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TEST REPORT

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

Test sponsor: Briggs Veneers Pty Ltd

Address: 409 Victoria Street
Wetherill Park, NSW, 2164
Australia.

Job number: RTF180222 Author: Muntaqim Pereira

Test date: 18 December 2018 Revision: R1.0

Amendment schedule

Version	Date	Information relating to report		
R1.0	02/02/2019	Description	Initial issue.	
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General conditions of use

Executive summary

Objective

To determine the fire hazard properties of veneered FR MDF subjected to a test in accordance with AS ISO 9705:2003 R2016 and AS 5637.1:2015.

Sponsor

Briggs Veneers Pty Ltd, 409 Victoria Street, Wetherill Park, NSW, 2164, Australia.

Summary of tested specimen

The Hoop Pine 12mm FRMDF boards were screw fixed to the test room walls using plasterboard screws. The boards lined three walls and the ceiling, with the wall with the doorway not lined.

The specimen was tested against the performance criteria for wall and ceiling linings specified in AS ISO 9705:2003 R2016 and AS 5637.1:2015.

Test results

The specimen achieved the following performance requirements as defined in AS ISO 9705:2003 R2016, AS 5637.1:2015:

- Group number : 2
- $SMOGRA_{RC}$ ($m^2 s^{-2} \times 1000$) : 4.7

The specimen achieved the following performance requirements as defined in the C/VM2 – Verification Method: Framework for Fire Safety Design:

- Group number : 2 – S
- Average smoke production rate : 0.77 $m^2 s^{-1}$

Date of test

18 December 2018

Contents

1. Construction details

1.1 Test assembly

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

1.2 Test specimen

The test specimen was conditioned in a conditioning chamber at 23°C and 50% RH until it reached constant mass. The Hoop Pine-veneered 12mm FR MDF boards were installed onto the room burn walls and ceiling using plasterboard screws. The screws were fixed at 600mm centres, with a 50mm offset from the edges. The ceiling panels were installed first, followed by the rear wall panels, the right and then the left wall panels.

The burn room was lined by eleven panels of various sizes as detailed in below.

A full description of the specimen is provided in Appendix A and Section 2.

Quantity	Location	Size (nominal)
2	Right wall	1200mm x 2386mm
1		1186mm x 2386mm
2	Left wall	1200mm x 2386mm
1		1186mm x 2386mm
2	Rear wall	1200mm x 2386mm
3	Ceiling	1200mm x 2400mm

Table 1 Relative size and location of the lining

1.3 Assembly and installation methods

The Hoop Pine-veneered FR MDF was considered hygroscopic and were therefore conditioned at 23˚C at 50% relative humidity. The materials were tested on the same day as installation.

The wall system was constructed and completed on 18 December 2018 by representatives of Warringtonfire Australia.

2. Schedule of components

Item		Description
Lining		
1.	Product name	Hoop Pine veneer on 12mm FLAMEBLOCK FRMDF
	Material	Natural pale-brown coloured Fire Retardant MDF (FR MDF). Briggs Flameblock FR MDF is made primarily from softwood (gymnosperm) wood fibres with up to 5% hardwood (angiosperm) wood fibres. The wood fibres are bonded together with melamine-urea-formaldehyde (MUF) adhesive. Fire retardancy is imparted by phosphate and other inorganic salts in the proportion 9% to 10% by weight. The veneer was adhered to the MDF using heat-cured crosslinked PVA.
	Measured uncut sheet size	2400mm x 1200mm x 13.5mm thick (measured) (12mm thick Flameblock sandwiched in between two layers of 0.6mm thick veneer (as nominated by the client))
	Mass per unit area	9.99 kg m^{-2} (unconditioned)
	Installation	The MDF boards were screw fixed to the room walls and ceiling using plasterboard screws (item 2). The ceiling panels were installed first, followed by the rear wall panels and lastly the right and left walls. The ceiling was installed with the full width and length panels. Three rows of screws were used, one through the centre of the panels lengthwise and on both sides. Fixings were at 600mm centres, with a 50mm offset from the edges. The wall panels were trimmed by 14mm to allow for the ceiling panel thickness. The same screw centres were used, with a 50mm offset from the edges of the panels.
Fixings		
2.	Product name	#8 x 65mm Needle point fine thread plasterboard screw
	Installation	Used to screw fix the panels (item 1) to the room walls and ceiling. Screw holes were pre-drilled.

Table 2 Schedule of components

3. Test procedure

3.1 Statement of compliance

The test was performed in accordance with the requirements of AS ISO 9705:2003 R2016 and AS 5637.1:2015 with the purpose of determining 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".

3.2 Variations to test method

None.

3.3 Pre-test conditioning

The burn room was lined with the sample material on 18 December 2018. Prior to construction, the panels were conditioned between 4 December 2018 to 12 December 2018 in a conditioning chamber to 50% relative humidity at 23°C. The samples were conditioned until it achieved a constant mass, which was determined by weighing the sample on 24-hour intervals. The samples were then installed and tested on the same day.

3.4 Sampling/specimen selection

The laboratory was not involved in sampling or selecting the test specimen for the reaction to fire test.

3.5 Ambient temperature

The ambient temperature of the laboratory at the start of the test was 25°C and varied between 24°C and 26°C during the test.

3.6 Test duration

The flashover occurred 756 seconds, i.e.636 seconds after burner ignition.

3.7 Instrumentation and equipment

The instrumentation was provided in accordance with AS ISO 9705-2003 R2016 and is detailed below:

- The fire test room consisted of galvanised studwork walls on three sides and ceiling, where each was lined with two layers of 16mm fire grade plasterboard supported by 15mm thick plywood on the external side. The floor comprised of 9mm thick cement sheeting. Without the specimen lining, the room had inner dimensions of 3600mm long × 2400mm wide × 2400mm high with a doorway 800mm wide × 2000mm high centrally located in one of the shorter walls.
- The ignition source was a propane gas fuelled box burner, whose specifications were in accordance with those given in AS ISO 9705:2003 R2016 Annex A. The burner was placed on the floor in the corner of the room, opposite the doorway, where 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-Bolter type heat-flux gauge, placed within the floor in the middle of the room.
- The products of combustion were collected in an exhaust hood adjacent to the doorway, outside of the room. The hood was connected to an exhaust duct 400mm in diameter, within which were instruments to measure the conditions and properties of the combustion products during the test.

