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The Building Test Centre

Fire Acoustics Structures

Report Number **BTC 17145F**

A FIRE RESISTANCE TEST ON A HORIZONTAL BRITISH GYPSUM SHAFTWALL SYSTEM CLAD WITH A DOUBLE LAYER OF 15mm GYPROC FIRELINE INCORPORATING 25mm ISOVER ACOUSTIC ROLL IN THE CAVITY, CONDUCTED IN ACCORDANCE WITH BS EN 1364-2: 1999.

Test Date: 2nd December 2010

www.btconline.co.uk

Customer: **British Gypsum**
East Leake
Loughborough
Leicestershire
LE12 6HX

UKAS TESTING
0296

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1. FOREWORD

This test report details a fire resistance test conducted on a horizontal British Gypsum ShaftWall, fired from the corridor side. The test sponsor was British Gypsum.

The test specimen was installed by Alltone Limited. The construction of the specimen took place between the 29th and 30th November 2010. British Gypsum Limited designed and selected the materials comprising the test specimen.

The test was conducted on the 2nd December 2010.

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedures outlined in EN 1363-1, and where appropriate EN 1363-2. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in EN 1364-2 is not covered by this report.

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
Lynda Cooper Technologist	**Paul Miller** BSc. (Hons) Laboratory Supervisor

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3. TEST REPORT AMENDMENTS

Page	Amendments	Date

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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.

Gypframe 62JC60 'J' Channels were fixed to the 4000mm edges of the test frame using 60mm fire resistant fixings at 300mm centres. Gypframe 60SC55 Starter Channels were fixed to the 3000mm edges of the test frame using 60mm fire resistant fixings at 300mm centres. Gypframe 60I70 'I' Studs were positioned between the Gypframe 60JC60 'J' Channels at 600mm centres spanning 3000mm.

One layer of Gyproc CoreBoard was positioned between the studs and secured in position with Gypframe G102 Retaining Channels inserted between the back of the Gyproc CoreBoard and the lower flange of the stud. The Gypframe 60I70 'I' Stud and the Gypframe 62JC60 'J' Channel were fixed together using two Gypframe Wafer Head Screws through the lower flange of the channel, one either side of the stud web. Horizontal joints in the Gyproc CoreBoard were positioned at mid-span, i.e. 1500mm. Sections of Gypframe GA3 Steel Angle were inserted between the board joints and 122mm wide Gyproc CoreBoard fire stops, with beads of Gyproc Sealant along both longer edges, were fixed to the angle using three 32mm Gyproc drywall screws.

Gypframe MF6 Perimeter Channels were fixed to the perimeter of the test frame using 60mm fire resistant fixings at 600mm centres. The channels were fixed flush to the underside of the Gypframe 60JC60 'J' Channel/60SC55 Starter Channel framework.

A layer of 25mm Isover Acoustic Partition Roll was positioned in the cavity.

Gypframe MF5 Ceiling Sections were positioned in the Gypframe MF6 Perimeter Channels at 450mm centres perpendicular to the Gypframe 60I70 'I' Studs. The Gypframe MF5 Ceiling Sections were fixed to the Gypframe 60I70 'I' Studs using two 13mm Gypframe Wafer Head Screws. The Gypframe MF5 Ceiling Sections were extended by overlapping two sections by 150mm and were fixed together using two 13mm Gypframe Wafer Head Screws.

A double layer of 15mm Gyproc FireLine was fixed perpendicular to the Gypframe MF5 Ceiling Sections.

The inner layer was fixed at 234mm centres (6 fixings per board width) within the field of the board. The ceiling perimeter was fixed at 234mm centres along the long edges of the frame perimeter and at 225mm centres along the short edges of the frame perimeter using 25mm Gyproc drywall screws.

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The outer layer was fixed at 234mm centres (6 fixings per board width) within the field of the board. The ceiling perimeter was fixed at 234mm centres along the long edges of the frame perimeter and at 225mm centres along the short edges of the frame perimeter using 42mm Gyproc drywall screws.

All joints were staggered and board ends coincided with the Gypframe MF5 Ceiling Sections.

All exposed face board joints were finished using Gyproc Paper Joint Tape and Gyproc Joint Filler as appropriate. All screw heads were spotted using Gyproc Joint Filler.

4.2 Test Construction Drawings

4.2.1 Horizontal Cross Section

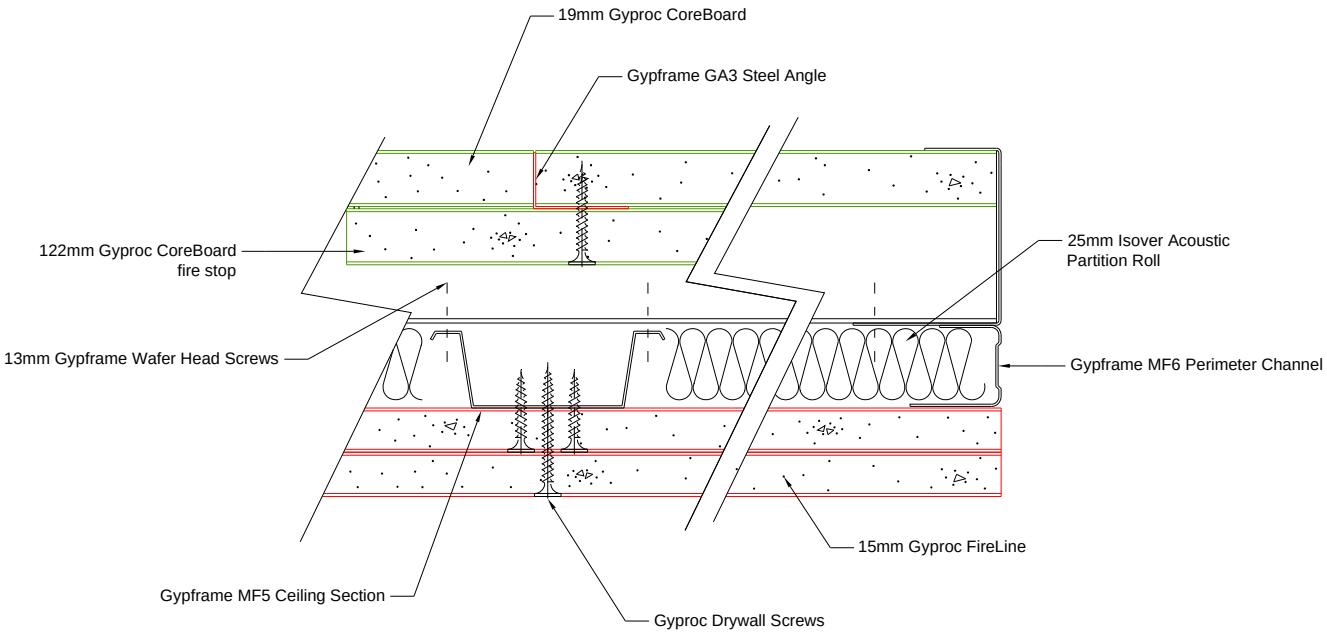

Figure 1 - Horizontal Cross Section

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4.2.2 Plan View of Unexposed Boards

