



TEST REPORT

Fire test of a room lined with Woven Image Muse 9mm PET panels, tested in accordance with AS ISO 9705 – 2003 R2016 and AS 5637.1:2015

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1 CONSTRUCTION DETAILS

TEST ASSEMBLY

The test assembly comprised a fire test room whose ceiling and 3 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 plaster board on the internal side. When unlined the fire test room had the internal dimensions of 3600mm long x 2400mm wide x 2400mm high. The short wall opposite the ignition source had a centrally located doorway opening 800mm wide by 2000mm in height. The room was lined with the sample material on three walls and the ceiling, leaving the wall with the doorway opening unlined.

TEST SPECIMEN

The test specimen comprised of a wall lining of 9mm thick Woven Image Muse Panel. The panels were made from PET. The panels comprised of two layers, an approximate 1.3mm front face (exposed) and 7.8mm layer (fixed to the wall). Full width panels were mainly used to line the walls and ceiling, however, thinner panels were used to fix the remaining exposed surfaces. The lining material was fixed to three walls and the ceiling using 65mm long - 8g screws. The larger wall panels, were fixed at the long edges at 400mm centres, 50mm from the sides, top and bottom. An extra screw was used 50mm away from both the top and bottom of the panels in the centre. For the smaller wall panels, the same side fixings were used without the additional fixings at the top and bottom of the panels. The ceiling panels used the same fixings as the wall panels, however, they had additional screws, 400mm centres, along the length through the centre of the larger panels.

The burn room was lined with fifteen panels of various sizes as detailed in Table 1.1 below:

Table 1.1: Relative size and locations of the Woven Image Muse Panel panels

Quantity	Location	Size (nominal)
3	Right hand side wall	2390mm high x 1120mm wide
1		2390mm high x 230mm wide
3	Left hand side wall	2390mm high x 1120mm wide
1		2390mm high x 230mm wide
2	Rear Wall	2390mm high x 1120mm wide
1		2390mm high x 160mm wide
3	Ceiling	2400mm long x 1120mm wide
1		2400mm long x 240mm wide

Note: Further details are provided in Figures A1.1 to A1.3 and the 'Schedule of Components' in Section 2.

ASSEMBLY AND INSTALLATION METHODS

The wall and ceiling system was constructed on behalf of the sponsor by Exova Warringtonfire Aus Pty Ltd on 16 August 2018.

2 SCHEDULE OF COMPONENTS

Item	Description	
Lining		
1	Name	Woven Image Muse 9mm PET Panel
	Material	The 9mm (nom) thick panels were made from PET and consisted of two layers. The thinner layer, ~1.5mm thick (100% PET – 68% recycled as nominated by test sponsor), exposed - facing into the room, and the thicker layer, ~7.8mm, (100% PET – 70% recycled as nominated by test sponsor), attached to the plasterboard. Mass per unit area: 1.81 kg/m ² (measured)
	Measured Uncut Sheet Size	1120mm wide x 2800mm long x ~9mm thick
	Installation	<p>The panels were cut to size to fit dimensions of the room.</p> <p>All panels were screw fixed to the walls and ceiling using 8g x 65mm long screws (item 2). All peripheral fixings were 50mm away from the edge/s of the board.</p> <p>The ceiling panels were installed first. Three 1120mm wide by 2400mm long panels were installed across the width of the room. The panels were fixed using screws (item 2). Fixings were at 400mm centres along the length of the board 50mm from the edges and down the centre of the panel. A 240mm wide by 2400mm panel was used to complete the lining of the ceiling. Screw fixings (item 2) at 400mm centres along the long side were used.</p> <p>The rear wall panels were then installed. These were 2390mm tall. Two full width panels were used followed by a 160mm wide panel. Fixings were at 400mm centres along the length of the panels on the long sides. Full width panels had an extra screw at both the top and bottom of the panel in the centre.</p> <p>The side walls were the last to be installed. These were 2390mm tall. Three full width panels and a 230mm wide panel per wall was used. The same fixing pattern to the rear wall was used.</p> <p>The room setup is illustrated in Appendix 1.</p>
Fixings		
2	Material	Screws, size 8g x 65 mm long bugle head, Philips drive
	Location	Screws were used to fix the panels (item 1) to the burn room ceiling and walls as described above and illustrated in Appendix 1.

3 TEST PROCEDURE

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.

VARIATIONS TO TEST METHOD

18 minutes after burner ignition, the burner had difficulty maintaining the required heat output. The test was carried out for an additional one minute to compensate for the lowered burner heat output. As the system had stabilised and there was no threat of flash over, the system can be given a group number as listed below.

PRE-TEST CONDITIONING

The burn room was lined with the sample material on 16 August 2018. Prior to construction, the components of the cladding system were subject to normal laboratory temperature and humidity conditions. The sample materials were not subjected to any conditioning as the material was considered to be non-hygroscopic. Therefore the materials were conditioned in manner suitable for non-hygroscopic materials.

SAMPLING / SPECIMEN SELECTION

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

AMBIENT TEMPERATURE

The ambient temperature at the start of the test was 18°C.

TEST DURATION

The test was terminated after 1380 seconds, i.e. 1260 seconds after burner ignition.

INSTRUMENTATION AND EQUIPMENT

The equipment used for the test was in accordance with AS ISO 9705 - 2003 R2016 and is detailed below:

The fire test room consisted of galvanised studwork walls and ceiling, where each was lined with two layers of 16 mm fire grade plasterboard supported by 15 mm thick plywood on the external side. The floor comprised of 9 mm thick cement sheeting. Without the specimen lining, the room had inner dimensions of 3600mm long x 2400mm wide x 2400mm high with a doorway 800mm wide x 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 a 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 the paramagnetic oxygen analyser, whilst the carbon monoxide and carbon dioxide concentrations were determined using infrared sensor equipment, also within the SERVOMEX analyser.

