The Building Test Centre

Fire Acoustics Structures

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Report Number **BTC 18074F**

A FIRE RESISTANCE TEST ON A TIMBER JOIST FLOOR CLAD WITH A DOUBLE LAYER OF 12.5mm GTEC FIRE BOARD INCORPORATING 6 VALVES AND A WALKING SURFACE OF 22mm TONGUE AND GROOVE CHIPBOARD, CONDUCTED IN ACCORDANCE WITH BS EN 1365-2: 1999.

Report amended 1st and 12th March 2013

Test Date: 10th January 2013
www.btconline.co.uk

Customer: **TENMAT Ltd**
Ashburton Road West
Trafford Park
Manchester
M17 1RU
UK

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A FIRE RESISTANCE TEST ON A TIMBER JOIST FLOOR CLAD WITH A DOUBLE LAYER OF 12.5mm GTEC FIRE BOARD INCORPORATING 6 VALVES AND A WALKING SURFACE OF 22mm TONGUE AND GROOVE CHIPBOARD, CONDUCTED IN ACCORDANCE WITH BS EN 1365-2: 1999.

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1. FOREWORD

This test report details a fire resistance test conducted on a full scale horizontal loaded timber joist floor. The test sponsor was Chiltern International Fire.

The test specimen was installed by Alltone Limited. The construction of the specimen took place between the 7th & 9th January 2013. The Building Test Centre played no role in the design or selection of materials comprising the test specimen.

The test was witnessed by Mr Mark Davies & Mr Rupert Coggon of Tenmat Limited and Mr Ross Newman of Chiltern International Fire. The test was conducted on 10th January 2012.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

2. REPORT AUTHORISATION

Report Author	Authorised by
J A Lucas	pp Lynda Cooper
James Lucas Laboratory Supervisor	Paul Miller BSc. (Hons.) Fire Test Manager

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3. TEST REPORT AMENDMENTS

Page	Amendments	Date
1	Title page to include report amended date.	01/03/2013
5	Test report amendments table to include all amendments.	01/03/2013
10	Test materials list to include valves were sampled at the production phase by Ross Newman of Chiltern Fire International and individually signed.	01/03/2013
1	Title page to include latest report amended date.	12/03/2013
5	Test report amendments table to include latest amendments.	12/03/2013
10	Valve dimensions corrected.	12/03/2013

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4. TEST CONSTRUCTION

4.1 Description of Construction

The specimen was constructed in a refractory concrete lined steel restraint frame having an opening of 4000mm long x 3000mm wide.

Timber joists nominally 225mm x 45mm were placed, nominally, at 600mm centres, spanning 4000mm length of the test frame. Full-depth noggings were fixed at each end of the joists (within the test aperture) with 3 inch nails. 50mm x 50mm noggings were fixed between the joists to coincide with the outer layer board joints using 3 inch nails.

The joists were covered with a walking surface of 22mm tongue and groove chipboard flooring (nominally 2400mm long x 600mm wide) which was fixed using 51mm drywall timber screws at 300mm centres.

The underside of the floor was lined with a double layer of 12.5mm Siniat GTEC fire board, (nominally 2400mm long x 1200mm wide).

The inner layer boards were fixed using 51mm Drywall timber screws at 230mm centres and the outer layer were fixed with 60mm drywall timber screws.

All joints were finished using Gyproc Joint Tape and Joint Filler. All screw heads were spotted using Gyproc Joint Filler.

Six valves were incorporated into the ceiling.
A 82mm diameter hole was cut into the plasterboards to accommodate the fire rated supply & extract valves in positions C & D.
A 127mm diameter hole was cut into the plasterboards to accommodate the fire rated supply & extract valves in positions A & F.
A 202mm diameter hole was cut into the plasterboards to accommodate the fire rated supply & extract valves in positions B & E.

See figure 7 for the positions of each valve.

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4.2 Test Construction Drawings

4.2.1 Horizontal Cross Section

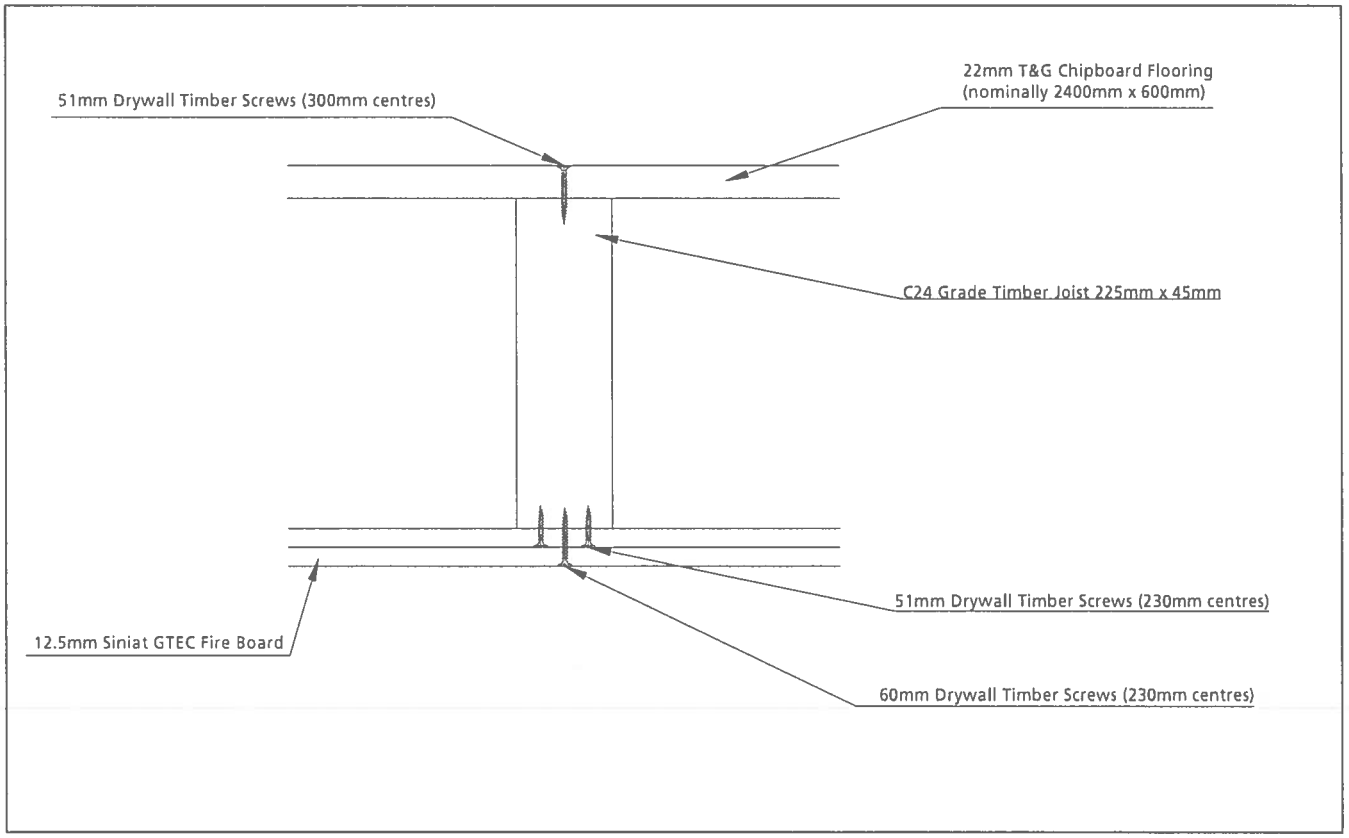

Figure 1 – Horizontal cross section

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4.2.2 Exposed Face Elevation

