



Sponsor:

Fire Combat Australia Pty Ltd
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NSW 2009

Test Report – Fire Resistance:

TESTING PERFORMED ON: A representative roof section comprising steel roofing sheet, insulation, timber framing and FCA board.

TEST DATE:	06/12/2017
REPORT WRITTEN BY:	M. Lewis
REPORT DATE:	16/01/2018
RTL REPORT NO:	TR-F013.01 (PR0039)
TEST ID:	FR013S4/2017
SCOPE:	Measurement of fire resistance in general accordance with AS1530.4-2014 Sections 1, 2 & 4

1. DOCUMENT HISTORY

Revision #	Date	Sent to	Additional Information
TR-F013.DR (PR0039)	25/01/2018	Client	Draft issue for comment
TR-F013.01 (PR0039)	01/02/2018	Client	Final Issue

2. TESTING FACILITY NAME AND ADDRESS

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3. REPORT AUTHORISATION

Report Written by	Title	Date	Signature
M. Lewis	Technical Manager Fire & Smoke	01/02/2018	


Report Authorised by	Title	Date	Signature
M. Lewis	Technical Manager Fire & Smoke	01/02/2018	

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4. REPORT SUMMARY

Fire resistance test on a representative roof section comprising steel roofing sheet, insulation, timber framing and FCA board. The test was carried out with the outside (steel roof sheeting side) exposed to the furnace. The specimen under test achieved the following fire-resistance levels in accordance with AS1530.4-2014.

Specimen

Test Results	
Structural adequacy	n/a
Integrity	61 minutes ¹
Insulation	55 minutes
FRL	-/60/30

¹ No failure recorded

5. INTRODUCTION

This report details a test carried out on a representative section of a roofing system comprising of corrugated steel roof sheet fixed to steel top hats with insulation fixed between, the top hats were fixed through the FCA board into timber trusses forming the non-fire side. The specimen was exposed to the interior of the furnace from the “outside” (corrugated steel facing furnace) The test was carried out in general accordance with AS 1530.4-2014 to measure the fire-resistance of the specimen. The specimen under test was installed into a steel restraint frame suitable for mounting to the test apparatus.

6. STANDARDS

The measurements leading to the results presented in this report have been undertaken in accordance with standards which specify a method for measuring the fire resistance of building elements:

- AS 1530.4—2014 Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction.

The test facility and equipment were in accordance with:

- AS 1530.4—2014 Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction.

7. DEVIATIONS FROM THE TEST STANDARD:

Pressure – there were a number of pressure variances outside of the control parameters during the test. These are not considered to have adversely affected the test results.

Section 4 of AS 1530.4-2014 requires horizontal separating elements to be subjected to fire exposure from below. As this specimen was inverted to expose the “outside” of the roof system to the furnace the exposure condition stipulated was varied. The sponsor requested this exposure as the intent for the test was to evaluate the specimen for Integrity and Insulation performance for an intended bushfire protection roofing system.

8. PERFORMANCE CRITERIA

Criteria of Failure

Under AS1530.4-2014 the following conditions are set out to describe failure of the element under test with regards to:

Structural Adequacy (loadbearing capacity)

No load was applied for this test. Structural adequacy not evaluated.

Integrity

Failure in relation to integrity shall be deemed to have occurred when evaluated in accordance with Clauses 2.13.2.2 to 2.13.2.4.

The measurement of the integrity of the test specimen shall be made by cotton pad, gap gauge or sustained flaming. For uninsulated assemblies, other than service penetrations, the cotton pad is deemed inappropriate and gap gauges shall be used. The cotton pad is also deemed inappropriate, except for penetration systems, where a fixed or roving thermocouple measures a temperature exceeding 300°C.

Insulation

The measurement of insulation performance is made by thermocouples on the unexposed face compared to the initial temperature.

The specimen shall be deemed to have failed when:

The average temperature on the unexposed face of the test specimen exceeds the initial temperature by more than 140 K; or

The temperature at any location on the unexposed face of the test specimen exceeds the initial temperature by more than 180 K.

Radiation

Not evaluated for this test.

9. CONSTRUCTION DETAILS

Manufacture Information

Lining boards manufactured by Fire Combat Australia Pty Ltd

Sealants manufactured by TREMstop

Insulation manufactured by CSR

Fixings manufactured by Buildex

Supporting Construction

No supporting construction was used for this test.

Test Specimen Description (client supplied and verified)

Roofing:

Colorbond roofing, custom orb style 0.48 BMT fixed to 90mm depth steel top hat sections 0.75 BMT set at 300 mm centres and screw fixed through the FCA MBE SE10 MgO sheets into the 90mm x 35mm timber trusses with Buildex self-tapping timber and steel application M6 x 50 Hex head exterior use fixings.

Truss specification:

Three timber truss sections measuring 2.03 m x 90 mm x 35 mm formed the rear or back structure (unexposed face) to emulate the truss section of the roof support.

Frame specification:

The square timber frame 2.1 m x 2.1 m was composed of 4 timber sections 90 mm x 35mm MGP10 2.1 m length these were secured with Buildex timber fixings as below (fixings).

Steel Top Hats:

7 off 90mm 0.75 BMT top hat sections were fixed to the 10mm FCA board and through into the timber trusses using Buildex self-taping M6 x 50mm screws which was further screwed to the timber trusses using the same screw specification.

Fire rated cladding:

The 10mm cladding board was screw fixed with 50mm M6 x 50 Hex screws specified above directly to the timber trusses at 200 mm centres with no fire-resistant vapour barrier for this test.

Insulation:

A 90mm thick CSR Bradford Anticon fire resistant fibre glass wool blanket was used as fire insulation and laid across and between the steel top hat sections prior to fixing the roof sheets.

Fixings:

The screw fixings were corrosion proof Buildex Self tapping timber and metal, Galvanised M6 x 50mm roofing screws to suit such fixings to the outer frame through the steel roof and the top hat sections.

