

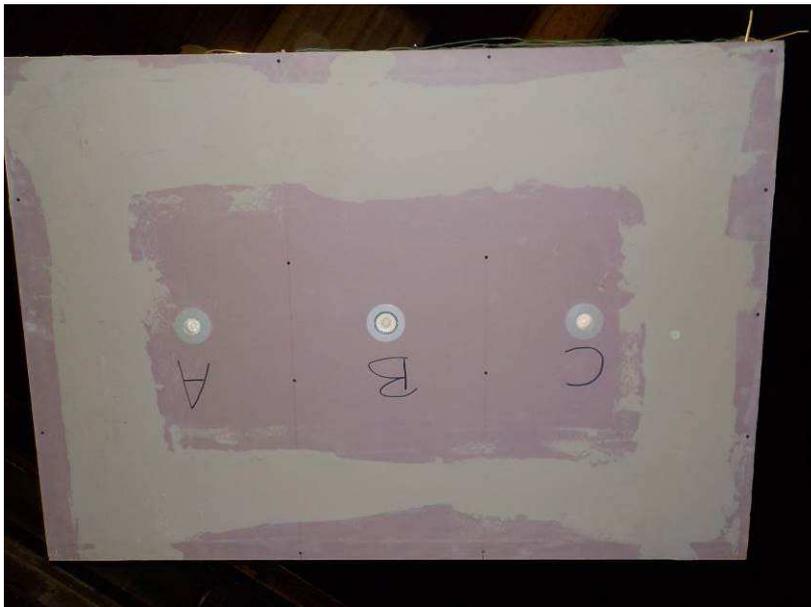
REPORT NUMBER
CFR1810171

**AD HOC FIRE RESISTANCE TEST TO THE
GENERAL PRINCIPLES OF BS 476: PART 21: 1987**

Sponsor: Suzhou Radiant Lighting Technology Co. Ltd.
Address: West Jiatai Road
Shuanglong Industrial Zone
Fenghuang Town
Zhangjiagang
Jiangsu
China
Date of test: 17th October 2018

Results:

Test duration: 100 minutes (test discontinued at request of the sponsor)
Integrity 100 minutes (no failure, the test having been discontinued)
Insulation: 100 minutes (no failure, the test having been discontinued)



Summary of test specimen

A timber joist ceiling sample with three voids and three downlights fitted into 2 x 15 British Gypsum FireLine boards.

LED Downlights

A: 5RS067**
B: 5RS078**
C: 5RS097**

Ceiling size:

1700 long x 1200 wide x 247 deep

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1 PREPARATION FOR TESTING

1.1 Specimen conditioning

The specimen components were at Cambridge Fire Research for a total period of more than 7 days, during which time they were stored, surveyed and prepared for testing. For the final 7 days the temperature and relative humidity were measured and recorded within the range of 14 to 22°C and 50 to 83% respectively.

1.2 Associated construction

Cambridge Fire Research constructed a 90 minute timber joist ceiling sample.

1.3 Specimen construction

The downlights were supplied by the sponsor.

1.4 Specimen verification

Cambridge Fire Research carried out a detailed survey of the specimens to verify the information provided by the sponsor. This included verifying the materials and dimensions of construction components wherever possible.

Details and drawings of the construction are shown in Appendix 1.

Photographs of details of the construction taken before the test are shown in Appendix 2.

1.5 Specimen installation and fixity

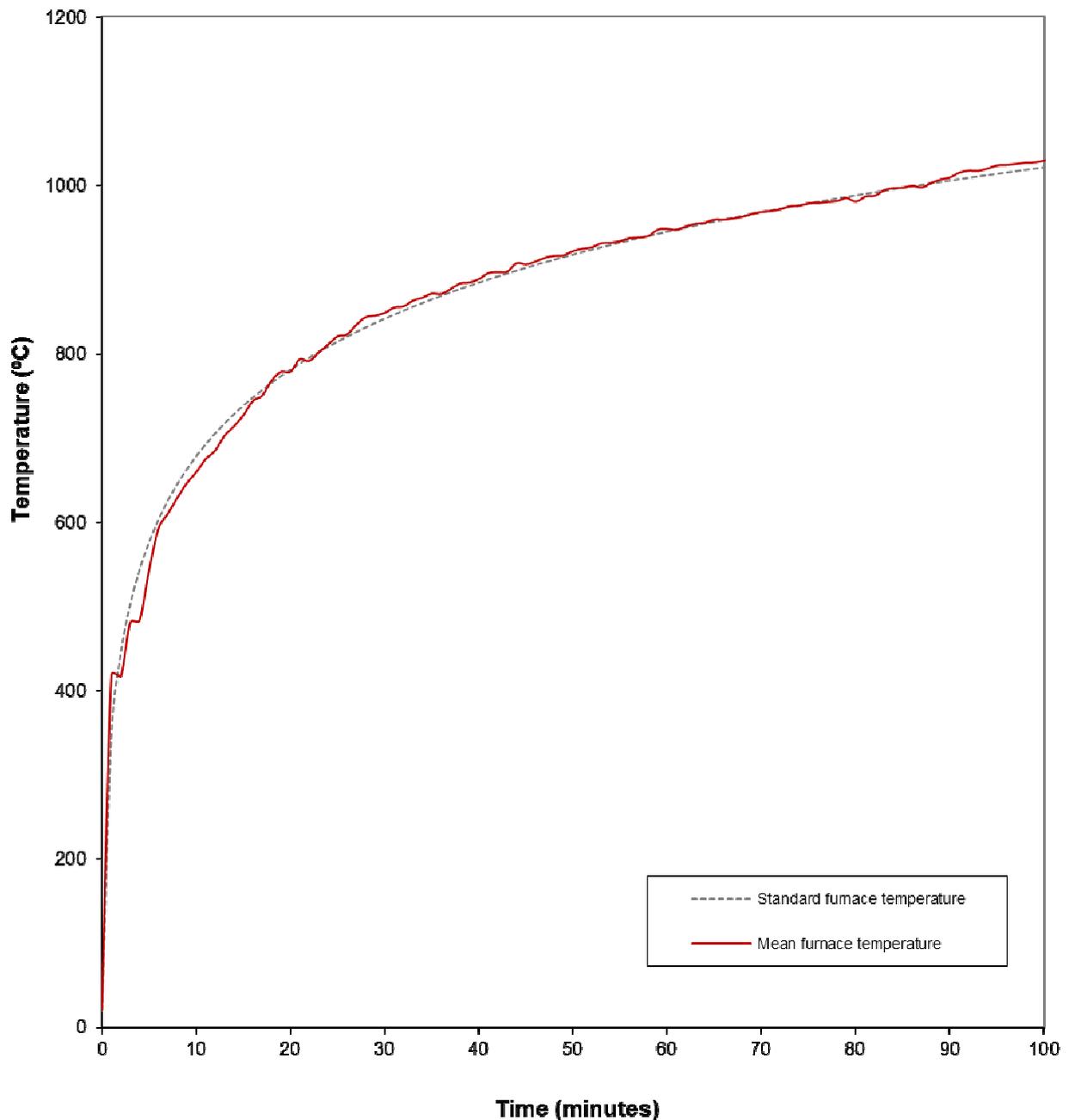
The downlights were installed by Cambridge Fire Research in accordance with the Sponsor's Installation Instructions into the ceiling sample. The installation was carried out from below as in practice.

The construction was simply supported without restraint from thermally induced movement. It was also not subject to external loading during the test.

