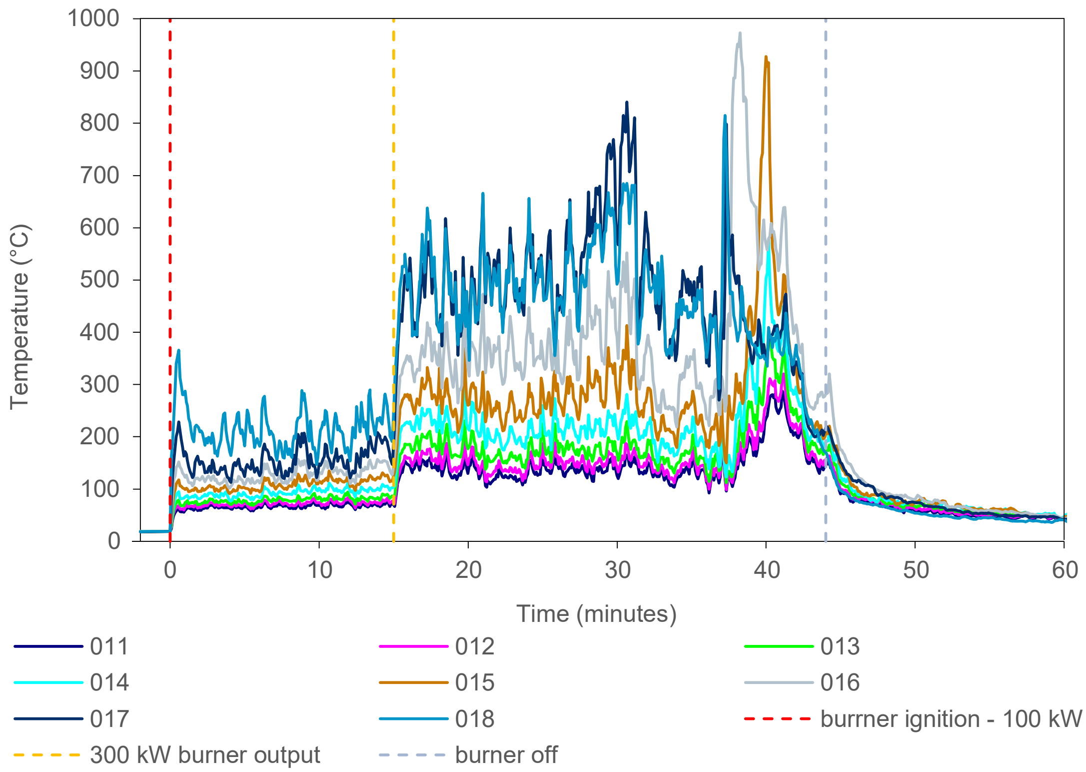


**Figure 3** **External temperature data collected by thermocouples placed 60 mm from the front face of the specimen.**

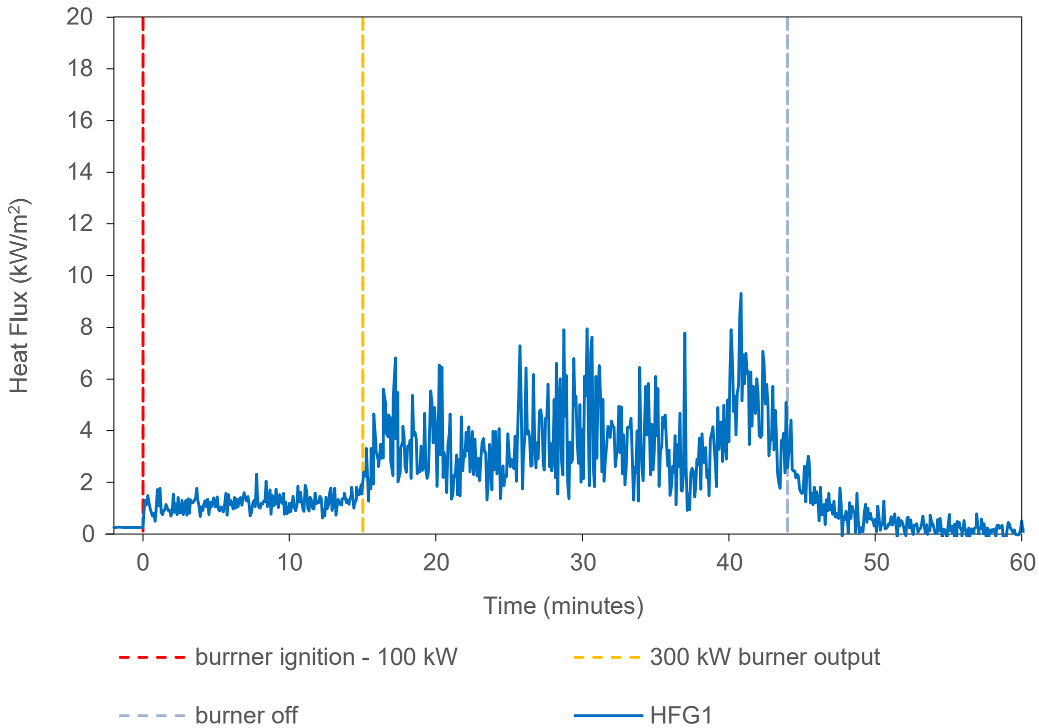


**Figure 4 Heat flux data collected by heat flux gauge.**

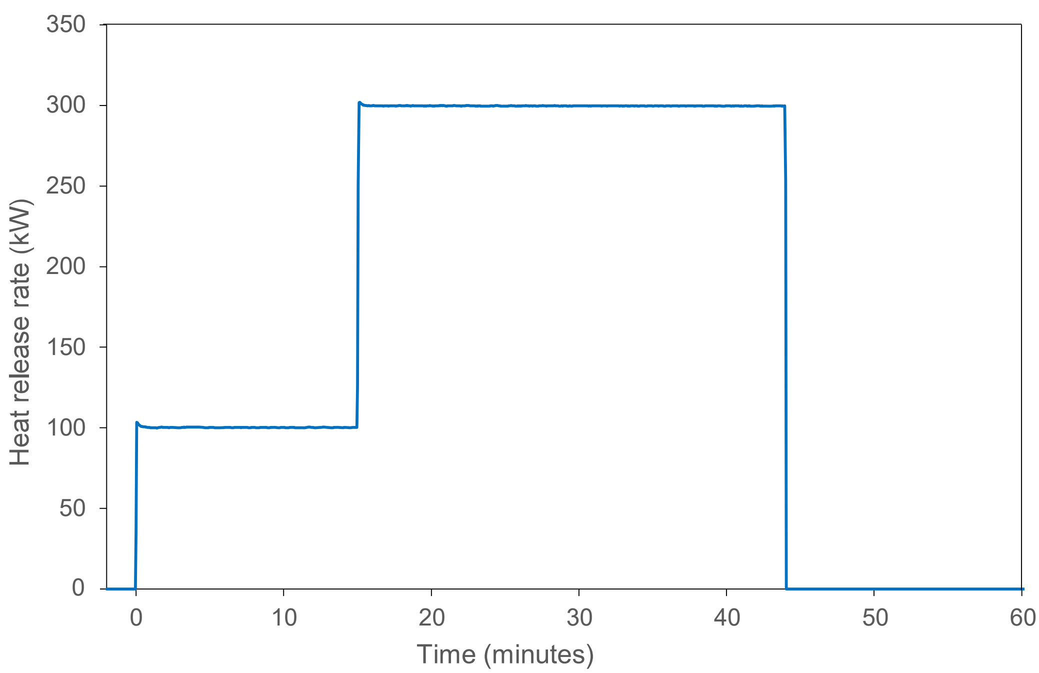


**Figure 5 Heat release rate of burner.**

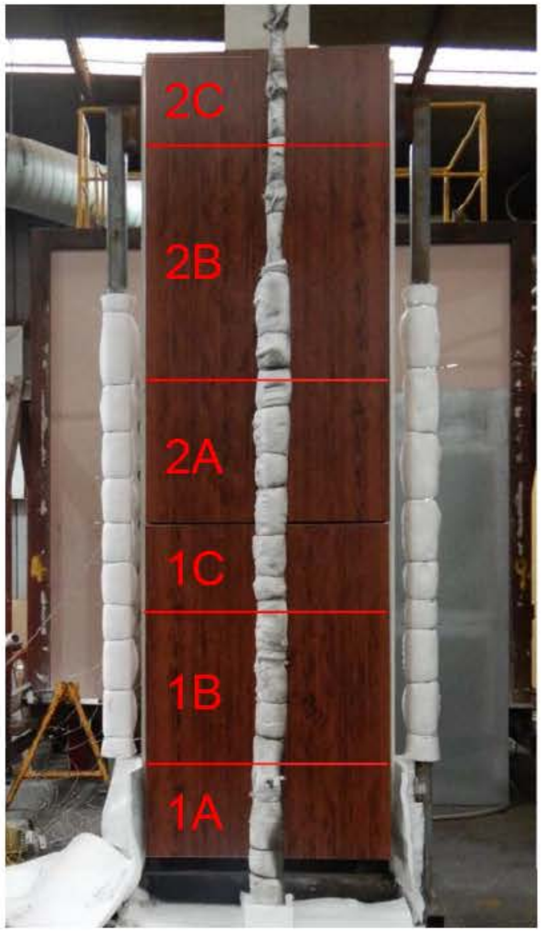


**Figure 6** **Designation for test specimen observations.**

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. |
| 2 | 30 | All | Smoke was emitted from the top corners of the test rig. |
| 3 | 11 | 1A | Flaming debris fell from the left side. |
| 3 | 47 | 1A | The skin had become discoloured. |
| 4 | 37 | 1A | Flaming debris fell from the left side and continued flaming for longer than 20 seconds. |
| 6 | 56 | 1A | Flaming debris fell from the right side and continued flaming for longer than 20 seconds. |
| 10 | 30 | All | Smoke was emitted from the plasterboard cavity at the top of the test rig. |
| 15 | 00 | All | The burner output was increased to 300 kW. |
| 15 | 09 | 1C | Flames were consistently reaching up to section 1C. |
| 15 | 52 | 1A/1B/1C | The panel skin was peeling off. |
| 16 | 06 | All | A buildup of gas was released from the sides of the specimen. |
| 16 | 30 | 1A | The core of the panel had become exposed on the left side. |
| 17 | 20 | 2A | Flames were consistently reaching up to section 2A. |
| 24 | 00 | 1A/1B/1C | The opening in the left side of the panel had become larger and higher. |