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 the 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 4.1 of Section 4 and the system response has been calculated to be 13 s, which is within the 20 s limit required to comply with AS ISO 9705 - 2003 R2016.

4 TEST MEASUREMENTS

INITIAL CONDITIONS

The horizontal wind speed at a horizontal distance of 1000 mm away from the door opening was measured just prior to the test and was found to be 0.2 ms^{-1} , which is less than 0.5 ms^{-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 18°C at the start of the test.

HEAT FLUX MEASUREMENTS

Heat flux measurements are provided in A3.1 in Appendix 3.

VOLUME FLOW RATE MEASUREMENTS

Volume flow rate measurements are provided in A3.2 in Appendix 3.

HEAT RELEASE RATE MEASUREMENTS

The Rate of Heat Release from the specimen and the burner are provided in A3.3 in Appendix 3.

CARBON MONOXIDE AND CARBON DIOXIDE PRODUCTION RATES

The rate of production of carbon monoxide and carbon dioxide are given in A3.4 and A3.5, respectively, in Appendix 3.

LIGHT OBSCURATION MEASUREMENTS

The smoke production rate is given in A3.6 in Appendix 3.

OBSERVATIONS

A table that includes observations of the significant behaviour of the specimen and details of the occurrence of the various performance criteria specified in AS ISO 9705 - 2003 R2016 is provided in Appendix 2. Photographs of the specimen are included in Appendix 4.

CALIBRATION TEST

The results of the calibration test are detailed in Table 4.1 below.

Time Interval (s)	Target Heat Output (kW)	Heat Output (kW)	Heat Measured (kW)	Time (s)	Variance (%)	Response Time (seconds)
0 to 120	0	0	0	-	-	-
120 to 420	100	100	104	234	2.9	12
420 to 720	300	300	302	453	0.0	12
720 to 1020	100	100	100	774	-1.5	15
1020 to 1140	0	0	0	-	-	-

Table 4.1: Response time measurements during the step calibration procedure

The response time, or delay time, as defined in Section 10.2 of AS ISO 9705 - 2003 R2016, of the system was found to be 13 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 TEST RESULTS

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 a 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 1MW 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 – Materials classified as Group 3 reach flashover after 2 minutes, but before 10 minutes of exposure to a 100 kW heat source.
- Group 4 – Materials are classified as Group 4 reach flashover before 2 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 being subjected to 100kW for 600s followed by exposure to 300 kW for 600 seconds. Therefore, the system has achieved a classification of Group 1.

The NCC and AS 5637.1:2015 also define the smoke growth rate index, or $SMOGR_{RC}$, as a quantity which may be obtained from the smoke obscuration measurements obtained in the AS ISO 9705 - 2003 R2016 test. The $SMOGR_{RC}$ 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 981 seconds into the test and was found to be $0.4 \text{ m}^2\text{s}^{-1}$. Therefore, the $SMOGR_{RC}$ value (smoke growth rate) for this material is $0.4 \text{ m}^2\text{s}^{-2} \times 1000$.

Group Number	1
$SMOGR_{RC}$	$0.4 \text{ m}^2\text{s}^{-2} \times 1000$

6 APPLICATION OF TEST RESULTS

TEST LIMITATIONS

The results of this fire test may be used to directly assess fire hazard, but it should be recognized that a single test method will not provide a full assessment of fire hazard under all fire conditions. The 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 nor do they necessarily reflect the actual behaviour in fires.

VARIATIONS FROM THE TESTED SPECIMENS

This report details the methods of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in AS ISO 9705 - 2003 R2016. Any significant variation with respect to size, constructional 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 in the first instance to obtain appropriate documentary evidence of compliance from Exova Warringtonfire Aus Pty Ltd or another Registered Testing Authority.

UNCERTAINTY OF MEASUREMENT

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.