Fire Sealant:

The exposed face timber truss facings were covered with 2 x 3mm beads of TREMstop PU fire sealant. The TREMstop PU was compressed/spread under the 10mm sheets when applied to the outer lower facings of the exposed inner board side of the module frame and screw fixed together into the timber trusses.

The centre joint was also filled with the sealant on compression and fixing at 200mm centres.

The edges and all cavities and potential air gap infiltration points of the joints were all similarly treated with TREMstop PU and the edge section of the custom orb open edges filled with the CSR Bradford Anticon 90mm blanket. This was compressed over the 0.75BMT steel top hats.

10. SUPPORT AND RESTRAINT CONDITIONS

The test specimen, measuring approximately 2.1m x 2.1m was installed within a steel test frame suitable for mounting onto the test furnace. The specimen was simply supported on all four sides of the test frame and sat upon a ceramic fibre blanket creating a seal. On insertion of the module into the specimen test frame the gap between the edges of the module and the steel frame were further protected with a fibre ceramic filling to seal the corrugation gaps and ensure a seal to the entire perimeter.

Due to the lightweight nature of the roofing system, it was restrained within the test specimen frame by way of 4 mechanical clamps, two on the West edge and two on the East edge. The clamps were only tightened to exert a small amount of force to the perimeter frame so as to ensure the sample would remain in place.

11. PRE-TEST CONDITIONING

The specimen was completed on 1st Dec and left to cure in the indoor laboratory environment for 5 days.

12. DIRECTION OF EXPOSURE

The specimen was subjected to fire exposure from the underside, the exposed side of the specimen was the “outside” of the roof system.

13. SELECTION OF TEST SPECIMEN

The laboratory was not involved in the selection of any specimen materials for this test. The Client supplied and installed all materials for their specimen.

14. TEST PROCEDURE

Furnace Heating Conditions – Temperature Curve

The temperature of the furnace shall be controlled to vary with time, as close as possible, in accordance with the following relationship:

$$T = 345 \log_{10} (8t + 1) + 20$$

Where

T = furnace temperature at time (t), in degrees centigrade

T = time into the test, measured from the ignition of the furnace, in minutes

Laboratory Ambient Temperature at Commencement of fire test

At 10:24 on the 6th Dec at the commencement of the test, the indoor ambient temperature was 29°C. Over the 61-minute test duration the temperature increased to 31°C.

Furnace Pressure Differential

Furnace pressure was measured with a Dwyer Magnesense pressure transmitter (S:N 71640), with a probe located 100mm below the underside of the test specimen.

Specimen Temperatures

Specimen temperatures measured with type K thermocouples of wire diameter not exceeding 0.5mm, with the measuring junction silver soldered to the face of a 12mm diameter by 0.2mm thick copper disc. Each thermocouple shall be covered with a 30±0.5mm x 30±0.5mm x 2.0±0.5mm thick millboard pad.

Deflection Measurement

Deflection measurement was not taken during this test.

15. TEST RESULTS

Performance (whole minutes and FRL)

Specimen

Test Results	
Structural adequacy	n/a
Integrity	61 minutes ¹
Insulation	55 minutes
FRL	-/60/30

STATEMENTS

THE RESULTS OF THESE FIRE TESTS MAY BE USED TO DIRECTLY ASSESS FIRE HAZZARD, BUT IT SHOULD BE RECOGNIZED THAT A SINGLE TEST METHOD WILL NOT PRODUCE A FULL ASSESSMENT OF FIRE HAZARD UNDER ALL FIRE CONDITIONS.

THIS REPORT DETAILS METHODS OF CONSTRUCTION, THE TEST CONDITIONS AND THE RESULTS OBTAINED WHEN THE SPECIFIC ELEMENT OF CONSTRUCTION DESCRIBED HERIN WAS TESTED FOLLOWING THE PROCEDURE OUTLINED IN AS1530.4. ANY SIGNIFICANT VARIATION WITH RESPECT TO SIZE, CONSTRUCTION DETAILS, LOADS STRESSES, EDGE OR END CONDITIONS, OTHER THAN THAT ALLOWED UNDER THE FIELD OF DIRECT APPLICATION IN THE RELEVANT TEST METHOD, IS NOT COVERED BY THIS REPORT.

BECAUSE OF THE NATURE OF FIRE RESISTANCE TESTING AND THE CONSEQUENT DIFFICULTY IN QUANTIFYING UNCERTAINTY OF MEASUREMENT OF FIRE RESISTANCE TESTING, IT IS NOT POSSIBLE TO PROVIDE A STATED DEGREE OF ACCURACY OF THE RESULT.

Test Limitations

The test was conducted on a small-scale furnace and as such not in accordance with the size requirements of the Standard for evaluating a full-size system. The intent of the test was to assess the specimen construction for integrity and insulation performance and the data contained within this report may be used to that end.