| 25 | 41 | 2A | The panel skin was peeling off the main face. The right side was flaming. |
| 29 | 20 | 1B/1C | The cavity sustained flaming which appeared to be independent of the burner. |
| 31 | 10 | All | Larger pieces of flaming debris fell from the specimen and continued flaming. |
| 36 | 05 | 2C | The top right corner of the specimen began flaming. |
| 36 | 17 | 1A/1B/1C | The top of 1C appeared to be flaming independently to the burner. |
| 36 | 40 | 1A/1B/1C | Larger pieces of flaming debris fell from the specimen and continued flaming. |
| 36 | 53 | 1A/1B/1C | The front face of the lower panel had become partially separated from the edges, and significant flaming was present behind it. |
| 37 | 18 | 1A/1B/1C | Most of the panel had melted or fallen away. |
| 40 | 30 | 2A/2B | Flames had breached inside the cavity of the upper panel. |
| 41 | 18 | 2A/2B | Flaming gas was released from the opening in the upper panel. |
| 43 | 28 | All | A large piece of insulation fell on and covered the burner. |
| 44 | 00 | All | The burner was switched off. |
| 45 | 30 | 1A/1C/2A | The debris continued to flame on and around the burner. The join between the two panels at sections 1C and 2A continued to flame. |
| 52 | 00 | 2A/2B | External flaming ceased. Flaming continued inside the upper panel cavity. |
| 58 | 50 | All | Internal flaming had decreased significantly. |
| 60 | 00 | All | The reaction to fire 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 7 to Figure 10 were provided by representatives of Warringtonfire. Dimensions, unless specified, are in mm.