2 TEST CONDITIONS, INSTRUMENTATION AND MEASURING

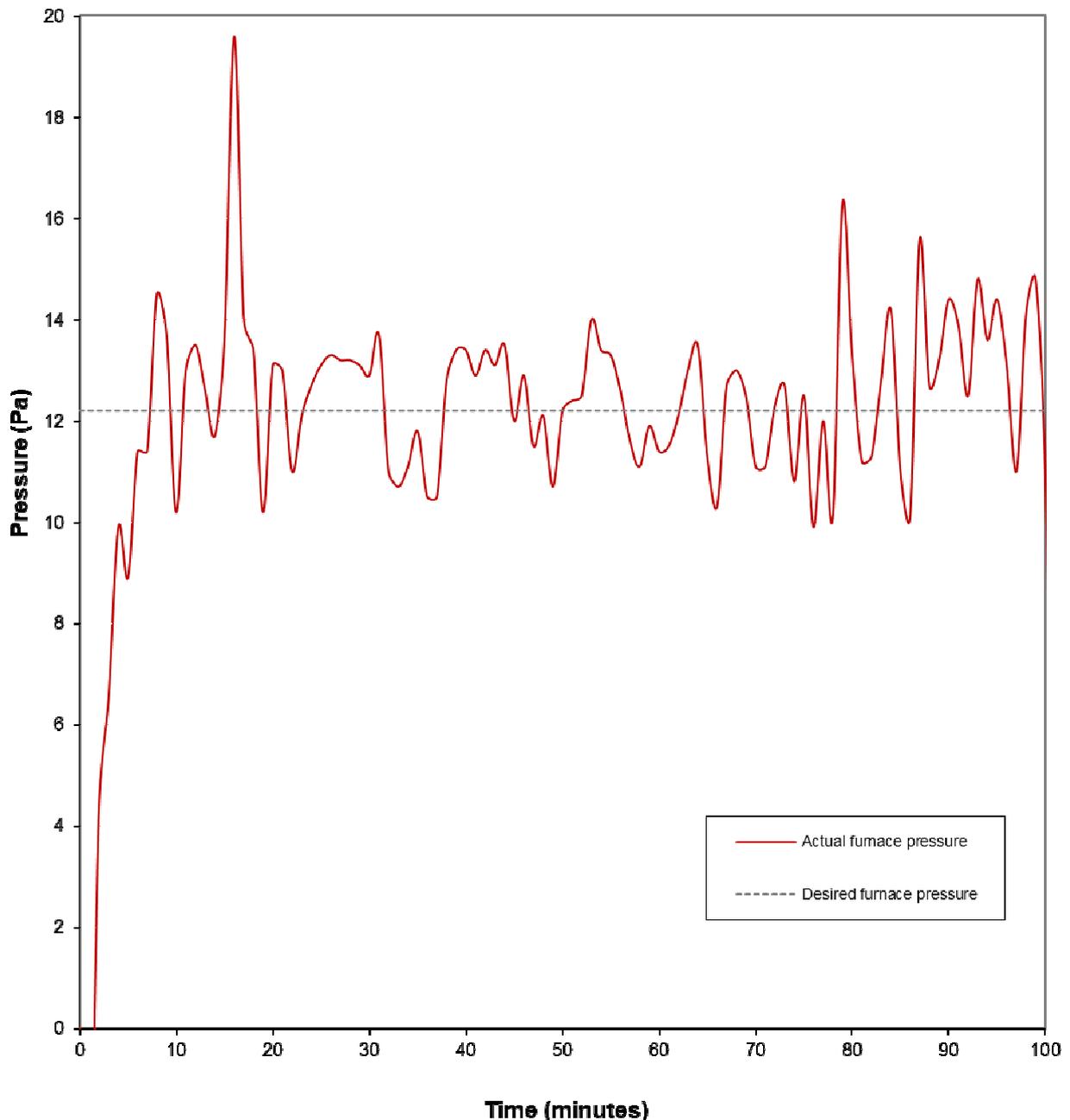
2.1 Furnace temperature

Furnace temperature was controlled so as to follow the standard temperature/time curve defined in the test standard and within the tolerances permitted. The furnace mean temperature was calculated from the output recorded using four furnace thermocouples of the design specified in the test standard. The following graph shows the standard and mean furnace temperature/time data.



2.2 Furnace pressure

Furnace pressure was maintained for the duration of the test at a nominal + 12.2 Pa measured at the pressure sensing head. When a linear pressure gradient of 8.5 Pa/m is applied this equates to + 20 Pa on the underside of the specimen to simulate the furnace conditions for a ceiling measuring 3.35 metres notional height. The furnace pressure was controlled within the tolerances permitted in the test standard except for 12 instantaneous occasions which were transient events. The following graph shows the actual and desired furnace pressure/time data.



2.3 Ambient temperature

Ambient temperature at the start of the test was 17°C.
Ambient temperature ranged between 17°C and 19°C during the test.

2.4 Unexposed face specimen thermocouples

Surface temperature measuring thermocouples of the design specified in the test standard were affixed to the specimen to monitor the temperature rise as follows:

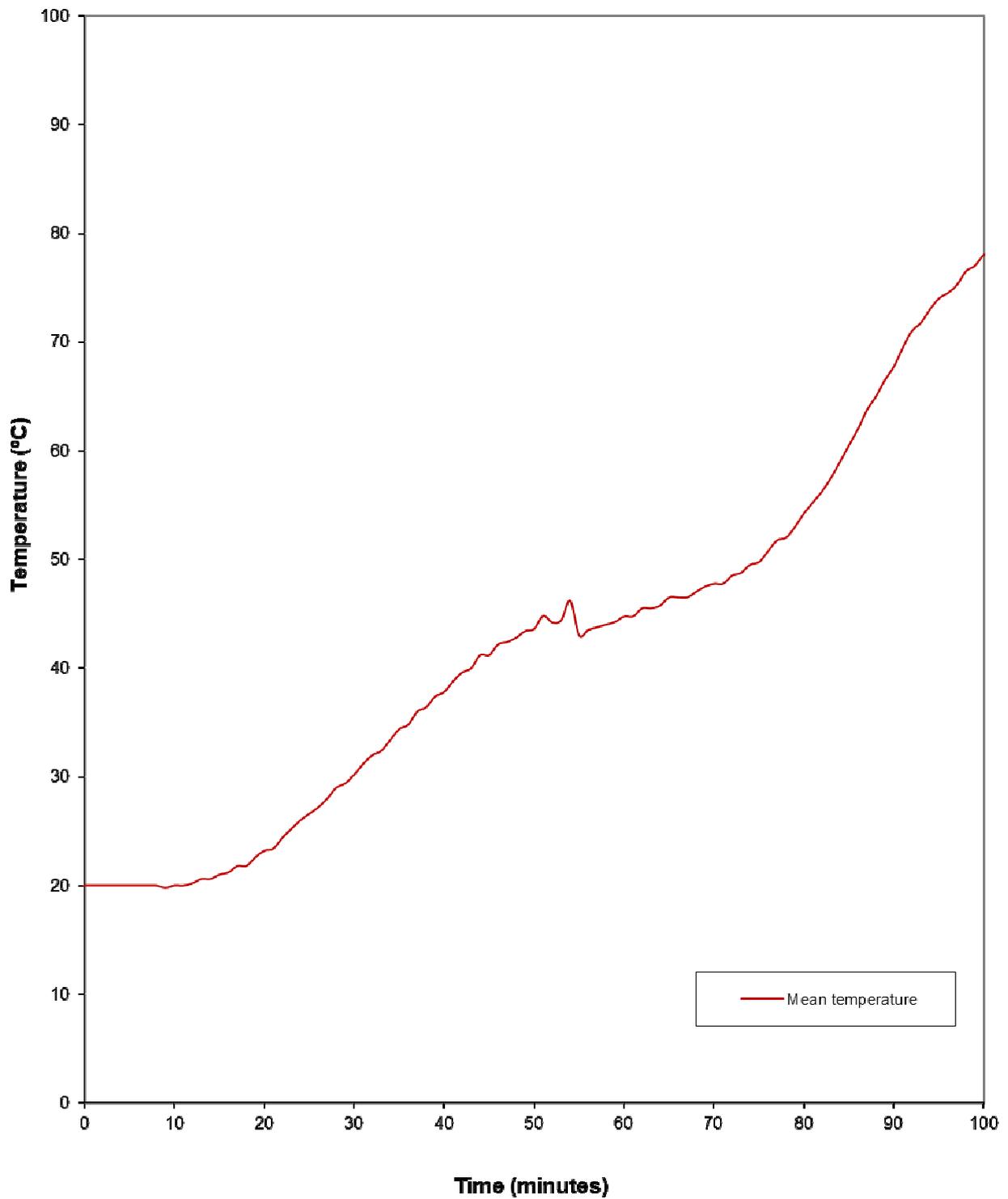
Unexposed face	Channels 16, 17, 18, 19 and 20 Channels 21 and 22	(mean and maximum) (information only)
Internal	Channels 26, 27 and 28 Channels 29, 30 and 31 Channels 23, 24 and 25	(information only, suspended under floor) (information only, on plasterboard) (information only, on joist at mid height)

The positions of these thermocouples are shown in Appendix 3.

A roving thermocouple was available for measurement of any specific hotspots. Any instances of the use of the roving thermocouple are noted in the observations in Section 3.

The recorded data of all individual thermocouples is shown in the tables in Appendix 3.

The following time/temperature graph shows the mean unexposed face temperature.



3 TEST OBSERVATIONS

Photographs taken during and after the test are shown in Appendix 2.

TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)		
Time (min:sec)	Face	Observation
00:00		Start of the test.
06:00	E	Bezel of downlight A and C softening.
10:00	E	Lens of all downlights missing.
18:00	E	Bezel of downlight B missing.
50:00	E	Internal components of downlight B visible.
59:00	E	Internal components of downlight A visible.
76:00	E	Plasterboard outer layer sagging at rear of void C.
77:58	E	Downlight C detaches.
80:00	E	Majority of plasterboard outer layer of void C detaches.
85:05	E	Plasterboard outer layer of void B partially detaches. Flaming occurs at the aperture of void C.
87:00	E	Downlight B detaches. Majority of plasterboard outer layer of void B detaches.
90:00	E	Flaming occurs at the plasterboard joint between voids B and C.
95:00	E	Flaming occurs at the aperture of void B.
97:00	E	Plasterboard outer layer of void A partially detaches
97:54	E	Downlight A detaches.
100:54	E	Test terminated.