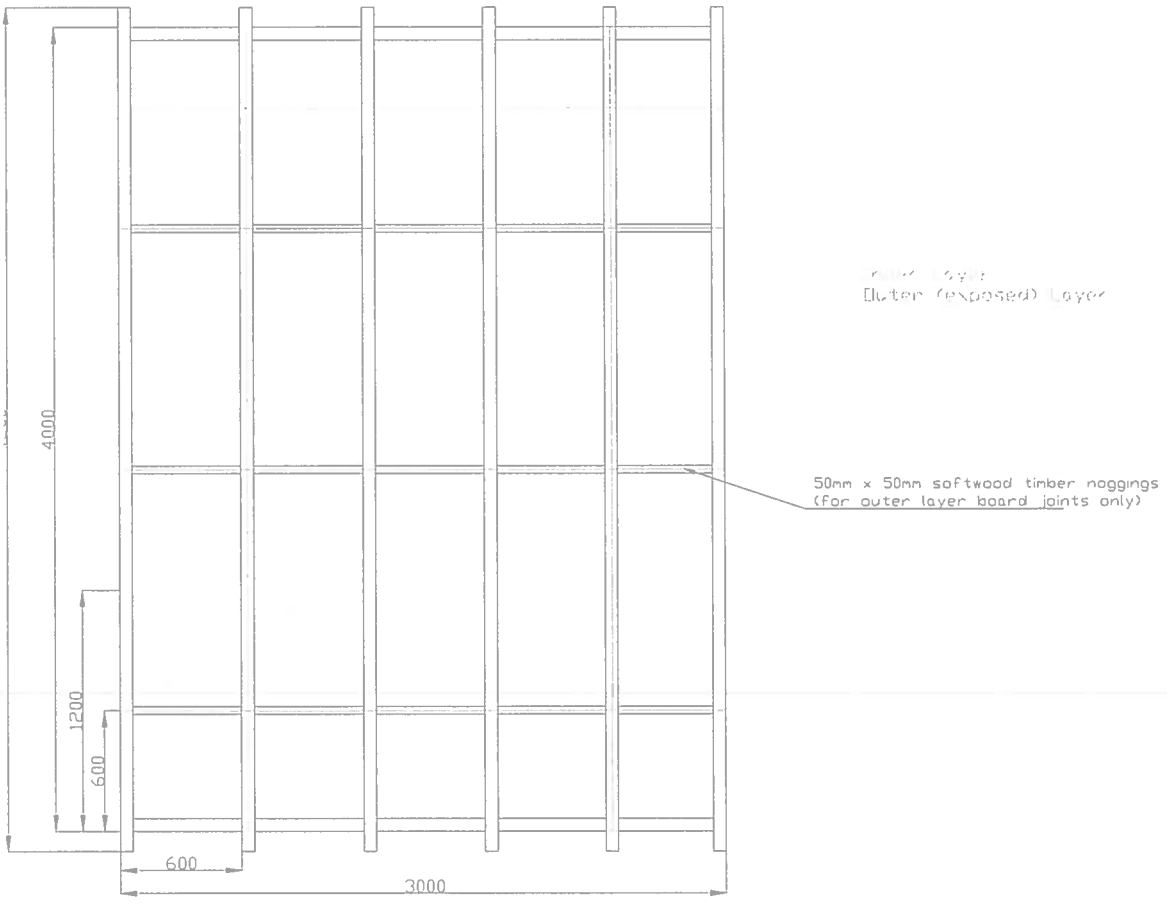

Figure 2 – Exposed Face Elevation

The descriptions of individual components making up the test specimen were provided by the customer and were checked for accuracy wherever possible.

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5. TEST MATERIALS

5.1 Siniat Fire Board

i) Nominally, 2400mm (long) x 1200mm (wide) x 12.5mm (thick), GTEC fire board manufactured by Siniat and supplied by The Building Test Centre.

Measured surface density:	11.1kg/m^2
Measured thickness:	12.6mm
Board identification numbers:	17823 00:25
	17823 00:26
	17823 00:26
Measured moisture content:	0.60%

The surface density and board thickness were calculated using a selection of boards used in the test specimen. The moisture content of plasterboard was determined using samples dried to constant weight in an oven at 50°C.

Material dimensions were measured by The Building Test Centre.

5.2 Joists

ii) Nominally, 4200mm (long) x 225mm (deep) x 45mm (wide), C24 grade softwood joists, supplied by The Building Test Centre. (50mm x 50mm noggings were also made from the same softwood)

Measured moisture content:	11.75%

The surface density and thickness were calculated using a selection of timber used in the test specimen. The moisture content of the timber joists and flooring was determined using samples dried to constant weight in an oven at 102°C.

Material dimensions were measured by The Building Test Centre.

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5.3 Chipboard Tongue and Groove Flooring

iii) Nominally 2400mm (long) x 600mm (wide) x 22mm (thick), supplied by The Building Test Centre.

Measured moisture content: 9.62%

The surface density and thickness were calculated using a selection of timber used in the test specimen. The moisture content of the timber joists and flooring was determined using samples dried to constant weight in an oven at 102°C.

Material dimensions were measured by The Building Test Centre.

5.4 Fasteners

iv) 51mm Gyproc Drywall Timber Screws
v) 60mm Gyproc Drywall Timber Screws
vi) 3inch nails

All fasteners supplied by The Building Test Centre.

5.5 Miscellaneous Components

vii) Gyproc Joint Filler
viii) Gyproc Paper Tape
ix) Gyproc Bonding Coat

All miscellaneous components supplied by The Building Test Centre.

5.6 Fire Rated Valves

x) 80mm supply
xi) 80mm extract
xii) 125mm supply
xiii) 125mm extract
xiv) 200mm supply
xv) 200mm extract

All valves were supplied by Tenmat Limited, and were sampled at the production phase by Ross Newman of Chiltern Fire International and individually signed.

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6. TEST PROCEDURE

The test was conducted fully in accordance with BS EN 1365-2:1999.

The asymmetrical specimen was subjected to fire from the underside (plasterboard side) this being the required direction of fire resistance as specified in BS EN 1365-2:1999.

The test procedure used was EN 1365-2, issue 3.

The ambient temperature at the commencement of the test was 9°C.

The furnace pressure was set to control at 18 ± 2 Pa positive with respect to atmosphere, at a position 100mm below the base of the specimen. Furnace pressure data is shown in figure 4.

A total load of 18kN (1.5kN/m^2) was applied to 36 equally distributed loading points. Loading requirements were supplied by the sponsor.

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7. TEST RESULTS

The requirements of the standard were satisfied for the following periods:

Load bearing Capacity:	70 minutes
Integrity:	70 minutes – By virtue of loadbearing capacity
Insulation:	70 minutes – By virtue of Integrity

The test was terminated at 70 minutes at the request of the laboratory.

8. LIMITATIONS

The results only relate 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.
The specification and interpretation of fire test methods is the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

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9. TEST DATA

9.1 Observations

Observers: Unexposed face L Woodford, S Potter
Exposed face M Shortland

Time		*Observations*
Hrs	mins	All observations refer to the exposed face unless otherwise stated.
0	0	Test started.
0	05	All board face papers charred.
0	10	Jointing material flaking away on all joints. All valves white in appearance.
0	12	*Unexposed face* Floor boards discoloured along 3 metre joints.
0	13	Hairline cracks visible on surface of valve B.
0	20	All board joints open to approximately 3-4mm.
0	25	Third horizontal joint open to approximately 4-6mm. All other joints open to approximately 3-4mm.
0	30	Joint adjacent to valve D open to approximately 8-10mm. All other joints open to approximately 4-6mm. *Unexposed face* No visible change.
0	40	No visible change.
0	45	No visible change.

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Time		*Observations* All observations refer to the exposed face unless otherwise stated.
Hrs	mins	
0	50	Joint adjacent to valve D open to approximately 10-12mm. Boards bowing into furnace between fixings. Flaming visible around valve A.
0	52	Left hand side of valve C board bowing into furnace.
0	54	Board fall from centre of specimen. Second layer boards bowed where visible between fixings. Surface flaming.
0	57	*Unexposed face* Cracking noises heard from specimen.
0	58	Second layer boards crazed. Further first layer board fall from right hand corner & rear side.
1	00	Second layer boards bowing into furnace in centre of specimen. *Unexposed face* Increased cracking noises heard from specimen. Moisture coming up through joints on floor boards.
1	03	Second layer board fall in centre of specimen.
1	04	Visibility poor, constant flaming in furnace.
1	10	*Unexposed face* **LOAD BEARING CAPACITY FAILURE.** Rate of deflection exceeded 8.9mm/minute after deflection of 133mm. **TEST TERMINATED** at the request of the laboratory.

