Intertek

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TEST REPORT

EVALUATION CENTER

Intertek Testing Services Ltd., Shanghai
Plant 7, No. 6958 Daye Road, Fengxian District, Shanghai
201405

RENDERED TO

Magnesium Oxide Board Corporation Pty Ltd
3 Allen Street Moffat Beach Queensland Australia 4551

PRODUCT EVALUATED

ResCom(R) Board Wall
Model: 12mm ResCom(R) HMR

EVALUATION PROPERTY
Fire Resistance

Report of ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR for compliance with the applicable requirements of the following criteria: *Modified ASTM E119-16a Standard Test Methods for Fire Tests of Building Construction and Materials.*

1 Table of Contents

2 Introduction

Intertek has conducted an evaluation for Magnesium Oxide Board Corporation Pty Ltd to determine the fire resistance characteristics of ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR for a 4 hour rating. This evaluation began on December 8, 2016 and was completed on December 23, 2016. The test was conducted on December 19, 2016.

The test was conducted in accordance with Modified ASTM E119-16a Standard Test Methods for Fire Tests of Building Construction and Materials.

3 Test Samples

3.1. Sample Selection

Samples were submitted to Intertek directly from the client. Samples were not independently selected for testing. Samples were received at the Evaluation Center on December 8, 2016 and December 17, 2016.

3.2. Sample and Assembly Description

ResCom(R) Board wall
Size: 3000 mm (height) × 3000 mm (width)
Nominal Thickness: 99 mm
Manufacturer: MgO Corp Asia
Manufacturer Address: South West of Interchange of YiHe East Road and Kunming Road, National Economic and Technological Development Zones of LinYi City

The description of the sample given below has been prepared from the information provided by the sponsor of this test. All values quoted are nominal, unless tolerances are given.

The detailed information of the tested specimen is listed in the following table.

No.	Item name	Specification	Manufacturer
1	ResCom(R) Board	Model: 12mm ResCom(R) HMR Density: 1100 g/cm^3	MgO Corp Asia
2	Rock wool	Density: 180 kg/m^3	Rockwool Beijing
3	Rock wool	Density: 170 kg/m^3	Rockwool Beijing
4	Nail	10gage Steel 1022A	Hongda Hardward Co Ltd
5	High Temperature Resistant Mortar	Model: AKN01	/
6	High Temperature Resistant Fiberglass Self-adhesive tape	/	HANO New Materials Limited Liability Company

7	Fire barrier sealant	CP25Wb+	3M
8	Steel track and Edge stud	size: 30x75x0.5mm	/
9	Steel stud	size: 45x75x0.7mm	/

The wall assembly was constructed using 75mm wide steel stud, filling with rock wool and clad with 12mm thick ResCom(R) Board.

The 30x75mm top track was fastened to concrete beam with expansion screws. The bottom track and the 30x75mm edge studs were fastened to the concrete supporting wall opening with screws. Before fastening, the tracks and the 30x75mm edge studs were covered by a layer of 3M Fire barrier sealant, model of CP25Wb+ on the back. The 45x75mm horizontal studs were fastened on the vertical edge tracks and the vertical studs were cut to 600mm long sections then fastened on horizontal studs. The stud cavities were filled with rock wool with a density of 170 kg/m^3. The other space was filled with rock wool with a 180kg/m^3 density. The both surface of the studs were covered by caulking compound. Then the 12mm thick ResCom(R) Board were fastened on the studs by screws on both sides.

All tapping screws spaced about 200mm around the perimeter and 300mm in the field. The screw heads were covered with caulking compound.

All joints were stick with tape then covered with caulking compound. The width of sealant covered the plasterboard joints was approximately 200mm.

The sample ID number is S160929005SHF-001.

The drawings of the test sample, the test wall construction can be found in Appendices A and B.

4 Testing and Evaluation Methods

4.1. Fire Endurance Test

Test was conducted in accordance with the applicable requirement of a Modified ASTM E119-16a Standard Test Methods for Fire Tests of Building Construction and Materials.

The test wall assembly was installed in a moveable restraint frame. The test assembly was moved in front of the furnace for the fire exposure, and away from the furnace for the hose stream test. The test samples were built into a concrete masonry unit partition, with fully mortared joints. The nominal dimensions of the test wall were 3m high and 3m wide. The test measurement data was shown in Appendices C and D.

After positioning the specimen over the furnace opening, the burners were ignited and the timer was started. Temperatures within the furnace were monitored using thermocouples and the data was recorded. The burners were controlled to keep the furnace temperatures within the allowable limits specified in the test standards. After 5 minutes, the furnace pressure was adjusted so that the neutral plane was established at a 1016mm (40 in.) below the top of the

test wall. Periodic observations were made of the surfaces of the test assembly during the fire endurance test.

After the Fire Endurance Test, the test specimen was moved into position for the Hose Stream Test. The exposed surface of the test assemblies was subjected to the impact, erosion, and cooling effects of a hose stream described in the test standards.

4.1.1. Deviation

The hose stream test was conducted on the test assembly after the fire endurance test. However, the result of hose stream test was not considered, the conclusion of the test report only present the time period in minute when the failure of average temperature rise, maximum temperature rise and cotton waste test occurred.

5 Testing and Evaluation Results

5.1. Fire Endurance Test

Observations made during the test are listed below:

Time (min'Sec")	Observations
0'00"	Test starts.
7'02"	Popping sound is heard from the test specimen.
11'45"	Smoke issues from the top edge of the test specimen.
36'20"	No significant change.
54'59"	No significant change.
86'08"	Smoke issues from the left vertical edge of the test specimen.
109'14"	No significant change.
129'38"	The tape that sticks to the top joint breaks.
130'10"	A cotton pad is applied on the middle of top joint, the pad is not ignited.
140'00"	The tape that sticks to the bottom joint splits from the ResCom(R) board.
160'00"	Discoloration is observed on the bottom joint. Discoloration is also observed on stud positions.
180'00"	A cotton pad is applied on the top joint between T3 and T7, the pad is lightly discolored but not ignited.
210'35"	A cotton pad is applied on the top joint between T6 and T11, the pad is lightly discolored but not ignited.
211'20"	A cotton pad is applied on the bottom joint, the pad is not ignited.
236'00"	A cotton pad is applied between T6 and T11 on the top joint and the pad is glowing.
240'00"	Test burners are turned off.
242'30"	Hose stream test starts.
242'52"	The vertical studs and the test wall are broken down by the stream.

Transmission of heat through the specimen during the fire endurance test did not raise any temperature on the unexposed surface more than 180°C until 95 minutes. Transmission of heat through the specimen during the fire endurance test did not raise the average temperature on the unexposed surface more than 139°C until 104 minutes.

After exposed to the fire for a period of 95 minutes, the maximum temperature on unexposed surface increased by more than 180°C, maximum temperature rise failure was deemed to occur. After exposed to the fire for a period of 104 minutes, the average temperature on unexposed surface increased by more than 139°C, average temperature rise failure was deemed to occur.

After exposed to the fire for a period of 236 minutes, a cotton pad was applied at the top joint between T6 and T11 and the pad was glowing by the hot gas. The cotton waste test failure was deemed to occur. The test specimen withstood the fire endurance test without passage of flame or gases hot enough to ignite cotton waste, for 236 minutes.

5.2. Hose Stream Test

After 2 1/2 minutes following the termination of fire test, the assembly was removed from the furnace, and the exposed surface was subjected to the impact, cooling and erosion effects of the standard hose stream test.

The water stream was applied from a distance of 20 feet from the exposed surface of the test wall. According to test methods, Hose Stream Test on 3 m x 3 m specimen should be conducted for 300 seconds based on a total exposed area of 9 square meters and a required duration of 5 minutes per 9 square meter of exposed area. The hose stream water pressure was 310 kPa.

Hose Stream Test Observations:

Time from commencement of fire test (min'Sec")	Observations
120'00"	The test specimen is moved out from the furnace and located in the area for hose stream.
122'30"	Hose stream test starts and conducted for 23 seconds according to ASTM E119-16a.
122'53"	Hose stream test is discontinued, a through hole developed that allows a projection of water from the stream beyond the unexposed side.

The test specimen did not withstand the hose stream test without the passage of water from the hose stream. Openings developed that permitted a projection of water from the stream beyond the unexposed surface during the time of the hose stream test.

5.3. Examination of Test Results

5.3.1. Correction Factor for the Fire Endurance Test

The correction factor was then mathematically added to the indicated fire resistance period, yielding the fire resistance period achieved by this specimen:

Correction Factor for the Fire Endurance Test

ITEM	DESCRIPTION	TEST VALUE
C	correction factor	0.30 minutes 18 seconds
I	indicated fire-resistance period	104 minutes
A	area under the curve of indicated average furnace temperature for the first three fourths of the indicated period	62660 (°C•min)
As	area under the standard furnace curve for the same part of the indicated period	62382 (°C•min)
L	lag correction in the same units as *A* and *As*	1800 (°C•min)

6 Conclusion

The ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR identified in this report has been tested in accordance with Modified ASTM E119-16a Standard Test Methods for Fire Tests of Building Construction and Materials.

After exposed to the fire for a period of 95 minutes, the temperature of T3 on unexposed surface increased by more than 180°C, failure of maximum temperature rise was deemed to occur.

After exposed to the fire for a period of 104 minutes, the average temperature on unexposed surface increased by more than 139°C, failure of average temperature rise was deemed to occur.

After exposed to the fire for a period of 236 minutes, a cotton pad was applied between T6 and T11 on the top joint and the pad was glowing. The failure of cotton waste test was deemed to occur.

