

**Title:**

Fire Resistance Test In Accordance With BS EN 1365-2: 2014, On A Loadbearing Timber Floor Construction Protected By A Plasterboard Ceiling Incorporating Four Lumi-Plugin Downlights

**Date of Test:**

23rd February 2020

**Issue 4:**

2nd March 2021

**WF Report No.**

424389/R



**Prepared for:**

**Lumi-Plugin Ltd**

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0249

**This report supersedes  
Issue 3 of report 424389,  
dated 11th January 2021.**

# Test Specimen

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## Summary of Tested Specimen

The timber floor assembly had overall nominal dimensions of 4590 mm long by 2960 mm wide by 257 mm deep. It comprised engineered timber I-joists with a height of 220 mm 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 exposed face by a direct fixed ceiling, formed from a single layer of 15 mm thick British Gypsum Gyproc 'Type A' plasterboard.

The ceiling incorporated four down lighter light fittings with a model reference of Lumi Plugin LP110.

The floor supported a uniformly distributed load of 1.0 kN/m<sup>2</sup>. This load was provided by the test sponsor as to represent the expected working load for the timber floor construction in practice.

*Detailed drawings of the test specimen(s) and a comprehensive description of the test construction based on a detailed survey of the specimen(s) and information supplied by the sponsor of the test are included in the Test Specimen and Schedule of Components sections of this report.*

## Performance Criteria and Test Results

<p><b>Loadbearing Capacity</b></p>	<p>This is the time in completed minutes for which the test specimen continues to maintain its ability to support the test load during the test. Support of the test load is determined by both the amount and the rate of Deflection. The limiting deflection and the limiting rate of deflection for the specimen, as specified by the Standard, are calculated as:</p> <table border="1" data-bbox="525 477 1369 732"> <thead> <tr> <th>Criteria</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>(L) Length of clear span, <i>in mm</i></td> <td>4250</td> </tr> <tr> <td>(d)Depth of Structural Section, <i>in mm</i></td> <td>220</td> </tr> <tr> <td>Max Deflection (<math>L^2/400d</math>) - <i>in mm</i></td> <td>205.3</td> </tr> <tr> <td>Rate (<math>L^2 / 9000d</math>) - <i>in mm</i></td> <td>9.1</td> </tr> <tr> <td>Max Deflection (<math>L^2/400d</math>) * 1.5 - <i>in mm</i></td> <td>308.0</td> </tr> </tbody> </table> <p>This criterion was satisfied for 36 minutes after which time the test was discontinued.</p>	Criteria	Value	(L) Length of clear span, <i>in mm</i>	4250	(d)Depth of Structural Section, <i>in mm</i>	220	Max Deflection ( $L^2/400d$ ) - <i>in mm</i>	205.3	Rate ( $L^2 / 9000d$ ) - <i>in mm</i>	9.1	Max Deflection ( $L^2/400d$ ) * 1.5 - <i>in mm</i>	308.0
Criteria	Value												
(L) Length of clear span, <i>in mm</i>	4250												
(d)Depth of Structural Section, <i>in mm</i>	220												
Max Deflection ( $L^2/400d$ ) - <i>in mm</i>	205.3												
Rate ( $L^2 / 9000d$ ) - <i>in mm</i>	9.1												
Max Deflection ( $L^2/400d$ ) * 1.5 - <i>in mm</i>	308.0												
<p><b>Integrity</b></p>	<p>It is required that the specimen retains its separating function, without:</p> <ul style="list-style-type: none"> <li>▪ causing ignition of a cotton pad when applied</li> <li>▪ permitting the penetration of a gap gauge as specified in BS EN 1363-1: 2012</li> <li>▪ sustained flaming on the unexposed surface</li> <li>▪ subsequent failure of loadbearing capacity</li> </ul> <p><b>These requirements were satisfied for the periods shown below:</b></p> <p><b>Sustained flaming</b> 36 minutes*</p> <p><b>Gap gauge</b> 36 minutes*</p> <p><b>Cotton pad</b> 36 minutes*</p>												
<p><b>Insulation</b></p>	<p>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 also occurs simultaneously with integrity failure.</p> <p><b>These requirements were satisfied for the period shown below:</b></p> <p><b>Specimen</b> 36 minutes*</p> <p>*Test was discontinued after a period of 36 minutes.</p>												
<p><b>Date of Test</b></p>	<p>23rd February 2020</p>												

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## Signatories

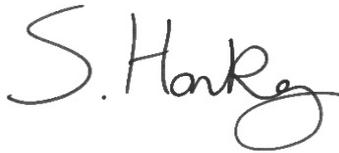
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Responsible Officer  
**C. Sweeney\***  
Technical Officer



Approved  
**D. Whittle\***  
Technical Officer



Head of Department  
**S. Hankey\***  
Business Unit Head – Fire Resistance

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

Report Issued: 5th May 2020

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## Revision History

Issue No: 2	Re-issue Date: 4th June 2020
Revised By: <b>W. Drazkiewicz</b>	Approved By: <b>D. Fitzsimmons</b>
Reason for Revision: Joists sizes amended to match the tested size. Changes to downlighters descriptions to match product labels. Cut out sizes indicated wrong in first issue, revision required.	

Issue No: 3	Re-issue Date: 11th January 2021
Revised By: <b>C. Sweeney</b>	Approved By: <b>W. Drazkiewicz</b>
Reason for Revision: Company name changed from 'Sleep Safe System Ltd T/A Lumi-Plugin' to 'Lumi-Plugin Ltd'. <b>Item 1.1:</b> reference changed from JJI 235 A+ to JJI 220 A+. Assembled joist size changed to 47 mm wide x 220 mm deep. Top and bottom chord cross section size changed to 45 mm high x 47 mm wide. Web cross section thickness changed to 9.0 mm. <b>Item 1.2:</b> material changed to softwood glulam. Grade changed to 'GL24c to BS EN 14080. Depth changed to 220 mm. In the fixing method the end joists were fitted across the ends of the JJI – Joists rather than posi-joists. <b>Item 1.3:</b> material changed to softwood glulam. Cross section changed to 45 mm wide x 220 mm deep. <b>Item 1.5:</b> in the fixing method the floorboards were bonded to the top chords, rather than bottom, of each joist and to the top of the end blocks not the end joists. All of the above changes to the schedule of components section were due to the details being indicated wrongly in the second issue.	