16. APPENDIX A - FIGURES

Figure 1: Specimen Thermocouple Locations - Figures

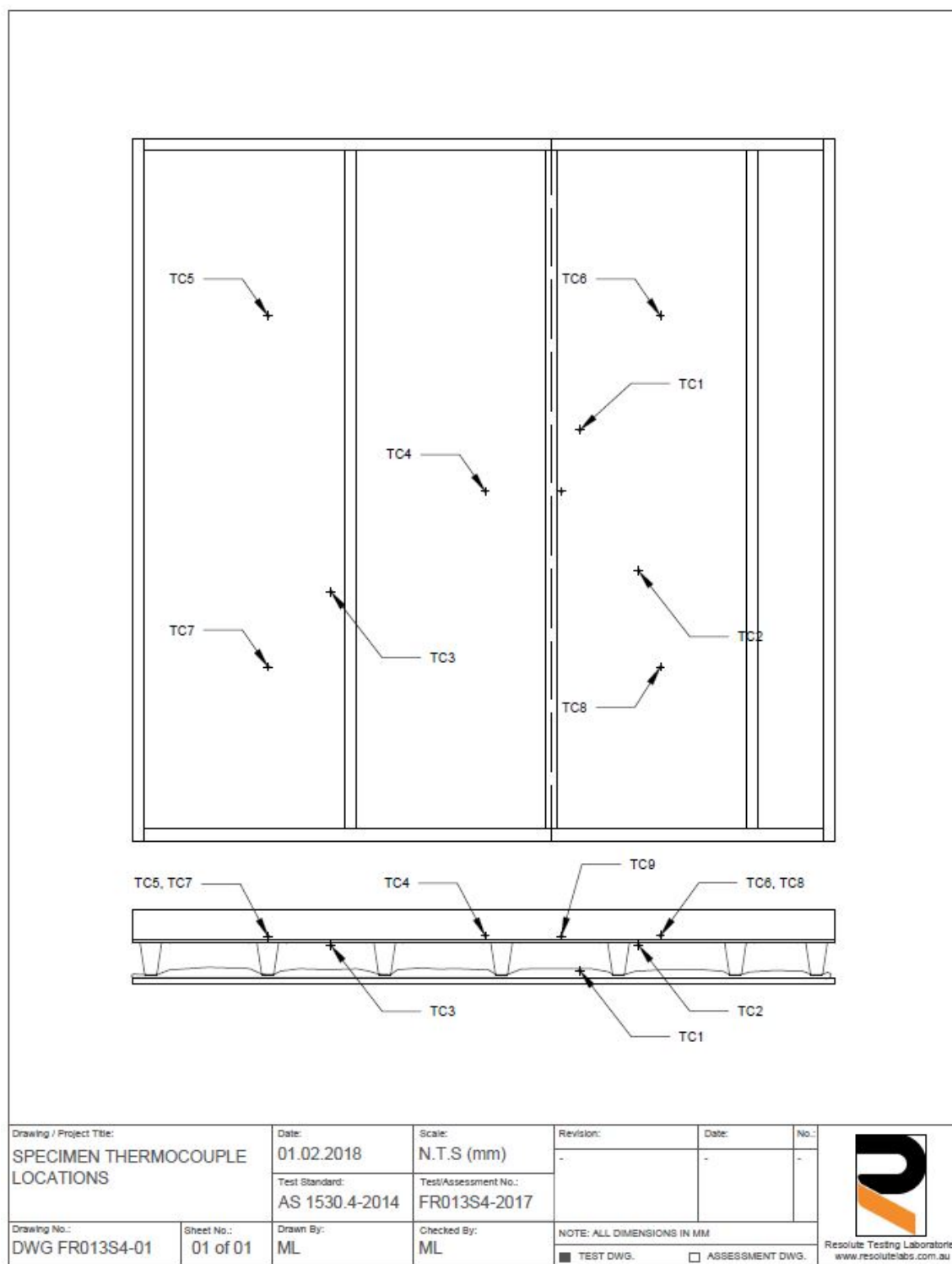


Figure 2: Furnace Temperature