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

INTERTEK

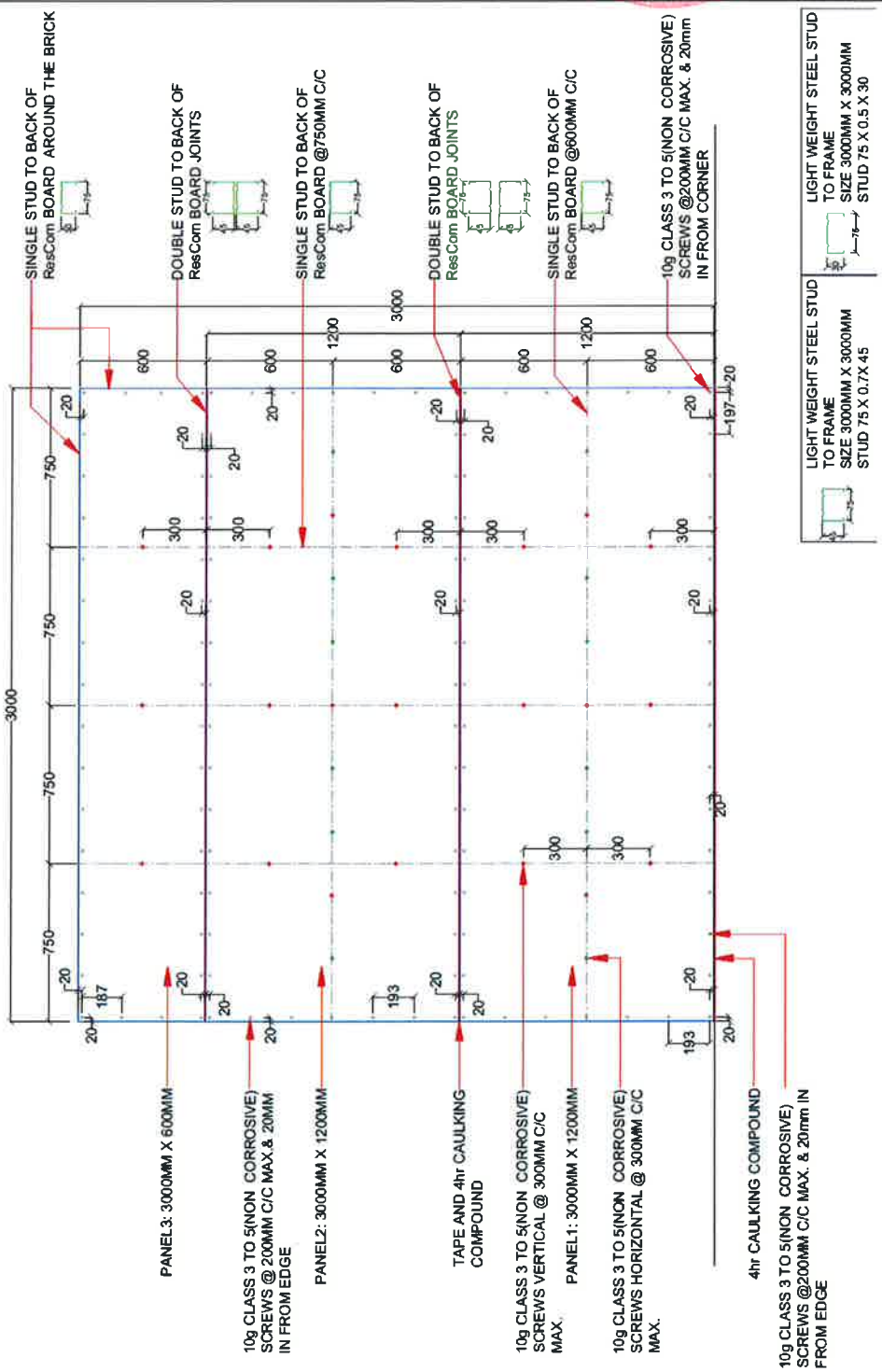
Reported by: Timothy Li

Timothy Li
Testing Engineer, Building Products

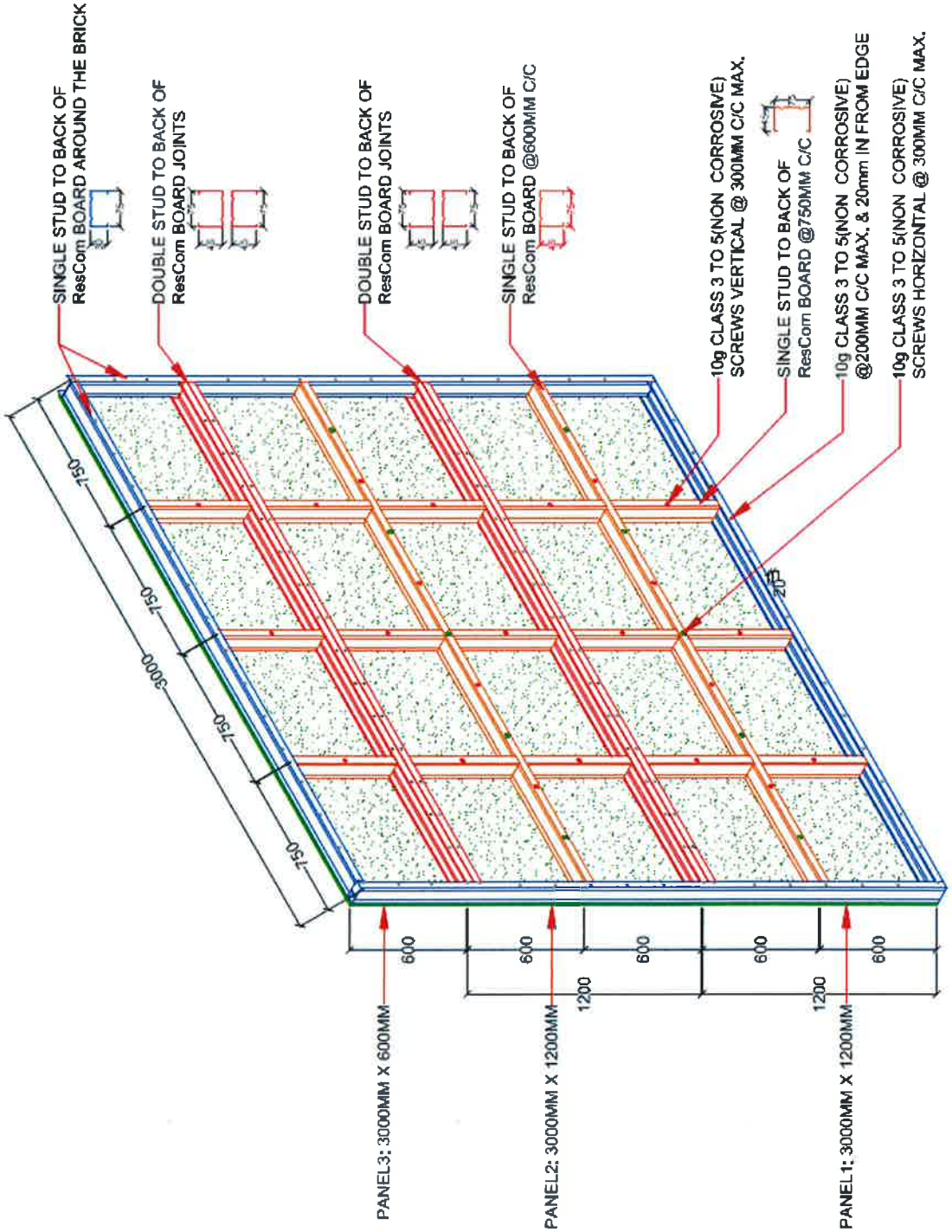
Reviewed by: Harrison Li

Harrison Li
Senior Project Engineer, Building Products

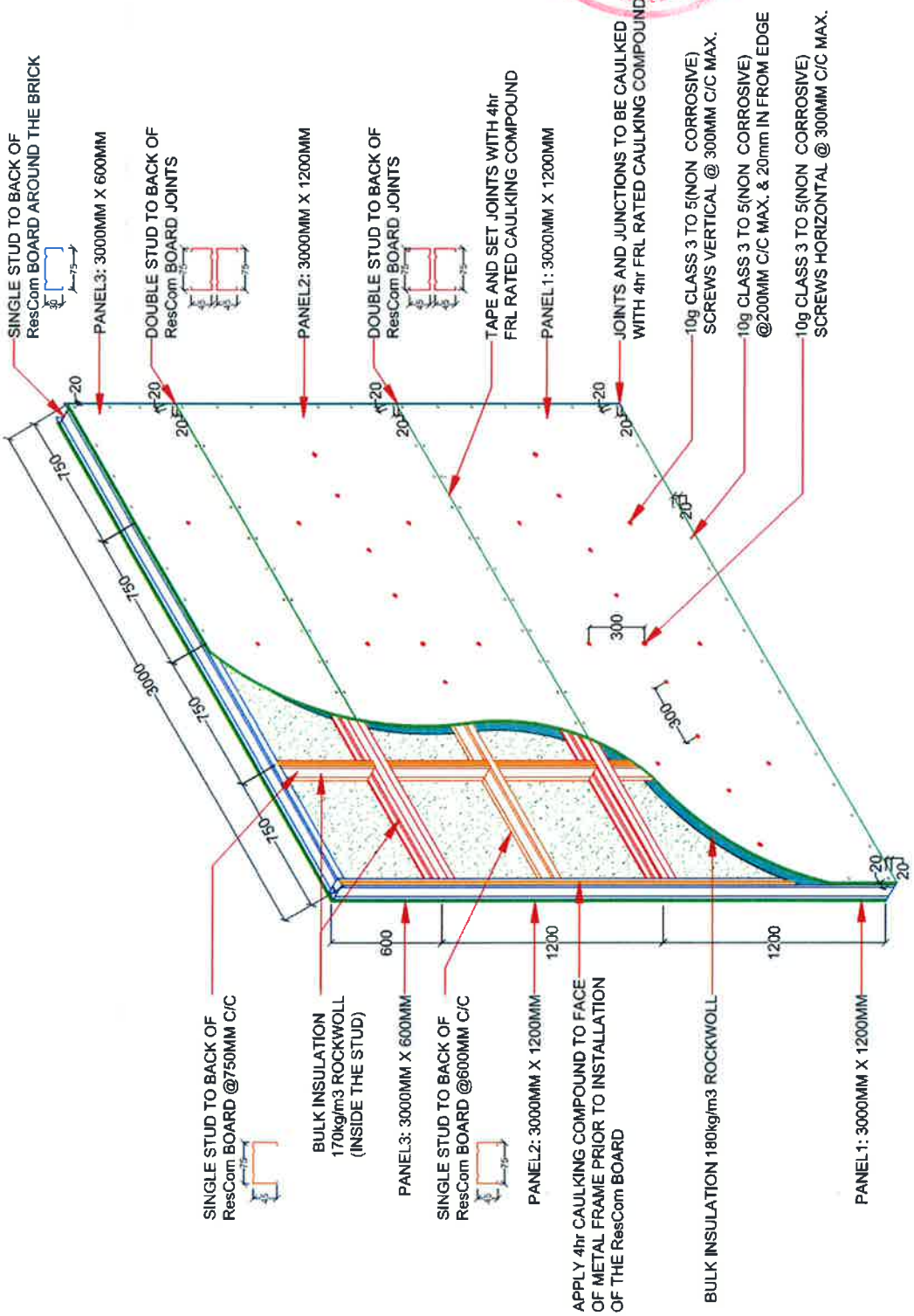
7 Appendix A: Test Specimen Drawing



Drawing of ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR

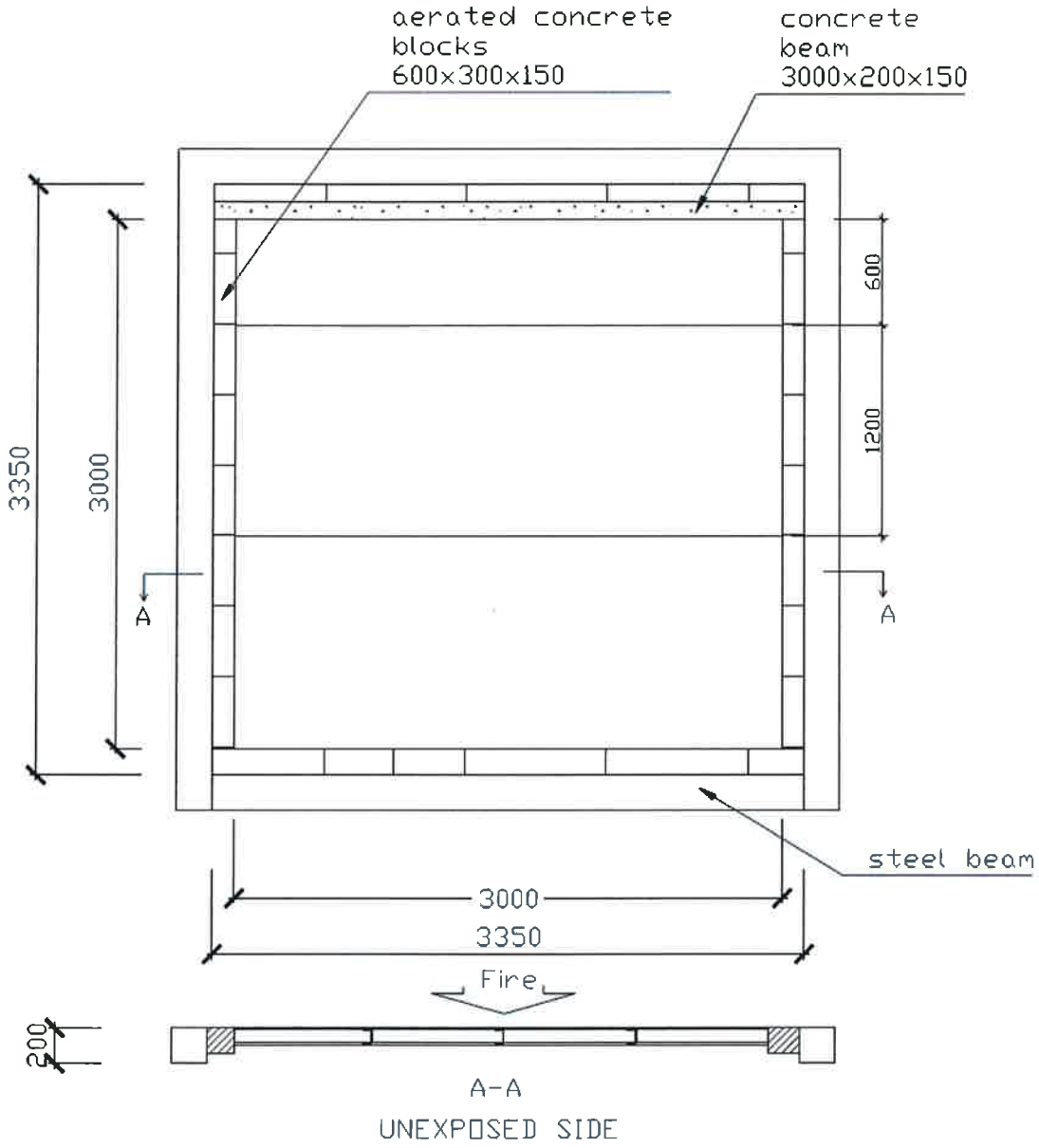


Sketch of studs of ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR

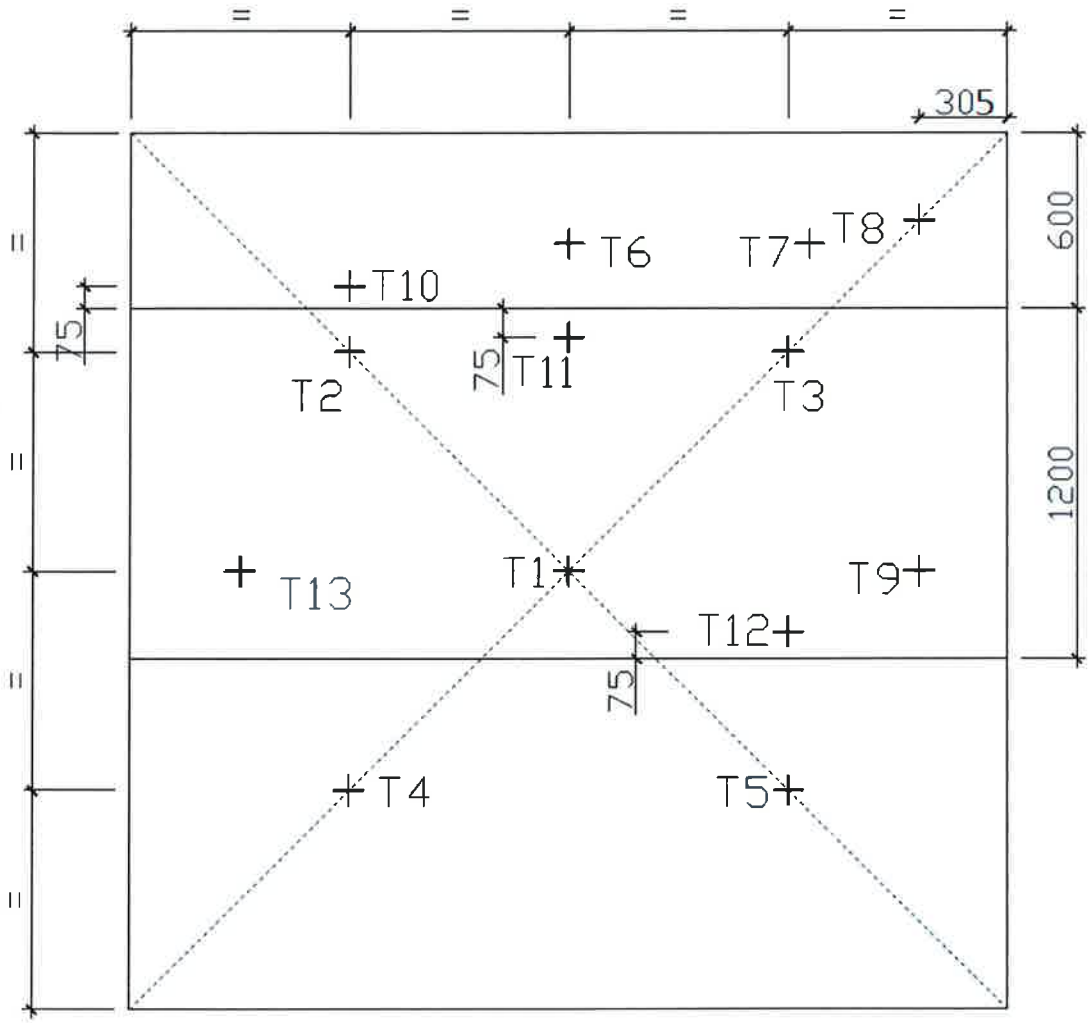


Drawing of ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR

8 Appendix B: Test Specimen Construction

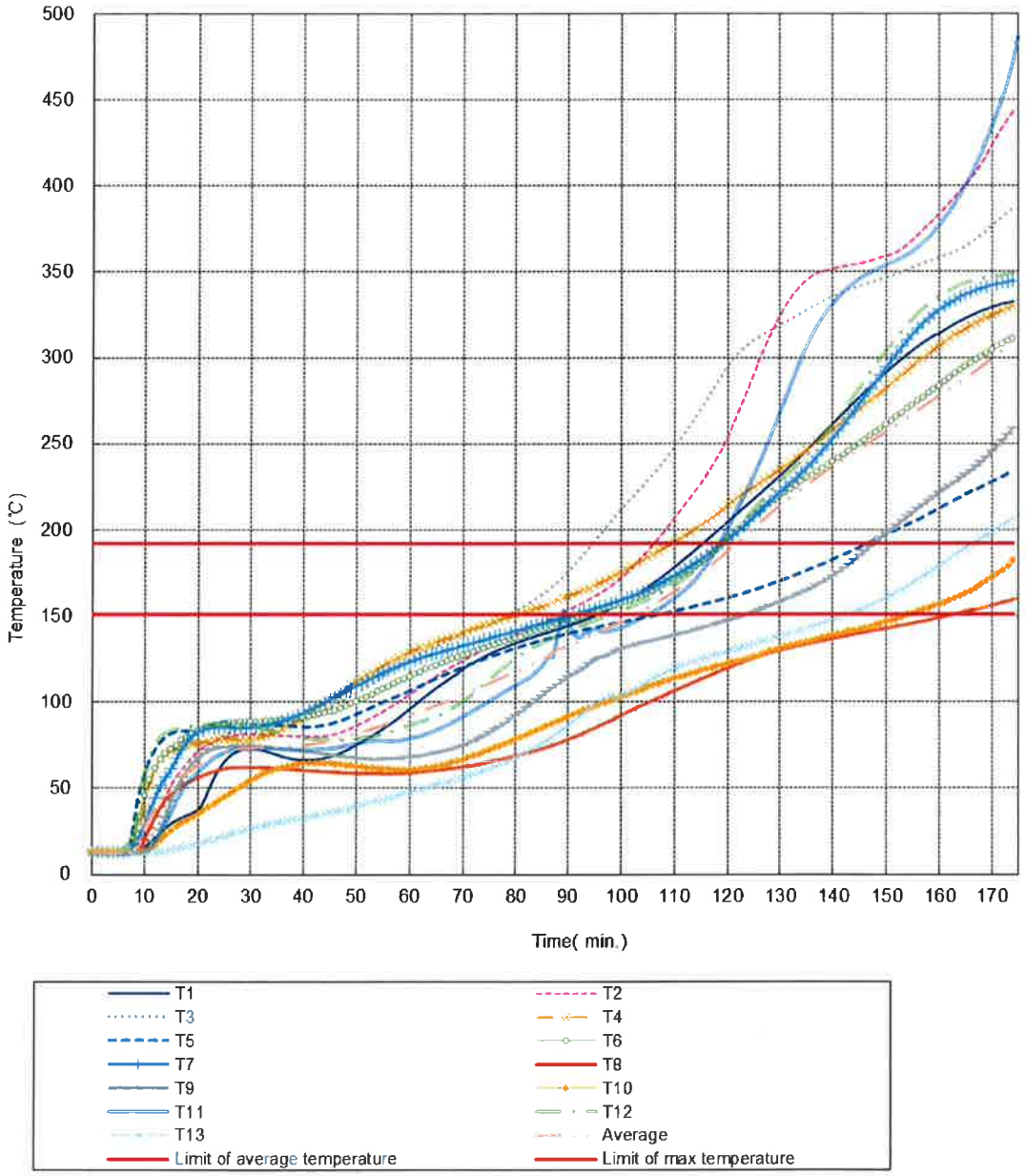


9 Appendix C: Thermocouple locations on the Specimen



Thermocouple location on ResCom(R) Board Wall, Model of 12mm ResCom(R) HMR

10 Appendix D: Test Data



UNEXPOSED SURFACE TEMPERATURES CURVE

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
0	12	13	13	13	13	12	13
1	12	13	13	13	13	13	13
2	12	13	13	13	13	13	13
3	12	13	13	13	13	13	13
4	12	13	13	13	13	13	13
5	12	13	13	13	13	13	13
6	12	13	13	13	13	13	13
7	12	14	13	15	14	16	13
8	12	16	14	18	30	21	17
9	13	18	15	25	47	33	22
10	15	22	17	39	59	45	29
11	18	27	21	52	67	55	37
12	21	33	25	60	73	62	45
13	24	38	31	67	77	67	52
14	27	45	36	70	80	70	56
15	29	51	42	72	82	72	61
16	31	56	49	72	83	75	67
17	33	60	53	73	83	78	73
18	34	65	57	75	83	80	77
19	36	68	62	76	83	81	80
20	37	71	66	76	84	83	82
21	42	74	70	77	85	84	84
22	49	75	74	77	86	85	85
23	56	77	77	78	87	86	85
24	61	78	79	79	88	86	85
25	66	79	81	79	88	87	85
26	69	80	83	79	89	87	85
27	71	81	84	79	89	88	85
28	72	81	85	78	88	88	85
29	73	81	85	78	88	88	85
30	73	81	86	78	87	88	85
31	73	81	86	79	87	88	86
