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Testing. Advising. Assuring.

**Title:**

The Fire Resistance Performance of a Specimen of a Loadbearing Timber Floor Assembly Protected by a Plasterboard Ceiling Designed to Provide 90 minutes Fire Resistance, Incorporating Seventeen Downlight Light Fittings, Tested in Accordance with BS 476: Part 21: 1987, Clause 7

**WF Report No:**

370975



**Prepared for:**

**Hong Kong Diaman International Lighting Co. Ltd**  
Unit 04, 7/F Bright Way Tower No. 33, Mong Kok Rd,  
KL Hong Kong.

In Partnership with:

**Integral LED**

Unit 6, Iron Bridge Close, Iron Bridge Business Park,  
London, NW10 0UF, UK

**Date:**

14<sup>th</sup> March 2017

**Notified Body No:**

0833



0249

# 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 seventeen downlight light fittings, when tested in accordance with Clause 7 of BS 476: Part 21: 1987.

**Sponsor** **Hong Kong Diaman International Lighting Co. Ltd**  
 Unit 04, 7/F Bright Way Tower No. 33 Mong Kok Rd KL Hong Kong.

**Co-Sponsor** **Integral LED**  
 Unit 6, Iron Bridge Close, Iron Bridge Business Park, London, NW10 0UF, UK

**Summary of Tested Assembly** The timber floor had overall nominal dimensions of 4200 mm long by 3000 mm wide and comprised softwood timber joists at 450 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 two layers of 15 mm thick British Gypsum Fireline plasterboard, both layers were screw fixed to the underside of the floor joists.

The floor supported an evenly distributed load of 0.947 kN/m<sup>2</sup>

The ceiling incorporated seventeen downlight lights.

Twelve of which were provided by Hong Kong Diaman International Lighting Co. Ltd and were referenced as follows:

Test Ref.	Model Ref.	Description
A	TC26XXX.XXX	Round, fixed model, Agate LED recessed downlight, 73 mm diameter cut-out
B	TC27XXX.XXX	Round, fixed, LED recessed downlight , 60 mm nominal diameter (64 mm diameter tested) cut-out
C	TC28XXX.XXX	Round, tiltable model, LED recessed down light, 85 mm diameter cut-out, with reflector
H	TC36XXX.XXX	Round, tiltable model, LED recessed down light, 83 mm diameter cut-out, with reflector
J	TC70XXX.XXX	Round, tiltable, LED recessed down light, 75 mm diameter cut-out, with reflector
K	TC77XXX.XXX	Round, fixed, LED recessed down light, 68 mm diameter cut-out, with reflector
L	TC80XXX.XXX	Round, tiltable, LED recessed down light, 75 mm diameter cut-out, with lens
M	TC85XXX.XXX	Round, fixed, LED recessed down light, 75 mm diameter cut-out, with reflector
N	TC86XXX.XXX	Round, fixed, LED recessed down light, 75 mm diameter cut-out, with reflector
O	FHT-086	Round, fixed, LED recessed down light, 72 mm diameter cut-out, with reflector
P	DC10XXX.XXX	Round, screw fixed, LED recessed down light, 70 mm diameter cut-out, with reflector
Q	DC11XXX.XXX	Round, screw fixed, LED recessed down light, 74 mm diameter cut-out, with reflector

Five of which were provided by Integral LED and were referenced as follows:

<b>Test Ref.</b>	<b>Model Ref.</b>	<b>Description</b>
D	ILD LFR60FXXX	Round, trim-less screw fixed down light, 60 mm diameter cut-out,
E	ILD LFR70EXXX	Round, fixed, LED recessed down light with bezel, 70 mm diameter cut-out,
F	ILD LFR70DXXX	Round, fixed, LED recessed down light, 70 mm diameter cut-out, with bracket
G	ILD LFR70DXXX	Round, fixed, LED recessed down light, 70 mm diameter cut-out, without bracket
I	ILD LFR70DXXX (accessory of slim fire)	Round, fixed, LED recessed down light, 100 mm maximum diameter cut-out

**Test Results:**

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**Loadbearing Capacity** 96 minutes\*

**Integrity** 96 minutes\*


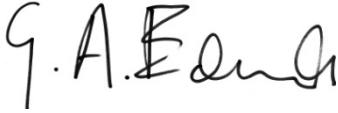
**Insulation** 96 minutes\*


\*The test was discontinued after a period of 96 minutes

**Date of Test** 16<sup>th</sup> September 2016

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## Signatories

	
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<hr/>	
	
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\* For and on behalf of **Exova Warringtonfire**.

Report Issued
Date: 14 <sup>th</sup> March 2017

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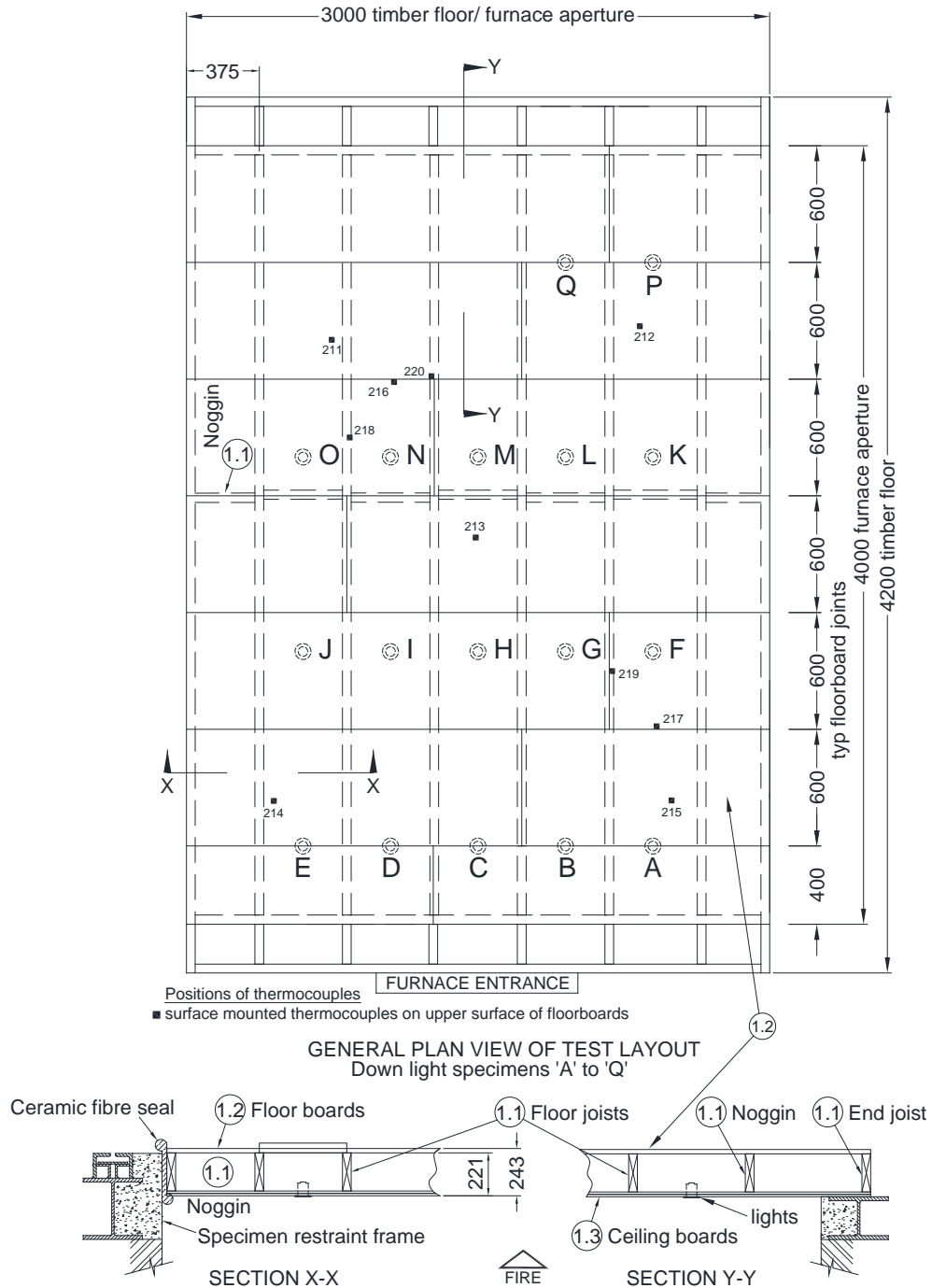
# Test Procedure