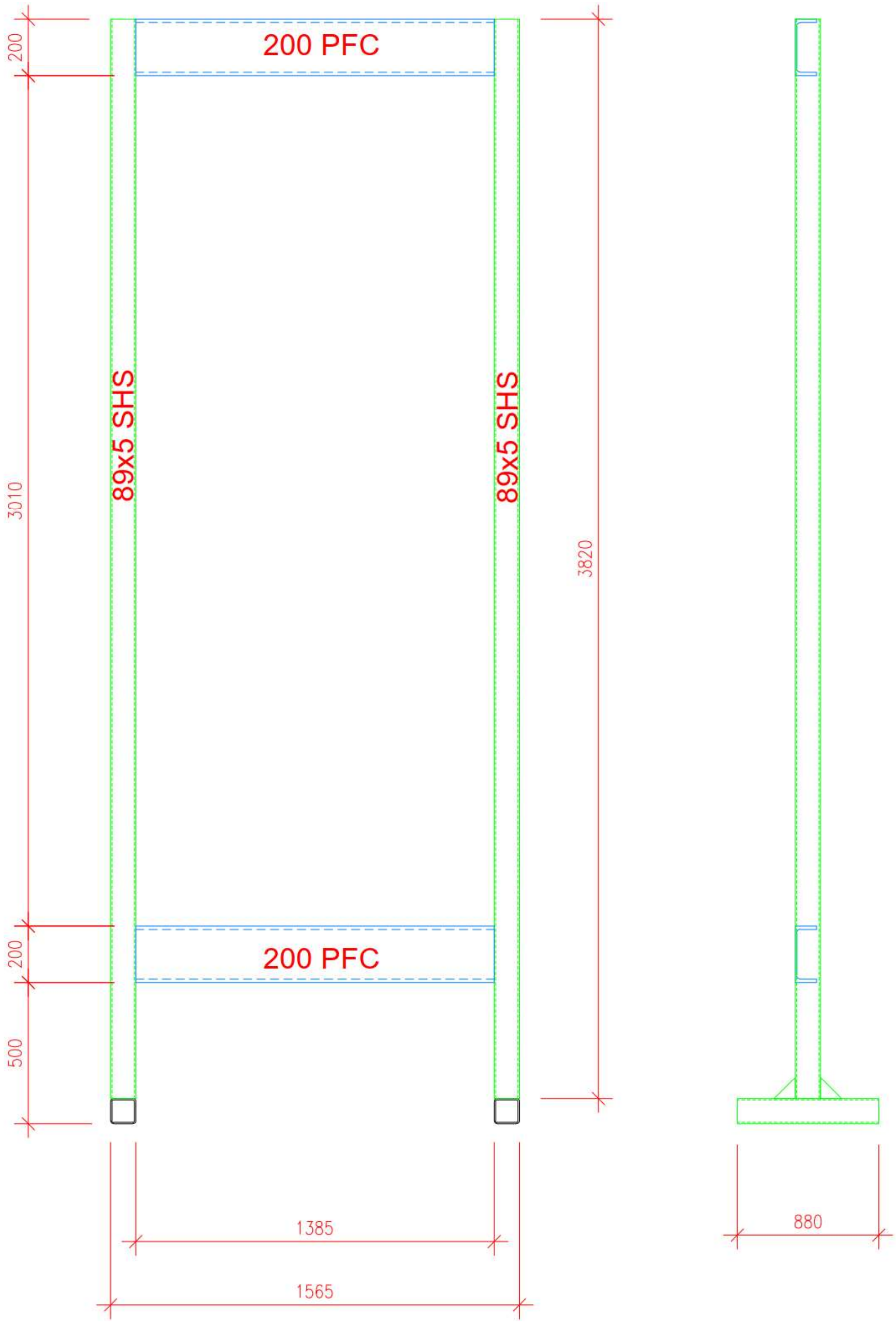


**Figure 7 Elevation of rig support.**

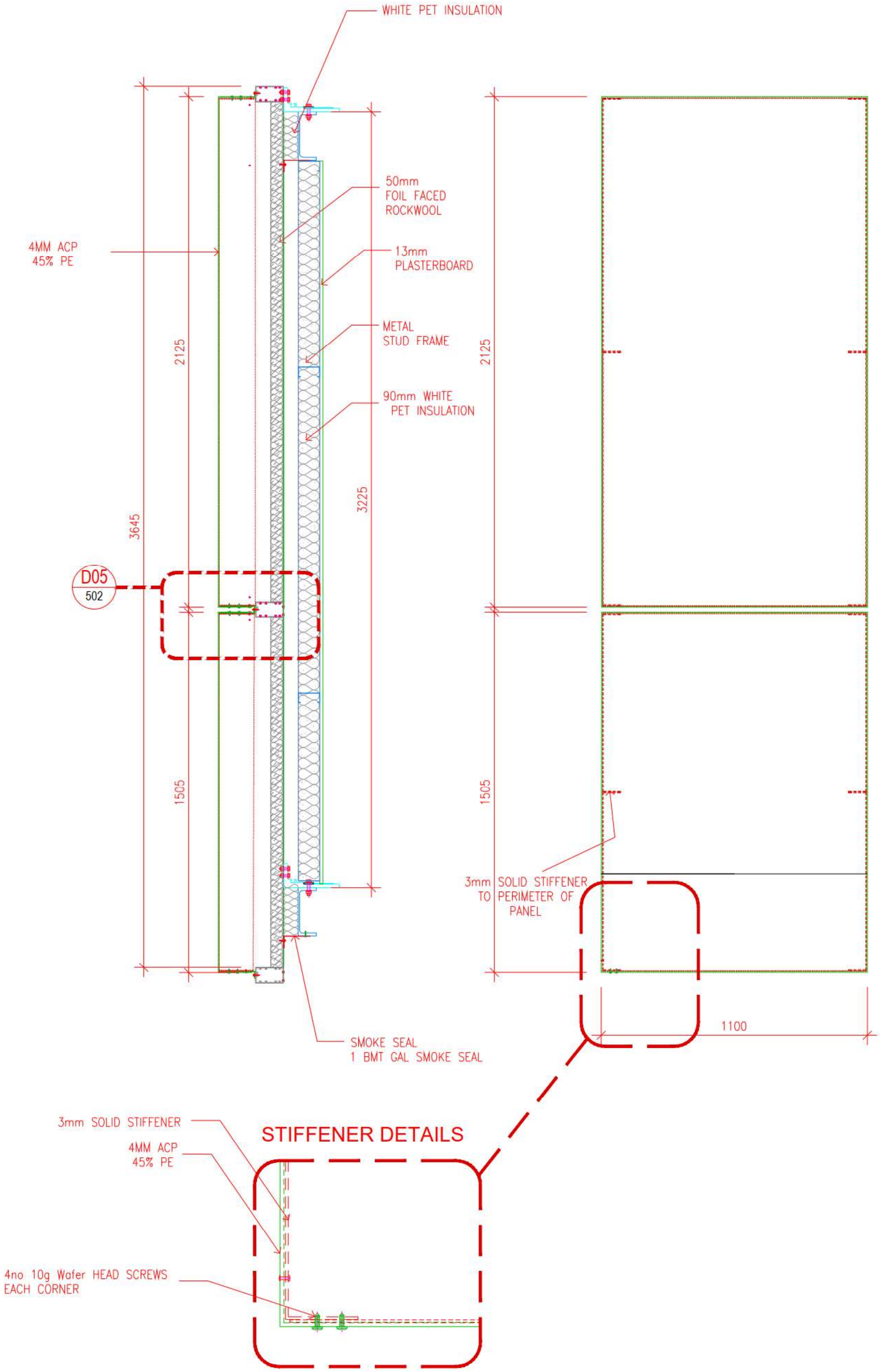


**Figure 8 System assembly – Front and side view**