- The volume flow rate was determined using bidirectional pressure probe attached to a differential pressure transducer in conjunction with a Type K MIMS thermocouple located near to 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 to 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, whilst the carbon monoxide and carbon dioxide concentrations were determined using infrared sensor equipment, also within the SERVOMEX analyser.

3.8 System performance

A calibration test was carried out prior to the testing of the product. The gas burner was placed directly under and 1000mm below the exhaust hood and the gas supply to the burner was adjusted such that the power output from the burner was 0 kW for 2 minutes, then 100 kW for five minutes then 300 kW for a further five minutes, then 100 kW for five minutes and finally 0 kW for two minutes, after which 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 so complied with the requirements of AS ISO 9705:2003 R2016 Section 10.1.

The system response was determined by calculating the average time taken for the measured rate of heat release to be within 10% of the final measured value of rate of heat release. System response data is shown in Table 1 of Section 4 and the system response has been calculated to be 15s, which is within the 20 s limit required to comply with AS ISO 9705:2003 R2016.

4. Test measurements

4.1 Initial conditions

The horizontal wind speed at a horizontal distance of 1000mm away from the door opening was measured just prior to the test and was found to be 0.2 - 0.4ms^{-1}, which is less than 0.5ms^{-1} and so satisfies the requirement of AS ISO 9705:2003 R2016 Section 12.1.2. The ambient temperature in the region of the fire test room was 25°C at the start of the test.

4.2 Heat flux measurements

The heat flux measurements are provided in Figure 5 in Appendix C.

4.3 Volume flow rate measurements

The volume flow rate measurements are provided in Figure 6 in Appendix C.

4.4 Heat release rate measurements

The rate of heat release from the specimen and the burner are provided in Figure 7 in Appendix C.

4.5 Carbon monoxide and carbon dioxide production rates

The rate or production of carbon monoxide and carbon dioxide are given in Figure 8 and Figure 9 respectively in Appendix C.

4.6 Light obscuration measurements

The smoke production rate is given in Figure 10 in Appendix C

4.7 Observation

Table 6 in Appendix B includes observations of any significant behaviour of the specimen and details of any occurrence of the various performance criteria specified in AS ISO 9705:2003 R2016. Photographs of the specimen are included in Appendix D.

4.8 Calibration test

The results of the calibration test are detailed in Table 3 below.

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	101	102	186	0.6	12
420 to 720	300	301	300	393	-0.2	15
720 to 1020	100	101	99	747	-2.2	18
1020 to 1140	0	0	0	0	0	0

Table 3 Response time measurements during the step calibration process

The response time, or delay time, as defined in AS ISO 9705:2003 R2016 Section 10.2, of the system was found to be 15 seconds. This is in accordance with AS ISO 9705:2003 R2016 Section 10.2, which requires the delay time to be less than 20 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.

5. Performance criteria and test results

Australia

The National Construction Code of Australia (NCC) and AS 5637.1:2015 allow the classification of materials by Group Number, which indicates the amount of time taken for the material being tested to reach flashover under AS ISO 9705:2003 R2016 test conditions. The NCC and AS 5637.1:2015 define flashover to be heat release rate of 1 MW, so materials are classified, in accordance with NCC 2016 Spec C1.10 and AS 5637.1:2015, by the time taken for the heat release rate, as measured during the AS ISO 9705:2003 R2016, to reach 1 MW as per the scheme below;

- 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 – Material classified as Group 3 reach flashover after two minutes, but before ten minutes of exposure to 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 achieved a heat release rate of 1 MW after 36 seconds exposure to a 300kW heat source. Therefore, the system has achieved a classification of Group 2.

The NCC and AS 5637.1:2015 also define the smoke growth rate index, or $SMOGRA_{RC}$, as a quantity which may be obtained from the smoke obscuration measurements obtained in the AS ISO 9705:2006 R2016 test. The $SMOGRA_{RC}$ for a material is obtained by finding the maximum value of the average rate of smoke growth, where the averages are found from the total smoke obscuration determined over intervals of one minute, then dividing that value by the time that maximum occurred and multiplying the result by 1000.

The maximum average rate of smoke growth for this material occurred at 618 seconds into the test and was found to be 3.8 $m^2 s^{-1}$. Therefore, the $SMOGRA_{RC}$ (in m^2s^{-2} × 1000) value for the material is 4.7.

Criteria	Results
Group number	2
$SMOGRA_{RC}$ (in m^2s^{-2} × 1000)	4.7

Table 4 Australian test results

New Zealand

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

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 classification scheme allows 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. The scheme 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 as per the scheme below;

- 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 that are classified as Group 1-S do not reach flashover after ten minutes exposure to a heat source to a heat source delivering 100 kW immediately followed by a further ten minutes exposure to 300 kW and 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^2s^{-1}.
- Group 2 – Materials classified as Group 2 reach flashover after ten minutes of exposure to a 100 kW heat source.
- Group 2 – S – Materials that are classified as Group 2-S do not reach flashover after ten minutes exposure to a heat source delivering 100 kW and 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^2s^{-1}.
- Group 3 – Material classified as Group 3 reach flashover after two minutes, but before ten minutes of exposure to 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 ISO 9705:2003 test reached flashover after 10 minutes of exposure to 100 kW but before a further 10 minutes of exposure to 300 kW. Therefore the material may be given a classification of Group 2 – S.

Between 0 and 10 minutes of the test period the average smoke production rate was 0.77m^2s^{-1}, therefore the C/VM2 – Verification Method: Framework for Fire Safety Design classifies this material as Group 2 – S.

Criteria	Results
Group number	2 – S
Average smoke production rate (0 to 10 minutes)	0.77 $m^2 s^{-1}$

Table 5 New Zealand test results

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 the 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

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

7. Conclusions

The Hoop Pine-veneered 12mm FR MDF wall and ceiling lining has been subjected to a reaction to fire test in accordance with AS ISO 9705:2003 R2016 and AS 5637.1:2015.