Issue No: 4	Re-issue Date: 2nd March 2021
Revised By: <b>C. Sweeney</b>	Approved By: <b>W. Drazkiewicz</b>
Reason for Revision: Page 11 - <b>Item 1.1:</b> web cross section height corrected to 156 mm from 190 mm. All of the above changes to the schedule of components section were due to the details being indicated wrongly in the third issue.	

**CONTENTS**

**PAGE NO.**

**TEST SPECIMEN .....2**

**PERFORMANCE CRITERIA AND TEST RESULTS.....3**

**SIGNATORIES.....4**

**REVISION HISTORY .....5**

**TEST CONDITIONS.....7**

**TEST CONSTRUCTION .....8**

**SCHEDULE OF COMPONENTS.....11**

**TEST OBSERVATIONS .....13**

**TEMPERATURE, PRESSURE AND DEFLECTION DATA.....17**

**ON-GOING IMPLICATIONS.....26**

**FIELD OF DIRECT APPLICATION .....27**

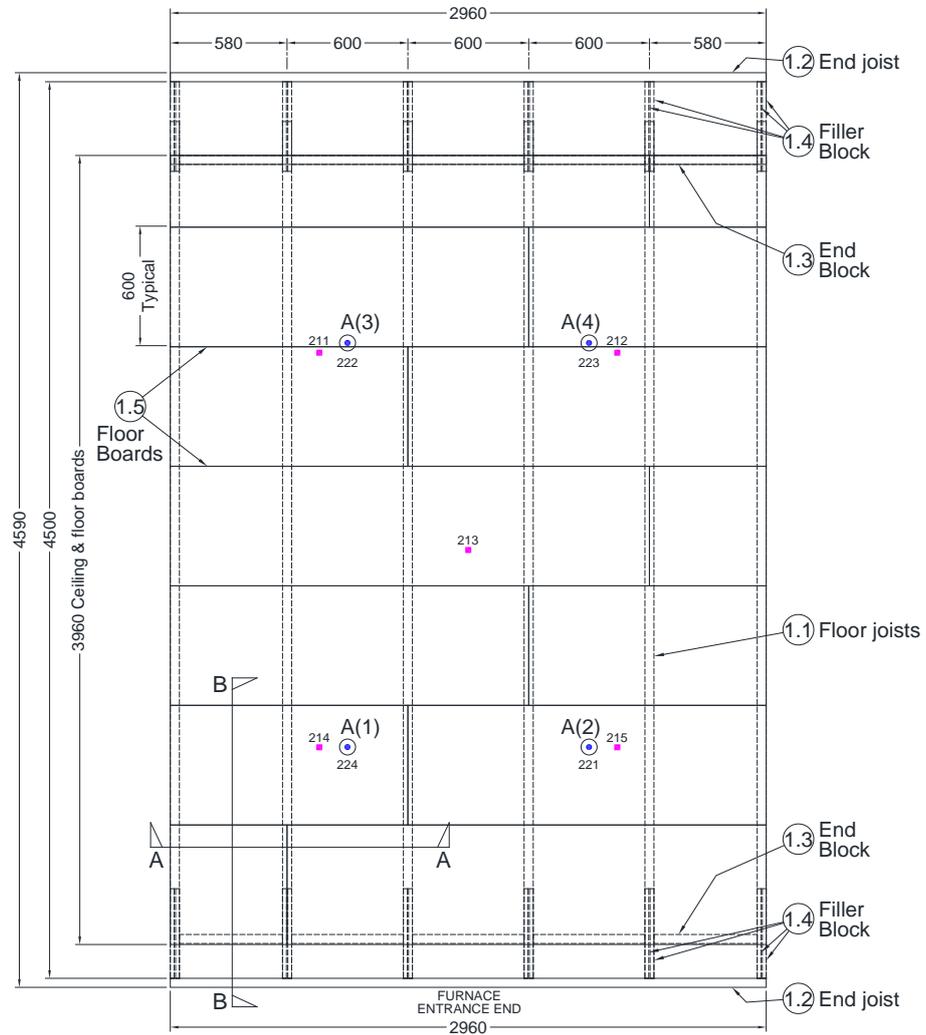
# Test Conditions

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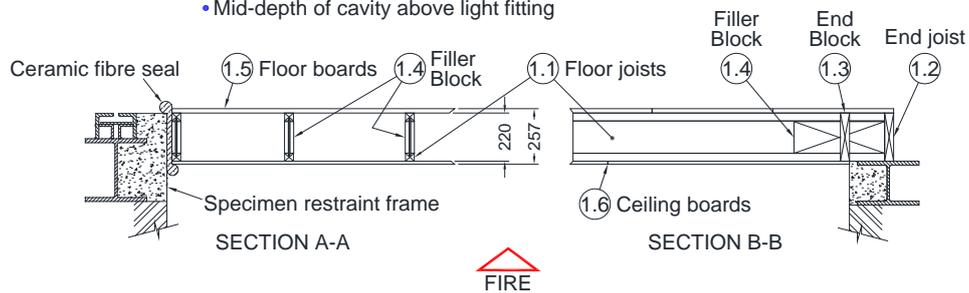
<b>Standard</b>	<p>BS EN 1365-2: 2014, 'Fire resistance tests for loadbearing elements – Part 2: Floors and Roofs'</p> <p>The purpose of the test was to evaluate the performance of a timber floor construction protected by a ceiling of known fire resistance, when incorporating down lighter light fitting assemblies.</p>
<b>Sampling</b>	<p><b>Warringtonfire</b> was not involved in the sampling or selection of the tested specimen or any of the components.</p> <p>The results obtained during the test only apply to the test samples as provided by the test sponsor.</p>
<b>Installation</b>	<p>Representatives of <b>Warringtonfire</b> assembled the floor construction and installed the downlighters between the 20<sup>th</sup> and 21<sup>st</sup> February 2020.</p>
<b>Conditioning</b>	<p>The specimen's storage, construction, and test preparation took place in the test laboratory over a total, combined time of four 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 14°C to 21°C and 40% to 60% respectively.</p>
<b>Instruction to Test</b>	<p>The test was conducted on the 23 February 2020 at the request of <b>Lumi-Plugin Ltd</b>, the test sponsor.</p> <p>Mr. B. Ward, a representative of the test sponsor witnessed the test.</p>
<b>Ambient Temperature</b>	<p>The ambient air temperature in the vicinity of the test construction was 17°C at the start of the test with a maximum variation of +1°C during the test.</p>
<b>Furnace</b>	<p>The furnace was controlled so that its mean temperature complied with the requirements of BS EN 1363-1: 2012 Clause 5.1 using eight plate thermometers, distributed over a plane 100 mm from the underside of test assembly.</p>
<b>Thermocouples</b>	<p>Thermocouples were provided to monitor the unexposed surface of the specimen. The output of all instrumentation was recorded at no less than one minute intervals. The locations and reference numbers of the various unexposed surface thermocouples are shown in Figure 1.</p>
<b>Application of the load</b>	<p>The full test load was applied via dead load uniformly distributed over the test specimen 60 minutes before the commencement of the test.</p>
<b>Loadbearing Capacity Criteria</b>	<p>A linear deflection transducer was provided at the approximate centre on the unexposed surface of the specimen to record its vertical deflection.</p>
<b>Furnace Pressure</b>	<p>After the first five minutes of testing and for the remainder of the test, the furnace atmospheric pressure was controlled so that it complied with the requirements of BS EN 1363-1: 2012, clause 5.2.1 The calculated pressure differential relative to the laboratory atmosphere 100 mm below the soffit of the specimen was 20 (± 5) Pa between 5 and 10 minutes and 20 (± 3) Pa thereafter.</p>