32	72	81	86	80	87	89	86
33	71	81	86	81	86	89	87
34	70	81	86	82	86	89	87
35	69	81	86	83	86	89	88
36	68	80	87	84	86	90	89
37	68	80	87	86	86	90	90
38	67	80	88	87	86	90	91
39	67	80	89	89	86	91	93
40	66	80	90	91	85	91	94

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
0	13	13	13	12	11	12	12
1	13	13	13	12	12	12	12
2	13	13	13	12	12	12	12
3	13	13	13	12	12	12	12
4	13	13	13	12	11	12	12
5	13	13	13	12	12	12	12
6	13	13	13	12	12	12	13
7	13	13	13	12	13	12	13
8	13	13	13	12	23	12	16
9	14	13	13	13	42	12	22
10	20	13	13	15	58	12	27
11	27	14	15	19	69	12	33
12	33	19	17	24	76	13	38
13	39	26	20	30	80	13	43
14	43	34	22	36	82	13	47
15	47	43	25	43	83	14	51
16	49	50	28	48	84	15	54
17	51	56	30	53	85	15	57
18	53	61	32	56	85	16	60
19	55	65	34	60	86	17	62
20	56	68	35	62	86	18	64
21	57	70	37	65	87	19	65
22	59	72	39	68	87	20	67
23	60	73	41	69	87	20	69
24	61	74	43	71	87	21	70
25	61	74	45	72	87	22	71
26	62	74	47	73	87	23	72
27	62	74	49	73	87	24	73
28	62	74	51	74	87	25	73
29	62	74	53	74	86	26	73
30	62	74	55	74	86	27	74
31	62	74	56	74	85	27	74
32	62	74	58	73	85	28	74
33	62	74	59	73	84	29	74
34	62	74	60	73	83	29	74
35	61	73	61	73	83	30	74
36	61	73	62	73	82	31	74
37	61	72	63	72	81	31	74
38	61	72	64	72	80	32	75
39	61	72	64	72	80	32	75
40	60	71	64	72	79	33	75

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
41	66	80	91	93	85	92	95
42	67	80	93	95	85	92	97
43	67	80	94	97	86	93	98
44	68	80	96	99	86	93	100
45	68	81	97	101	87	94	101
46	69	81	99	103	88	95	103
47	71	82	100	106	89	96	105
48	72	83	102	108	90	98	106
49	74	85	104	110	91	99	108
50	75	86	105	112	93	100	109
51	77	88	107	114	94	101	111
52	79	89	109	116	96	103	112
53	81	91	111	118	97	104	114
54	83	93	113	119	98	106	115
55	85	95	115	121	100	107	117
56	87	96	117	123	101	109	118
57	89	98	119	124	102	110	120
