Reaction-to-fire test report

Wall and ceiling lining tested in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015

Test sponsor: Alpine MDF Industries Pty Ltd

Product: 12 mm thick Alpine FR MDF – Fire Retardant Panels

Job number: RTF200031

Test date: 24 February 2020 Revision: R1.0

Amendment schedule

Version	Date	Information about the report			
R1.0	6 March 2020	Description	Initial issue.		
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Executive summary

This report documents the findings of the reaction-to-fire test of a wall and ceiling lining undertaken on 24 February 2020 in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015.

The tested system consisted of a fire test room where the ceiling and three walls were lined with 12 mm thick Alpine FR MDF – Fire Retardant Panels. A summary of the classifications achieved in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015 is provided in Table 1.

A summary of the classifications achieved in accordance with C/VM2 – Verification Method: Framework for Fire Safety Design is provided in Table 2.

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

Criteria	Results
Group number	2
$SMOGRA_{RC}$ (in $m^2/s^2 \times 1000$)	8.5

Table 2 Classification for C/VM2 – Verification Method: Framework for Fire Safety Design

Criteria	Results
Group number	2-S
Average smoke production rate (0 to 600 s) (in m^2/s)	0.25

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1. Introduction

This report documents the findings of the reaction-to-fire test of a wall and ceiling lining undertaken on 24 February 2020 in accordance with AS ISO 9705:2003 (R2016) and AS 5637.1:2015.

Warringtonfire Australia did the test at the request of Alpine MDF Industries Pty Ltd.

Table 3 Test sponsor details

Test sponsor	Address
Alpine MDF Industries Pty Ltd	99 Crosher Lane Wangaratta VIC - 3677 Australia.

2. Construction details

The tested system consisted of a fire test room where the ceiling and three walls were lined with 12 mm thick Alpine FR MDF – Fire Retardant Panels The fire test room had studwork walls and ceiling lined with 18 mm thick particleboards and two layers of 16 mm thick fire-grade plasterboards on the internal side. The wall with the doorway was lined with two layers of 25 mm thick kaowool insulation. Without the specimen lining, 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.

The fire test room was lined by 11 panels of various sizes as detailed in Table 4. Table 5 shows the installation method and orientation of the test specimen.

Table 4 Test assembly

Location	Quantity	Size (nominal)
Rear Wall	2	2388 mm × 1200 mm
Ceiling	3	2400 mm × 1200 mm
Right wall	2	2388 mm × 1200 mm
	1	2388 mm × 1188 mm
Left wall	2	2388 mm × 1200 mm
	1	2388 mm × 1188 mm

Table 5 Installation details

Item	Detail
Start date of construction	24 February 2020
Completion date of construction	24 February 2020
Room lining installed by	Warringtonfire Melbourne.

3. Schedule of components

Table 6 lists the schedule of components for the test specimen. These were provided by the test sponsor and surveyed by Warringtonfire Australia.

Table 6 Schedule of components

Item	Description	
Lining		
1.	Product name	FR treated MDF
	Product description	The panels are described by the test sponsor as FR treated medium density fibreboard (MDF) panels. No veneers were bonded to the panels.
	Measured Thickness	12 mm
	Colour	Pale brown
	Measured uncut sheet size	1218 mm × 2400 mm × 12 mm
	Measured density	797 kg/m^3
	Installation	The panels were fixed to the internal plasterboard linings using chipboard screws (item 2). The ceiling panels were installed first followed by the rear and side walls. Refer to drawings in Appendix A for fixing dimensions.
Fixings		
2.	Product name	8G × 60 mm Countersunk Rib Head Chipboard screws
	Details	Material: Hardened Carbon Steel Screw thread type: Coarse Screw point type: Needle point Screw head type: Countersunk Ribbed The screws were used to fix the panels (item 1) to the internal plasterboard walls and ceiling. Screw holes were pre-drilled.

4. Test procedure

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

Table 7 Test procedure

Item	Detail	
Statement of compliance	The test was performed in accordance with the requirements of 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 construction and installation of the test specimen was completed on 24 February 2020. Prior to construction, the samples were conditioned at 50% relative humidity and 23 °C until constant mass was achieved. The test specimen was subjected to normal laboratory temperatures and conditions between the completion of construction of the test specimen and the start of the test.	
Sampling / specimen selection	The laboratory was not involved in sampling or selecting the test specimen for reaction-to-fire test report.	
Ambient laboratory temperature	Start of the test	25 °C
	Minimum temperature	25 °C
	Maximum temperature	25 °C
Initial ambient temperature of the fire test room	25 °C	
Initial horizontal wind speed	0 – 0.2 m/s (measured at a horizontal distance of 1000 mm away from the door opening before the test)	
Test duration	924 seconds at which a heat release rate of 1 MW was recorded.	
Instrumentation and equipment	The instrumentation was provided in accordance with AS ISO 9705:2003 (R2016) as follows: • 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 100 kW of power during the first ten minutes of heat exposure followed by 300 kW for a further 10 minutes. • 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. • 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. • 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 Multiexact 4100 gas analyser.	

