Reaction to fire test report

Test standard: AS ISO 9705:2003 (R2016)

Test sponsor: TBA Textiles Pty Ltd

Product: TBA Firefly™ Intubatt® with TBA FIREFLY™ NON-COMBUSTIBLE Sarking-Non-BREATHABLE

Job number: RTF210386

Test date: 4 October 2021 Revision: R1.0

Warringtonfire: accredited for compliance with ISO/IEC 17025 – Testing

Accreditation No. 3277

Quality management

Revision	Date	Information about the report			
R1.0	26 October 2021	Description	Initial issue.		
			Prepared by	Reviewed by	Authorised by
		Name	Muntaqim Pereira	Tanmay Bhat	Tanmay Bhat
		Signature			

Executive summary

This report documents the findings of the reaction to fire test of a wall and ceiling lining performed on 4 October 2021 in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015.

Warringtonfire performed the test at the request of TBA Textiles Pty Ltd.

The test specimen consisted of TBA Firefly™ Intubatt® that was screw fixed on to the internal plasterboard lining of the fire test room, which was then clad over with TBA FIREFLY™ NON-COMBUSTIBLE Sarking-Non-BREATHABLE. A full description of the specimen is provided in Appendix A and Section 2.

A summary of the results is provided in Table 1 and Table 2.

Table 1 Classification for AS ISO 9705:2003 (R2016) and AS 5637.1:2015

Criteria	Results
Group number	1
$SMOGRA_{RC}$ (in $m^2/s^2 \times 1000$)	0.4

Table 2 Classification for AS ISO 9705:2003 (R2016) and C/VM2 – Verification Method: Framework for Fire Safety Design

Criteria	Results
Group number	1 – S
Average smoke production rate (0 to 20 minutes) (in m^2/s)	0.0

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1. Introduction

This report documents the findings of the reaction to fire test of a wall and ceiling lining performed on 4 October 2021 in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015.

Warringtonfire performed the test at the request of the test sponsor listed in Table 3.

Table 3 Test sponsor details

Test sponsor	Address
TBA Textiles Pty Ltd	Unit 12, 8 Leighton Place Hornsby NSW 2077 Australia

2. Test specimen

2.1 Schedule of components

Table 4 describes the test specimen and lists the schedule of components. These were provided by 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 4 Schedule of components

Item	Description	
Lining		
1.	Item name	TBA Firefly™ Intubatt®
	Material	Ablative coated basalt rock fibre slab (ablative coating, is spray grade TBA Firefly™ Intumastic factory applied to a nominal thickness of 1mm). The slabs were khaki in colour, while the ablative coating was white in colour.
	Measured uncut sheet size	600 mm x 1200 mm x 50 mm thick
	Weight measurements	Mass per unit area = 10.3 kg/m^2 Core density = 180 kg/m^3
	Jointing method	All joints and abutments were butt jointed and coated with TBA Firefly™ Intumastic Brush Grade.
Sealant/mastic		
2.	Item name	TBA Firefly™ Intumastic (Brush Grade)
	Description	Brush Grade Fire Rated Sealant, acrylic-base
	Density	1324 kg/m^3
3.	Item name	TBA Firefly™ Intumastic
	Description	Fire Rated Sealant, acrylic-base
	Density	1597 kg/m^3
Sarking		
4.	Item name	TBA FIREFLY™ NON-COMBUSTIBLE SARKING-Non-BREATHABLE
	Material	A layer of woven glass fabric with aluminium foil laminate on one side. The aluminium foil side was installed on the fire side.
	Size	1250 mm x 0.2 mm thick
	Mass per area	232 g/m^2
5.	Item name	TBA Firefly™ Reinforced TAPE AFRT 75mm x 50m x 0.14 mm thick

Item	Description	
	Material	Fire-retardant acrylic adhesive and two non-combustible layers, a Fortaglas reinforcement layer and an aluminium foil layer.
Fixing		
6.	Item name	14g x 100mm Hex Head, no seal timber screws – galvanised steel
	Size	106mm (100mm shaft section) x 5mm
7.	Item name	50 mm Pigtail screws – galvanised steel
	Size	Ø8 mm (shaft)/ Ø20 mm (head) x 50 mm
Installation method		
The panels (Item 1) were installed onto the ceiling section first, followed by the back then the side walls. All edges, joints and abutments of each panel (Item 1) were coated with TBA Firefly™ Intumastic (Brush Grade) sealant (Item 2) during installation. The full-size panels (Item 1) were secured into place using 6 x hex head screws (Item 6) at 50 mm in from each corner, then centrally along the length of the panels (Item 1) at 50 mm in from the edge. The half-size panels (Item 1) were secured into place using 4 x hex head screws (Item 6) at 50 mm in from each corner. Details can be found in drawings in Appendix A. Once all panels (Item 1) were installed, an additional 15 mm bead of (Item 3) was applied over all internal corners of the specimen and also along the bottom of the wall sections where they met the floor junction of the test room floor. The sarking (item 4) was then draped over the panels (item 1) as per illustrated in Appendix A, and fixed into place using item 7. The sarking-to-sarking joints were taped over using item 5. The wall sarkings were wrapped around the three walls, without a break at the corner joints. The TBA Firefly™ Intumastic (item 2 and 3) was left to cure for at least 72 hours. Panel sizing details can be found in Appendix A.		

2.2 Installation details

The test assembly consisted of a fire test room whose ceiling and three walls were lined with the sample material being tested, leaving the wall with the doorway opening unlined. The fire test room had studwork walls and ceiling lined with particleboard and two layers of 16 mm thick fire-grade plasterboard on the internal side. When unlined with the sample material, the internal dimensions of the fire test room were 3600 mm long × 2400 mm wide × 2400 mm high. The short wall opposite the ignition source had a centrally located doorway opening which was 800 mm wide × 2000 mm high.

Table 5 lists the installation details for the test specimen.

Table 5 Installation details

Item	Detail
Material delivery date	25 August 2021
Start date of construction	30 September 2021
Completion date of construction	4 October 2021
Room lining installed by	Warringtonfire

3. Test procedure

Table 6 details the test procedure for this reaction to fire test.

Table 6 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of AS ISO 9705:2003 (R2016) to determine the group number that may be assigned to the material using the classification schemes given in AS 5637.1:2015 and C/VM2 – Verification Method: Framework for Fire Safety Design.	
Variations	Smoke obscuration measurements were made using a helium-neon laser smoke photometer, as outlined in annex H of ISO 9705-1:2016.	
Pre-test conditioning	The panels were not subjected to any conditioning as they were considered to be non-hygroscopic. The system was subjected to ambient laboratory temperatures and conditions between construction and testing.	
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.	
Ambient laboratory temperature	Start of the test	24 °C
	Minimum temperature	23 °C
	Maximum temperature	24 °C
Initial ambient temperature of the fire test room	20 °C	
Initial horizontal wind speed	0.0 - 0.1 m/s (measured at a horizontal distance of 1000mm away from the door opening before the test)	
Test duration	1200 seconds at which the system failed to achieve a heat release rate of 1 MW.	
Instrumentation and equipment	The instrumentation was provided in accordance with AS ISO 9705:2003 (R2016) as follows: • The fire test room had galvanised studwork walls on three sides and ceiling, where each was lined with two layers of 16 mm fire-grade plasterboard supported by 18 mm thick particleboard on the external side. The floor was 18 mm thick cement sheeting. Without the specimen lining, the room had internal dimensions of 3600 mm long × 2400 mm wide × 2400 mm high with a doorway 800 mm wide × 2000 mm high centrally located in one of the shorter walls. • The ignition source was a propane gas fuelled box burner, with specifications in accordance with those given in Annex A of AS ISO 9705:2003 (R2016). The burner was placed on the floor in the corner of the room, opposite the doorway, so that two of the side walls of the burner were as close as possible to the specimen material. The gas flow during the test was controlled to provide an amount of gas equivalent to 100 kW of power during the first ten minutes of heat exposure and 300 kW of power during the second ten minutes of heat exposure. • The heat-flux emanating from the fire generated in the room was measured by a Schmidt-Boelter type heat-flux gauge, placed on the floor in the middle of the room. • The products of combustion were collected in an exhaust hood next to the doorway and outside the room. The hood was connected to an exhaust duct 400 mm in diameter, which had instruments inside to measure the conditions and properties of the combustion products during the test.	