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<b>Introduction</b>	<p>The specimen tested was of a loadbearing construction. The test was conducted in accordance with Clause 7 of BS 476: Part 21: 1987, 'Methods for determination of the fire resistance of loadbearing elements of construction'. This test report should be read in conjunction with that Standard and with BS 476: Part 20: 1987, 'Method for determination of the fire resistance of elements of construction (general principles)'.</p> <p>The purpose of the test was to evaluate the performance of a timber floor construction protected by a ceiling of previously proven fire resistance, when incorporating down lighter fitting assemblies.</p> <p>The specimen was judged on its ability to comply with the performance criteria for loadbearing capacity, integrity and insulation, as required by BS 476: Part 21: 1987, Clause 7.</p>
<b>Fire Test Study Group/EGOLF</b>	<p>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.</p>
<b>Instruction To Test</b>	<p>The test was conducted on the 16<sup>th</sup> September 2016 at the request of the test sponsors.</p> <p>Mr. A. Gooding a representative of the test sponsor witnessed the test.</p>
<b>Test Assembly Construction</b>	<p>A comprehensive description of the test construction is given in the Schedule of Components. The description is based on a detailed survey of the specimens and information supplied by the sponsors of the test.</p>
<b>Installation</b>	<p>Representatives of Exova Warringtonfire assembled the floor construction and installed the down lighters on the 15<sup>th</sup> September 2016.</p>
<b>Conditioning</b>	<p>The specimens' storage, construction, and test preparation took place in the test laboratory over a total combined time of 4 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 16°C to 26°C and 53% to 87% respectively.</p>

# Test Specimens

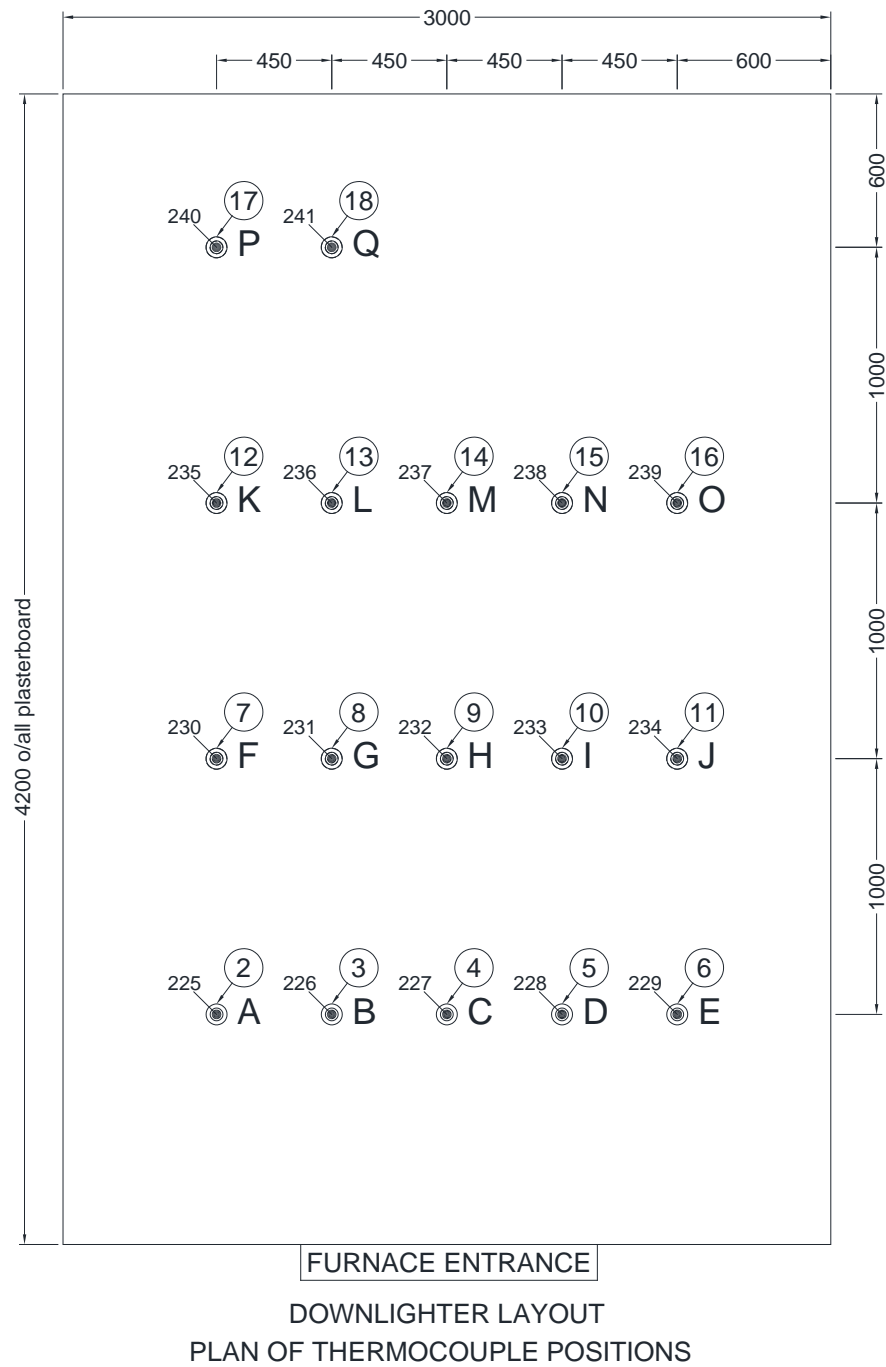
Figure 1- General Elevation of Test Specimens