APPENDIX 1 DRAWINGS OF TEST ASSEMBLY

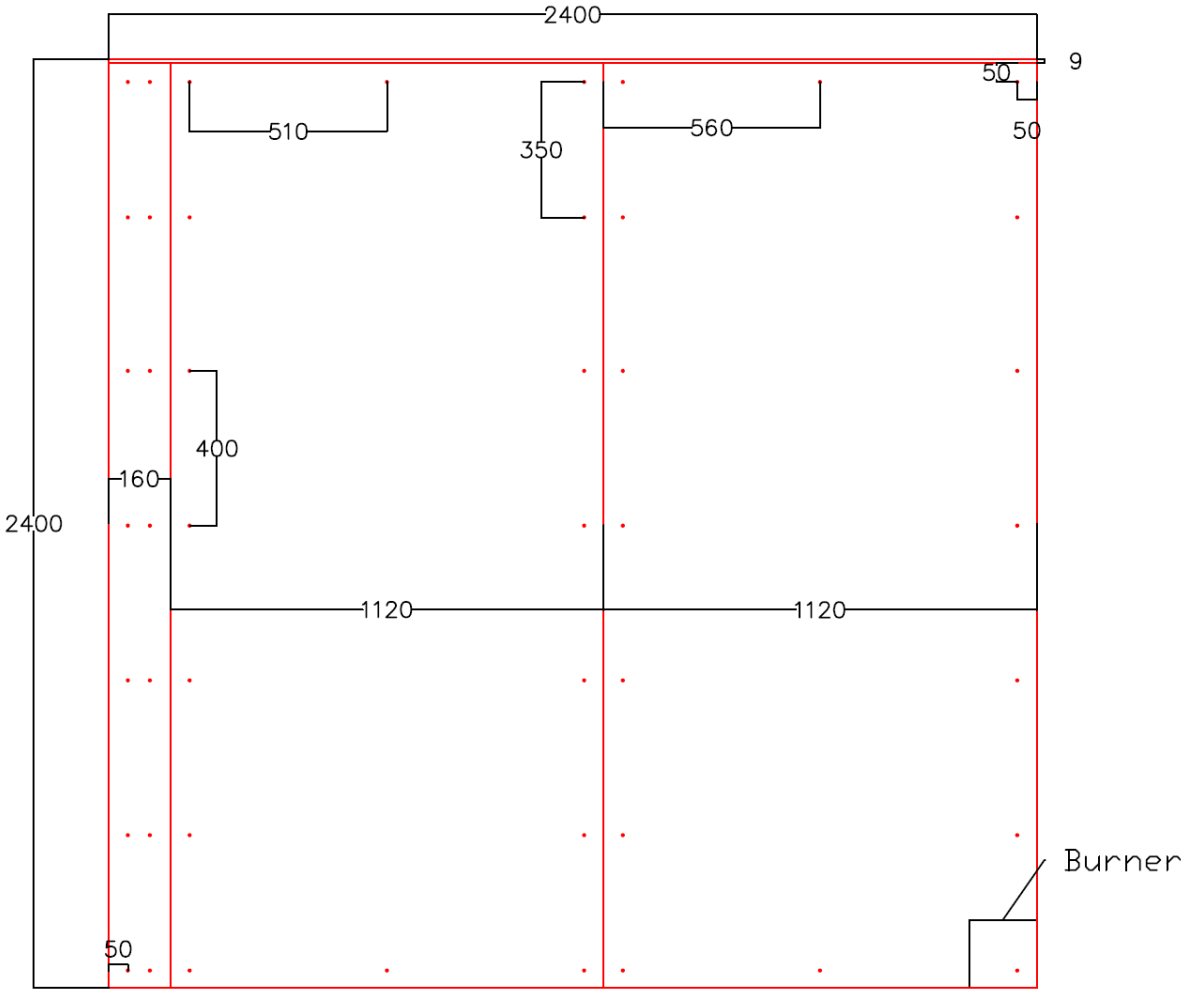


Figure A1.1: Rear Wall
(Dimensions in mm)

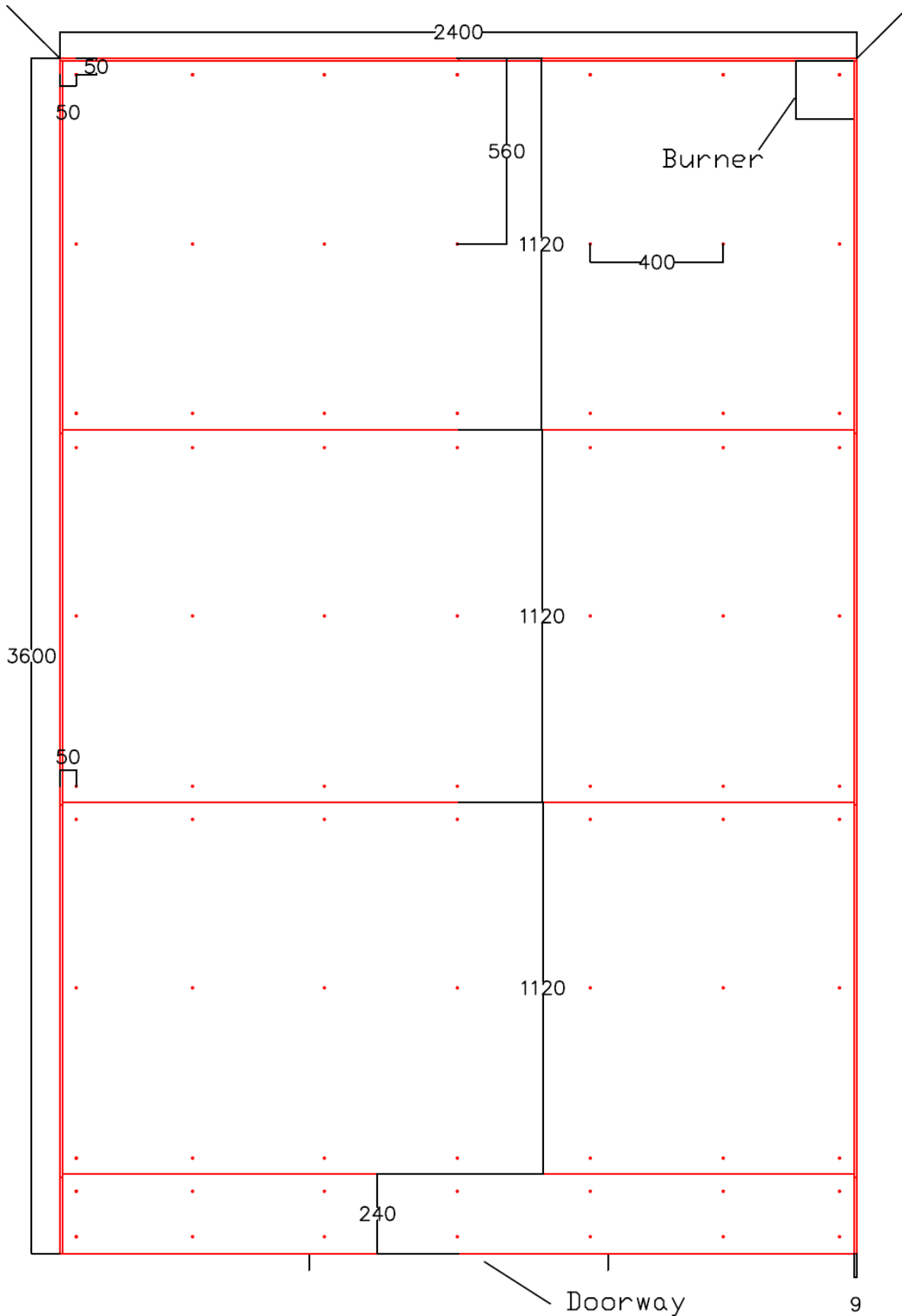


Figure A1.2: Ceiling (from above)
(Dimensions in mm)