58	91	100	121	126	104	112	121
59	94	102	123	127	105	113	122
60	96	104	125	129	106	115	123
61	99	106	127	130	108	116	125
62	101	108	128	131	109	118	126
63	104	111	130	133	111	119	127
64	106	113	131	134	112	120	128
65	108	115	133	135	113	121	128
66	110	117	134	136	115	123	129
67	113	119	136	137	116	124	130
68	115	121	137	138	118	125	131
69	117	122	139	139	119	126	132
70	119	124	140	140	120	127	133
71	121	126	142	142	121	128	134
72	123	127	143	143	123	129	134
73	125	129	143	143	124	130	135
74	126	130	144	145	125	131	136
75	128	132	145	146	126	132	137
76	129	133	146	147	127	133	138
77	131	135	148	148	128	134	139
78	132	136	149	149	129	135	140
79	133	138	151	150	130	136	140
80	134	139	153	151	131	137	141

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
41	60	71	65	72	79	33	76
42	60	71	65	73	79	34	76
43	60	70	65	73	78	35	77
44	60	70	65	73	78	35	77
45	59	69	65	74	78	36	78
46	59	69	64	74	78	37	78
47	59	69	64	75	78	37	79
48	59	68	64	75	78	38	80
49	59	68	63	76	78	39	81
50	59	68	63	76	79	39	82
51	59	67	63	77	79	40	83
52	59	67	62	77	80	41	84
53	59	67	62	78	80	42	85
54	59	67	62	78	81	42	86
55	58	67	61	77	81	43	87
56	58	67	61	77	82	44	88
57	58	67	61	78	83	45	89
58	59	67	61	78	84	46	90
59	59	68	61	79	85	47	91
60	59	68	61	80	87	48	92
61	59	68	61	80	88	49	94
62	59	69	61	81	89	50	95
63	60	69	62	83	90	50	96
64	60	70	62	84	91	51	97
65	60	71	63	85	92	52	98
66	61	71	64	87	93	53	99
67	61	72	64	88	94	54	101
68	62	73	65	90	96	55	102
69	62	74	66	92	98	56	103
70	63	75	67	93	100	56	104
71	63	76	68	95	103	57	106
72	64	77	69	97	105	58	107
73	64	79	70	99	108	59	108
74	65	81	71	101	111	60	110
75	66	82	72	103	113	62	111
76	66	84	74	105	116	63	112
77	67	86	75	106	118	64	114
78	67	88	76	108	121	65	115
79	68	90	77	110	123	66	116
80	69	92	79	111	126	68	118

