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Report Number **BTC 13188F**

FULL SCALE FIRE RESISTANCE TEST ON A BRITISH GYPSUM CASOLINE MF SUSPENDED CEILING CLAD WITH A DOUBLE LAYER OF 12.5mm GYPROC FIRELINE CONDUCTED IN ACCORDANCE WITH BS EN 1364-2: 1999.

Test Date: 15th January 2004

www.btconline.co.uk

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

0296

The Building Test Centre
Fire Acoustics Structures

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FOREWORD

This test report details a full scale fire resistance test on a suspended ceiling. The test sponsor was British Gypsum Limited.

The test specimen was installed by the British Gypsum Limited. The construction of the specimen took place between the 13th and 14th January 2004. British Gypsum Limited designed and selected the materials comprising the test specimen.

The test was carried out on the 15th January 2004.

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, construction 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.

REPORT AUTHORISATION

Report Author	Authorised by
Robert Evans MEng. (Hons.), AMIMechE, AIFireE *Project Leader*	**Eur Ing. Paul Howard** BSc. (Hons.), CEng., MIOA *Head of Laboratory*

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TEST CONSTRUCTION

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

Two 254mm x 146mm x 31kg/m structural steel I beams were positioned at 1200mm centres, approximately 900mm from the frame edge, spanning the 4000mm length of the test frame.

Gypframe MF6A Perimeter Channel was fixed around the perimeter of the restraint frame, approximately 200mm below the joists, using 60mm fire resistant fixings at 600mm centres.

Gypframe MF12 Soffit Cleats were bolted to the underside of each I beam at 1200mm centres (forming 1200mm x 1200mm grids).

Gypframe MF8 Strap Hanger was fixed to each Gypframe MF12 Soffit Cleat using a Gypframe MF11 Nut and Bolt.

The primary grid was formed using Gypframe MF7 Support Channels fitted on the top flange of the Gypframe MF6A Perimeter Channel at 1200mm centres, running parallel to (and directly below) the I beams. The Gypframe MF7 Support Channels were extended by overlapping two sections by 150mm and fixing together with two Gypframe Wafer Head Jack-Point Screws.

The Gypframe MF7 Support Channel was fixed to each section of Gypframe MF8 Strap Hanger using two Gypframe Wafer Head Jack-Point Screws.

The secondary grid was formed below and perpendicular to the primary grid using Gypframe MF5 Ceiling Section at 450mm centres. The grids were joined together using Gypframe MF9 Connecting Clips.

The ceiling consisted of a double layer of 12.5mm Gyproc FireLine screw fixed to the Gypframe MF5 Ceiling Section as follows:

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

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

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

25mm thick Rockwool Marine Firebatt 825 was laid on top of the Gypframe MF5 Ceiling Sections and the joints coincided with the Gypframe MF5 Ceiling Sections.

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

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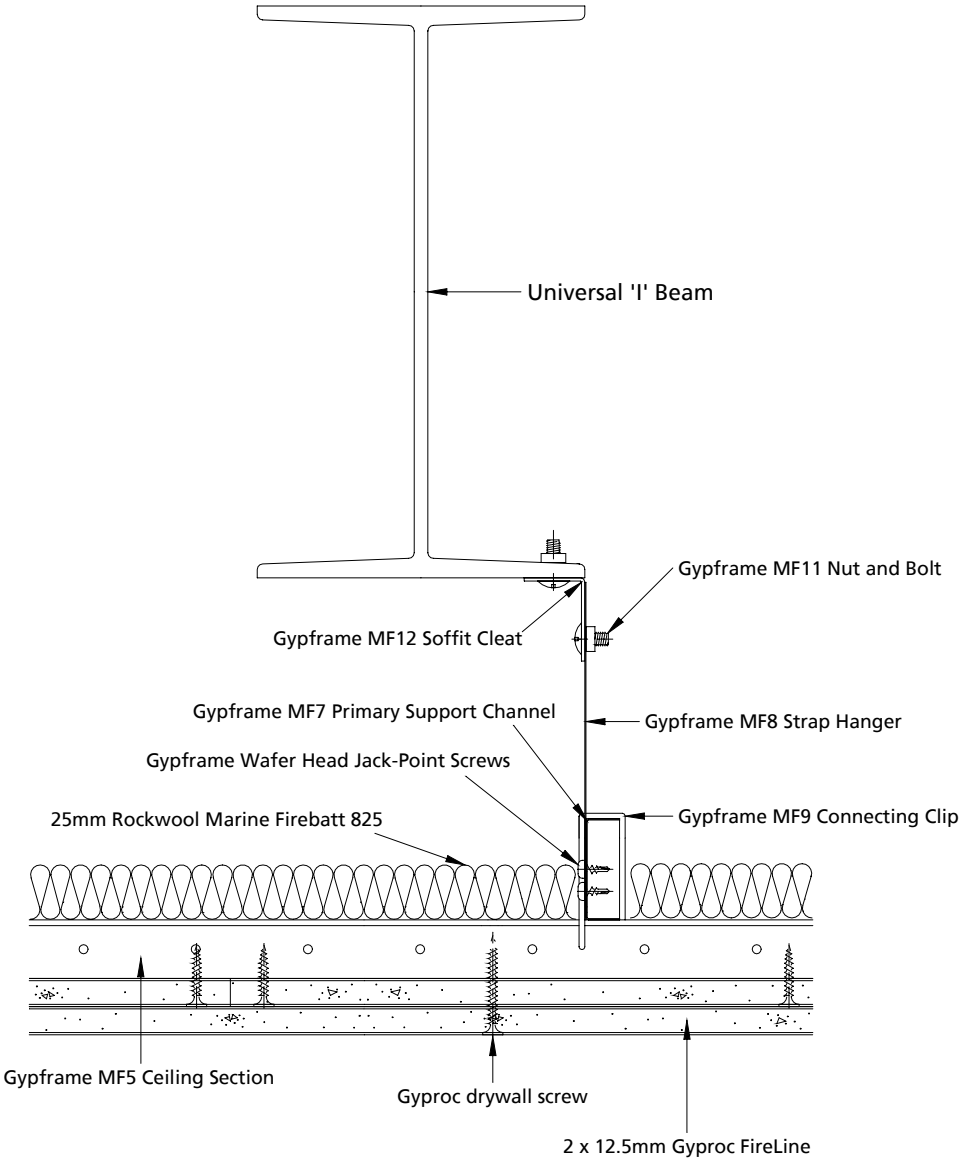