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9.2 Furnace Temperature Graph

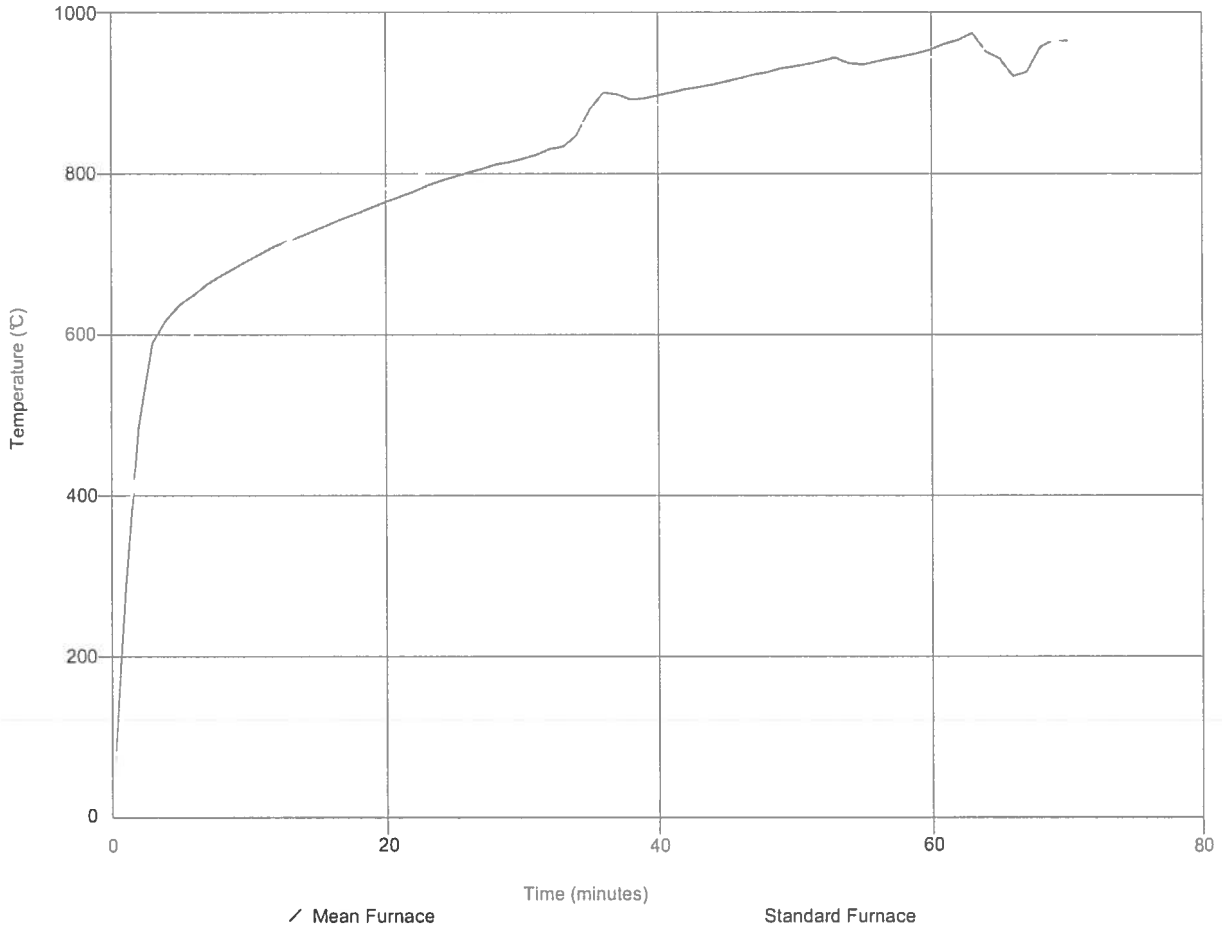

Figure 3 – Furnace temperature graph

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9.3 Furnace Pressure Graph

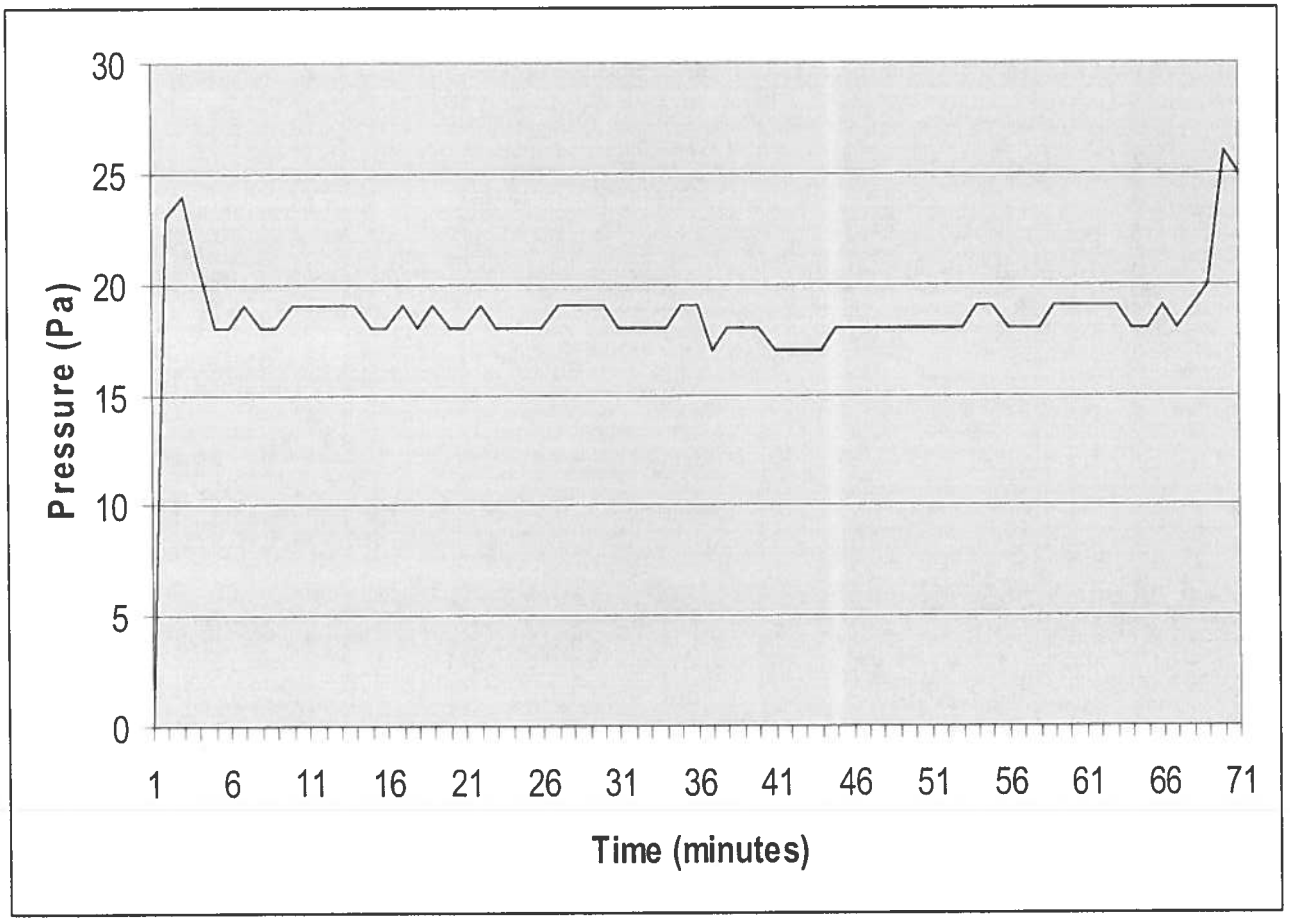

Figure 4 – Furnace pressure graph

The furnace pressure was set to control at 18 ± 2 Pa positive with respect to atmosphere, at a position approximately 100mm below the base of the specimen.

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9.4 Unexposed Face Temperature Graph