Item	Detail
	• The horizontal wind speed was measured using a Testo 425 anemometer at a horizontal distance of 1 m from the centre of the doorway.
System performance	A calibration test was carried out before testing the product. The gas burner was placed centrally 1 m below the exhaust hood by subjecting it to a stepwise change in heat release shown in Table 8. 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 (2016). 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 8.3 s, which is within the 20 s limit required to comply with AS ISO 9705:2003 (R2016).

Table 8 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	104	129	4.1	9
420 to 720	300	299	286	432	-4.5	12
720 to 1020	100	100	104	732	3.5	12

5. Test measurements, performance criteria and test results

5.1 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 11 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 C.

5.2 Performance criteria and test results

Australia

AS 5637.1:2015 allows the classification of materials by group number, which is an indication on 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.

The group classifications are:

- Group 1 – Material that does not reach flashover when exposed to 100 kW for 10 minutes followed by exposure to 300 kW for a further 10 minutes.
- Group 2 – Material that reaches flashover following exposure to 300 kW within 10 minutes after not reaching flashover having first been exposed to 100 kW for 10 minutes.
- Group 3 – Material that reaches flashover between 2 – 10 minutes when exposed to 100 kW.
- Group 4 – Material that reaches flashover within 2 minutes when exposed to 100 kW.

The material subjected to this AS ISO 9705:2003 (R2016) test achieved a heat release rate of 1 MW after 600 seconds of exposure to 100 kW followed by 324 seconds exposure to a 300 kW heat source. The maximum value of the 60 s running average was recorded to be 5.8 m^2/s at 681 s.

Table 9 Classification for AS ISO 9705:2003 (R2016) and AS 5637.1:2015

Criteria	Results
Group number	2
$SMOGRA_{RC}$ (in $m^2/s^2 \times 1000$)	8.5

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: Material that does not reach flashover when exposed to 100 kW for 10 minutes followed by exposure to 300 kW for a further 10 minutes.
- 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 m^2/s.
- Group 2: Material that reaches flashover following exposure to 300 kW within 10 minutes after not reaching flashover having first been exposed to 100 kW for 10 minutes.
- 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 m^2/s.
- 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 system subjected to this AS ISO 9705:2003 (R2016) test achieved a heat release rate of 1 MW after 600 of exposure to 100 KW followed by 324 seconds of exposure to a 300 kW heat source.

Table 10 Classification for AS ISO 9705:2003 (R2016) and C/VM2 – Verification Method: Framework for Fire Safety Design

Criteria	Results
Group number	2-S
Average smoke production rate (0 to 600 s) (in m^2/s)	0.25

6. Application of test results

6.1 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.

6.2 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 Australia Pty Ltd or another registered testing authority.

6.3 Uncertainty of measurements

This report has been prepared based on information provided by others. Warringtonfire has not verified the accuracy and/or completeness of that information and will not be responsible for any errors or omissions that may be incorporated into this report as a result.

It is not possible to provide a stated degree of accuracy of the result, because of difficulty in quantifying the uncertainty of measurements obtained from a reaction-to-fire test.