Figure 1. Cross-section of specimen showing British Gypsum CasoLine MF detail.

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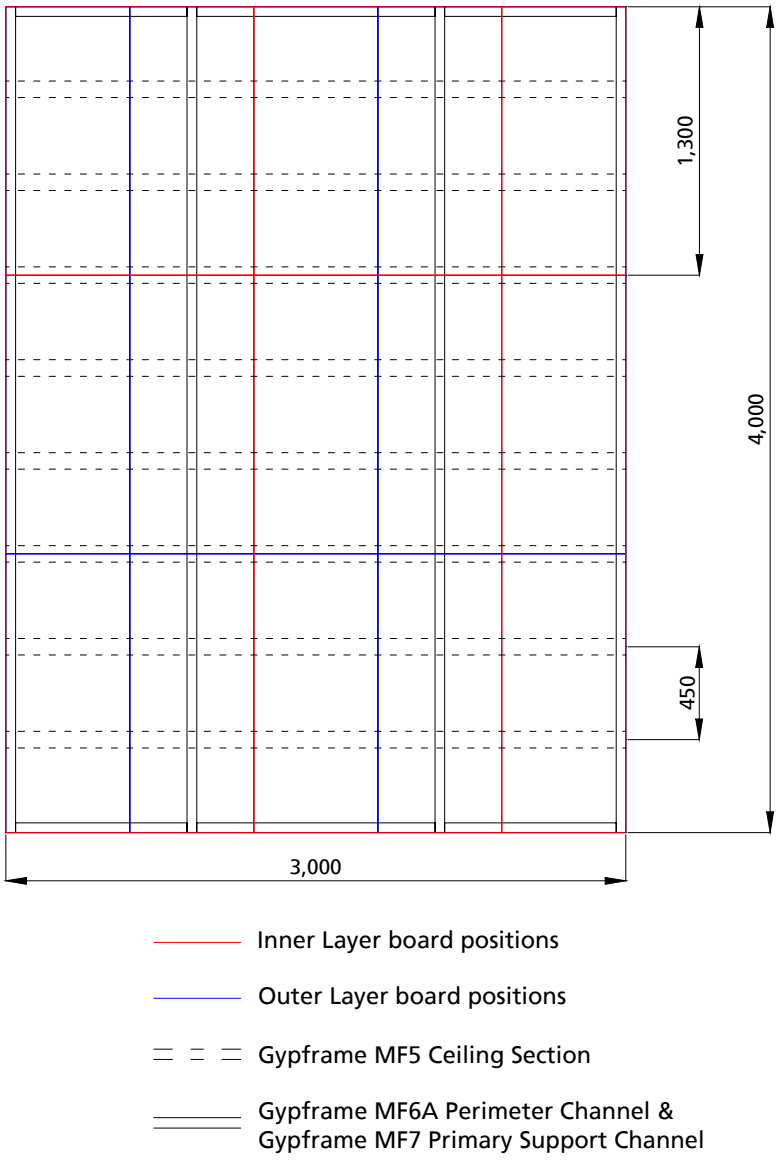

Figure 2. Board and ceiling grid layout.

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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TEST MATERIALS

Gyproc FireLine

Nominally, 3000mm (long) x 1200mm (wide) x 12.5mm (thick), Gyproc FireLine T/E manufactured and supplied by British Gypsum Limited, ex East Leake works.