Do not scale. All dimensions are in mm



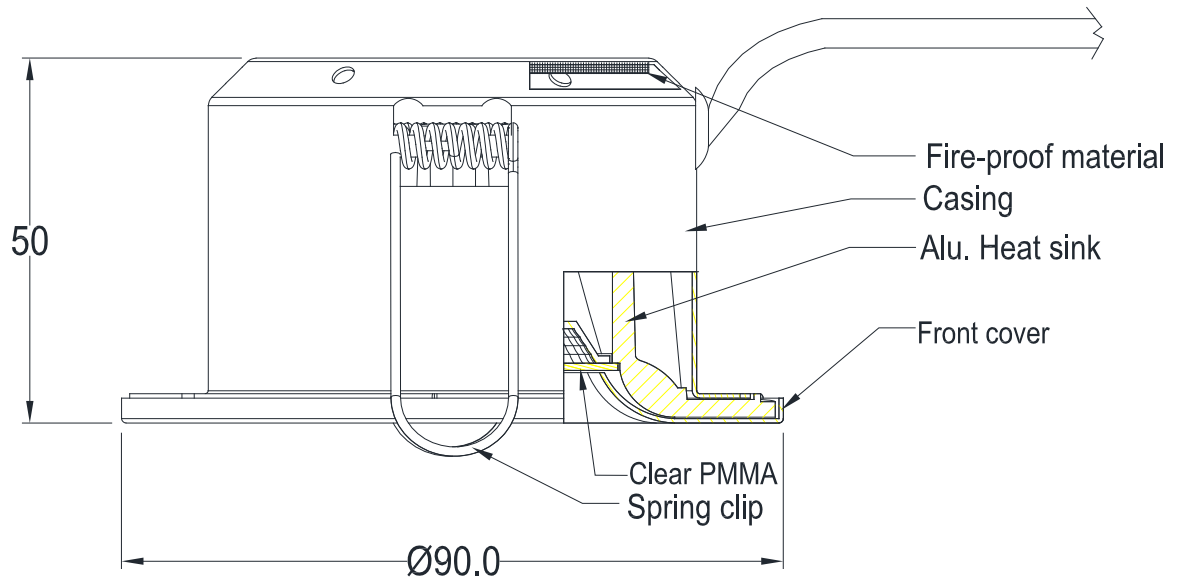
**Figure 2 – Details of Downlighter Positions**



• Mineral insulated thermocouples at mid-cavity height

Do not scale. All dimensions are in mm

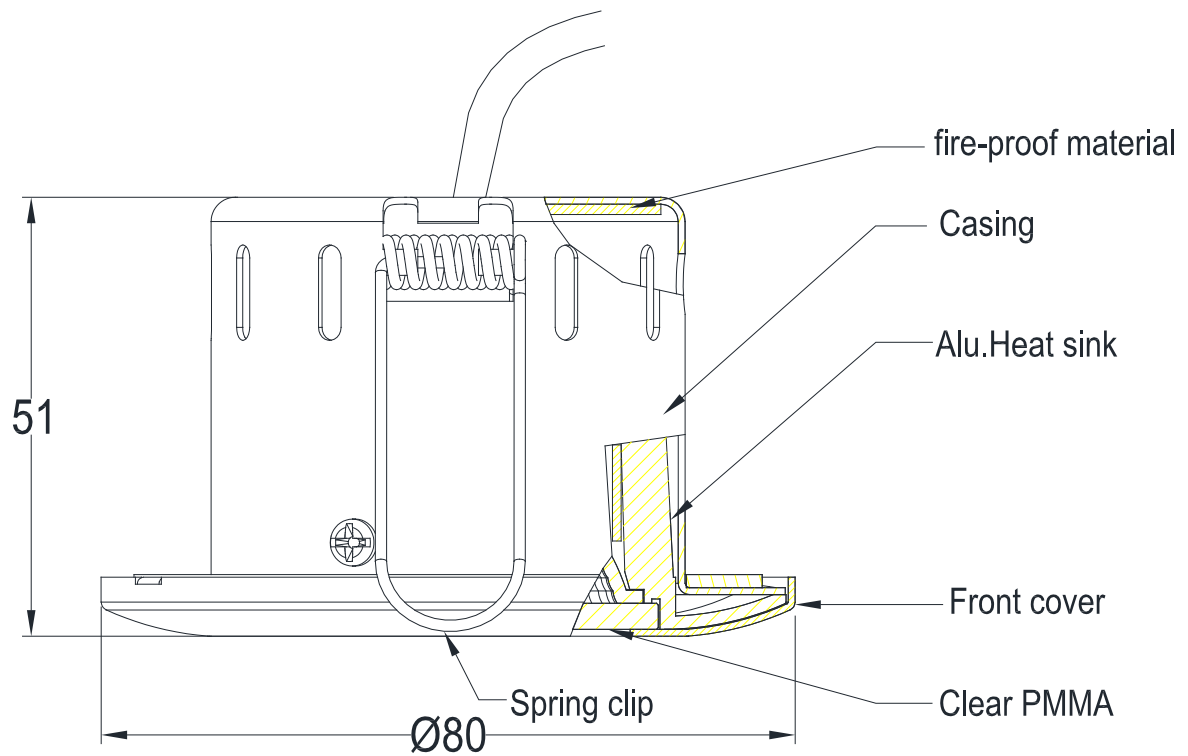
Figure 3 – Details of Downlighter Specimen A



Fixed  
With reflector:TC26XXX. XXX  
Cut out:  $\text{Ø}73$

Do not scale. All dimensions are in mm

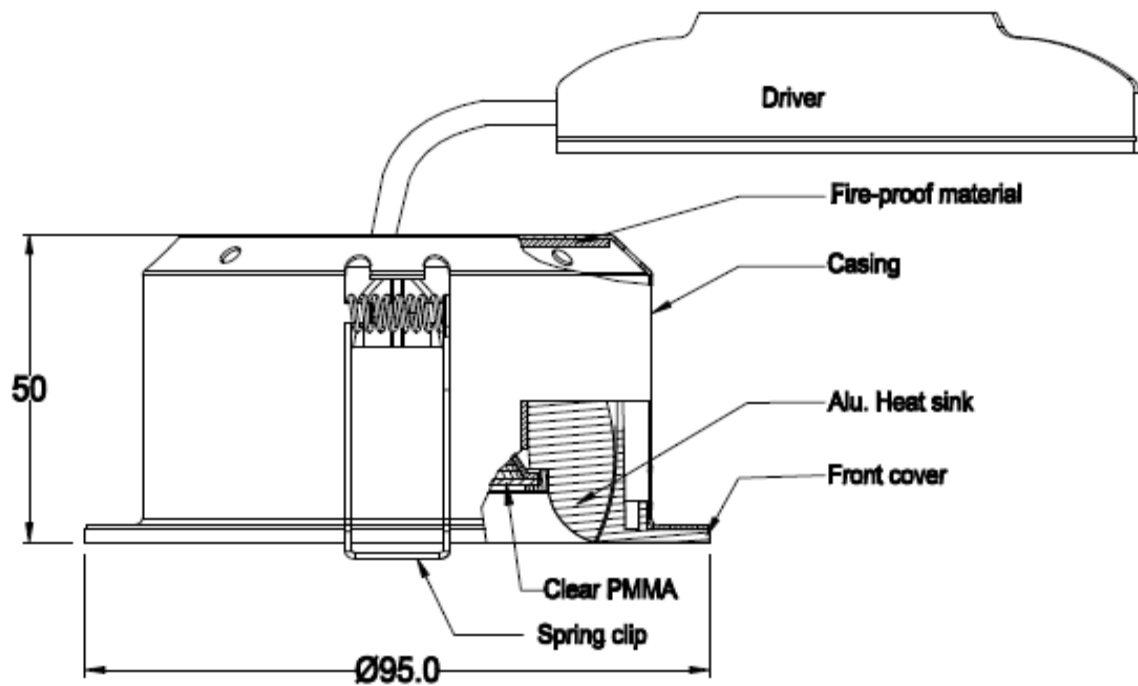
Figure 4 – Details of Downlighter Specimen B