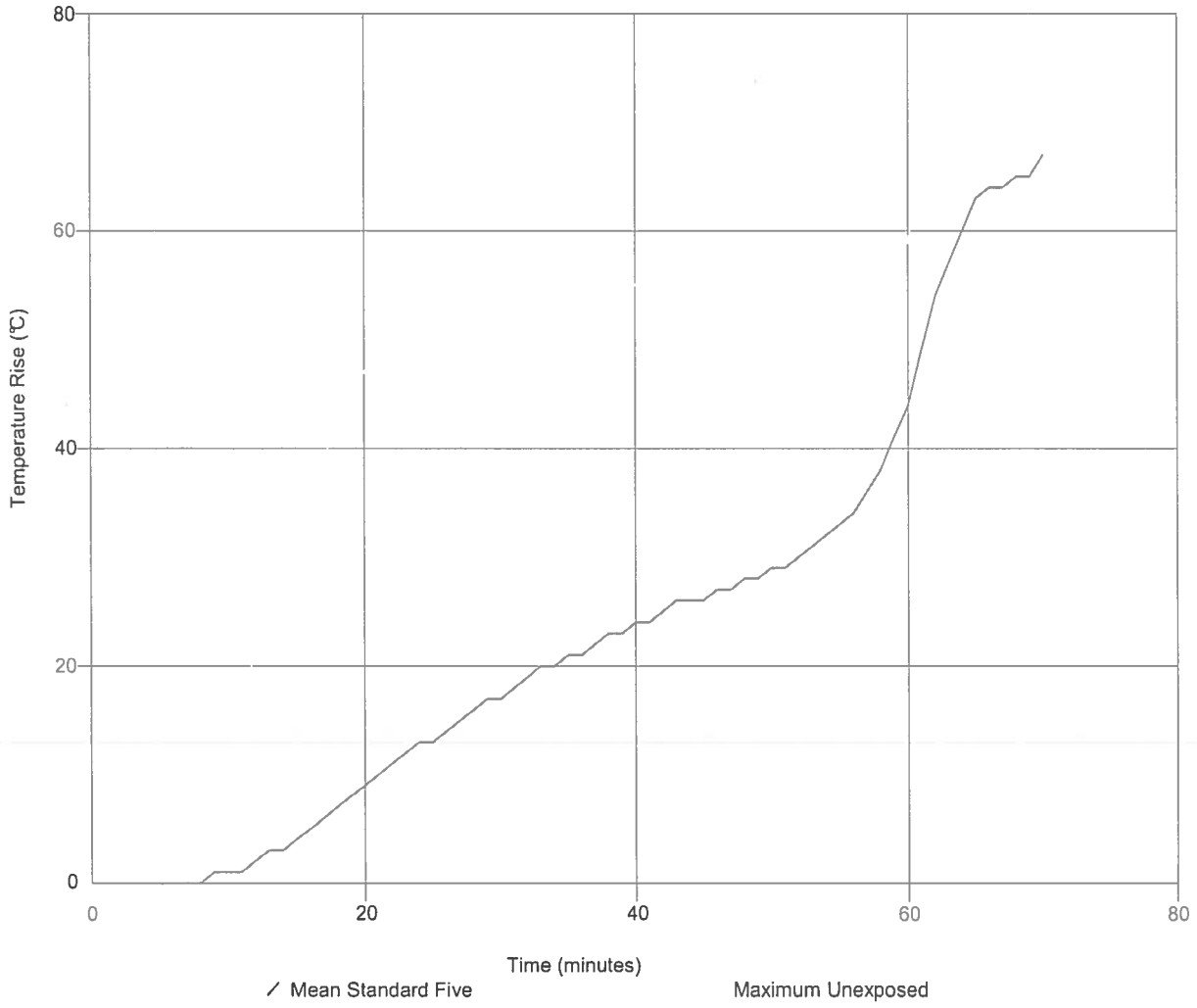

Figure 5 – Unexposed face temperature graph

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9.5 Unexposed Face Thermocouple and Valve Layout

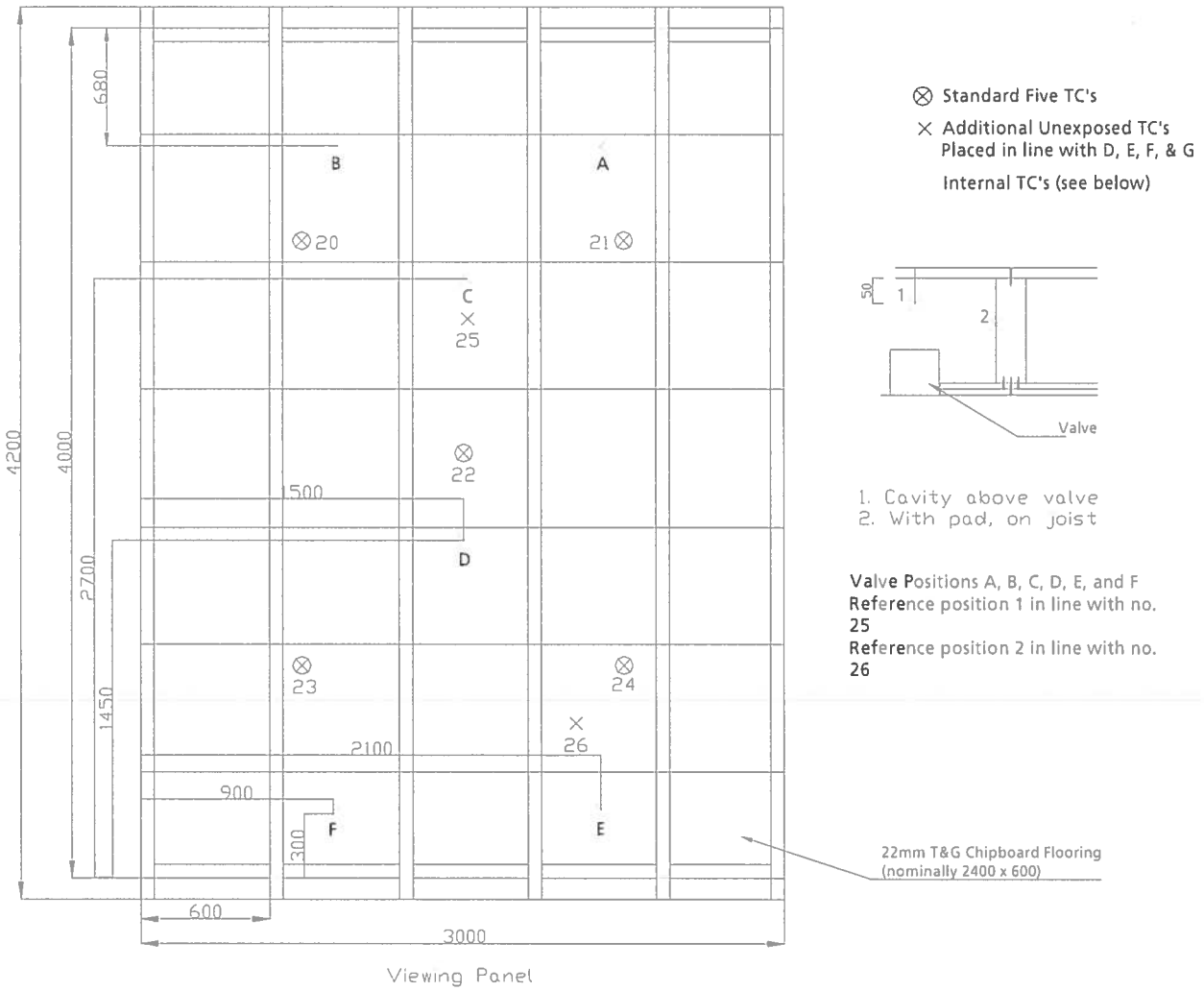

Figure 6 – Unexposed face thermocouple and valve layout

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9.6 Unexposed Face Standard Five Temperature Data

Time (mins)	Temperature Rise (°C)					
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24	Mean Standard 5
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	1	0	0	0	0
8	0	1	0	0	1	0
9	0	2	0	0	2	1
10	0	2	0	0	2	1
11	1	3	0	0	3	1
12	1	4	1	0	4	2
13	2	5	1	1	5	3
14	2	6	2	1	6	3
15	3	7	2	1	8	4
16	4	8	3	2	9	5
17	5	9	4	3	10	6
18	6	10	5	3	11	7
19	7	12	5	4	12	8
20	9	13	6	4	13	9
21	10	14	7	5	14	10
22	11	15	8	5	15	11
23	12	15	9	6	16	12
24	13	16	10	6	18	13
25	14	17	10	7	19	13
26	15	18	11	7	20	14
27	16	19	12	8	21	15
28	17	20	13	8	22	16
29	17	20	14	9	23	17
30	18	21	14	9	24	17
31	19	22	15	9	25	18
32	20	22	16	10	26	19
33	21	23	17	10	27	20
34	21	24	17	11	28	20
35	22	25	18	11	28	21
36	23	25	19	11	29	21
37	24	26	19	12	30	22

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Time (mins)	Temperature Rise (°C)					
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24	Mean Standard 5
38	25	27	20	12	30	23
39	25	27	21	13	31	23
40	26	28	21	13	31	24
41	27	28	22	13	32	24
42	27	29	22	13	32	25
43	28	30	23	14	33	26
44	29	30	24	14	33	26
45	29	31	24	14	33	26
46	30	31	25	15	34	27
47	30	32	25	15	34	27
48	31	32	26	15	35	28
49	31	33	26	16	35	28
50	32	33	27	16	36	29
51	33	33	28	16	37	29
52	33	33	28	17	39	30
53	34	34	29	17	41	31
54	34	35	30	17	43	32
55	35	36	31	18	45	33
56	36	37	33	18	48	34
57	36	38	36	19	51	36
58	37	39	40	20	54	38
59	39	41	46	21	56	41
60	41	43	54	24	59	44
61	43	46	66	28	61	49
62	45	49	79	33	63	54
63	48	52	76	41	66	57
64	53	56	71	51	71	60
65	61	61	67	50	75	63
66	65	67	66	50	74	64
67	67	68	65	51	71	64
68	67	69	66	52	70	65
69	68	68	66	55	69	65
70	71	68	68	58	70	67

See Figure 6 for thermocouple layout.