Actual surface density:	10.09kg/m^2.
Actual thickness:	12.83mm.
Board identification numbers:	16 320 3 23:13
Actual moisture content:	0.84%

The surface density was calculated using the actual weight and size of a selection of the boards used in the test specimen. The moisture content of the plasterboard used in construction was established from measurements made using samples dried to a constant weight in an oven at 40°C.

Insulation Components

Nominally, 900mm (long) x 600mm (wide) x 25mm (thick), Rockwool Marine Firebatt 825, manufactured by Rockwool Limited and supplied by Sheffield Insulations Group plc.

Actual density:	104.4kg/m^3

The density was calculated using the actual weight and size of a selection of the insulation used in the test specimen.

Metal Components

i) Gypframe MF6A Perimeter Channel. Manufactured from galvanised mild steel.
ii) Gypframe MF5 Ceiling Section. Manufactured from galvanised mild steel.
iii) Gypframe MF7 Primary Support Channel. Manufactured from galvanised mild steel.
iv) Gypframe MF8 Strap Hanger. Manufactured from galvanised mild steel.
v) Gypframe MF9 Connecting Clip. Manufactured from galvanised mild steel.
vi) Gypframe MF12 Soffit Cleat. Manufactured from galvanised mild steel.
vii) Structural steel I beams.

All metal components, except vii) were supplied by British Gypsum Limited.

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Fixings

i) 25mm Gyproc drywall screws supplied by British Gypsum Limited.
ii) 42mm Gyproc drywall screws supplied by British Gypsum Limited.
iii) 13mm Gypframe Wafer Head Jack-Point Screws supplied by British Gypsum Limited.
iv) Gypframe MF11 Nuts and Bolts supplied by British Gypsum Limited.
v) 60mm fire resistant fixings.

Miscellaneous Components

i) Gyproc Joint Filler supplied by British Gypsum Limited.
ii) Gyproc Paper Tape supplied by British Gypsum Limited.

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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 procedure used was EN 1364-2 Issue 1.

The ambient temperature at the commencement of the test was 14°C.

The furnace pressure was set to control at 18 ±2 Pa positive with respect to atmosphere, at the top of the specimen, except during the first 5 minutes of the test.

The allowable tolerances are ±5 Pa from 5 minutes to 10 minutes and ±3 Pa from 10 minutes onwards. It is of the opinion of the laboratory that the variations in the furnace pressure exceeding the tolerances stated in BS EN 1363-1:1999 have not unduly influenced the results of this test. The furnace pressure graph is on page 17.

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 test centre is of the opinion that these deviations from the documented method will not unduly effect the result of the test.

TEST RESULTS

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

Integrity- Sustained flaming	**48 minutes**	No failure (test discontinued)
Integrity- Cotton pad	**48 minutes**	
Integrity - 25mm gap gauge	**48 minutes**	
Integrity- 6mm gap gauge	**48 minutes**	
Insulation	**47 minutes**	

The test was terminated at 48 minutes.

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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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TEST DATA

Observations

Observers: Unexposed face R Evans and L Cooper
Exposed face J McLavy

Time		*Observations* All observations refer to the exposed face unless otherwise stated.
hrs	mins	
	0	Test started.
	5	The face paper and jointing material had started to char.
	10	The jointing material and face paper continued to char.
	15	All exposed board joints had opened to approximately 1-2mm. The boards had sagged slightly between their fixings.
	20	All board joints had opened to approximately 2-3mm. All the jointing material had fallen into the furnace.
	25	All the board joints had opened to approximately 3-4mm. The boards had sagged approximately 5mm between fixings.
	27	All board joints had opened to approximately 7-8mm.
	30	All the board joints had opened to approximately 10-12mm. The boards had sagged approximately 10mm between fixings. *Unexposed face* The insulation slabs had sagged into the furnace between the metal frame sections.
	32	*Unexposed face* The volume of smoke issued from insulation joints had increased.

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Time		*Observations*
hrs	mins	All observations refer to the exposed face unless otherwise stated.
	35	No visible change in the specimen. *Unexposed face* Discolouration was visible on the insulation slab adjacent to the viewing platform, approximately 600mm from the right-hand side of the specimen.
	36	*Unexposed face* The joints in the insulation slabs had opened to approximately 5mm at mid-span of the specimen (approximately 2000mm from viewing platform).
	37	All boards had started to pull away from their fixings adjacent to the longitudinal joints. *Unexposed face* Discolouration was visible on the insulation slab approximately 3000mm from the viewing platform and approximately 600mm from the right-hand side of the furnace.
	40	All board joints had opened to approximately 10-15mm. *Unexposed face* Discolouration was visible at approximately mid-span of the specimen, approximately in line with the inner layer board joint. Discolouration was visible adjacent to the insulation joints noted at 36 minutes.
	42	The right-hand corners of the centreboards and the left-hand corners of the right-hand boards adjacent to the lateral board joint had bowed into the furnace by approximately 50mm. All board joints had opened to approximately 10-20mm. *Unexposed face* A gap developed between the second insulation slab from the viewing platform and the metal channel supported below the steel beam.

