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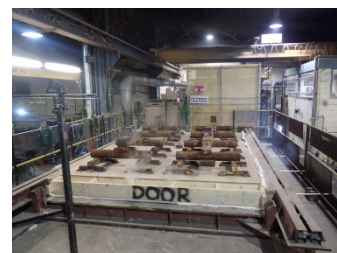
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Title:

The Fire Resistance
Performance of a
Loadbearing Timber Floor
Assembly Protected by a
Plasterboard Ceiling
Designed to Provide 90
minutes Fire Resistance,
Incorporating Four
Downlight Fittings, When
Tested Accordance with
BS EN 1365 - 2: 2014

WF Report No: 400398



Prepared for:

Orlight LTD
Victor Way,
Radlett Road,
Colney Street,
St Albans,
AL2 2FL

Date:

7th September 2018



Summary

Objective To determine the fire resistance performance of a loadbearing timber floor assembly protected by a plasterboard ceiling designed to provide 90 minutes fire resistance, incorporating four light fittings, when tested in accordance with BS EN 1365 - 2: 2014.

Sponsor **Orlight LTD**, Victor Way, Radlett Road, Colney Street, St Albans, AL2 2FL

Summary of Tested Assembly The timber floor had overall nominal dimensions of 4400 mm long by 3000 mm wide and comprised softwood timber joists at 600 mm centres. The upper surface of the floor comprised nominally 22 mm thick tongue and grooved chipboard flooring. The floor assembly was protected on its underside by a direct fixed ceiling, formed from three layers of 12.5 mm plasterboard referenced 'Gyproc Fireline Wallboard'.

The floor supported an evenly distributed load of 0.777 kN/m².

The ceiling incorporated 4 down lighter light fittings referenced as follows:

Test Ref.	Model Ref.	Type
A	Tempus – Mini	Compact 3W Recessed LED Downlight
B	Tempus	Compact 7W Recessed LED Downlight
C	SHP105	Fixed Solid State Downlight
D	MTG21	Fixed Downlight

Test Results:

Loadbearing Capacity	90 minutes*
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Integrity Performance

Sustained flaming	90 minutes*
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Gap gauge	90 minutes*
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Cotton pad	90 minutes*
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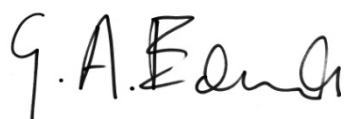
Insulation	90 minutes*
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*The test duration. The test was discontinued after a period of 90 minutes.

Date of Test 25th July 2018

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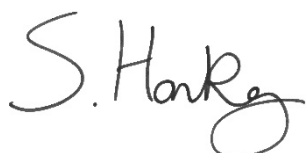
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* For and on behalf of **Exova Warringtonfire**.

Report Issued

Date : 7th September 2018

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Test Procedure

Introduction

The specimen tested was of a loadbearing timber floor construction protected by a direct fix ceiling assembly. The test was conducted in accordance with BS EN 1365-2: 2014, 'Fire resistance tests for loadbearing elements – Part 2: Floors and Roofs'. This test report should be read in conjunction with that Standard and with BS EN 1363-1: 2012, 'Fire resistance tests part 1, general requirements' and BS EN 1363-2: 1999, 'Fire resistance tests part 2, alternative and additional procedures'.

The purpose of the test was to evaluate the performance of a timber floor construction protected by a ceiling of known fire resistance, when incorporating down lighter light fitting assemblies.

The specimen was judged on its ability to comply with the performance criteria for loadbearing capacity, integrity and insulation, as required by BS EN 1365-2: 2014.

Fire Test Study Group/EGOLF

Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.

Instruction To Test

The test was conducted on the 25th July 2018 at the request of **Orlight LTD**, the test sponsor.

Mr. P. Burke, a representative of the test sponsor witnessed the test.

Test Assembly Construction

A comprehensive description of the test construction is given in the Schedule of Components. The description is based on a detailed survey of the specimen light fittings and information supplied by the sponsor of the test.

Installation

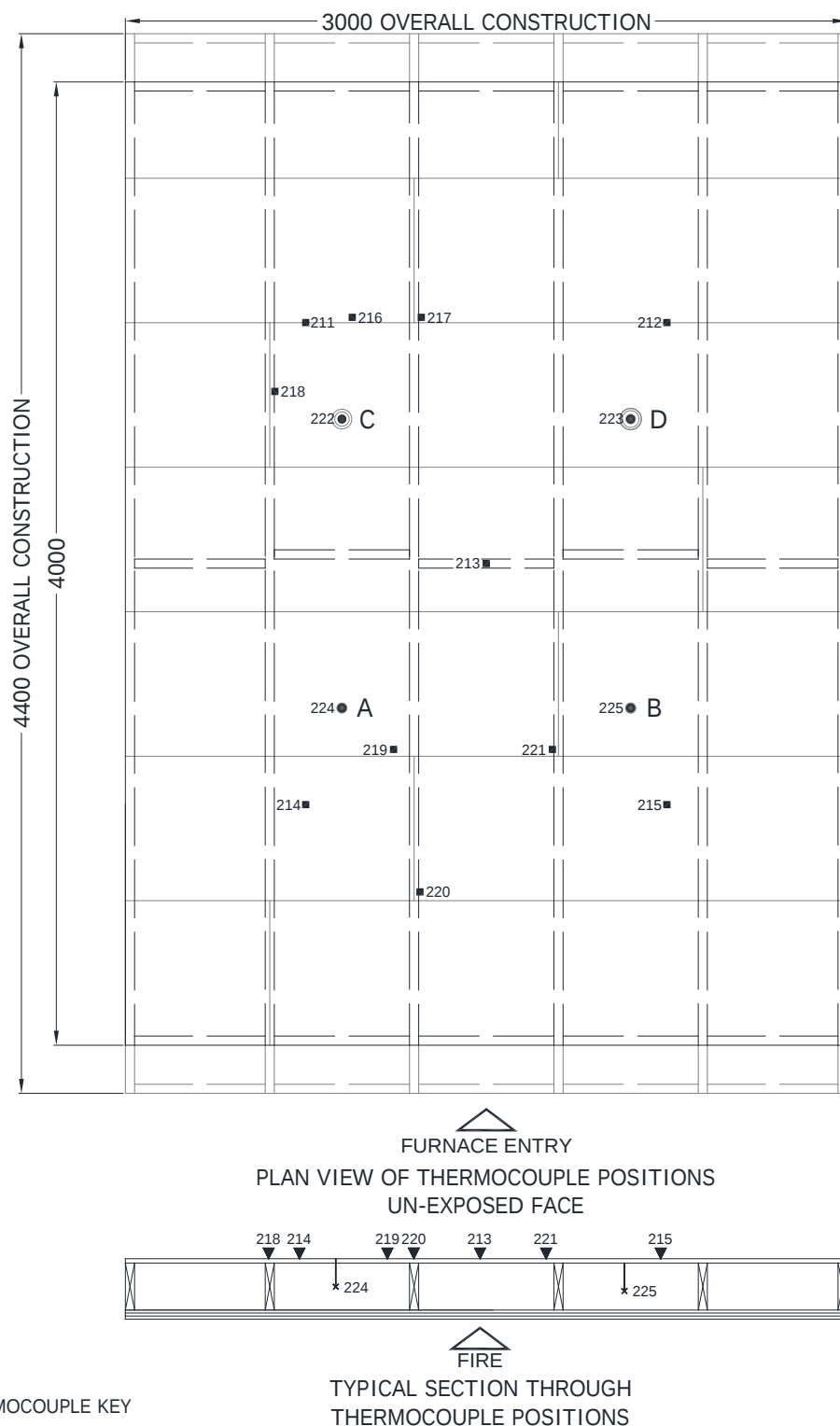
Representatives of **Exova Warringtonfire** assembled the floor construction and installed the downlighters between the 18th and the 25th July 2018.