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9.7 Additional Unexposed Face Temperature Data

Time (mins)	Temperature Rise (°C)	
	Thermocouple No. 25	Thermocouple No. 26
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	1
7	0	3
8	0	6
9	0	9
10	1	13
11	1	17
12	2	21
13	3	25
14	3	29
15	4	32
16	5	36
17	6	39
18	7	42
19	8	45
20	10	47
21	10	49
22	12	51
23	12	52
24	13	53
25	14	55
26	15	56
27	16	56
28	17	57
29	18	57
30	18	57
31	19	58
32	20	58
33	21	58
34	22	57
35	23	57
36	24	56

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Time (mins)	Temperature Rise (°C)	
	Thermocouple No. 25	Thermocouple No. 26
37	24	56
38	25	56
39	26	55
40	27	55
41	28	54
42	28	53
43	29	53
44	30	53
45	31	52
46	32	52
47	33	51
48	34	51
49	36	51
50	37	51
51	39	51
52	40	51
53	42	51
54	44	51
55	46	52
56	48	52
57	50	53
58	52	54
59	54	55
60	56	56
61	58	57
62	61	59
63	65	63
64	65	69
65	65	76
66	64	73
67	65	69
68	66	68
69	68	68
70	71	69

See Figure 6 for thermocouple layout.

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9.8 Internal Temperature Data

Time (mins)	Actual Temperature (°C) Position					
	A1	A2	B1	B2	C1	C2
0	14	15	14	14	14	14
1	15	15	16	15	14	14
2	15	16	32	19	15	15
3	16	18	45	26	16	19
4	17	25	51	38	18	27
5	20	36	53	53	20	39
6	25	51	57	69	25	53
7	33	64	62	82	30	66
8	42	75	68	90	37	75
9	52	82	74	94	43	81
10	61	87	79	98	50	84
11	68	90	83	100	56	87
12	73	92	86	102	60	88
13	77	94	88	103	64	89
14	79	95	90	105	67	90
15	81	95	91	106	69	91
16	83	96	93	107	70	92
17	83	97	94	110	71	92
18	83	97	95	114	73	94
19	84	99	97	118	75	96
20	86	99	98	122	77	96
21	86	100	99	124	79	97
22	87	101	101	126	80	99
23	87	102	102	127	82	101
24	88	104	104	127	83	104
25	88	107	105	128	84	106
26	89	109	106	128	85	109
27	90	111	108	129	87	111
28	91	113	109	130	88	114
29	92	114	110	130	89	116
30	93	116	111	129	90	117
31	94	117	112	129	91	118
32	94	118	112	128	92	119
33	95	119	112	128	93	120
34	95	119	111	128	93	120
35	96	120	111	129	94	121
36	96	121	111	131	94	122

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Time (mins)	Actual Temperature (°C) Position					
	A1	A2	B1	B2	C1	C2
37	97	121	111	136	95	123
38	97	123	110	145	95	124
39	97	124	110	156	95	127
40	97	127	111	167	96	131
41	98	131	111	175	96	137
42	98	136	112	190	96	145
43	98	147	113	212	96	161
44	98	163	115	230	96	175
45	98	174	118	247	97	191
46	98	191	122	262	97	220
47	98	218	128	275	97	242
48	98	238	135	288	97	262
49	98	256	142	300	97	279
50	99	271	150	311	98	293
51	99	286	158	321	99	305
52	100	299	167	331	100	316
53	100	312	175	342	101	325
54	101	326	184	350	104	334
55	102	340	193	359	119	342
56	103	354	200	367	135	353
57	110	371	208	375	151	370
58	135	390	217	382	168	388
59	160	414	226	389	181	402
60	183	444	236	398	195	421
61	204	470	247	406	212	456
62	230	485	256	416	235	491
63	273	501	271	440	276	530
64	351	522	292	478	439	859
65	753	754	319	516	603	845
66	804	804	413	593	671	820
67	812	802	554	791	808	811
68	846	837	663	833	841	840
69	838	832	757	849	833	836
70	841	834	778	830	836	837

See Figure 6 for thermocouple layout.

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Time (mins)	Actual Temperature (°C) Position					
	D1	D2	E1	E2	F1	F2
0	13	14	14	14	14	14
1	14	15	15	16	24	16
2	15	15	15	17	38	19
3	16	18	18	18	41	25
4	17	26	26	21	43	35
5	20	39	40	27	47	49
6	24	54	55	35	53	65
7	31	66	69	44	60	78
8	39	75	78	55	66	86
9	46	81	85	65	71	91
10	53	85	89	72	76	94
11	57	87	91	77	79	95
12	62	88	93	80	81	96
13	64	89	94	83	82	97
14	67	90	95	85	83	97
15	69	90	95	86	83	96
16	70	91	96	86	84	96
17	72	92	96	86	83	96
18	74	95	96	86	83	96
19	76	95	97	88	84	99
20	78	96	98	89	85	100
21	80	97	100	90	85	102
22	81	98	102	91	86	104
23	83	100	105	91	87	106
24	84	103	107	92	88	108
25	86	106	110	93	88	110
26	87	109	113	94	89	113
27	89	111	116	95	90	115
28	90	113	118	95	91	116
29	91	115	119	96	92	117
30	93	116	120	97	92	118
31	94	117	121	98	93	118
32	94	118	121	98	94	118
33	95	119	121	99	94	119
34	96	119	122	99	95	119
35	96	120	122	100	95	120
36	96	121	123	101	96	121
37	97	122	125	101	96	122
38	97	124	126	102	96	123

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Time (mins)	Actual Temperature (°C) Position					
	D1	D2	E1	E2	F1	F2
39	97	127	129	102	96	125
40	98	132	133	103	97	127
41	98	139	138	104	97	131
42	98	153	148	104	97	138
43	98	169	164	106	98	149
44	98	179	175	107	98	163
45	98	206	183	109	99	176
46	98	230	208	113	99	194
47	98	251	229	117	100	215
48	98	269	247	123	102	233
49	99	285	264	129	103	249
50	100	298	279	137	105	264
51	101	309	293	145	109	278
52	102	318	306	153	114	292
53	105	326	317	161	121	305
54	115	332	327	169	127	316
55	132	340	336	177	133	326
56	148	351	345	185	139	335
57	166	369	353	192	145	344
58	185	395	360	200	152	353
59	208	427	367	209	158	359
60	232	457	377	217	164	363
61	262	487	400	230	174	384
62	335	531	424	243	187	411
63	492	466	444	255	202	433
64	802	854	464	276	221	455
65	823	825	478	306	264	475
66	786	784	499	423	324	488
67	796	805	674	665	394	487
68	831	825	796	783	494	484
69	838	834	816	802	586	628
70	829	822	810	797	682	768

See Figure 6 for thermocouple layout.

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Fire Acoustics Structures

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Time (mins)	Actual Temperature (°C)			
	Position			
	Ref. 1 Joist	Ref. 1 Board	Ref. 2 Joist	Ref. 2 Board
0	14	14	13	14
1	15	14	16	14
2	15	15	26	16
3	16	17	33	21
4	18	23	38	30
5	22	35	42	43
6	27	49	46	59
7	33	62	51	72
8	41	72	58	80
9	50	79	64	85
10	59	84	70	88
11	67	87	73	91
12	71	89	75	92
13	74	90	76	92
14	77	91	77	92
15	79	92	78	92
16	80	92	79	92
17	81	92	79	93
18	81	93	79	95
19	82	95	80	97
20	83	97	81	97
21	84	97	82	97
22	85	97	83	97
23	86	97	83	98
24	87	97	84	99
25	87	98	85	101
26	88	100	85	103
27	89	102	86	105
28	90	105	87	108
29	91	107	89	110
30	92	109	90	112
31	93	112	91	114
32	94	113	92	115
33	94	115	92	116
34	95	116	92	117
35	95	117	92	118
36	96	117	93	119

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Time (mins)	Actual Temperature (°C) Position			
	Ref. 1 Joist	Ref. 1 Board	Ref. 2 Joist	Ref. 2 Board
37	96	118	93	119
38	96	118	93	120
39	97	119	93	122
40	97	120	93	124
41	97	121	93	126
42	97	123	94	130
43	97	125	94	135
44	97	128	94	142
45	97	133	95	154
46	97	140	95	169
47	98	155	95	181
48	97	171	95	211
49	97	180	95	234
50	97	201	95	254
51	97	226	96	271
52	97	245	96	285
53	97	263	97	298
54	97	277	97	308
55	96	306	98	325
56	99	358	100	363
57	101	402	101	405
58	102	435	103	438
59	103	457	106	460
60	103	476	141	478
61	106	492	187	493
62	117	508	217	507
63	192	531	243	522
64	792	778	272	534
65	812	810	329	570
66	800	798	463	736
67	797	793	619	822
68	835	841	745	835
69	842	847	806	843
70	835	837	810	831

See Figure 6 for thermocouple layout.