Item	Detail
	• The volume flow rate was determined using a bidirectional pressure probe attached to a differential pressure transducer together with Type K MIMS thermocouple positioned near the probe. • Smoke obscuration measurements were made using a pair of aligned lenses with a halogen lamp placed at the focal point of one lens and a photo-detector placed at the opposing focal length of an identical lens on the opposite side of the duct. The amount of light obscuration was then determined by comparing the output voltage from the photo-detector before the ignition source was lit to the output voltage of the photo-detector during the test. The temperature of the exhaust stream near the light beam was measured using a Type K MIMS thermocouple. • An exhaust sampling probe sampled the combustion products which were then analysed by a Servomex 4100 gas purity analyser. The oxygen concentration during the test was determined by paramagnetic oxygen analyser, and the carbon monoxide and carbon dioxide concentrations were determined using infrared sensor equipment, also within the Servomex 4100 gas purity analyser. • The horizontal wind speed was measured by a Testo 425 anemometer at 1000 mm forward from the centre line of the doorway.
System performance	A calibration test was carried out before testing the product. The gas burner was placed centrally and 1 m below the exhaust hood by subjecting it to a stepwise change in heat release shown in Table 7, followed by a further 2 minutes. After that time the test was stopped. Data from instruments was collected and analysed every 3 seconds. At steady state conditions, the difference between the mean rate of heat release over 1 minute calculated from the measured oxygen consumption and that calculated from the metered gas output did not exceed ± 5% for each level of heat output – and therefore complied with the requirements of Section 10.1 of AS ISO 9705:2003 (R2016). The system response time was determined by calculating the average time taken for the measured rate of heat release to be within 10% of the final measured rate of heat release. System response data is listed in Table 7 and the system response has been calculated to be 9 s, which is within the 20 s limit required to comply with AS ISO 9705:2003 (R2016).

Table 7 Response time measurements during the step calibration process

Time interval (s)	Target heat output (kW)	Heat output (kW)	Heat measured (kW)	Time (s)	Variance (%)	Response time (s)
0 to 120	0	0	0	0	0	0
120 to 420	100	100	105	129	5.0	9
420 to 720	300	300	287	429	-4.3	9
720 to 1020	100	100	105	729	4.8	9

4. Test measurements, performance criteria and test results

4.1 Test measurements

The measurements taken for the heat flux, volume flow rate, heat release rate and light obscuration – along with the production rates of carbon monoxide and carbon dioxide – are included in Appendix C.

Table 10 in Appendix B includes observations of any significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS ISO 9705:2003 (R2016).

Photographs of the specimen are included in Appendix D.

4.2 Performance criteria and test results

Australia

AS 5637.1:2015 allows the classification of materials by group number – this indicates the amount of time taken for the material being tested to reach flashover under AS ISO 9705:2003 (R2016) test conditions. AS 5637.1:2015 defines flashover to be a heat release rate of 1 MW, so materials are classified, in accordance with AS 5637.1:2015, by the time taken for the heat release rate to reach 1 MW.

The group classifications are:

- Group 1 – Materials classified as Group 1 do not reach flashover after ten minutes exposure to a heat source delivering 100 kW immediately followed by a further ten minutes exposure to 300 kW.
- Group 2 – Materials classified as Group 2 reach flashover after ten minutes of exposure to a 100 kW heat source.
- Group 3 – Materials classified as Group 3 reach flashover after two minutes, but before ten minutes of exposure to a 100 kW heat source.
- Group 4 – Materials classified as Group 4 reach flashover before two minutes of exposure to a 100 kW heat source.

The material subjected to this AS ISO 9705:2003 (R2016) test did not achieve a heat release rate of 1 MW after 600 seconds exposure to a 100 kW heat source immediately followed by a further 600 seconds exposure to a 300 kW heat source Therefore, the system has achieved a classification of Group 1.

The maximum average rate of smoke growth for this material occurred at 168 seconds into the test and was found to be 0.1 m^2/s. Therefore, the $SMOGRA_{RC}$ (in $m^2/s^2 \times 1000$) value for the material is 0.4.

Table 8 Classification for AS ISO 9705:2003 (R2016) and AS 5637.1:2015

Criteria	Results
Group number	1
$SMOGRA_{RC}$ (in $m^2/s^2 \times 1000$)	0.4

New Zealand

AS ISO 9705:2003 (R2016) states that it is identical to and has been reproduced from ISO 9705:1993, so the data obtained from the test referenced in this report may be used where data obtained from ISO 9705:1993 is required.

The New Zealand Ministry of Business, Innovation and Employment's verification method – C/VM2 – Verification Method: Framework for Fire Safety Design – provides guidelines on establishing group numbers for lining materials. The scheme allows the classification of materials by group number, which indicates the amount of time taken for the material being tested to reach flashover under ISO 9705:1993 test conditions. It defines flashover to be a heat release rate of 1 MW so materials are classified – in accordance with appendix A of C/VM2 – by the time taken for the heat release rate as measured during the ISO 9705:1993 test – to reach 1 MW.

The group classifications for New Zealand are:

- Group 1 – Materials classified as Group 1 do not reach flashover after ten minutes exposure to a heat source delivering 100 kW immediately followed by a further ten minutes exposure to 300 kW.
- Group 1 – S – Materials classified as Group 1-S do not reach flashover after ten minutes exposure to a heat source delivering 100 kW immediately followed by a further ten minutes exposure to 300 kW. In addition, the average smoke production rate for the period between 0 and 20 minutes of the test period does not exceed 5.0 m2/s.
- Group 2 – Materials classified as Group 2 reach flashover after ten minutes of exposure to a 100 kW heat source.
- Group 2 – S – Materials classified as Group 2-S do not reach flashover after ten minutes exposure to a heat source delivering 100 kW. In addition, the average smoke production rate for the period between 0 and 10 minutes of the test period does not exceed 5.0 m2s-1.
- Group 3 – Materials classified as Group 3 reach flashover after two minutes, but before ten minutes of exposure to a 100 kW heat source.
- Group 4 – Materials classified as Group 4 reach flashover before two minutes of exposure to a 100 kW heat source.

The material subjected to this AS ISO 9705:2003 (R2016) test did not achieve a heat release rate of 1 MW after 600 seconds exposure to a 100 kW heat source immediately followed by a further 600 seconds exposure to a 300 kW heat source. Between 0 and 20 minutes of the test period, the average smoke production rate was 0.0 m^2/s. Therefore, the C/VM2 – Verification Method: Framework for Fire Safety Design – classifies this material as Group 1 – S.

Table 9 Classification for AS ISO 9705:2003 (R2016) and C/VM2 – Verification Method: Framework for Fire Safety Design

Criteria	Results
Group number	1 – S
Average smoke production rate (0 to 20 minutes) (in m^2/s)	0.0

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 AS ISO 9705:2003 (R2016). 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 were prepared by Warringtonfire and reviewed by the test sponsor. All measurements – unless indicated – are in millimetres.