The specimen achieved the following performance requirements as defined in AS ISO 9705:2003 R2016, AS 5637.1:2015, and the National Construction Code of Australia (NCC):

- Group number : 2
- $SMOGRA_{RC}$ (in $m^2s^{-2} \times 1000$) : 4.7

The specimen achieved the following performance requirements as defined in the C/VM2 – Verification Method: Framework for Fire Safety Design:

- Group number : 2 – S
- Average smoke production rate : 0.77 $m^2 s^{-1}$

Appendix A Drawings of test assembly

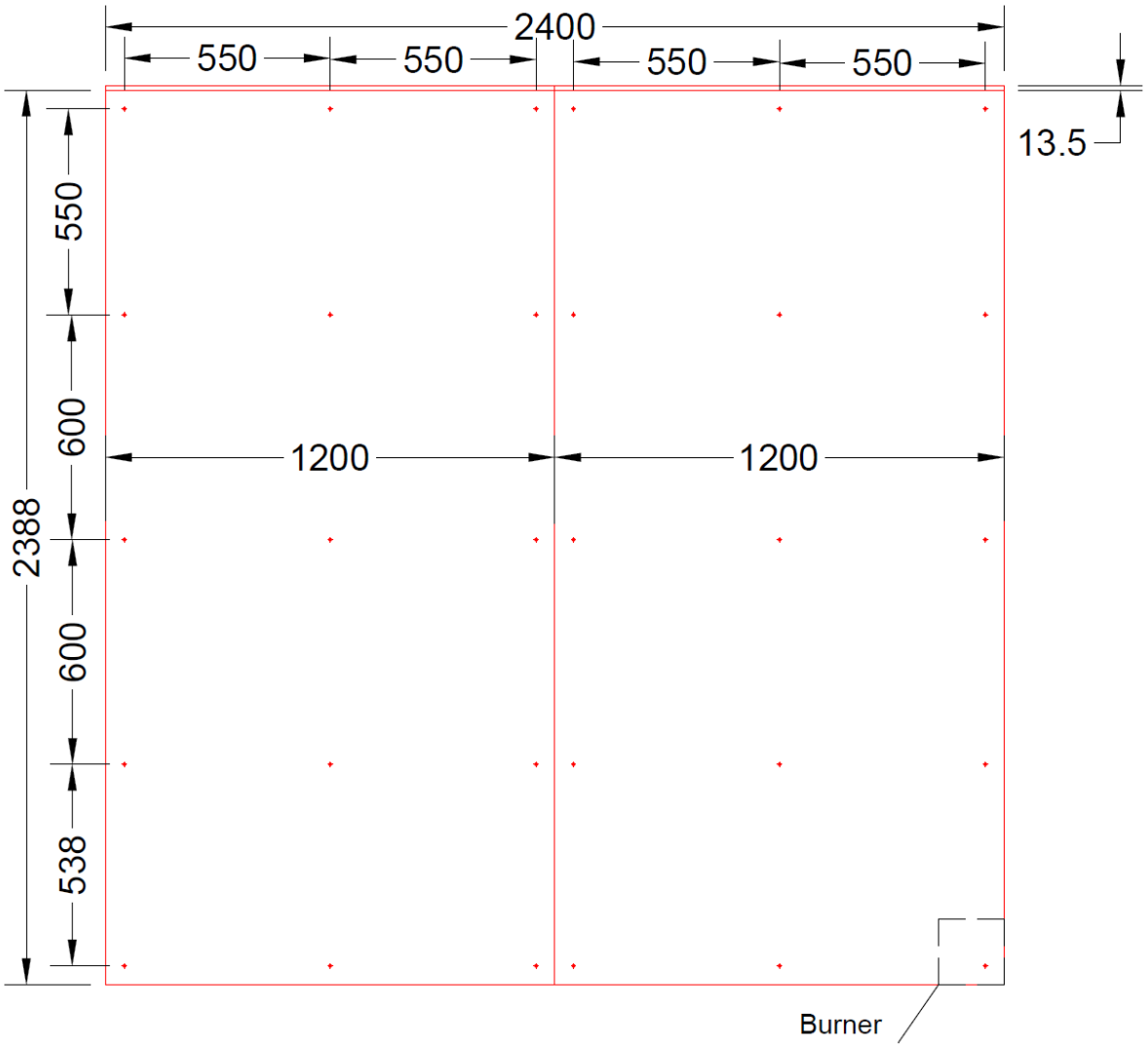

Figure 1 Rear wall

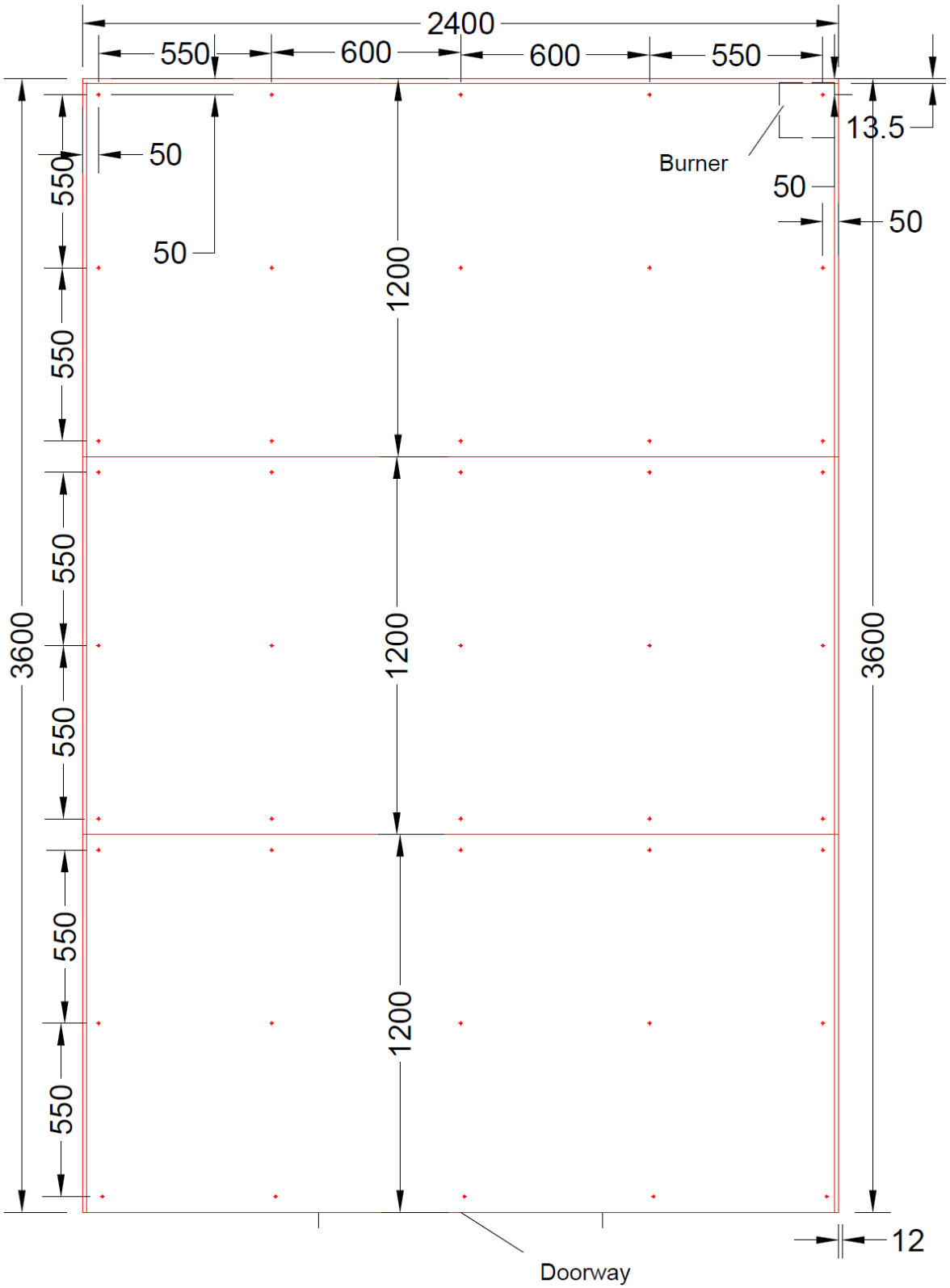

Figure 2 Ceiling (from above)