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9.9 Specimen Vertical Deflection

Time (mins)	Centre Deflection (mm)	Maximum Rate of deflection (mm/minute)
0	0	0.0
1	1.8	0.9
2	1.9	0.1
3	1.9	0.0
4	1.8	-0.1
5	2.3	0.3
6	2.1	-0.1
7	2.2	0.0
8	2	-0.1
9	1.9	-0.1
10	2.3	0.2
11	1.9	-0.2
12	1.8	-0.1
13	1.9	0.1
14	2.1	0.1
15	1.9	-0.1
16	2.4	0.2
17	1.9	-0.2
18	2.3	0.2
19	2.3	0.0
20	2.3	0.0
21	1.8	-0.3
22	2.1	0.2
23	2	0.0
24	2.5	0.3
25	2.5	0.0
26	3.1	0.3
27	3.6	0.3
28	4.5	0.4
29	4.7	0.1
30	5.1	0.2
31	5.6	0.3
32	6.9	0.7
33	7.1	0.1
34	7.3	0.1
35	8	0.3

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Time (mins)	Centre Deflection (mm)	Maximum Rate of deflection (mm/minute)
36	8.8	0.4
37	9	0.1
38	10.2	0.6
39	10.3	0.1
40	10.5	0.1
41	10.8	0.2
42	12.4	0.8
43	12.5	-1.7
44	12.4	0.7
45	13.9	0.8
46	13.9	0.0
47	14.3	0.2
48	14.3	0.0
49	15.6	0.6
50	15.7	0.1
51	15.6	-0.1
52	16.4	0.4
53	17.1	0.4
54	17	-0.1
55	17.3	0.1
56	18.3	0.5
57	18.6	0.2
58	19.2	0.3
59	20.3	0.6
60	22.8	1.2
61	23.8	0.5
62	26.4	1.3
63	29.4	1.5
64	33.5	2.1
65	39.5	3.0
66	45.9	3.2
67	52.6	3.3
68	61.9	4.7
69	83.7	10.9
70	133.3	24.9

The deflection was recorded at the approximate centre of the specimen. Positive readings indicate deflection into the furnace.

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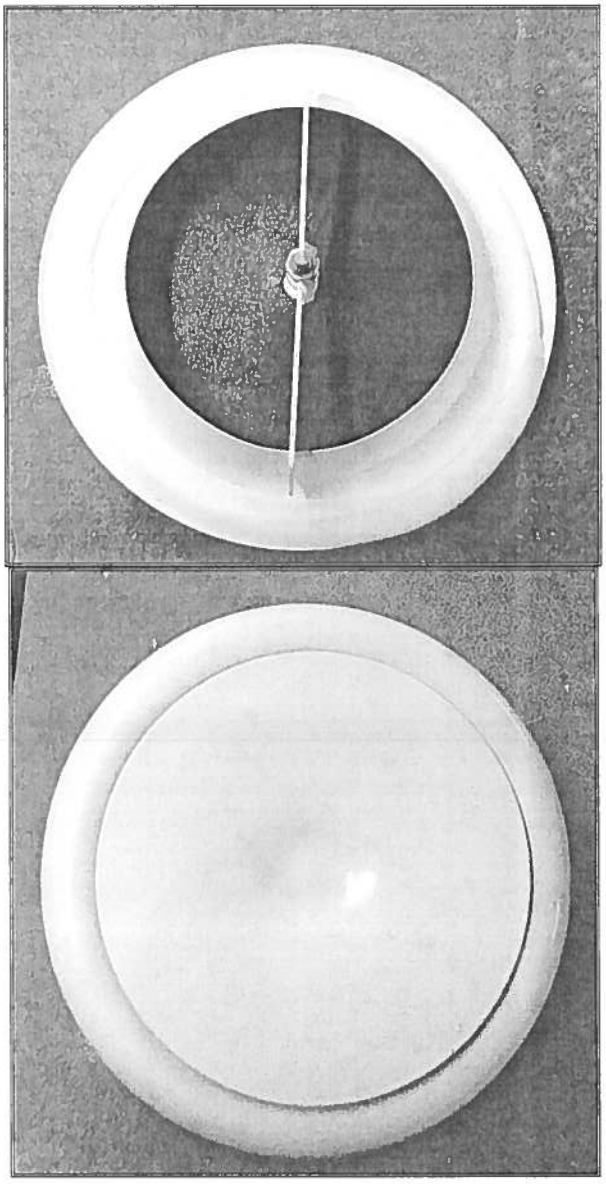
10. PHOTOGRAPHS

10.1 Valve A prior to installation, viewed from above & below



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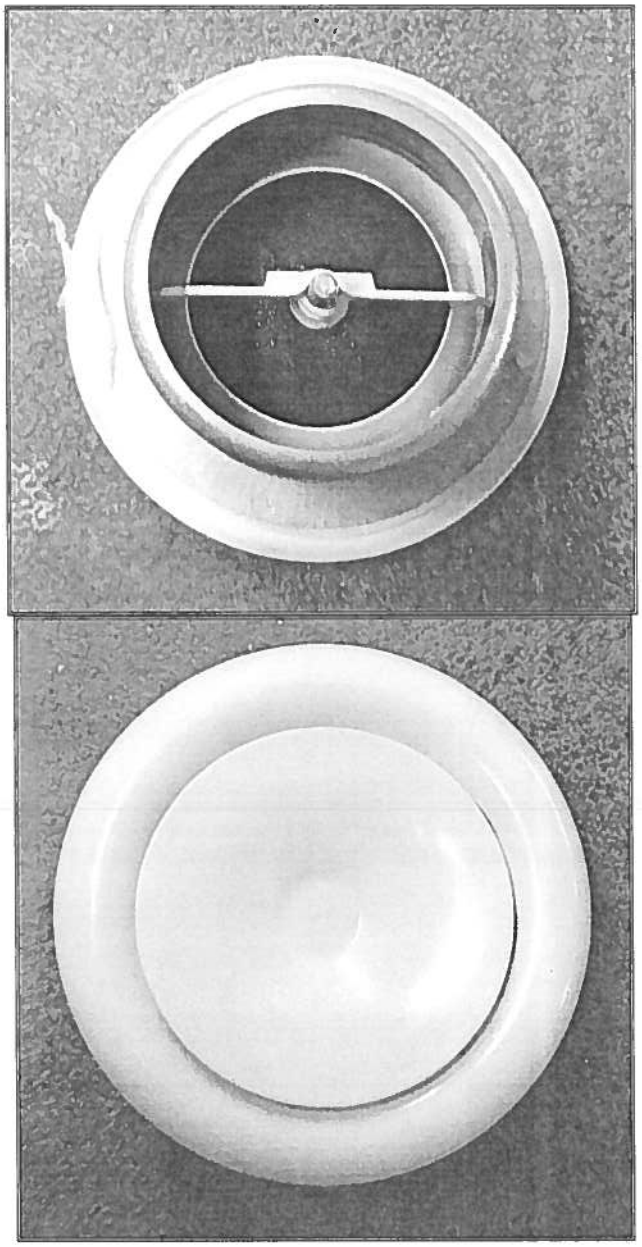
10.2 Valve B prior to installation, viewed from above & below



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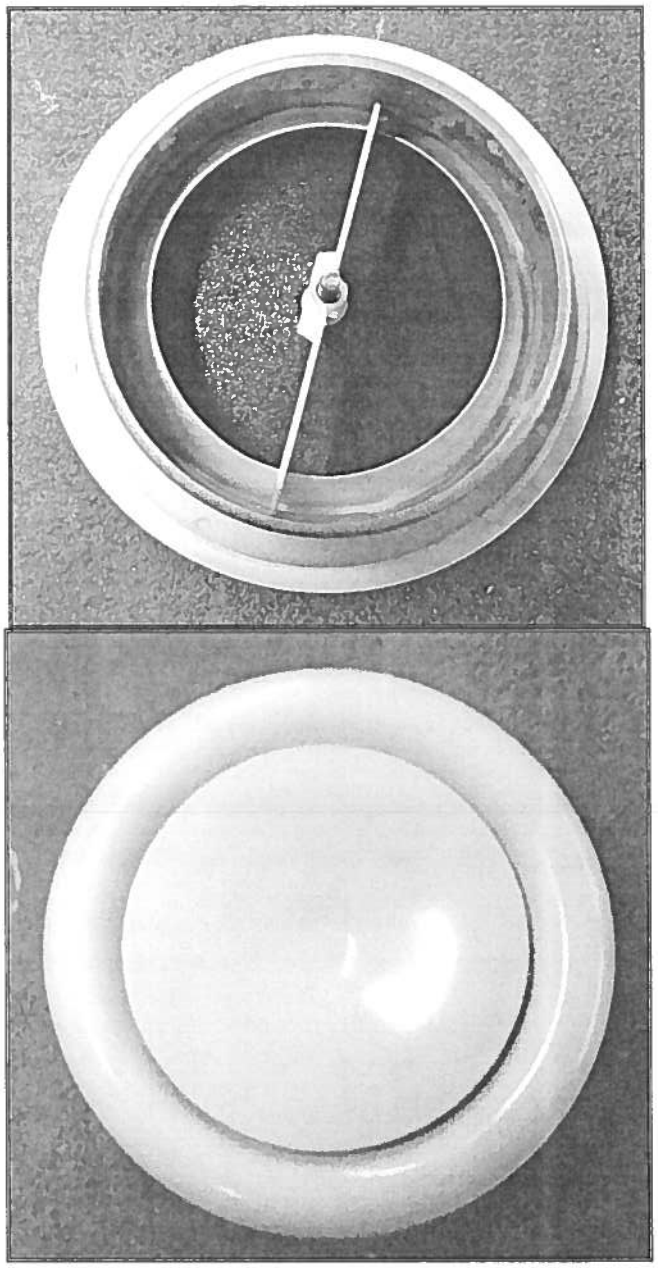
10.3 Valve C prior to installation, viewed from above & below