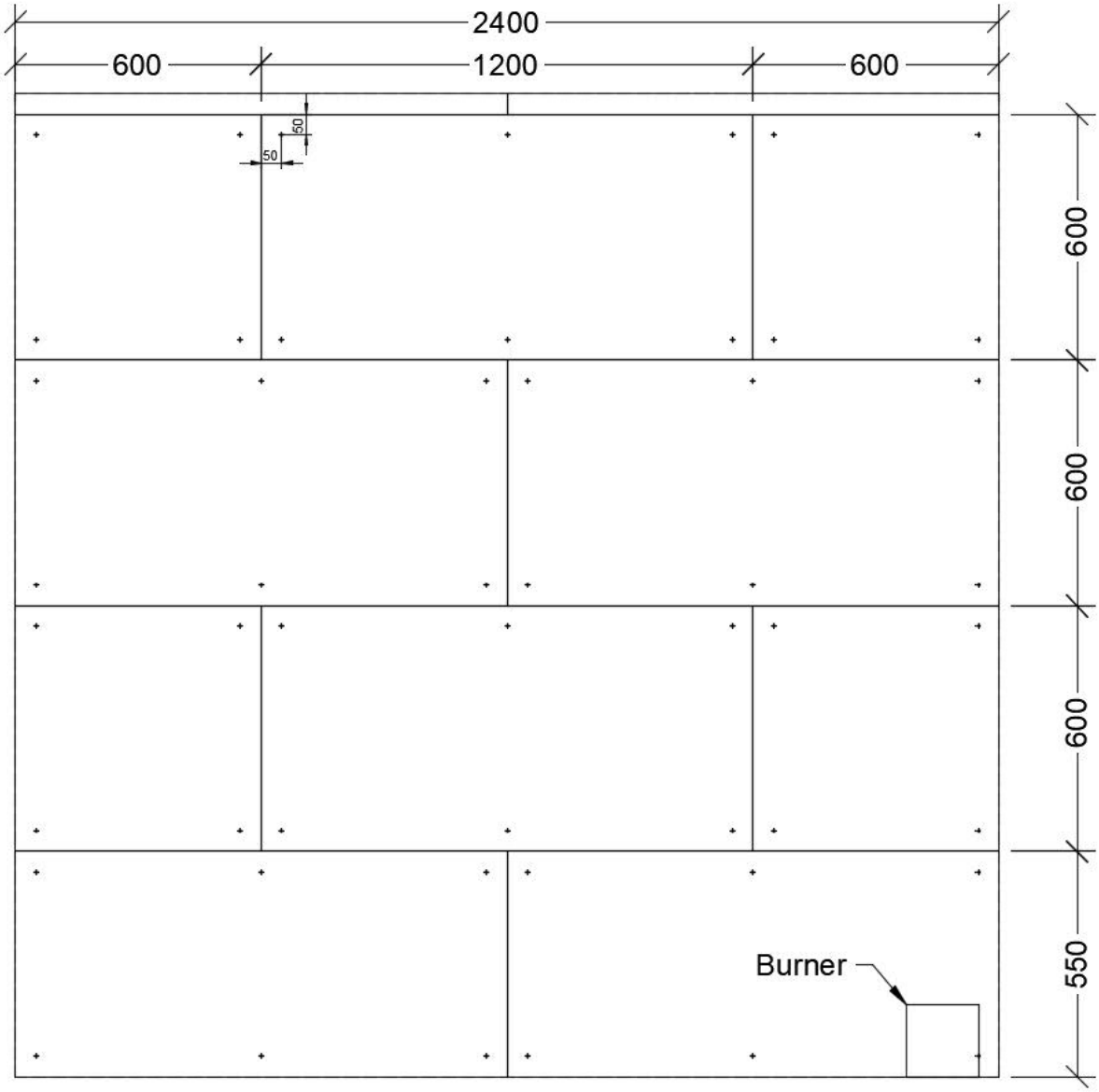

Figure 1 Back wall panel arrangement

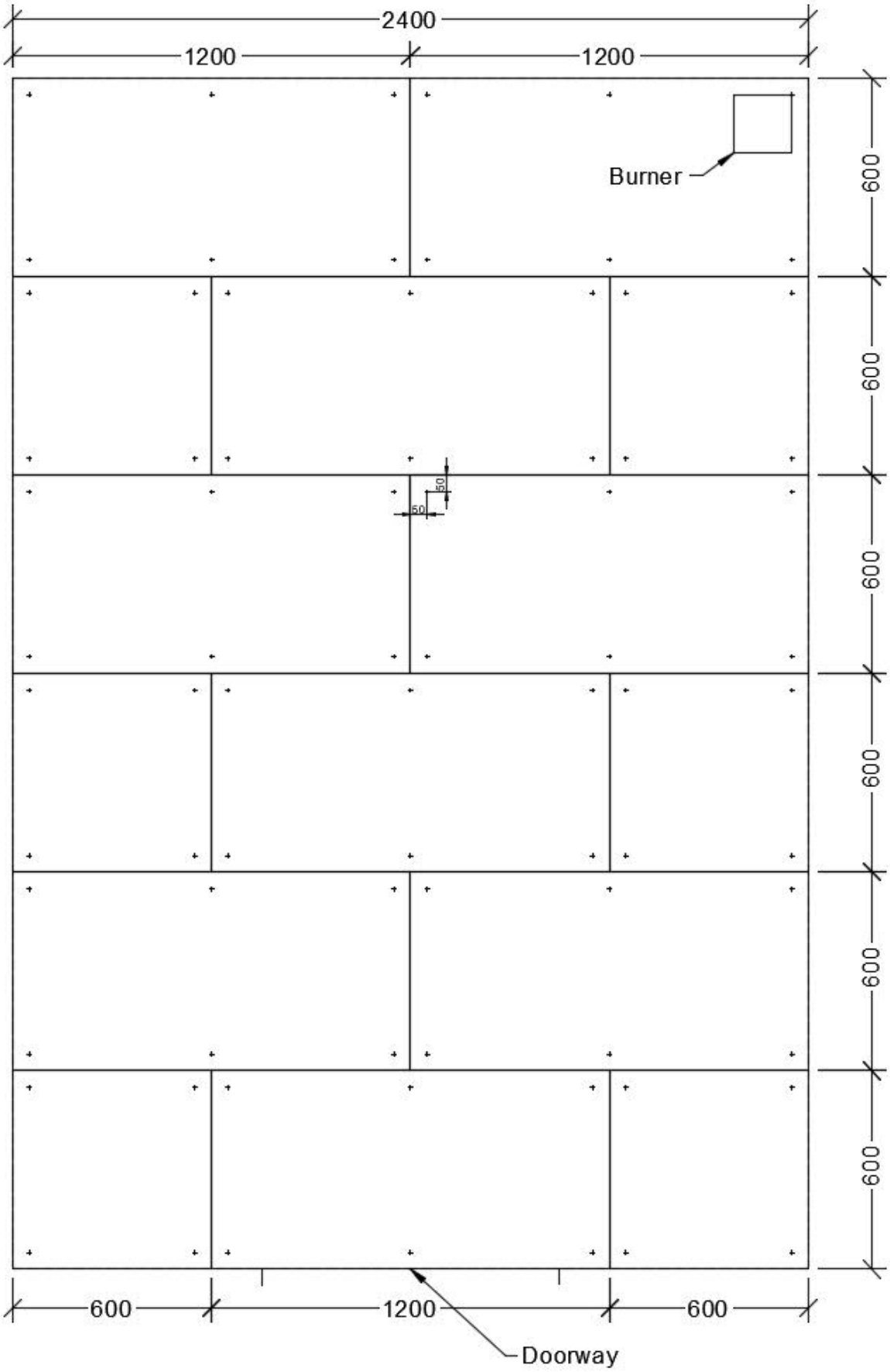

Figure 2 Ceiling wall panel arrangement

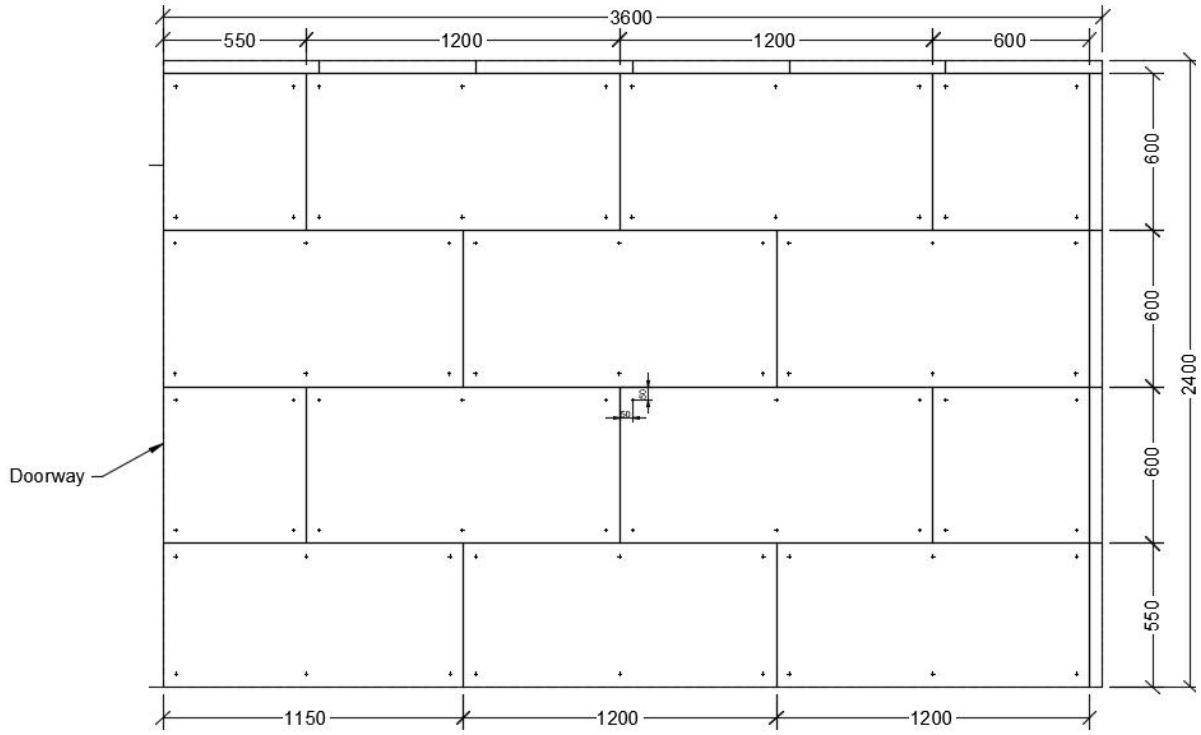

Figure 3 **Left wall panel arrangement**