# Test Construction

Figure 1- Plan View of Test Specimen

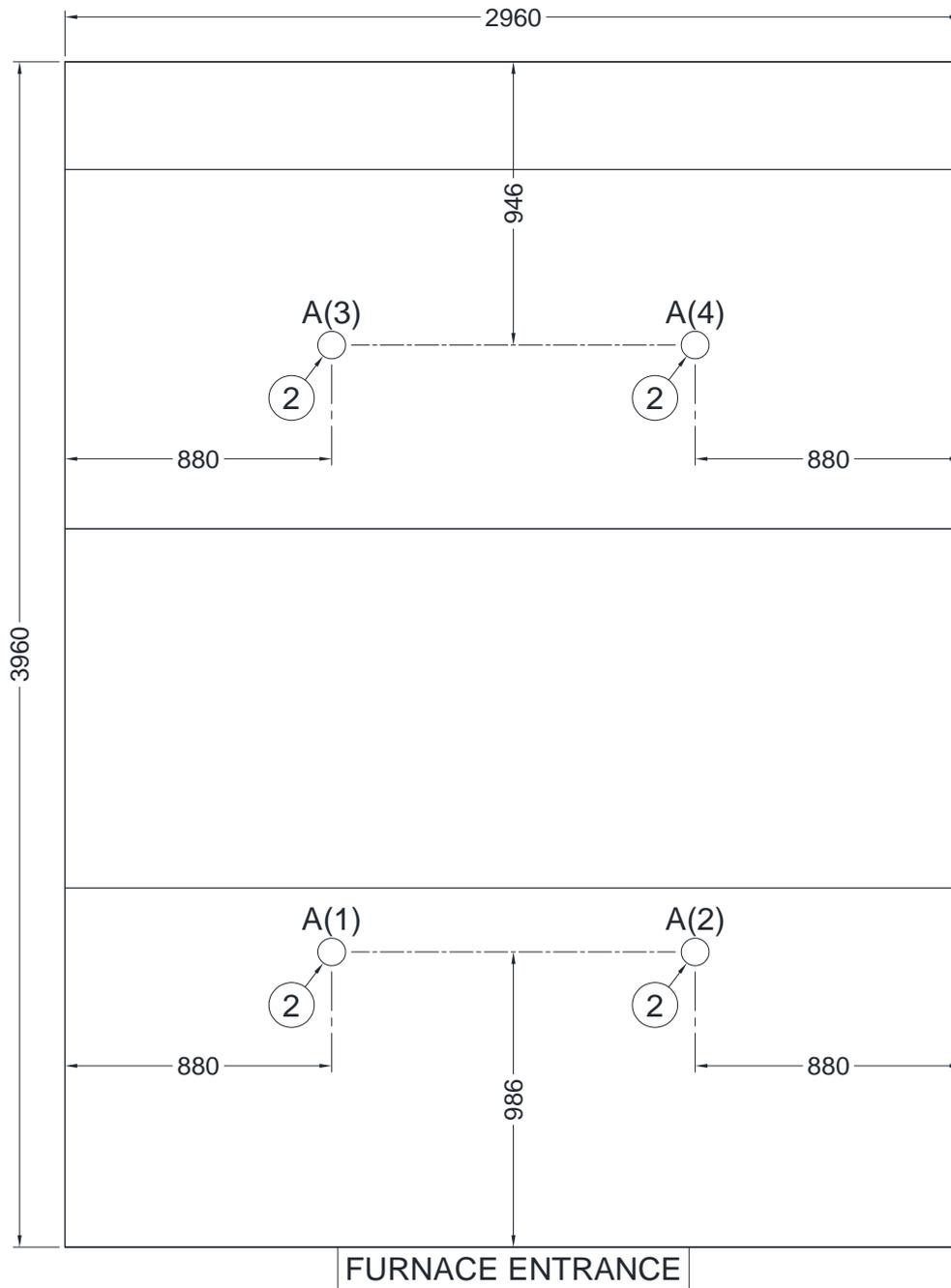


- Positions of thermocouples
- Mid-depth of cavity above light fitting



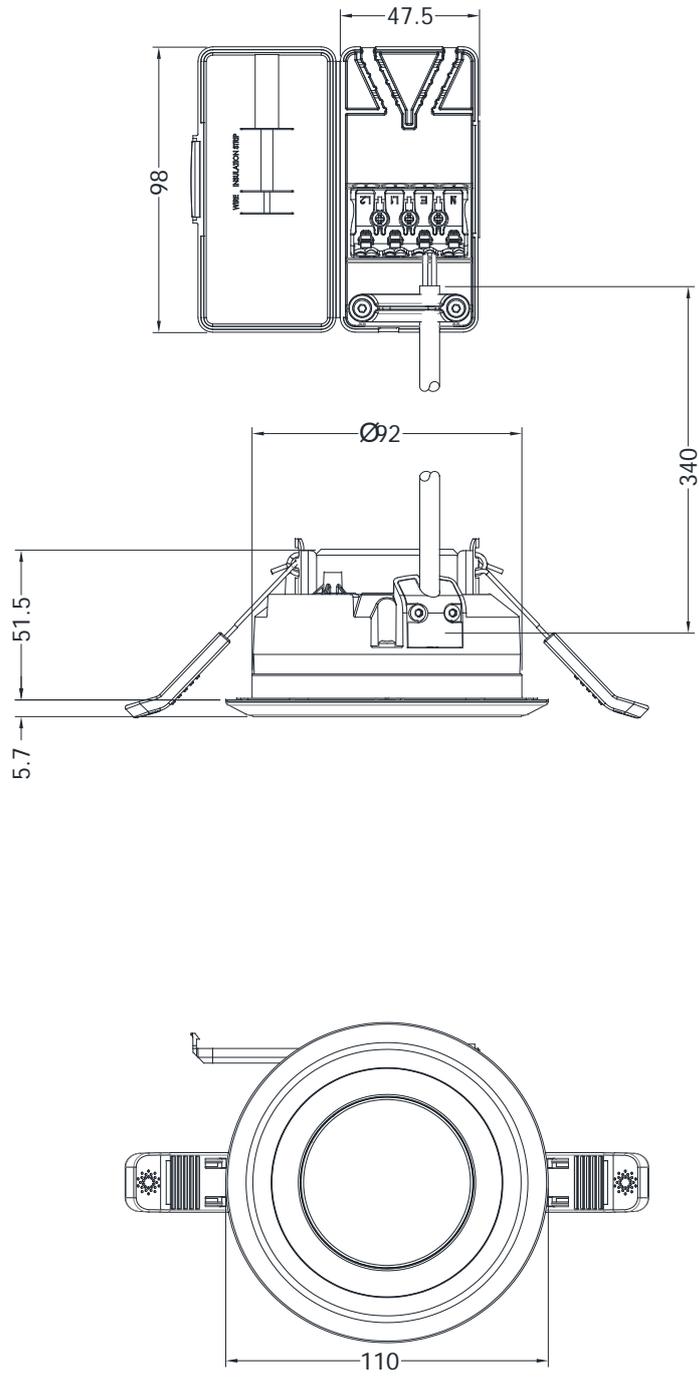
Do not scale. All dimensions are in mm

**Figure 2 – Details of Downlighter Positions**



Do not scale. All dimensions are in mm

**Figure 3 – Details of Downlighters**



Do not scale. All dimensions are in mm

# Schedule of Components

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(Refer to Figures 1 to 3)

(All other details are as stated by the sponsor)

<u>Item</u>	<u>Description</u>
<b>1. Timber Floor</b>	
1.1. Engineered-Joints	
Manufacturer	: James Jones & Sons Ltd
Reference	: JJI 220 A+
Assembled joist size	: 47 mm wide x 220 mm deep x 4500 mm long
Top and bottom chords	
i. material	: General commercial softwood
ii. density	: 447.0 kg/m <sup>3</sup> , measured
iii. cross section	: 45 mm high x 47 mm wide x 4500 mm long
Web	
i. material	: Oriented Strand Board, OSB
ii. density	: 698.9 kg/m <sup>3</sup> , measured
iii. cross section	: 156 mm high x 9.0 mm thick x 4500 mm
Centres	: 600 mm, please see Figure 1
1.2. End Joists	
Material	: Softwood, glulam
Grade	: GL24c, to BS EN 14080
Density	: 505.9 kg/m <sup>3</sup> , measured
Size	: 45 mm wide x 220 mm deep x 2960 long
Fixing method	: Fitted across the ends of the JJI-Joists and fixed with 2 off fired nails to the top and bottom chords of each joist
1.3. Ceiling Closure Joist (Section of End-Joist)	
i. materials	: Softwood, glulam
ii. cross section	: 45 mm wide x 220 mm deep
iii. fixing method	: Fitted between the joists, item 1.2, and fixed with fired nails. Please see Figure 1 for positions
1.4. Filler & Backer Blocks	
i. material	: Oriented Strand Board, OSB
ii. density	: 619.2 kg/m <sup>3</sup> , measured