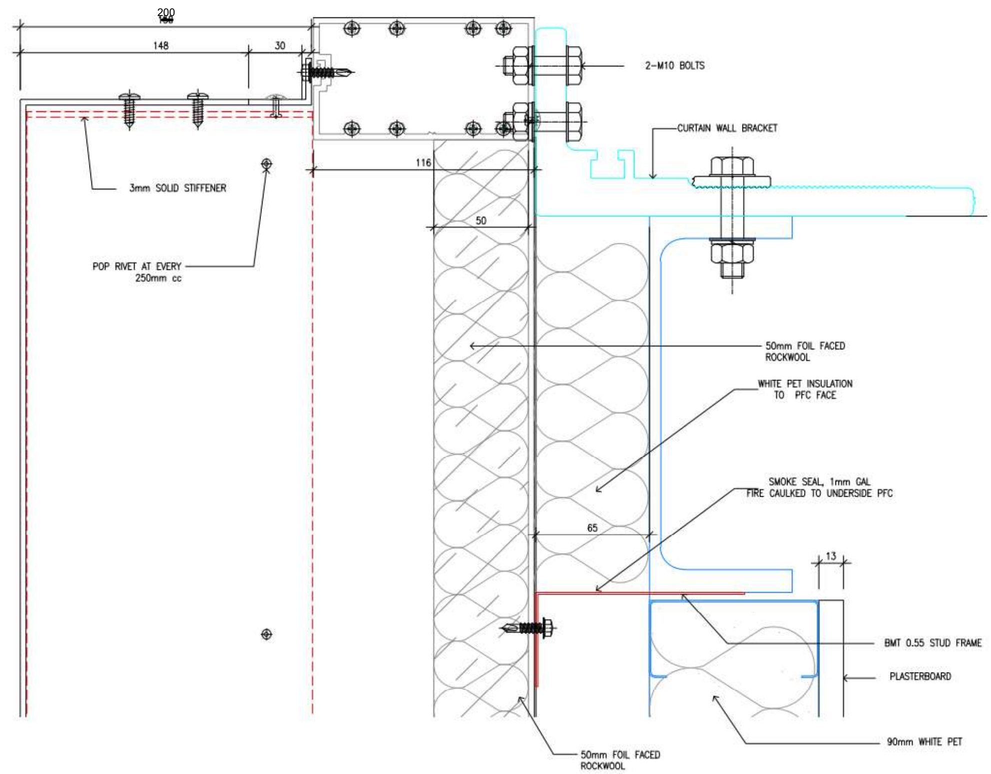


**Figure 9 System assembly – top edge detail**

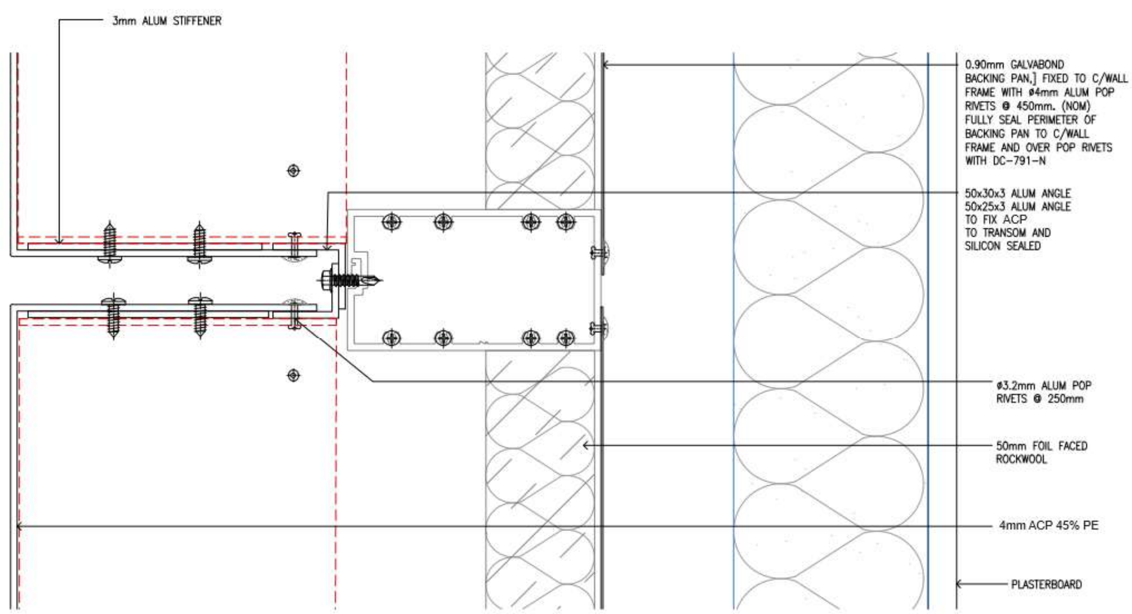


**Figure 10 System assembly – middle