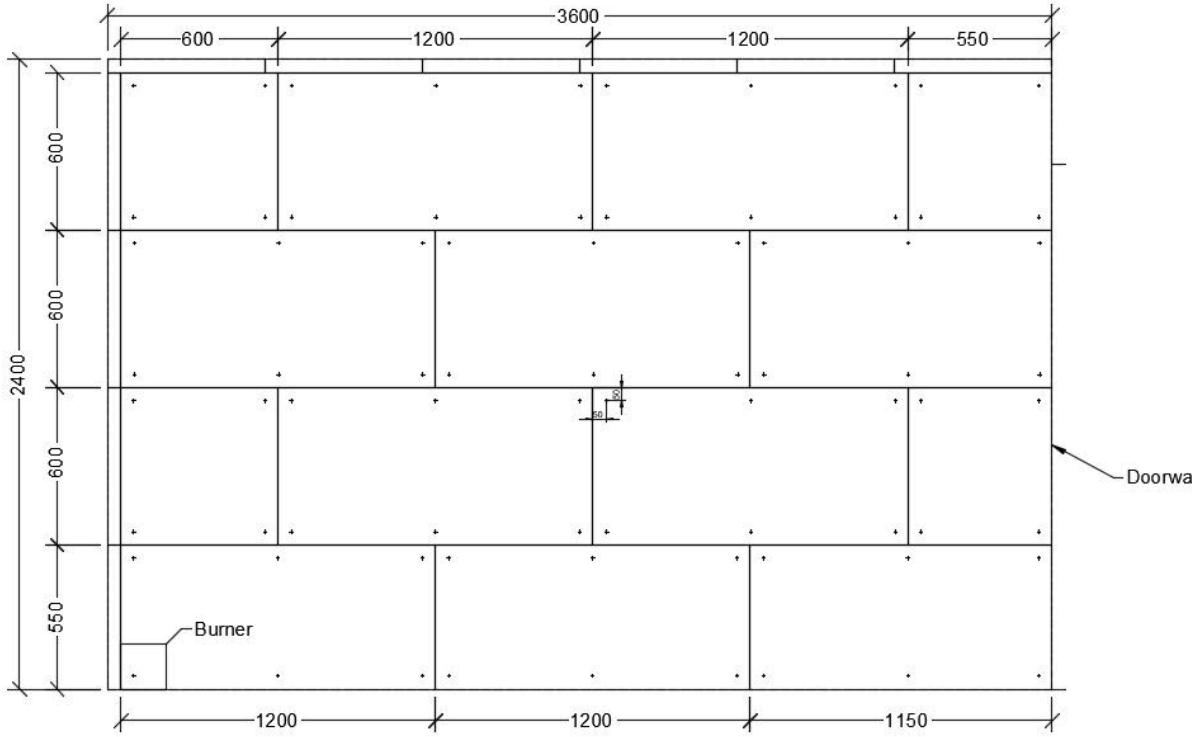

Figure 4 **Right wall panel arrangement**

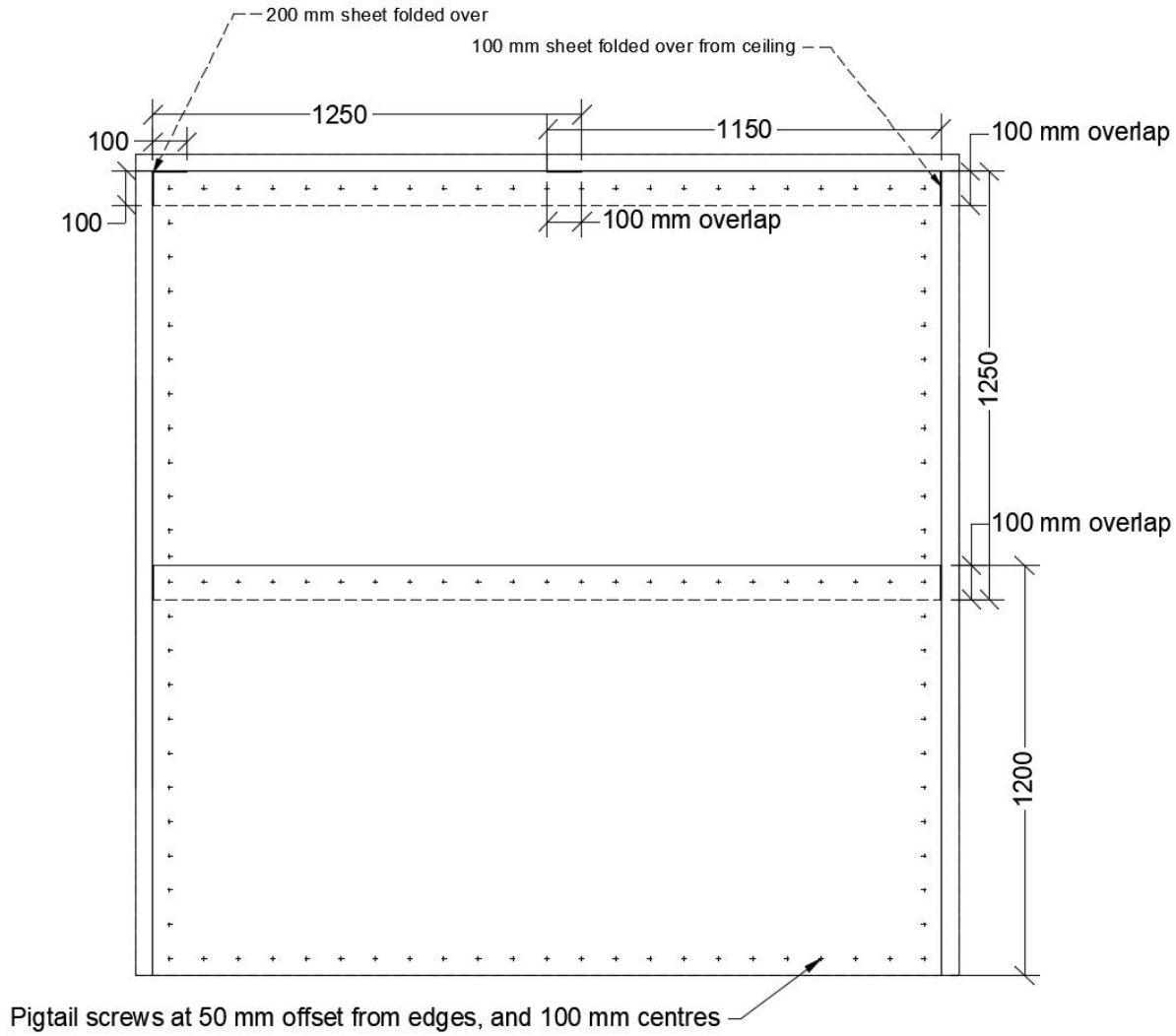

Figure 5 Back wall – Sarking installation detail

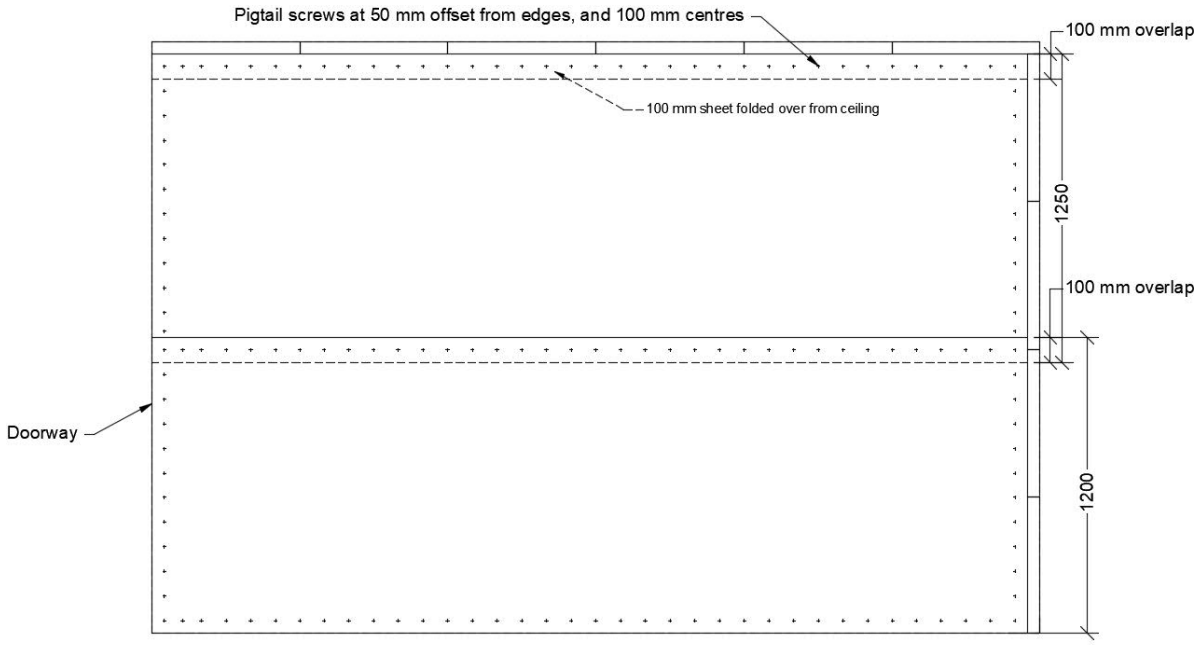

Figure 6 Side walls – Sarking installation detail