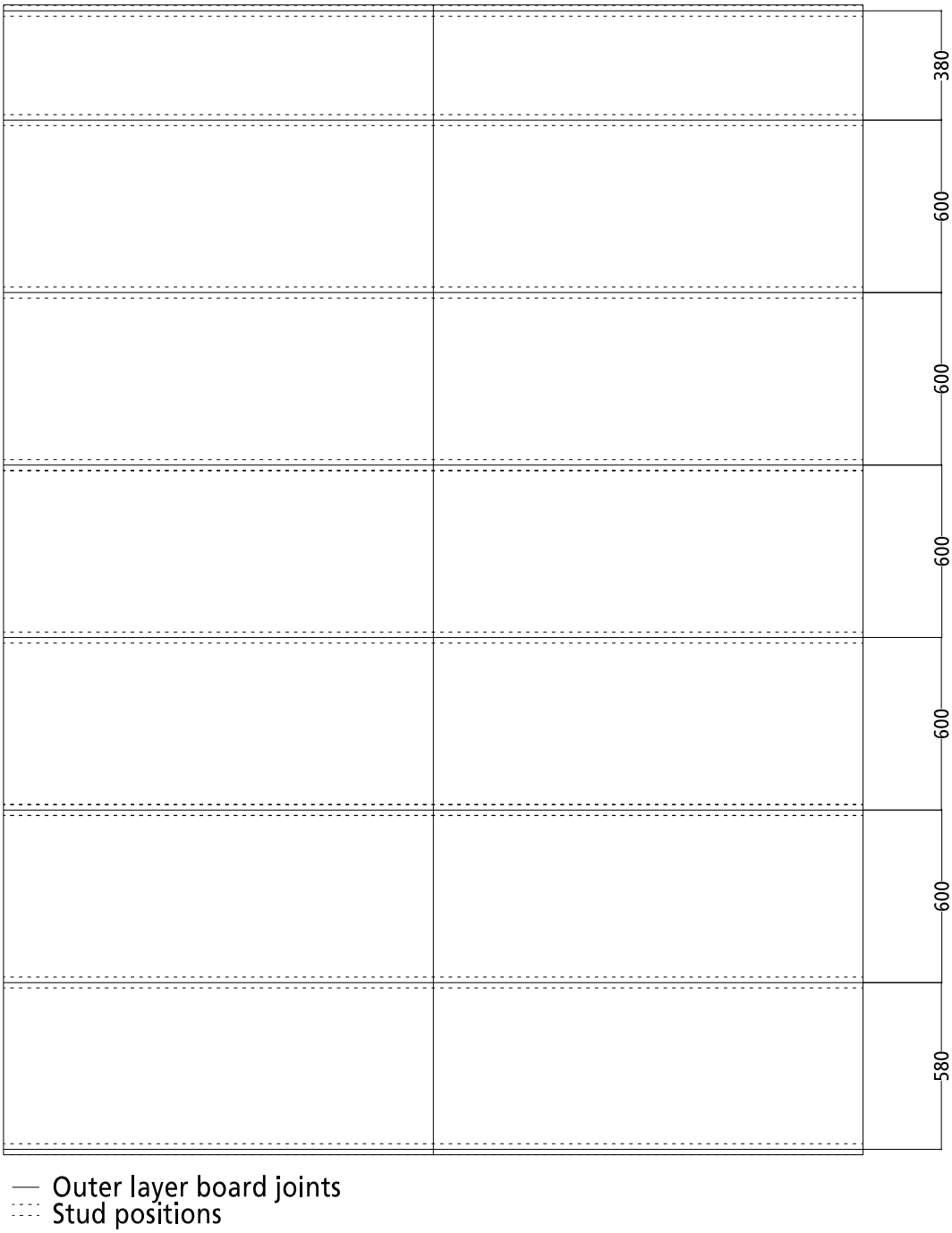

Figure 2 - Unexposed face boards

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4.2.3 Plan View of Exposed Face Outer Layer Boards

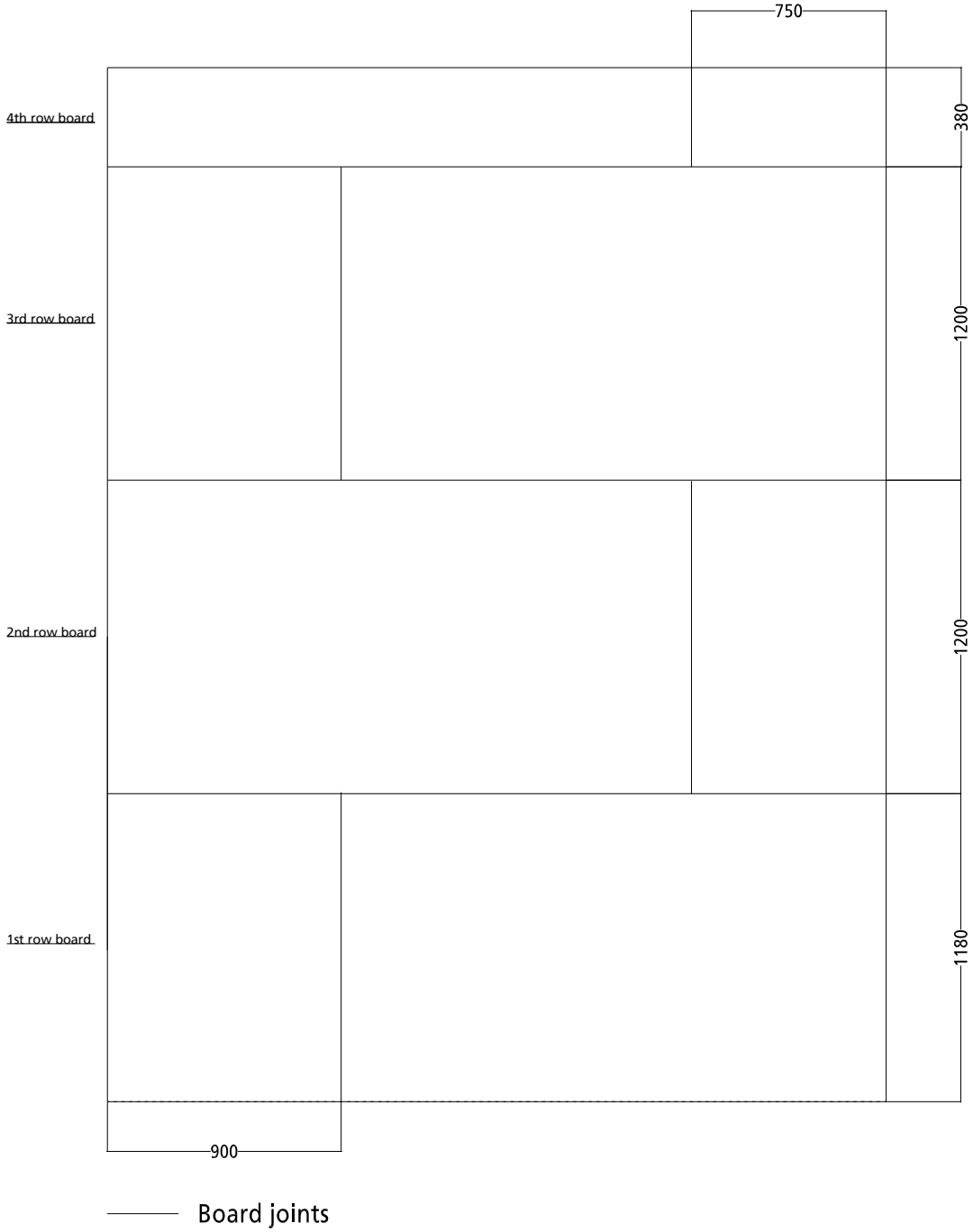

Figure 3 - Exposed face outer layer boards

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4.2.4 Plan View of Exposed Face Inner Layer Boards