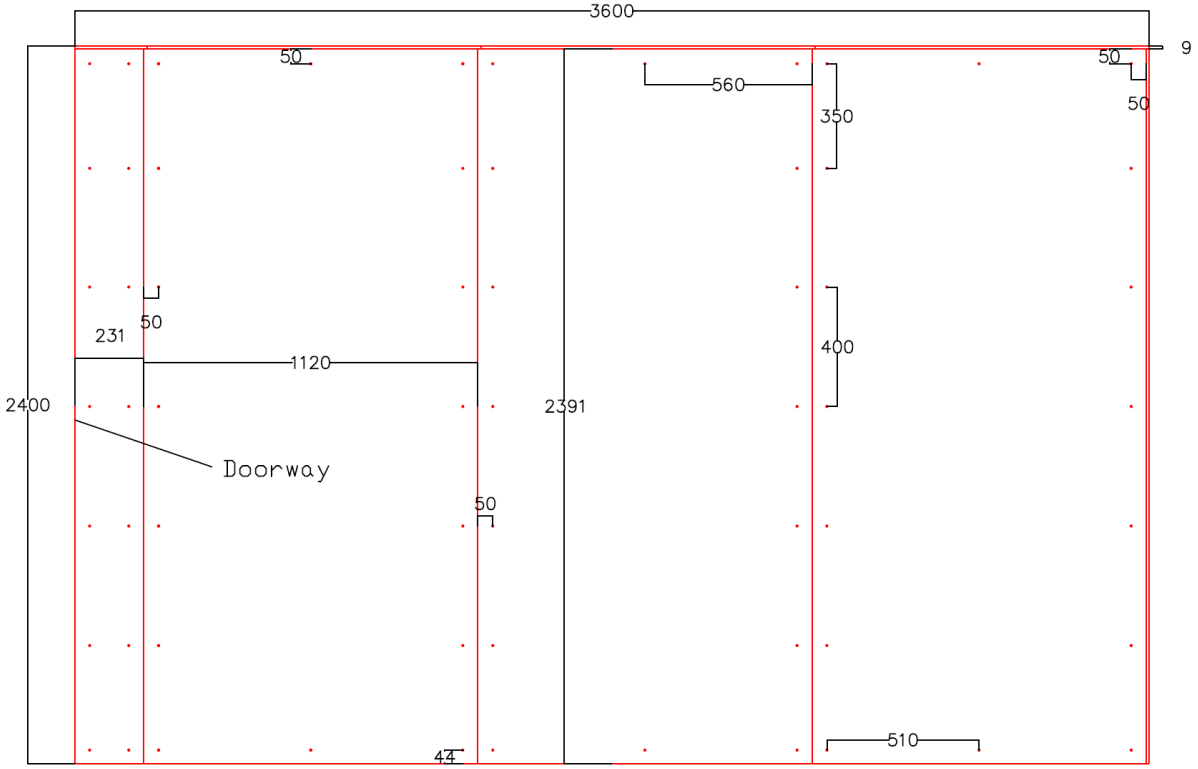


Figure A1.3: West Side Wall
(Dimensions in mm)

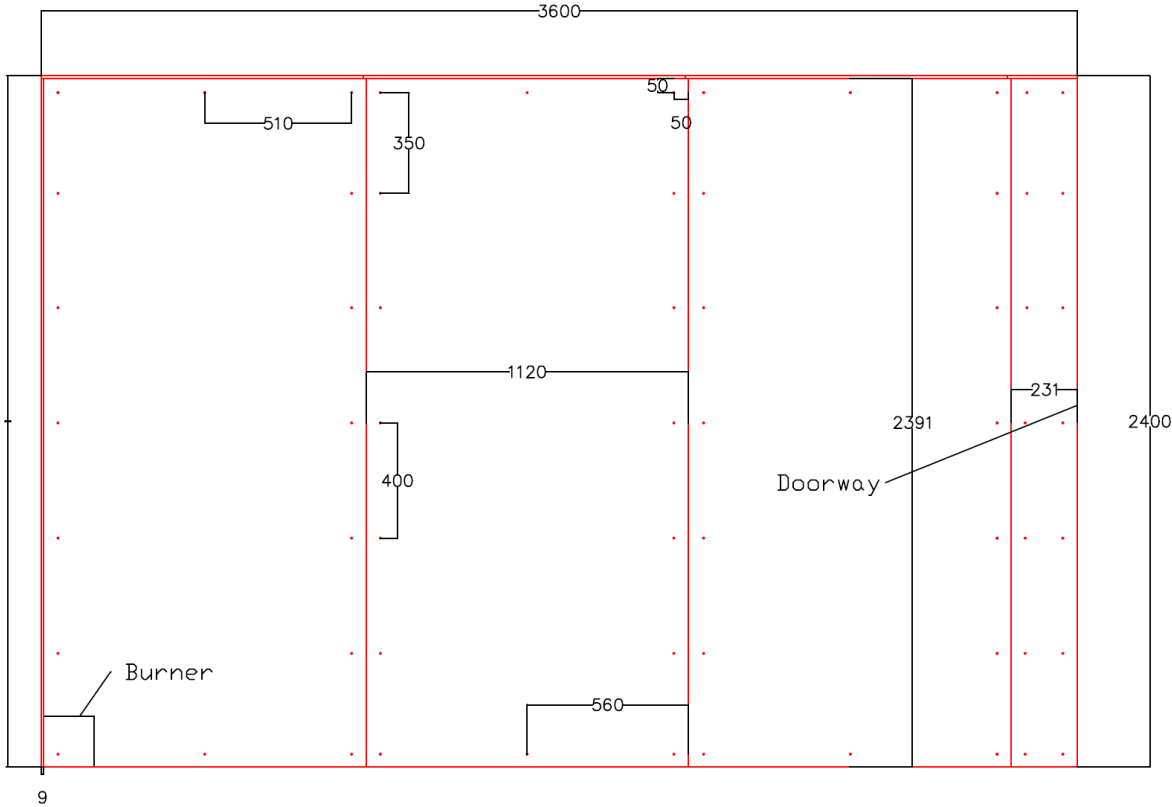


Figure A1.3: East Side Wall
(Dimensions in mm)

APPENDIX 2 TEST OBSERVATIONS

The following include observations of the significant behaviour of the specimen.

