

C A M B R I D G E
FIRE RESEARCH

REPORT NUMBER
CFR1404291

**AD HOC FIRE RESISTANCE TEST GENERALLY
FOLLOWING THE PRINCIPLES OF BS 476: PART 22: 1987**

Sponsors:	Sealmaster	Intumescent Seals
Address:	Brewery Road Pampisford Cambridge Cambridgeshire CB22 3HG	Unit 3 The Old Brewery Pampisford Cambridge Cambridgeshire CB22 3EW
Date of test:	29 th April 2014	

Results:		
	Left hand panel	Right hand Panel
Test duration:	118 minutes	118 minutes
Integrity:	117 minutes	104 minutes
Insulation:	28 minutes	25 minutes



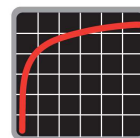
Summary of test specimens:

Two identical 90 minute Strebord door panels glazed with Pilkington Pyrodur EW60-10 and using different glazing seal systems.

Left hand panel glazing system
SM Fireglaze tape.

Right hand panel glazing system
ISL 60 Plus tape.

Individual panel size:
2135 high x 665 wide x 64 thick



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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 7 days prior to the test the temperature and relative humidity were measured and recorded within the range of 12 to 19 °C and 40 to 82 % respectively.

1.2 Associated construction

Cambridge Fire Research installed a furnace closure which provided an aperture of nominally 2140 mm high x 1350 mm wide.

1.3 Specimen construction

The specimen was constructed, on behalf of and to a specification provided by the sponsors, entirely by Cambridge Fire Research from its component parts.

1.4 Specimen verification

Cambridge Fire Research carried out a detailed survey of the specimen which included verifying the densities, 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

Cambridge Fire Research installed the specimens into the associated construction. Each door panel was affixed on the unexposed side using brackets at mid height on either side and at the top and bottom on either side of a separating fin of British Gypsum Glasroc F Multiboard.

The specimen was affixed to the associated construction as described in Appendix 1.

1.6 Specimen selection

Cambridge Fire Research was not involved in any selection or sampling procedures for the tested specimens.

2 PRE-TEST MEASUREMENTS AND SETTING

2.1 Gap measurements

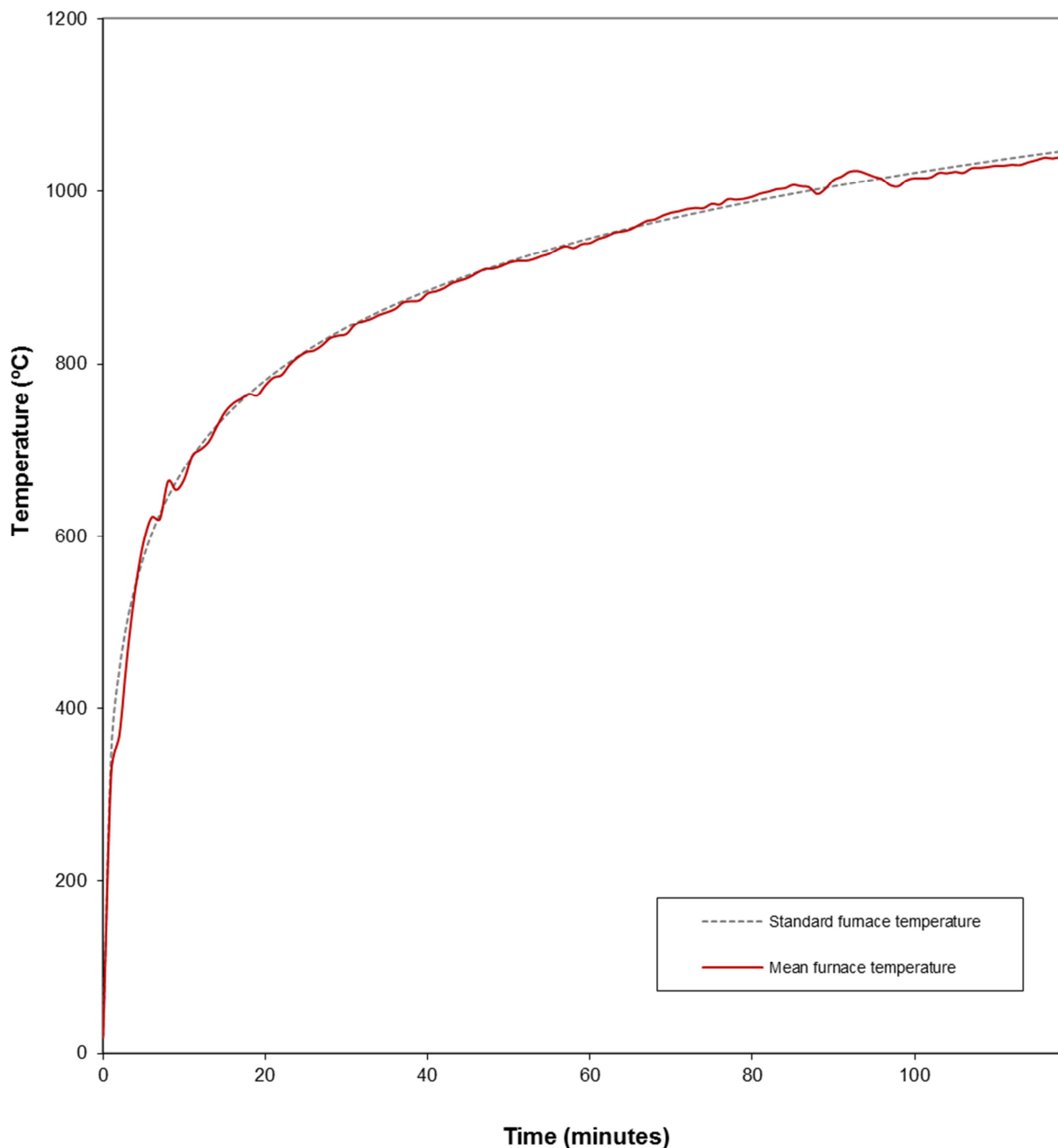
The gaps between the glass edges and the glazing liner were not measured during installation since the edge cover is not regarded as critical for this type of glass. The glass was placed centrally with regard to width and on 5mm setting blocks so the top gaps and side gaps were calculated as follows:

	Left hand pane	Right hand pane
Top:	7 mm	8 mm
Sides:	6 mm	7 mm
Bottom:	5 mm	5 mm

3 TEST CONDITIONS, INSTRUMENTATION AND MEASURING

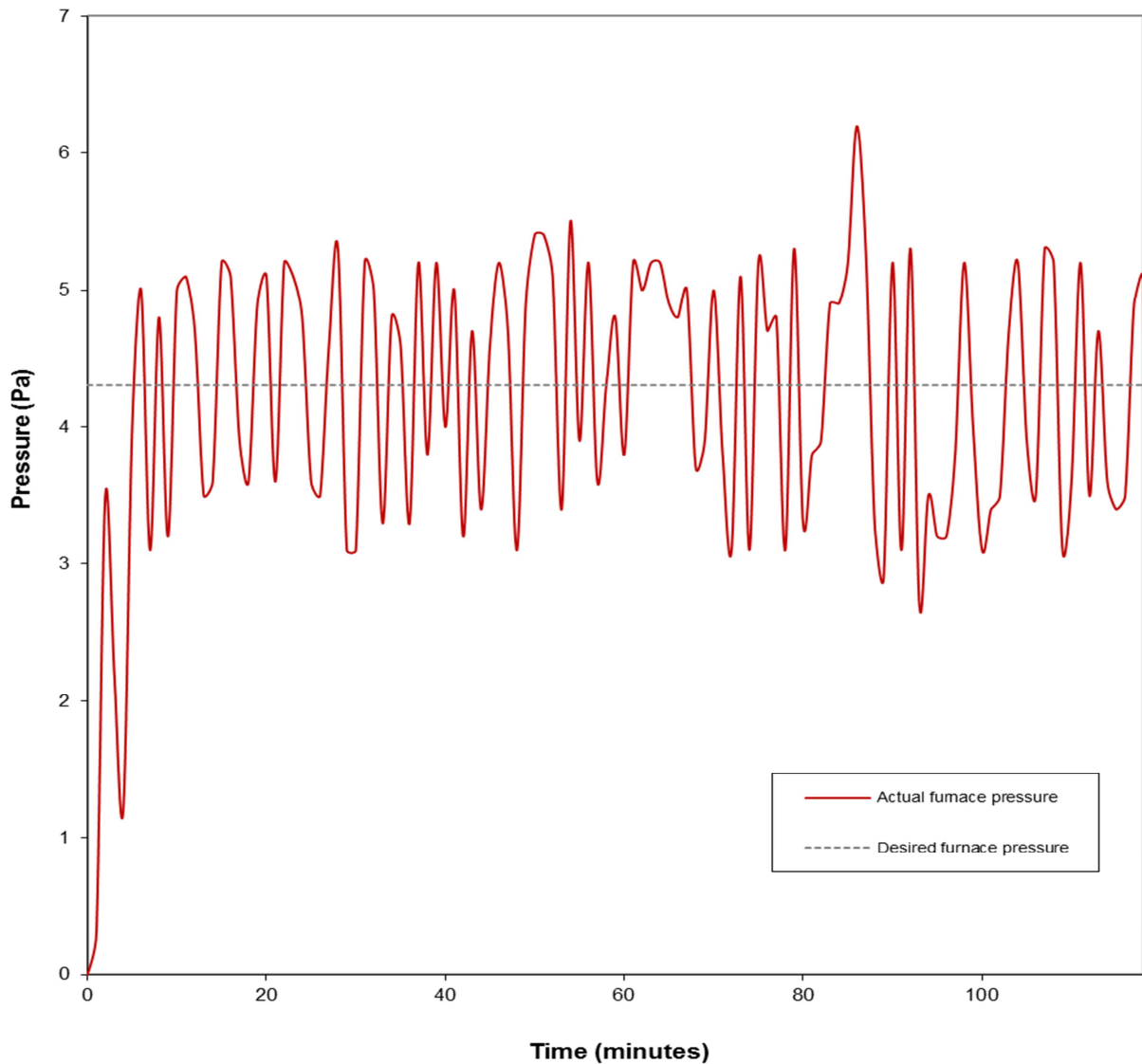
3.1 Furnace temperature

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 five furnace thermocouples of the design specified in the test standard. The following graph shows the standard and mean furnace temperature/time data.



3.2 Furnace pressure

Furnace pressure was maintained for the duration of the test at a nominal + 4.3 Pa measured at the pressure sensing head. When a linear pressure gradient of 8.5 Pa/m is applied this equates to + 0 Pa at 1 m above the bottom of the specimen. The furnace pressure was controlled within the tolerances permitted in the test standard. The following graph shows the actual and desired furnace pressure/time data.



3.3 Ambient temperature

Ambient temperature at the start of the test was 15°C.
Ambient temperature ranged between 15°C and 18°C during the test.

3.4 Unexposed face specimen thermocouples

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

Left hand panel

Panel	Channels	16 and 18	(maximum)
Glass	Channels	20 and 21	(maximum)

Right hand panel

Panel	Channels	17 and 19	(maximum)
Glass	Channels	22 and 23	(maximum)

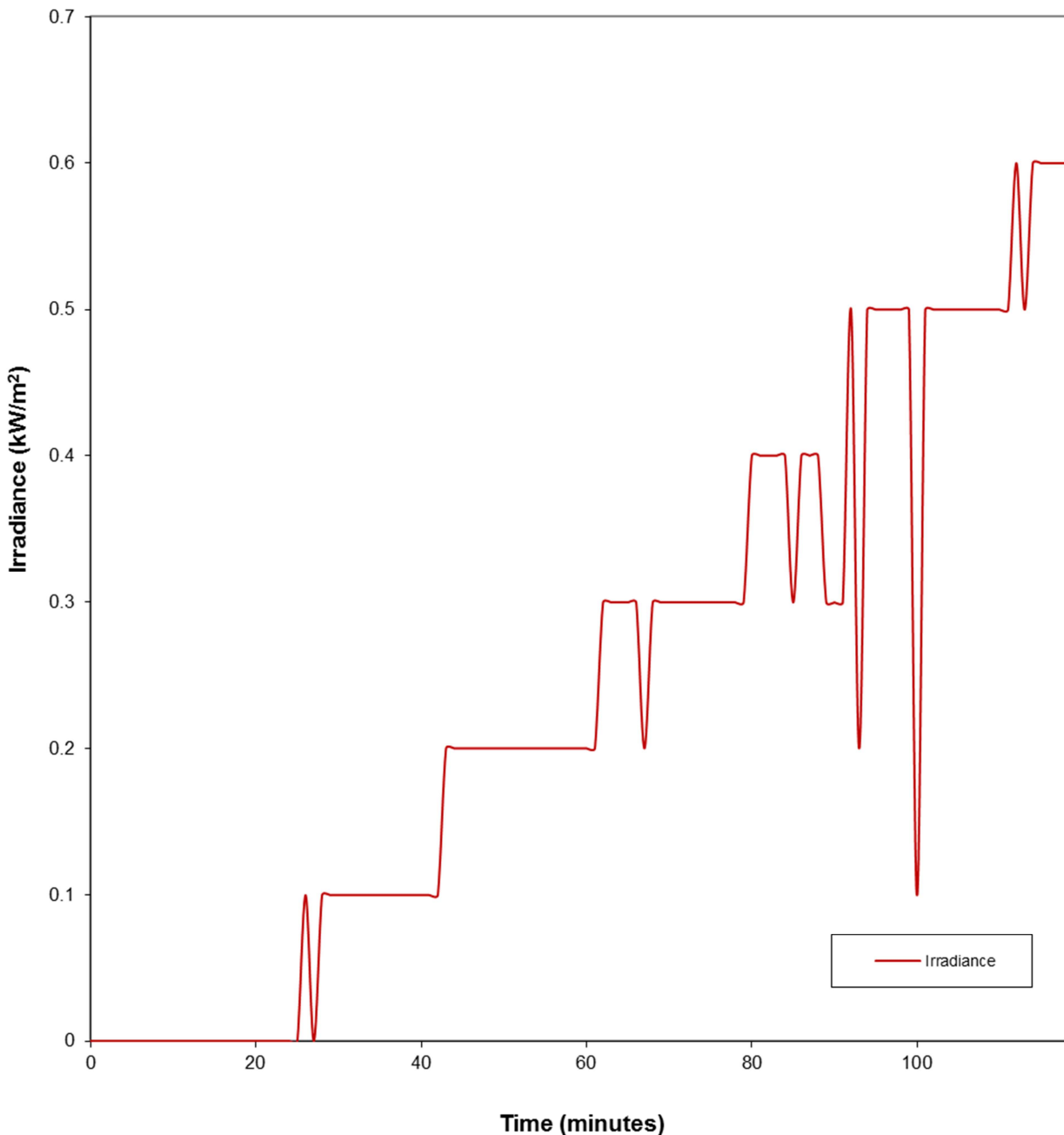
The positions of these thermocouples are shown in Appendix 3.