4 LIMITATIONS

1. The test results relate only to the specimens tested. Appendix A of BS476: Part 20: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data. Application of the results to specimens of different dimensions, orientation or incorporating different components should be the subject of a design appraisal or further testing.
2. The results relate only to the behaviour of the specimen of the element of construction under the particular conditions of test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, nor do they reflect the actual behaviour in fires.
3. The fire test was conducted generally in accordance with BS476: Part 21:1987, except that the size of the separating element exposed to the heating conditions in the furnace was limited to 1.4(l) x 1.0(w) m, the ceiling sample was as described and unexposed face thermocoupling was as described. These facts should be taken into account when considering the applicability of the result.
4. No additional loading was applied to the floor.

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Report prepared by:



**T Smith
Senior Technical Officer**

Report checked by:



**J Moir
Technical Officer**

Report issued: 15th November 2018

APPENDIX 1 SPECIMEN CONSTRUCTION

The item numbers listed in Appendix 1 Table 1 and shown in the figures in Appendix 1 refer to the components of the specimen construction. Any photo numbers refer to those in Appendix 2.

Please note that unless otherwise indicated the following applies:

- a) All dimensions and materials of construction were verified by the laboratory.
- b) Figures are not to scale.
- c) All dimensions are given in mm.

Appendix 1 Table 1

Item	Component	Information
1	Ceiling layers Supplier: Name: Description: Overall size (l x w x t):	British Gypsum FireLine EN520 Type F 2No. FireLine layers affixed to the exposed side of the perimeter frame, joists and noggins using Ø3.5 x 36 long drywall screws set at 300 * centres for the first layer with joints as Appendix 1 Figure 3 and Ø3.5 x 60 long drywall screws set at 300 * centres for the second layer with taped and skimmed joints as Appendix 1 Figure 2. 1700 x 1200 x 15 (2No layers)
2	Floor Manufacturer: Name: Description: Overall size (l x w x t): Density (kg/m ³):	Egger EGGER TG4 22mm Moisture resistant tongue and groove chipboard affixed to the unexposed side of the ceiling frame using No.8 x 2" long steel countersunk screws set at 250 * centres with joints as Appendix 1 Figure 4. 1700 x 1200 x 22 620 *
3	Ceiling Frame Supplier: Species: Density (kg/m ³): Description: Overall size (l x w x h): Section size (w x h):	Cambridge Fire Research Spruce 450 * Softwood perimeter frame supported with butt jointed joists at 450 centres using 2No. steel countersunk screws per joint set at 110 * vertical centres and 2No. noggins between adjacent joists at 800 centres as Appendix 1 Figure 1. 1700 x 1200 x 195 45 x 195 (noggin 45 x 45)

Item	Component	Information
4	<p>Downlight A Supplier: Name: Description:</p> <p>Hole size (Ø): Weight (g) Overall size (Ø x h): Silicone ring size (Ø x t):</p>	<p>Suzhou Radiant Lighting Technology Co., Ltd. 5RS067 A 7 LED downlight with steel back can painted black with spring clip retainers and integral driver unit on top of can. A white finish bevelled plastic bezel is attached with plastic clips, magnets and adhesive to the back can and contains a multi-faceted plastic diffuser lens. An silicone ring fits around the top face of the steel front end against the ceiling underside. The downlight is fitted central to the void.</p> <p>60 150 (including driver) 86 x 60 (including driver) 83 OD x 52 ID x 1</p>
5	<p>Downlight B Supplier: Name: Description:</p> <p>Hole size (Ø): Weight (g) Overall size (Ø x h): Silicone shroud size (Ø x h x t): Driver size (l x w x h):</p>	<p>Suzhou Radiant Lighting Technology Co., Ltd. 5RS078 (switchable) An LED downlight with die-cast aluminium heat sink attached to a steel tilt ring and pressed steel front end. The steel tilt ring retains a multi-faceted plastic reflector and separate diffuser lens. The steel front end contains the spring clips and white steel bezel. A moulded silicone hood fits around the bottom of the heatsink and the top face of the inner steel ring. A separate driver is connected to the downlight. The downlight is fitted central to the void.</p> <p>65 233 (including driver) 90 x 46 55 OD x 15 x 0.7 115 x 38 x 25</p>
6	<p>Downlight C Supplier: Name: Description:</p>	<p>Suzhou Radiant Lighting Technology Co., Ltd. 5RS097 A 7 LED downlight with die-cast aluminium heat sink with PCB attached, pressed steel back can painted black with, magnets and spring clip retainers. A black plastic top cover is adhered over the back can with holes for the springs and cable entry. A white finish bevelled plastic bezel is attached with plastic clips, magnets and adhesive to the back can and contains a multi-faceted plastic diffuser lens. An silicone ring fits around the flange of the heat sink so that it is in contact with the</p>

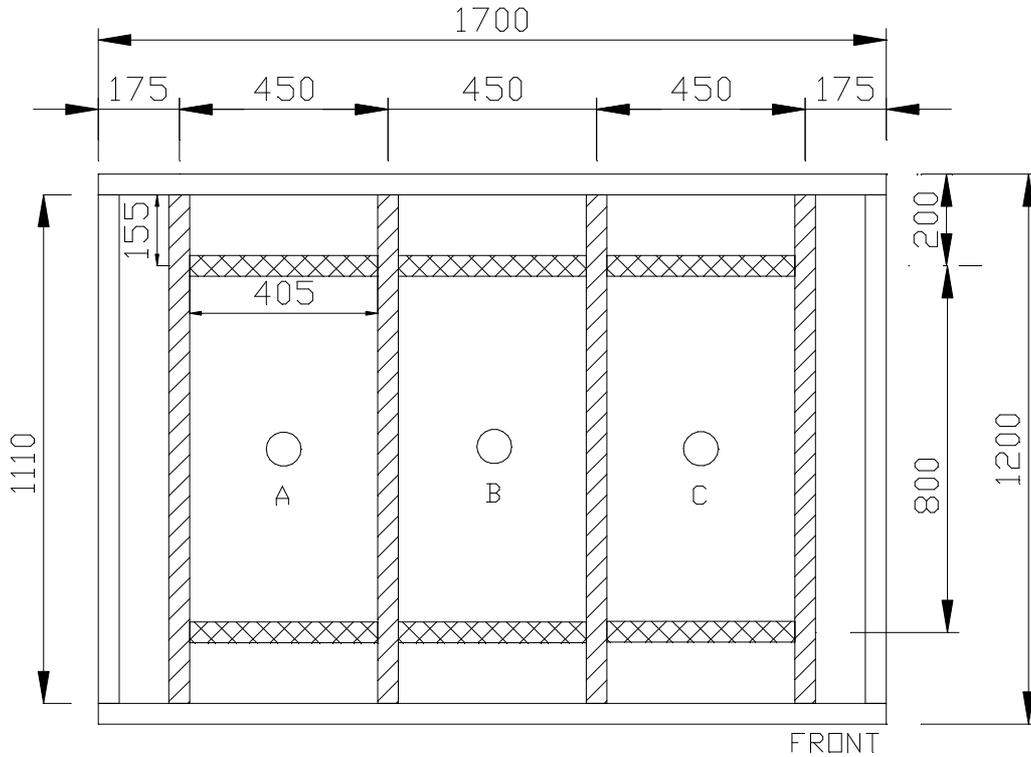
Item	Component	Information
6 cont	Hole size (Ø): Weight (g): Overall size (Ø x h): Silicone ring size (Ø x t): Driver size (l x w x h):	ceiling when the downlight is in place. A separate driver is connected to the downlight. The downlight is fitted central to the void. 65 220 (including driver) 86 x 59 83 OD: 52 ID x 1 112 x 38 x 25

Key:

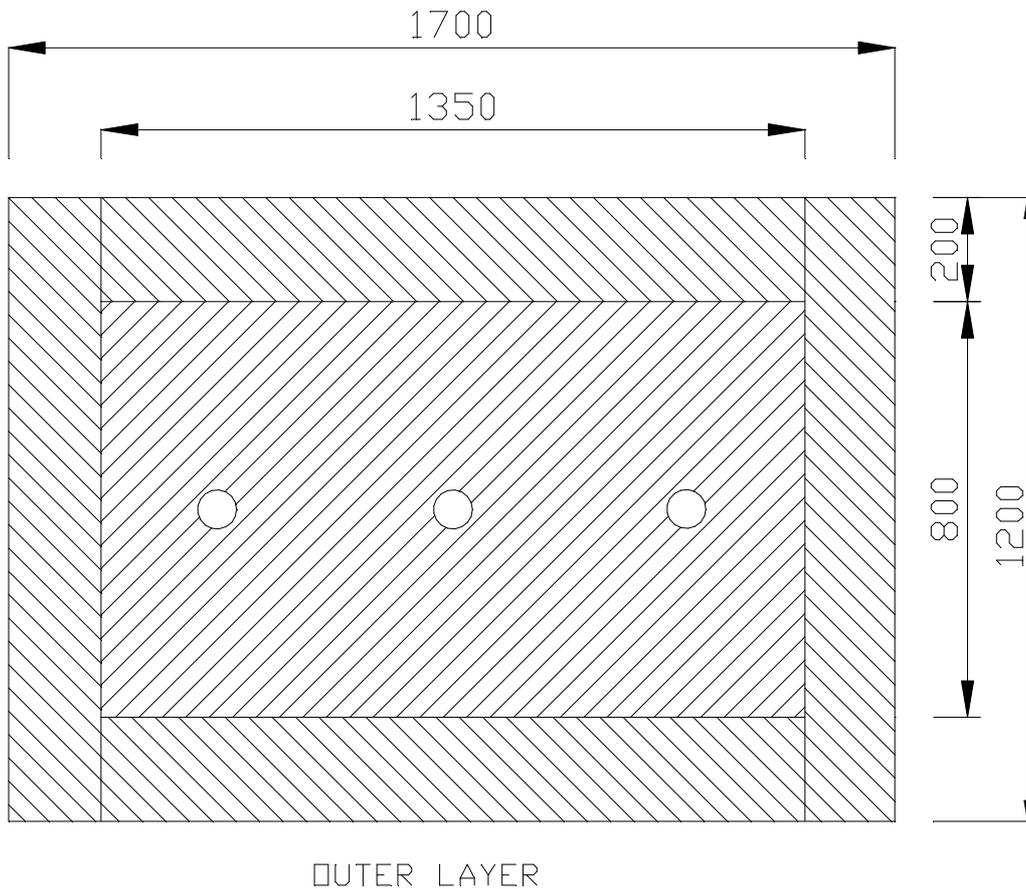
* Nominal value

** Sponsor declared value or detail, not verified by laboratory

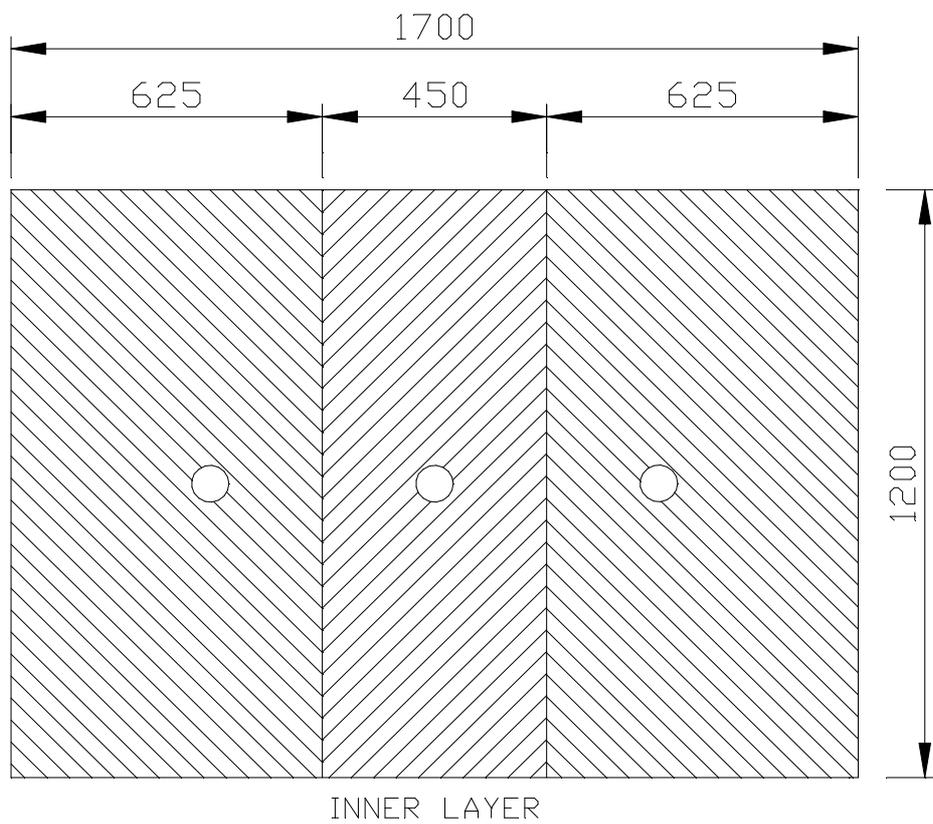
Appendix 1 Figure 1 – Section showing ceiling frame



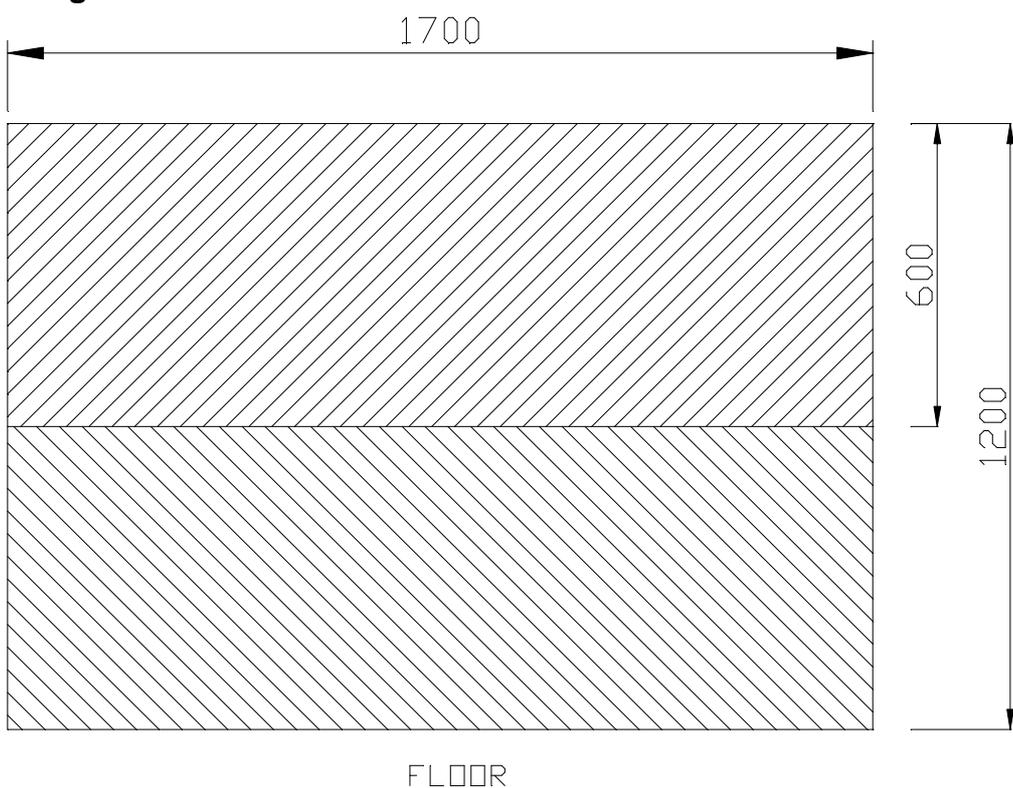
Appendix 1 Figure 2 – Ceiling membrane outer layer