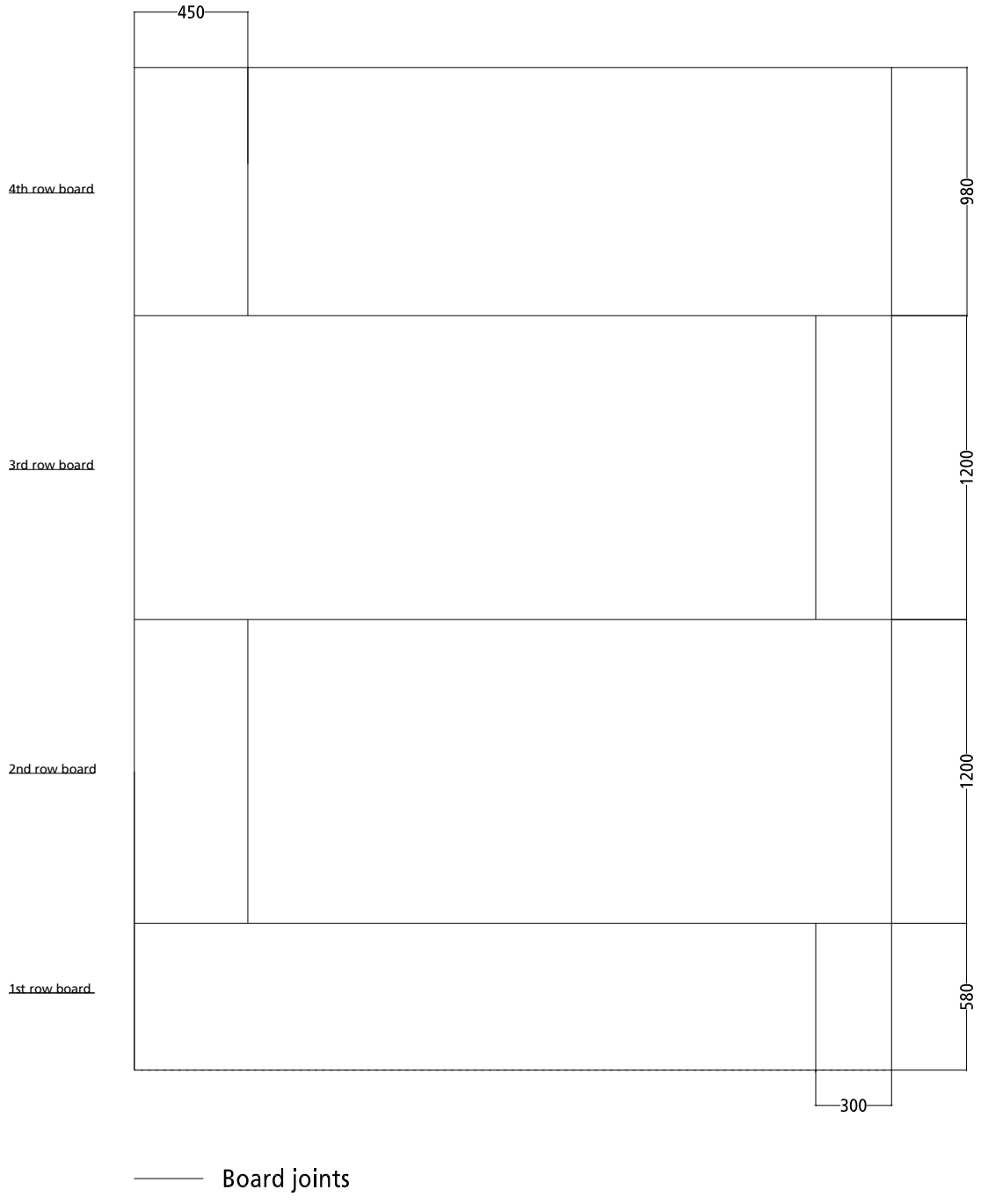

Figure 4 - Exposed face inner layer boards

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5. TEST MATERIALS

5.1 Gyproc FireLine (TE)

i) Nominally, 2700mm (long) x 1200mm (wide) x 15mm (thick), Gyproc FireLine (TE), manufactured and supplied by British Gypsum, ex East Leake.

Measured weight per unit area:	12.5 kg/m^2
Measured thickness:	15.5 mm
Board identification numbers:	18 289 10 11:58
	18 289 10 11:58
	18 289 10 11:59
Measured moisture content:	0.35 %

The surface density and board thickness were calculated using the actual weight and size of 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 supplied by British Gypsum.

5.2 Gyproc CoreBoard

ii) Nominally, 3000mm (long) x 598mm (wide) x 19mm (thick), Gyproc CoreBoard manufactured and supplied by British Gypsum, ex East Leake.

Measured weight per unit area:	16.8 kg/m^2
Measured thickness:	18.9 mm
Board identification numbers:	18 308 10 07:21
	18 308 10 07:22
	18 308 10 07:23
Measured moisture content:	0.35%

The surface density and board thickness were calculated using the actual weight and size of 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 supplied by British Gypsum.

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5.3 Metal Components

iii) Gypframe 62JC60 'J' Channel
iv) Gypframe 60SC55 Starter Channel
v) Gypframe 60I70 'I' Stud
vi) Gypframe MF6 Perimeter Channel
vii) Gypframe MF5 Ceiling Section
viii) Gypframe GA3 Steel Angle
ix) Gypframe G102 Retaining Channel

All metal components were supplied by British Gypsum.

5.4 Fasteners

x) 25mm Gyproc drywall screws supplied by British Gypsum.
xi) 32mm Gyproc drywall screws supplied by British Gypsum.
xii) 42mm Gyproc drywall screws supplied by British Gypsum
xiii) 13mm Gypframe Wafer Head screws supplied by British Gypsum
xiv) 60mm fire resistant fixings, supplied by the Building Test Centre

5.5 Miscellaneous Components

xv) Gyproc Paper Joint Tape, supplied by British Gypsum
xvi) Gyproc Joint Filler, supplied by British Gypsum

5.6 Insulation

xvii) Nominally 25mm (thick) Isover Acoustic Partition Roll manufactured and supplied by Saint-Gobain Isover.

Measured density:	17.4 kg/m^3
Measured surface density:	0.43 kg/m^2

The density was calculated using the insulation roll used in the test specimen.

Where measurements could not be taken then weight and dimensions were provided by the customer or the manufacturer e.g. from material labelling. Material information was recorded according to procedure MAT/1.

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6. TEST PROCEDURE

The test was conducted fully in accordance with BS EN 1364-2: 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 1363-1: 1999.

The test specimen was not symmetrical and should therefore be tested in both orientations. No performance can be claimed for the system if installed with the shaft side (CoreBoard) exposed to the furnace without a separate test being undertaken to substantiate this orientation.

Where areas of the test specification are ambiguous, or open to interpretation, the Fire Test Study Group Resolutions 43, 72, 83 and 85 have been followed (where appropriate). These Resolutions provide the basis of common agreements between the fire test laboratories, which are members of this group.