Appendix A Drawings of test assembly

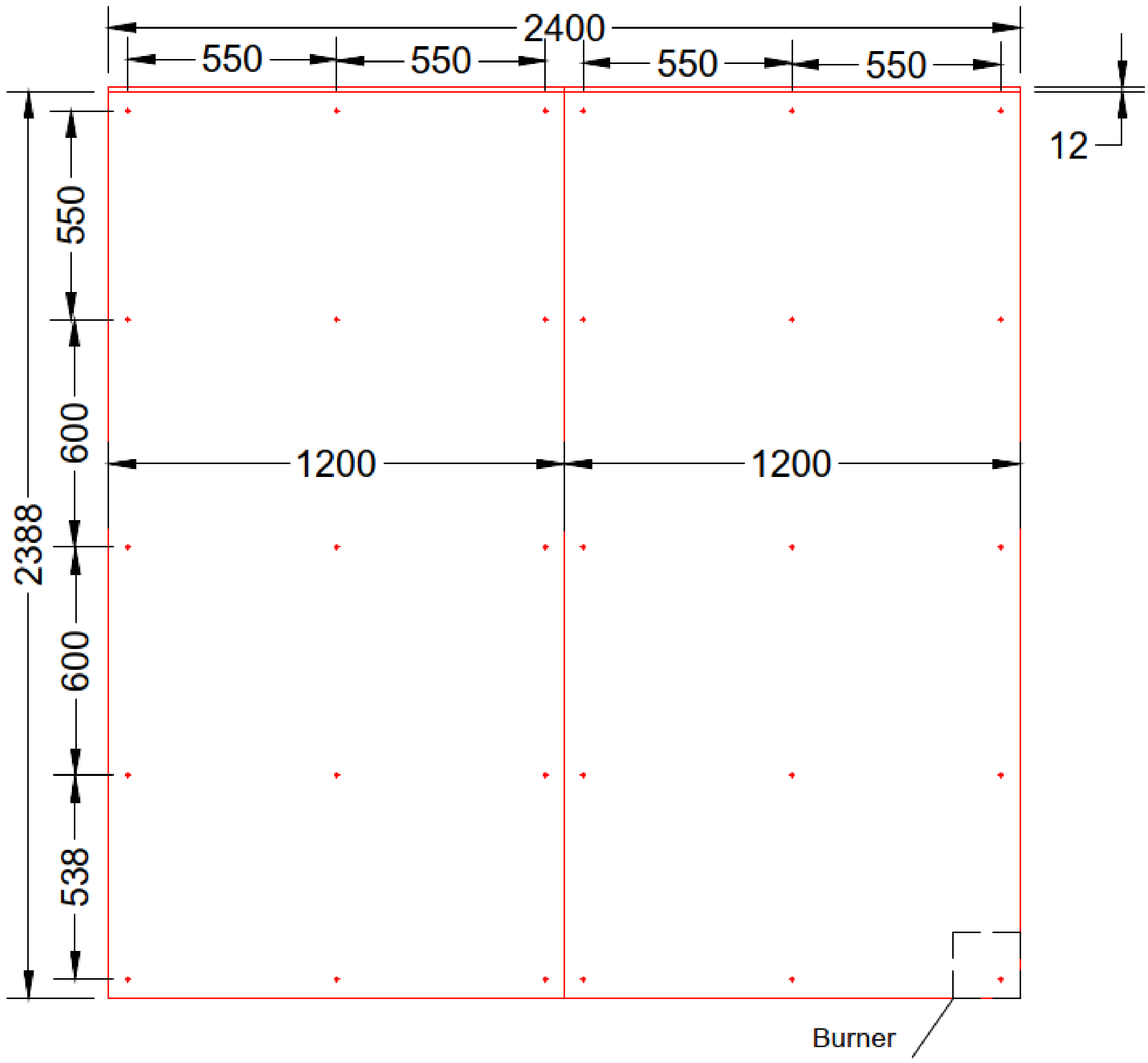

Figure 1 Rear wall (dimensions in mm)