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
81	135	141	155	151	132	138	142
82	136	142	157	153	133	139	143
83	137	143	158	154	134	140	144
84	138	145	160	154	135	141	145
85	139	146	162	155	136	142	146
86	140	148	165	157	136	143	146
87	141	149	167	158	137	144	147
88	142	150	170	159	138	145	148
89	143	152	173	160	139	146	149
90	144	153	176	161	139	147	150
91	145	155	179	163	140	148	151
92	146	156	182	164	141	149	151
93	147	158	186	165	142	150	152
94	149	159	190	166	142	151	153
95	150	161	193	168	143	152	154
96	151	163	197	169	143	153	155
97	153	165	201	170	144	154	156
98	154	167	205	172	145	155	157
99	156	169	208	174	145	156	158
100	157	172	212	175	146	157	159
101	159	174	215	177	147	158	160
102	161	177	219	179	147	159	161
103	163	181	222	181	148	160	163
104	165	184	225	182	149	161	164
105	167	188	229	184	149	163	165
106	169	191	232	186	150	164	167
107	171	195	236	188	150	166	168
108	173	198	240	189	151	168	170
109	176	202	244	191	152	169	172
110	178	207	248	193	152	171	173
111	181	211	252	195	153	173	175
112	183	215	256	197	154	175	177
113	186	219	261	198	154	176	179
114	189	223	266	201	155	178	181
115	191	227	270	203	156	180	183
116	194	232	275	205	157	183	185
117	196	236	280	207	158	185	187
118	199	242	285	210	158	188	189
119	202	247	290	212	159	191	192
120	205	254	295	214	160	195	194

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
81	70	95	80	113	128	69	119
82	70	97	81	115	129	71	120
83	71	99	83	118	131	72	122
84	72	101	84	121	133	74	123
85	73	104	85	126	134	76	125
86	74	106	86	126	136	78	126
87	75	108	88	140	137	80	129
88	76	110	89	153	138	82	131
89	77	112	90	146	140	85	132
90	78	115	91	140	141	87	132
91	80	116	93	137	142	89	134
92	81	118	94	140	144	91	135
93	82	120	95	141	145	94	137
94	84	122	96	142	146	96	138
95	85	124	98	141	147	98	140
96	86	126	99	141	148	100	141
97	88	126	100	141	150	102	142
98	89	128	101	142	151	104	144
99	91	129	102	143	152	103	145
100	92	131	103	144	153	104	147
101	94	132	104	146	154	105	148
102	95	133	105	148	155	107	150
103	97	133	106	149	157	108	151
104	98	134	108	151	158	110	153
105	100	135	109	152	159	112	155
106	101	136	110	154	161	114	156
107	102	136	111	156	162	115	158
108	104	137	112	158	164	117	160
109	105	138	113	160	166	118	162
110	107	139	114	163	168	120	164
111	108	139	115	165	170	121	166
112	109	140	116	168	172	122	168
113	111	141	116	171	174	123	170
114	112	142	117	175	177	124	172
115	113	143	118	179	179	125	174
116	114	144	119	184	182	126	177
117	116	144	120	190	185	127	179
118	117	145	121	195	188	128	182
119	118	146	121	201	191	129	185
120	120	147	122	207	195	129	187

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
121	207	260	299	217	161	197	197
122	210	267	302	219	162	200	199
123	213	275	305	221	163	202	202
124	215	283	308	223	164	205	205
125	218	291	310	225	165	208	208
126	221	298	312	227	166	210	210
127	223	306	314	229	167	212	214
128	226	312	315	231	168	215	216
129	229	318	317	233	169	217	219
130	232	324	319	235	170	219	222
131	234	329	321	237	171	222	225
132	237	334	322	239	172	224	227
133	240	338	324	242	173	226	230
134	243	342	326	244	175	228	233
135	246	345	328	246	176	230	236
136	249	347	329	249	177	232	239
137	252	349	331	251	178	233	242
138	255	350	333	253	180	236	246
139	259	351	334	256	181	237	249
140	262	351	335	258	182	240	253
141	265	352	337	261	184	242	257
142	268	353	338	263	185	243	261
143	271	354	340	266	187	245	265
144	274	354	341	268	188	248	269
145	277	355	342	270	189	250	273
146	280	356	343	273	191	252	278
147	283	356	344	275	192	254	282
148	286	357	345	277	194	256	286
149	289	358	346	280	195	259	290
150	292	359	347	282	197	261	294
151	294	360	348	285	198	263	298
152	297	361	349	288	200	265	302
153	299	363	350	290	201	268	306
154	302	366	351	293	203	270	310
155	304	368	353	295	204	272	314
156	307	371	354	298	205	274	317
157	309	374	355	300	207	277	320
158	311	377	356	302	209	279	323
159	313	380	357	305	210	281	325
160	314	383	358	307	212	284	328

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
121	121	148	123	213	198	130	190
122	122	149	124	219	201	131	193
123	123	150	125	226	205	132	196
124	124	151	125	232	208	133	198
125	126	152	126	239	212	134	201
126	127	153	127	246	215	135	204
127	128	154	128	254	219	136	206
128	128	156	129	261	222	137	209
129	129	157	130	269	225	137	212
130	130	158	131	277	228	138	214
131	131	159	132	285	231	139	217
132	132	161	133	293	234	140	219
133	132	162	134	300	237	141	221
134	133	163	134	306	240	142	224
135	134	165	135	313	243	143	226
136	134	166	136	318	246	144	228
137	135	168	137	323	250	145	230
138	135	169	137	328	253	146	232
139	136	171	138	332	257	147	235
140	137	173	139	335	261	148	237
141	137	175	140	338	265	149	239
142	138	177	141	341	269	150	241
143	139	180	141	344	274	151	243
144	139	182	142	346	278	152	245
145	140	185	142	348	283	153	247
146	140	187	143	350	287	155	249
147	141	190	144	351	291	156	251
148	142	193	145	353	296	158	253
149	142	195	146	354	300	159	255
150	143	198	146	356	304	161	257
151	143	200	147	357	308	162	259
152	144	203	148	358	312	164	261
153	144	205	149	360	315	165	263
154	145	208	151	362	319	167	265
155	146	210	152	365	323	169	267
156	146	212	153	367	326	171	269
157	147	215	154	370	329	173	271
158	147	217	155	373	331	175	274
159	148	219	156	377	334	177	276
160	149	221	157	381	336	179	278

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
161	316	387	359	309	214	286	330
162	318	390	360	311	215	288	332
163	320	394	362	313	217	290	334
164	321	397	363	315	218	292	335
165	323	400	365	317	220	294	337
166	324	404	367	318	221	297	338
167	326	408	369	320	223	299	339
168	327	413	371	322	224	301	340
169	328	418	374	323	226	303	341
170	329	424	376	325	227	304	342
171	330	429	379	326	229	306	343
172	331	434	382	327	231	308	343
173	332	439	384	329	232	309	344
174	333	443	387	330	234	311	345
175	331	/	/	331	235	313	345
176	331	/	/	332	237	314	346
177	332	/	/	334	239	315	347
178	333	/	/	335	240	317	348
179	333	/	/	336	242	318	349
180	334	/	/	337	244	319	349
181	335	/	/	338	246	320	350
182	335	/	/	339	248	321	350
183	336	/	/	340	249	322	351
184	336	/	/	341	251	322	352
185	336	/	/	341	253	323	353
186	337	/	/	342	255	324	354
187	338	/	/	343	257	324	354
188	338	/	/	344	259	325	355
189	339	/	/	345	261	326	356
190	339	/	/	345	263	326	357
191	340	/	/	346	264	327	357
192	340	/	/	348	266	327	358
193	341	/	/	349	268	328	359
194	341	/	/	350	270	329	359
195	342	/	/	351	272	329	360
196	343	/	/	351	274	330	361
197	343	/	/	352	276	331	362
198	344	/	/	353	278	331	363
199	345	/	/	354	280	332	364
200	345	/	/	355	282	332	366

Note: 175min, T2, T3 and T11 falls down due to high temperature.

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
161	150	224	158	385	338	181	280
162	150	226	159	390	339	183	282
163	151	228	160	395	341	185	284
164	152	230	162	401	342	187	286
165	152	232	163	406	344	189	288
166	153	234	165	413	344	191	290
167	154	237	166	419	345	193	292
168	154	239	168	427	346	195	294
169	155	242	170	435	347	197	297
170	156	245	172	443	347	199	299
171	157	248	174	451	348	200	302
172	158	252	177	461	348	202	304
173	158	255	179	473	349	204	307
174	159	259	182	487	349	206	310
175	160	263	185	/	350	208	/
176	161	267	188	/	350	210	/
177	162	272	191	/	351	212	/
178	162	276	194	/	352	214	/
179	164	281	198	/	352	216	/
180	165	285	201	/	353	218	/
181	166	290	205	/	353	220	/
182	167	294	209	/	354	221	/
183	168	299	214	/	355	223	/
184	169	302	218	/	355	225	/
185	170	306	223	/	356	228	/
186	172	309	228	/	357	230	/
187	173	312	233	/	357	232	/
188	174	314	238	/	358	234	/
189	176	317	243	/	359	237	/
190	177	319	249	/	360	239	/
191	179	321	255	/	362	242	/
192	180	322	262	/	363	244	/
193	182	324	269	/	365	247	/
194	183	325	276	/	366	250	/
195	185	326	282	/	368	252	/
196	186	327	290	/	370	255	/
197	188	327	297	/	372	258	/
198	189	328	304	/	374	261	/
199	191	329	310	/	376	264	/
200	192	329	316	/	378	267	/

Note: 175min, T2, T3 and T11 falls down due to high temperature.