The test procedure used was EN 1364-2 Issue 2.

The ambient temperature at the commencement of the test was 12 °C.

The furnace pressure was set to control at 18 ± 2 Pa positive with respect to atmosphere, at the top of the specimen. Furnace pressure data is shown in figure 6.

The test conditions did not meet the full requirements of BS EN 1363-1: 1999 as the test frame stiffness did not fully comply.

The specimen and associated construction were not conditioned in accordance with clause 8 of BS EN 1363-1: 1999.

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7. TEST RESULTS

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

Integrity	Sustained flaming	No Failure (the test having been discontinued at the request of the laboratory)
	6mm gap gauge	No Failure (the test having been discontinued at the request of the laboratory)
	25mm gap gauge	No Failure (the test having been discontinued at the request of the laboratory)
	Cotton Pad	87 minutes
Insulation		75 minutes

The test was terminated at 88 minutes at the request of the laboratory.

8. LIMITATIONS

The specification and interpretation of fire test methods are 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 Rhea Akiens, Lynda Cooper
Exposed face Mark Shortland

Time		Observations
hours	mins	*All observations refer to the exposed face unless otherwise stated.*
0	0	Test started.
0	10	Paper liner charred. Jointing material was flaking away.
0	15	All of paper liner had burnt away. Most of jointing material had fallen. No gaps visible in joints.
0	20	End board joint in second row of boards had opened to approximately 1-2mm. Joint between first and second row boards had opened to approximately 2mm, where visible.
0	25	All first layer board joints open to approximately 2-3mm.
0	30	Joints between first and second row boards and end joints in second and third row boards open to approximately 5-6mm. All other board joints open to approximately 3-4mm. *Unexposed face* No visible change.
0	35	Boards bowed into furnace slightly between fixings along the long edges of the boards. All first layer board joints open to approximately 6-8mm.
0	40	No visible change.
0	45	Fourth row boards bowed into furnace between fixings by approximately 10mm. All end board joints open to approximately 8-10mm.

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Time		Observations
hours	mins	*All observations refer to the exposed face unless otherwise stated.*
0	50	No visible change.
0	55	No visible change.
1	00	Right-hand third row board bowed into furnace, adjacent to second row boards, by approximately 15-20mm. *Unexposed face* No visible change.
1	05	Corner of right-hand second row board peeled into furnace. Corner of left-hand third row board peeled into furnace.
1	06	Approximately 75% of left-hand third row board fell into furnace. Second layer boards 'crazed' where visible.
1	08	Right-hand third row board fell, approximately 2100mm x 1200mm. Second layer joints open to approximately 10-12mm. *Unexposed face* Boards discoloured along the 4 metre edges of the specimen. Condensation visible around perimeter of test frame.
1	09	*Unexposed face* Deflection adjacent to second stud greater than the deflection in the centre of the specimen.
1	10	First row, second layer left-hand board bowed into furnace.
1	11	Right-hand second row board fell, approximately 750mm x 1200mm. *Unexposed face* Discoloration adjacent to second and fourth studs from the viewing platform.
1	12	*Unexposed face* Discolouration adjacent to all studs.

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Time		Observations
hours	mins	*All observations refer to the exposed face unless otherwise stated.*
1	13	*Unexposed face* Deflection into furnace visibly increased.
1	15	First row, second layer left-hand board hanging into furnace. *Unexposed face* **INSULATION FAILURE.** The temperature rise of thermocouple no.25 positioned on the fourth stud from the viewing platform, at approximately 100mm from the mid-span joint, exceeded 180°C.
1	16	First row, first layer boards fell, approximately 1180mm x 3000mm. First row, second layer left-hand board fell, approximately 700mm x 1800mm. Insulation not visible in cavity.
1	20	Second row, second layer board fell, approximately 1400mm x 1200mm. *Unexposed face* The perimeter channel pulled away from the test frame along the top edge, along the 4 metre edges of the specimen.
1	21	*Unexposed face* Cotton pad attempt adjacent to first stud, to left-hand side of mid-span – no failure.
1	22	*Unexposed face* Glow visible and cotton pad attempt adjacent to first stud, to left-hand side of mid-span – no failure.
1	23	Insulation was dripping at far end of specimen at mid-span, as second layer boards bowed into furnace.
1	24	Remainder of first layer boards had fallen (100%). Second layer boards were hanging down into the furnace but still attached at the left and right of the specimen. *Unexposed face* Cotton pad attempt adjacent to first stud, to left-hand side of mid-span – no failure.

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Time		Observations
hours	mins	*All observations refer to the exposed face unless otherwise stated.*
1	25	*Unexposed face* Cotton pad attempt adjacent to first stud, to left-hand side of mid-span – no failure.
1	26	Approximately 80% of second layer boards had fallen from the centre of the specimen. *Unexposed face* Cotton pad attempt adjacent to first stud, to left-hand side of mid-span – no failure.
1	27	*Unexposed face* **INTEGRITY FAILURE**. The cotton pad ignited (flamed) when held over the first stud, to left-hand side of mid-span.
1	28	**TEST TERMINATED** at the request of the laboratory.

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9.2 Furnace Temperature Graph