iii. cross section	: 450 mm wide x 155 mm high
iv. fixing method	: Fitted between the bottom chords of joist and fixed with 65 mm long ring shank nails that were bent at 90 degrees. Please see Figure 1 for positions

<b><u>Item</u></b>	<b><u>Description</u></b>
<b>1. Timber Floor (Continued)</b>	
1.5. Floor Boards	
i. material	: Flooring grade tongue and groove chipboards
ii. thickness	: 22 mm
iii. density	: 685 kg/m <sup>3</sup> , measured
iv. fixing method	: Fitted in a single layer and bonded to the top chords of each joist as well as in the tongue and groove of adjoining boards. Also, fixed with 64.3 mm long x 4.4 mm diameter countersunk steel screws to floor joists at 300 mm centres around the perimeter and 600 mm in the field of each board
1.6. Ceiling Boards	
Manufacturer	: British Gypsum
Reference	: Gyproc Wallboard
Material	: Type A gypsum complete with strong paper liners
Thickness	: 1 off layer 15 mm thick
Fixing method	The boards were screw fixed to the soffit of the joists with all joints staggered, paper taped and skimmed with British Gypsum jointing compound
i. manufacturer	: British Gypsum
ii. overall size	: 40 mm long x 3.5 mm diameter drywall screws
iii. centres	: 150 mm centres along joints and 150 mm to the perimeter of the ceiling. There were no screws into the end joists, item 1.2
<b>2. Specimen A</b>	
Manufacturer	: Lumi-Plugin Ltd
Reference	: LP110
Overall dimensions and construction	: See Figure 3 for details
Luminaire Details	
i. driver	: Internal Driver
ii. power consumption	: 8.5W 220V-240VAC~50Hz 0.05A PF>0.8
iii. current	: 0.05A
iv. colour temperature	: 3000K & 4000K
v. light output	: 600lm
vi. beam angle	: 100°
vii. chip life TM-21	: CR180 – 50,000hrs
viii. cut out	: 92mm diameter
ix. tilt	: Fixed
x. rotation	: Fixed
xi. IP rating	: IP65
xii. finish	: White Alu Finish