Fixed  
With reflector:TC27XXX.XXX  
Cut out:Ø60 Nominal, Ø64 Tested

Do not scale. All dimensions are in mm

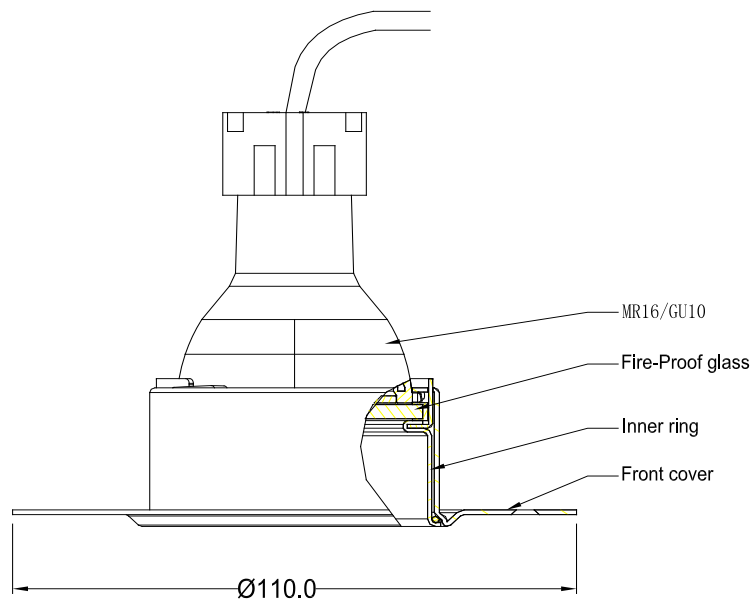
Figure 5 – Details of Downlighter Specimen C



Tilttable  
With reflector:TC28XXX. XXX  
Cut out:Ø85

Do not scale. All dimensions are in mm

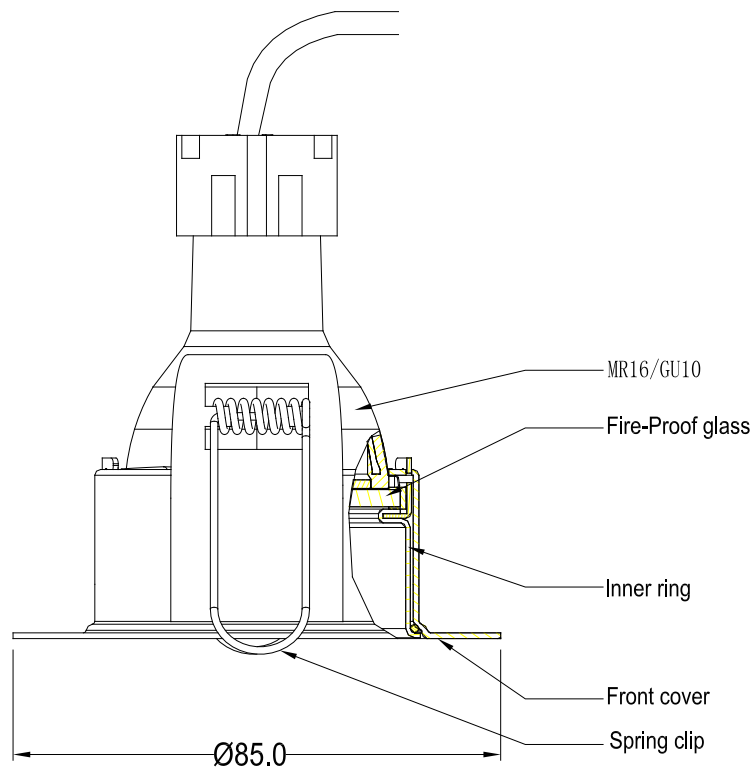
Figure 6 – Details of Downlighter Specimen D



Fixed  
ILD LFR60FXXX  
Cut out:  $\text{Ø}60$

Do not scale. All dimensions are in mm

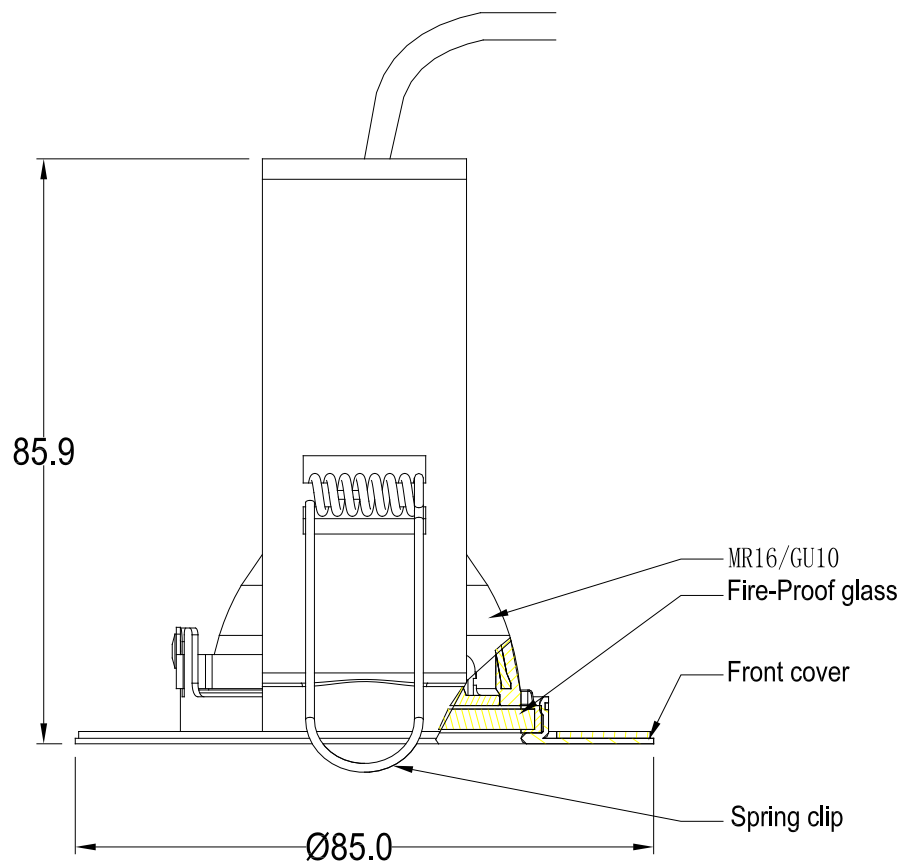
Figure 7 – Details of Downlighter Specimen E



Fixed  
ILD LFR70EXXX  
Cut out:  $\text{Ø}70$

Do not scale. All dimensions are in mm

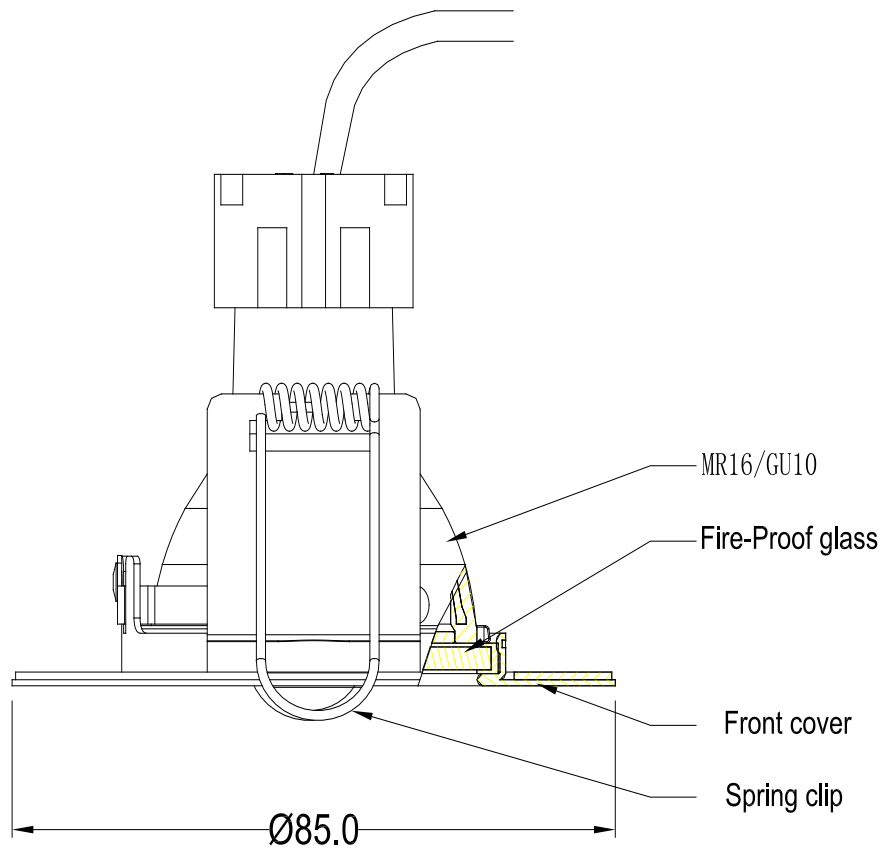
Figure 8 – Details of Downlighter Specimen F