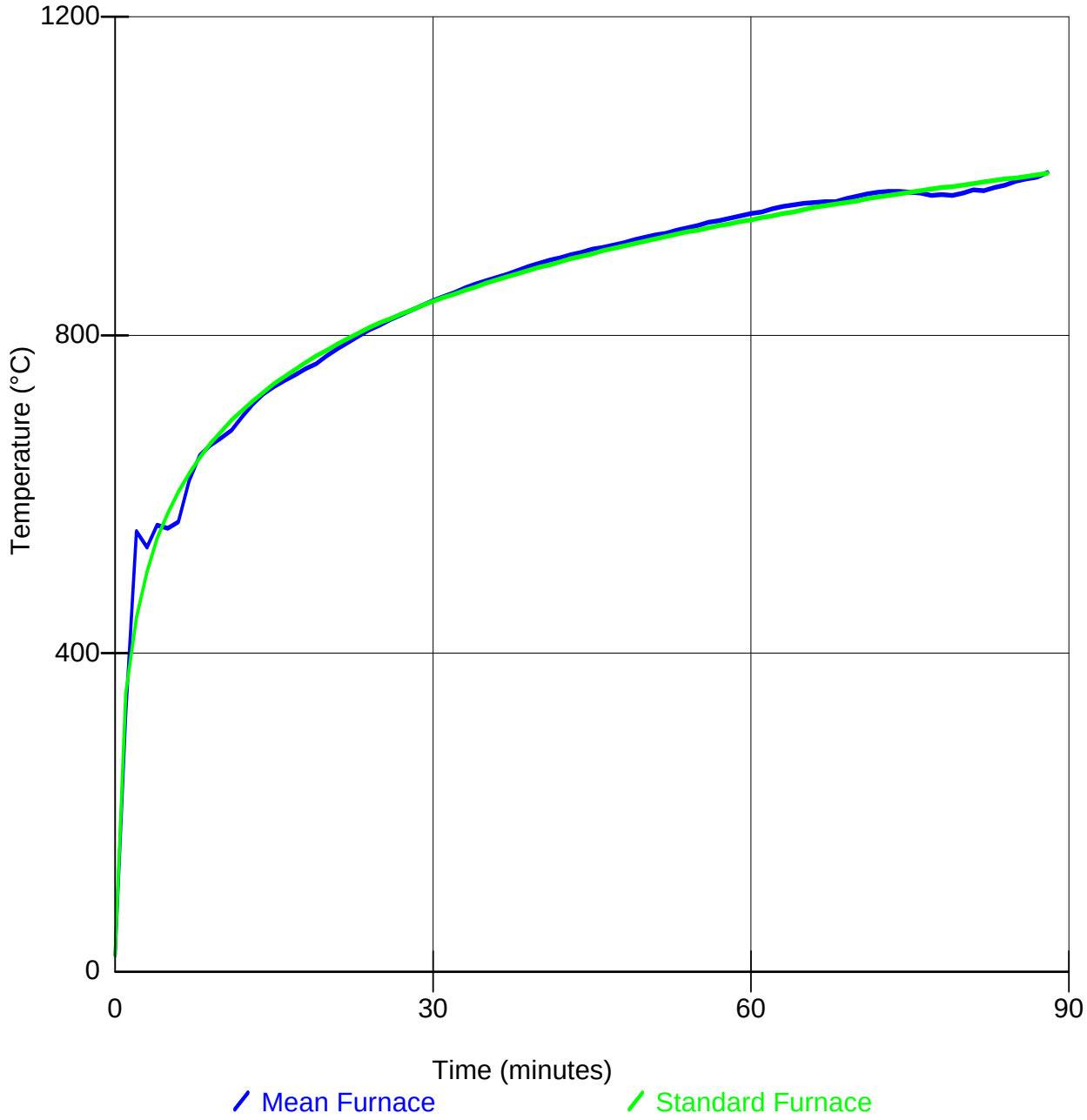

Figure 5 - Furnace temperature graph

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9.3 Furnace Pressure Graph

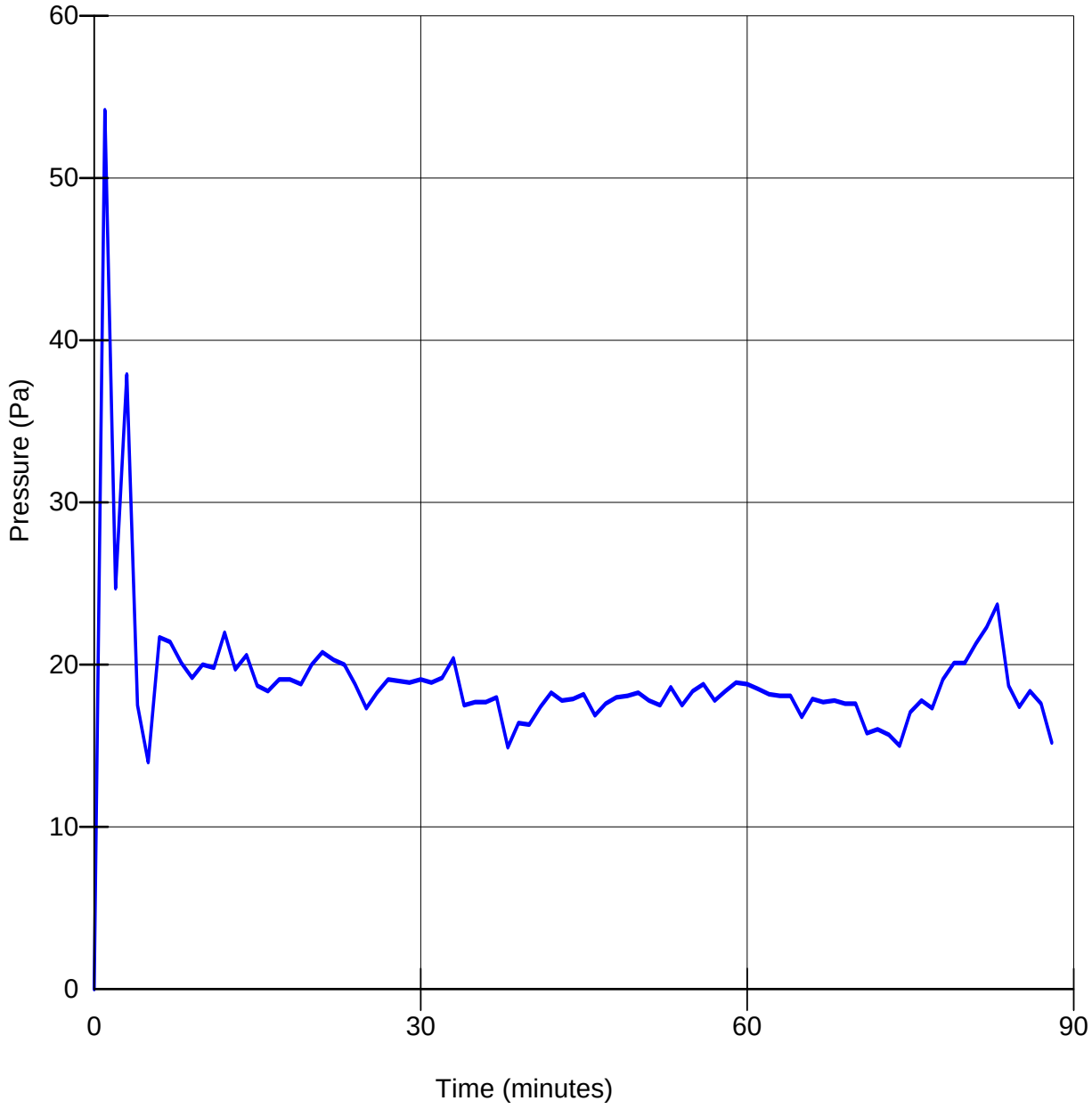

Figure 6 - Furnace pressure graph
The furnace pressure was set to control at 18 ± 2 Pa positive with respect to atmosphere, at the top of the specimen.

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9.4 Unexposed Face Temperature Graph