## Test Observations

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Time		All observations are from the unexposed face unless noted otherwise.
-60	00	Load applied.
00	00	<b>The test commences.</b>
02	44	Flaming visible across the plasterboard on the exposed face.
05	24	Joint coverings and paper face of plasterboard burning away on the exposed face.
09	03	Steam/smoke release from the supported ends of the construction.
10	00	All light fitting faces have fallen from the plasterboard.
10	33	Flaming at light fitting A3 on the exposed face.
13	36	Flaming at light fitting A2 on the exposed face.
15	38	Flaming at light fitting A1 on the exposed face.
16	32	The plasterboards are beginning to ripple on the exposed face.
20	00	The joint gaps are beginning to open up between the long edges of the central sections of plasterboard. The plasterboards begin to sag.
21	54	The long edge joint gaps have opened up to around 6 mm.
22	00	The plasterboard face is glowing red on the exposed face.
23	00	The long edge joint gaps have opened up to around 8 mm.
27	45	The short edge gaps between the plasterboards have opened up to around 6 mm.
30	00	The test specimen continues to satisfy all criteria.
32	00	The long edge joint gaps have opened up to around 15 mm.
36	00	<b>Test discontinued, the test specimen continues to satisfy the load-bearing, integrity and insulation criteria.</b>

## Test Photographs

The exposed face of the floor assembly prior to test



The unexposed face of the floor assembly prior to test



The unexposed face of the floor assembly after 10 minutes of testing



The unexposed face of the floor assembly after 20 minutes of testing



The unexposed face of the floor assembly after 30 minutes of testing



The unexposed face of the floor assembly after 36 minutes of testing



# Temperature, Pressure and Deflection Data

Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In The Standard BS EN 1363-1: 2012

Time Mins	Specified Furnace Temperature Deg. C	Actual Furnace Temperature Deg. C
0	20	48
1	349	311
2	445	429
3	502	515
4	544	542
5	576	559
6	603	634
7	626	657
8	646	661
9	663	668
10	678	675
11	693	679
12	706	684
13	717	676
14	728	716
15	739	754
16	748	763
17	757	767
18	766	769
19	774	773
20	781	778
21	789	784
22	796	790
23	802	796
24	809	801
25	815	806
26	820	811
27	826	816
28	832	821
29	837	828
30	842	838
31	847	844
32	852	851
33	856	855
34	860	861
35	865	865
36	869	871

**Individual Temperatures And Mean Recorded On The Unexposed Surface Of The Specimen**

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	20	19	20	21	19	20
1	20	19	20	21	19	20
2	20	19	20	21	19	20
3	20	19	20	21	19	20
4	20	19	20	21	19	20
5	20	19	20	21	19	20
6	20	19	20	21	19	20
7	20	19	20	21	20	20
8	20	20	20	21	20	20
9	20	20	20	21	20	20
10	21	21	21	22	21	21
11	22	21	22	22	21	22
12	23	22	22	23	22	22
13	23	23	23	24	23	23
14	24	24	24	25	24	24
15	26	25	25	26	25	25
16	26	26	26	27	25	26
17	28	27	27	28	26	27
18	29	28	27	28	27	28
19	30	29	28	29	28	29
20	31	30	29	30	29	30
21	32	31	30	31	30	31
22	33	32	31	32	31	32
23	34	33	32	33	32	33
24	35	34	32	34	33	34
25	36	35	33	34	34	34
26	37	36	34	35	35	35
27	38	37	35	36	36	36
28	40	39	37	37	37	38
29	42	41	38	38	38	39
30	46	43	40	40	40	42
31	49	46	42	41	42	44
32	53	49	44	43	45	47
33	57	53	47	45	48	50
34	62	57	50	48	51	54
35	66	62	53	51	55	57
36	70	66	56	54	59	61

**Individual Temperatures Recorded On The Unexposed Surface Of The Specimen Adjacent to Joints**

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	20	19	20	20	20	20
1	20	19	20	20	20	20
2	20	19	20	20	20	20
3	20	19	20	20	20	20
4	20	19	20	20	20	20
5	20	19	20	20	20	20
6	20	19	20	20	20	20
7	20	19	20	20	20	20
8	20	19	20	20	21	21
9	20	20	20	20	21	21
10	21	20	20	21	21	21
11	22	20	20	21	22	22
12	23	20	21	21	23	23
13	24	20	21	22	23	24
14	24	21	21	22	24	24
15	26	21	22	23	25	25
16	27	21	22	24	26	26
17	28	22	23	24	27	27
18	29	23	24	25	29	29
19	30	23	24	25	30	30
20	31	24	25	26	32	31
21	32	24	25	27	33	32
22	33	25	26	27	35	34
23	34	25	27	28	36	35
24	35	26	27	29	38	37
25	36	27	28	29	40	38
26	38	27	29	30	41	39
27	40	28	29	31	44	41
28	42	29	30	31	46	43
29	44	29	31	32	47	45
30	47	30	32	33	49	47
31	51	31	32	33	51	49
32	55	32	33	34	52	52
33	59	33	34	35	54	55
34	63	33	35	36	56	57
35	67	35	37	37	57	59
36	71	36	38	38	59	61