Fixed  
ILDLFR70DXXX  
with bracket  
Cut out:  $\phi 70$

Do not scale. All dimensions are in mm

Figure 9 – Details of Downlighter Specimen G

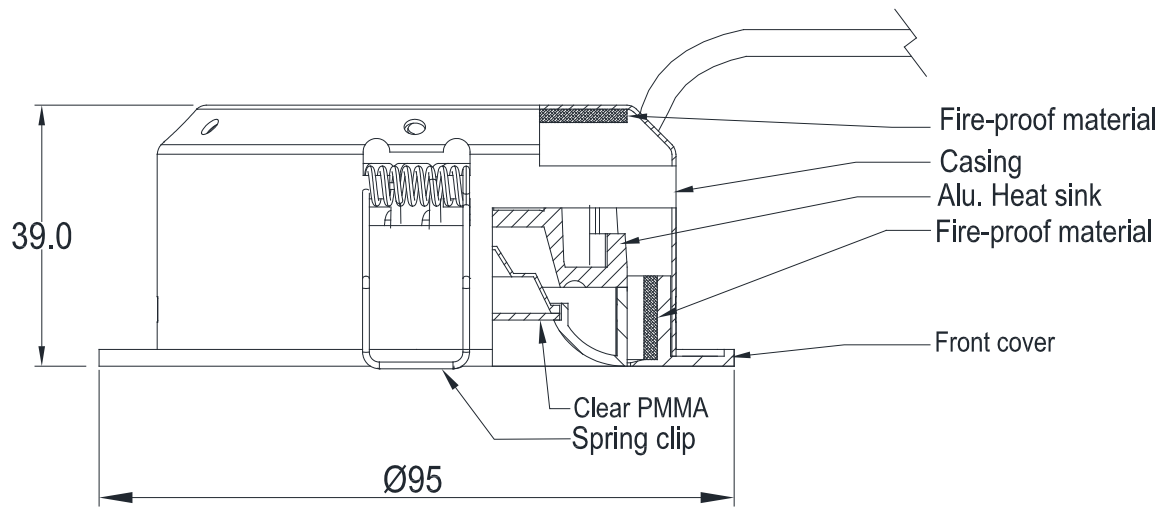


Fixed  
ILD LFR70DXXX  
Cut out:  $\text{Ø}70$

Do not scale. All dimensions are in mm



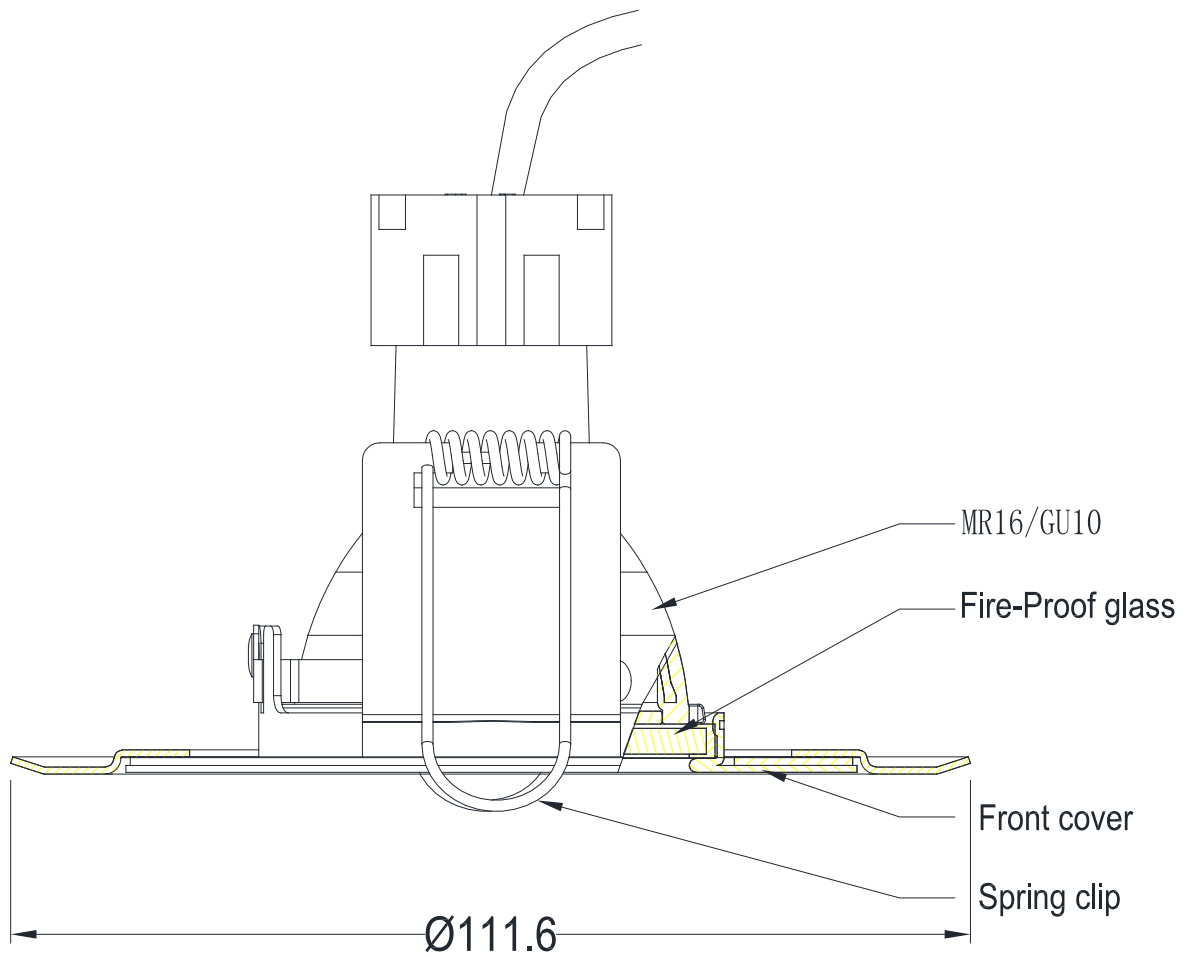
Figure 10 – Details of Downlighter Specimen H