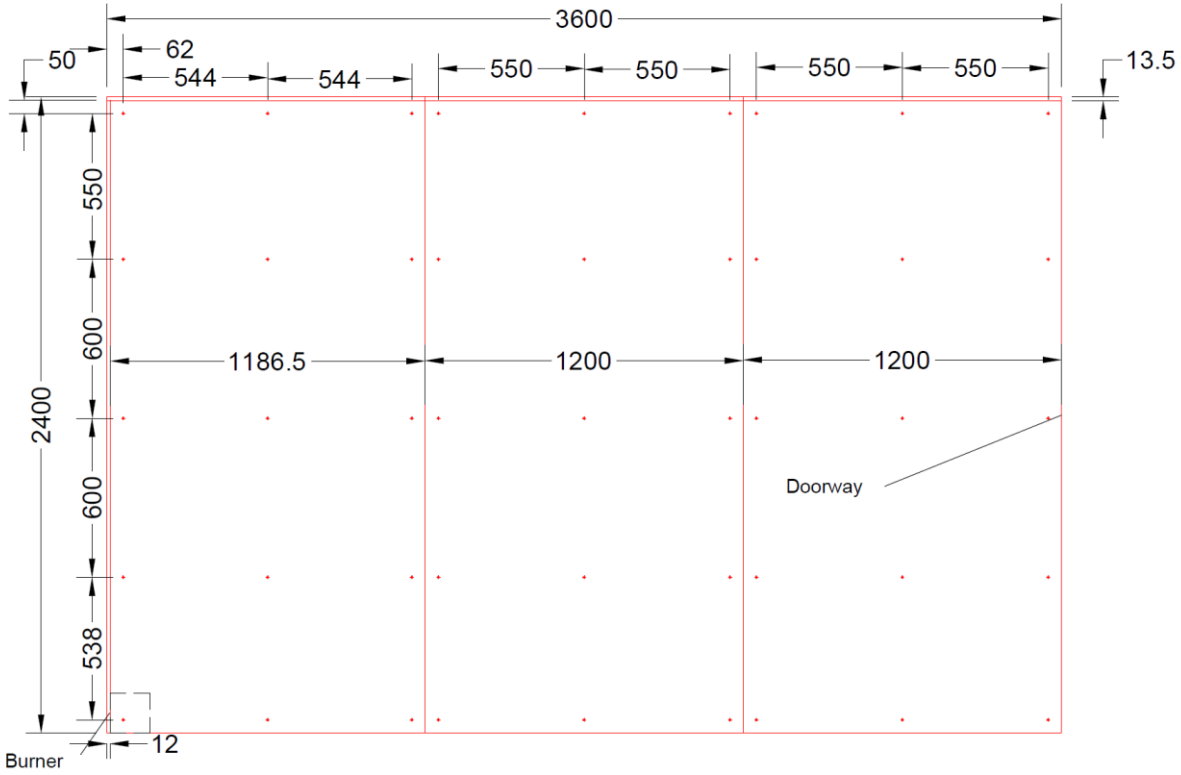

Figure 3 Right wall

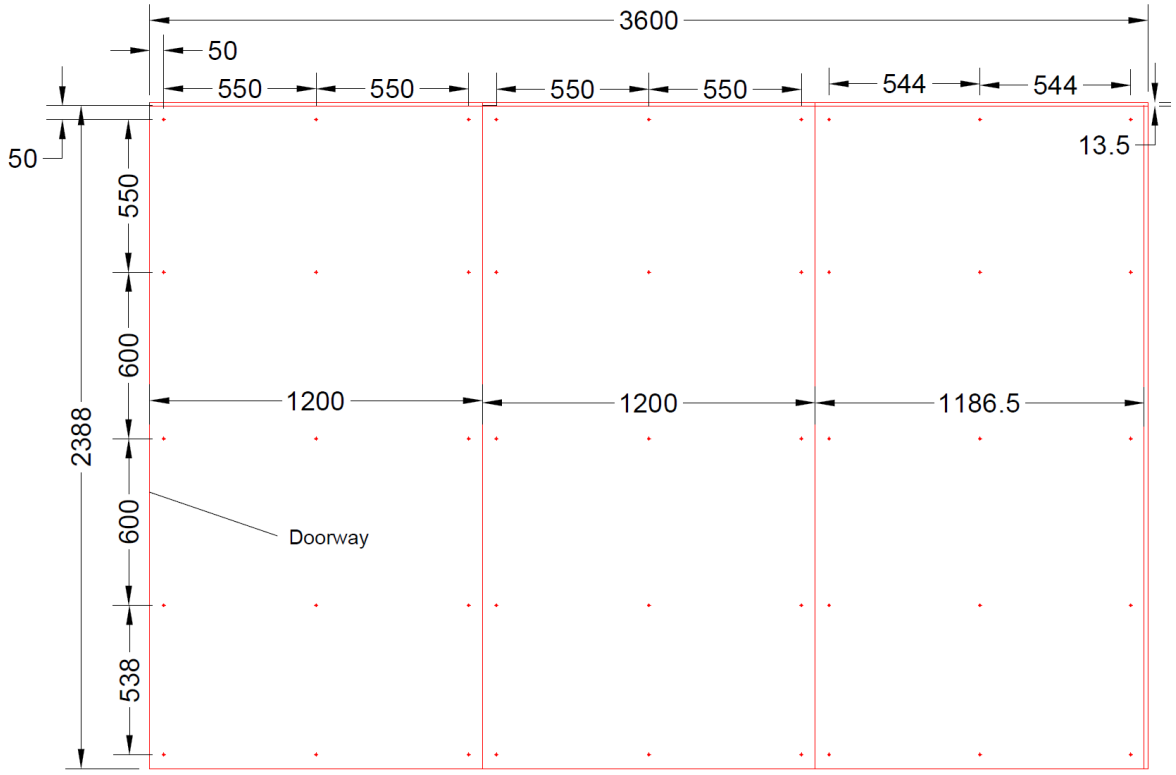

Figure 4 Left wall

Appendix B Test observations

Table 6 shows observations of any significant behaviour of the specimen during the test.

Time		Observation
Min	Sec	
00	00	Reaction to fire test is started.
02	00	Burner ignition with an output of 100kW.
02	45	Discolouration of panels at burner corner was observed.
03	00	Spread of flames on the panels was observed.
03	11	Debris was observed falling from the ceiling.
03	20	Smoke was observed coming out of the door.
03	35	Flaming of the ceiling panels was observed.
04	00	Larger debris was observed falling from the ceiling.
04	20	Panels around the burner corner charred.
04	40	Flaming of the back wall next to the burner was observed.
04	50	Flaming of the right wall next to burner was observed.
05	20	Discolouration at the top of the left wall panels was observed.
05	50	Flame spread reduction and charring of the ceiling panels was observed.
06	50	Large debris was observed falling from the ceiling.
12	00	Burner output increased to 300kW.
12	19	Large debris observed falling from the ceiling.
12	30	Flame spread to all panels was observed.
12	36	**1MW heat released was confirmed.**
12	40	Flame was observed escaping through the door.
13	**05**	**The fire test was ended.**