join detail (D05)**

## Appendix B Photographs

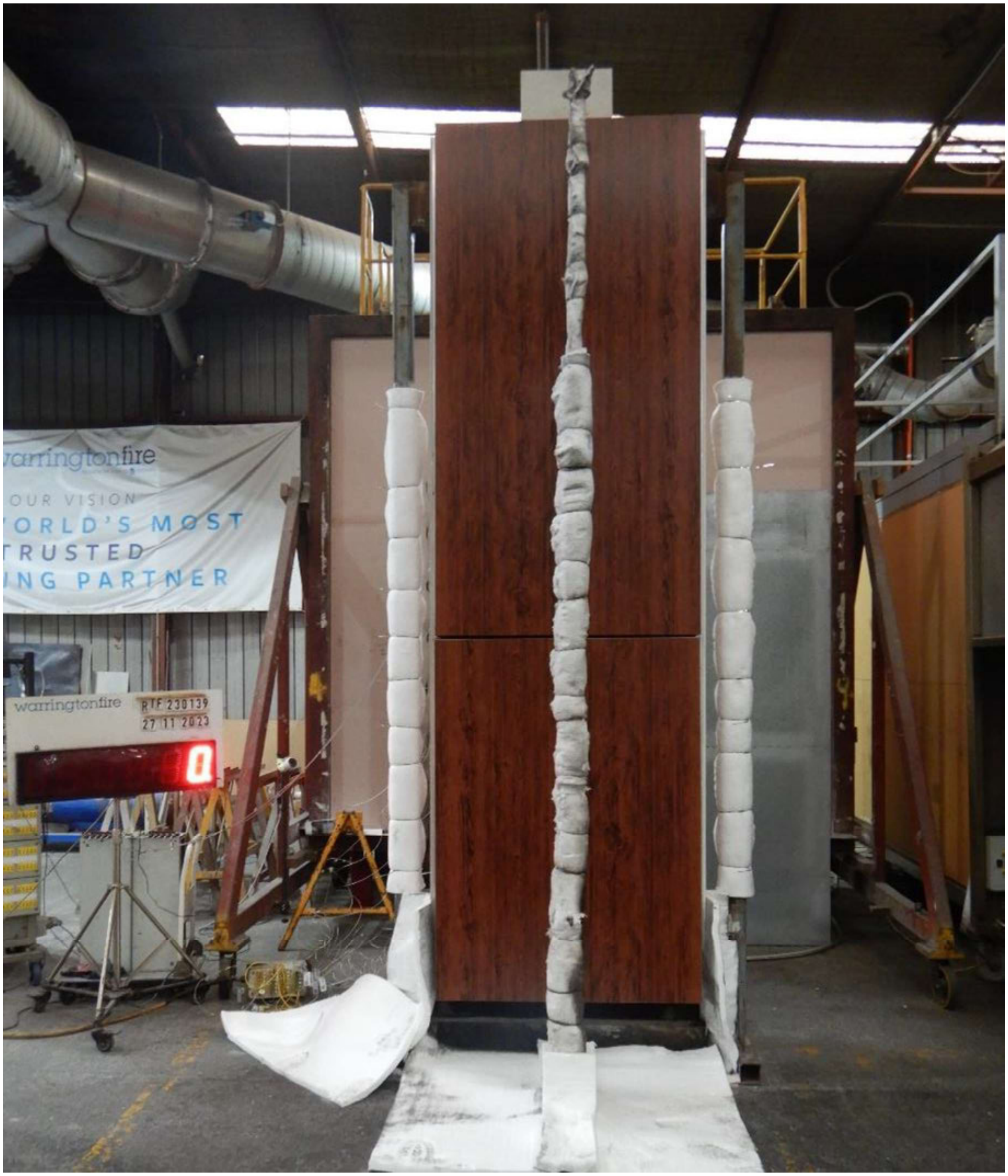


**Figure 11 The specimen before the reaction to fire test**

Figure 12 The specimen