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Time		*Observations*
hrs	mins	All observations refer to the exposed face unless otherwise stated.
	44	A section, approximately 250mm x 1200mm, of the second row centreboard adjacent to the lateral board joint had fallen into the furnace. The left-hand corner of the second row right-hand board adjacent to the lateral board joint had fallen into the furnace. *Unexposed face* The discolouration approximately 600mm from the right-hand side of the specimen had spread over the entire length of the specimen.
	45	*Unexposed face* The insulation slabs in the centre of the specimen had bowed into the furnace.
	46	The inner layer board joints had opened to approximately 10mm where exposed.
	47	Sections of the centreboards and right-hand boards adjacent to the lateral board joint fell into the furnace. *Unexposed face* **INSULATION FAILURE.** The roving thermocouple exceeded a temperature rise of 180°C when placed approximately 1500mm from the viewing platform and approximately 750mm from the right-hand side of the specimen. Thermocouple no.23 also exceeded a temperature rise of 180°C. The cotton pad failed to ignite or glow when placed on the specimen. A glow was visible approximately 1500mm from the viewing platform and approximately 900mm from the right-hand side of the specimen.

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Time		*Observations*
hrs	mins	All observations refer to the exposed face unless otherwise stated.
	48	*Unexposed face* **INTEGRITY FAILURE.** The cotton pad ignited when placed approximately 1500mm from the viewing platform and approximately 900mm from the right-hand side of the specimen. **FURTHER INTEGRITY FAILURE.** 6mm x 150mm gap gauge would have entered the furnace through a gap at approximately 1500mm from the viewing platform and approximately 900mm from the right-hand side of the specimen. **FURTHER INTEGRITY FAILURE.** 25mm diameter gap gauge would have entered the furnace through a gap at approximately 1500mm from the viewing platform and approximately 900mm from the right-hand side of the specimen. **TEST TERMINATED.**

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Furnace Temperature Graph

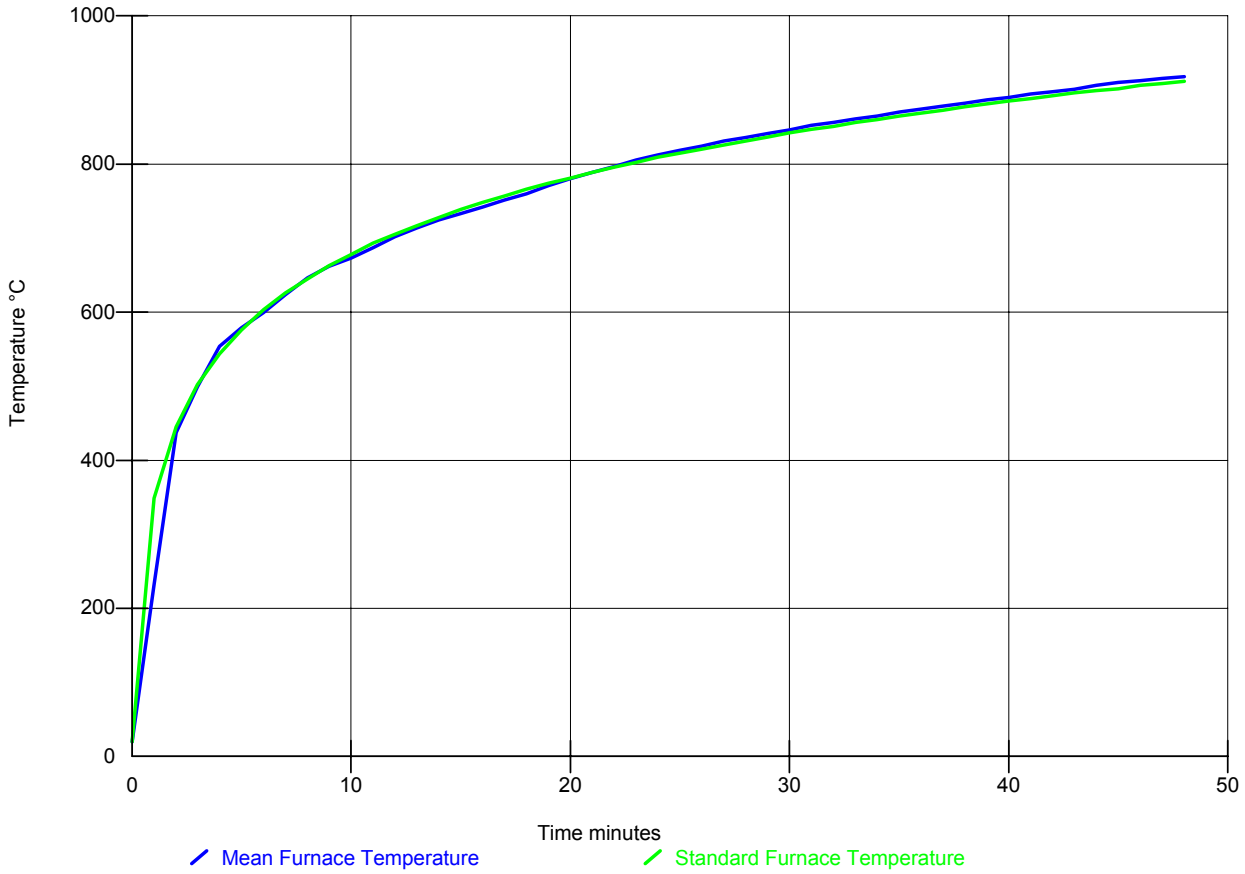

Figure 3. Furnace temperature graph.