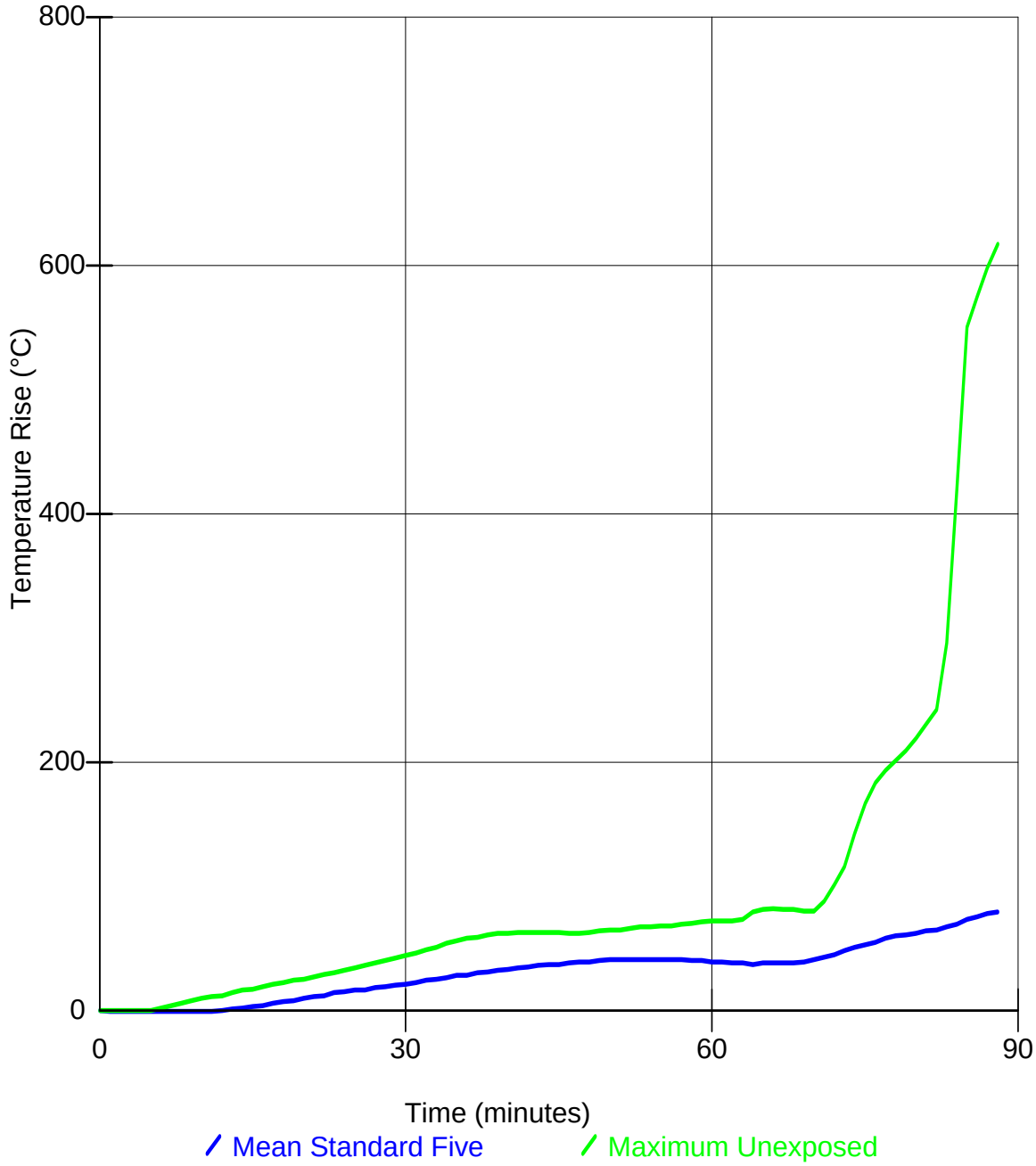

Figure 7 - Unexposed face temperature graph

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9.5 Unexposed Face Thermocouple Layout

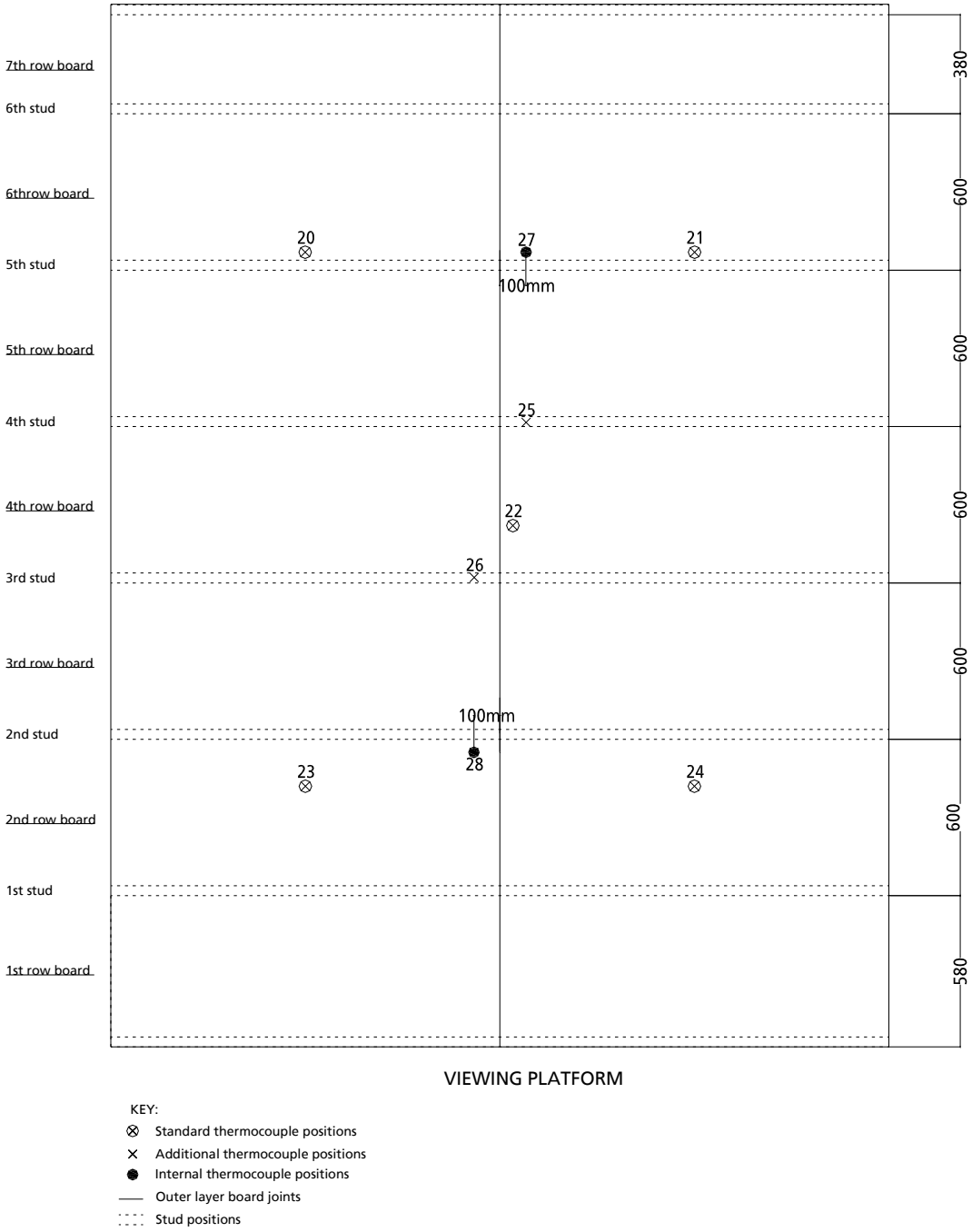

Figure 8 - Unexposed face thermocouple layout

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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	-1	0	0	-1	0	-1
2	-1	0	0	-1	0	-1
3	-1	0	0	-1	0	-1
4	-1	-1	-1	-1	0	-1
5	-1	-1	-1	-1	0	-1
6	-1	-1	-1	-1	-1	-1
7	-1	-1	-1	-1	-1	-1
8	-1	-1	-1	-1	-1	-1
9	-1	-1	-1	-1	-1	-1
10	0	0	-1	-1	0	-1
11	0	0	0	-1	0	-1
12	2	0	0	0	0	0
13	3	1	0	1	1	1
14	6	1	0	2	1	2
15	8	2	1	3	2	3
16	11	3	1	5	3	4
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18	16	5	3	9	5	7
19	18	6	3	11	6	8
20	20	8	4	13	7	10
21	22	9	5	15	8	11
22	23	10	6	16	9	12
23	25	11	7	18	10	14
24	26	12	7	20	11	15
25	26	13	8	21	12	16
26	27	14	9	22	12	16
27	28	15	10	24	13	18
28	29	16	12	25	14	19
29	30	17	13	27	15	20
30	31	19	14	29	15	21
31	32	20	15	31	16	22
32	33	22	17	32	17	24
33	34	24	18	34	17	25
34	35	25	19	36	18	26
35	36	27	21	37	19	28
36	36	28	22	38	20	28