before the reaction to fire test – unexposed side

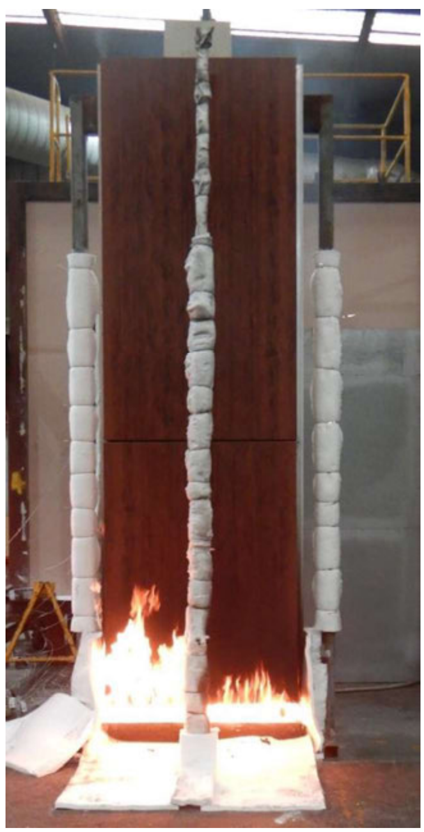

Figure 13 The specimen 3 minutes 58 seconds into the test (burner output at 100 kW)