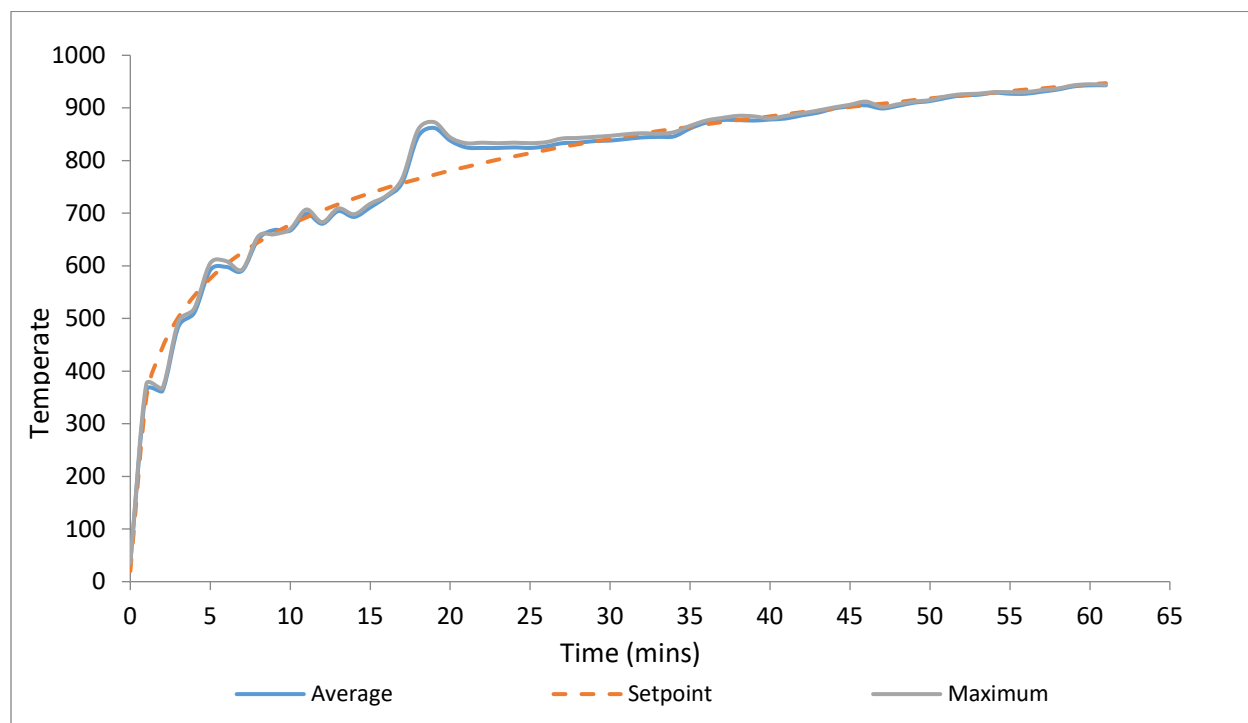


Figure 3: Average Furnace Temperature Severity

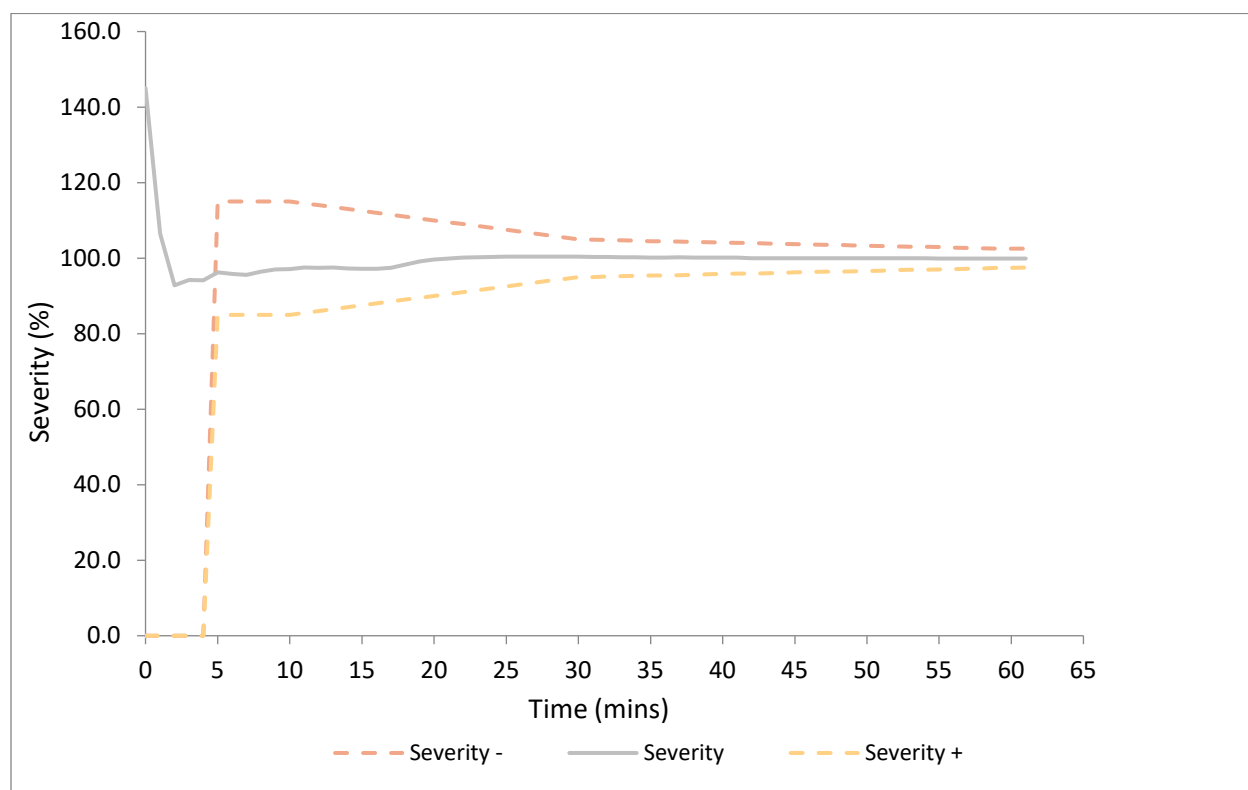


Figure 4: Furnace Pressure