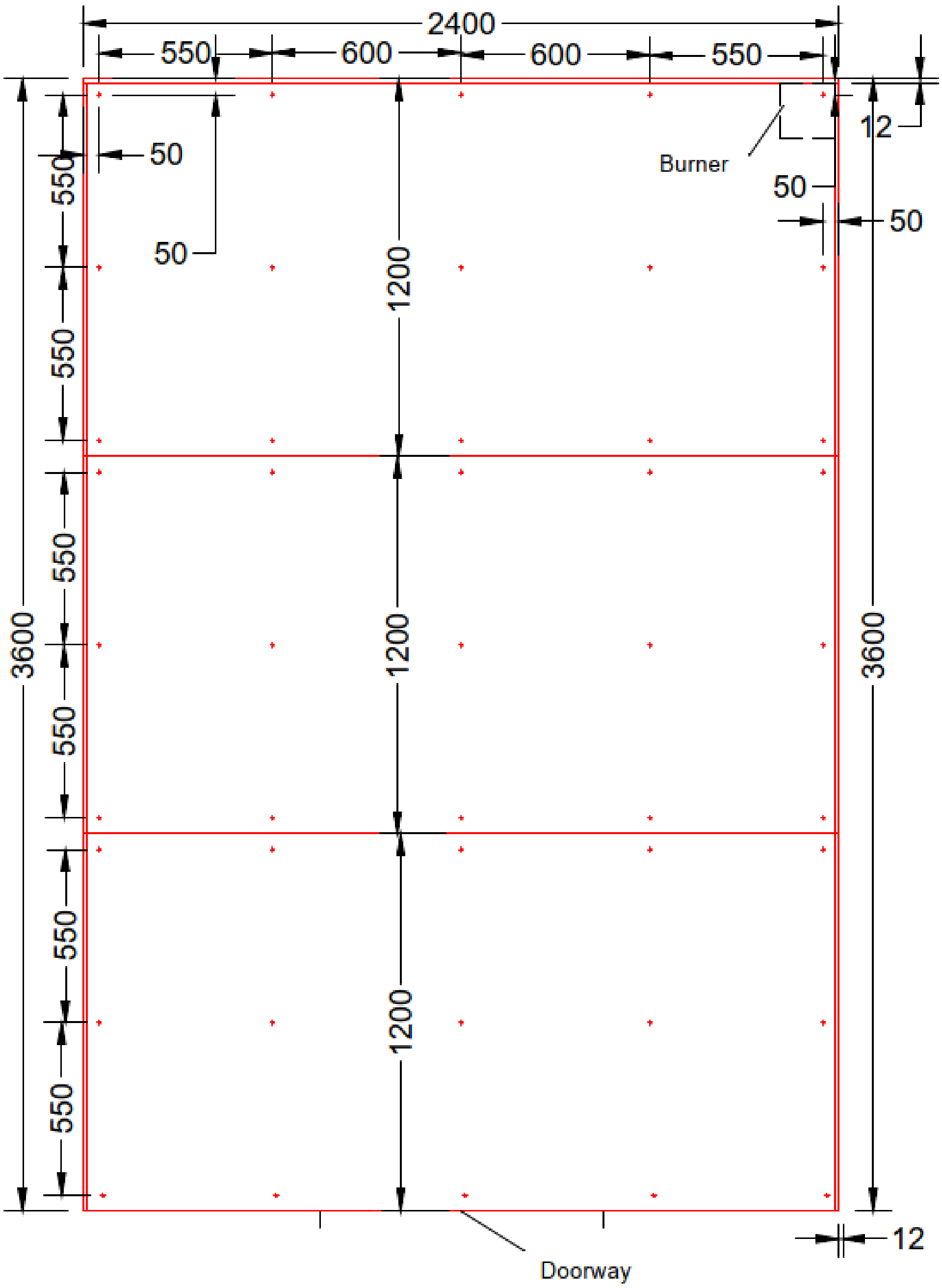

Figure 2 **Ceiling (from above) (dimensions in mm)**

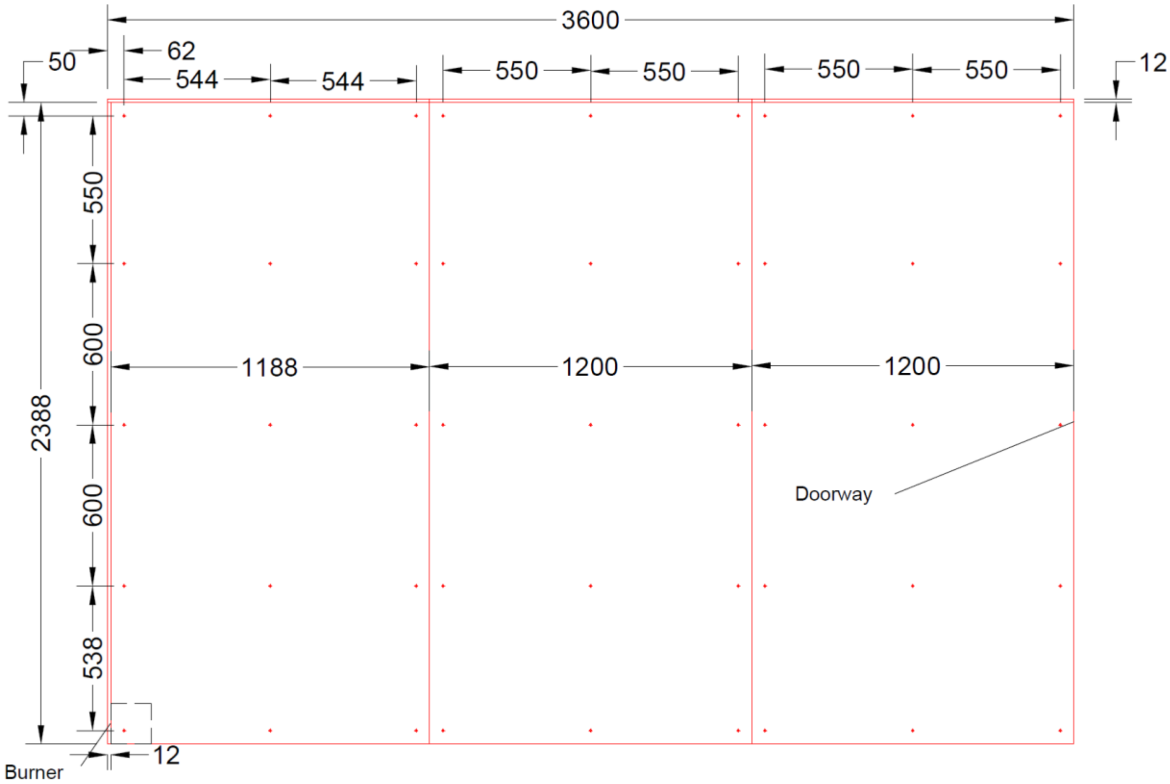

Figure 3 Side walls (dimensions in mm)

Appendix B Test observations

Table 11 shows observations of any significant behaviour of the specimen during the test.

Table 11 Test observations

Time		Observation
Min	Sec	
-02	00	The reaction-to-fire test was started.
00	00	With the burner output set to 100 kW, the burner was ignited.
00	43	The panels around the burner corner started charring.
02	00	A light layer of smoke filled the room.
04	00	The smoke density inside the room increased, resulting in reduced visibility.
07	00	The panels around the burner corner started cracking. The smoke density reduced slightly, resulting in improved visibility.
10	00	The burner output was increased to 300 kW.
10	17	Flames started spreading across the ceiling towards the left wall and the door.
13	14	Debris started falling from the ceiling and continued for the duration of the test.
15	21	Flames started exiting the doorway.
15	**24**	**The heat release rate of 1 MW heat output was confirmed.**
17	55	The charred layers of the ceiling panels started delaminating.
18	00	The reaction-to-fire test was ended.