Tilttable  
With reflector: TC36XXX. XXX  
Cut out: Ø83

Do not scale. All dimensions are in mm

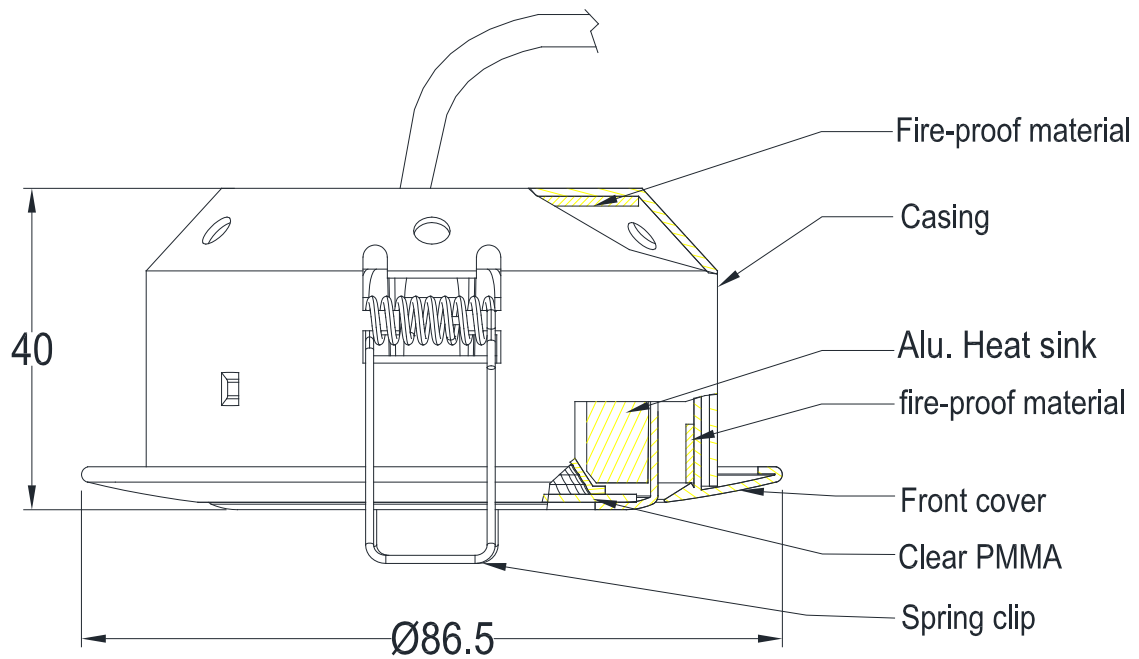
Figure 11 – Details of Downlighter Specimen I



Fixed  
ILDLFR70DXXX  
accessory of Slim Fire  
Cut out:  $\text{Ø}100\text{mm}$

Do not scale. All dimensions are in mm

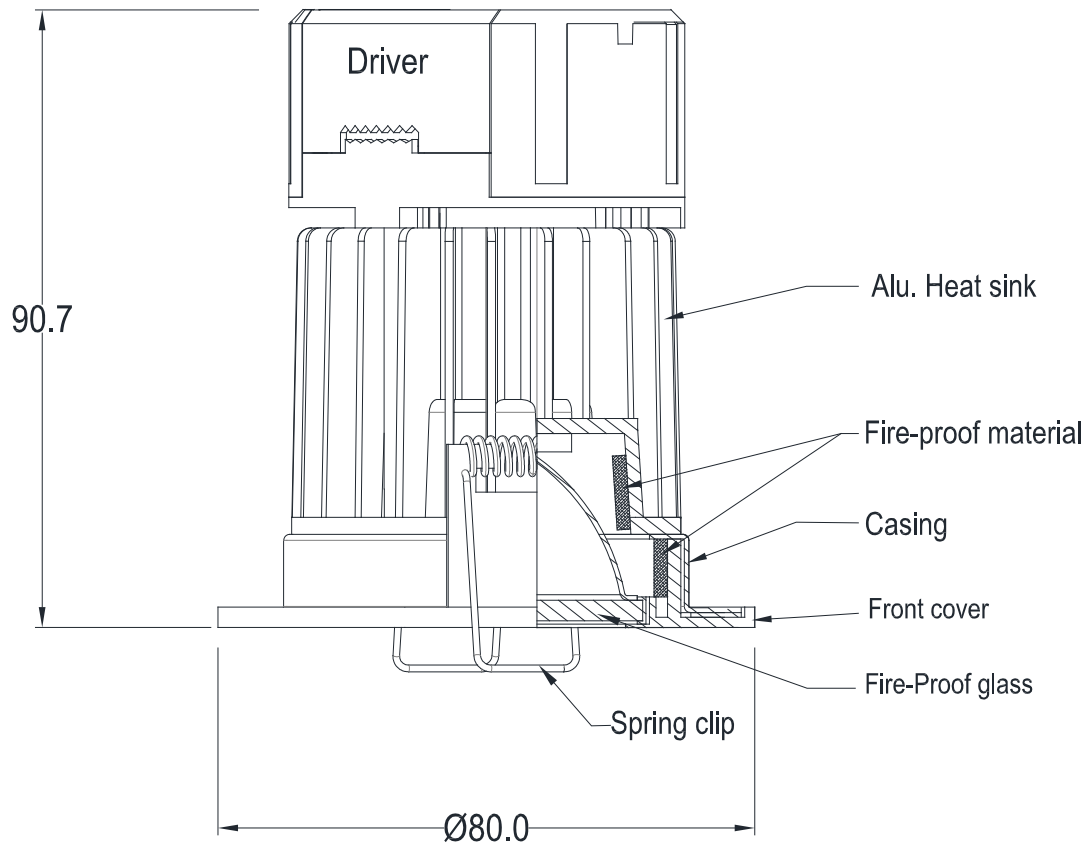
Figure 12 – Details of Downlighter Specimen J



Tilttable  
With reflector:TC70XXX. XXX  
Cut out:  $\phi 75$

Do not scale. All dimensions are in mm

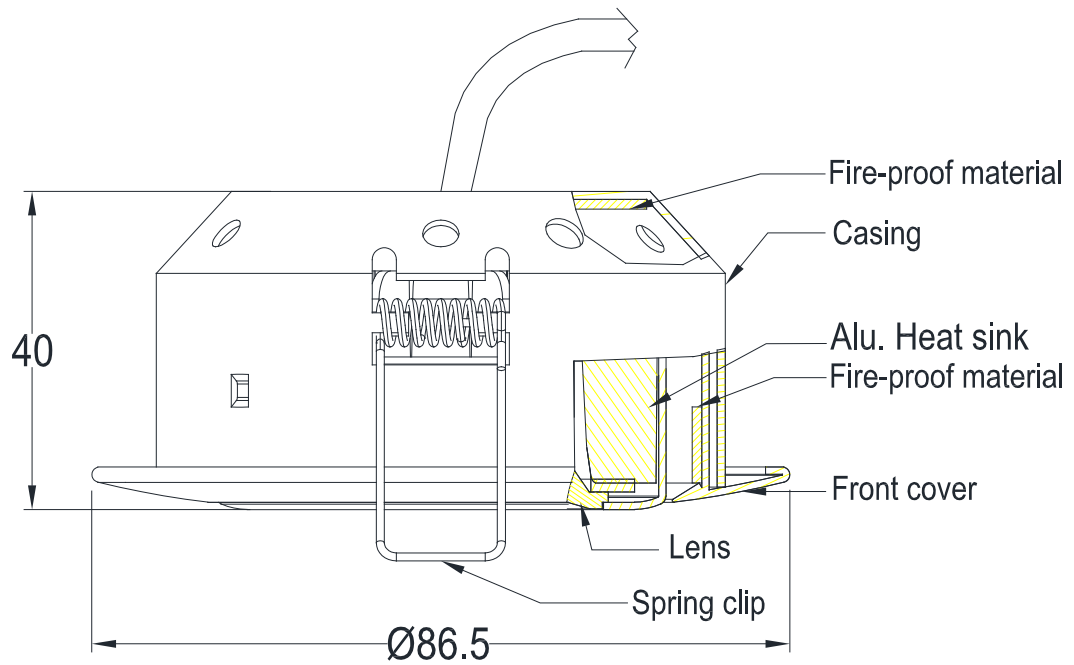
**Figure 13 – Details of Downlighter Specimen K**