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Furnace Pressure Graph

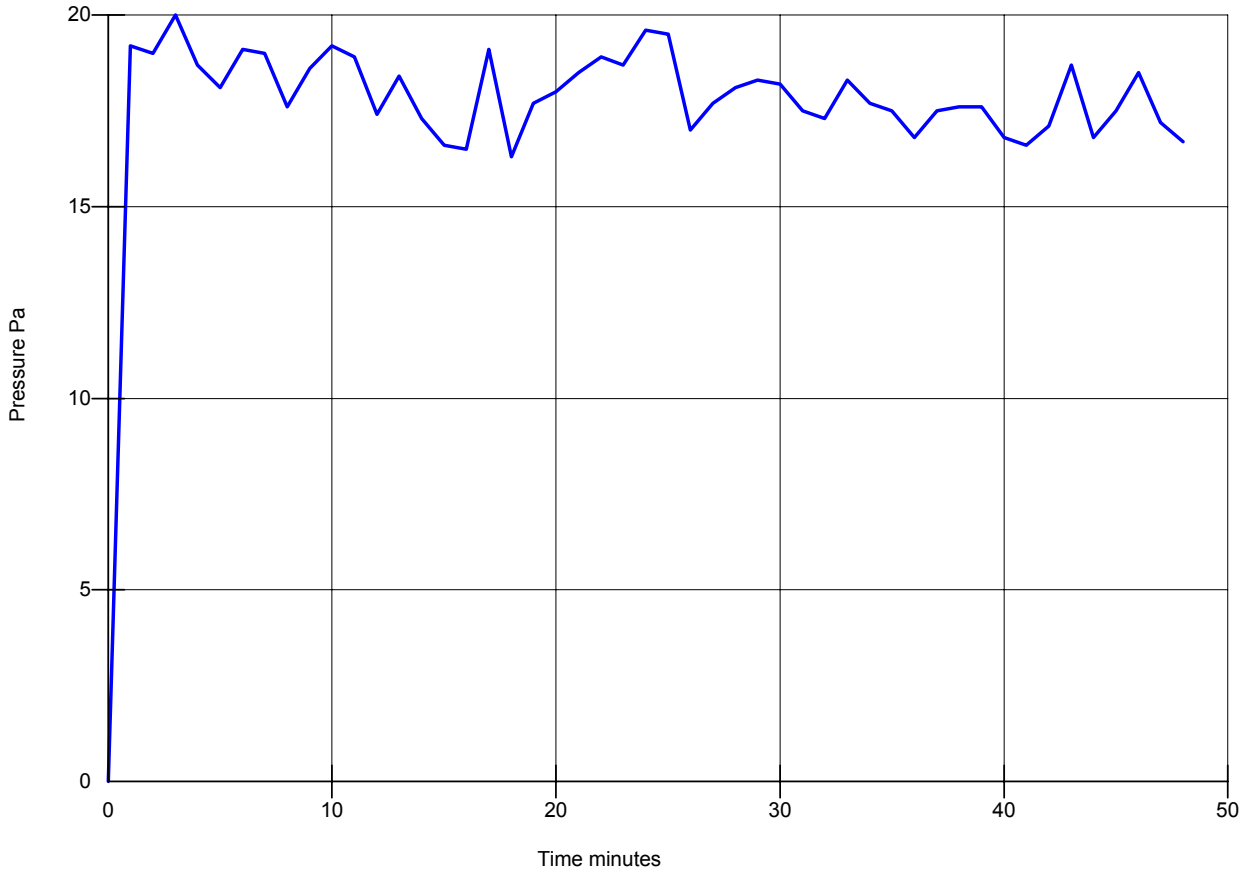

Figure 4. Furnace pressure graph.