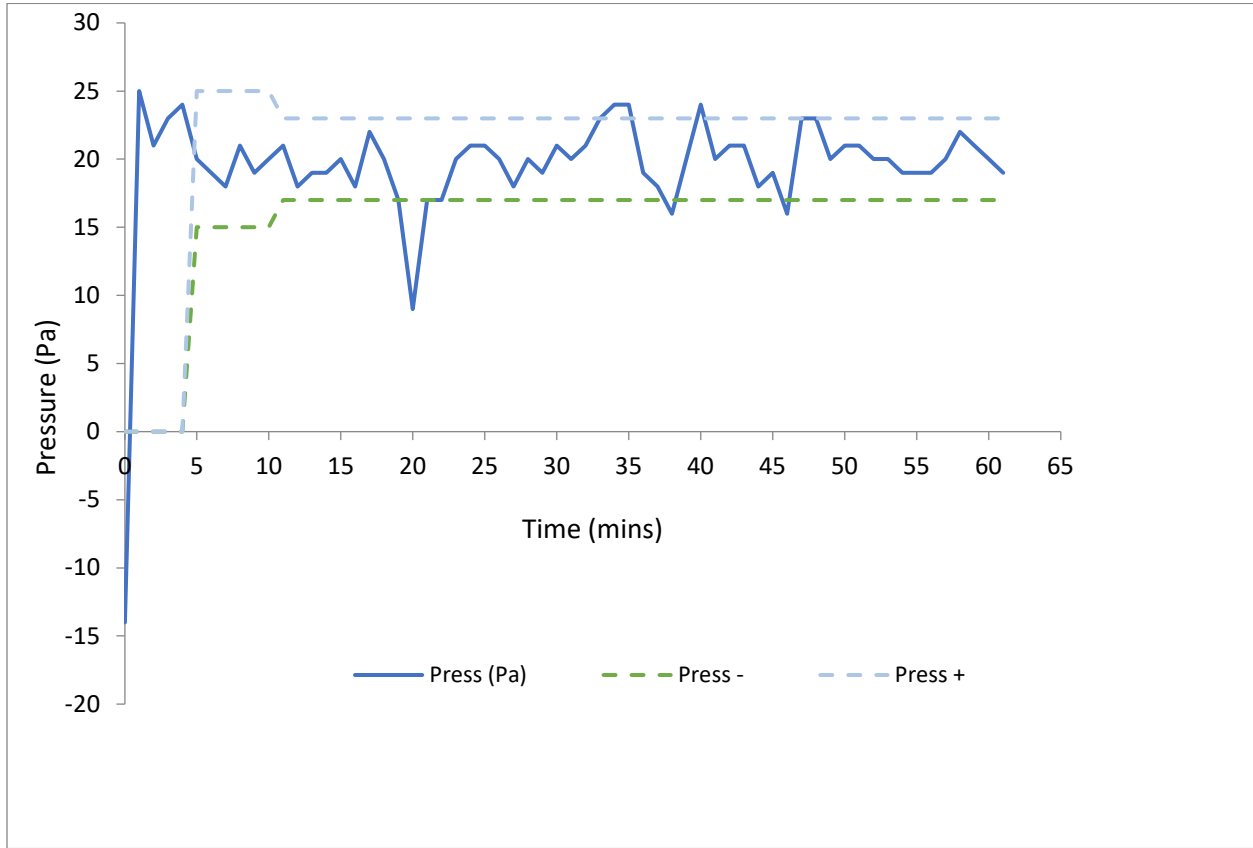


Figure 5: Specimen TC1

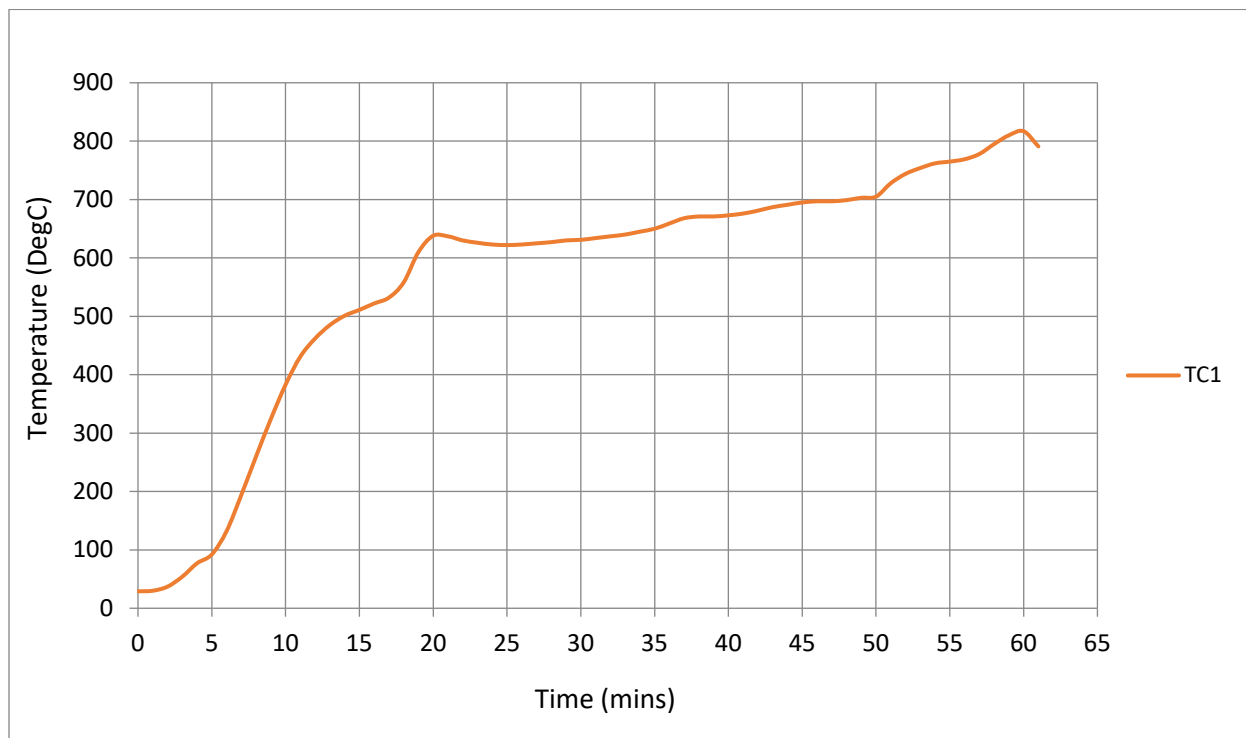


Figure 6: Specimen TC's 2 & 3