Time		Observations
Min	Sec	
00	00	9705 ISO room burn test commenced
02	00	Burner ignition with an exposure of 100kW
02	19	Panel at burner corner starting to melt
02	40	Wall panels near burner corner melted
03	45	Ceiling panel corner near to burner melted
04	15	Deformation of ceiling panel started
05	00	Wall plasterboard at burner corner charred
06	00	Thin smoke layer started to form
09	00	Melted ceiling panel droplets falling
12	03	Burner exposure increased to 300kW
12	22	Ceiling panels melted
12	30	Rear wall and right wall panels melted
13	05	Top half of left wall panels melted
13	45	Charring of top half wall plasterboard
15	30	More ceiling panel droplets fell near doorway
16	00	Top half of right wall panels melted
16	45	Ceiling panel layer start falling
19	00	Melting of rear wall panels
20	00	Burner out
21	05	Burner on
23	00	End of 9705 ISO room burn test

APPENDIX 3 TEST DATA

A 3.1 HEAT FLUX

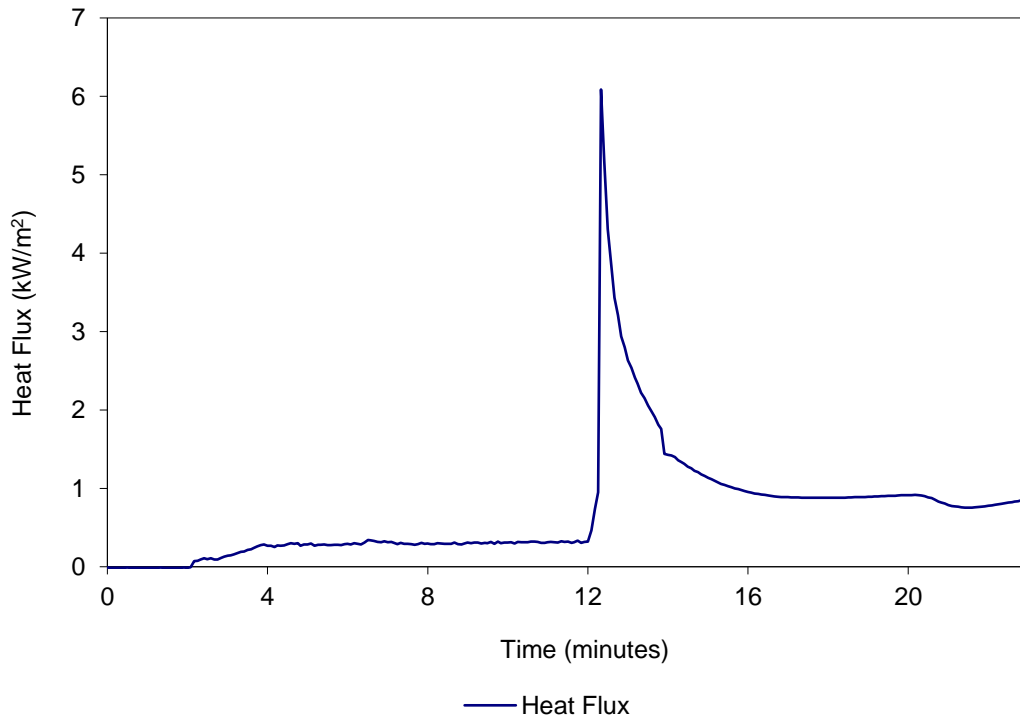


Figure A3.1: Heat flux vs time

A 3.2 VOLUME FLOW

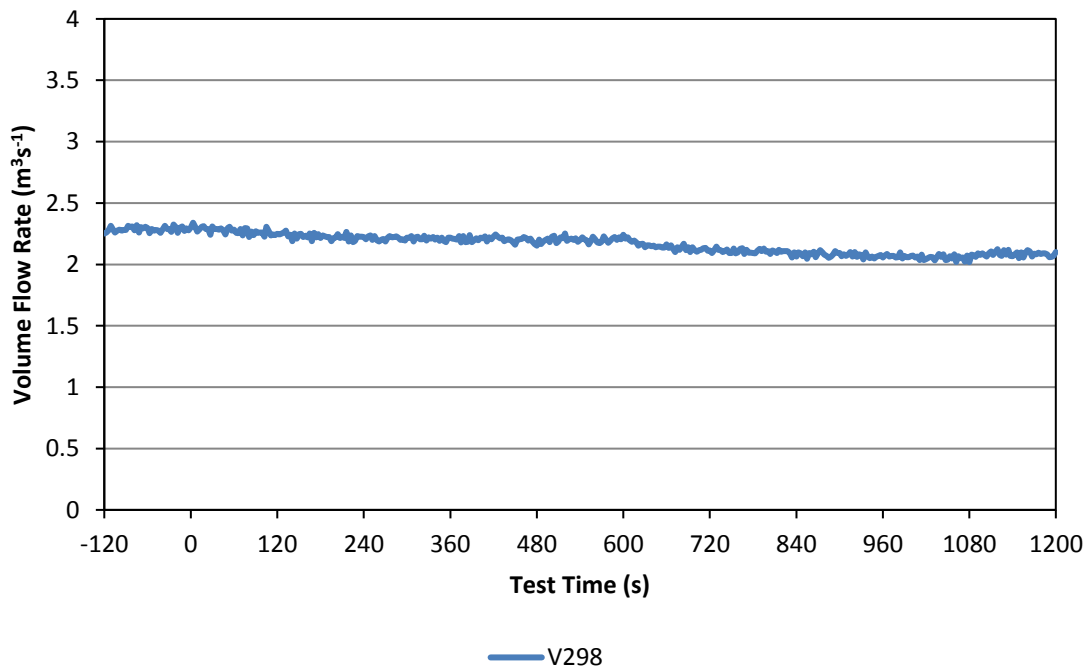


Figure A3.2: Volume flow rate in duct vs time

A 3.3 HEAT RELEASE RATE

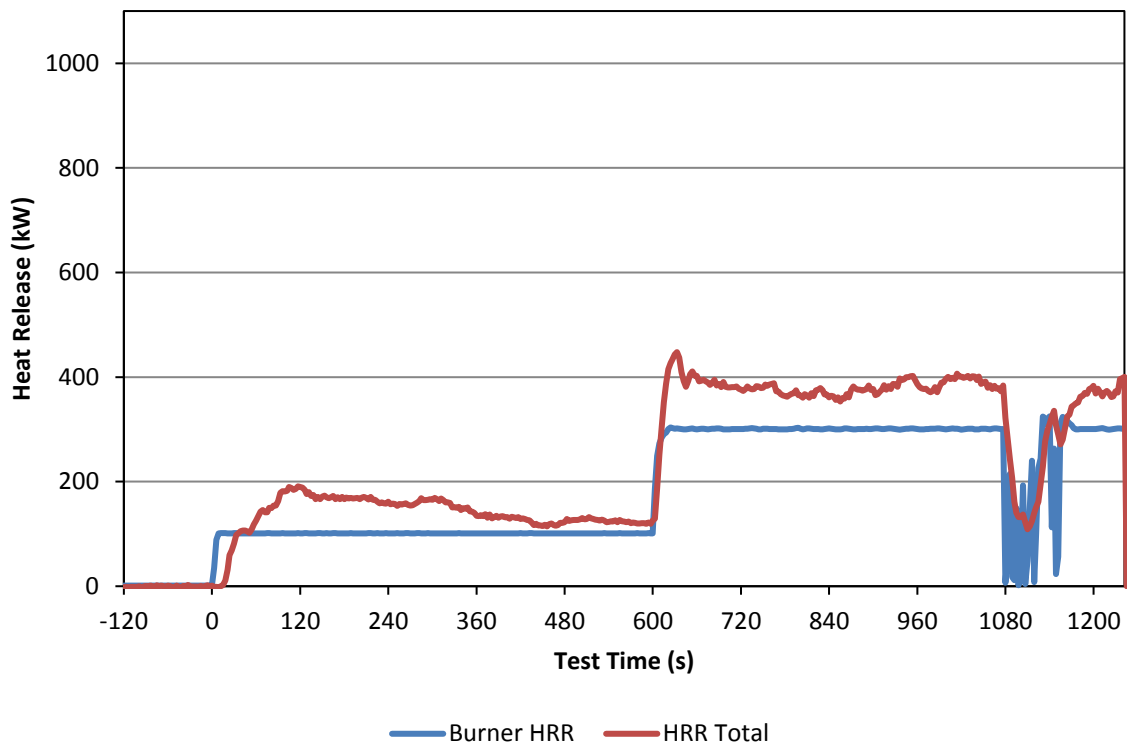


Figure A3.3: Heat Release Rate (HRR) of specimen and burner vs time

A 3.4 CARBON MONOXIDE PRODUCTION

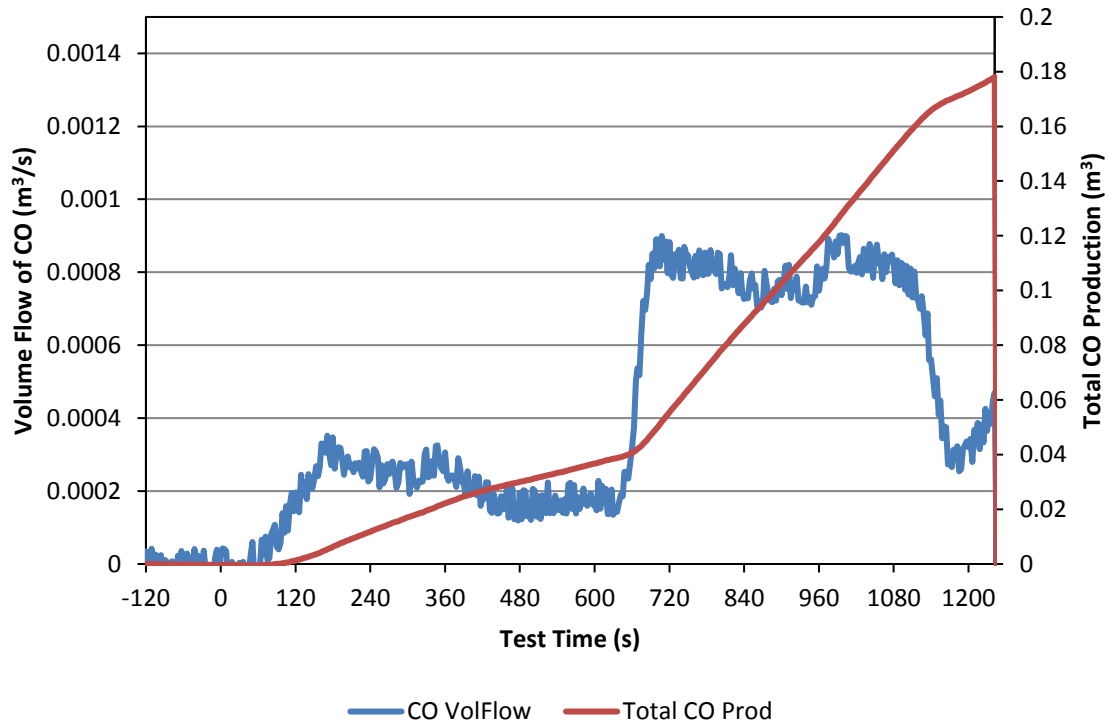


Figure A3.4: Production of carbon monoxide versus time, at reference temperature and pressure