Appendix C Test data

C.1 Heat flux

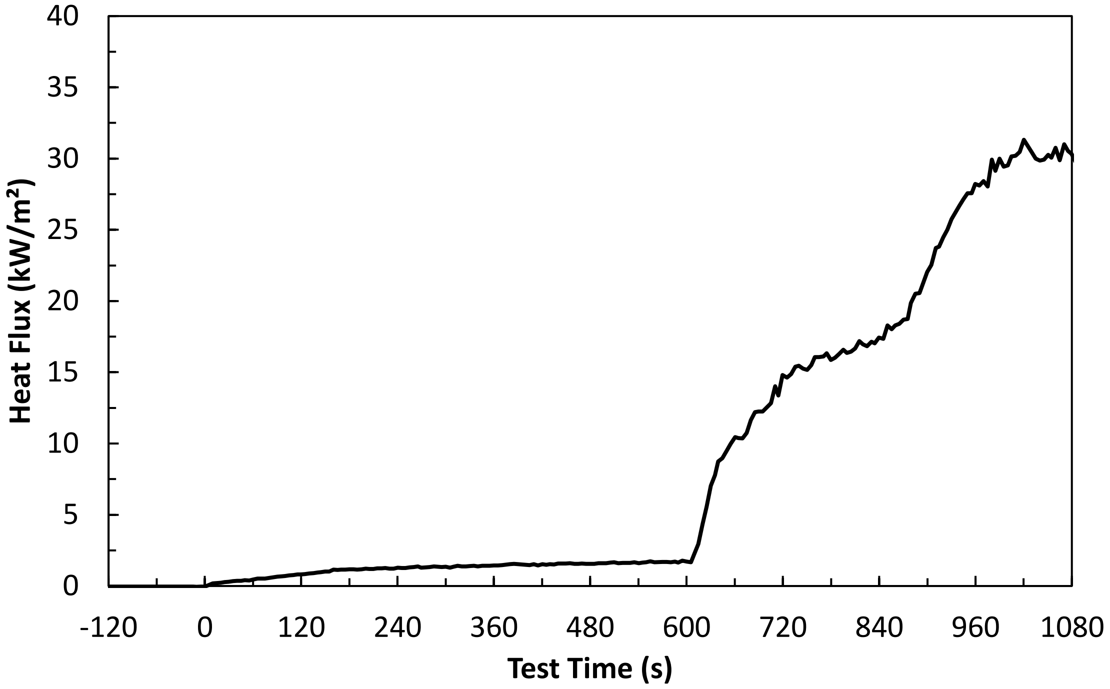

Figure 4 Heat flux vs time

C.2 Volume flow

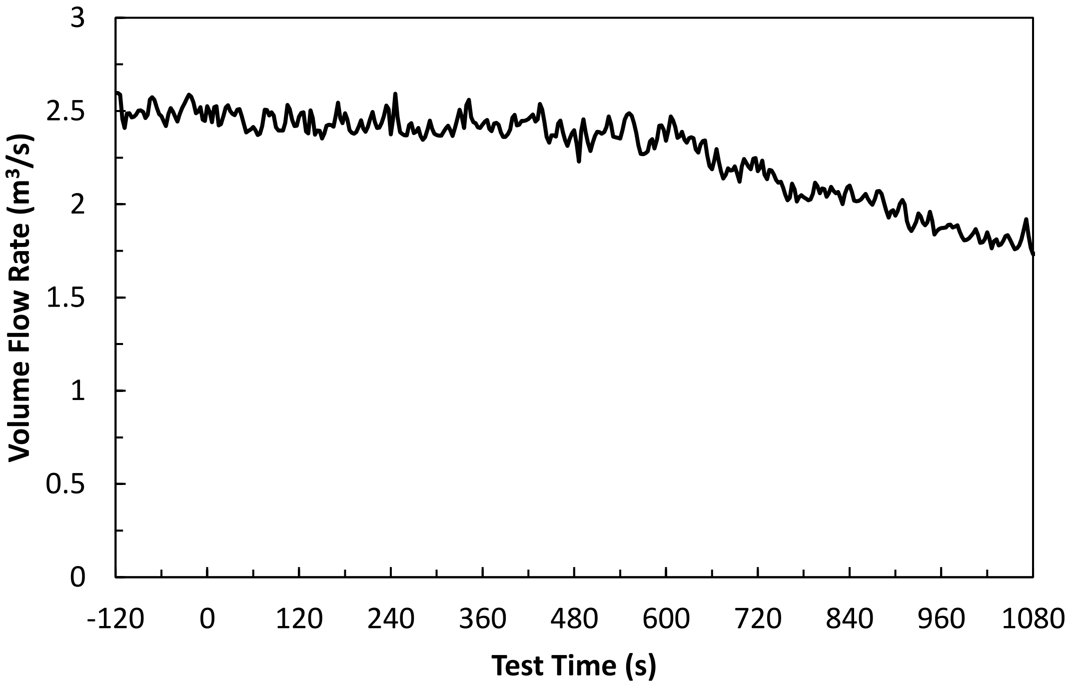

Figure 5 Volume flow rate in duct vs time

C.3 Heat release rate