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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
37	37	30	23	40	21	30
38	38	32	25	41	21	31
39	38	34	26	42	22	32
40	39	35	27	43	23	33
41	39	37	28	43	25	34
42	40	38	29	43	26	35
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72	41	40	40	43	63	45
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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
76	45	44	49	62	78	55
77	46	45	52	72	78	58
78	48	47	54	77	77	60
79	50	49	56	77	77	61
80	52	51	57	77	76	62
81	54	52	59	78	77	64
82	55	54	62	77	77	65
83	55	56	67	78	79	67
84	56	60	75	77	80	69
85	56	72	78	77	82	73
86	57	79	79	78	85	75
87	58	80	78	78	96	78
88	60	80	78	79	102	79

See figure 8 for thermocouple layout.

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9.7 Additional Unexposed Face Temperature Data and Cavity Temperature Data

Time (mins)	Temperature Rise (°C)		Actual temperature (°C)	
	I studs		Mid-height in cavity	
	Thermocouple No. 25	Thermocouple No. 26	Thermocouple No. 27	Thermocouple No. 28
0	0	0	16	16
1	0	0	16	16
2	0	0	16	16
3	0	0	16	16
4	0	0	16	17
5	0	0	17	19
6	2	-1	19	21
7	4	0	21	26
8	6	0	24	33
9	8	0	29	43
10	10	2	34	52
11	11	4	40	58
12	12	6	46	62
13	14	8	51	64
14	16	11	54	68
15	17	13	57	69
16	19	16	59	70
17	21	18	61	71
18	22	21	62	71
19	24	23	64	72
20	25	25	65	73
21	27	27	67	74
22	28	29	68	75
23	30	30	70	77
24	32	32	72	80
25	33	34	74	82
26	35	36	76	84
27	37	38	78	85
28	39	40	80	86
29	41	42	82	87
30	44	43	83	88
31	46	45	85	89
32	49	47	87	90
33	51	48	89	91
34	54	50	91	92
35	56	51	93	92

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Time (mins)	Temperature Rise (°C)		Actual temperature (°C)	
	I studs		Mid-height in cavity	
	Thermocouple No. 25	Thermocouple No. 26	Thermocouple No. 27	Thermocouple No. 28
36	58	52	95	93
37	59	53	97	93
38	61	54	99	93
39	62	55	100	93
40	62	55	101	93
41	63	56	103	93
42	63	56	104	92
43	63	57	105	92
44	63	57	105	92
45	63	59	106	92
46	62	60	107	92
47	62	60	107	92
48	63	60	108	91
49	64	60	110	92
50	65	61	111	92
51	65	60	113	97
52	66	60	115	106
53	67	60	117	114
54	67	59	119	122
55	68	59	122	131
56	68	58	126	142
57	69	58	131	155
58	70	57	138	170
59	71	57	145	185
60	72	58	153	201
61	72	60	162	216
62	72	61	175	231
63	73	63	190	244
64	79	65	205	256
65	81	70	219	267
66	82	76	234	278
67	81	79	250	392
68	81	79	263	465
69	80	79	279	538
70	80	80	295	665
71	88	80	310	779
72	101	80	323	873
73	116	80	338	921

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Time (mins)	Temperature Rise (°C)		Actual temperature (°C)	
	I studs		Mid-height in cavity	
	Thermocouple No. 25	Thermocouple No. 26	Thermocouple No. 27	Thermocouple No. 28
74	142	79	359	950
75	167	83	376	992
76	183	86	390	997
77	193	90	404	1008
78	201	97	417	1012
79	209	107	432	1013
80	219	118	449	1017
81	230	140	464	1034
82	242	201	487	1032
83	263	296	528	1044
84	291	420	582	1051
85	321	550	693	1059
86	351	575	858	1060
87	386	598	889	1069
88	417	617	940	1073

Figures highlighted in red indicate the minute in which the temperature rise exceeded 180°C.

See figure 8 for thermocouple layout.

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9.8 Specimen Vertical Deflection

Time (mins)	Deflection (mm)
	Centre
0	0
1	4
2	4
3	4
4	4
5	4
6	4
7	4
8	5
9	7
10	9
11	10
12	11
13	11
14	11
15	11
16	11
17	11
18	11
19	11
20	11
21	11
22	11
23	11
24	10
25	10
26	10
27	10
28	9
29	9
30	9
31	9
32	9
33	9
34	9
35	9
36	9

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Time (mins)	Deflection (mm)
	Centre
37	9
38	9
39	9
40	9
41	9
42	9
43	9
44	8
45	8
46	8
47	8
48	8
49	8
50	8
51	8
52	8
53	9
54	10
55	11
56	13
57	16
58	19
59	22
60	26
61	31
62	36
63	41
64	46
65	52
66	58
67	65
68	71
69	78
70	83
71	90
72	96
73	101
74	106
75	111

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Time (mins)	Deflection (mm)
	Centre
76	116
77	121
78	126
79	133
80	143
81	154
82	167
83	180
84	194
85	203
86	211
87	217
88	223