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Unexposed Face Temperature Graph

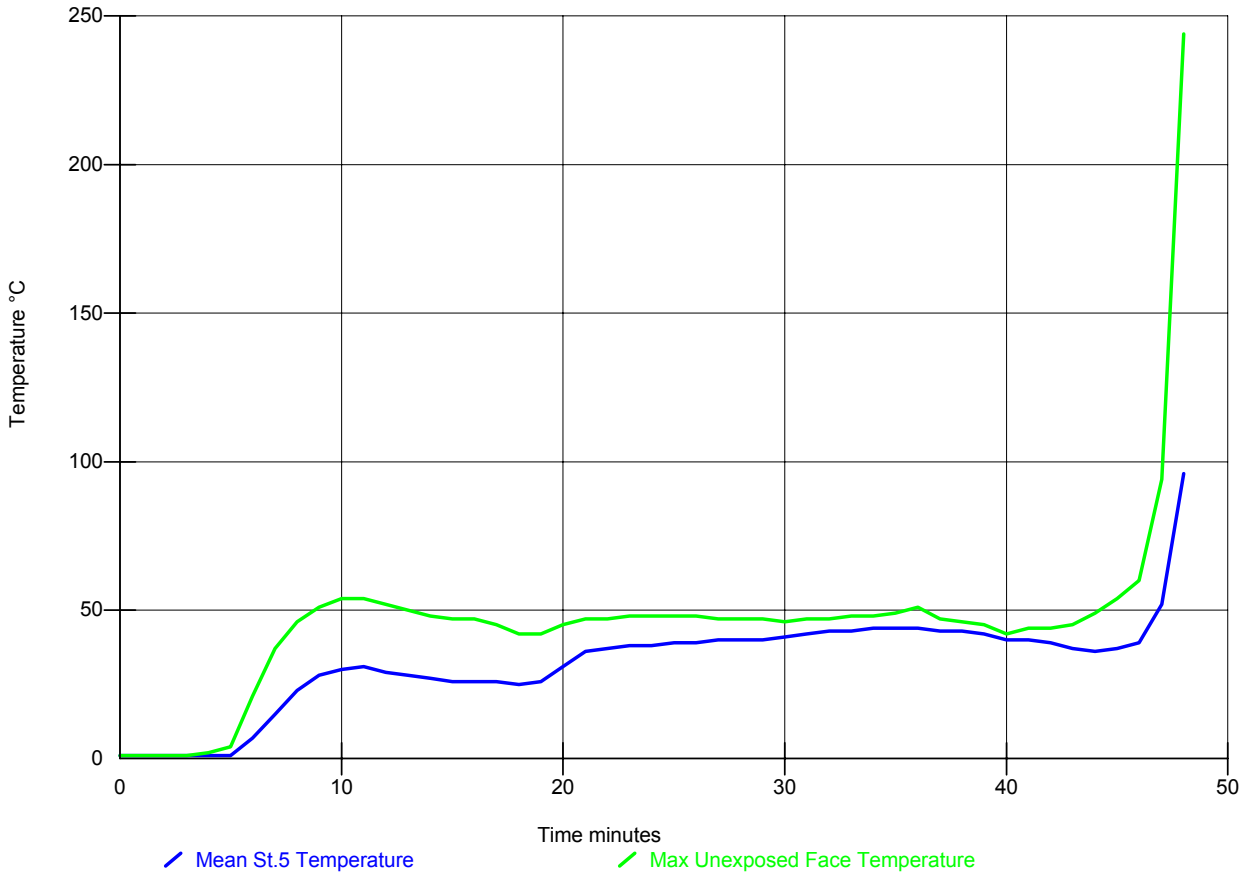

Figure 5. Unexposed face temperature graphs.

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Unexposed Face Thermocouple Layout

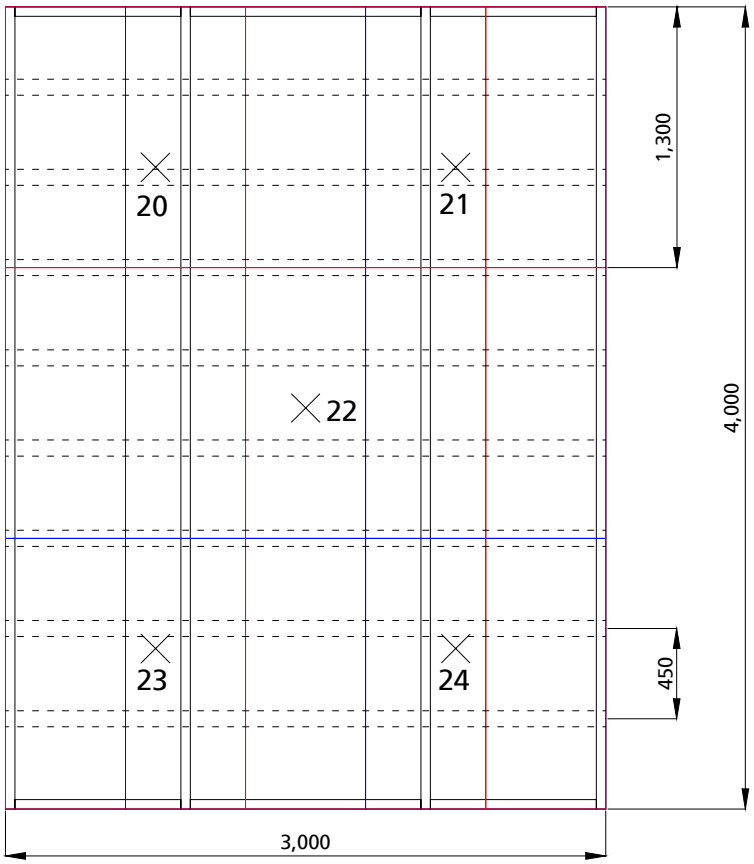

Figure 6. Unexposed face thermocouple layout.