Table 6 Test observations

Appendix C Test data

C.1 Heat flux

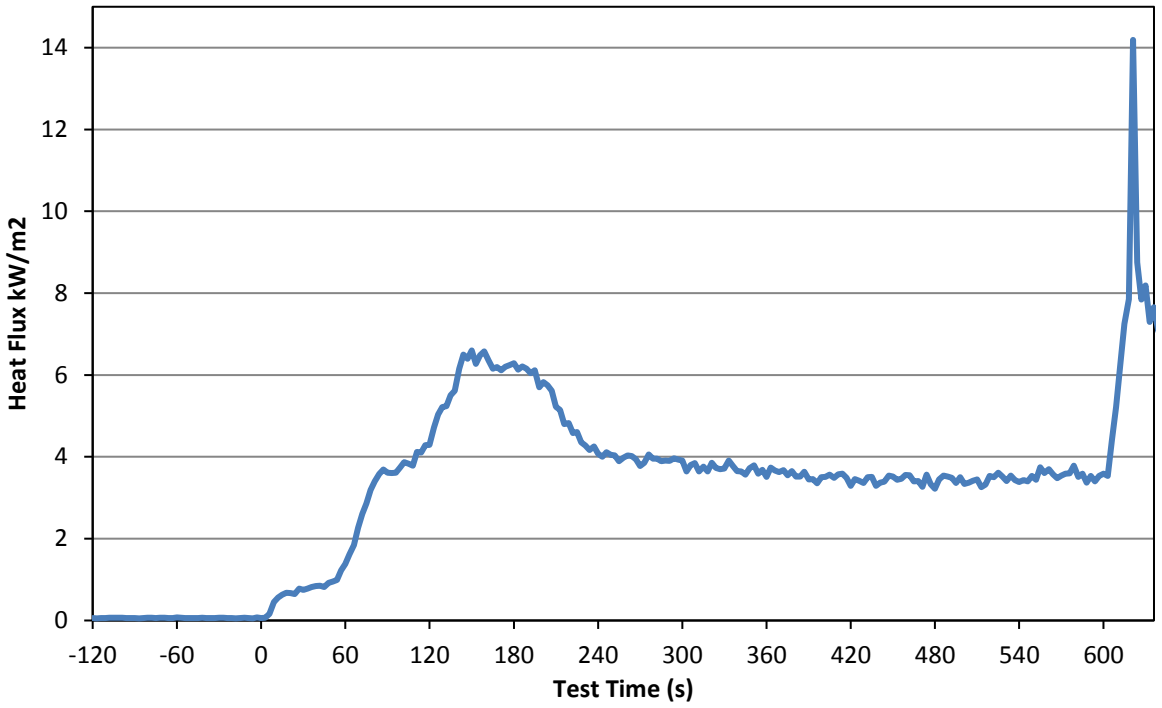

Figure 5 Heat flux vs time

C.2 Volume flow

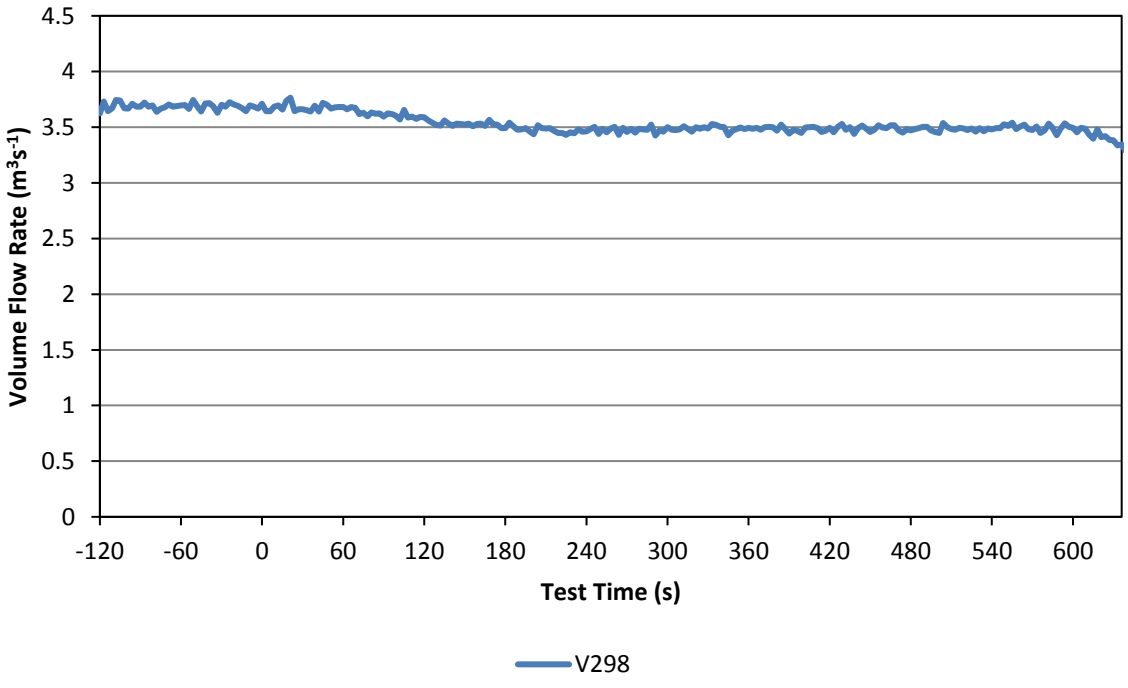

Figure 6 Volume flow rate in duct vs time

C.3 Heat release rate