Conditioning

The specimens' storage, construction, and test preparation took place in the test laboratory over a total combined time of 8 days. Throughout this period of time both the temperature and the humidity of the laboratory were measured and recorded as being within a range of from 18°C to 29.5°C and 35.5% to 75.5% respectively.

Test Construction

Figure 1- Plan View of Thermocouple Positions on the Unexposed Face

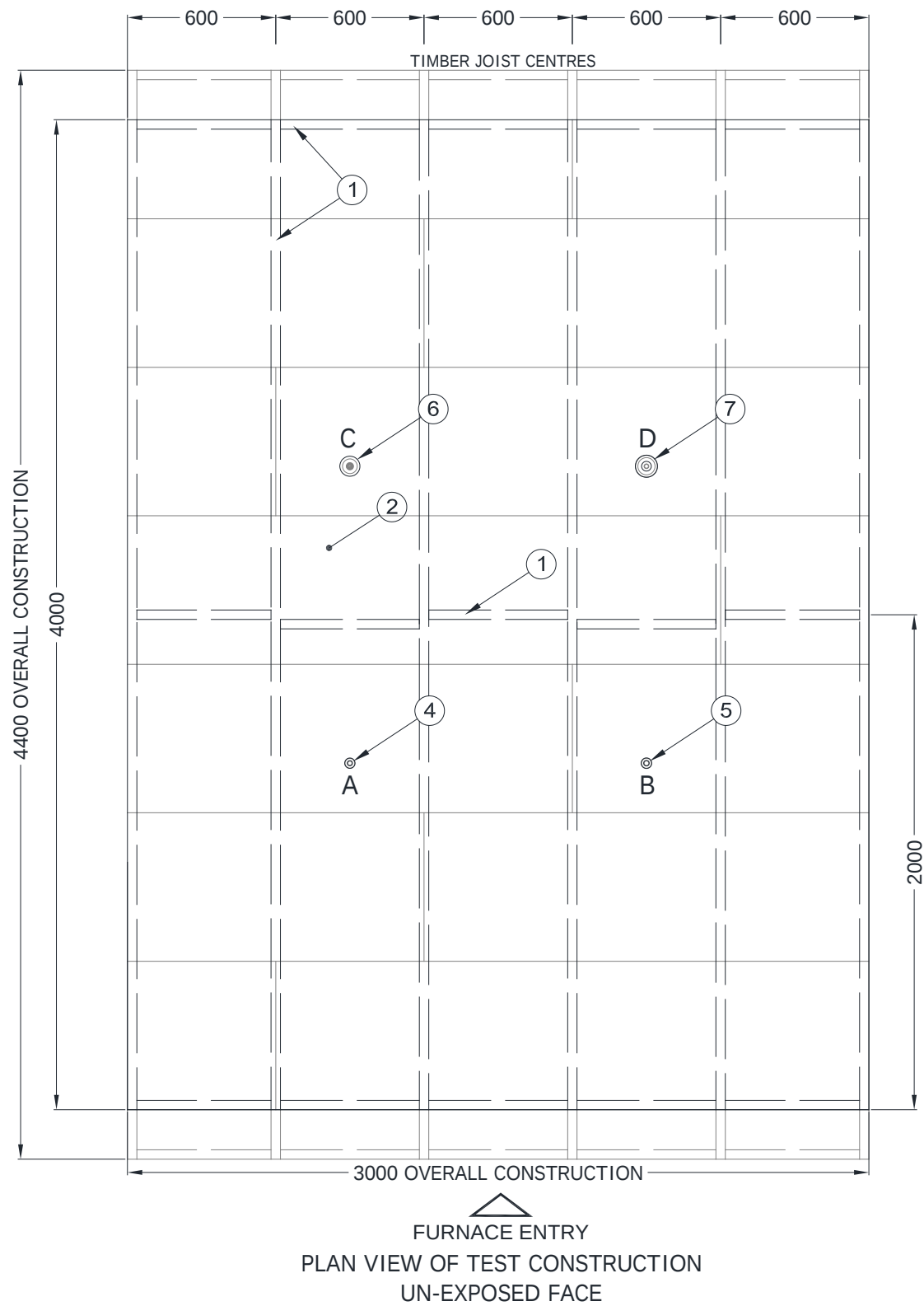


THERMOCOUPLE KEY

- /▲ Positions of surface thermocouples
- Positions of internal mineral insulated thermocouples