A roving thermocouple was available for measurement of any specific hotspots and was recorded on Channel 15. Any position(s) of use of the roving thermocouple are noted in the observations in Section 4.

The recorded data of all reported individual thermocouples is shown in the tables in Appendix 4.

3.5 Irradiance

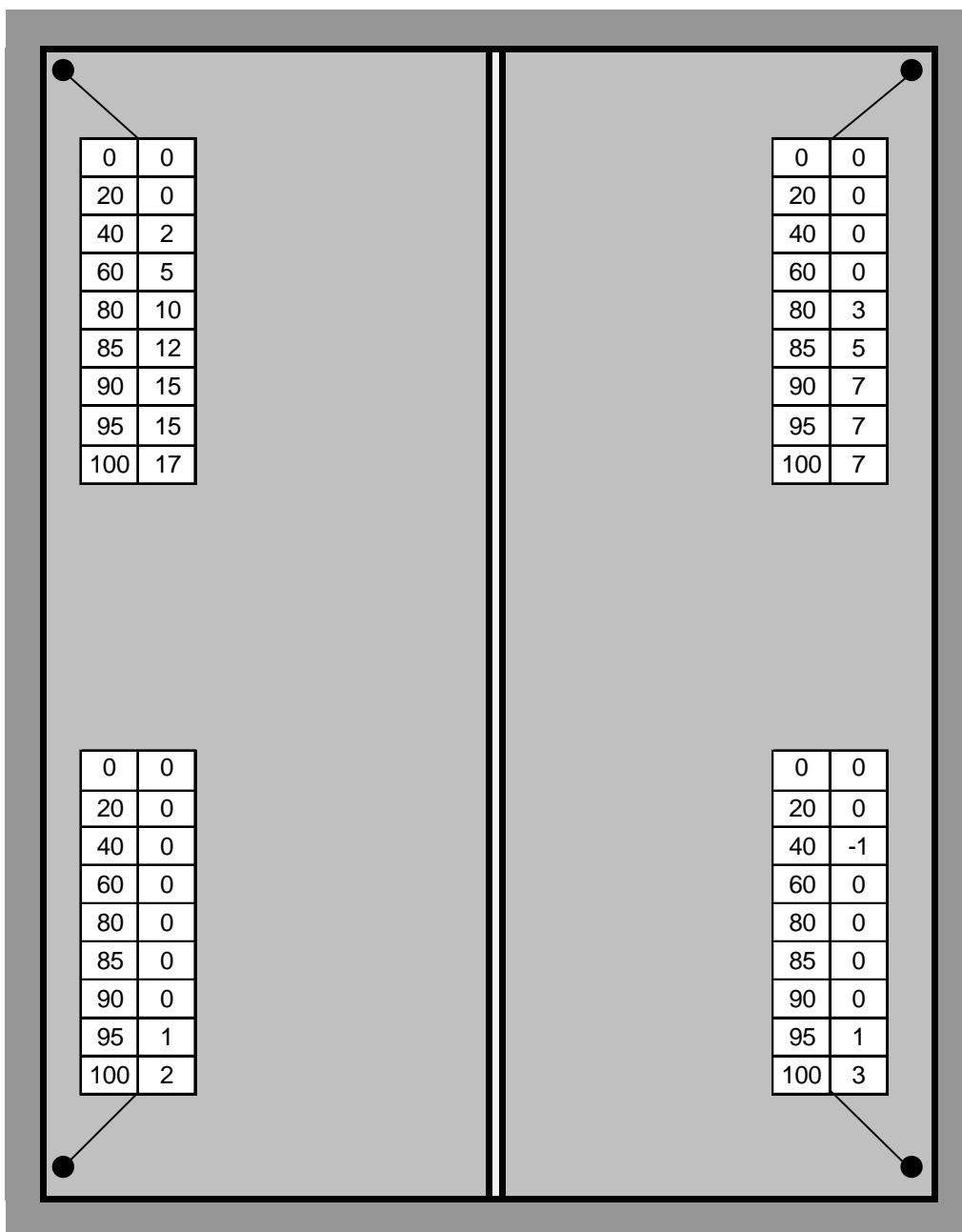
Irradiance from the unexposed face was monitored during the test. A 180° field of view water cooled heat flux meter was positioned with its target 2.183 m from and parallel to the unexposed face of the specimen and at its geometric centre. The following graph shows the recorded irradiance/time data.



It should be noted that the recorded value for irradiance drops when the field of view is physically interrupted during the measurement of deflection and the application of cotton pads.

3.6 Deflection

Taut stainless steel wires were anchored horizontally across the unexposed face of the specimen such that any deflection experienced by the test construction could be measured. One wire was positioned 10 mm vertically below the top of the leaves, the second 10 mm vertically above the bottom of the leaves. The following figure shows these positions with the elapsed time (minutes) in the left hand column and the recorded deflection (mm) in the right hand column. Positive values indicate deflection towards the heating conditions of the test.



4 TEST OBSERVATIONS

Photographs taken during the test are shown in Appendix 2.