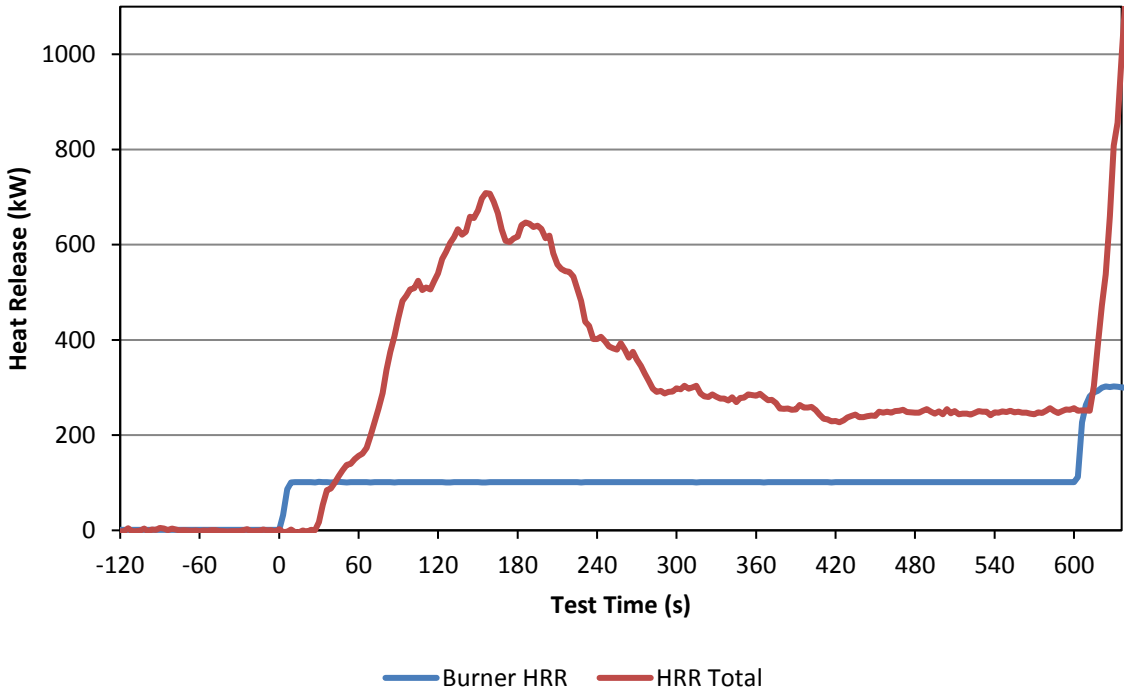

Figure 7 Heat release rate (HRR) of specimen and burner vs time

C.4 Carbon monoxide production

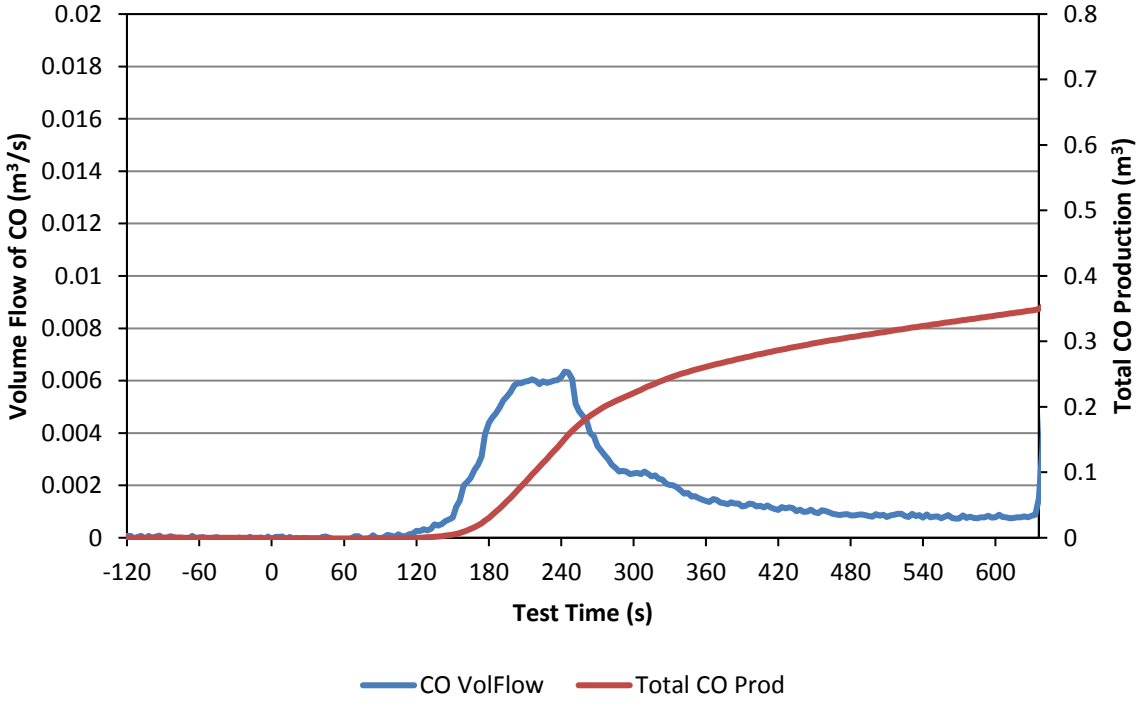

Figure 8 Production of carbon monoxide vs time, at reference temperature and pressure