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Unexposed Face Standard Five Thermocouple Data

Time (mins)	Temperature Rise (°C)				
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24
0	1	1	1	1	1
1	1	1	1	1	1
2	1	1	1	1	1
3	1	1	1	1	1
4	1	2	1	1	2
5	1	4	1	1	2
6	3	21	2	2	8
7	8	37	3	2	27
8	18	46	6	5	41
9	26	51	9	8	46
10	28	54	12	11	46
11	29	54	14	13	45
12	25	52	15	14	42
13	24	50	15	15	40
14	21	48	15	15	38
15	21	47	15	14	37
16	20	47	15	14	36
17	20	45	15	14	36
18	18	42	16	15	37
19	19	42	18	16	38
20	32	45	24	20	38
21	39	47	30	26	38
22	41	47	32	28	37
23	42	48	32	30	38
24	43	48	33	31	38
25	43	48	34	32	38
26	43	48	34	33	39
27	44	47	35	34	40
28	44	47	35	35	42
29	43	47	36	36	42
30	44	46	37	36	43
31	45	47	36	37	45
32	45	47	38	39	47
33	45	47	39	40	48
34	46	47	41	41	48

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Time (mins)	Temperature Rise (°C)				
	Thermocouple No. 20	Thermocouple No. 21	Thermocouple No. 22	Thermocouple No. 23	Thermocouple No. 24
35	45	46	43	40	49
36	45	45	43	39	51
37	44	44	43	41	47
38	45	43	42	41	46
39	43	42	45	40	44
40	41	40	40	41	42
41	40	38	40	41	44
42	38	36	38	41	44
43	36	34	34	38	45
44	34	33	32	36	49
45	32	32	34	35	54
46	29	34	36	37	60
47	29	36	36	94	68
48	30	38	39	244	133

See figure 6 for the location of the thermocouples.

Figures highlighted in red indicate time and position of insulation failure.

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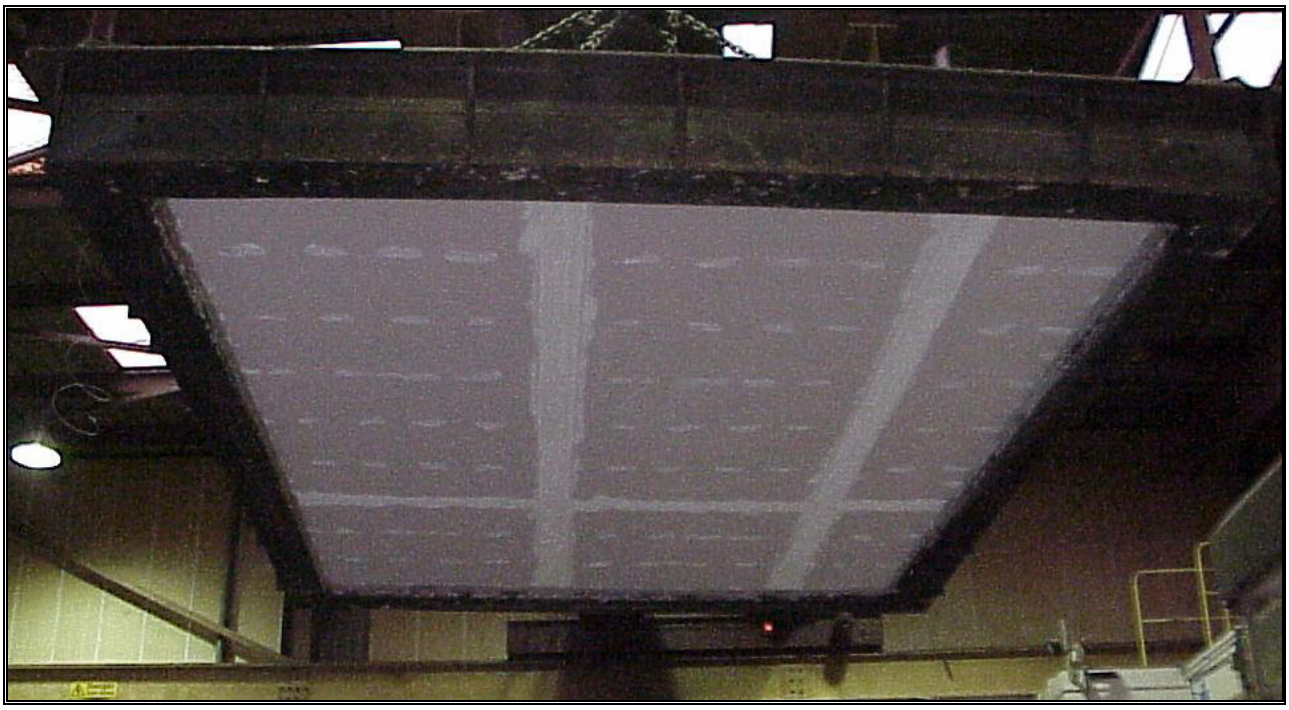
PHOTOGRAPHS



Photograph 1. Exposed face prior to test.