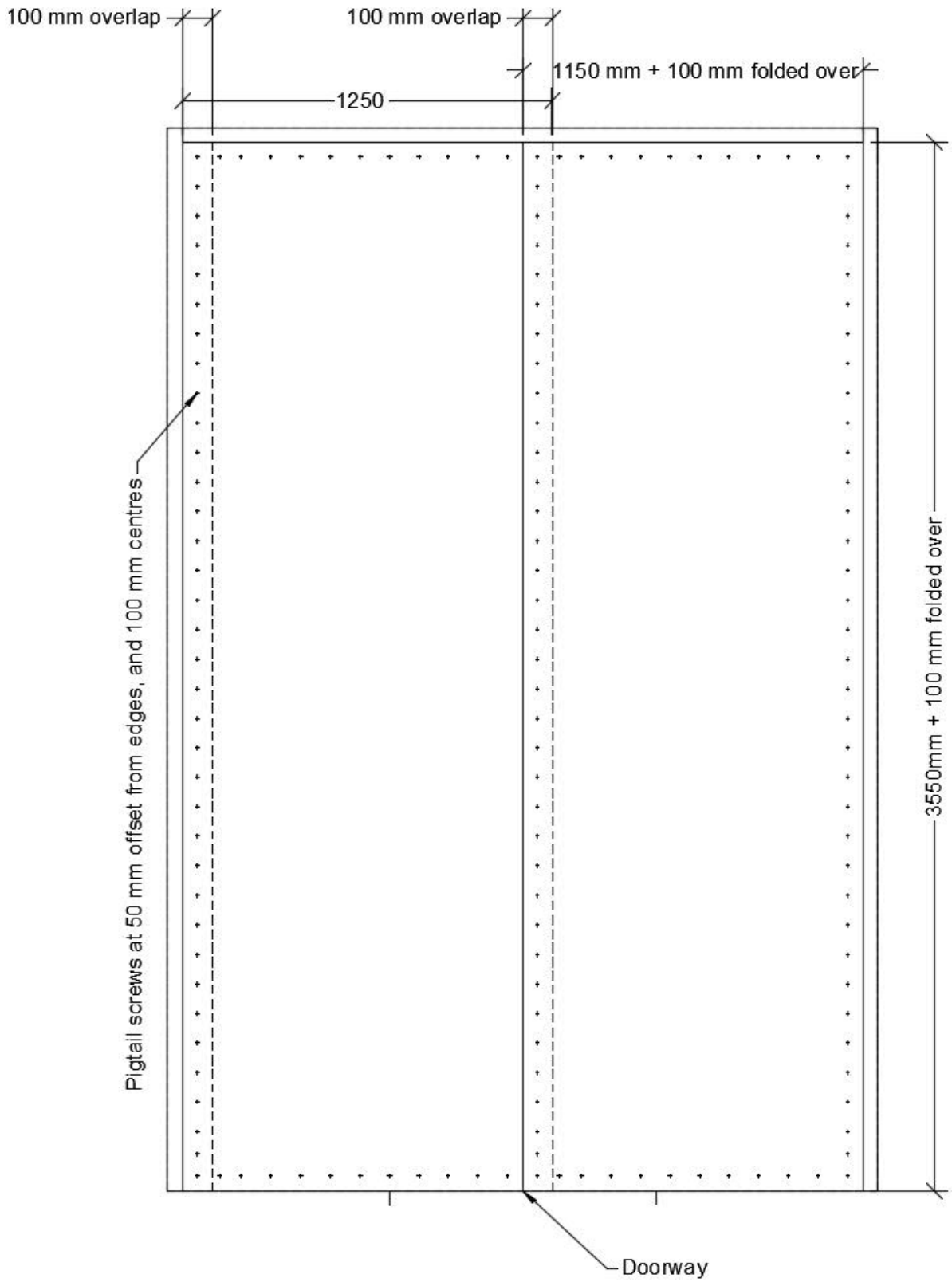

Figure 7 **Ceiling (top view) – Sarking installation detail**

Appendix B Test observations

Table 10 shows the observations of any significant behaviour of the specimen during the test.