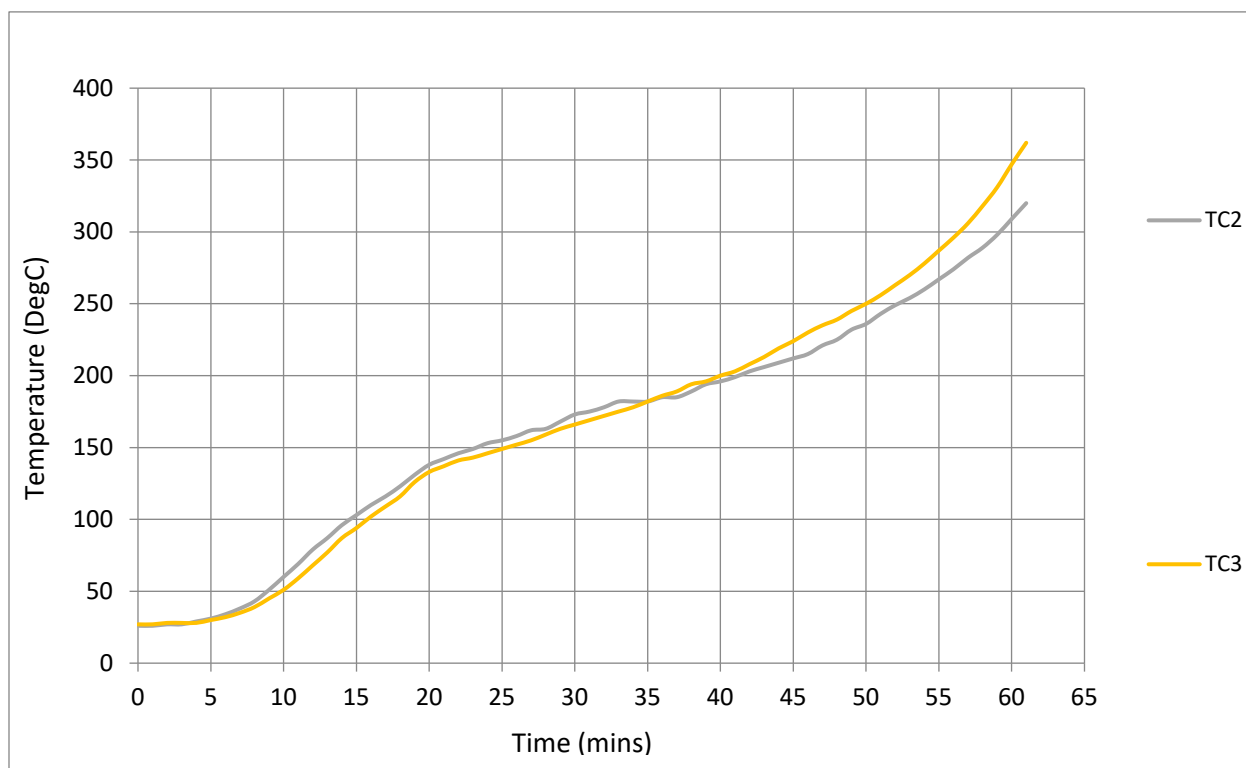


Figure 7: Specimen TC's 4 to 9

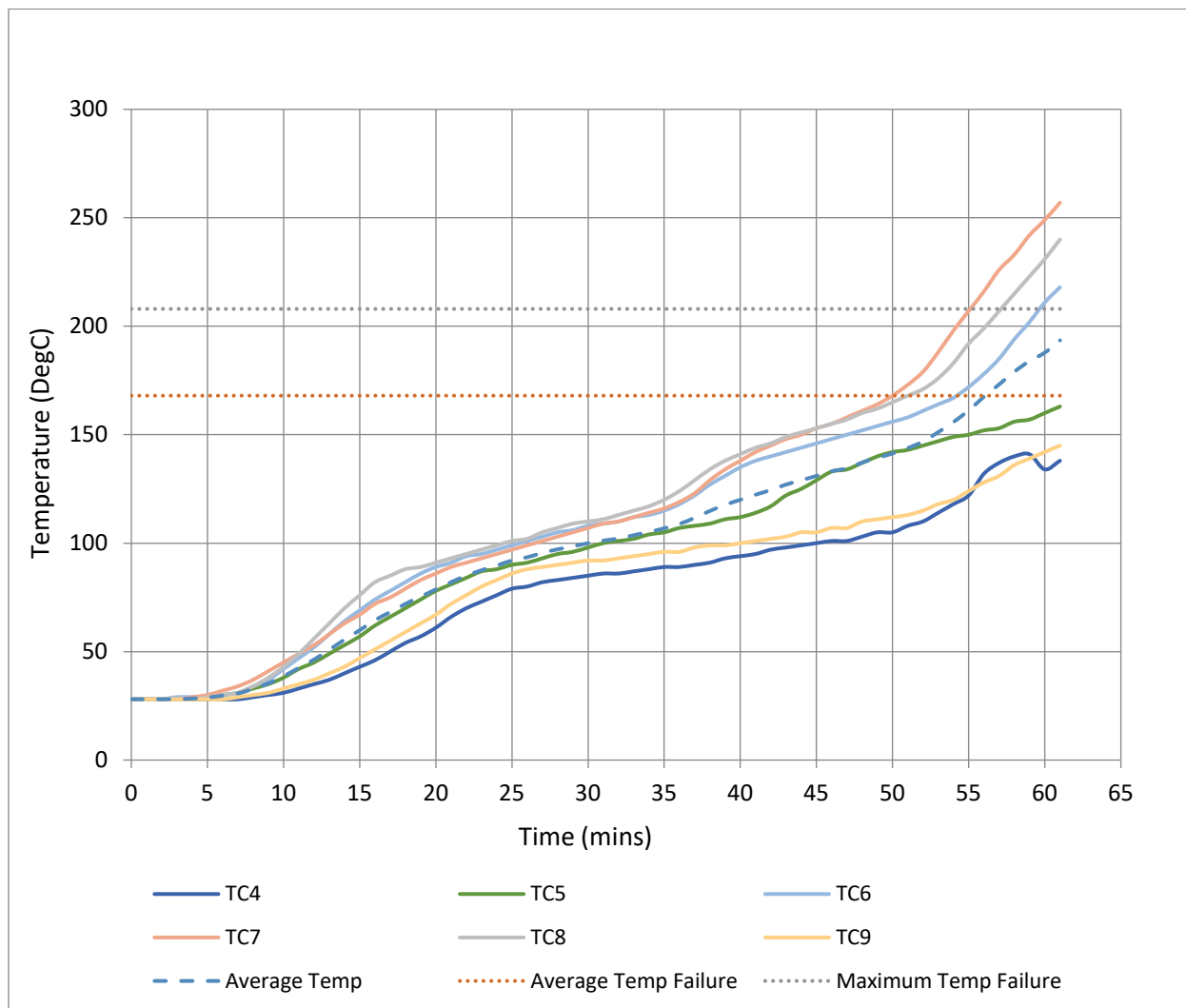
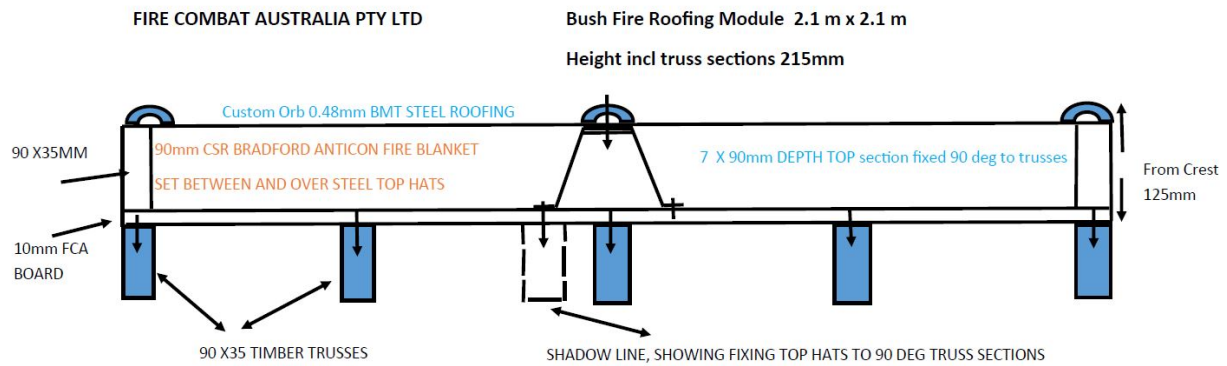