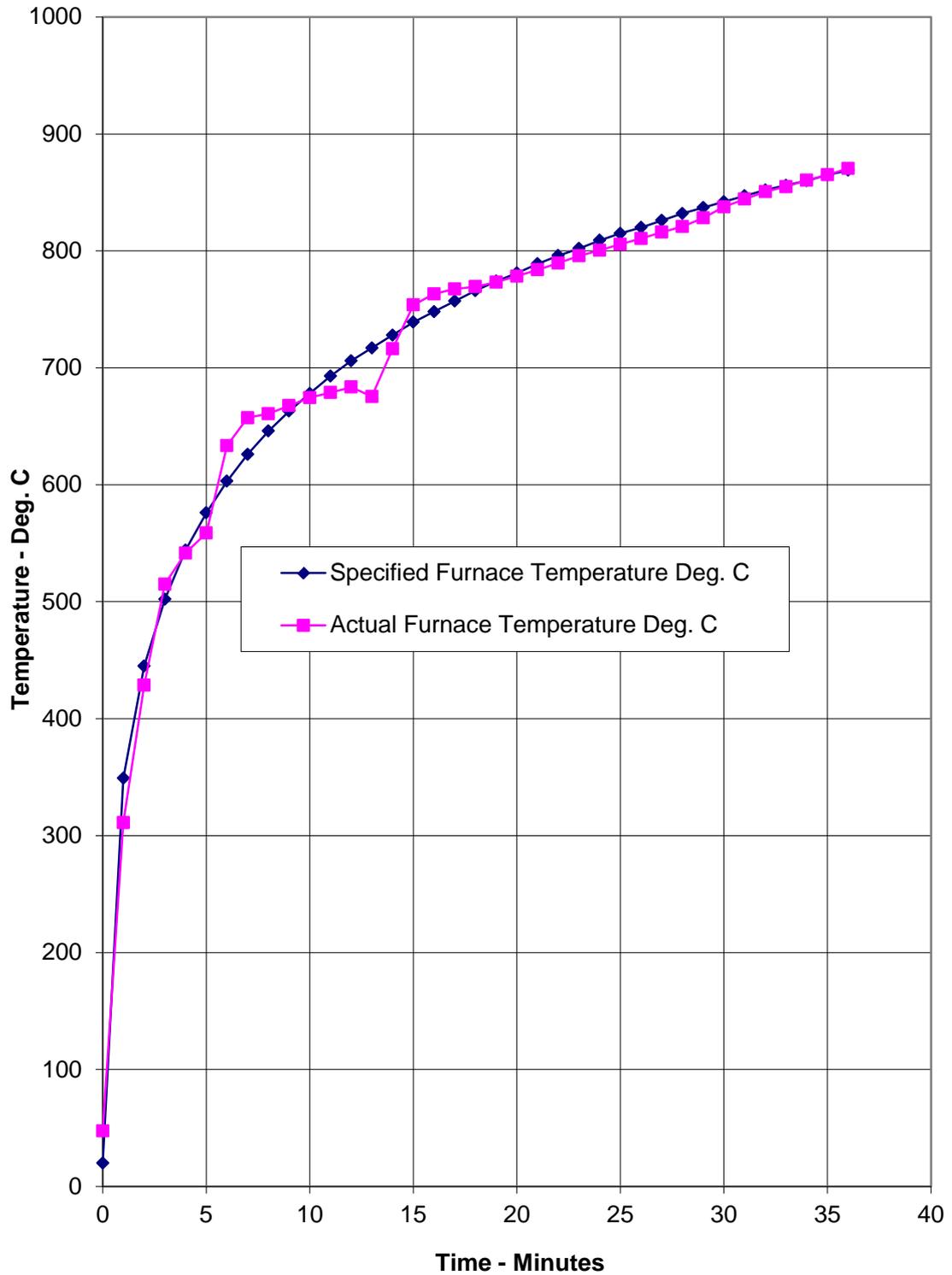
**Individual Temperatures Recorded At Mid-Height Of The Cavity Coincidental With The Light Fittings**

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	18	18	19	19
1	19	19	19	19
2	30	31	26	25
3	47	47	44	43
4	58	56	55	54
5	66	65	59	60
6	71	71	65	64
7	75	74	69	67
8	82	78	71	71
9	89	83	75	74
10	99	92	78	79
11	108	110	86	91
12	118	122	99	102
13	125	131	101	103
14	127	128	102	103
15	118	132	104	112
16	124	121	112	111
17	141	134	119	111
18	148	133	115	113
19	158	149	119	118
20	174	177	122	124
21	199	200	135	132
22	218	212	144	148
23	227	223	159	166
24	236	234	177	188
25	250	244	194	206
26	256	253	217	219
27	262	259	228	229
28	271	269	242	245
29	276	275	250	249
30	284	284	261	255
31	297	293	260	265
32	302	301	274	268
33	309	315	280	275
34	318	324	285	281
35	326	331	294	286
36	337	340	299	295

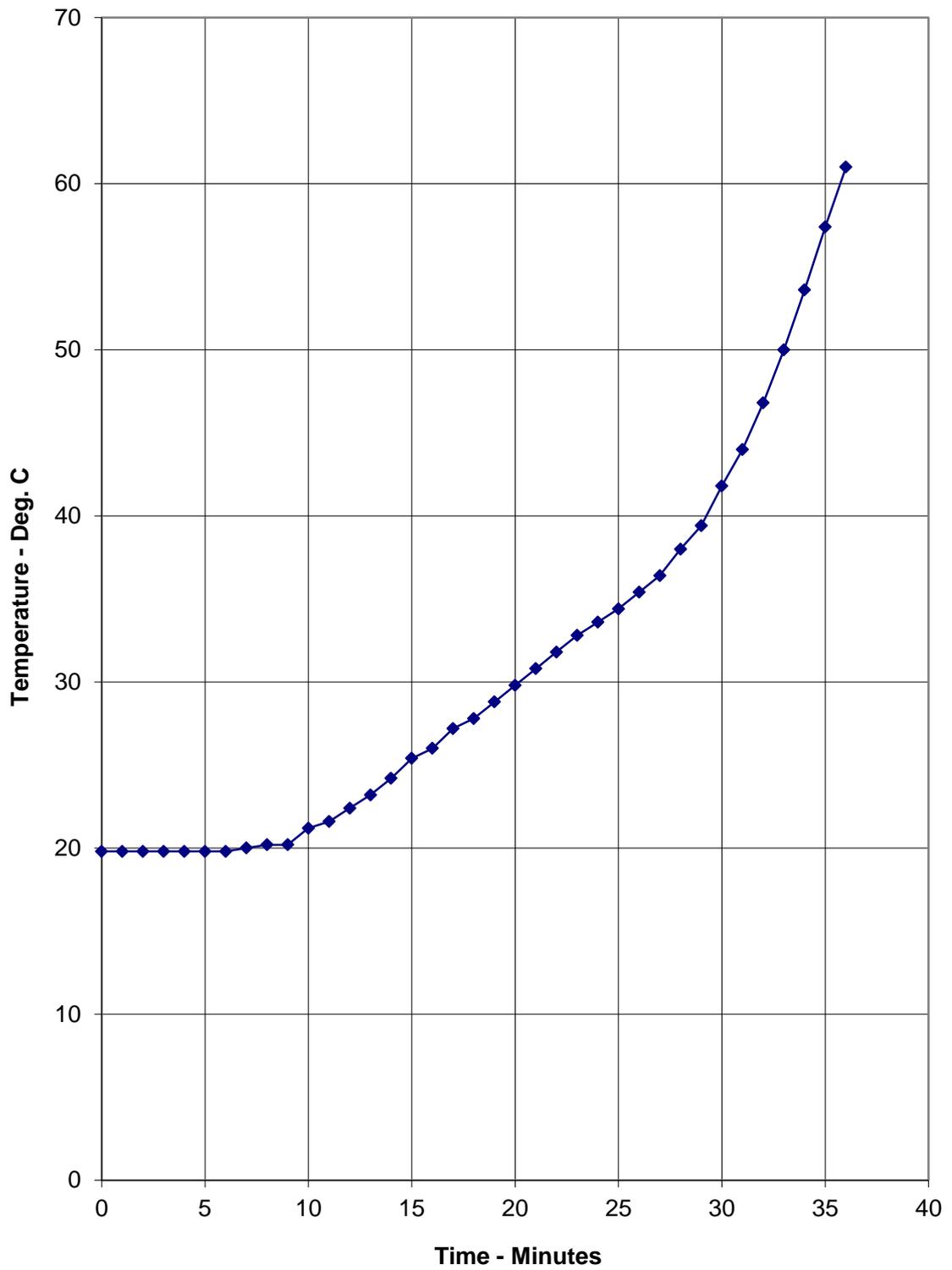
**Central Vertical Deflection Of The Specimen**