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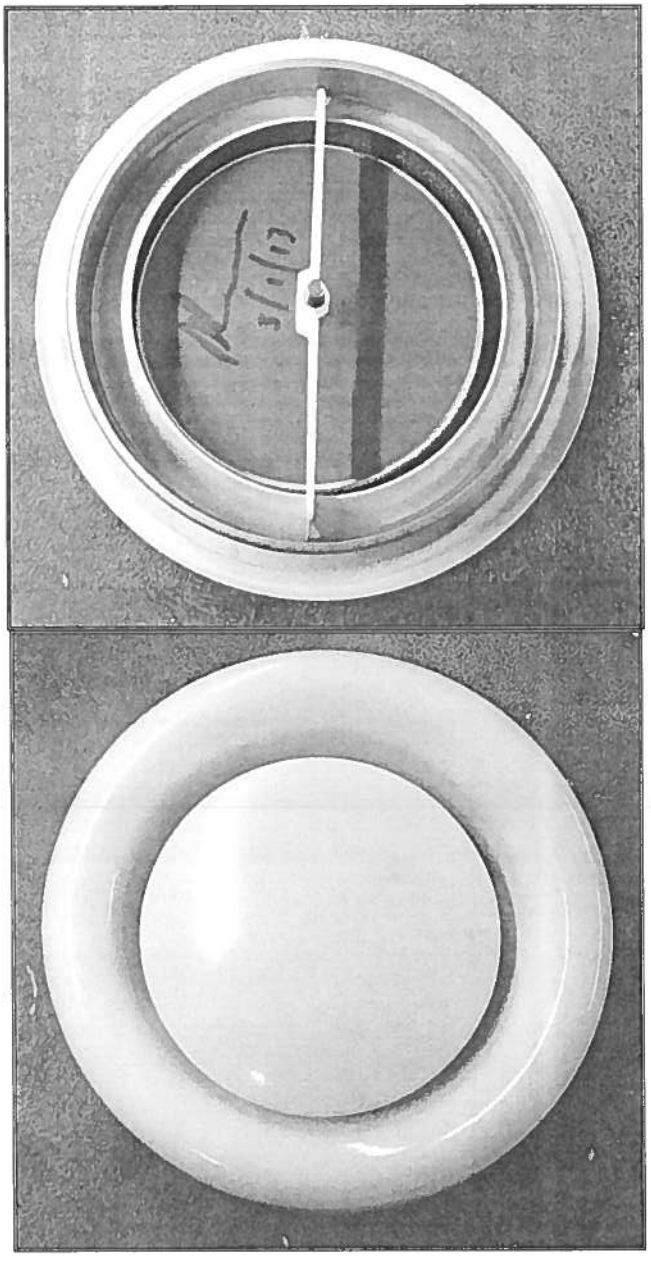
10.4 Valve D prior to installation, viewed from above & below



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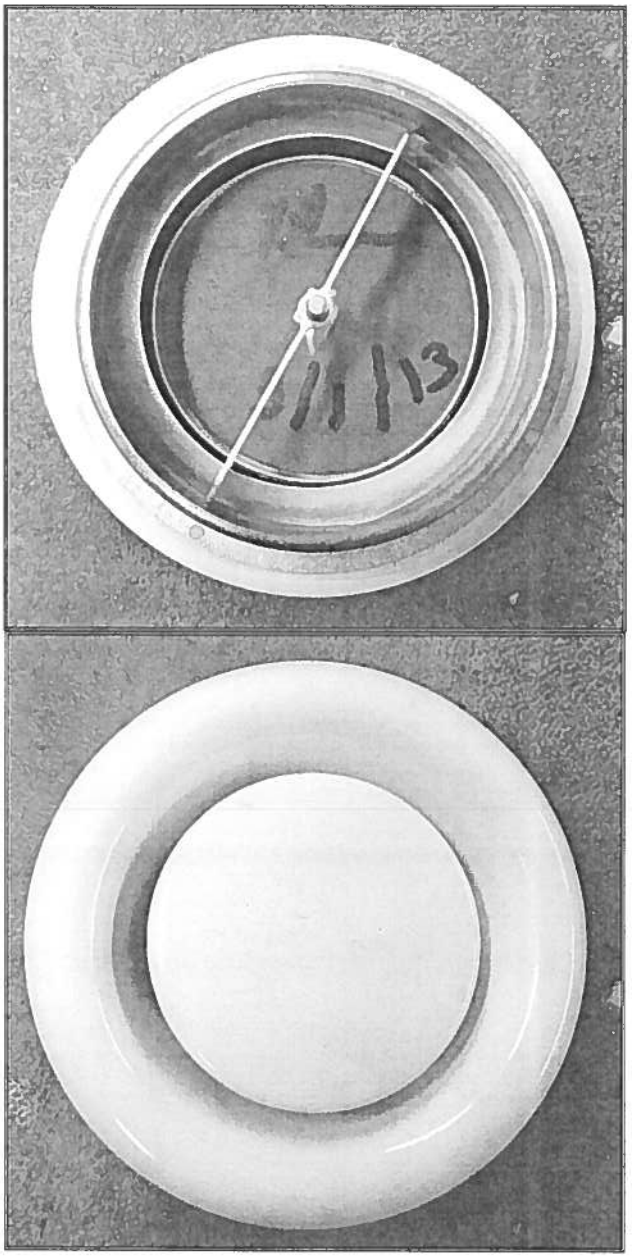
10.5 Valve E prior to installation, viewed from above & below



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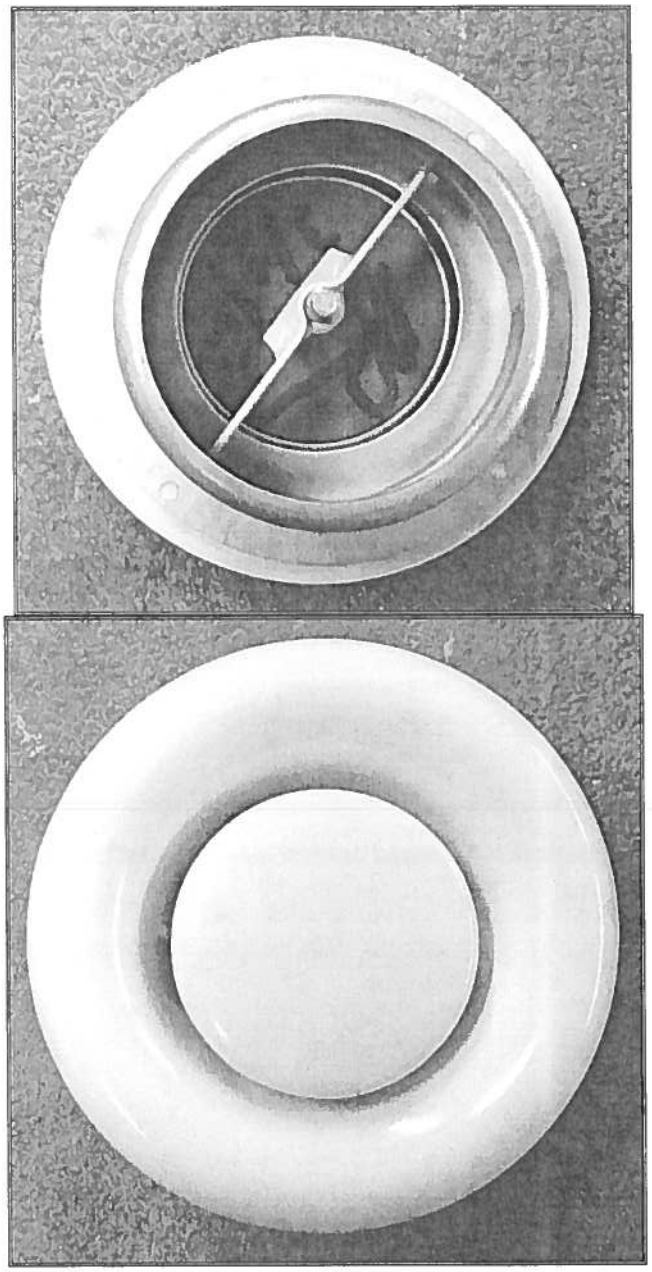
10.6 Valve F prior to installation, viewed from above & below