Appendix 1 Figure 3 – Ceiling membrane inner layer



Appendix 1 Figure 4 – Floor



APPENDIX 2 PHOTOGRAPHS

Appendix 2.1 Pre-test photos

Photo 2.1.1 – Downlight A



Photo 2.1.2 - Downlight A



Photo 2.1.3 - Downlight A

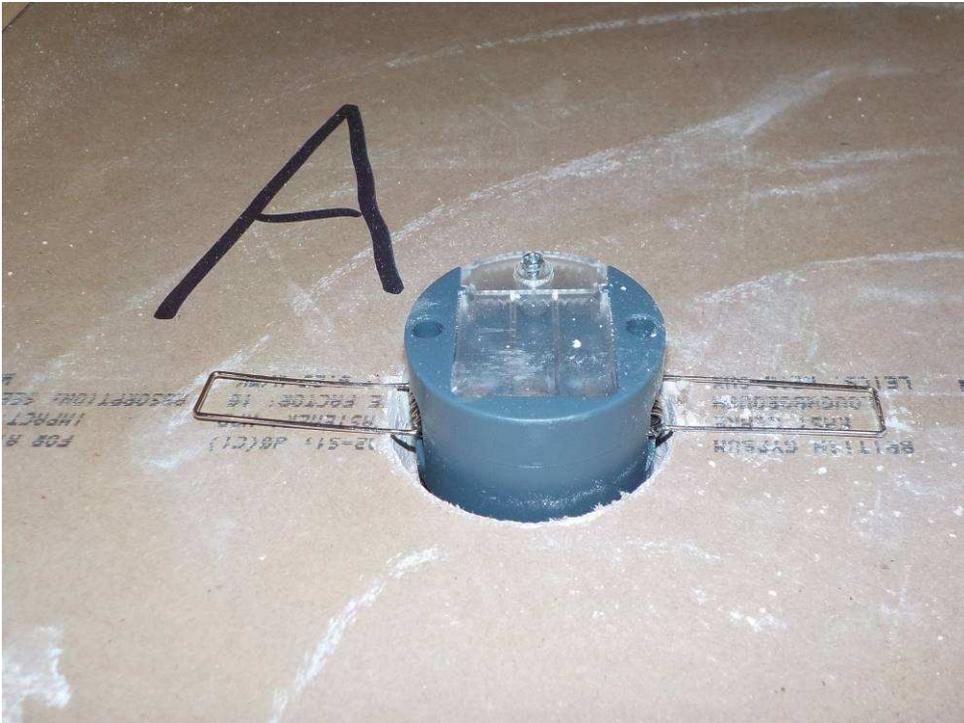


Photo 2.1.4 - Downlight B

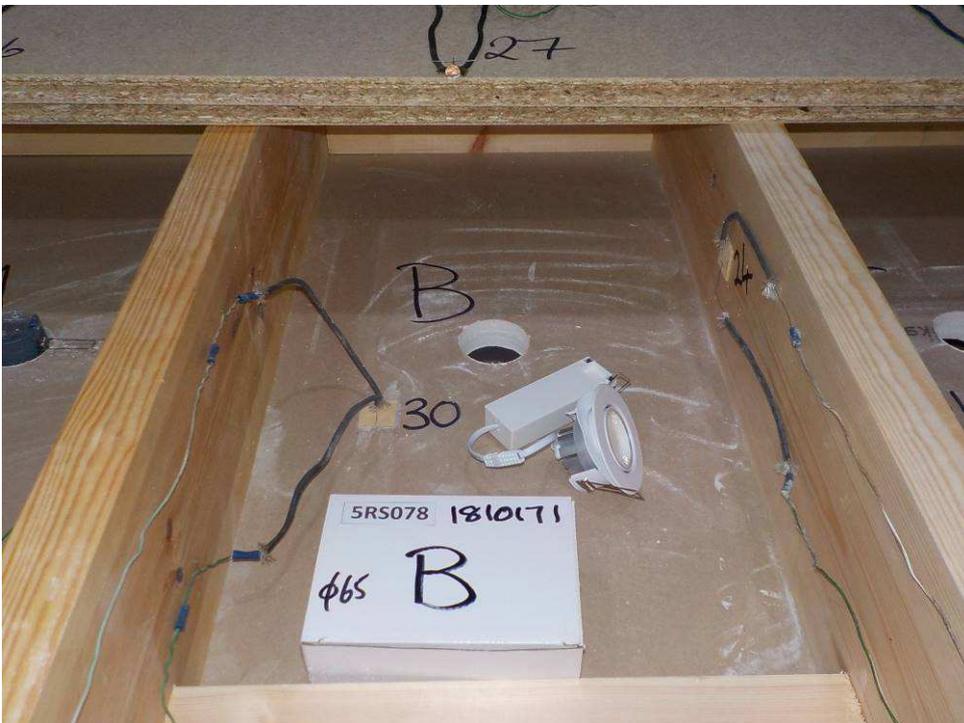


Photo 2.1.5 - Downlight B



Photo 2.1.6 - Downlight B

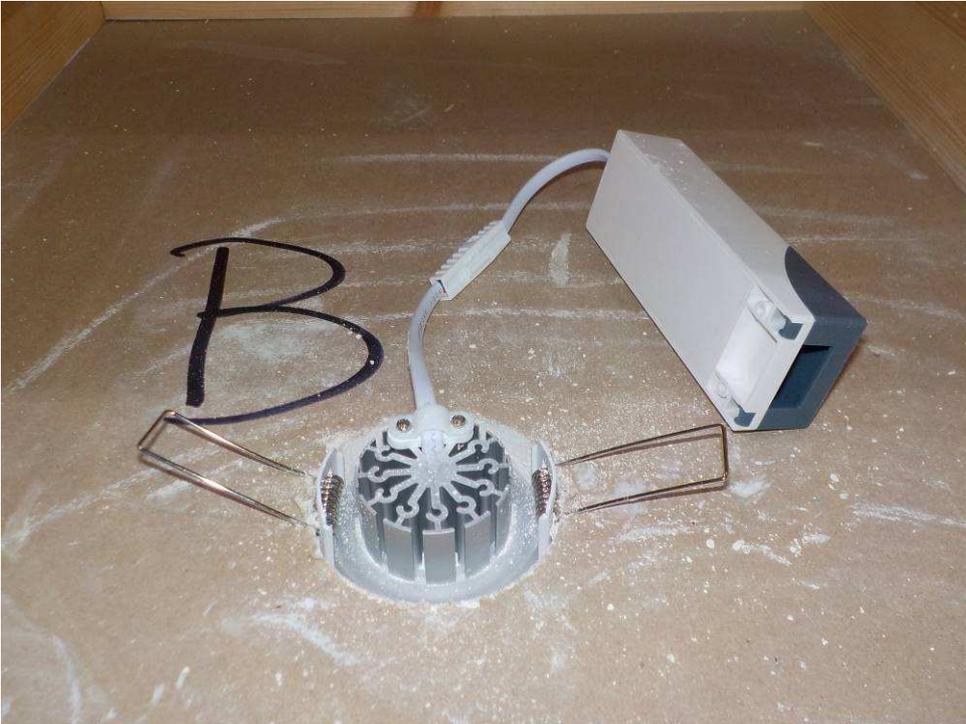


Photo 2.1.7 - Downlight C



Photo 2.1.8 - Downlight C



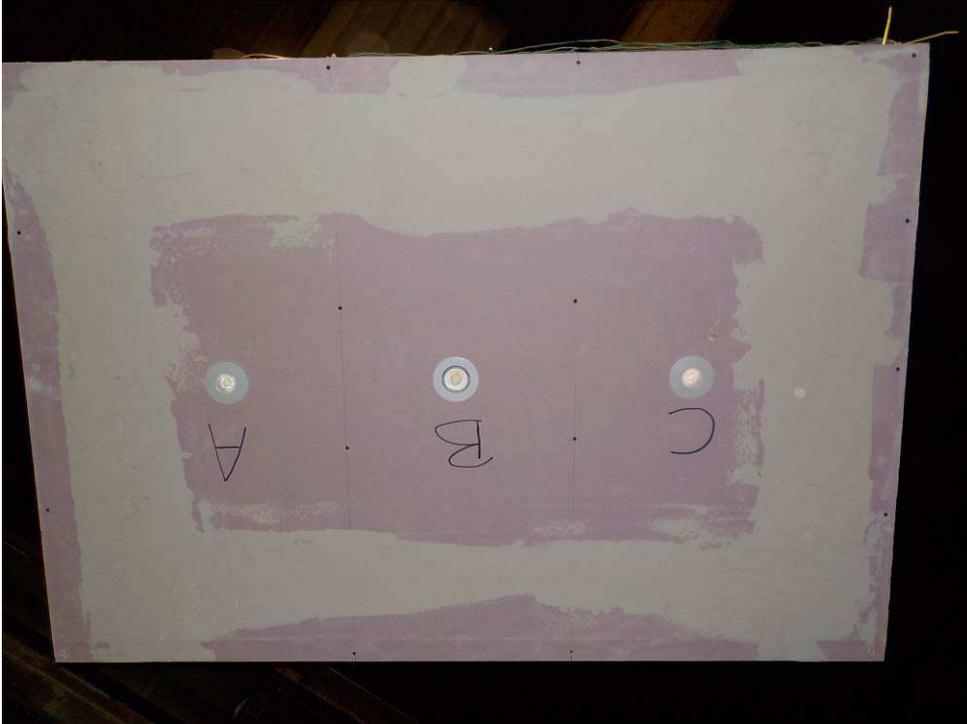
Photo 2.1.9 - Downlight C



Photo 2.1.10 – Voids A, B and C



Photo 2.1.11 – Exposed face



Appendix 2.2 During test photos

Photo 2.2.1 – Unexposed face



Photo 2.2.2 – Exposed face after 45 minutes.

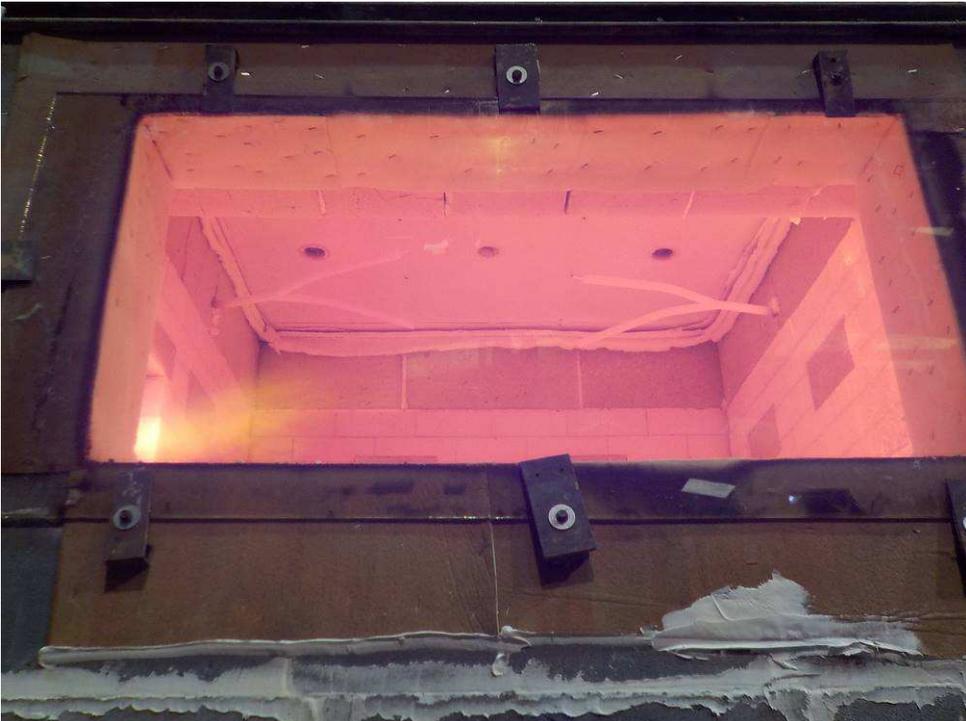


Photo 2.2.3 – Exposed face after 60 minutes.