Time Mins	Central Vertical Deflection mm	Rate Of Deflection mm/min
0	0.000	0.000
1	1.108	1.108
2	1.763	0.655
3	2.031	0.268
4	2.199	0.168
5	2.367	0.168
6	2.753	0.386
7	3.089	0.336
8	3.408	0.319
9	3.744	0.336
10	4.079	0.335
11	4.398	0.319
12	4.734	0.336
13	5.170	0.436
14	5.506	0.336
15	5.892	0.386
16	6.211	0.319
17	6.714	0.503
18	7.151	0.437
19	7.537	0.386
20	7.973	0.436
21	8.359	0.386
22	9.014	0.655
23	9.568	0.554
24	10.172	0.604
25	10.844	0.672
26	11.381	0.537
27	12.203	0.822
28	12.875	0.672
29	13.798	0.923
30	14.687	0.889
31	15.560	0.873
32	16.618	1.058
33	17.876	1.258
34	19.421	1.545
35	21.116	1.695
36	23.483	2.367

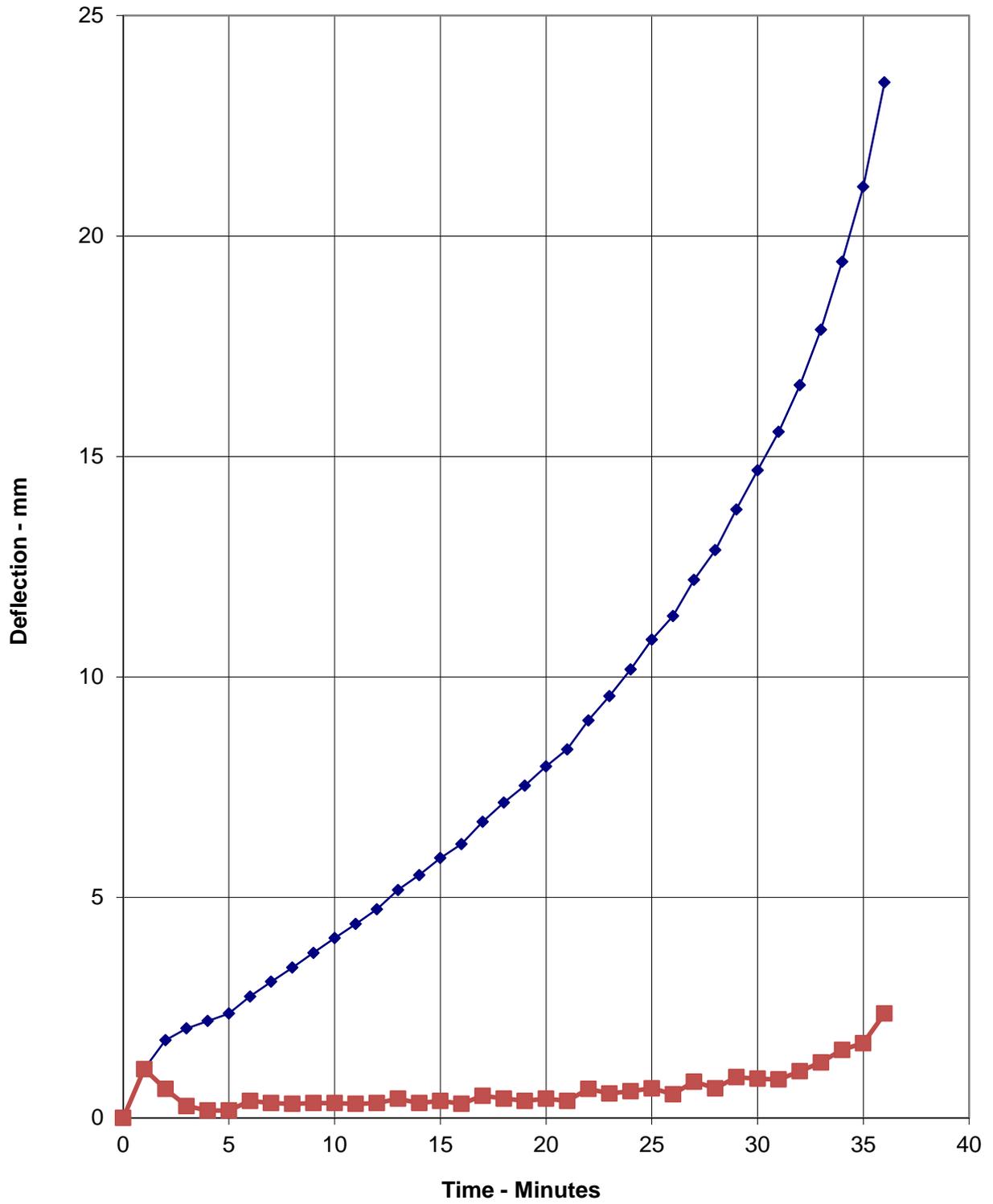
**Graph Showing Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In The Standard**