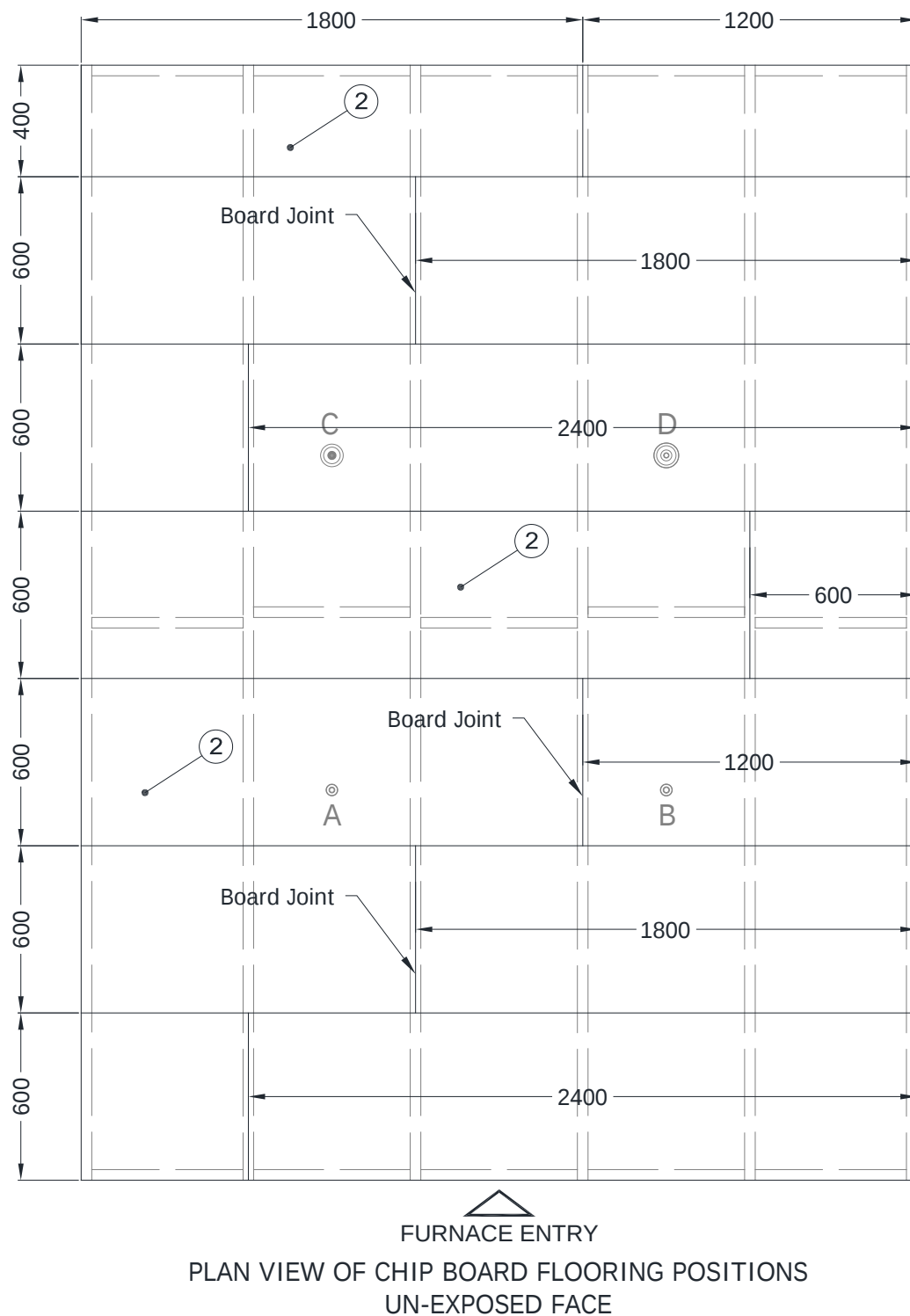
Do not scale. All dimensions are in mm

Figure 2 – Plan View of Test Construction – Un-Exposed Face



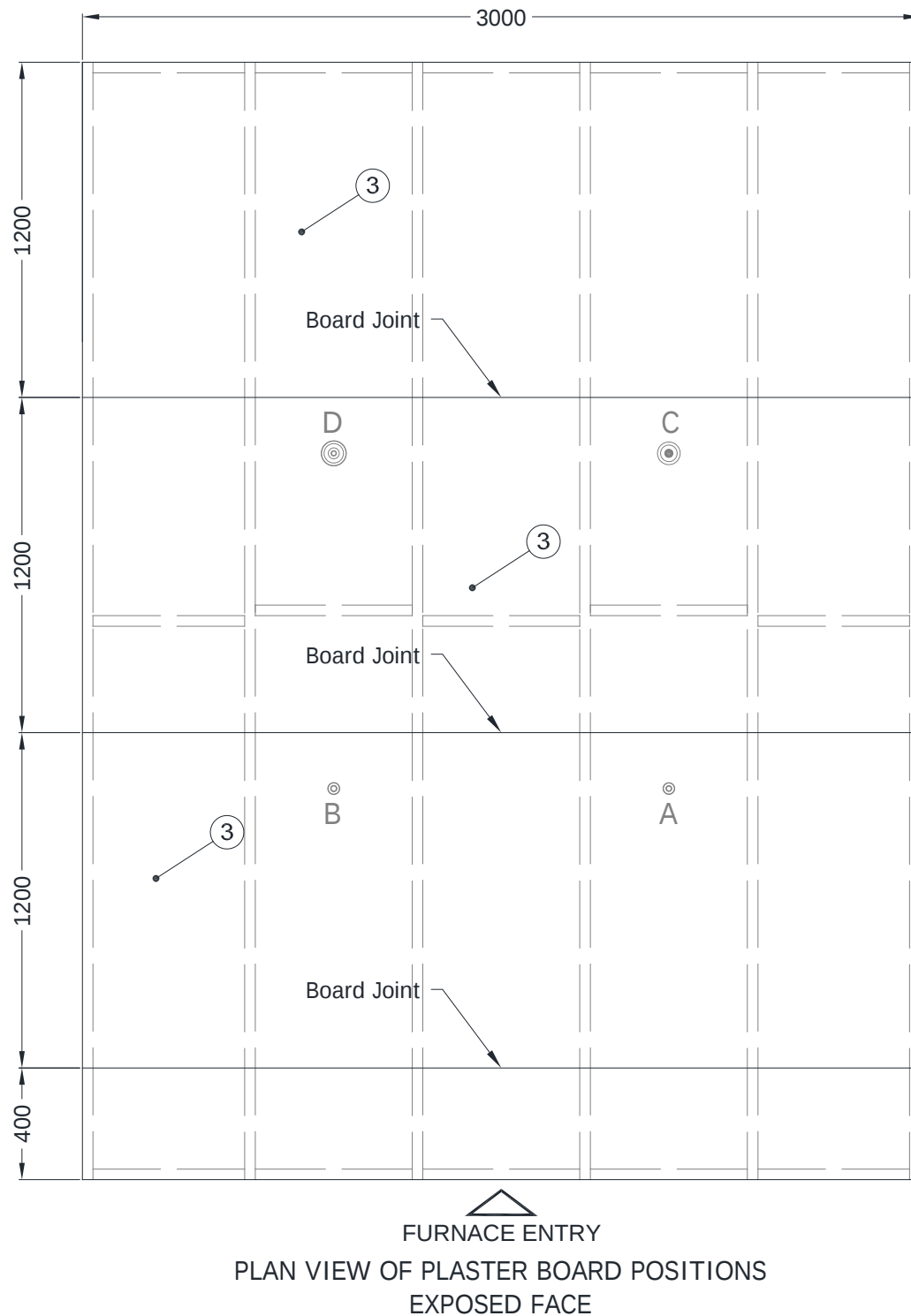
Do not scale. All dimensions are in mm

Figure 3 – Plan View of Chip Board Flooring Positions – Un-Exposed Face



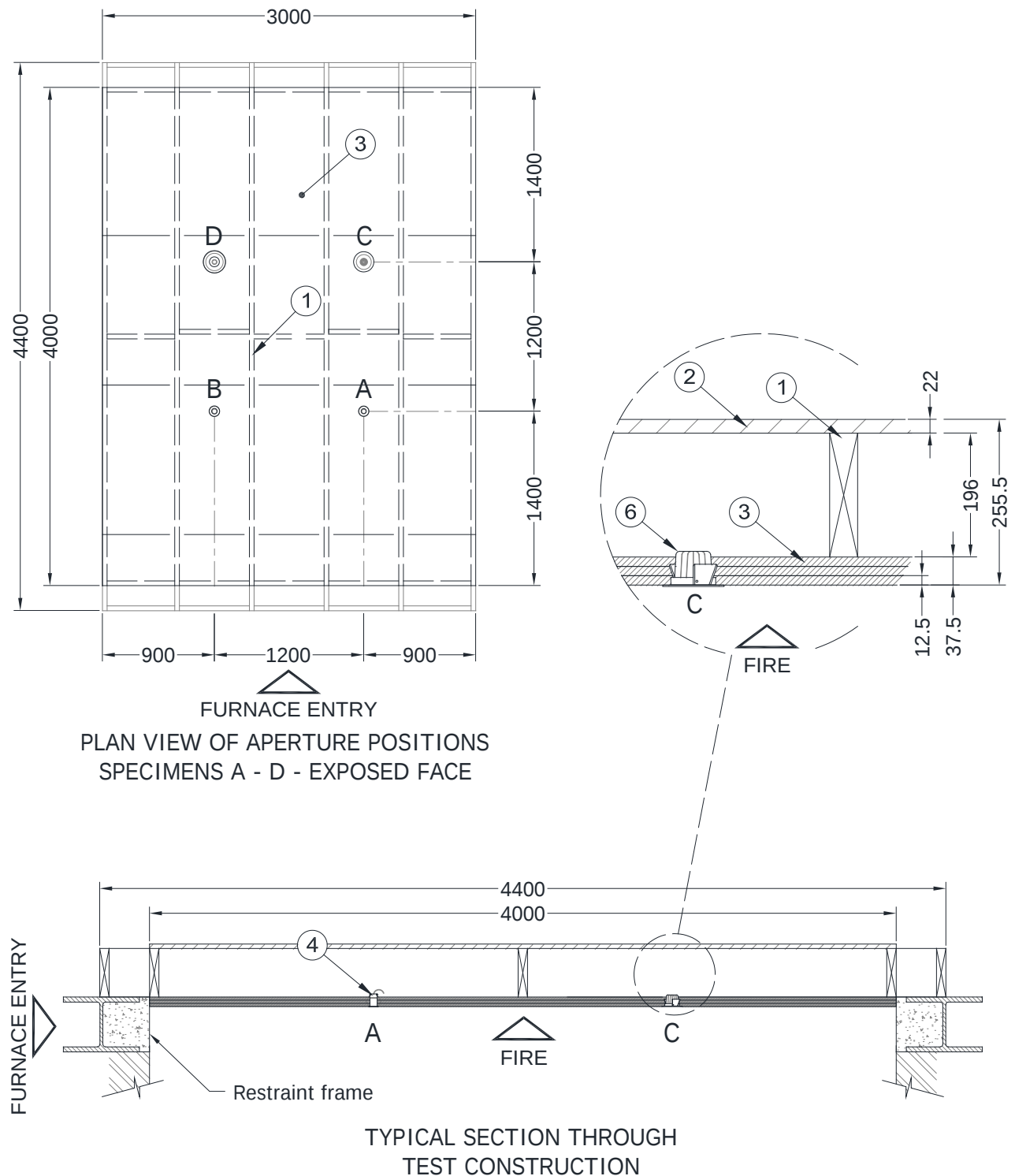
Do not scale. All dimensions are in mm

Figure 4 – Plan View of Plaster Board Ceiling Positions – Exposed Face