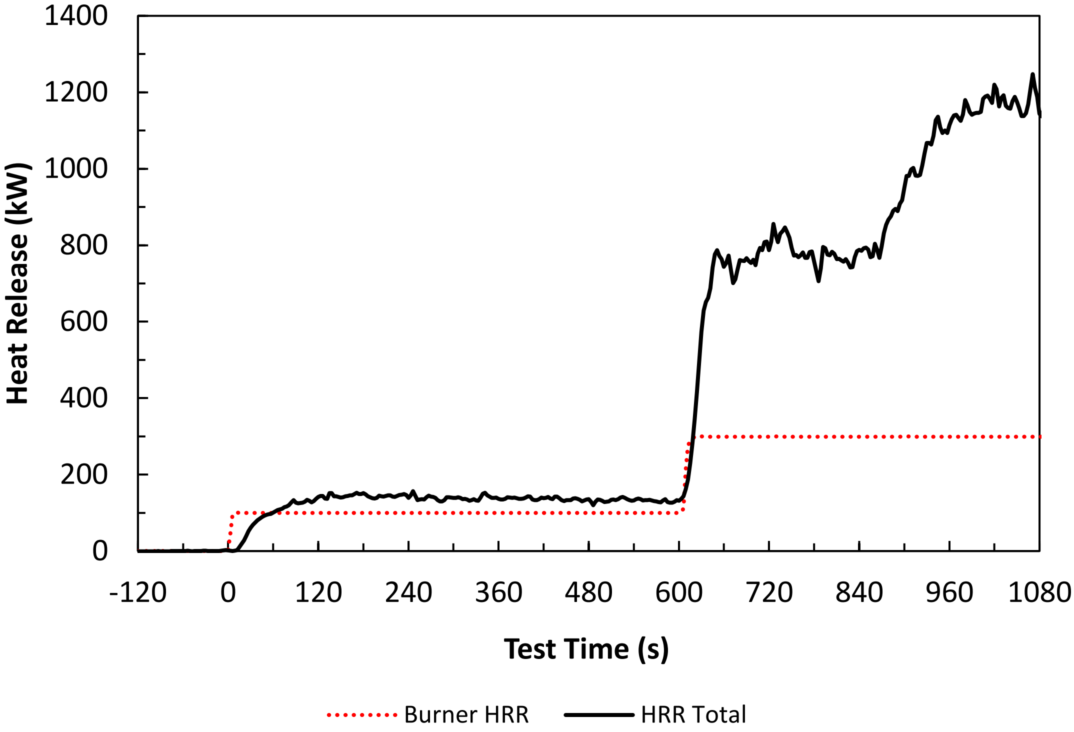

Figure 6 Heat release rate (HRR) of specimen and burner vs time

C.4 Carbon monoxide production

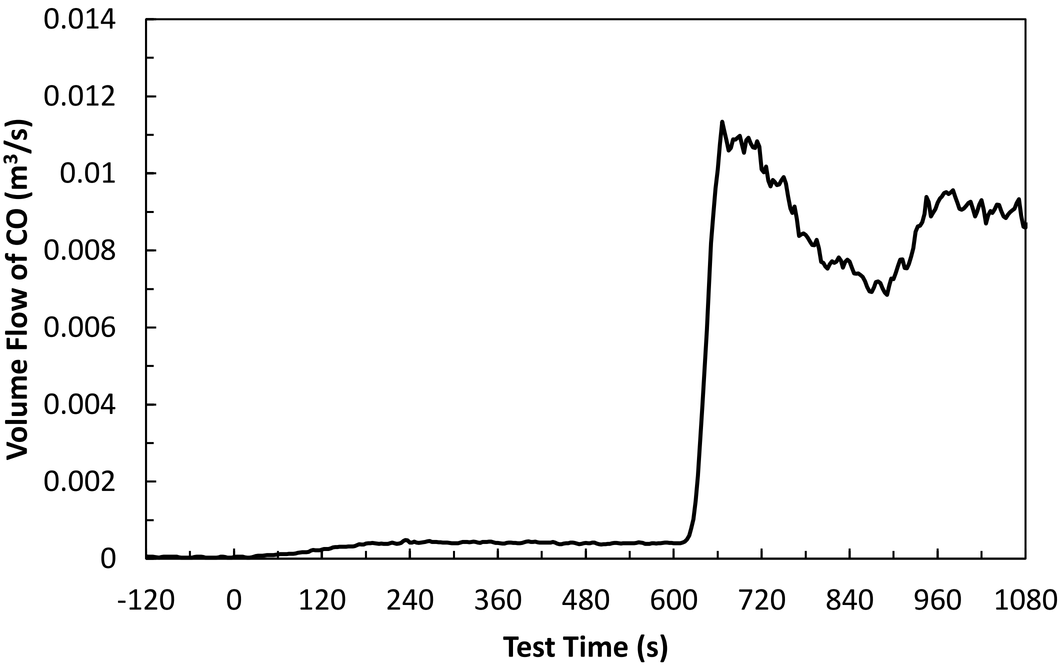

Figure 7 Production of carbon monoxide vs time, at reference temperature and pressure