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#1 (°C)	TC#2 (°C)	TC#3 (°C)	TC#4 (°C)	TC#5 (°C)	TC#6 (°C)	TC#7 (°C)
201	346	/	/	355	284	333	367
202	346	/	/	356	286	334	369
203	347	/	/	357	288	334	370
204	348	/	/	357	289	335	372
205	349	/	/	358	291	335	373
206	350	/	/	358	293	336	375
207	350	/	/	359	294	336	376
208	351	/	/	360	296	337	378
209	352	/	/	361	297	337	380
210	352	/	/	362	299	338	382
211	352	/	/	362	301	338	383
212	353	/	/	363	302	338	385
213	273	/	/	364	303	339	387
214	274	/	/	366	305	340	388
215	275	/	/	367	306	340	390
216	277	/	/	368	308	341	392
217	275	/	/	369	309	342	394
218	275	/	/	370	310	343	396
219	276	/	/	372	311	343	398
220	275	/	/	373	312	344	401
221	275	/	/	374	314	344	403
222	277	/	/	375	315	345	405
223	279	/	/	376	316	346	408
224	279	/	/	378	317	347	410
225	280	/	/	379	318	347	412
226	280	/	/	380	320	348	415
227	280	/	/	381	321	349	417
228	280	/	/	383	322	350	420
229	280	/	/	384	322	351	423
230	281	/	/	386	323	352	426
231	289	/	/	387	324	353	429
232	289	/	/	389	325	354	432
233	289	/	/	390	326	355	436
234	289	/	/	392	326	356	439
235	62	/	/	393	327	357	442
236	/	/	/	/	/	/	/
237	/	/	/	/	/	/	/
238	/	/	/	/	/	/	/
239	/	/	/	/	/	/	/
240	/	/	/	/	/	/	/

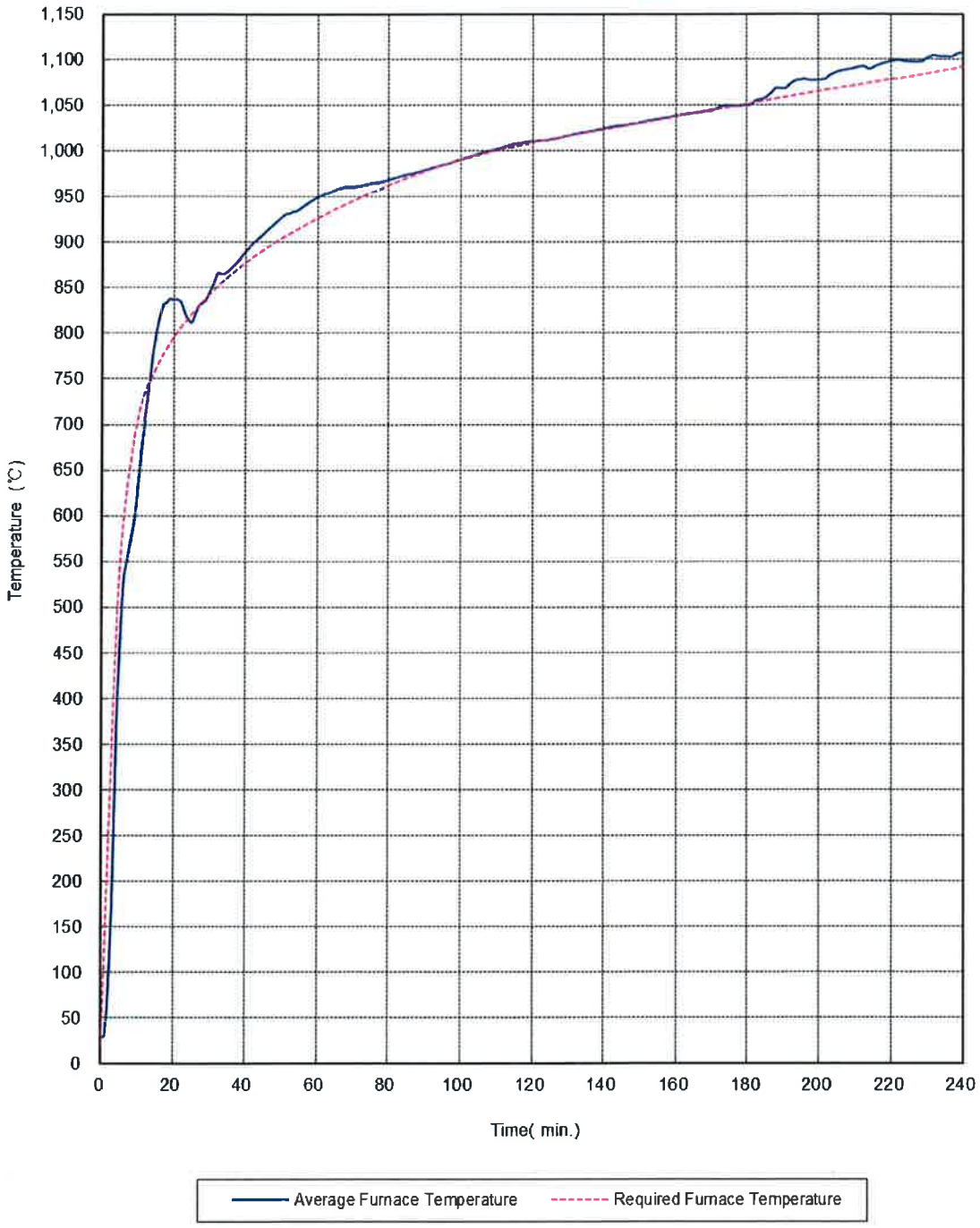
Note: 236min, the thermal couples were removed due to high temperature.

UNEXPOSED SURFACE TEMPERATURES (°C)

Time (min)	TC#8 (°C)	TC#9 (°C)	TC#10 (°C)	TC#11 (°C)	TC#12 (°C)	TC#13 (°C)	Average (°C)
201	194	330	322	/	380	270	/
202	196	330	327	/	382	273	/
203	197	331	332	/	384	277	/
204	199	331	335	/	386	280	/
205	201	332	339	/	388	282	/
206	203	332	342	/	390	285	/
207	204	333	344	/	392	288	/
208	206	333	346	/	394	290	/
209	208	334	348	/	396	293	/
210	210	334	353	/	398	294	/
211	212	334	355	/	401	295	/
212	213	335	357	/	404	296	/
213	215	335	358	/	407	298	/
214	217	335	360	/	410	298	/
215	219	335	362	/	413	300	/
216	220	335	364	/	416	301	/
217	222	335	366	/	419	303	/
218	224	335	369	/	422	304	/
219	226	335	372	/	424	304	/
220	228	335	375	/	427	305	/
221	230	335	378	/	428	305	/
222	232	335	382	/	430	306	/
223	235	335	386	/	432	307	/
224	237	336	391	/	434	307	/
225	239	336	396	/	436	308	/
226	242	336	401	/	437	309	/
227	245	337	407	/	439	309	/
228	248	337	414	/	440	309	/
229	251	337	421	/	442	310	/
230	254	338	428	/	444	310	/
231	257	338	436	/	447	310	/
232	260	338	445	/	451	311	/
233	263	339	454	/	455	311	/
234	267	339	464	/	461	312	/
235	270	340	511	/	466	/	/
236	/	/	/	/	/	/	/
237	/	/	/	/	/	/	/
238	/	/	/	/	/	/	/
239	/	/	/	/	/	/	/
240	/	/	/	/	/	/	/

Note: 236min, the thermal couples were removed due to high temperature.

FURNACE TEMPERATURES



TIME-TEMPERATURE CURVE INSIDE FURNACE

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
0	29	20	0	0	0.00%
1	32	123	10	52	-80.25%
2	97	227	55	207	-73.55%
3	205	331	186	466	-60.11%
4	365	434	451	828	-45.55%
5	462	538	845	1294	-34.72%
6	531	571	1321	1829	-27.74%
7	552	604	1843	2396	-23.09%
8	574	638	2386	2997	-20.39%
9	597	671	2951	3632	-18.73%
10	632	704	3546	4299	-17.52%
11	673	720	4178	4991	-16.29%
12	704	731	4847	5697	-14.92%
13	736	740	5547	6412	-13.49%
14	773	749	6281	7137	-11.99%
15	798	760	7046	7871	-10.48%
16	817	766	7833	8614	-9.06%
17	831	773	8637	9364	-7.76%
18	834	780	9449	10120	-6.63%
19	838	787	10265	10884	-5.68%
20	836	795	11082	11655	-4.91%
21	837	799	11899	12432	-4.29%
22	834	804	12714	13213	-3.77%
23	823	810	13523	14000	-3.41%
24	815	815	14322	14793	-3.18%
25	812	821	15115	15591	-3.05%
26	822	825	15912	16394	-2.94%
27	831	829	16718	17201	-2.81%
28	833	834	17530	18012	-2.68%
29	837	838	18345	18828	-2.56%
30	846	843	19167	19649	-2.45%
31	854	847	19997	20474	-2.33%
32	865	851	20837	21303	-2.19%
33	865	854	21682	22135	-2.05%
34	865	858	22528	22971	-1.93%
35	868	862	23374	23811	-1.83%
36	872	865	24225	24655	-1.74%
37	876	868	25079	25501	-1.66%
38	880	872	25937	26351	-1.57%
39	885	874	26800	27204	-1.49%
40	890	878	27668	28060	-1.40%

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
41	895	881	28540	28920	-1.31%
42	899	884	29417	29782	-1.23%
43	902	887	30297	30648	-1.14%
44	906	889	31181	31516	-1.06%
45	910	892	32069	32386	-0.98%
46	913	895	32961	33260	-0.90%
47	917	898	33856	34136	-0.82%
48	921	900	34755	35015	-0.74%
49	924	903	35658	35897	-0.67%
50	928	905	36564	36781	-0.59%
51	931	908	37473	37667	-0.52%
52	932	910	38384	38556	-0.45%
53	934	912	39296	39447	-0.38%
54	934	914	40210	40340	-0.32%
55	937	917	41126	41236	-0.27%
56	940	919	42044	42134	-0.21%
57	942	921	42965	43034	-0.16%
58	945	923	43889	43936	-0.11%
59	947	926	44815	44840	-0.06%
60	950	927	45743	45747	-0.01%
61	951	929	46674	46655	0.04%
62	953	932	47606	47565	0.09%
63	954	933	48540	48478	0.13%
64	956	936	49475	49392	0.17%
65	958	937	50411	50309	0.20%
66	959	939	51350	51227	0.24%
67	960	941	52290	52147	0.27%
68	961	943	53230	53069	0.30%
69	961	944	54171	53992	0.33%
70	961	946	55112	54917	0.35%
71	961	948	56053	55844	0.37%
72	962	950	56995	56773	0.39%
73	963	952	57937	57704	0.40%
74	963	953	58880	58637	0.42%
75	965	955	59824	59571	0.43%
76	965	956	60769	60506	0.43%
77	965	958	61714	61443	0.44%
78	966	959	62660	62382	0.45%
79	967	961	63607	63322	0.45%
80	969	963	64555	64264	0.45%