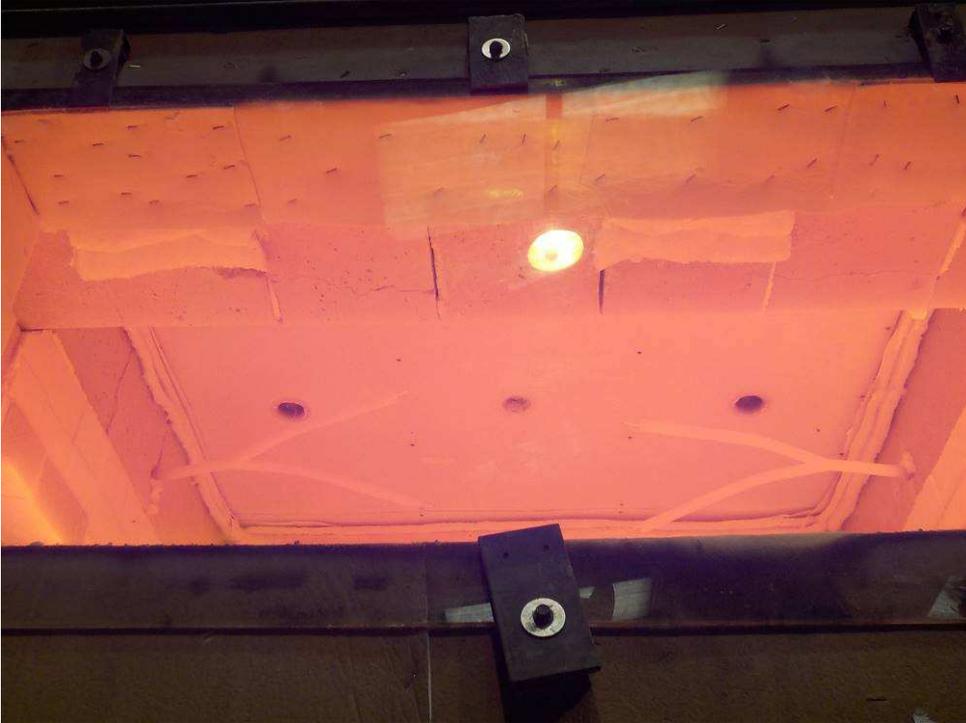


Photo 2.2.4 – Exposed face after 85 minutes.



Photo 2.2.5 – Exposed face after 90 minutes.

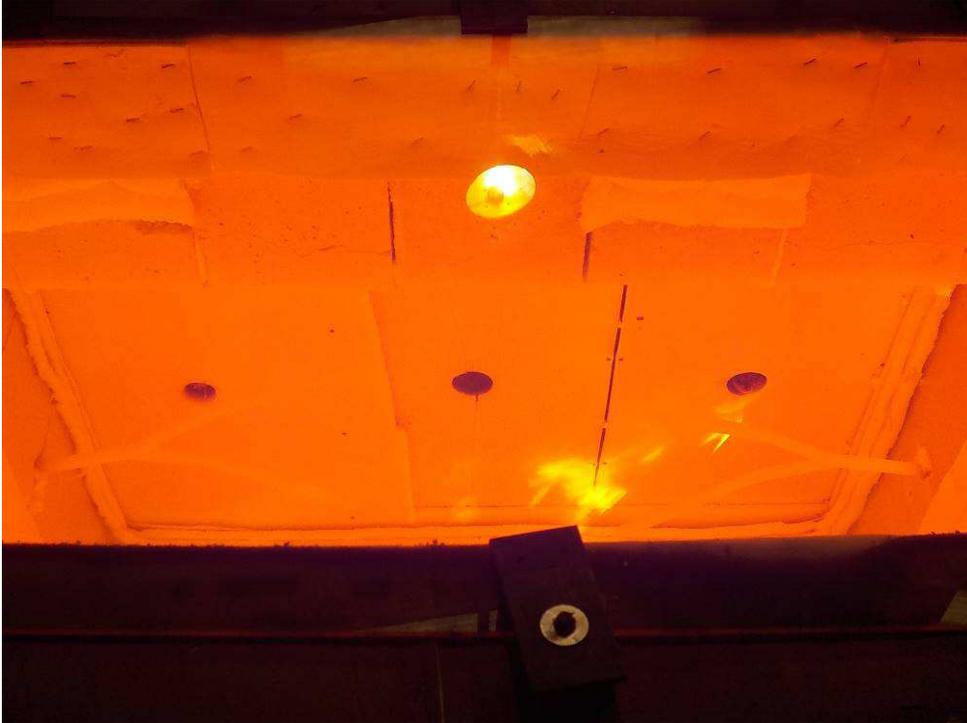


Photo 2.2.6 – Unexposed face after 90 minutes.

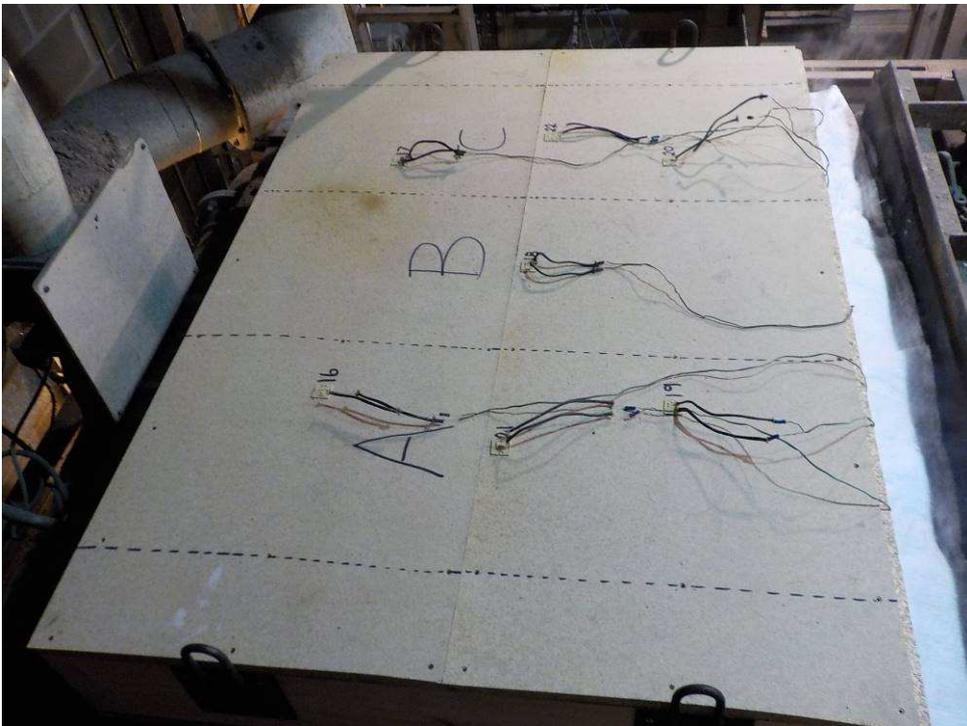
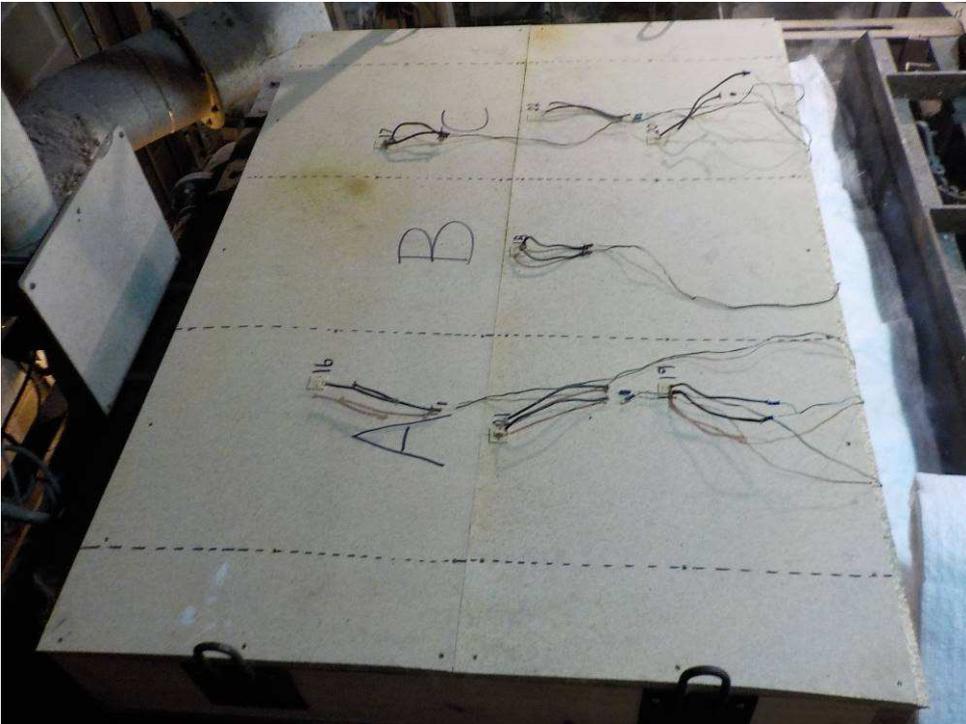


Photo 2.2.7 – Exposed face after 100 minutes.