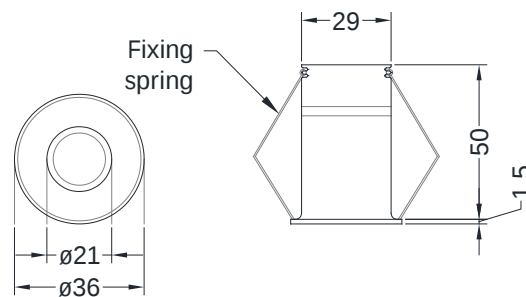
Do not scale. All dimensions are in mm

Figure 5 – Details of Test Construction

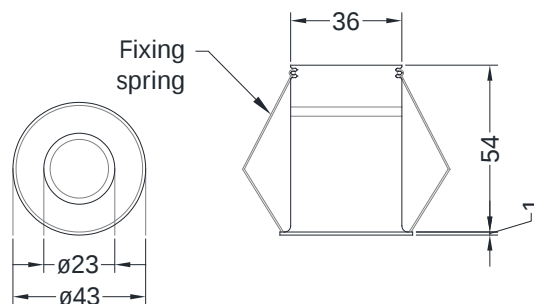


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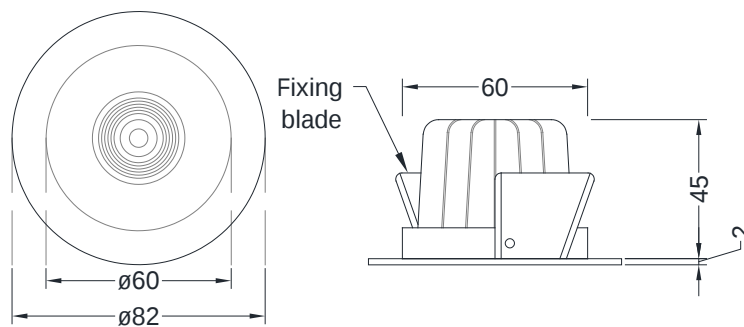
Figure 6 – Details of Downlight Specimens



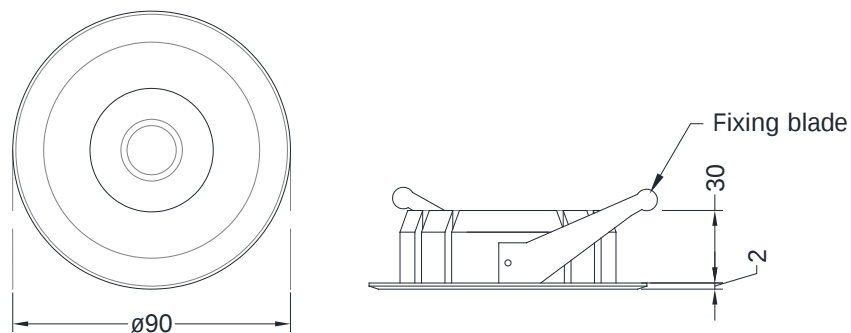
ITEM 4 : Specimen A - Tempus-Mini Compact 3W Recessed Led