**Figure 14 The specimen 8 minutes 49 seconds into the test (burner output at 100 kW)**

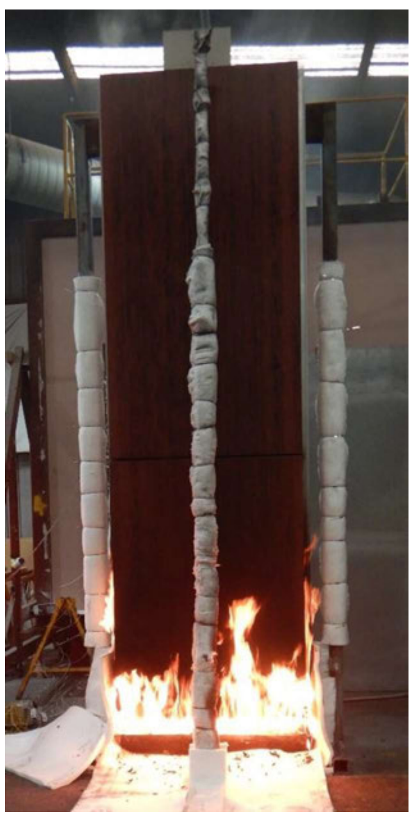

**Figure 15 The specimen 12 minutes into the test (burner output at 100 kW)**

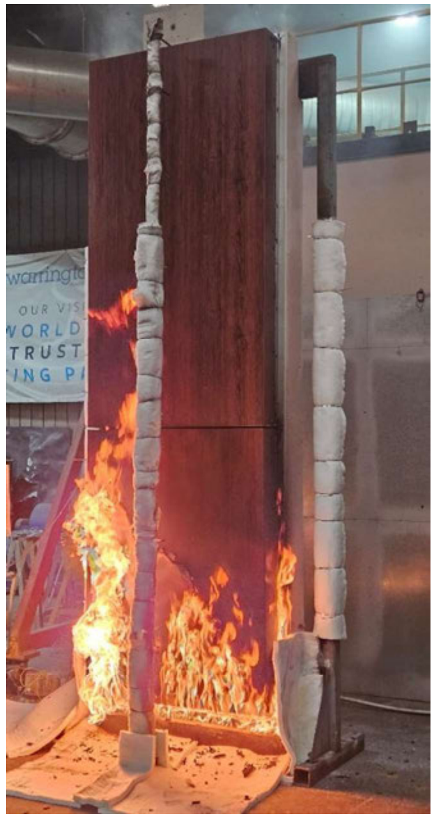

**Figure 16** The specimen 16 minutes 12 seconds into the test (1 minute 12 seconds after burner output was changed to 300 kW)

**Figure 17** The specimen 18 minutes 44 seconds into the test (3 minutes 44 seconds after burner output was changed to 300 kW)

Figure 18 The specimen 21 minutes 40 seconds into the test (6 minutes 40 seconds after burner output was changed to 300 kW)

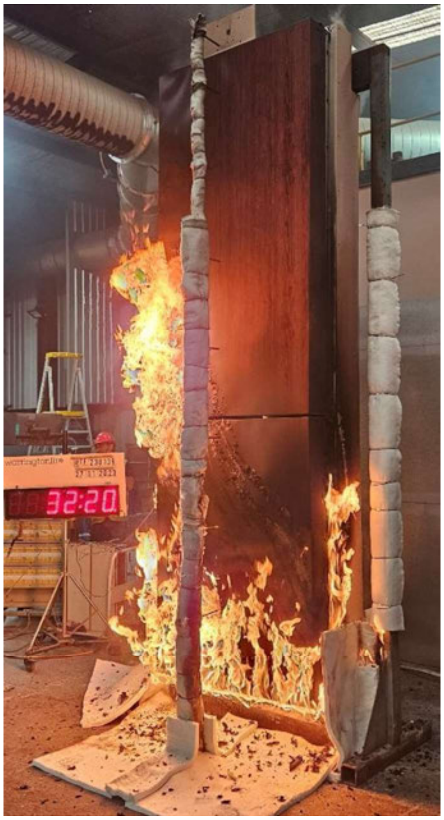


Figure 19 The specimen 32 minutes 20 seconds into the test (17 minutes 20 seconds after burner output was changed to 300 kW)

**Figure 20 The specimen 36 minutes 37 seconds into the test (21 minutes 37 seconds after burner output was changed to 300 kW)**


**Figure 21 The specimen 38 minutes 9 seconds into the test (23 minutes 9 seconds after burner output was changed to 300 kW)**


**Figure 22** **The specimen 43 minutes 50 seconds into the test (28 minutes 50 seconds after burner output was changed to 300 kW)**


**Figure 23** **The specimen 45 minutes into the test (1 minute after burner was switched off)**

**Figure 24 The specimen 47 minutes 58 seconds into the test (3 minutes 58 seconds after burner was switched off)**


**Figure 25 The specimen at the end of the test**

Figure 26 The specimen after the test, after being sprayed with water.

Figure 27 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: UB8388

For

**Company:** Warrington Fire

**Contact:** [redacted]

**Date:** 17 October 2023

**Project No:** 23197

**Prepared by:** [redacted]

**Approved by:** [redacted]

**COMMERCIAL-IN-CONFIDENCE**

UNSW SYDNEY

# Analysis of Cladding Samples
# REF: UB8388

## 1. SAMPLES

One plastic sachet containing two ACP cores was received for analysis. The samples were identified as follows:

| CCL sample coding | Client sample coding |
|---|---|
| 23197-1 | Oak |
| 23197-2 | Silver |

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

## 2. METHODOLOGY AND RESULTS

The aluminium metal was removed from the ACPs cladding polymer, 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 spectrum is presented in Figures 1-2.