Figure 8: Client Supplied Drawing of Specimen



17. APPENDIX B – TABLES

Table 1: Specimen Temperatures (TC 1 to 9)

TIME	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9
0	29	26	27	28	28	28	28	28	28
1	30	26	27	28	28	28	28	28	28
2	37	27	28	28	28	28	28	28	28
3	54	27	28	28	28	29	28	28	28
4	77	29	28	28	28	29	29	28	28
5	92	31	30	28	29	29	30	29	28
6	132	34	32	28	30	30	32	30	28
7	194	38	35	28	31	31	34	31	29
8	260	43	39	29	33	34	37	34	30
9	324	51	45	30	35	37	41	38	31
10	383	60	51	31	38	42	45	43	33
11	431	69	59	33	42	47	49	49	35
12	462	79	68	35	45	52	53	56	37
13	485	87	77	37	49	58	58	63	40
14	501	96	87	40	53	64	63	70	43
15	511	103	94	43	57	69	67	76	47
16	522	110	102	46	62	74	72	82	51
17	532	116	109	50	66	78	75	85	55
18	558	123	116	54	70	82	79	88	59
19	610	131	126	57	74	86	83	89	63
20	638	138	133	61	78	89	86	91	67
21	637	142	137	66	81	91	89	93	72
22	630	146	141	70	84	94	91	95	76
23	626	149	143	73	87	95	93	97	80
24	623	153	146	76	88	97	95	99	83
25	622	155	149	79	90	99	97	101	86
26	623	158	152	80	91	101	99	102	88
27	625	162	155	82	93	103	101	105	89
28	627	163	159	83	95	105	103	107	90
29	630	168	163	84	96	106	105	109	91
30	631	173	166	85	98	108	107	110	92

Table 1: Specimen Temperatures (TC 1 to 9) cont.

TIME	TC1	TC2	TC3	TC4	TC5	TC6	TC7	TC8	TC9
31	634	175	169	86	100	109	109	111	92
32	637	178	172	86	101	110	110	113	93
33	640	182	175	87	102	112	112	115	94
34	645	182	178	88	104	113	114	117	95
35	650	182	182	89	105	115	116	120	96
36	659	185	186	89	107	118	119	124	96
37	668	185	189	90	108	122	123	129	98
38	671	189	194	91	109	127	129	134	99
39	671	194	196	93	111	131	134	138	99
40	673	196	200	94	112	135	138	141	100
41	676	199	203	95	114	138	142	144	101
42	681	203	208	97	117	140	145	146	102
43	687	206	213	98	122	142	148	149	103
44	691	209	219	99	125	144	150	151	105
45	695	212	224	100	129	146	153	153	105
46	697	215	230	101	133	148	155	155	107
47	697	221	235	101	134	150	158	157	107
48	699	225	239	103	137	152	161	160	110
49	703	232	245	105	140	154	164	162	111
50	705	236	250	105	142	156	168	165	112
51	728	243	256	108	143	158	173	168	113
52	744	249	263	110	145	161	179	171	115
53	754	254	270	114	147	164	188	176	118
54	762	260	278	118	149	167	198	183	120
55	765	267	287	122	150	172	207	192	124
56	769	274	296	132	152	178	216	199	128
57	778	282	306	137	153	185	226	207	131
58	795	289	318	140	156	194	233	215	136
59	810	298	331	141	157	202	242	223	139
60	817	309	347	134	160	211	249	231	142
61	791	320	362	138	163	218	257	240	145

Table 3: Critical Observations

TIME		OBSERVATIONS
MINS	SECS	
15	00	Slight smoke emitting from specimen perimeter.
42	00	Smoke coming from centre most joist (where board join is), slightly south of centre point.
46	00	Some discolouration evident where sealant is thinner at smoke location noted at 42 mins.
55	00	Increasing smoke and discoloration at location noted at 42 mins.
59	00	Cotton pad applied over smoke/discoloration area. Pass.
59	30	FCA board cracked in south-west corner