4.1 Left hand panel

(E = Exposed face: U = Unexposed face)		
Time (min:sec)	Face	Observation
00:00		Start of the test.
02:36	U	The panel glazing cracks.
03:50	U	Glazing intumescent is active.
04:00	U	Unexposed glazing cracked.
10:00	U	Smoke/steam issues at the top left hand corner.
15:45	U	Smoke/steam issues at the top left hand corner has ceased.
19:00	U	Glazing interlayer has become discoloured.
21:00	U	Smoke/steam issues at periphery of glazing.
25:00	E	All timber is fissured but the beads are still in position and the bead mitres have opened.
29:00	U	INSULATION FAILURE due to the maximum criteria being exceeded with a result of 28 minutes.
35:00	U	Intumescent is apparent at the head of the glazing.
38:40	E	Segments of beading missing.
43:00	U	Smoke/steam issuing decreases generally.
50:00	U	Glazing intumescent has expanded all round the aperture.
53:00	U	Smoke/steam issuing at 500mm up on left hand vertical bead.
55:00	U	Moisture is visible behind beads at various locations.
62:00	E	Further beading is missing
64:00	U	Beading is charred at the head and tops of verticals. Smoke/steam is decreasing.
80:00	U	Staining on panel face above glazing is apparent.
87:30	E	The first layer of core segments detached around aperture
90:00	U	Further first layer core is detached. Glowing is apparent through the cracks.
108:50	U	Glazing beads tight to face of panel.
109:21	U	Charring is developing at left hand side of top bead.
109:43	U	Smoke/steam issuing at the top left hand corner.
111:00	U	Gap is visible between right hand bead and panel due to panel distortion at mid height. Glow is visible at the top left hand corner.
117:25	U	Flash flaming at top of left hand bead.
117:43	U	Flaming commences at top of left hand bead.
117:53	U	INTEGRITY FAILURE due to continuous flaming at the top of the left hand bead.
118:53	U	The test is terminated.

4.2 Right hand panel

(E = Exposed face: U = Unexposed face)		
Time (min:sec)	Face	Observation
00:00		Start of the test.
02:36	U	The panel glazing cracks.
03:25	U	Glazing intumescent is active.
04:00	U	Unexposed glazing cracked.
19:00	U	Glazing interlayer has become discoloured.
21:00	U	Smoke/steam issues at periphery of glazing.
25:00	E	All timber is fissured but the beads are still in position and the bead mitres have opened.
26:00	U	INSULATION FAILURE due to the maximum criteria being exceeded with a result of 25 minutes.
38:40	E	Segments of beading missing.
43:00	U	Smoke/steam issuing decreases generally.
55:00	U	Moisture is visible behind beads at various locations.
62:00	E	Further beading is missing
78:00	E	Majority of bead is missing.
80:00	U	Staining on panel face above glazing is apparent.
87:30	U	The first layer of core segments detached around aperture
90:00	U	Further first layer core is detached. Glowing is apparent through the cracks.
98:00	U	Smoke is increasing in the glazing area.
101:00	U	Glow is visible through top left hand bead mitre.
104:40	U	Flaming commences at head of glazing starts.
104:50	U	INTEGRITY FAILURE due to continuous flaming at the head of the glazing.
105:00	U	Flames extinguished.
108:50	U	Glazing beads tight to face of panel.
118:53	U	The test is terminated.

5 LIMITATIONS

1. The test results relate only to the specimen 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.

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Report checked by:



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Head of Testing**

Report issued:

19th March 2015

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 – Left hand panel

Item	Component	Information
1L	<p>Door blank panel Supplier: Type: Description:</p> <p>Overall size (h x w x d): Glazing aperture size (h x w): Photo(s):</p>	<p>Falcon Panel Products Ltd. Strebord FD90 door core Spano mill. A Strebord graduated density particle board consisting of two boards 32mm thick, bonded together with PVA adhesive, with a central aperture. The panel was affixed to the rigid supporting construction with brackets at mid height and at the right hand edge top and bottom. It was separated from the adjacent panel by plasterboard strip 6mm thick and projecting 84mm on the unexposed side.</p> <p>2135 x 665 x 64 1626 x 276 2.1.2, 2.1.5 to 2.1.7</p>
2L	<p>Glazing pane Supplier: Type: Description:</p> <p>Overall size (h x w x t): Sight size (h x w): Setting blocks: Size (h x w x d): Position: Photo(s):</p>	<p>Pilkington (UK) Ltd Pyrodur EW60-10 10mm CS A three layer insulating glass laminate with two interlayers of sodium silicate.</p> <p>1602 x 252 x 10 1559 x 209 Calcium silicate. 5 x 25 x 10 35 from corners of aperture. 2.1.2, 2.1.5 to 2.1.7</p>

Item	Component	Information
3L	Glazing beads Supplier: Description: Overall size (h x d): Splay angle (°): Photo(s):	Intumescent Seals. Sapele glazing beads with mitre joints affixed to the panel using No.8 x 3" steel countersunk woodscrews set at 150 * centres, all at a skew angle of 25° relative to the glass. 35 x 29.5 including a 10 x 5 bolection 25 2.1.5 to 2.1.7
4L	Aperture lining Supplier: Description: Section size (w x t): Photo(s):	Cambridge Fire Research Ltd. A sapele lining strip affixed to the aperture using PU adhesive and steel pins, 40 long x 1.6Ø set 16 from each face at 150 centres. 64 x 6 2.1.2
5L	Glazing Liner Manufacturer: Reference: Description: Overall size (w x t): Photo(s):	Sealmaster Fireglaze Tape An intumescent strip with self-adhesive tape on one face lining the aperture. 64 x 2.5 2.1.2
6L	Glazing bead intumescent Manufacturer: Reference: Description: Overall size (w x t): Photo(s):	Sealmaster FireGlaze Tape An intumescent strip with self-adhesive tape on one face positioned between the glass and glazing bead, affixed to the glazing bead. 25 x 2.5 2.1.2, 2.1.5 and 2.1.6
7L	Fire stopping detail Manufacturer: Type: Description: Photo(s):	Sealmaster GRS64 graphite seal 1mm thick with self-adhesive tape. The perimeter of the panel was sealed with a strip of GRS64 graphite seal and capped with Firewise intumescent & acoustic acrylic sealant on both faces. 2.1.5 and 2.1.7

Key:

* Nominal value

Appendix 1 Table 2 – Right hand panel

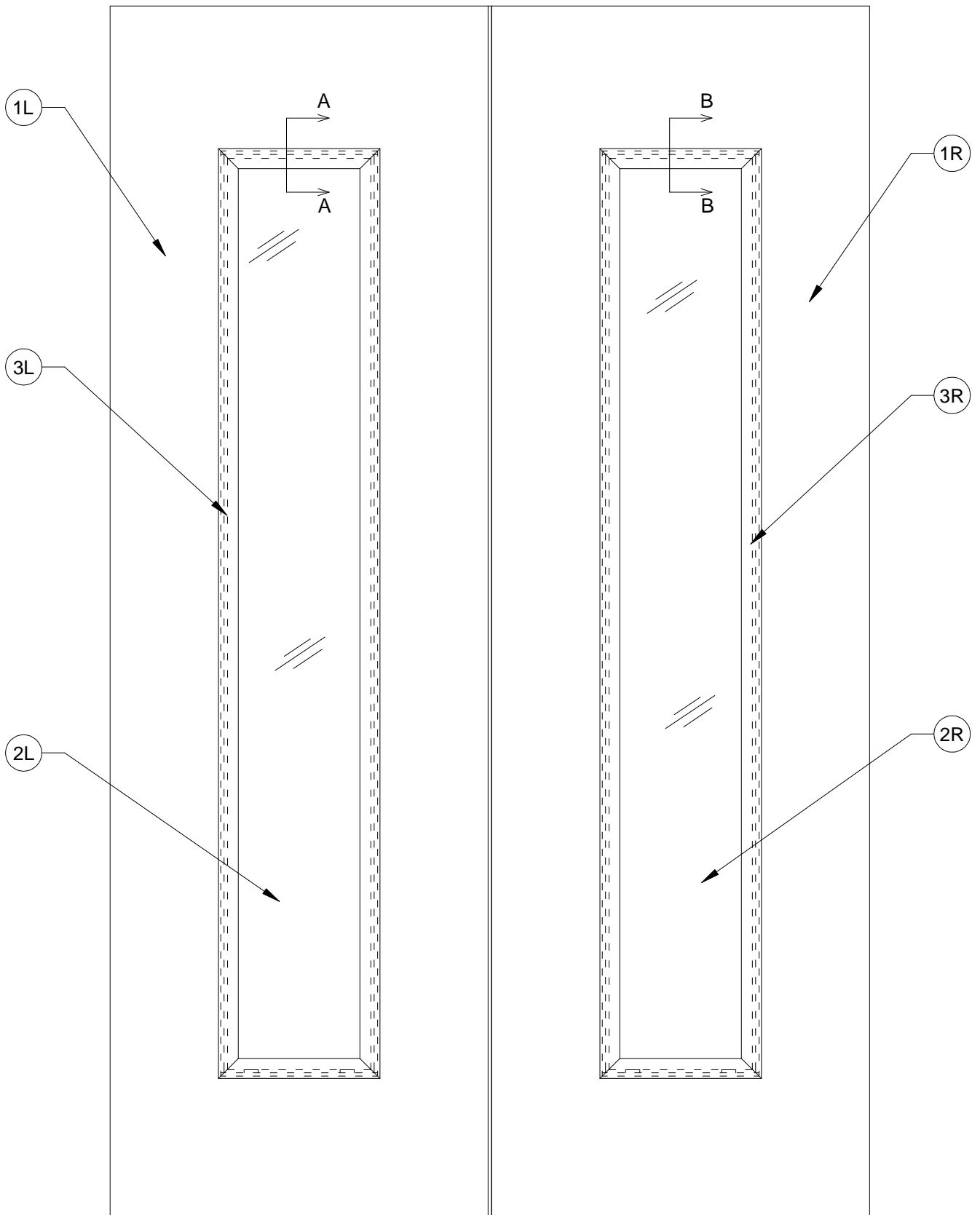
Item	Component	Information
1R	<p>Door blank panel Supplier: Type: Description:</p> <p>Overall size (h x w x d): Glazing aperture size (h x w): Photo(s):</p>	<p>Falcon Panel Products Ltd. Strebord FD90 door core Spano mill. A Strebord graduated density particle board consisting of two boards 32mm thick, bonded together with PVA adhesive, with a central aperture. The panel was affixed to the rigid supporting construction with brackets at mid height and at the left hand edge top and bottom.</p> <p>2135 x 665 x 64 1626 x 276 2.1.1, 2.1.3, 2.1.4 and 2.1.7</p>
2R	<p>Glazing pane Supplier: Type: Description:</p> <p>Overall size (h x w x t): Sight size (h x w): Setting blocks: Size (h x w x d): Position: Photo(s):</p>	<p>Pilkington (UK) Ltd Pyrodur EW60-10 10mm CS A three layer insulating glass laminate with two interlayers of sodium silicate.</p> <p>1601 x 250 x 10.2 1560 x 210 Calcium silicate. 5 x 25 x 10 35 from corners of aperture. 2.1.1, 2.1.3, 2.1.4 and 2.1.7</p>
3R	<p>Glazing beads Supplier: Description:</p> <p>Overall size (h x d): Splay angle (°): Photo(s):</p>	<p>Intumescent Seals Sapele glazing beads with mitre joints affixed to the panel using No.8 x 3" steel countersunk woodscrews set at 150 * centres, all at a skew angle of 25° relative to the glass.</p> <p>35 x 27 including a 10 x 5 bolection 25 2.1.3, 2.1.4 and 2.1.7</p>
4R	<p>Aperture lining Supplier: Description:</p> <p>Section size (w x t): Photo(s):</p>	<p>Cambridge Fire Research Ltd. A sapele lining strip affixed to the aperture using PU adhesive and steel pins, 40 long x 1.6Ø set 16 from each face at 150 centres reduced to fit at corners.</p> <p>64 x 6 2.1.1</p>

Item	Component	Information
5R	Glazing Liner Manufacturer: Reference: Description: Overall size (w x t): Photo(s):	Intumescent Seals Therm-A- Line Strip of acrylic polymer and intumescent fillers with self-adhesive tape on one face lining the aperture. 63 x 2 2.1.1
6R	Glazing bead intumescent Manufacturer: Reference: Description: Overall size (w x t): Photo(s):	Intumescent Seals ISL60 Plus An intumescent mineral fibre strip with self-adhesive tape on one face positioned between the glass and glazing bead, affixed to the glazing bead. 25 x 5.8 (compressed to 4*) 2.1.1 2.1.3 2.1.4 and 2.1.7
7R	Fire stopping detail Manufacturer: Type: Description: Photo(s):	Intumescent Seals Therm-A-Flex graphite seal 1mm thick with self-adhesive tape. The perimeter of the panel was sealed with a strip of Therm-A-Flex graphite seal and capped with Firewise intumescent & acoustic acrylic sealant on both faces. 2.1.3, 2.1.4 and 2.1.7

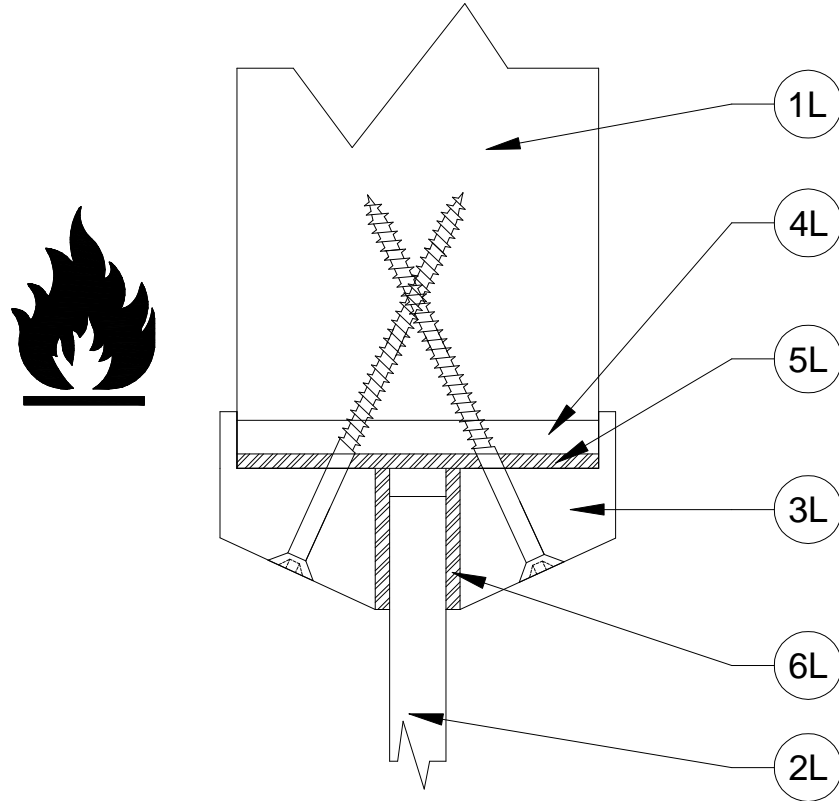
Key:

* Nominal value

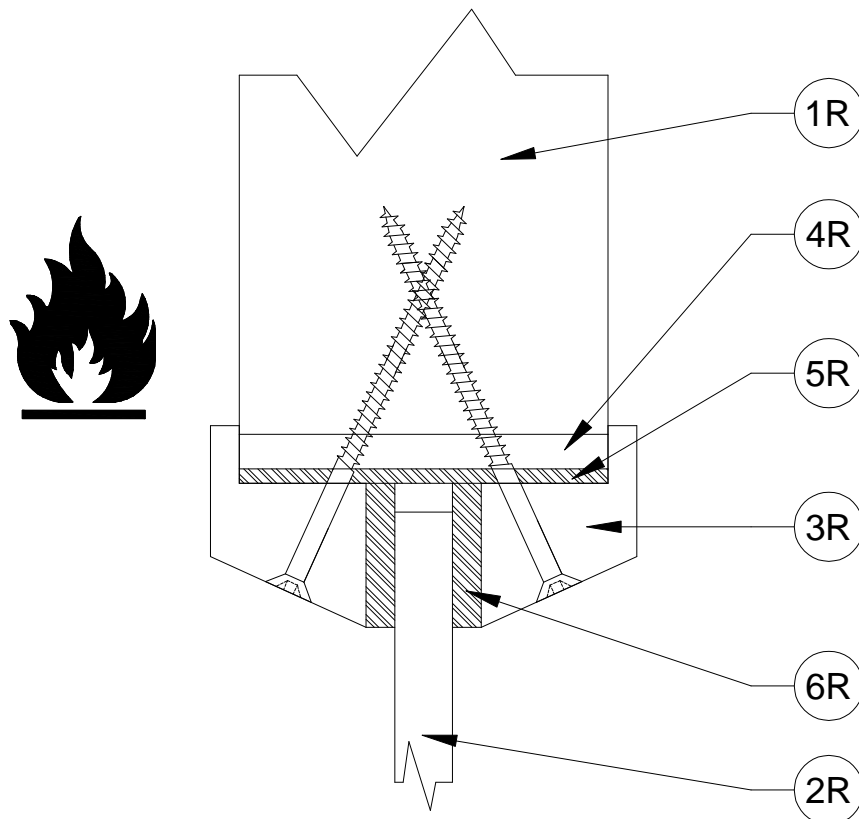
Appendix 1 Figure 1 – Elevation viewed from the unexposed side including hidden detail