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 Exposed face prior to test

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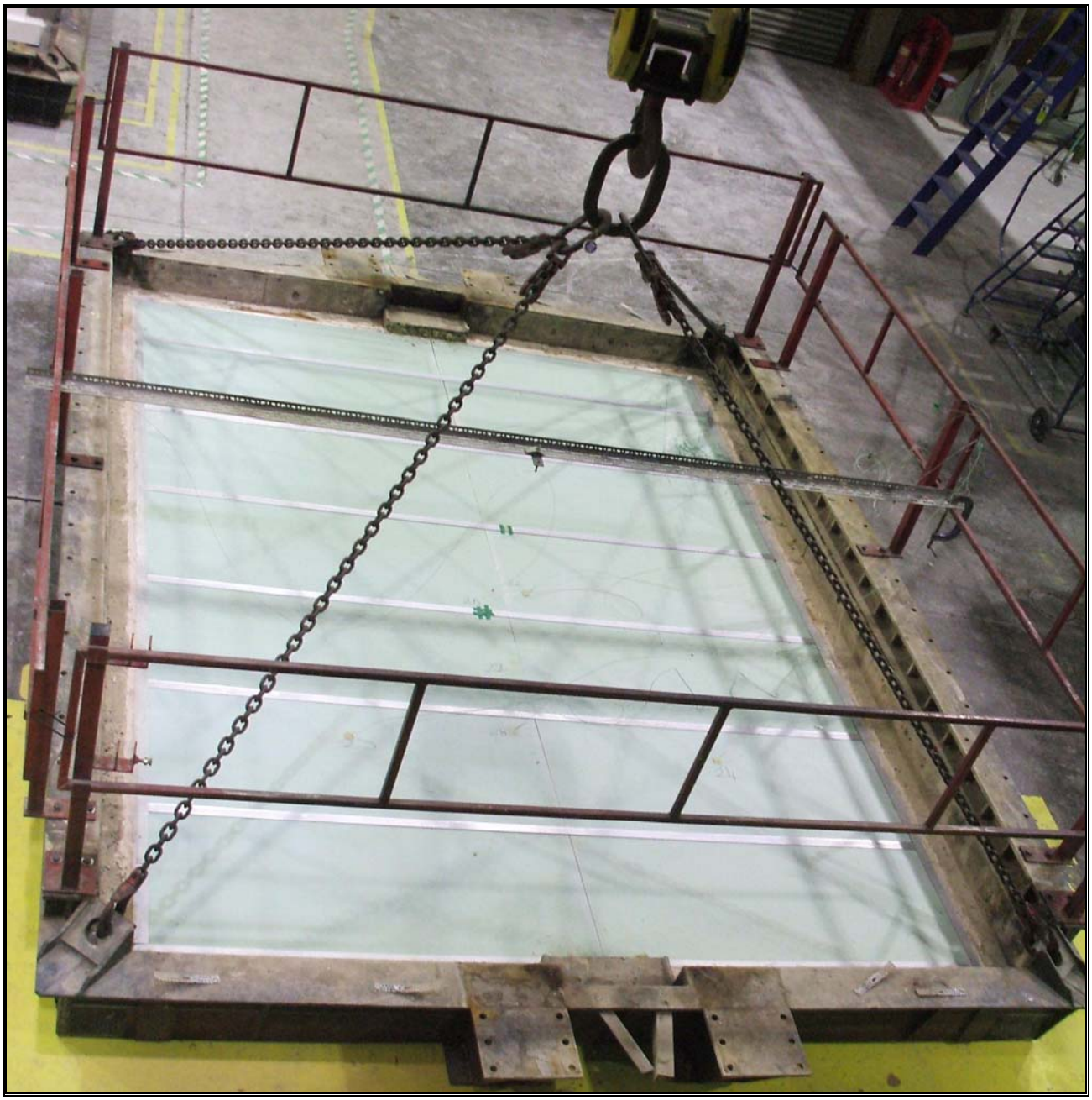
10.2 Unexposed face prior to test



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10.3 Unexposed face at 59 minutes

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10.4 Unexposed face at 1 hour, 19 minutes

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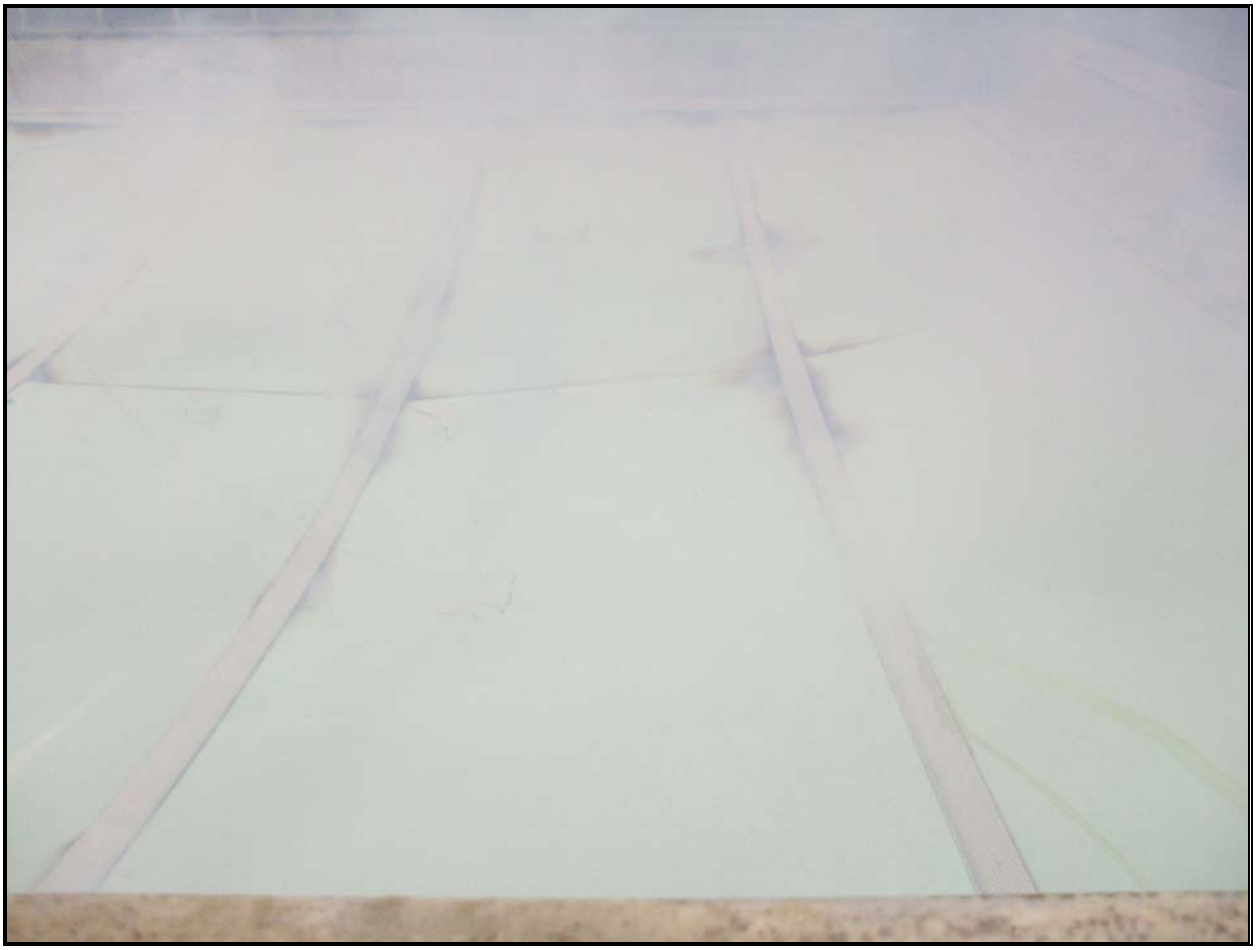
10.5 Unexposed face at 1 hour, 20 minutes



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11. FIELD OF DIRECT APPLICATION

11.1 General

The applicability of the test results shall be restricted to other constructions where the installation of the ceiling is carried out from below.

11.2 Size

For ceilings of full size span less than 4m but of width equal or greater than 3m (tested at full size span and 3m width) and in which the most onerous direction lies in the 4m direction of the furnace*, the results may be applied to ceilings of the same span or less than that tested. There shall be no restriction on the application of the result in the width direction. The provisions with respect to most onerous configuration as given in BS EN 1364-2: 1999 section 6.3.2 shall be followed in the direct application of results.

*The specimen was tested at its full size span of 3m in the 3m direction of the furnace not the 4m direction as this was the more onerous condition. The construction method of the specimen does not differ with direction. Therefore the results may be applied to ceilings of the same span or less than that tested and there shall be no restriction on the application of the result in the width direction.

Maximum Joist Span	Maximum Ceiling Width
3000mm	Unlimited

11.3 Fittings

Fittings which may be installed are those which have been included in the test specimen, with a distribution per unit area not greater than that tested.

11.4 Cavities above self-supporting ceilings exposed to fire from below

The test results are valid for cavities of any height.