ITEM 5 : Specimen B - Tempus Compact 7W Recessed Led



ITEM 6 : Specimen C - SHP105 - Fixed Solid State Downlight



ITEM 7 : Specimen D - MTG21 - Fixed Downlight

Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 6)
(All values are nominal unless stated otherwise)

Item	Description
1. Timber Frame	
Manufacturer	: Vida Wood UK Ltd.
Material	: Softwood, Grade C16.
Section Size	: 196 x 44 mm.
Surface Finish	: Planed all round.
Fixing Method	: 4400 mm joists placed at 600 mm centres with full depth noggins fixed at either end and at mid-span of the test construction
Fixings	
i. manufacturer	: SFD Ltd
ii. type	: Round wire bright nails
iii. material	: Galvanised steel
iv. size	: 4.5 x 100 mm
2. Tongue and Groove Timber Flooring	
Reference	: Caber Floor FSC E1 P5.
Material	: Flooring grade tongue and groove chipboards.
Thickness	: 22 mm
Supplied Board Length	: 2400 mm
Fixing Method	: Fixed in a single layer with 4 mm diameter x 65 mm long countersunk steel screws to floor joists at 300 mm centres.
3. Ceiling Boards	
Manufacturer	: British Gypsum
Type	: Gyproc Fireline Wallboard, Type F to EN 520
Board size	: 1200 x 3000 mm
Thickness	: 12.5 mm
Density	: 680 kg/m ³ (stated)
Fixing method	: The boards were screw fixed to the soffit of the joists with all joints staggered with respect to those of the other layers
Fixings	
i. manufacturer	: British Gypsum
ii. type	: Drywall screw
iii. material	: Galvanised steel
iv. size	: 25 mm
Centres	
v. perimeter of floor	: 150 mm.
vi. inner field of boards	: 300 mm - screws staggered on board joints.
Joint Tape	
vii. manufacturer	: Gyproc Joint Tape
viii. reference	: Plasterboard scrim tape
Joint Filler	
ix. manufacturer	: Gyproc
x. reference	: Gyproc Promix
xi. description	: Gypsum based material for filling and finishing joints in plasterboard systems. All screw heads spotted with Gyprock Promix.

Item	Description
4. Specimen A	
Manufacturer	: ORLIGHT Ltd
Reference	: Tempus - Mini
Type	: Compact 3W Recessed LED Downlight
Overall dimensions	
i. overall	: 50 mm x 29 mm - See Figure 6 for details
ii. cut out size	: 32 mm diameter
iii. lens aperture	: 21 mm diameter
iv. bezel	: 36 mm diameter
5. Specimen B	
Manufacturer	: ORLIGHT Ltd
Reference	: Tempus
Type	: Compact 7W Recessed LED Downlight
Overall dimensions	
i. overall	: 54 mm x 36 mm - See Figure 6 for details
ii. cut out size	: 38 mm diameter
iii. lens aperture	: 23 mm diameter
iv. bezel	: 43 mm diameter
6. Specimen C	
Manufacturer	: ORLIGHT Ltd
Reference	: SHP105
Type	: Fixed Solid State Downlight
Overall dimensions	
i. overall	: 45 mm x 60 mm - See Figure 6 for details
ii. cut out size	: 68 mm diameter
iii. lens aperture	: 60 mm diameter
iv. bezel	: 82 mm diameter
7. Specimen D	
Manufacturer	: ORLIGHT Ltd
Reference	: MTG21
Type	: Fixed Downlight
Overall dimensions	
i. overall	: 30 mm x 70 mm - See Figure 6 for details
ii. cut out size	: 76 mm diameter
iii. lens aperture	: 70 mm diameter
iv. bezel	: 90 mm diameter

Instrumentation

General	The instrumentation was provided in accordance with the requirements of the Standard.
Furnace	The furnace was controlled so that its mean temperature complied with the requirements of BS EN 1363-1: 2012, using eight plate thermometers distributed over a plane 100 mm from the underside of the test construction.
Thermocouple Allocation	Thermocouples were provided to monitor the unexposed surface of the floor assembly and the output of all instrumentation was recorded at no less than one minute intervals as follows:
Thermocouples 211 to 215	At five positions on the unexposed surface of the floor assembly, one approximately at the centre and one at approximately the centre of each quarter section.
Thermocouples 216 to 221	At six positions on the unexposed surface of the floor assembly, positioned adjacent to joints in the floor boarding.
Thermocouples 222 to 225	At four positions in the air cavity of the floor assembly, adjacent to the light fittings. The locations and reference numbers of the various unexposed surface and internal thermocouples are shown in Figure 1.
Roving Thermocouple	A roving thermocouple was available to measure temperatures on the unexposed surface of the specimen at any position which might appear to be hotter than the temperatures indicated by the fixed thermocouples.
Furnace Pressure	After the first five minutes of testing and for the remainder of the test. The calculated pressure differential relative to the laboratory atmosphere 100 mm away from the underside of the assembly was 20(+0, -5) Pa between 5 and 10 minutes of testing and 20(+0, -3) Pa after 10 minutes of testing and for the remainder of the test.
Loadbearing Capacity Criteria	Linear deflection transducer was provided at the approximate centre on the unexposed surface of the specimen to record its vertical deflection.
Integrity Criteria	Cotton pads and gap gauges were available to evaluate the integrity of the floor assembly.

Test Observations

Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	
00	00	Test commences.
24	00	Slight amount of steam release from the end of the floor.
30	00	The floor is maintaining its loadbearing capacity, integrity and insulation.
35	00	The ceiling is radiating an orange colour.
50	00	No visible evidence of the light fittings falling away from the ceiling.
55	00	No visible significant changes to the unexposed face of the floor.
60	00	The floor is maintaining its loadbearing capacity, integrity and insulation.
76	00	The first layer of the plasterboard is rippling and cracking on the exposed face.
80	00	Smoke release increases slightly but is still only minor.
90	00	The floor assembly incorporating the light fitting is maintaining its loadbearing capacity, integrity and insulation. There is no visible evidence of the light fittings causing detriment to the ceiling.