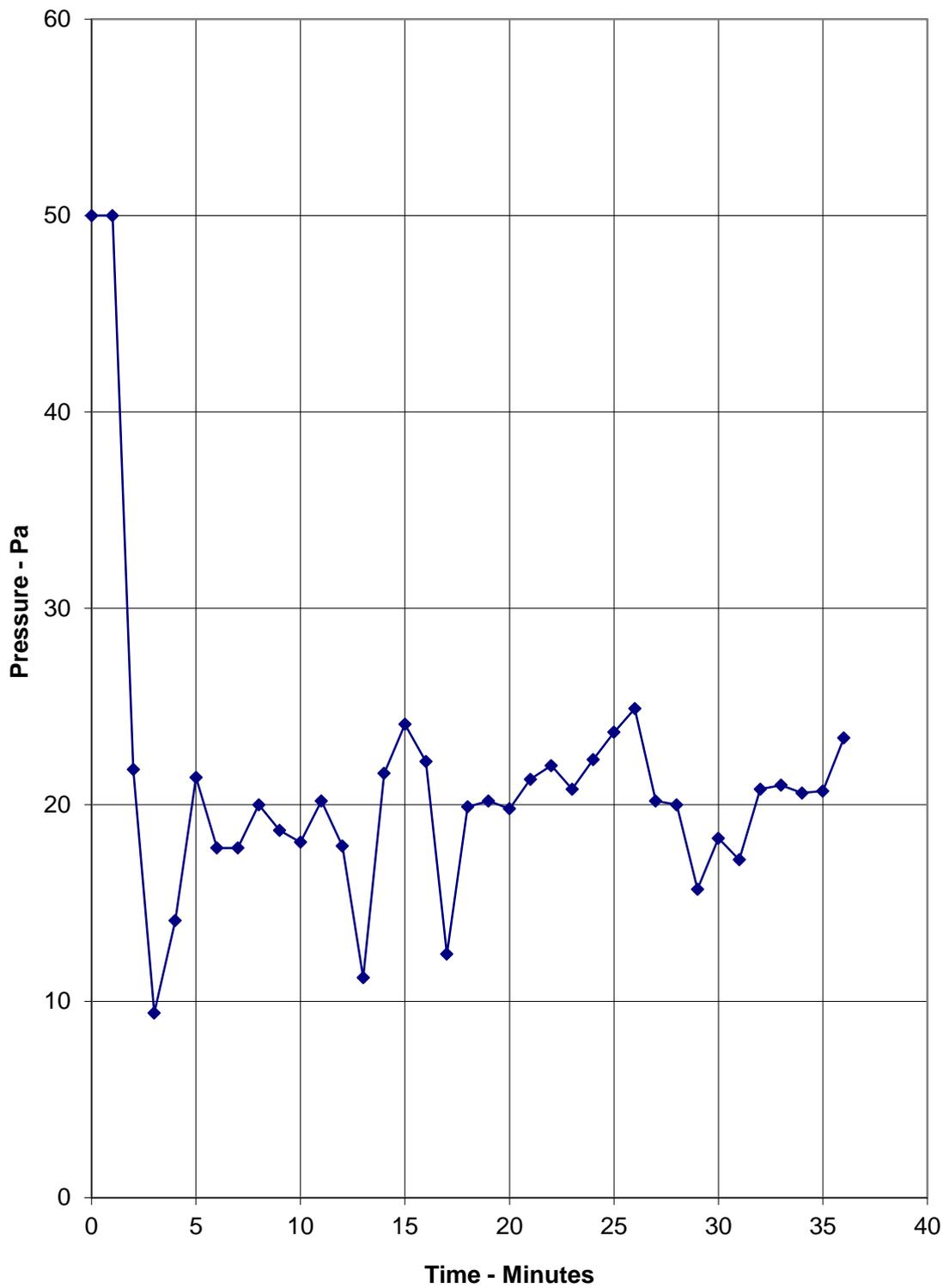
**Graph Showing Mean Temperature Recorded On The Unexposed Surface Of The Specimen**



Graph Showing The Recorded Vertical Deflection Of The Specimen



Graph Showing Recorded Furnace Pressure 100 mm Below The Underside Of The Specimen



# On-going Implications

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## Limitations

This report details the method of construction, the test conditions and the results obtained when the specific elements of construction described herein were tested following the procedure 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.

**This report supersedes Issue 1 of report 424389, dated 5<sup>th</sup> May 2020.**

## EGOLF

Certain aspects of some fire test specifications are open to different interpretations. 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

# Field of Direct Application

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

**a) With respect to the structural building member:**

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

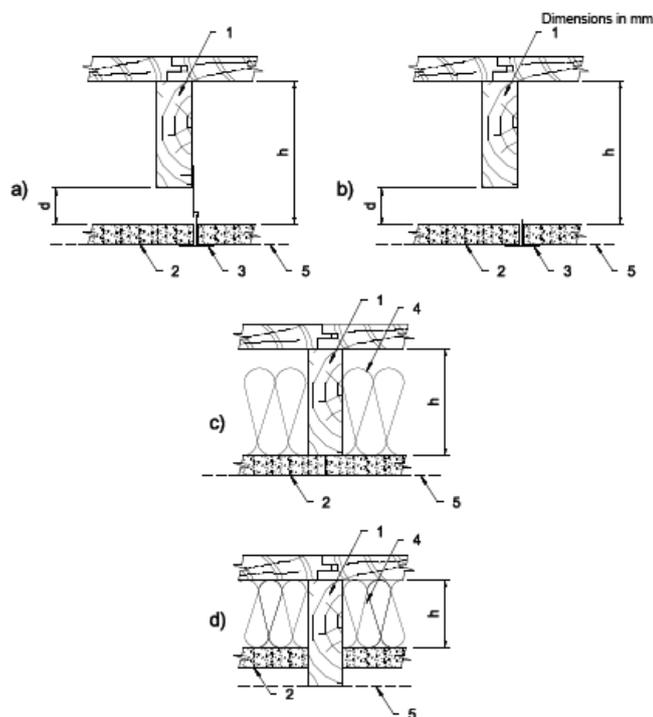
**b) With respect to the ceiling system:**

The size of panels of the ceiling lining may be increased by a maximum of 5 % but limited to a maximum of 50 mm. The length of the grid members can be increased accordingly.

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.

**c) With respect to the cavity:**

The height of the cavity 'h' and the minimum distance 'd' between the ceiling and the structural members (see Figure below) are equal to or greater than those tested.



## KEY

- |  |   |
|--|---|
| a) suspended ceiling                                     | 4 insulation                                      |
| b) self-supported ceiling                                | 5 pressure reference line                         |
| c) and d) direct fixed ceiling with insulation in cavity | d distance between ceiling and structural members |
| 1 supporting construction (joist)                        | h height of cavity                                |
| 2 ceiling lining   |   |
| 3 supporting frame                                       |   |