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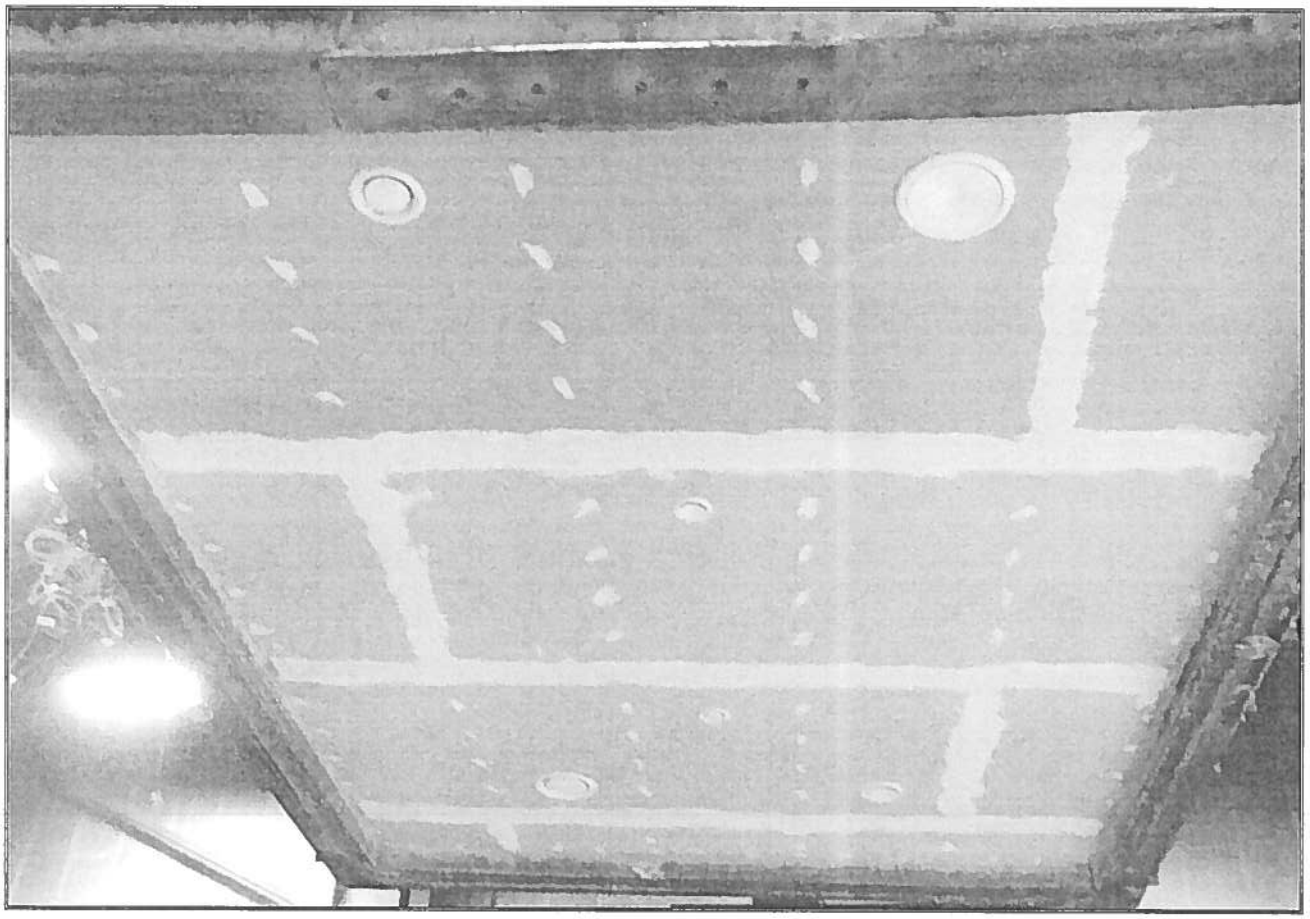
10.7 Exposed face prior to test



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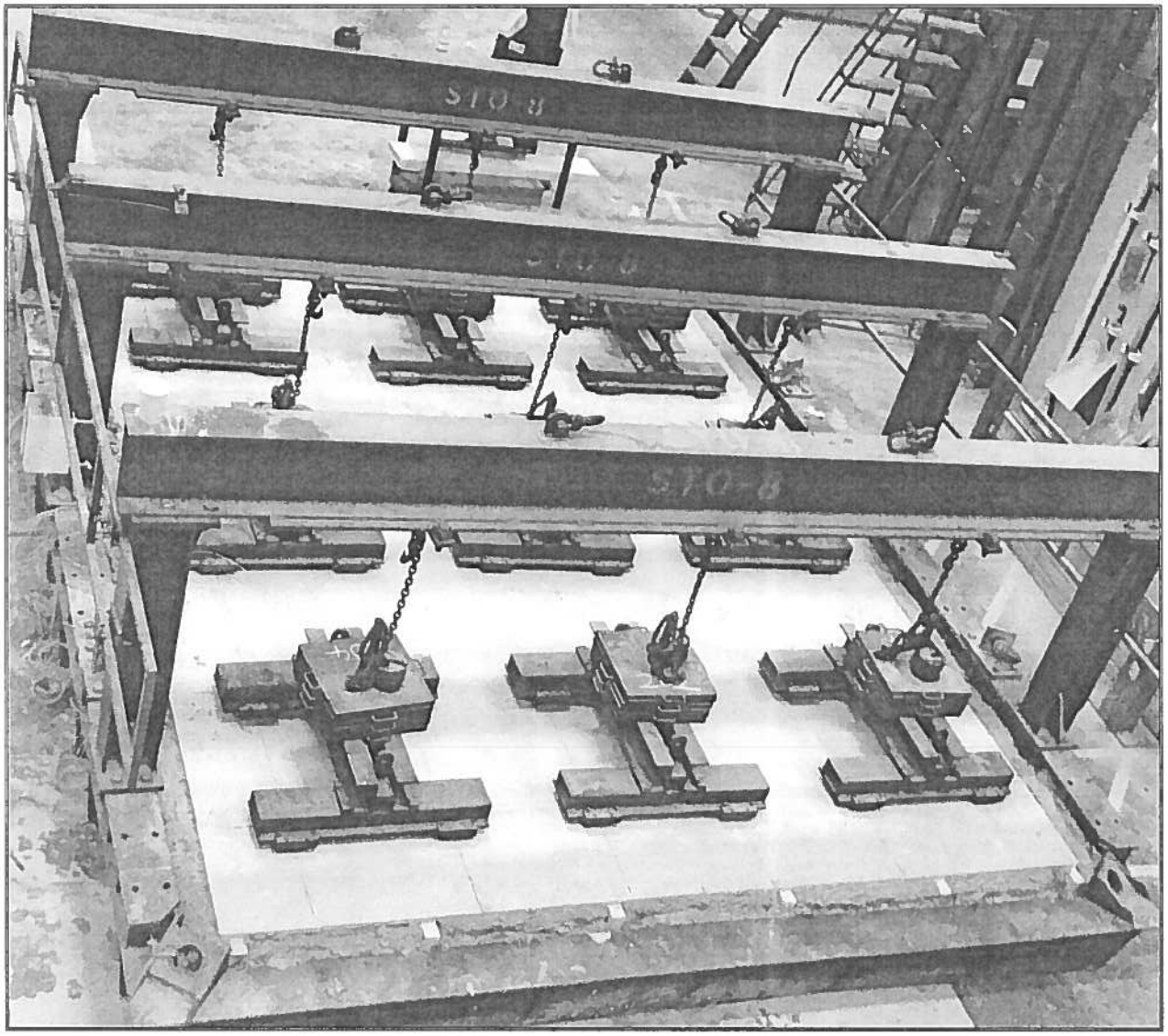
10.8 Unexposed face prior to test



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