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
81	970	964	65504	65207	0.46%
82	971	966	66454	66152	0.46%
83	972	967	67406	67099	0.46%
84	973	969	68358	68047	0.46%
85	974	970	69312	68996	0.46%
86	975	972	70266	69947	0.46%
87	976	973	71221	70900	0.45%
88	977	974	72178	71853	0.45%
89	978	976	73135	72808	0.45%
90	979	977	74094	73765	0.45%
91	980	978	75053	74722	0.44%
92	981	980	76014	75681	0.44%
93	983	981	76976	76642	0.44%
94	984	982	77939	77603	0.43%
95	985	984	78903	78566	0.43%
96	986	985	79868	79531	0.42%
97	987	986	80834	80496	0.42%
98	988	987	81802	81463	0.42%
99	990	989	82771	82431	0.41%
100	991	990	83741	83400	0.41%
101	992	991	84712	84371	0.40%
102	993	992	85685	85342	0.40%
103	995	993	86659	86315	0.40%
104	996	995	87634	87289	0.40%
105	997	996	88610	88264	0.39%
106	998	997	89588	89241	0.39%
107	999	998	90566	90218	0.39%
108	1000	999	91546	91197	0.38%
109	1001	1000	92526	92176	0.38%
110	1002	1001	93508	93157	0.38%
111	1004	1002	94491	94138	0.37%
112	1005	1003	95475	95121	0.37%
113	1006	1004	96461	96104	0.37%
114	1007	1005	97447	97089	0.37%
115	1008	1006	98435	98074	0.37%
116	1009	1007	99423	99061	0.37%
117	1009	1008	100412	100048	0.36%
118	1010	1008	101402	101036	0.36%
119	1010	1009	102392	102025	0.36%
120	1010	1010	103382	103014	0.36%

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
121	1011	1010	104373	104004	0.35%
122	1011	1011	105364	104995	0.35%
123	1011	1012	106355	105986	0.35%
124	1012	1013	107347	106979	0.34%
125	1013	1013	108339	107972	0.34%
126	1013	1014	109332	108965	0.34%
127	1014	1014	110326	109959	0.33%
128	1015	1015	111320	110954	0.33%
129	1016	1016	112316	111949	0.33%
130	1017	1017	113312	112946	0.32%
131	1018	1017	114310	113943	0.32%
132	1019	1018	115308	114940	0.32%
133	1019	1019	116307	115939	0.32%
134	1020	1019	117307	116938	0.32%
135	1021	1020	118307	117937	0.31%
136	1021	1021	119309	118938	0.31%
137	1022	1022	120310	119939	0.31%
138	1023	1022	121313	120941	0.31%
139	1024	1023	122317	121944	0.31%
140	1025	1024	123321	122947	0.30%
141	1026	1024	124326	123951	0.30%
142	1026	1025	125332	124956	0.30%
143	1027	1026	126339	125961	0.30%
144	1027	1027	127346	126968	0.30%
145	1028	1027	128354	127975	0.30%
146	1028	1028	129362	128982	0.29%
147	1029	1029	130371	129991	0.29%
148	1030	1029	131381	131000	0.29%
149	1030	1030	132390	132009	0.29%
150	1031	1030	133401	133019	0.29%
151	1032	1032	134413	134030	0.29%
152	1033	1032	135425	135042	0.28%
153	1034	1033	136439	136055	0.28%
154	1034	1033	137453	137068	0.28%
155	1035	1034	138467	138081	0.28%
156	1036	1035	139482	139096	0.28%
157	1036	1035	140498	140111	0.28%
158	1037	1036	141515	141126	0.28%
159	1038	1037	142532	142143	0.27%
160	1038	1038	143550	143160	0.27%

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
161	1039	1038	144569	144178	0.27%
162	1039	1039	145588	145197	0.27%
163	1040	1040	146608	146216	0.27%
164	1040	1040	147628	147236	0.27%
165	1041	1041	148649	148257	0.26%
166	1041	1042	149670	149278	0.26%
167	1042	1043	150691	150301	0.26%
168	1043	1043	151714	151324	0.26%
169	1043	1044	152737	152347	0.26%
170	1044	1044	153760	153371	0.25%
171	1045	1045	154784	154396	0.25%
172	1048	1046	155811	155421	0.25%
173	1049	1047	156839	156448	0.25%
174	1050	1047	157869	157475	0.25%
175	1050	1048	158899	158502	0.25%
176	1049	1049	159928	159531	0.25%
177	1049	1049	160957	160560	0.25%
178	1049	1050	161986	161589	0.25%
179	1050	1051	163016	162620	0.24%
180	1050	1052	164046	163651	0.24%
181	1050	1052	165076	164683	0.24%
182	1054	1053	166108	165716	0.24%
183	1056	1054	167143	166749	0.24%
184	1057	1054	168179	167783	0.24%
185	1058	1055	169217	168818	0.24%
186	1061	1056	170256	169853	0.24%
187	1064	1057	171298	170890	0.24%
188	1069	1057	172345	171927	0.24%
189	1069	1058	173393	172964	0.25%
190	1068	1059	174442	174003	0.25%
191	1069	1059	175491	175042	0.26%
192	1073	1060	176541	176081	0.26%
193	1076	1060	177596	177121	0.27%
194	1078	1062	178652	178162	0.28%
195	1078	1062	179710	179204	0.28%
196	1079	1063	180768	180247	0.29%
197	1078	1063	181827	181290	0.30%
198	1077	1064	182884	182333	0.30%
199	1077	1065	183942	183378	0.31%
200	1077	1065	184999	184423	0.31%

FURNACE TEMPERATURES (°C)

Time (min)	Avg Furnace Temp (°C)	Standard Curve (°C)	Integration of Furnace Avg (°C•min)	Integration of Std (°C•min)	Error (%)
201	1078	1066	186057	185468	0.32%
202	1079	1067	187115	186515	0.32%
203	1082	1068	188175	187562	0.33%
204	1084	1068	189239	188610	0.33%
205	1086	1069	190304	189659	0.34%
206	1087	1070	191371	190708	0.35%
207	1088	1070	192439	191758	0.35%
208	1089	1071	193507	192809	0.36%
209	1090	1072	194576	193860	0.37%
210	1091	1073	195646	194913	0.38%
211	1092	1073	196718	195966	0.38%
212	1092	1074	197789	197019	0.39%
213	1092	1074	198862	198073	0.40%
214	1090	1075	199932	199128	0.40%
215	1091	1076	201003	200183	0.41%
216	1093	1077	202074	201240	0.41%
217	1094	1078	203148	202297	0.42%
218	1096	1078	204223	203355	0.43%
219	1097	1079	205300	204414	0.43%
220	1098	1079	206377	205473	0.44%
221	1099	1080	207456	206532	0.45%
222	1100	1081	208535	207593	0.45%
223	1099	1082	209614	208654	0.46%
224	1098	1082	210693	209716	0.47%
225	1098	1083	211771	210779	0.47%
226	1098	1084	212849	211842	0.48%
227	1098	1084	213926	212906	0.48%
228	1098	1085	215004	213971	0.48%
229	1099	1086	216082	215036	0.49%
230	1102	1087	217162	216103	0.49%
231	1103	1087	218245	217170	0.50%
232	1105	1088	219329	218237	0.50%
233	1104	1089	220413	219306	0.51%
234	1103	1089	221497	220375	0.51%
235	1104	1090	222580	221444	0.51%
236	1103	1090	223664	222514	0.52%
237	1103	1092	224747	223585	0.52%
238	1106	1092	225832	224657	0.52%
239	1107	1093	226918	225730	0.53%
240	1107	1093	228005	226803	0.53%