C.5 Carbon dioxide production

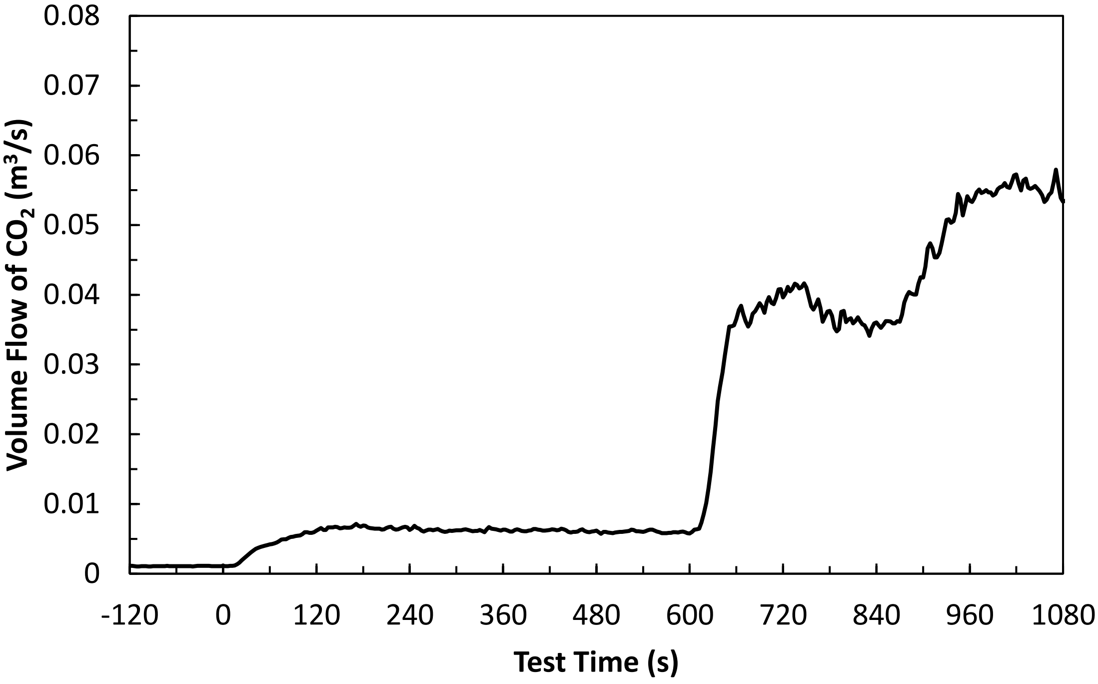

Figure 8 Production of carbon dioxide vs time, at reference temperature and pressure

C.6 Smoke production rate

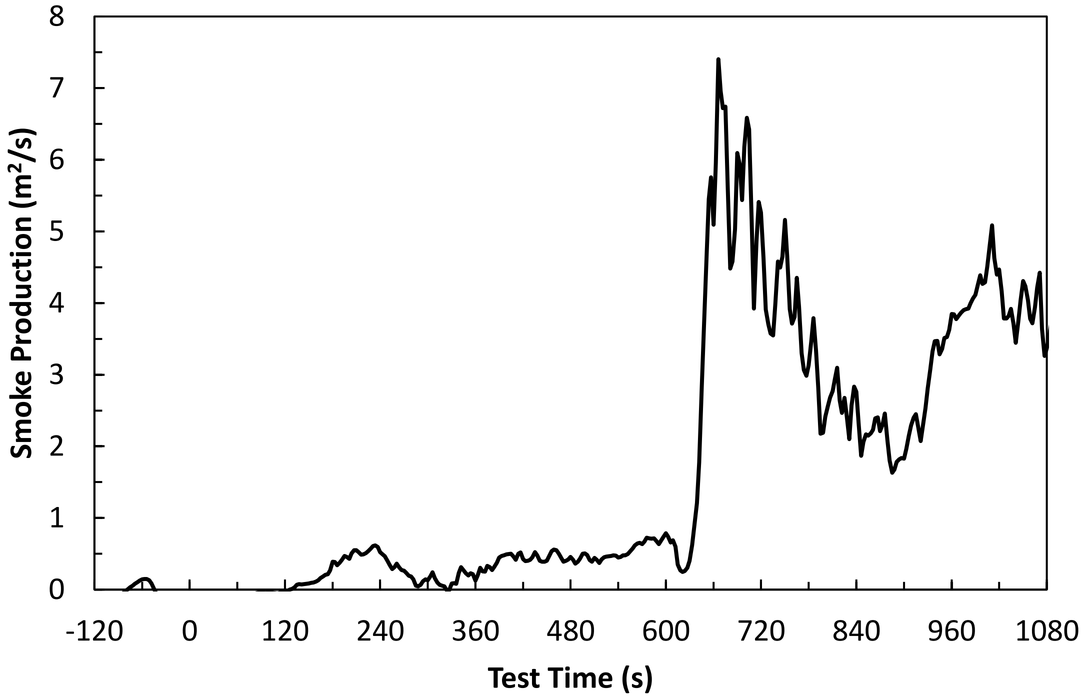

Figure 9 Production of light obscuring smoke vs time, at reference temperature and pressure