Test Photographs

The unexposed face of the partition prior to the start of the test



The unexposed face of the assembly after a test duration of 64 minutes



The unexposed face of the assembly after a test duration of 90 minutes



The exposed face of the ceiling assembly immediately after the test



Temperature & Deflection Data

Mean furnace temperature, together with the temperature/time relationship specified in the Standard

Time Mins	Specified Furnace Temperature Deg. C	Actual Furnace Temperature Deg. C
0	20	31
3	502	653
6	603	597
9	663	660
12	706	697
15	739	731
18	766	768
21	789	789
24	809	808
27	826	823
30	842	848
33	856	862
36	869	875
39	881	886
42	892	898
45	902	908
48	912	917
51	921	924
54	930	933
57	938	939
60	945	949
63	953	957
66	960	960
69	966	961
72	973	968
75	979	976
78	985	981
81	990	987
84	996	992
87	1001	997
90	1006	998

Individual and mean temperatures recorded on the unexposed surface of the floor assembly

Time Mins	T/C Number 211 Deg. C	T/C Number 212 Deg. C	T/C Number 213 Deg. C	T/C Number 214 Deg. C	T/C Number 215 Deg. C	Mean Temp Deg. C
0	24	24	24	24	27	25
3	24	24	24	24	27	25
6	24	24	24	24	27	25
9	24	24	24	24	27	25
12	24	25	24	24	27	25
15	25	27	24	25	28	26
18	26	29	24	26	29	27
21	29	32	25	28	31	29
24	31	35	26	30	33	31
27	35	38	27	33	35	34
30	38	41	28	35	38	36
33	42	44	29	37	40	38
36	45	46	30	39	42	40
39	48	49	31	41	44	43
42	50	51	33	43	45	44
45	52	52	34	44	47	46
48	53	54	35	45	48	47
51	53	55	36	46	49	48
54	54	56	37	47	50	49
57	54	57	38	48	51	50
60	55	58	39	48	51	50
63	55	59	40	49	52	51
66	56	59	41	49	52	51
69	56	59	42	49	53	52
72	56	60	43	50	53	52
75	57	60	44	50	54	53
78	58	60	45	51	54	54
81	58	60	45	51	54	54
84	59	61	46	51	55	54
87	59	61	47	51	55	55
90	59	61	47	51	55	55

Individual temperatures recorded adjacent to joints in the flooring

Time Mins	T/C Number 216 Deg. C	T/C Number 217 Deg. C	T/C Number 218 Deg. C	T/C Number 219 Deg. C	T/C Number 220 Deg. C	T/C Number 221 Deg. C
0	25	27	26	27	27	27
3	25	27	26	27	27	27
6	25	27	26	27	27	27
9	25	27	26	27	27	27
12	26	27	27	28	27	27
15	26	28	27	29	27	27
18	28	30	28	33	27	28
21	31	34	29	37	28	29
24	35	38	31	42	28	30
27	40	42	33	46	29	32
30	44	46	37	51	30	34
33	49	50	41	56	32	36
36	52	53	45	59	33	39
39	54	55	47	62	35	41
42	56	56	48	63	36	43
45	56	56	49	64	37	44
48	56	56	50	65	39	45
51	56	56	50	65	40	47
54	56	57	51	65	41	49
57	57	57	52	66	43	51
60	58	58	53	66	44	52
63	58	58	55	67	45	54
66	59	59	56	67	46	56
69	59	59	58	67	47	57
72	60	60	59	67	48	58
75	61	60	60	68	49	59
78	61	61	61	68	50	59
81	62	61	62	68	50	60
84	62	61	63	68	51	60
87	62	62	63	68	51	60
90	62	62	64	67	52	60

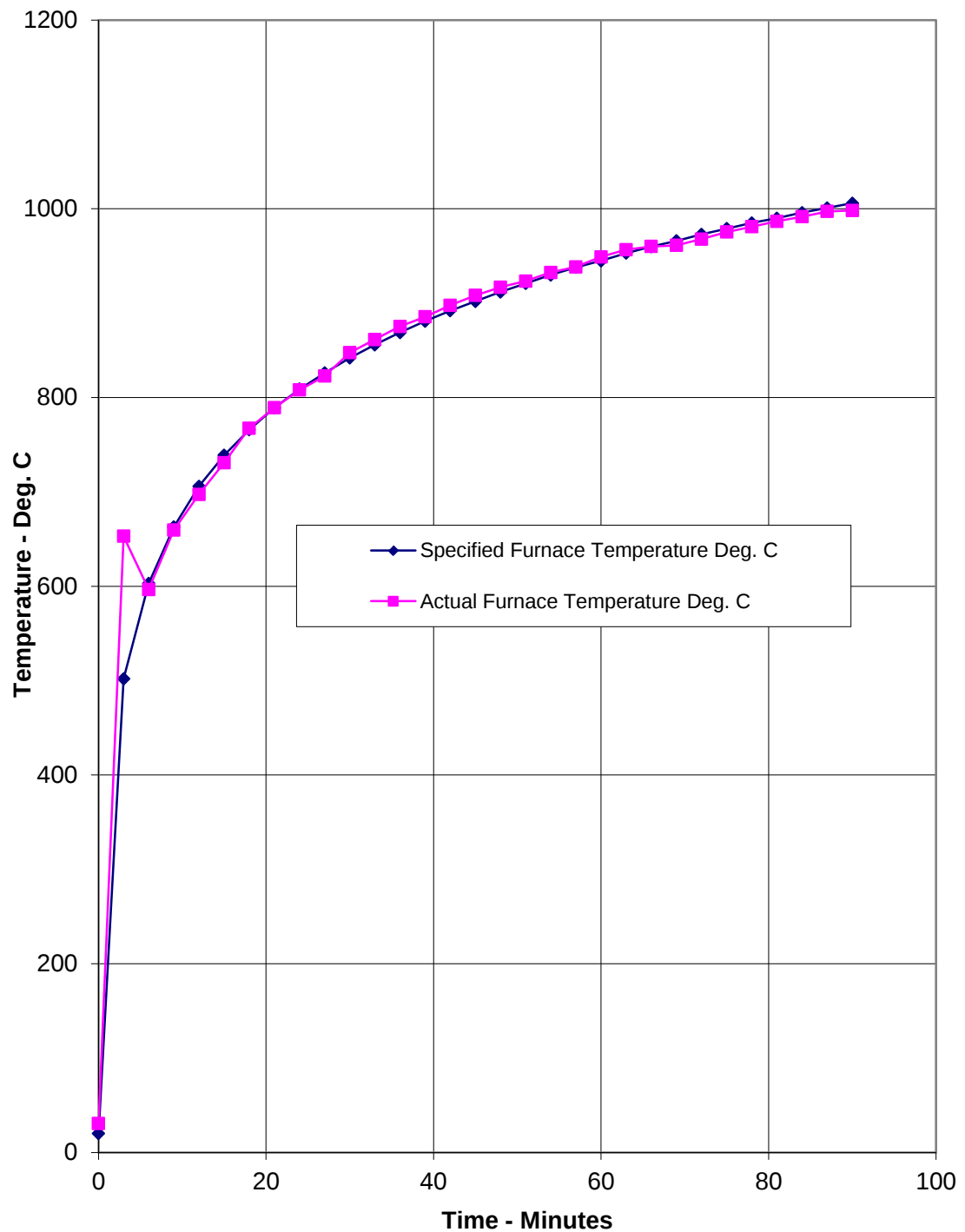
Individual temperatures recorded in the air cavity adjacent to the lights