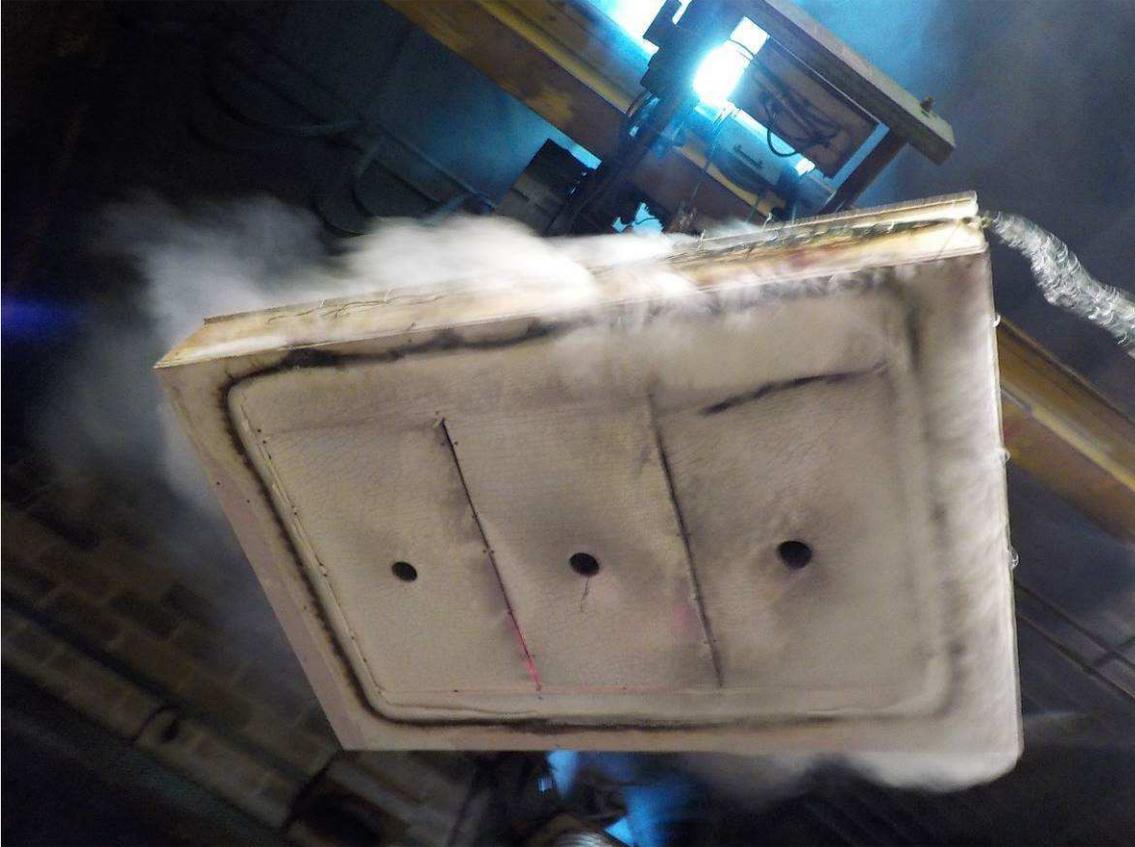


Photo 2.2.8 – Unexposed face after 100 minutes.



Appendix 2.3 Post-test photos

Photo 2.3.1



APPENDIX 3 POSITIONING OF INSTRUMENTATION

Figure 3.1 – Unexposed face thermocouple positions:

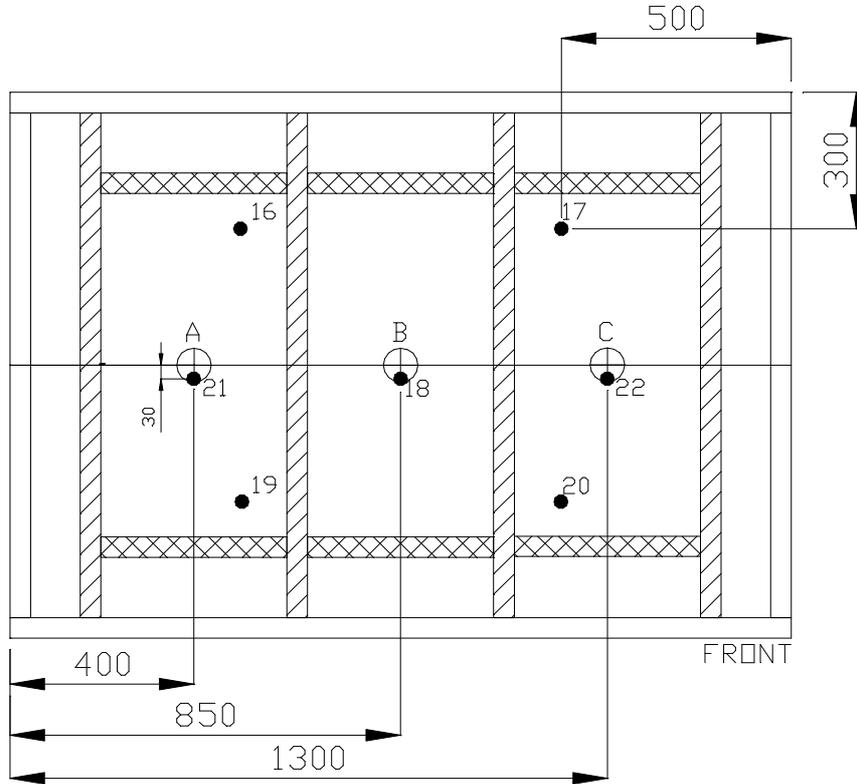
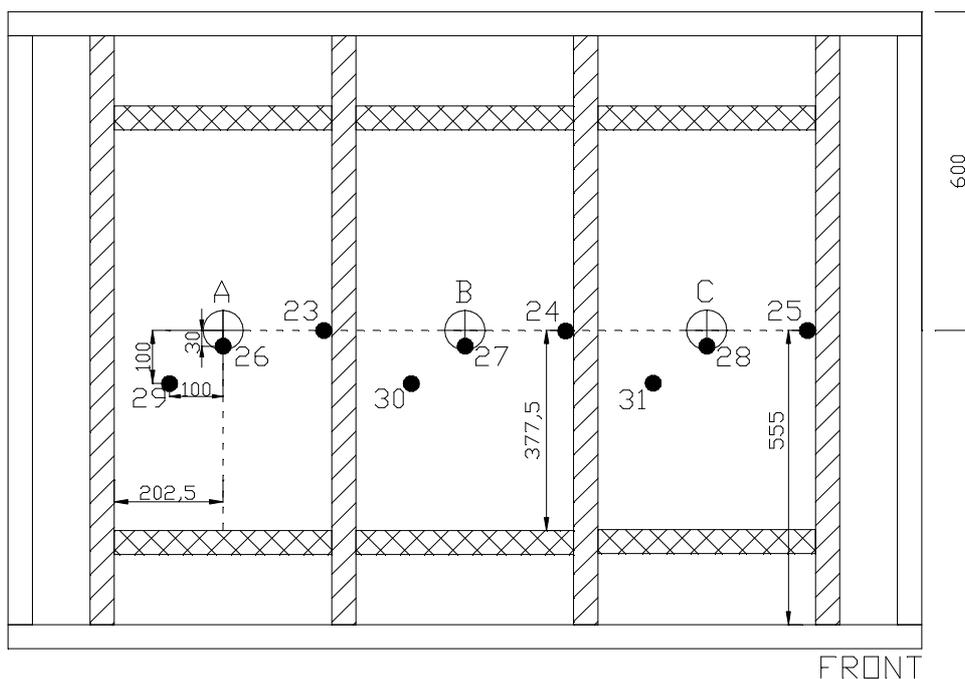
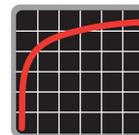


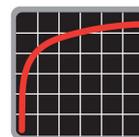
Figure 3.2 – Internal thermocouple positions:





APPENDIX 4 RECORDED THERMOCOUPLE DATA

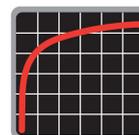
Time min	Chan 16 °C	Chan 17 °C	Chan 18 °C	Chan 19 °C	Chan 20 °C	Chan 21 °C	Chan 22 °C	Chan 23 °C
0	20	20	20	20	20	20	20	20
1	20	20	20	20	20	20	20	20
2	20	20	20	20	20	20	20	20
3	20	20	20	20	20	20	20	20
4	20	20	20	20	20	20	20	20
5	20	20	20	20	20	20	20	20
6	20	20	20	20	20	20	19	20
7	20	20	20	20	20	20	19	21
8	20	20	20	20	20	20	20	22
9	19	20	20	20	20	20	20	23
10	20	20	20	20	20	20	20	25
11	20	20	20	20	20	20	20	27
12	20	20	21	20	20	20	20	30
13	20	21	21	20	21	20	21	33
14	20	21	21	20	21	21	21	36
15	20	21	22	21	21	21	22	39
16	20	21	22	21	22	22	22	45
17	21	22	23	21	22	22	23	48
18	21	22	23	21	22	23	24	50
19	21	23	24	22	23	24	24	53
20	22	23	25	22	24	24	26	56
21	22	24	25	22	24	25	27	57
22	23	25	26	23	25	26	28	58
23	23	26	27	24	26	26	29	60
24	24	27	28	24	27	27	30	62
25	25	27	28	25	28	27	31	63
26	25	28	29	26	28	28	33	64
27	26	29	30	26	29	29	33	65
28	27	30	31	27	30	29	34	67
29	27	30	32	28	30	30	35	68
30	28	31	33	28	31	31	36	69
31	28	32	35	29	32	31	38	71
32	29	33	36	29	33	32	42	72
33	29	33	37	30	33	32	44	73
34	30	34	38	31	34	33	44	75
35	31	35	40	31	35	34	45	76
36	31	35	41	32	35	35	46	77
37	32	36	43	33	36	36	47	78
38	32	36	45	33	36	37	47	79
39	33	37	46	34	37	39	47	80
40	33	38	47	34	37	40	48	81
41	34	38	49	35	38	41	49	82
42	35	39	50	35	39	43	50	83
43	35	39	51	36	39	45	50	84
44	36	40	53	37	40	47	50	84
45	36	40	53	37	40	48	51	85
46	37	41	54	38	41	50	51	86
47	37	41	55	38	41	51	52	86
48	37	42	55	39	41	52	52	86
49	38	42	55	40	42	54	52	87
50	38	43	55	40	42	55	52	87



Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C							
51	39	43	58	41	43	56	53	88
52	40	43	54	41	43	57	53	88
53	40	44	54	41	43	57	53	88
54	41	44	60	42	44	58	53	89
55	41	45	*	42	44	59	54	89
56	41	45	*	43	45	59	54	89
57	42	45	*	43	45	60	53	89
58	42	46	*	43	45	60	53	89
59	42	46	*	44	45	61	53	90
60	43	46	*	44	46	62	54	91
61	43	46	*	44	46	62	54	90
62	44	47	*	45	46	62	54	91
63	44	47	*	45	46	63	54	91
64	44	47	*	45	47	63	55	91
65	45	48	*	46	47	64	54	91
66	45	48	*	46	47	64	54	91
67	45	48	*	46	47	64	54	91
68	45	48	*	47	48	64	55	92
69	46	49	*	47	48	65	55	91
70	46	49	*	47	49	65	55	92
71	46	48	*	48	49	65	55	92
72	47	49	*	48	50	65	56	92
73	47	49	*	48	51	66	59	93
74	47	50	*	49	52	66	62	94
75	47	50	*	49	53	66	63	94
76	48	51	*	49	55	67	62	95
77	48	52	*	50	57	67	62	96
78	48	52	*	50	58	67	66	97
79	48	53	*	50	61	67	64	98
80	49	54	*	51	63	68	65	100
81	49	55	*	52	65	69	64	104
82	49	57	*	52	67	69	66	109
83	50	58	*	53	69	70	68	114
84	51	60	*	54	71	70	68	118
85	51	62	*	55	74	71	70	121
86	52	64	*	56	76	71	70	125
87	53	67	*	57	78	71	78	128
88	54	69	*	58	79	71	78	131
89	55	72	*	59	80	72	78	135
90	56	74	*	60	81	72	79	139
91	58	76	*	62	82	73	80	142
92	59	78	*	64	83	74	83	146
93	60	79	*	65	83	74	82	149
94	61	81	*	66	84	74	83	152
95	63	82	*	67	84	74	82	155
96	63	83	*	68	84	75	81	159
97	65	83	*	69	84	75	79	163
98	66	84	*	71	85	76	77	169
99	67	84	*	72	85	76	81	175
100	68	85	*	73	86	77	78	183



Time	Chan 24	Chan 25	Chan 26	Chan 27	Chan 28	Chan 29	Chan 30	Chan 31
min	°C							
0	20	20	20	20	20	20	20	20
1	20	20	20	20	20	20	20	20
2	20	20	20	20	20	20	20	21
3	20	20	20	22	21	20	21	21
4	20	20	21	25	21	21	21	21
5	20	21	26	28	22	22	23	23
6	20	22	29	33	24	23	25	26
7	21	24	32	39	25	28	29	31
8	22	26	37	38	26	33	35	37
9	23	29	39	38	27	40	41	45
10	25	33	43	41	28	49	49	53
11	27	36	47	46	29	56	55	60
12	30	40	53	49	31	63	61	67
13	32	43	55	54	31	68	67	72
14	35	47	58	58	30	72	71	76
15	37	52	63	66	28	76	75	79
16	40	58	80	60	*	78	78	82
17	42	61	83	65	*	81	80	84
18	44	64	85	70	*	81	81	85
19	47	67	76	76	*	83	83	86
20	49	69	73	84	*	84	84	87
21	51	70	71	83	*	84	85	88
22	53	72	79	89	*	85	86	89
23	54	73	76	95	*	85	86	90
24	56	74	82	96	*	86	87	90
25	57	75	79	98	*	86	87	90
26	59	76	79	100	*	87	88	91
27	60	76	81	102	*	87	88	92
28	61	77	86	103	*	87	90	92
29	63	79	91	105	*	88	91	92
30	64	80	98	107	*	89	92	92
31	65	80	108	109	*	91	93	92
32	67	81	115	113	*	92	93	94
33	68	83	120	116	*	92	94	93
34	70	83	148	119	*	93	95	93
35	71	85	150	119	*	94	96	97
36	73	85	157	126	*	95	96	97
37	74	86	147	127	*	96	97	97
38	76	86	150	131	*	96	98	100
39	77	87	173	130	*	98	98	99
40	78	87	155	129	*	99	98	105
41	79	88	156	129	*	101	99	105
42	81	84	146	131	*	103	100	108
43	81	83	144	131	*	137	101	110
44	83	84	160	132	*	153	104	112
45	84	89	150	134	*	*	107	112
46	84	86	145	136	*	*	109	114
47	85	87	183	137	*	*	111	114
48	86	88	169	136	*	*	113	114
49	87	89	142	137	*	*	115	114
50	87	86	149	137	*	*	117	117



Time	Chan 24	Chan 25	Chan 26	Chan 27	Chan 28	Chan 29	Chan 30	Chan 31
min	°C							
51	88	91	181	138	*	*	118	114
52	89	88	172	139	*	*	119	117
53	89	88	202	139	*	*	119	119
54	90	88	226	137	*	*	120	120
55	90	89	*	138	*	*	121	116
56	90	93	*	136	*	*	121	117
57	91	87	*	137	*	*	122	125
58	91	93	*	132	*	*	122	119
59	91	90	*	138	*	*	124	124
60	92	88	*	139	*	*	125	133
61	92	89	*	137	*	*	128	135
62	92	92	*	136	*	*	132	139
63	92	93	*	134	*	*	134	150
64	92	89	*	138	*	*	136	169
65	93	91	*	139	*	*	140	176
66	93	93	*	137	*	*	154	191
67	93	93	*	148	*	*	166	215
68	93	94	*	158	*	*	175	232
69	94	100	*	144	*	*	187	243
70	94	96	*	198	*	*	207	260
71	94	118	*	197	*	*	223	274
72	95	111	*	263	*	*	236	288
73	97	114	*	253	*	*	247	300
74	99	118	*	273	*	*	256	310
75	102	121	*	295	*	*	265	320
76	107	125	*	324	*	*	274	330
77	111	129	*	307	*	*	281	339
78	115	132	*	310	*	*	286	348
79	119	137	*	537	*	*	292	356
80	124	143	*	81	*	*	297	366
81	128	149	*	192	*	*	301	360
82	132	155	*	247	*	*	305	364
83	135	162	*	225	*	*	310	376
84	139	170	*	202	*	*	314	390
85	144	179	199	215	*	*	319	402
86	148	188	201	216	*	*	324	412
87	153	196	205	238	*	*	331	421
88	161	205	211	248	*	*	341	427
89	168	214	215	259	*	*	356	431
90	176	224	219	270	*	*	378	434
91	185	234	222	280	*	331	401	441
92	193	244	226	290	*	338	420	449
93	202	252	230	298	*	340	435	456
94	212	263	233	305	*	344	449	463
95	221	273	237	314	*	347	459	469
96	230	283	242	321	*	350	469	476
97	241	294	248	328	*	354	476	482
98	250	305	278	336	*	360	484	489
99	261	317	289	344	*	367	489	493
100	270	327	304	352	*	379	495	499

* Thermocouple malfunction