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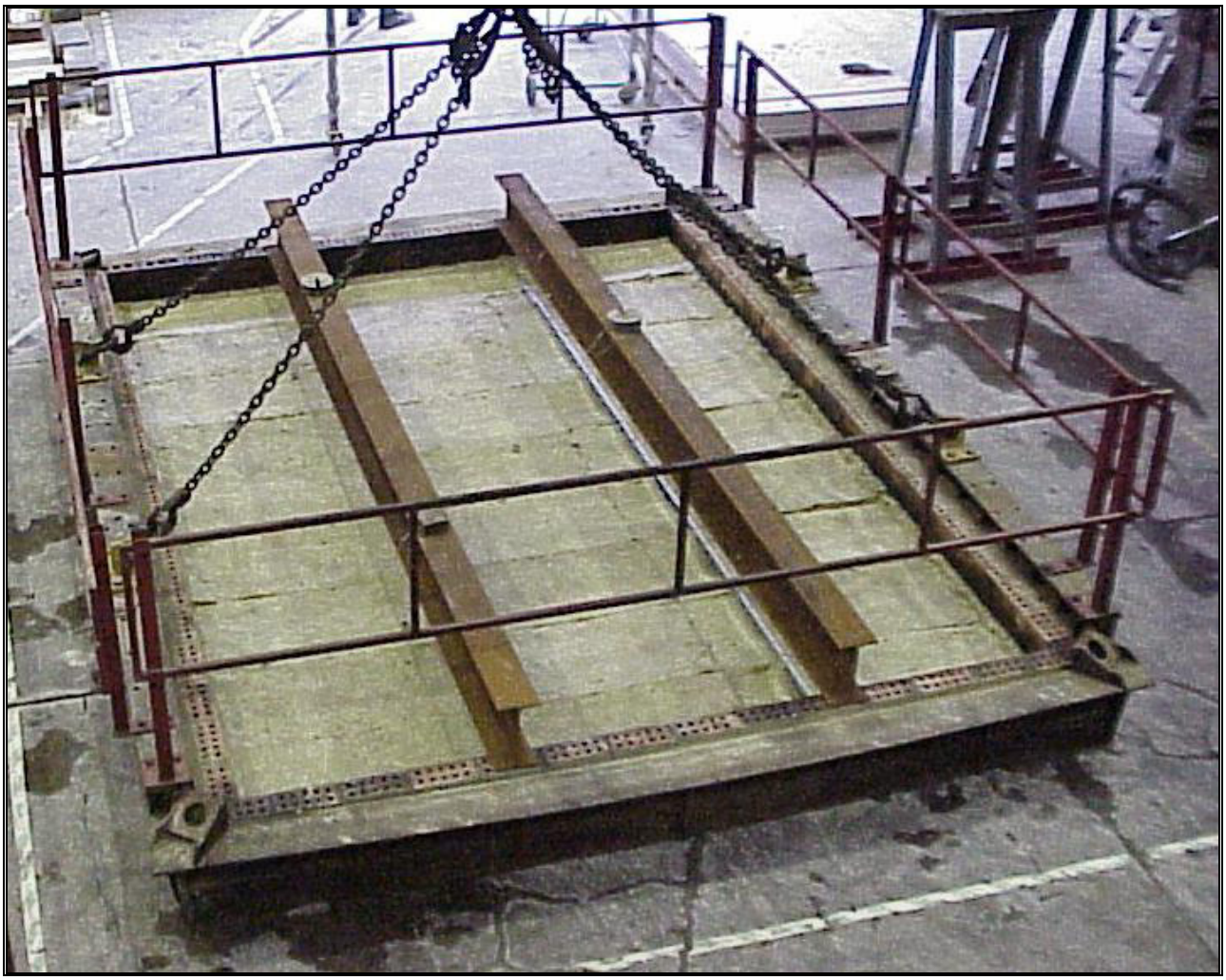

Photograph 2. Unexposed face prior to test.

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Photograph 3. Position of integrity failure at 48 minutes.

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FIELD OF DIRECT APPLICATION

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

Suspended ceilings with fire from below:

i) Size:

- Test results obtained on a (4 x 3) m, or greater, test specimen may be applied to ceilings of any dimension, provided that the distance between the suspension devices is not increased, and that provisions for expansion are increased accordingly.

ii) Fittings:

- Test results on ceilings containing fittings with their own suspension devices may be applied to ceilings containing such suspension devices provided the distribution does not exceed those tested.

iii) Cavity:

- The test results are valid for cavities of any height.