C.5 Carbon dioxide production

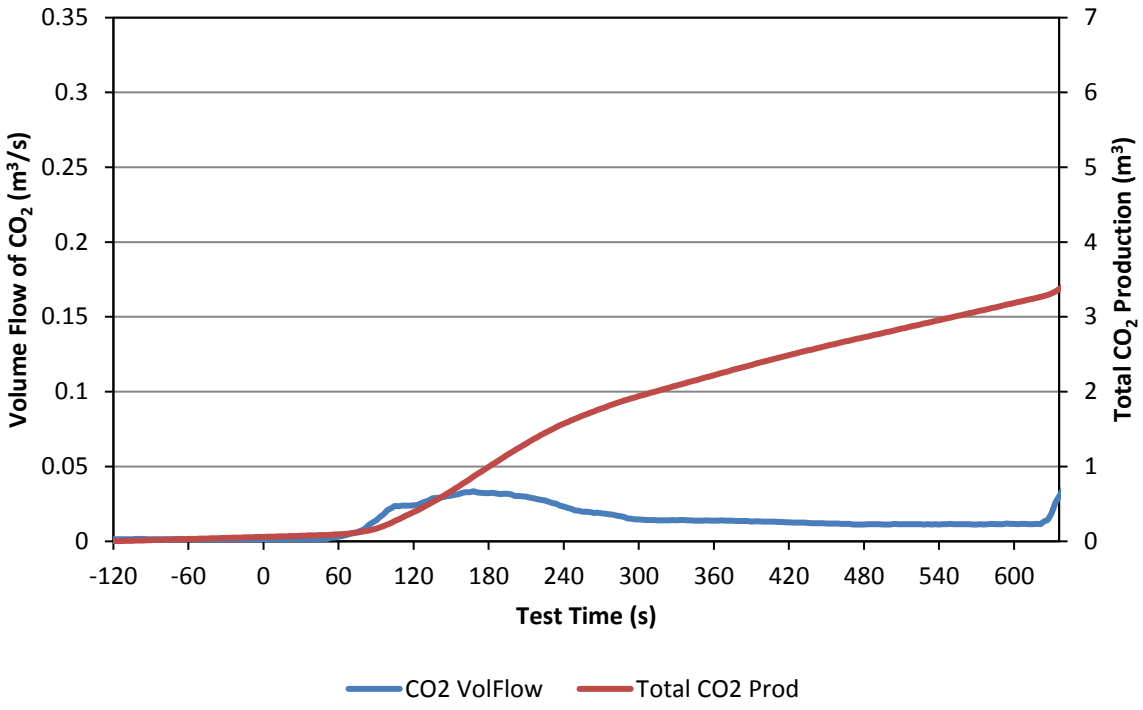

Figure 9 Production of carbon dioxide vs time, at reference temperature and pressure

C.6 Smoke production rate

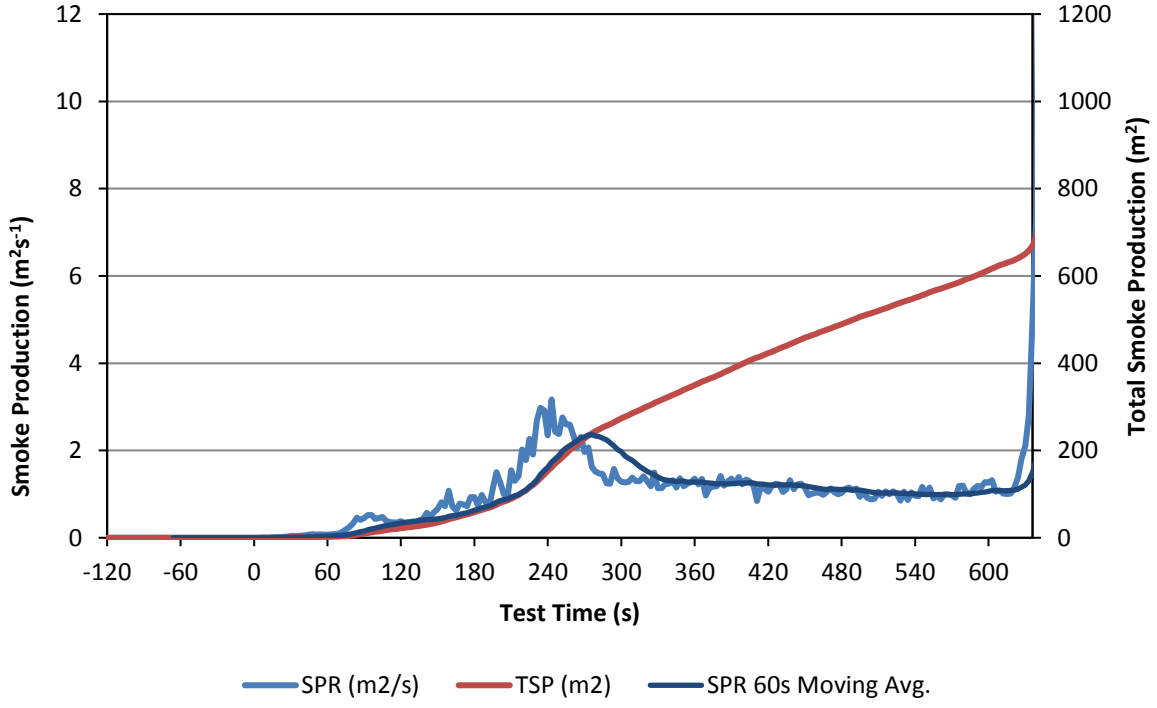

Figure 10 Production of light obscuring smoke vs time, at reference temperature and pressure