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 was analysed for elemental composition by X ray fluorescence spectroscopy. Results are presented in Table 2.

**Table 1 Ash content of samples.**

| Sample coding | Ash content (w/w%) |
|---|---|
| 23197-1 | 39.5 |
| 23197-2 | 21.6 |

**Table 2 Elemental composition of 23197-1**

| Element Oxide wt.% | 23197-1 |
|---|---|
| $Na_2O$ | 0.45 |
| $MgO$ | 79.26 |
| $Al_2O_3$ | 0.39 |
| $SiO_2$ | 4.87 |
| $P_2O_5$ | 0.12 |
| $SO_3$ | 0.26 |
| $K_2O$ | 0.04 |
| $CaO$ | 8.66 |
| $TiO_2$ | 2.24 |
| $V_2O_5$ | 0.01 |
| $Cr_2O_3$ | <0.01 |
| $Mn_3O_4$ | 0.04 |
| $Fe_2O_3$ | 0.55 |
| $NiO$ | <0.01 |
| $CuO$ | <0.01 |
| $ZnO$ | 0.01 |
| $SrO$ | <0.01 |
| $ZrO_2$ | <0.01 |
| $BaO$ | 0.09 |
| $HfO_2$ | <0.01 |
| $PbO$ | <0.01 |
| L.O.I. | ND |

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

### 3. CONCLUSIONS

The cladding sample #1 consisted of consisted of 45.3% magnesium hydroxide, 6.1% calcium carbonate, 4.8% other inert material and approximately 43.9% polyethylene/EVA copolymer.

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

The cladding sample#2 consisted of consisted of 21.6% inert material and approximately 78.4% polyethylene/EVA copolymer.

**The cladding sample #2, 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

17 October 2023

UNSW SYDNEY

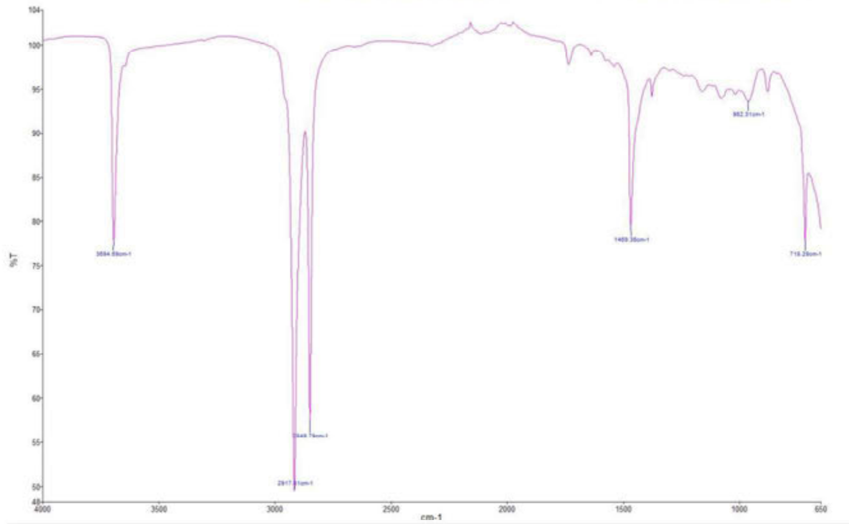


**Figure 1. FT-IR spectrum of Sample #1**





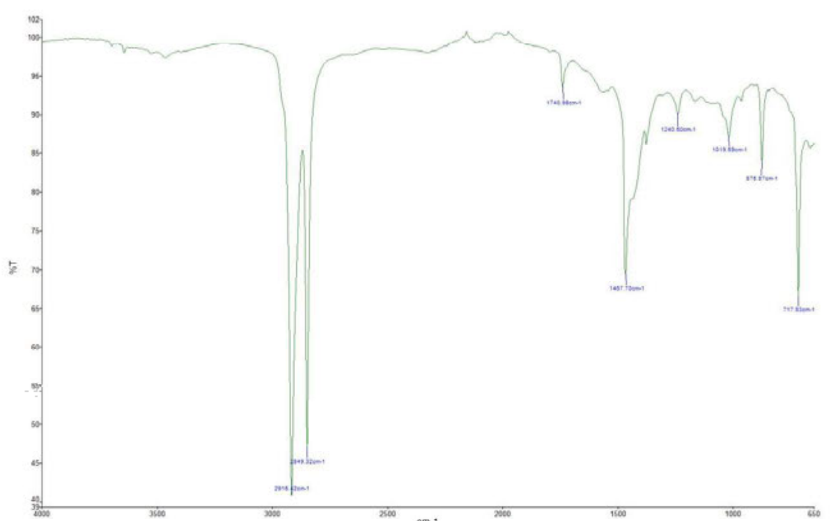


**Figure 2. FT-IR spectrum of sample #2**

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