Table 10 Test observations

Time		Observation
Min	Sec	
-2	00	The reaction to fire test was started.
0	00	With an output set to 100 kW, the burner was ignited.
1	00	Independent flaming was observed at the burner corner.
1	13	The sarking at the burner corner started to discolour.
1	45	Some melting was observed at the burner corner.
2	01	Some debris started to dislodge from the sarking at the burner corner and floated inside the room.
8	12	The foil face of the sarking at the burner corner started to delaminate.
9	02	Independent flaming was observed at the ceiling join above the burner.
10	00	The burner output was increased to 300 kW.
10	11	The flames started to spread across the ceiling. It did not spread any further throughout the test.
10	21	More debris dislodged from the sarking, and floated inside the room.
10	35	A thin layer of smoke had build up inside the room, and started to escape through the doorway.
13	02	The foil facing of the ceiling sarking above the burner corner started to delaminate.
20	00	The reaction to fire test was ended.
Post test observations		
20	03	Some flaming was still observed at multiple locations.
21	04	All flaming had ceased.

Appendix C Test data

C.1 Heat flux

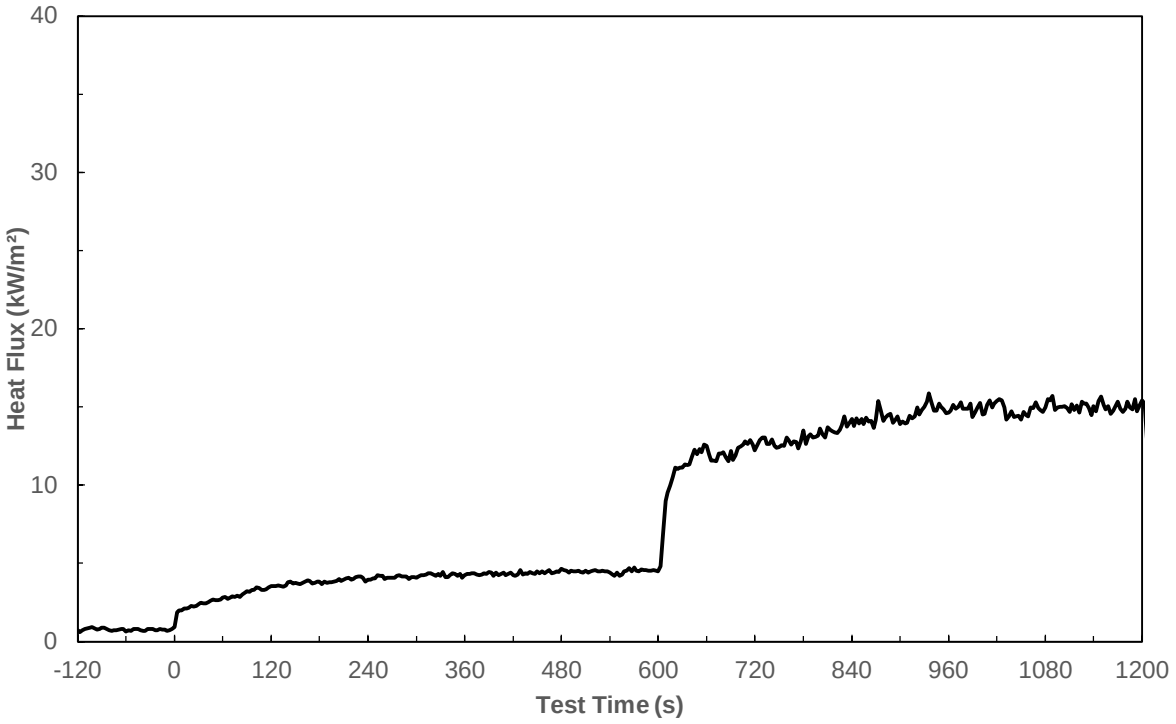

Figure 8 Heat flux vs time

C.2 Volume flow

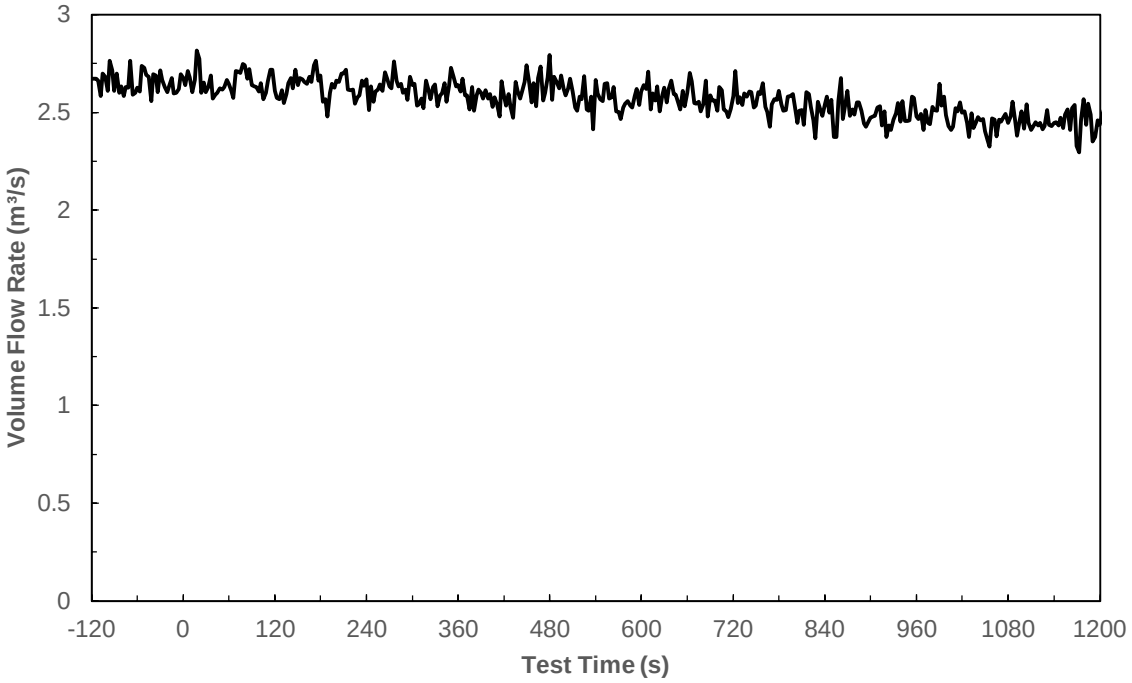

Figure 9 Volume flow rate in duct vs time

C.3 Heat release rate

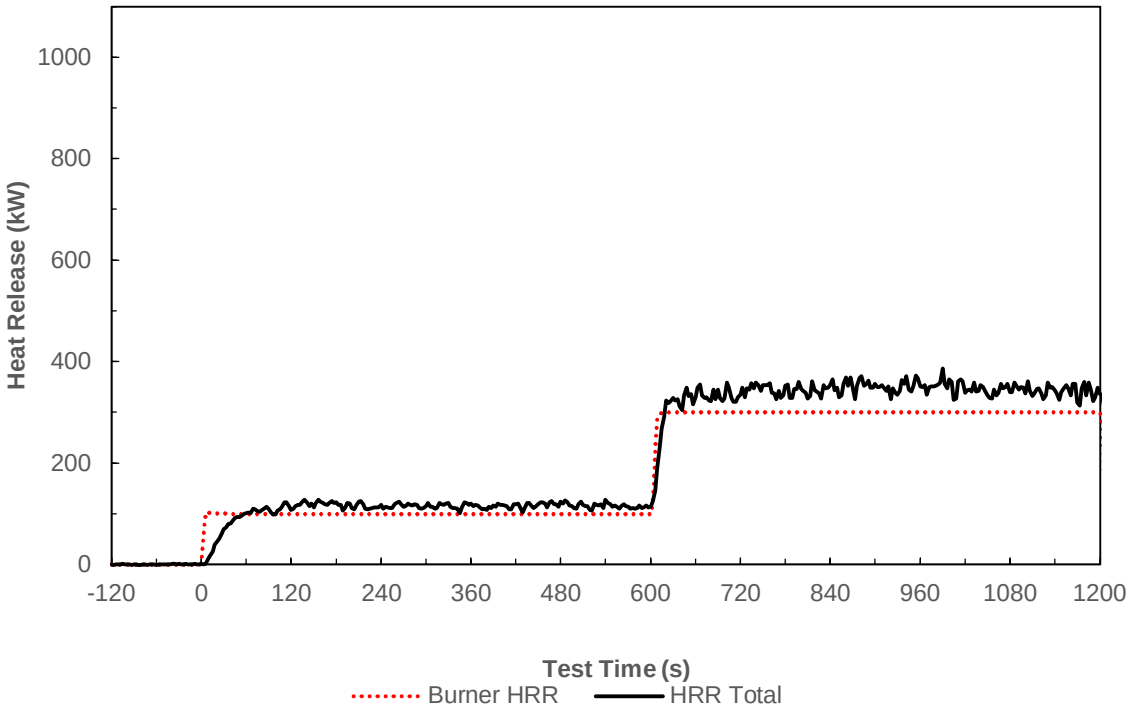

Figure 10 Heat release rate (HRR) of specimen and burner vs time

C.4 Carbon monoxide production

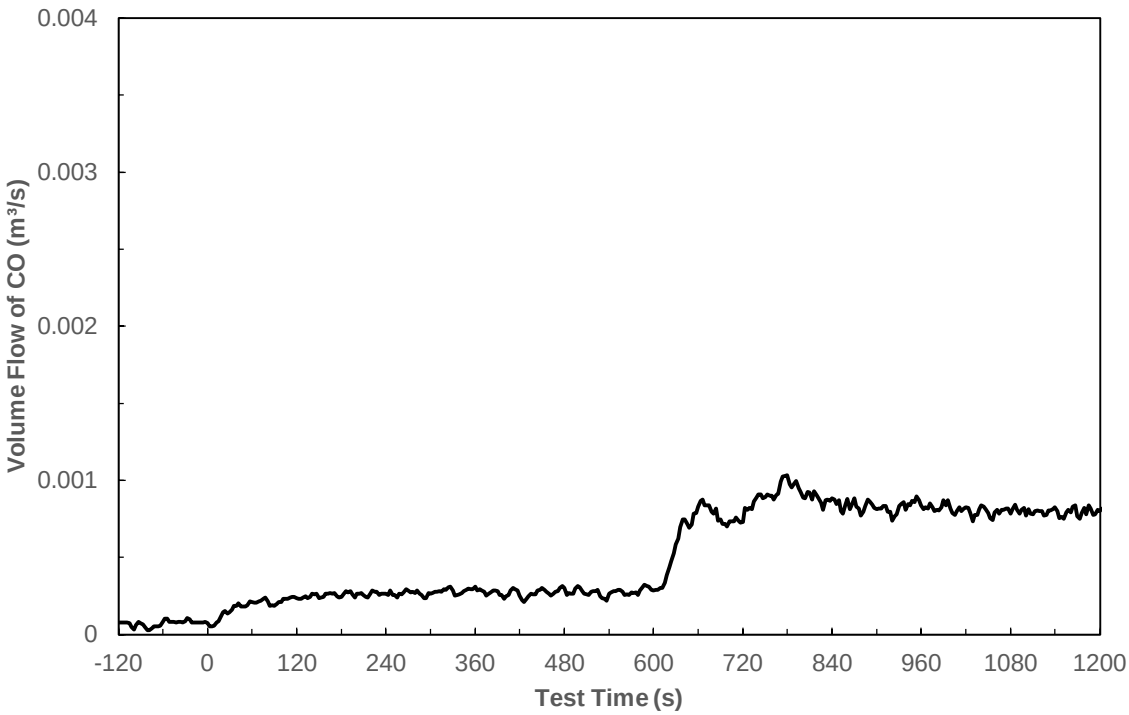

Figure 11 Production of carbon monoxide vs time, at reference temperature and pressure

C.5 Carbon dioxide production

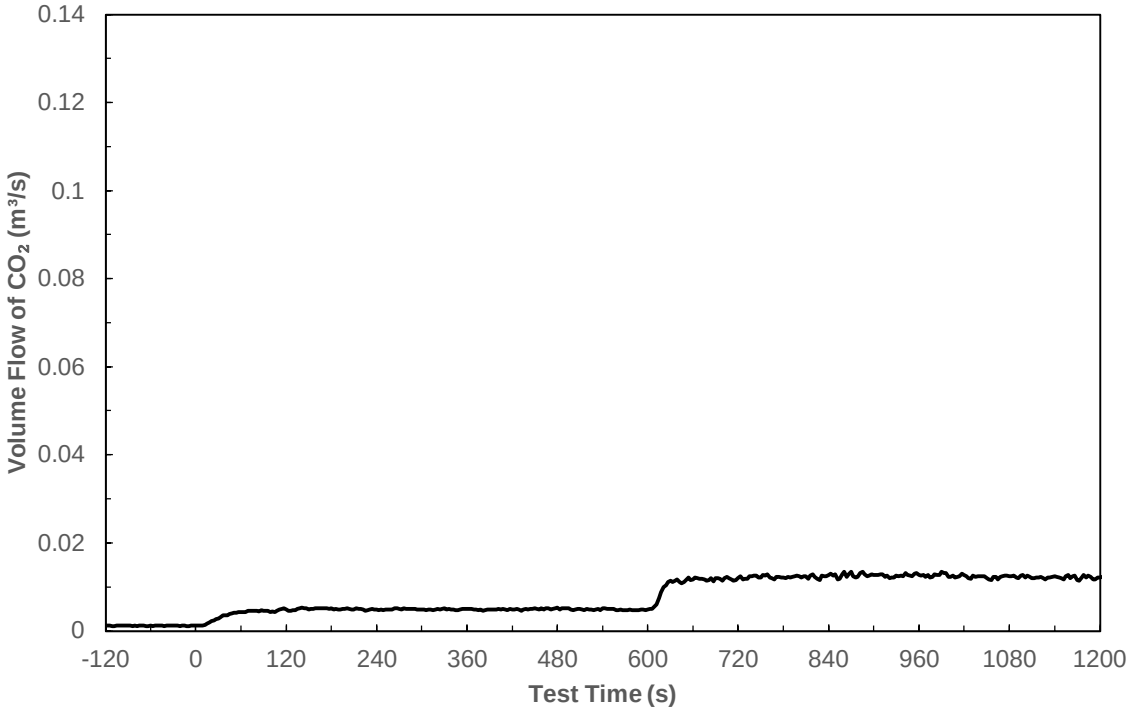

Figure 12 Production of carbon dioxide vs time, at reference temperature and pressure

C.6 Smoke production rate

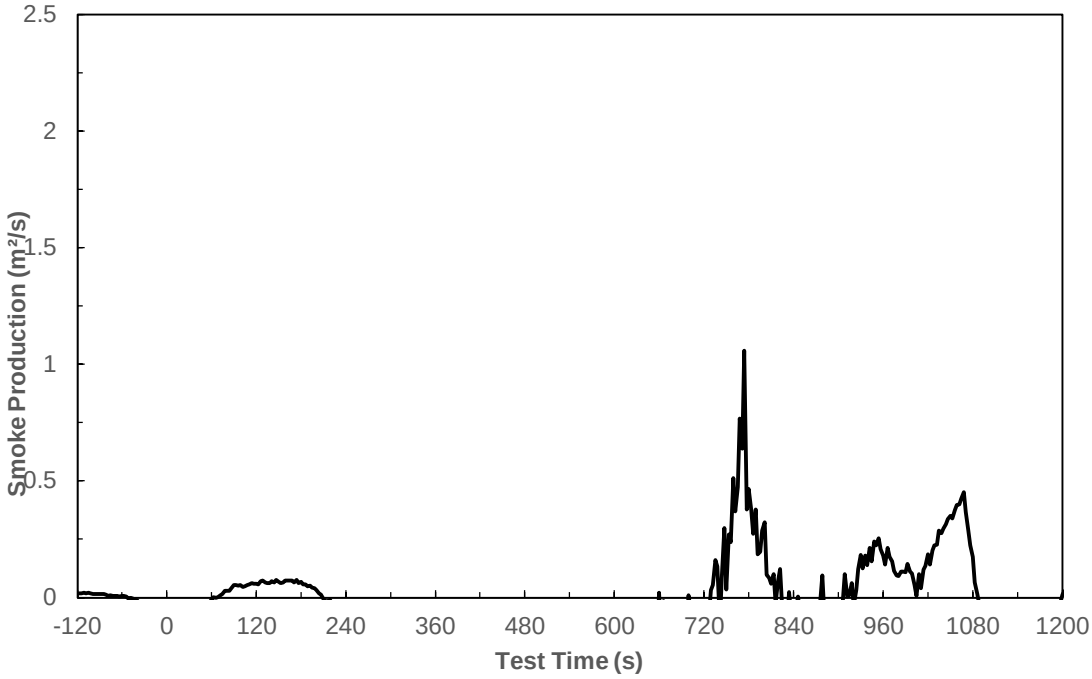

Figure 13 Production of light obscuring smoke vs time, at reference temperature and pressure