11 Appendix E: Test Photographs

Fig. 1 - Exposed Side Prior to the Fire Test

Fig. 2 - Unexposed Side Prior to the Fire Test

Fig. 3 - Unexposed Side after 30 Minutes

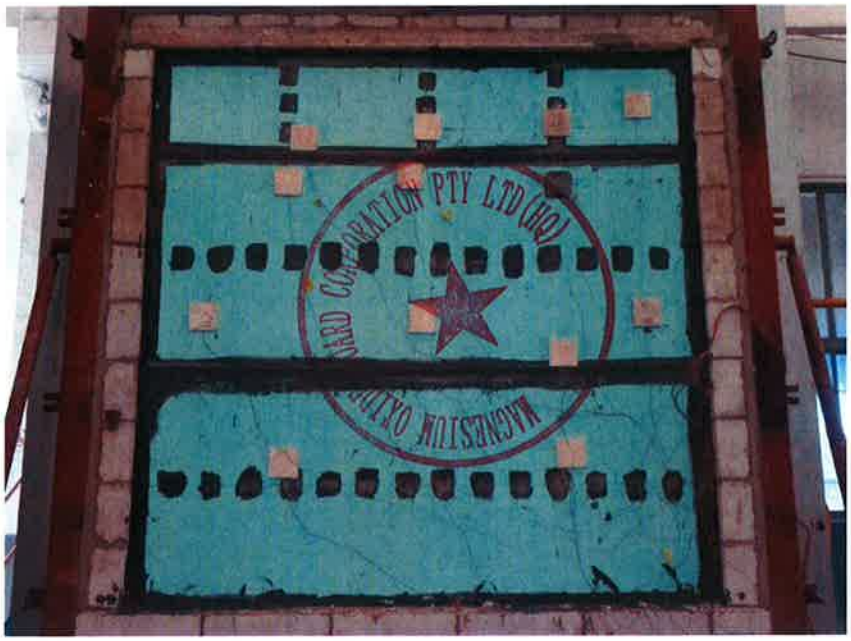


Fig. 4 - Unexposed Side after 60 Minutes

Fig. 5 - Unexposed Side after 122 Minutes

Fig. 6 - Unexposed Side after 150 Minutes

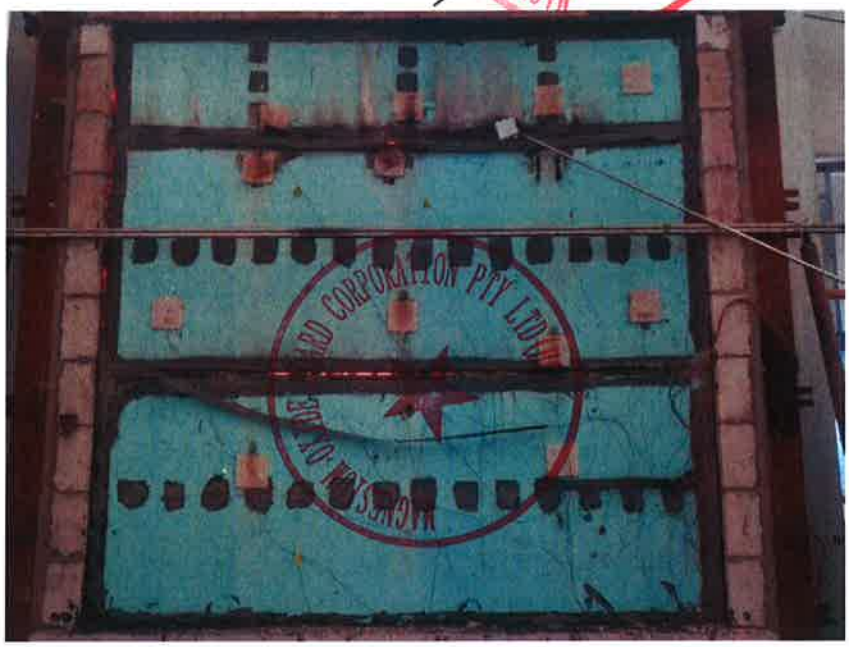


Fig. 7 - Unexposed Side after 180 Minutes

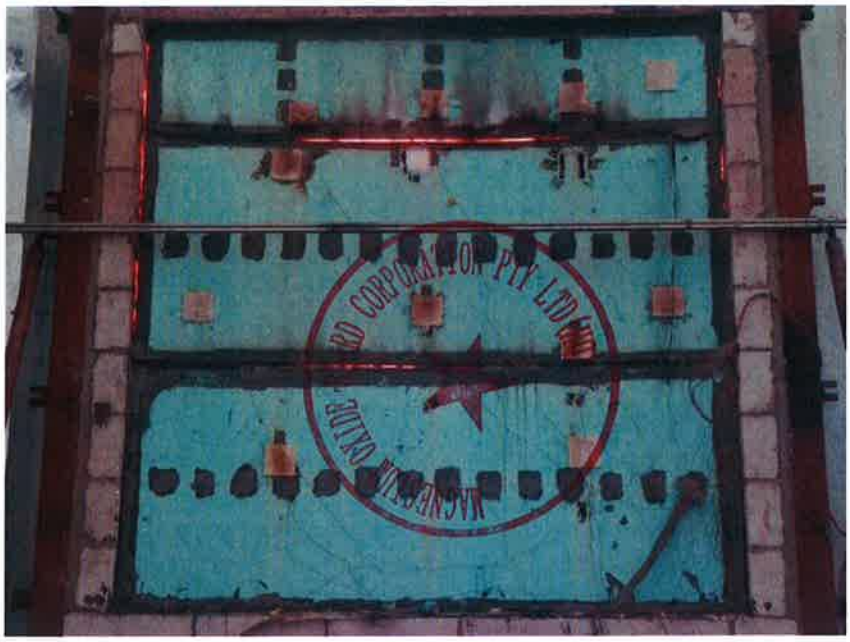


Fig. 8 - Unexposed Side after 210 Minutes

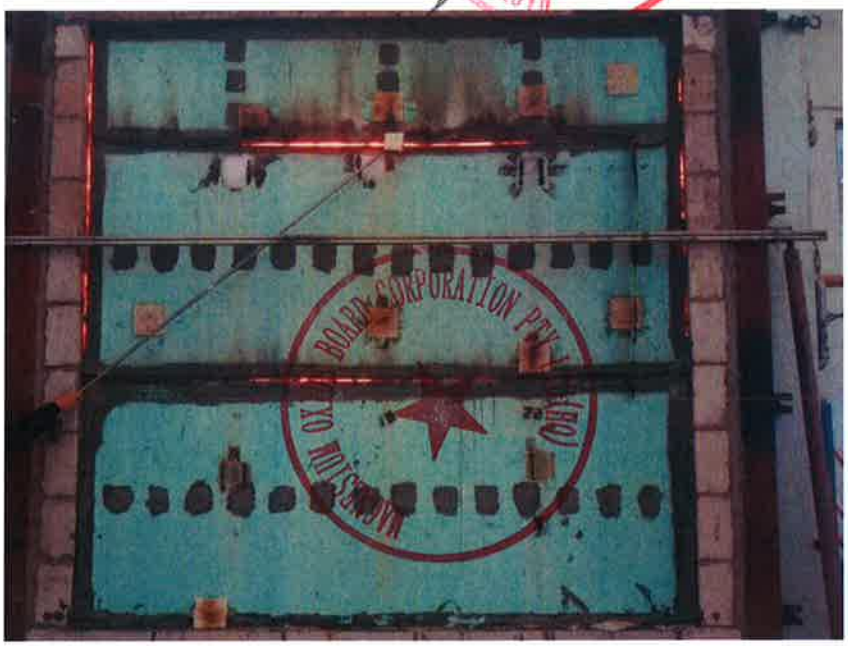


Fig. 9 - Unexposed Side after 236 Minutes

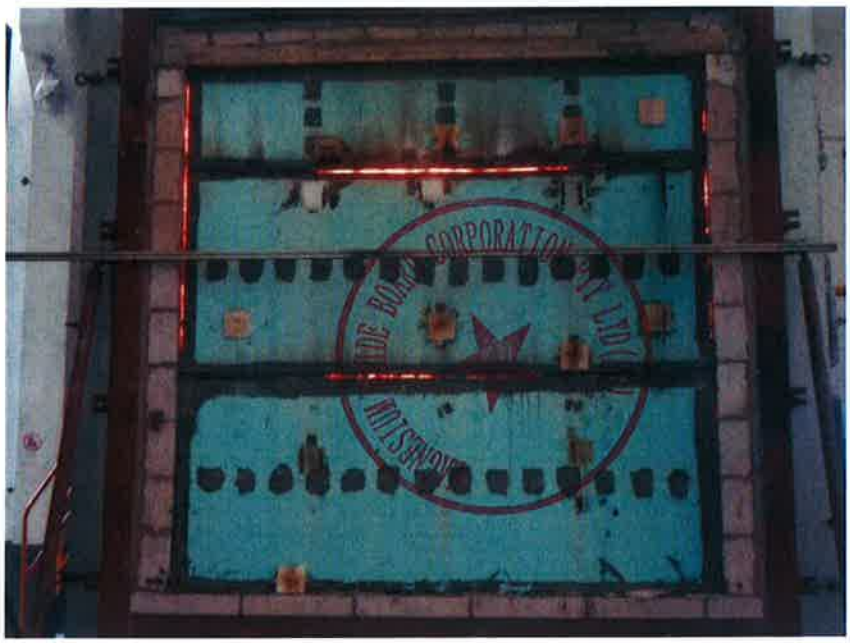


Fig. 10 - Unexposed Side after 240 Minutes

Fig. 11 - Exposed Side after 240 Minutes

Fig. 12 - Exposed Side during Hose Stream Test

Fig. 13 - Exposed Side after Hose Stream Test

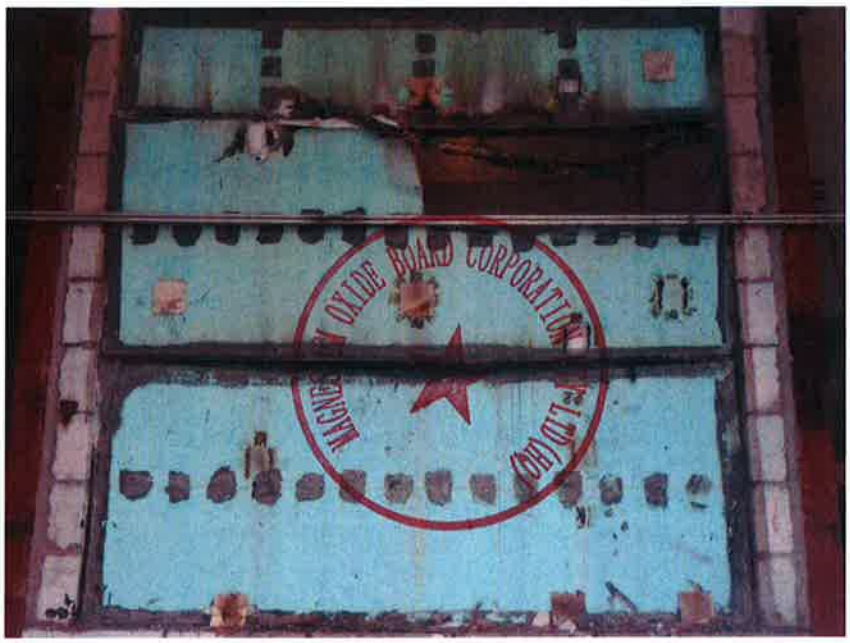


Fig. 14 - Unexposed Side after Hose Stream Test

12 Revision Page

Revision No.	Date	Changes	Author	Reviewer
0	December 23, 2016	First issue	Timothy Li	Harrison Li

END OF DOCUMENT