Fixed  
With reflector:TC77XXX. XXX  
Cut out:Ø68

Do not scale. All dimensions are in mm

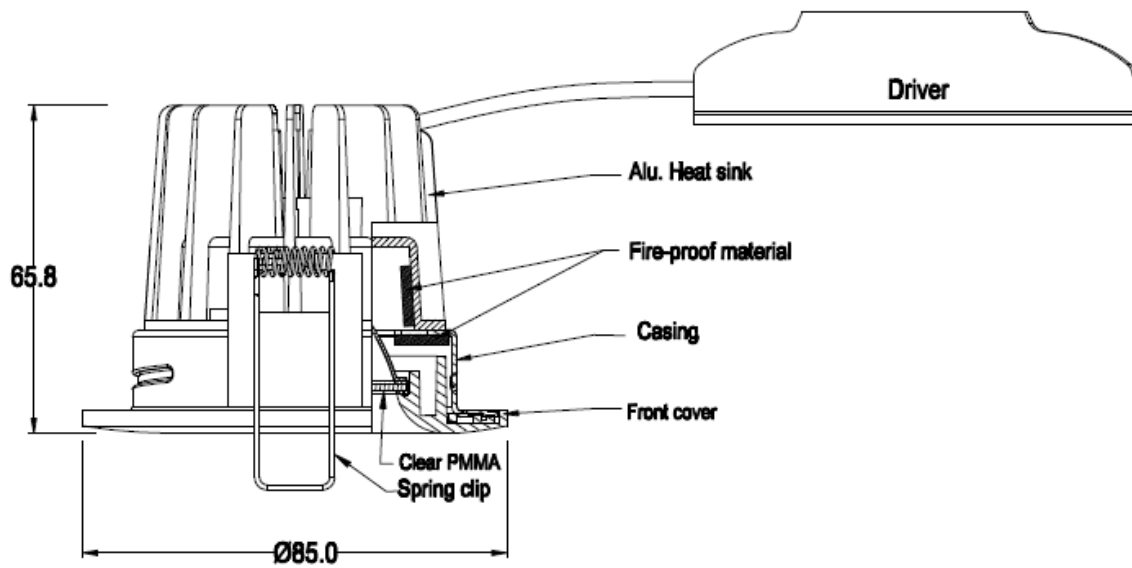
Figure 14 – Details of Downlighter Specimen L



Tilttable  
With lens:TC80XXX. XXX  
Cut out:Ø75

Do not scale. All dimensions are in mm

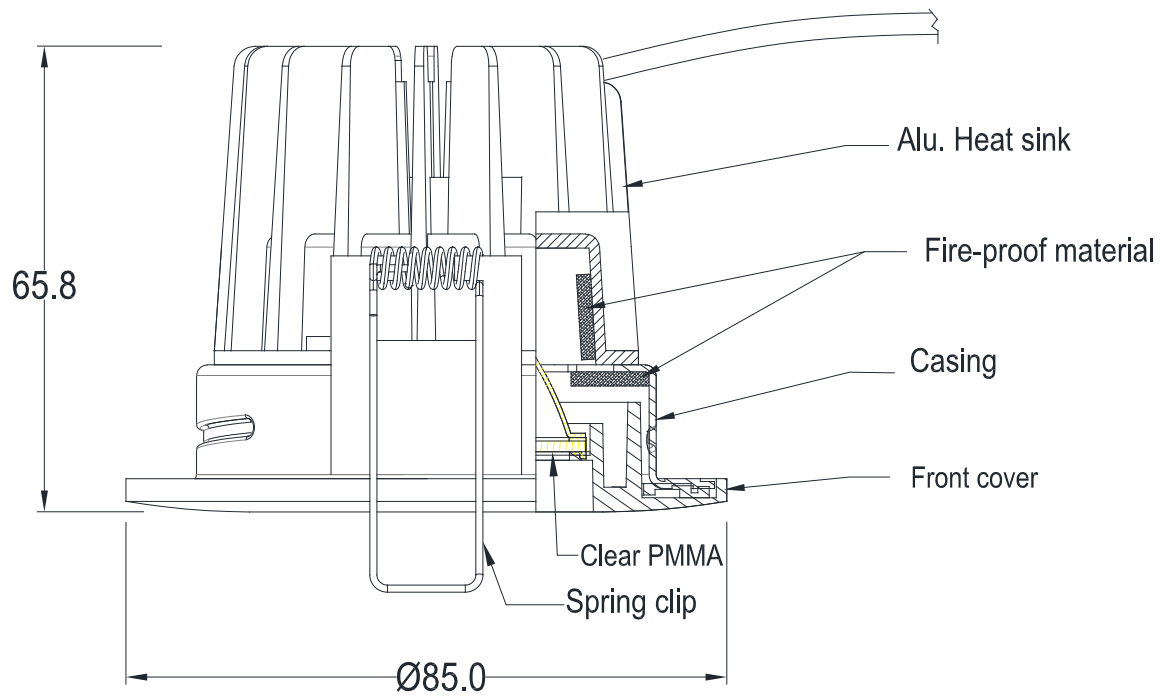
Figure 15 – Details of Downlighter Specimen M



Fixed  
With reflector:TC85XXX. XXX  
Cut out:Ø75

Do not scale. All dimensions are in mm

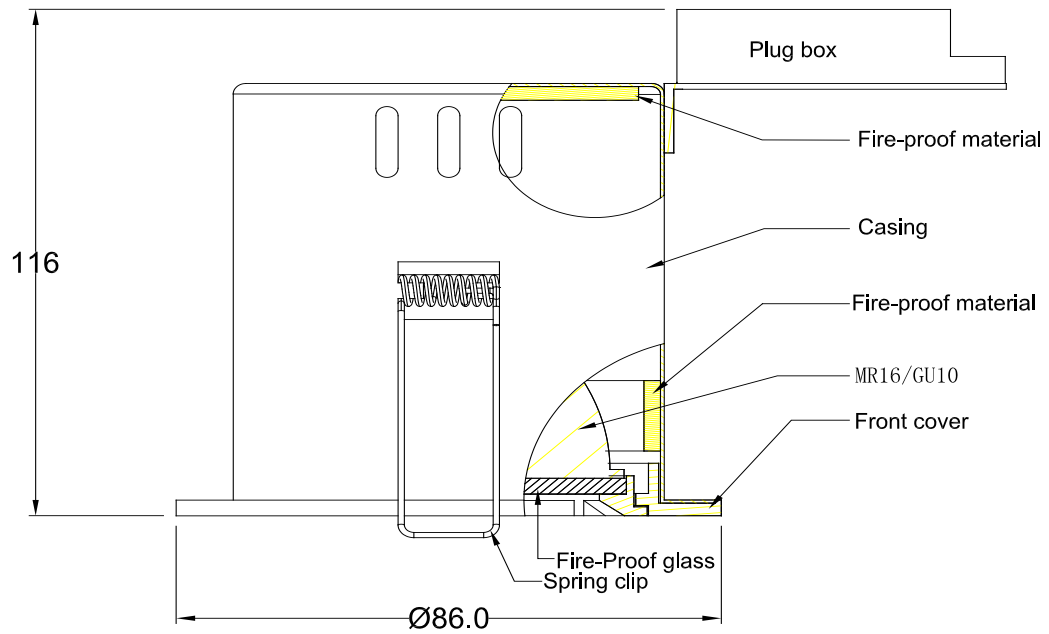
Figure 16 – Details of Downlighter Specimen N