Time Mins	T/C Number 222 Deg. C	T/C Number 223 Deg. C	T/C Number 224 Deg. C	T/C Number 225 Deg. C
0	26	26	27	27
3	26	27	27	28
6	28	47	30	40
9	38	96	40	47
12	54	118	56	58
15	70	123	71	69
18	80	215	76	77
21	87	230	82	85
24	93	224	86	90
27	96	166	89	92
30	102	153	91	97
33	99	163	93	104
36	99	157	103	108
39	99	175	104	113
42	99	206	104	116
45	100	231	105	123
48	102	248	106	204
51	104	240	107	169
54	106	241	108	141
57	108	220	109	125
60	108	203	108	126
63	110	189	107	127
66	110	171	108	125
69	111	167	108	129
72	111	168	110	123
75	112	162	112	123
78	114	181	113	118
81	118	181	116	124
84	126	192	123	134
87	138	211	133	149
90	153	240	147	172

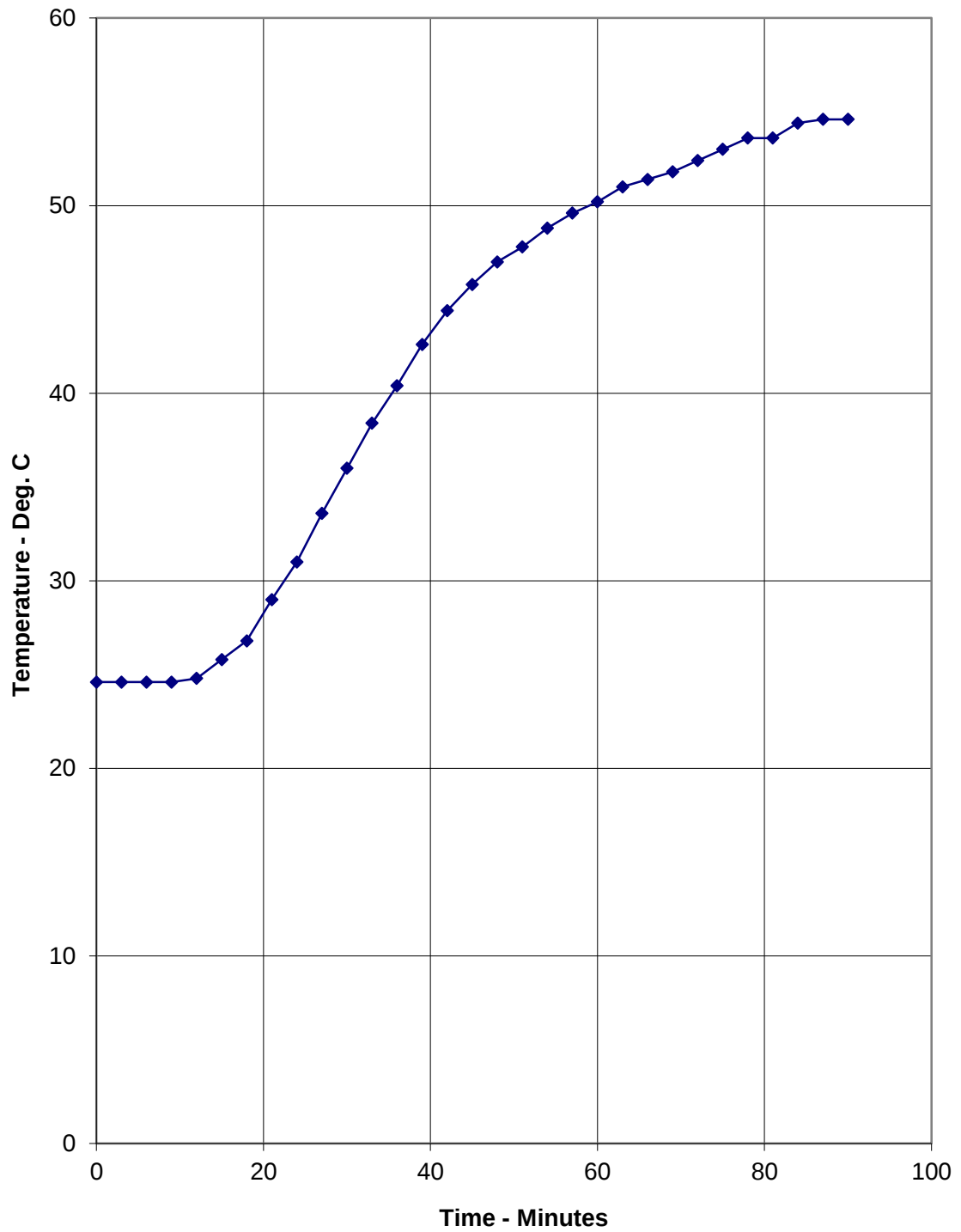
Deflection of the floor assembly during the test

Time Mins	Central Vertical Deflection mm
0	0
10	3
20	4
30	6
40	9
50	11
60	13
70	14
80	15
90	18