A 3.5 CARBON DIOXIDE PRODUCTION

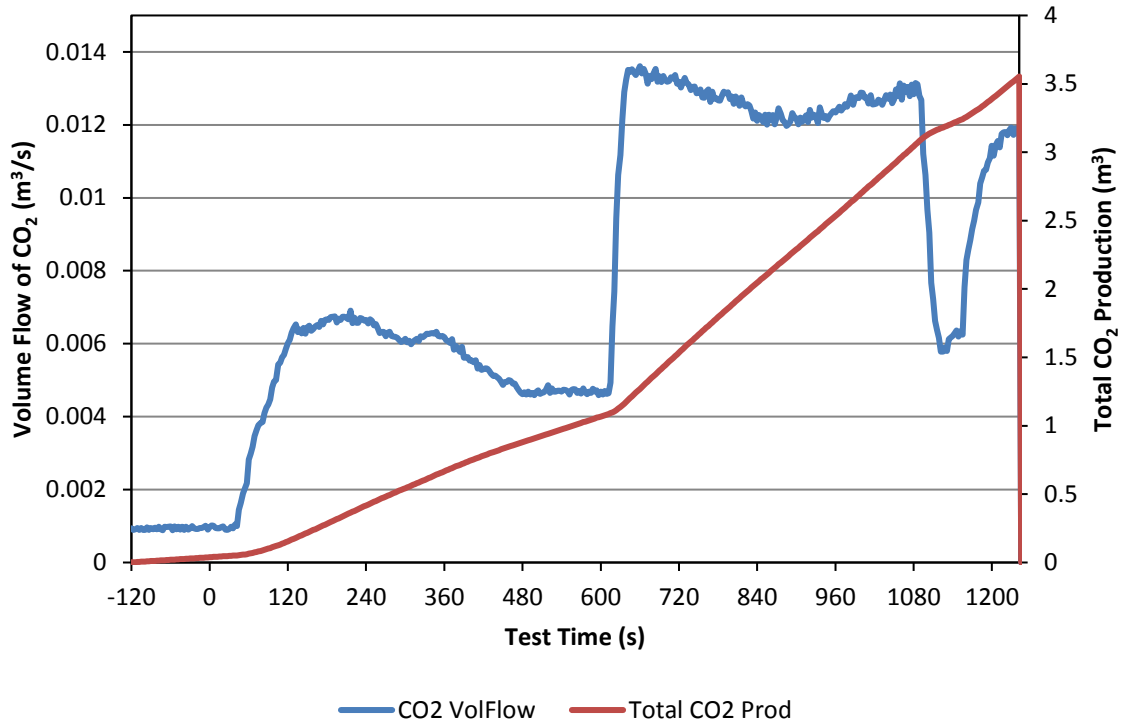


Figure A3.5: Production of carbon dioxide versus time, at reference temperature and pressure

A 3.6 SMOKE PRODUCTION RATE

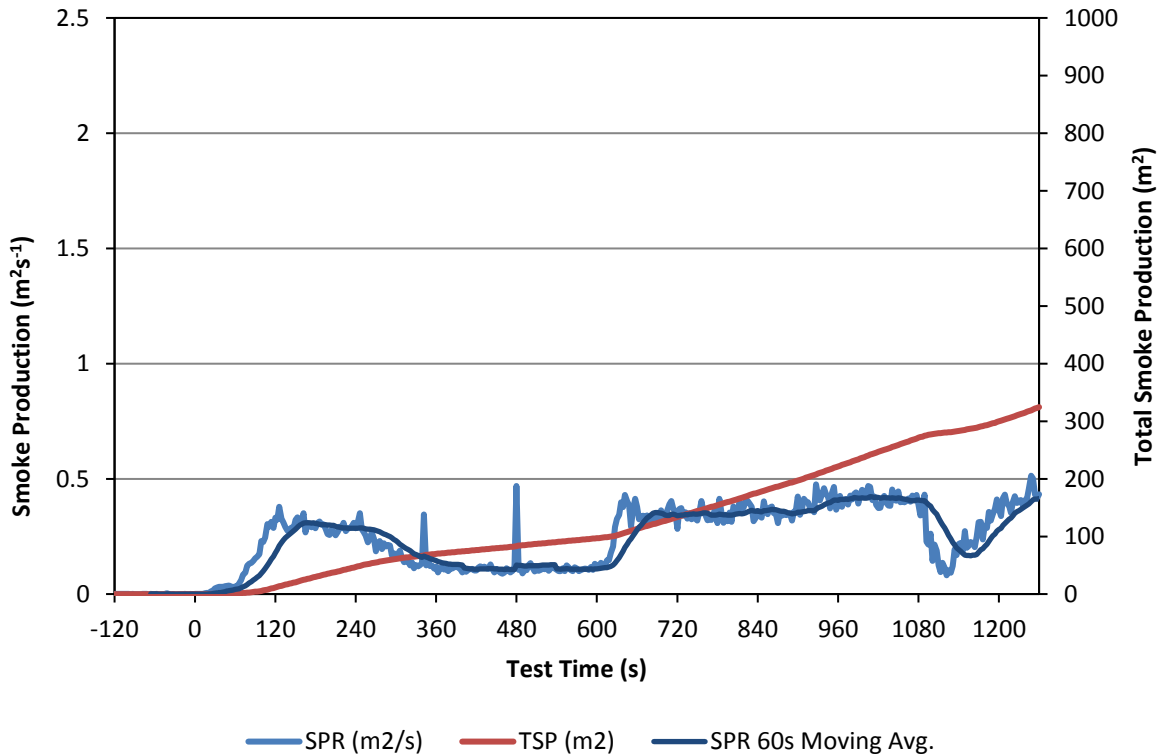


Figure A3.6: Production of light obscuring smoke versus time.