C.7 Temperature at different heights

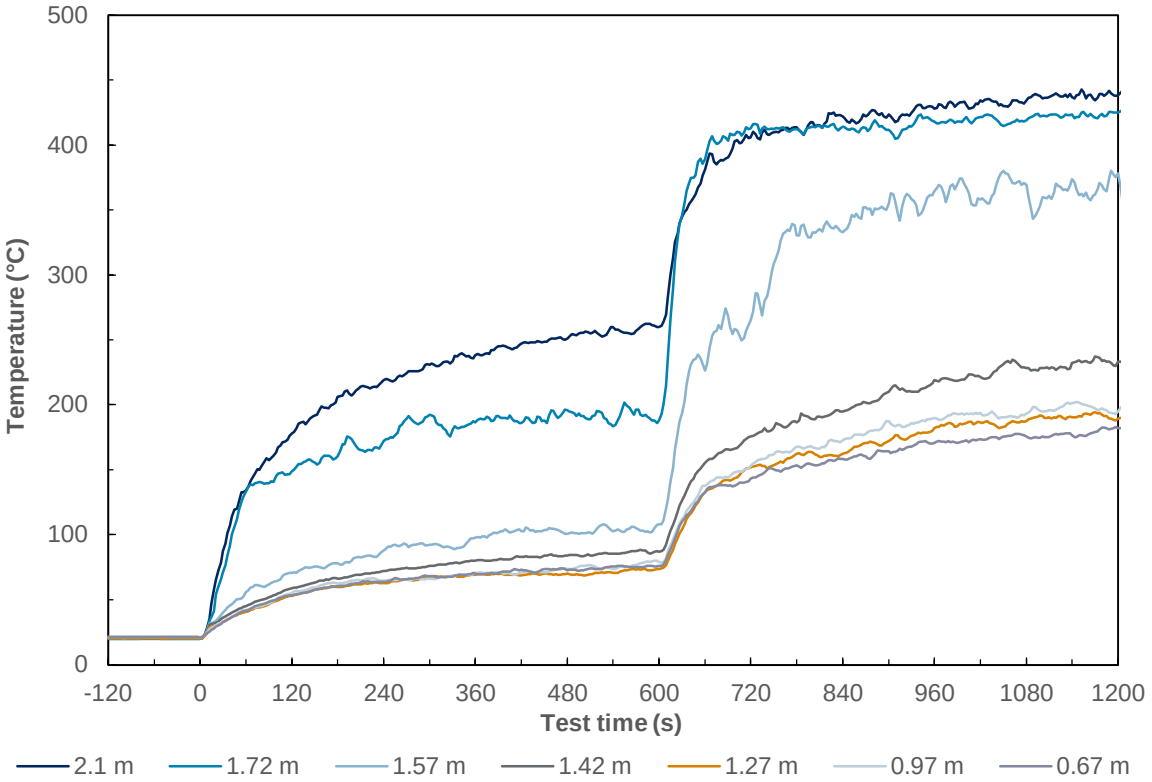

Figure 14 Temperature at the measured heights (from the floor) in the corner opposite to the burner vs time

Appendix D Photographs

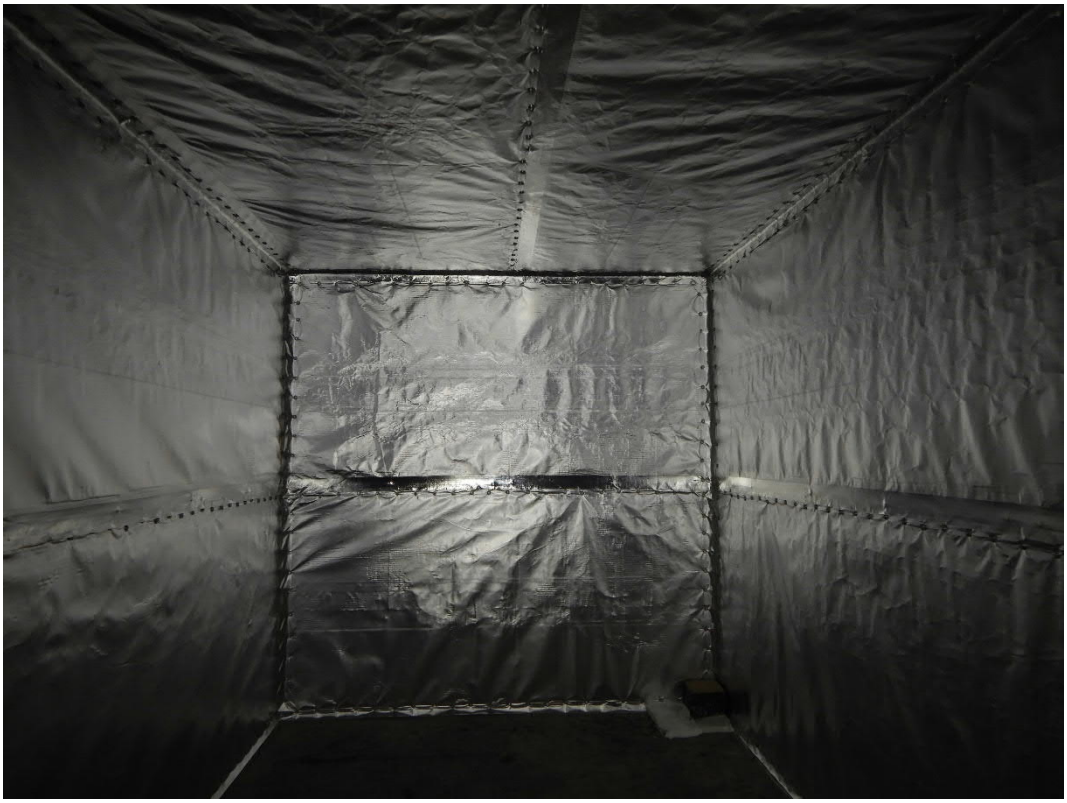

Figure 15 The specimen before the reaction to fire test

Figure 16 The specimen 4 seconds after burner ignition with the burner output of 100 kW

Figure 17 The specimen 2 minutes 18 seconds after burner ignition with the burner output of 100 kW

Figure 18 The specimen 4 minutes 13 seconds after burner ignition with the burner output of 100 kW

Figure 19 The specimen 6 minutes 47 seconds after burner ignition with the burner output of 100 kW

Figure 20 The specimen 8 minutes 15 seconds after burner ignition with the burner output of 100 kW

Figure 21 The specimen 17 seconds after burner output was increased to 300 kW

Figure 22 The specimen 2 minutes 16 seconds after burner output was increased to 300 kW

Figure 23 The specimen 4 minutes 29 seconds after burner output was increased to 300 kW

Figure 24 The specimen 6 minutes 40 seconds after burner output was increased to 300 kW

Figure 25 The specimen 8 minutes 24 seconds after burner output was increased to 300 kW

Figure 26 The specimen 9 minutes 38 seconds after burner output was increased to 300 kW

Figure 27 The specimen after the reaction to fire test

warringtonfire

Proud to be part of element

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