C.7 Temperature at different heights

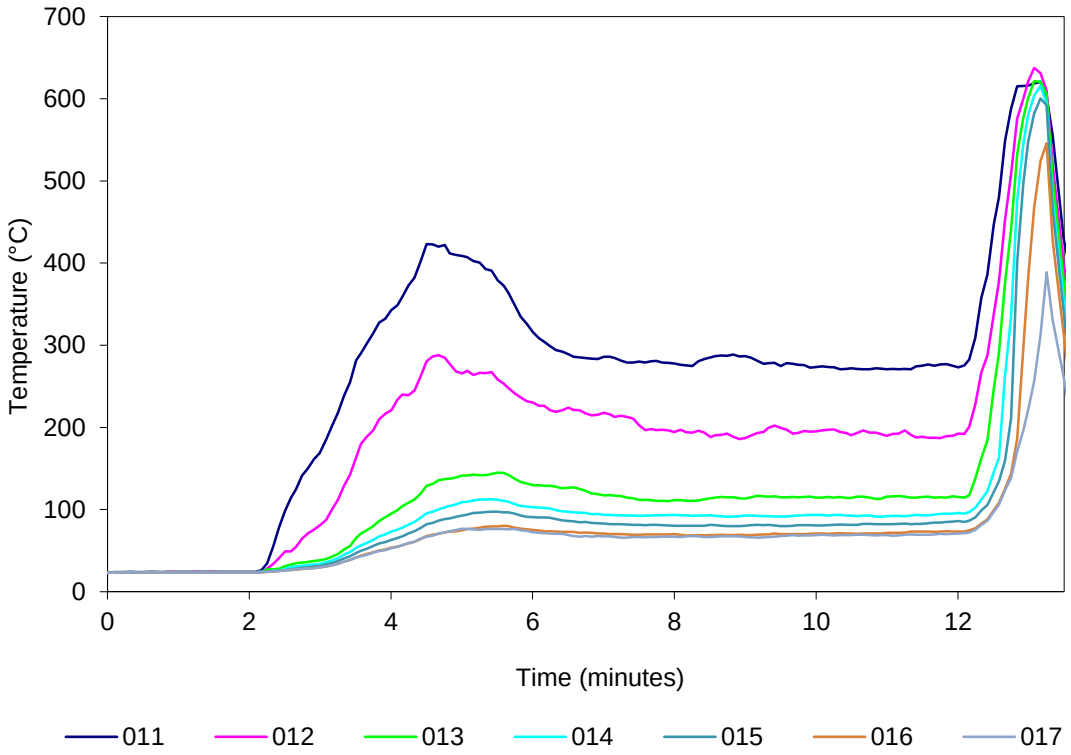

Figure 11 Temperature at height in the corner opposite to the burner vs time

05: 2.00m 06:1.72m 07:1.57m 08:1.42m 11:1.27m 12:0.70m 13:0.67m (from the room floor)

Appendix D Photographs

Figure 12 The specimen before commencement of the reaction to fire test

Figure 13 Specimen 5 seconds after ignition of burner.

Figure 14 **Specimen 50 seconds after ignition of burner.**

Figure 15 **Specimen 1 minute and 45 seconds after ignition of burner.**

Figure 16 Specimen 3 minute and 57 seconds after ignition of burner.

Figure 17 Specimen 7 minute and 55 seconds after ignition of burner.

Figure 18 Specimen 17 seconds after burner output was increased to 300kW.

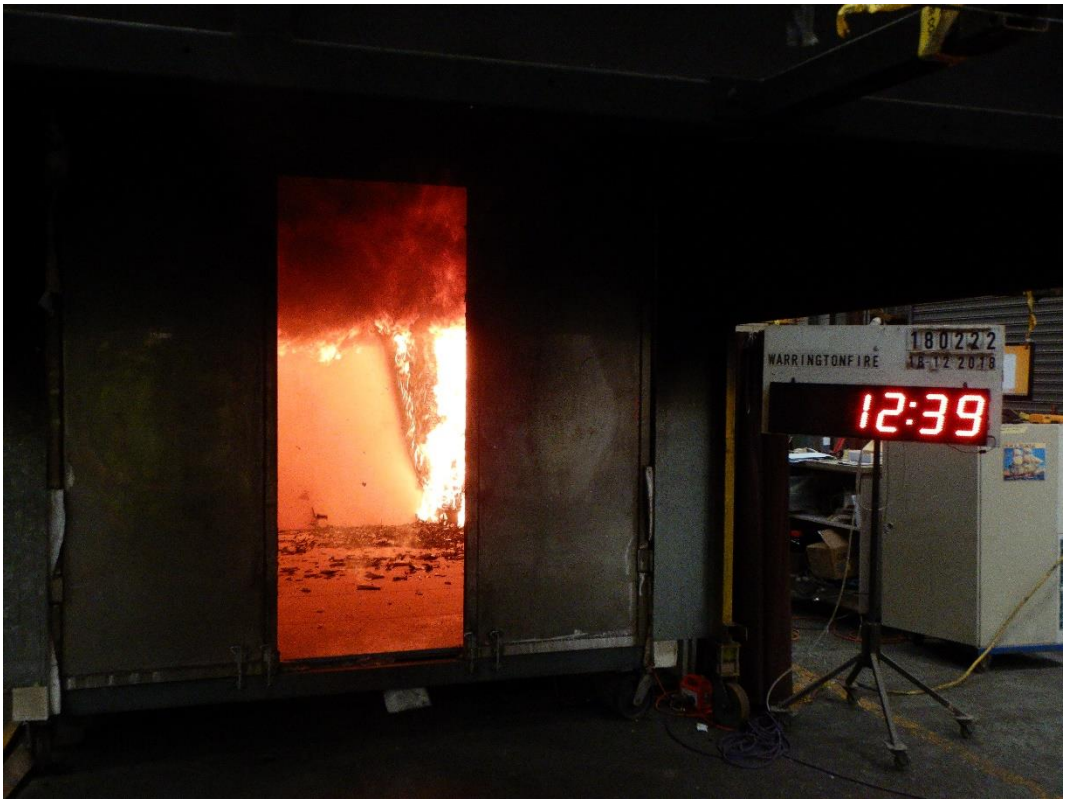

Figure 19 Specimen at flashover.

Figure 20 **Specimen at the end of the reaction to fire test.**

Figure 21 **The specimen after the reaction to fire test**