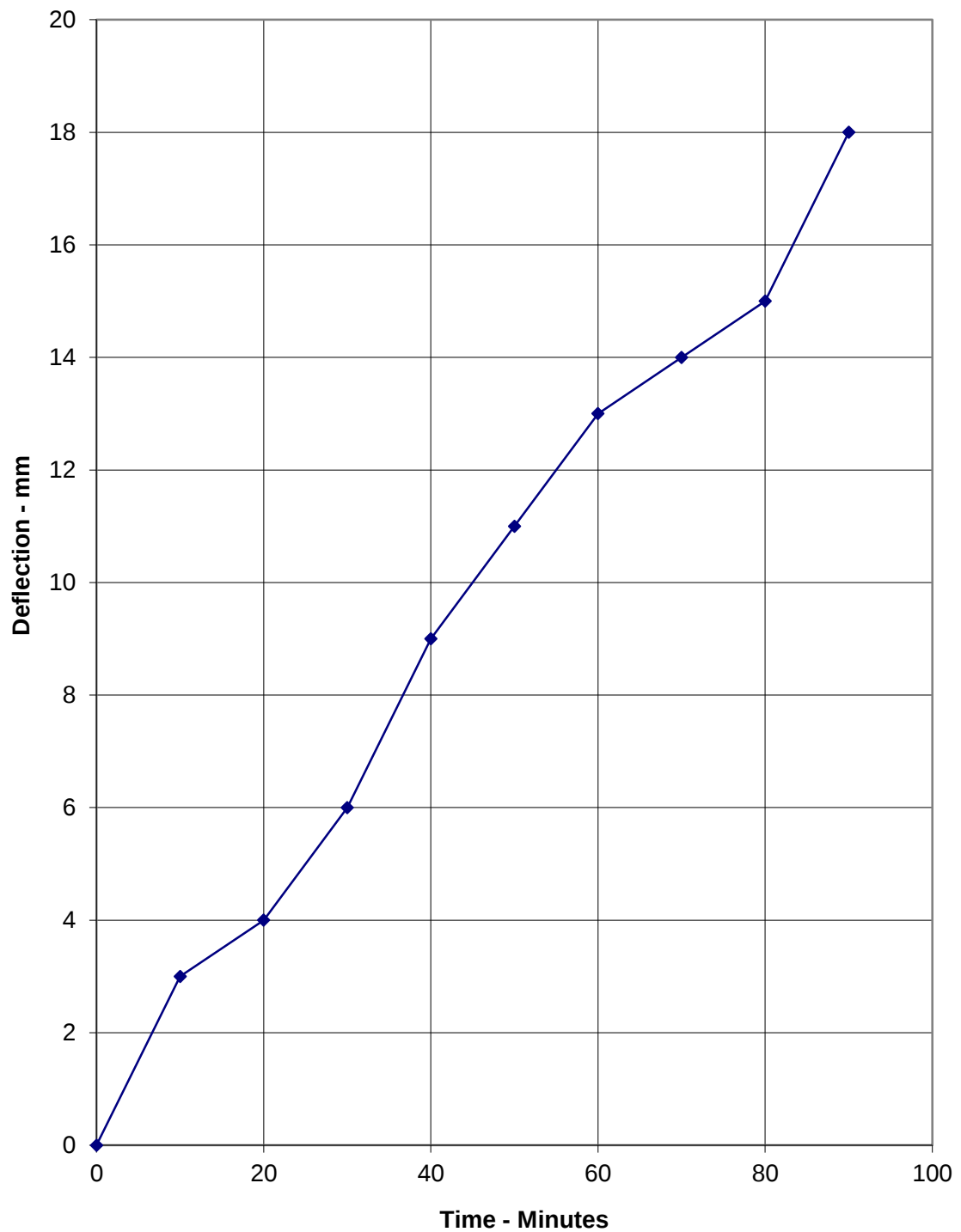
Graph showing specified and actual furnace temperatures



Graph showing mean unexposed surface temperature of the floor assembly



Graph showing the central vertical deflection of the floor assembly during the test



Load Calculations

1. Physical Parameters of Timber Joists

Measured Joist dimensions (d x b)	: 196 mm deep by 44 mm thick
Mean spacing (M)	: 600 mm
Effective span (L)	: 4200 mm
Timber grade of joists	: C16

2. Parameters - BS 5268: Part 2: 1996

Basic dry stress in bending	: 5.3 N/mm ² (Table 7)
Modification factor for loading	: 1.1 (Table 2.9 (a))
Therefore working stress (F)	: 5.83 N/mm ²
Nominal density	: 344 kg/m ³

3. Total Loading Required Per Joist

Moment of Inertia (I)	: $bd^3/12$: $(46 \times 196^3)/12$: 28863221 mm ⁴
Distance from neutral axis to base of joist (y)	: 98 mm
Maximum bending stress	: FI/y : $(5.83 \times 28863221)/98$: 1717067 N/mm ²
Also maximum bending stress	: $wL^2/8$: 1717067 N/mm ²
Where w	= Load per unit length
∴ w	= $(1717067 \times 8)/(4200 \times 4200)$ = 0.7787 N/mm = 778.7 N/m
∴ Total loading (W)	: 3270.54 N : 333.4 kg

4. Dead Weight

Combined weight of overall specimen:

Actual density of joist	: 472 kg/m ³
Actual density of floor boarding	: 650 kg/m ³
Actual density of ceiling board	: 859 kg/m ³

Effective width of floor supported per joist (m) : 0.6 m

Weight of joist	: 17.09 kg
Weight of floorboard	: 34.32 kg
Weight of ceiling (3 layers of board)	: 77.31 kg

Total dead weight per joist : 133.72 kg

5. **Imposed Load**

Imposed load per joist required : total load per joist - dead weight per joist
: 333.4 – 133.72
: 204.7 kg

Assuming even distribution of loading

Maximum imposed load per metre square : $(199.68 \times 9.81) / (4.2 \times 0.60)$
: 777.3 N/m²
: **0.7773 kN/m²**
: 79.23 kg/m²

Calculation made by

Checked by

G. Edmonds
Senior Technical Officer
For and on behalf of
Exova Warringtonfire

W. Drazkiewicz
Senior Technical Officer
Fire Resistance Department

Performance Criteria and Test Results

Loadbearing Capacity The limiting deflection and the limiting rate of deflection for the specimen, as specified by the Standard, are calculated as 202 mm and 10 mm per minute respectively. The allowable rate of deflection criteria is not applicable for the first 10 minutes of the test. This criterion was satisfied for the 81 minute total test duration.

Integrity It is required that specimens retain their separating function, without:

- Causing ignition of a cotton pad when applied
- Permitting the penetration of a gap gauge in the prescribed manner
- Sustained flaming on the unexposed surface
- Integrity failure also occurs simultaneously with loadbearing capacity failure.

These requirements were satisfied for the duration of the test:

Sustained flaming 90 minutes*

Gap gauge 90 minutes*

Cotton pad 90 minutes*

*The test duration. The test was discontinued after a period of 90 minutes

Insulation It is required that the mean temperature rise of the unexposed surface shall not be greater than 140°C and that the maximum temperature rise shall not be greater than 180°C. Insulation failure occurs simultaneously with integrity failure. The insulation requirements were satisfied for the 90 minute test duration.

Ongoing Implications

Limitations 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 BS EN 1363-1: 2012, and where appropriate BS EN 1363-2: 1999. 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 the relevant test method is not covered by this report. Annex A of BS EN 1363-1: 2012, provides guidance information on the application of fire resistance tests and the interpretation of test data.

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.

Conclusions

Evaluation against objective	A specimen of a loadbearing timber floor assembly protected by a direct fix ceiling assembly incorporating four light fittings, has been subjected to a fire resistance test in accordance with the procedures given in BS EN 1365-2:2014. The specimen satisfied the performance requirements for the periods shown below:
-------------------------------------	---

Loadbearing capacity		90 minutes*
Integrity performance	Sustained flaming	90 minutes*
	Gap Gauge	90 minutes*
	Cotton pad	90 minutes*
Insulation performance		90 minutes*

The test was discontinued after a period of 90 minutes*

Direct Field Of Application

The results are directly applicable to a similar untested floor construction provided the following is true:

The maximum moments and shear forces, which when calculated on the same basis as the test load, shall not be greater than those tested.

With respect to the ceiling system:

The size of panels of the ceiling lining shall not be changed.

The total area occupied by fixtures and fittings relative to the area of the ceiling lining is not increased and the maximum tested opening in the lining is not exceeded.

With respect to the cavity:

The height of the cavity or cavities is equal to or greater than the height tested.

No combustible or insulating material is added to the cavity unless the same amount (fire load) of combustible or insulating material was included in the test specimen.