18. APPENDIX C – PHOTOGRAPHS

Photo Group 1 – Specimen Thermocouple Locations

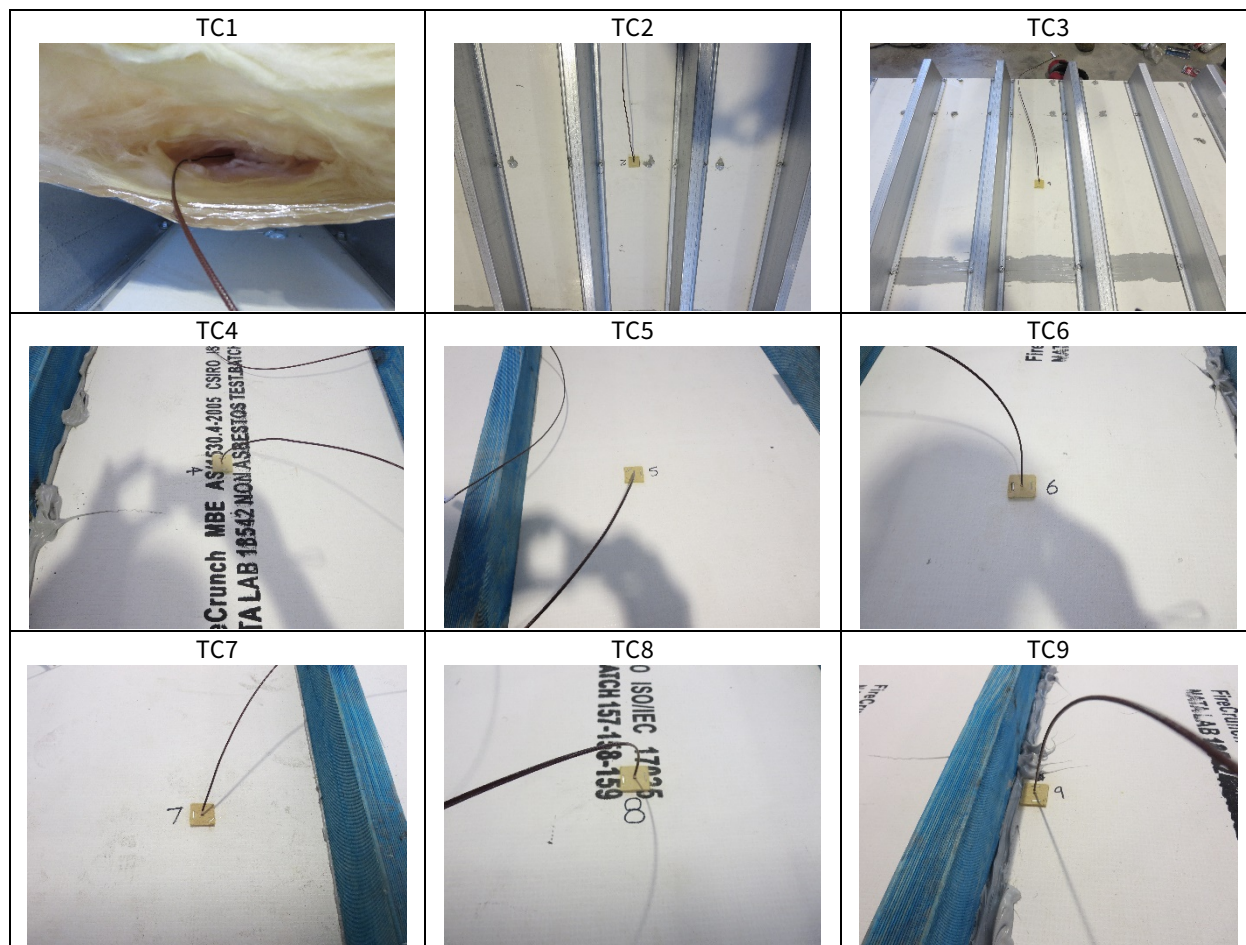


Photo 2 – Exposed side prior to mounting on furnace



Photo 3 – Unexposed side prior to test commencement

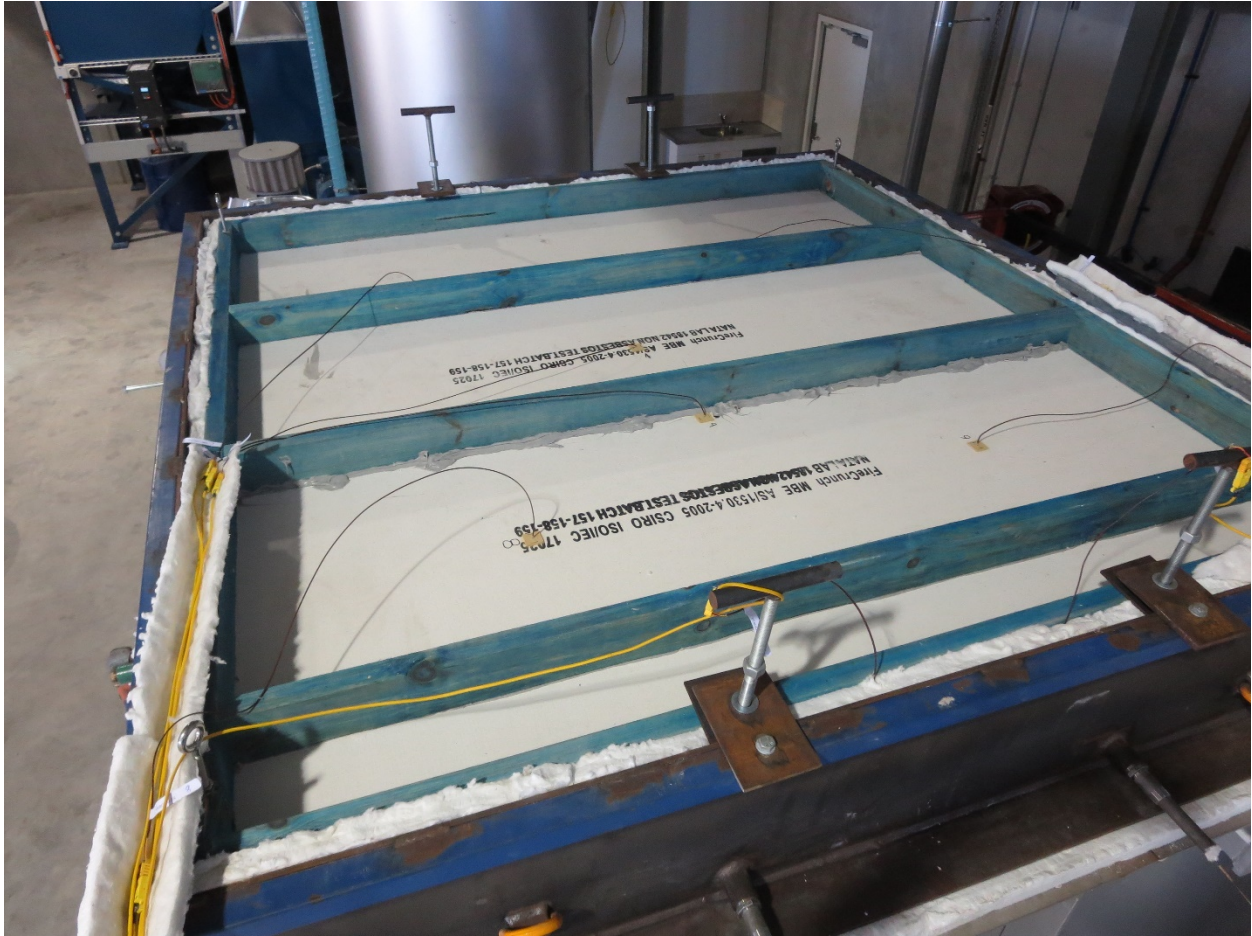


Photo Group 4 – Smoke and discolouration at 55 mins



Photo 5 – Cotton Pad Pass at 59 mins



Photo 6 – Board cracking noted at 59 mins 30 sec



Photo 7 & 8 -Exposed side of specimen after removal from furnace



-----END OF REPORT-----