Appendix 1 Figure 2 – Section A – A



Appendix 1 Figure 3 – Section B – B



APPENDIX 2 PHOTOGRAPHS

Appendix 2.1 Pre-test photos

Photo 2.1.1 Right hand panel



Photo 2.1.2 Left hand panel



Photo 2.1.3 Right hand panel



Photo 2.1.4 Right hand panel



Photo 2.1.5 Left hand panel



Photo 2.1.6 Left hand panel



Photo 2.1.7 Exposed face



Appendix 2.2 During test photos

Photo 2.2.1

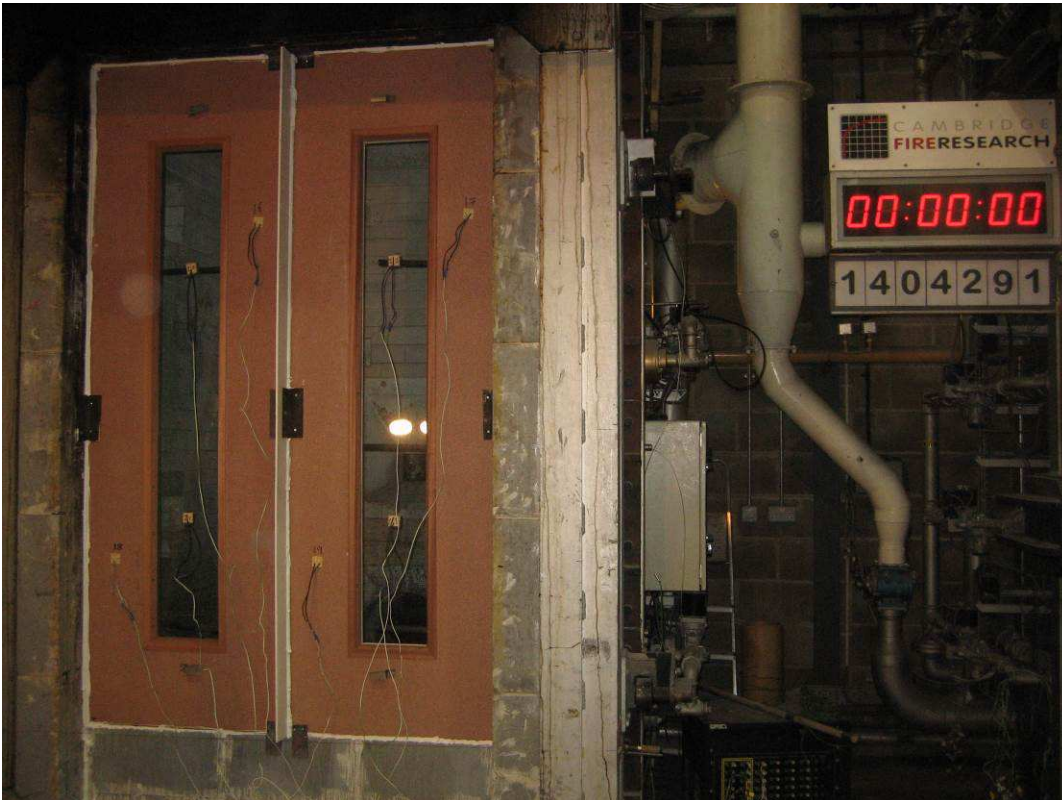


Photo 2.2.2



Photo 2.2.3

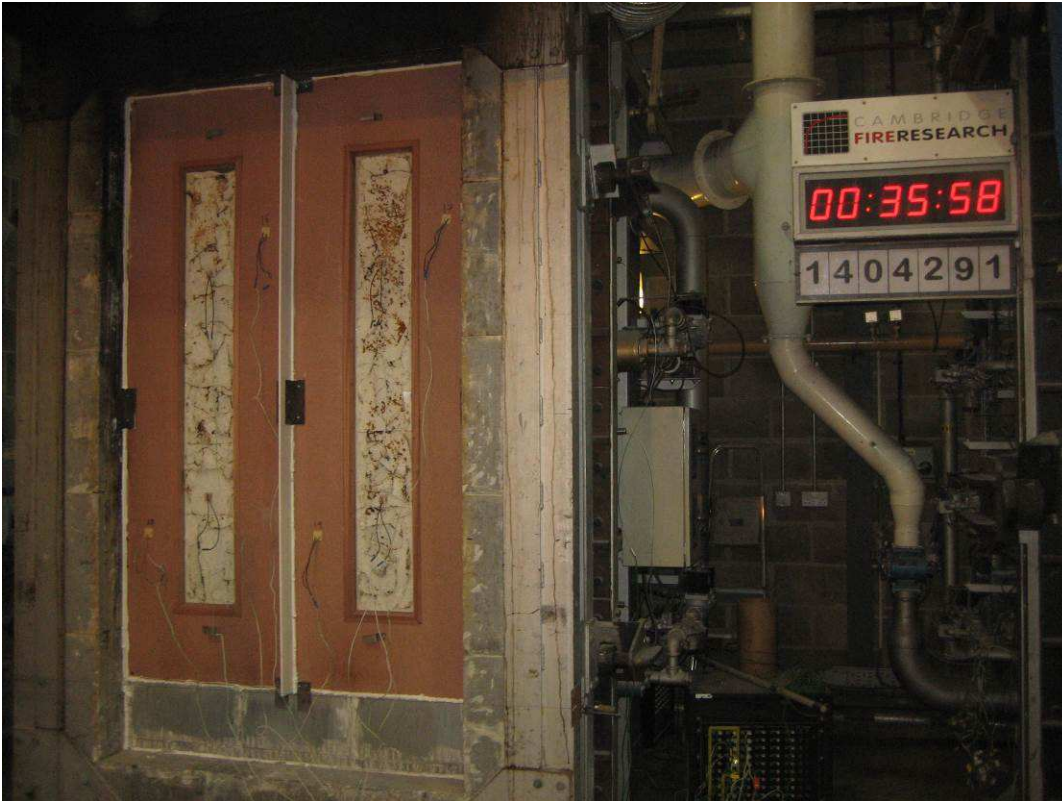


Photo 2.2.4

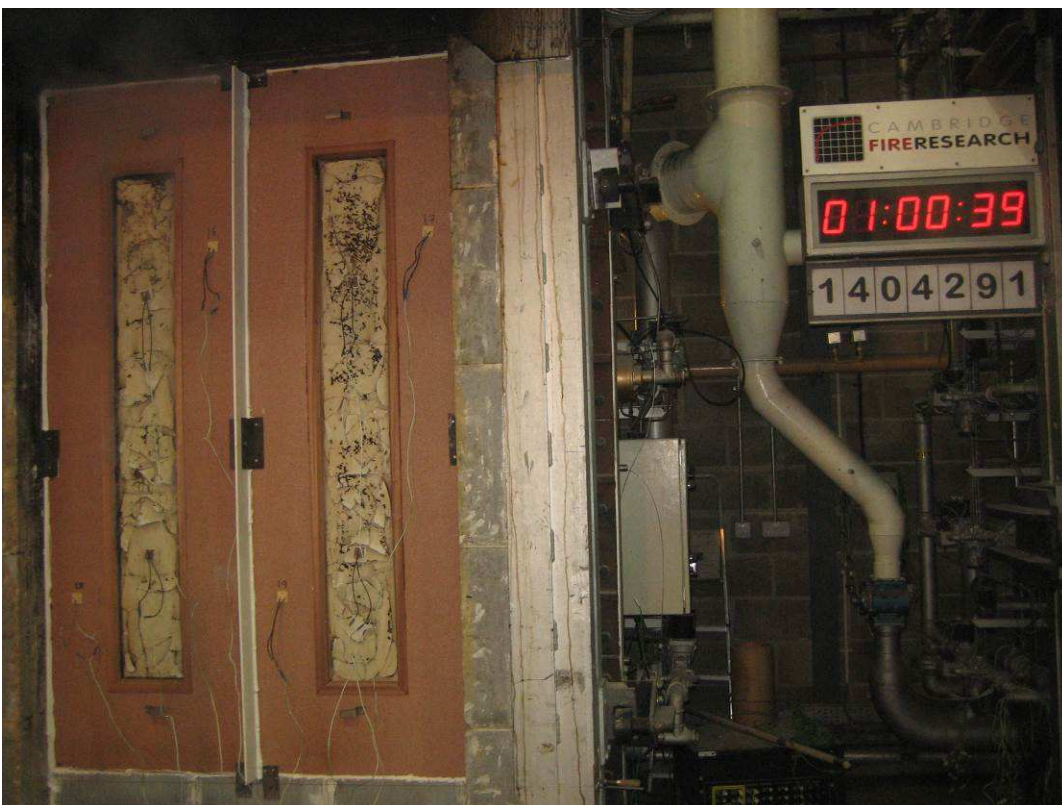


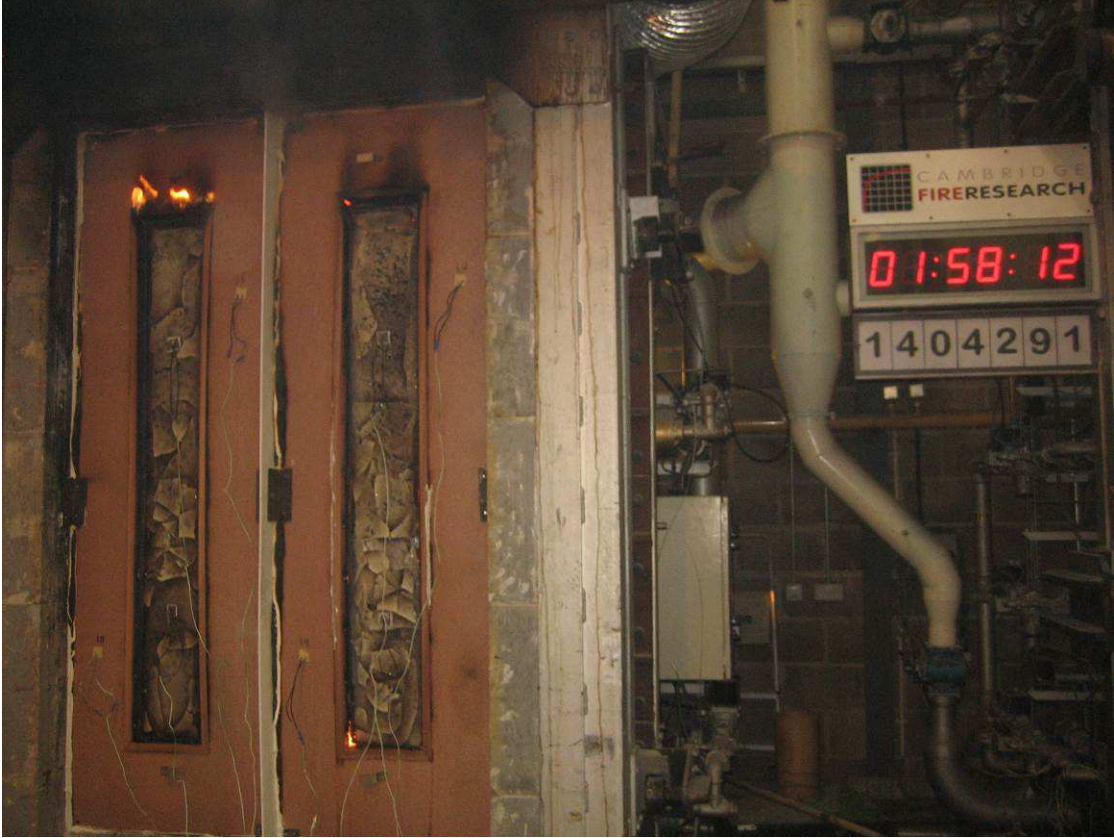
Photo 2.2.5



Photo 2.2.6



Photo 2.2.7



Appendix 2.3 Post test photos

Photo 2.3.1



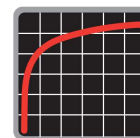
Photo 2.3.2



APPENDIX 3 POSITIONING OF INSTRUMENTATION

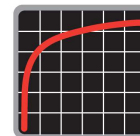


● Unexposed face specimen thermocouple

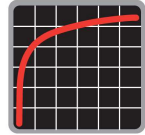


APPENDIX 4 RECORDED THERMOCOUPLE DATA

Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C	°C	°C	°C	°C	°C	°C	°C
0	16	16	16	16	16	16	16	16
1	16	16	16	16	18	19	19	19
2	16	16	16	16	28	28	29	29
3	16	16	16	16	41	41	42	43
4	16	16	16	16	63	63	66	70
5	16	16	16	16	92	91	95	95
6	16	16	16	16	107	103	110	109
7	16	16	16	16	120	114	124	126
8	16	16	16	16	126	124	119	127
9	16	16	16	16	126	119	117	120
10	16	16	16	16	127	117	119	118
11	16	16	16	16	130	117	121	117
12	16	16	16	16	131	118	122	118
13	16	16	16	16	129	120	122	119
14	16	16	16	16	124	122	123	119
15	17	16	16	17	122	124	126	121
16	17	16	17	17	123	126	129	124
17	17	16	16	16	125	129	135	129
18	17	16	16	16	129	133	141	134
19	17	16	16	17	133	138	147	139
20	17	17	17	17	138	143	154	145
21	17	17	17	17	144	148	161	151
22	17	17	17	17	150	153	168	157
23	18	17	17	17	157	158	175	164
24	18	18	17	17	163	163	183	171
25	18	18	17	18	170	168	191	178
26	19	18	18	18	177	174	198	185
27	19	18	18	18	184	180	207	192
28	19	19	18	18	192	186	216	199
29	20	19	19	19	200	194	226	208
30	20	20	19	20	207	201	236	216
31	21	20	20	20	216	209	246	225
32	21	20	20	21	225	218	256	234
33	22	21	20	21	234	227	265	243
34	22	22	21	22	243	236	273	251
35	23	22	21	22	251	245	281	260
36	24	23	22	23	259	254	288	268
37	24	23	22	23	266	263	294	275
38	25	24	23	24	273	272	300	282
39	25	25	24	24	279	280	305	288
40	26	25	24	25	284	287	310	293
41	27	26	25	25	289	294	314	298
42	27	26	25	26	294	301	318	303
43	28	27	26	27	298	307	323	307
44	28	27	26	27	303	312	327	311
45	29	28	27	27	307	318	331	315



Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C	°C	°C	°C	°C	°C	°C	°C
46	29	29	27	28	311	324	336	319
47	30	29	28	28	315	329	340	324
48	30	30	28	29	319	336	345	328
49	31	31	29	30	322	342	349	332
50	31	31	29	30	326	349	352	336
51	32	32	30	31	331	355	354	340
52	33	32	31	31	335	361	357	344
53	33	33	31	32	339	365	358	348
54	34	33	32	32	343	369	360	351
55	34	34	32	33	348	372	362	355
56	35	35	33	33	352	374	363	358
57	35	35	33	34	356	376	364	360
58	36	36	34	34	359	379	366	363
59	37	37	34	35	362	381	367	365
60	37	37	35	36	365	383	368	367
61	38	38	35	36	368	386	370	370
62	38	38	36	36	371	388	372	372
63	39	39	37	37	373	390	373	375
64	40	40	37	38	375	393	375	377
65	41	41	38	38	378	396	377	379
66	41	43	39	39	381	398	379	381
67	43	44	39	40	383	400	381	384
68	44	45	40	41	386	403	382	386
69	46	47	41	42	389	405	385	389
70	48	49	42	43	391	407	387	391
71	51	52	43	45	394	409	389	394
72	53	55	46	47	397	412	392	396
73	56	59	48	50	401	415	395	399
74	59	62	51	53	403	418	398	401
75	61	65	54	57	406	421	400	404
76	64	67	57	62	408	422	402	406
77	66	70	60	66	411	425	404	408
78	68	72	63	71	413	428	407	411
79	69	74	66	75	416	430	408	414
80	71	76	68	78	418	433	410	417
81	72	77	71	79	420	435	412	420
82	73	78	74	80	421	437	413	423
83	75	80	77	81	423	439	415	426
84	77	82	79	83	424	441	417	429
85	80	84	82	84	426	445	419	432
86	83	86	85	85	428	447	421	436
87	88	87	91	86	431	451	424	440
88	90	88	93	87	434	455	426	443
89	89	89	94	87	438	459	430	447
90	87	89	93	89	442	462	433	450



Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C	°C	°C	°C	°C	°C	°C	°C
91	86	90	92	94	446	467	437	455
92	85	91	90	93	450	472	442	459
93	85	91	88	91	454	476	446	464
94	84	90	88	89	456	480	450	468
95	85	89	87	88	459	481	452	470
96	84	88	86	88	460	481	453	471
97	84	87	85	87	461	480	453	471
98	83	87	84	87	461	479	453	470
99	83	86	85	87	461	478	452	468
100	84	86	85	88	461	477	451	467
101	86	85	85	90	460	478	451	466
102	87	85	86	91	461	478	450	466
103	88	84	87	92	461	479	450	466
104	89	85	87	92	462	481	451	467
105	89	86	89	93	463	483	452	469
106	90	86	91	94	464	485	453	471
107	91	87	93	94	465	486	453	472
108	92	88	96	95	466	488	455	473
109	92	89	97	96	467	490	456	476
110	92	90	97	96	469	492	457	477
111	93	91	98	96	470	494	458	479
112	93	92	97	96	471	496	458	481
113	94	92	97	96	473	497	455	482
114	95	94	97	97	475	499	457	482
115	95	95	97	97	477	501	454	486
116	97	95	98	97	478	503	454	488
117	102	96	100	96	480	505	459	489
118	110	97	112	97	483	507	462	489