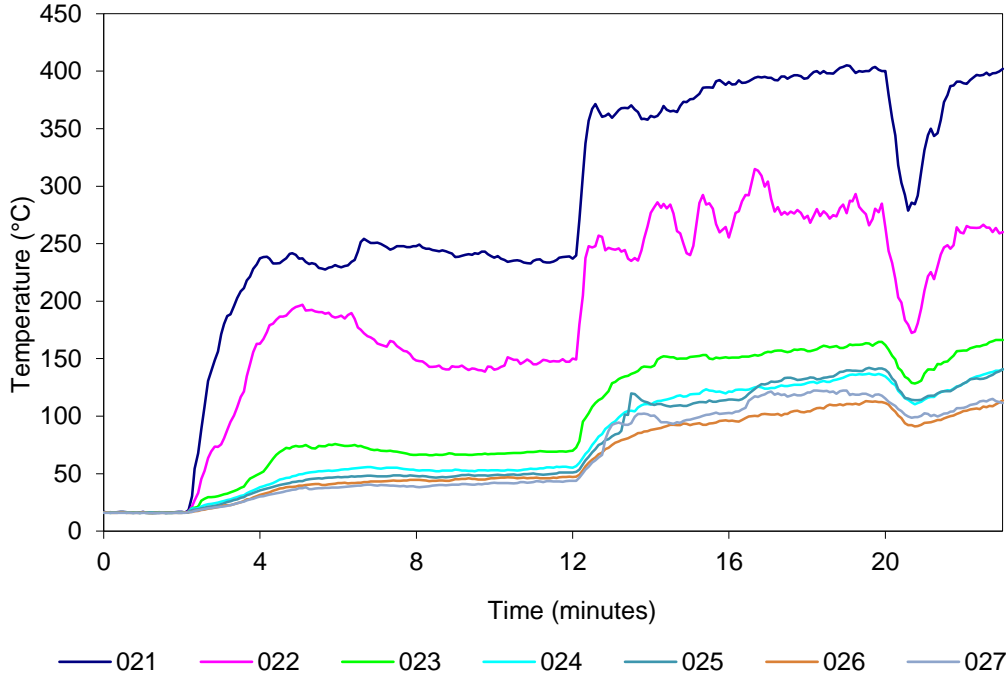


Figure 6: Temperature at height in the corner opposite to the burner vs. time.
21: 2.00m 22: 1.72m 23: 1.57m 24: 1.42m 25: 1.27m 26: 9.70m
27: 0.67m (from the room floor)

APPENDIX 4 PHOTOGRAPHS



Figure A4.1. Exposed corner of the specimen before commencement of the reaction to fire test.



Figure A4.2 Specimen at the commencement of the fire test

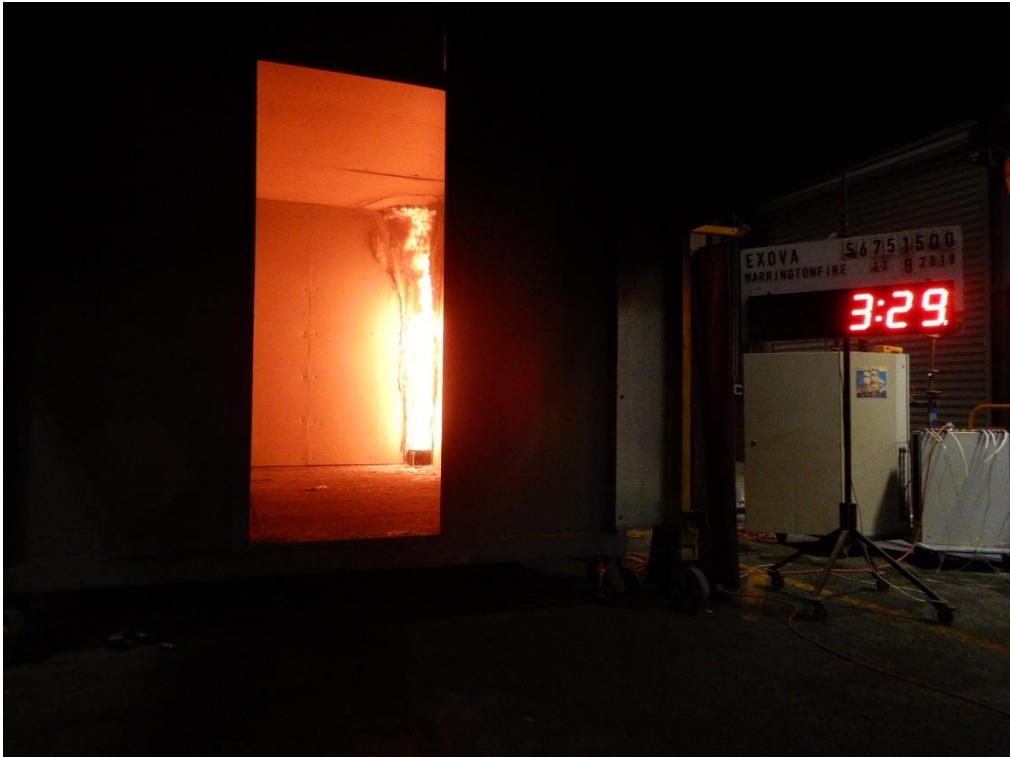


Figure A4.3 Specimen 3 minute 29 seconds after commencement of the reaction to fire test.



Figure A4.4 Specimen 11 minutes and 57 seconds after commencement of the reaction to fire test.



Figure A4.5 Specimen 12 minutes 52 seconds after commencement of the reaction to fire test.



Figure A4.6 Specimen 19 minutes 29 seconds after commencement of the reaction to fire test.



Figure A4.7 Specimen at end of test



Figure A4.8 Specimen 5 seconds after burner cut off