C.7 Temperature at different heights

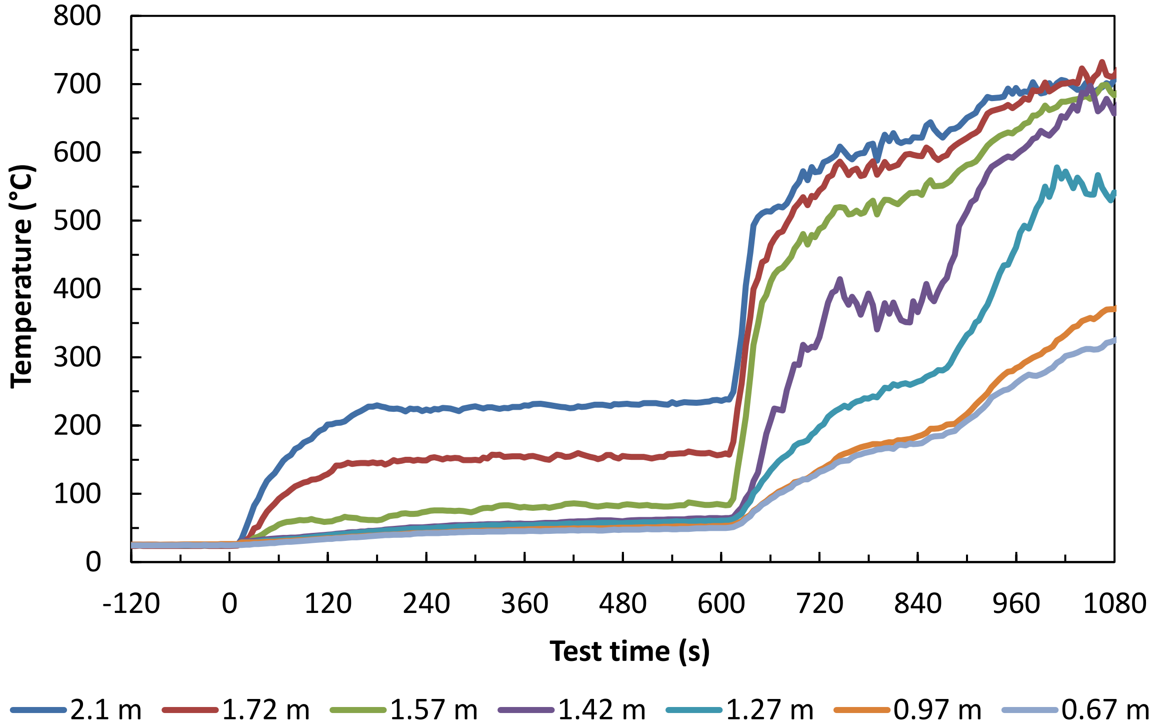

Figure 10 Temperature at height in the corner opposite to the burner vs time (from the room floor)

Appendix D Photographs

Figure 11 The system before the reaction-to-fire test.

Figure 12 The system 24 seconds after burner ignition with the burner output of 100 kW.

Figure 13 The system 06 minutes and 15 seconds after burner ignition with the burner output of 100 kW.

Figure 14 The system 09 minutes and 57 seconds after burner ignition with the burner output of 100 kW.

Figure 15 The system 11 seconds after the burner output was increased to 300 kW.

Figure 16 The system 03 minutes and 20 seconds after the burner output was increased to 300 kW.

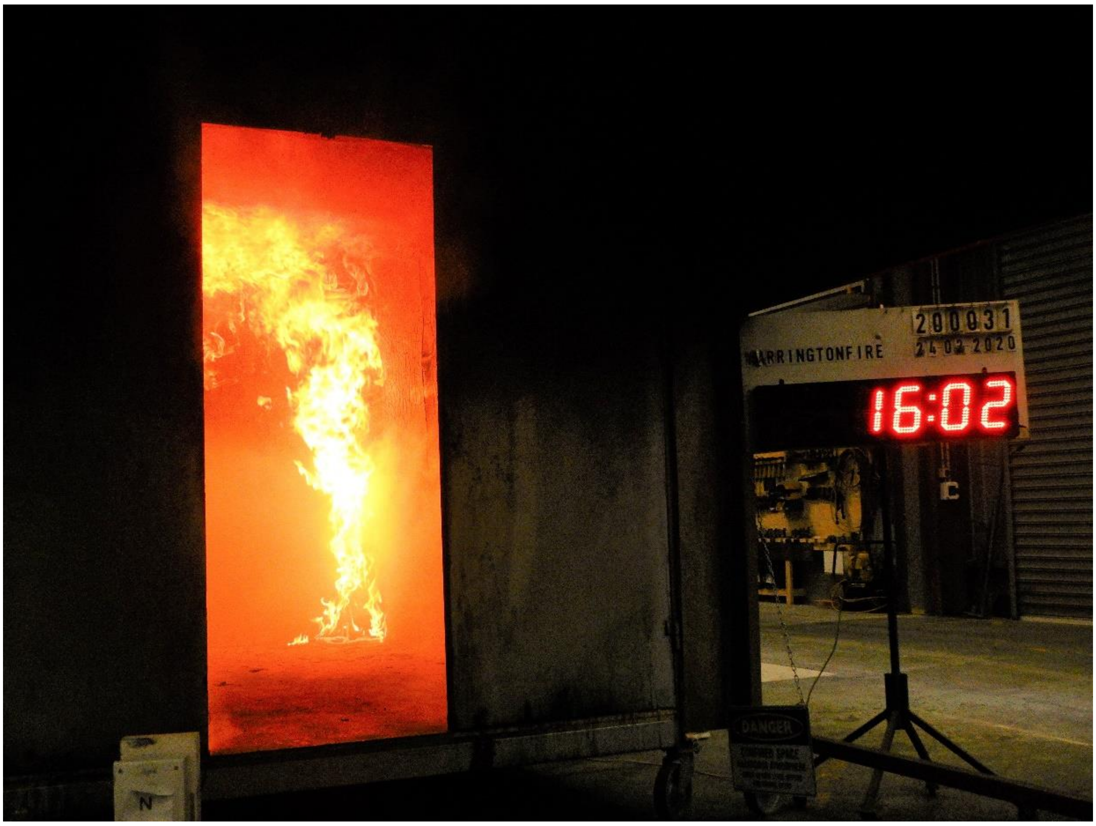

Figure 17 The system 06 minutes and 02 seconds after the burner output was increased to 300 kW.

Figure 18 The system at the end of the reaction-to-fire test.