Fixed  
With reflector:TC86XXX. XXX  
Cut out:Ø75

Do not scale. All dimensions are in mm

Figure 17 – Details of Downlighter Specimen O



Fixed

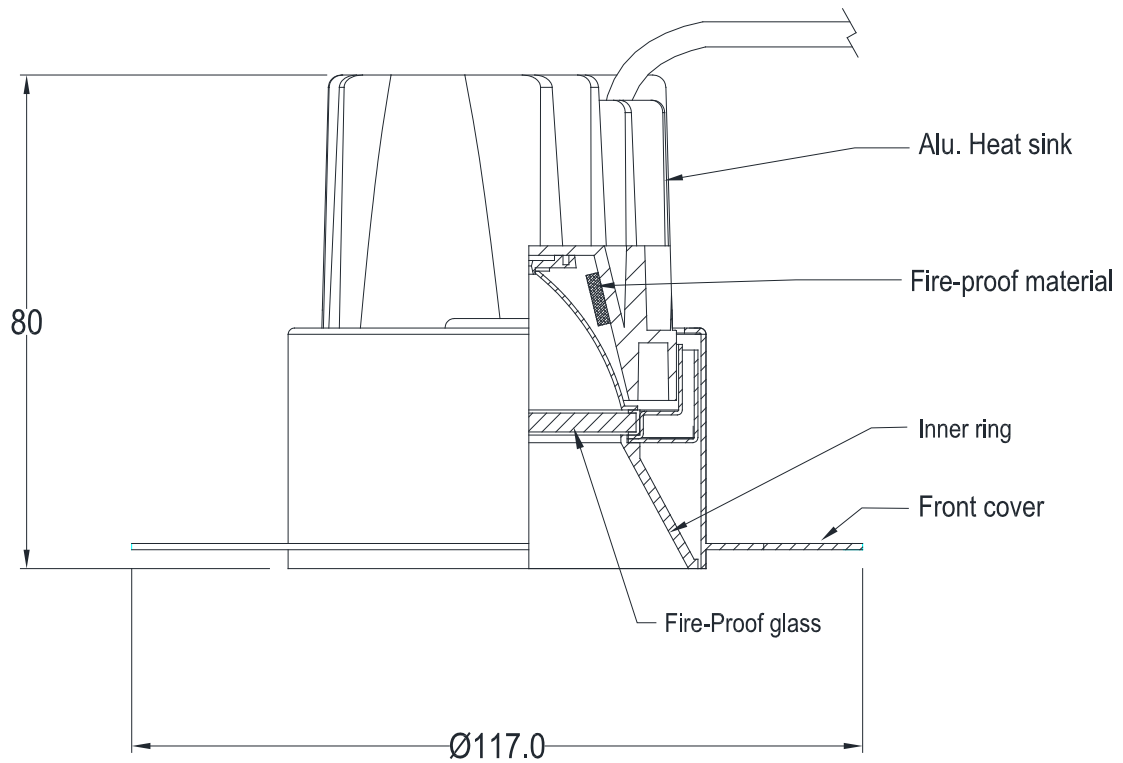
With reflector:FHT-086

Cut out:  $\phi 72$

Do not scale. All dimensions are in mm



Figure 18 – Details of Downlighter Specimen P



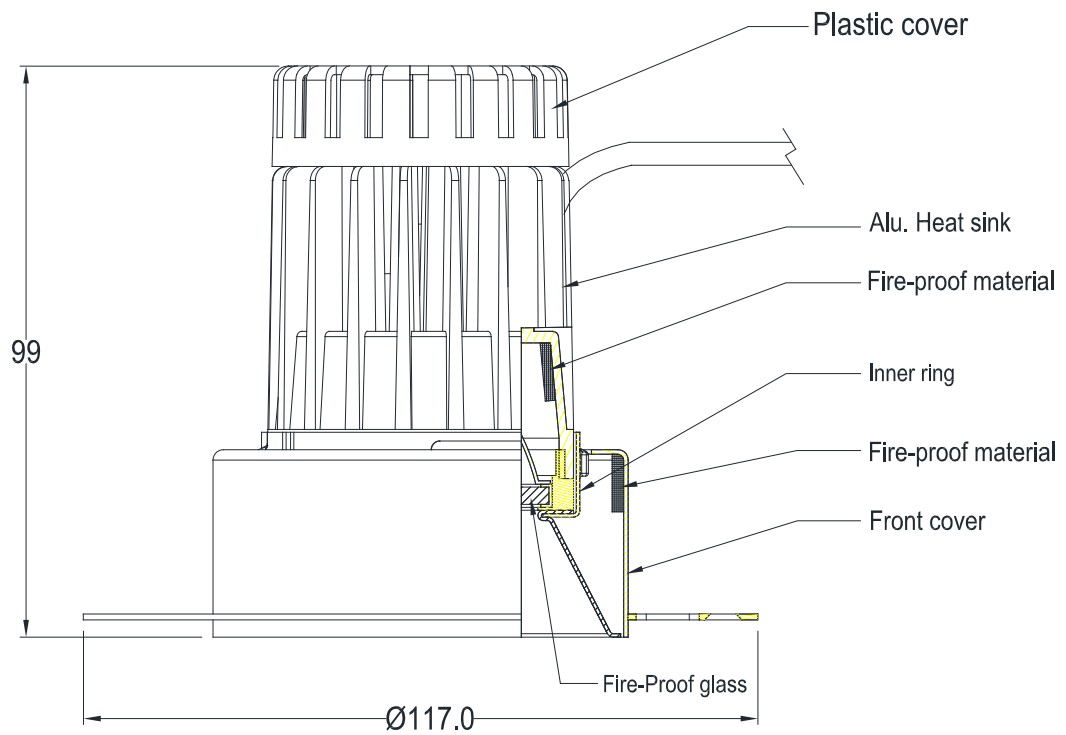
Fixed

With reflector:DC10XXX. XXX

Cut out:Ø70

Do not scale. All dimensions are in mm

**Figure 19 – Details of Downlighter Specimen Q**



Fixed

With reflector:DC11XXX. XXX

Cut out:Ø74

Do not scale. All dimensions are in mm

# Schedule of Components

---

(Refer to Figures 1 to 19)  
 (All values are nominal unless stated otherwise)  
 (All other details are as stated by the sponsors)

<u>Item</u>	<u>Description</u>
<b>1. Timber Floor</b>	
1.1 Floor Joists	
Material	: British Home-grown, rough sawn softwood, kiln dried
Grade	: C24, to BS EN 519
Density	: 508.9 kg/m <sup>3</sup>
Size	: 45 mm x 194 mm
Joist centres	: 450 mm
1.2 Floor Boards	
Material	: Flooring grade tongue and groove chipboards
Reference	: FSC E1 P5
Density	: 467.4 kg/m <sup>3</sup>
Thickness	: 22 mm
Size	: 600 mm wide
Fixing	: Fixed in a single layer with 6 mm diameter x 60 mm long countersunk steel screws to floor joists at 300 mm centres
1.3 Ceiling Boards	
Manufacturer	: British Gypsum
Type / reference	: Gyproc Fireline Wallboard
Density	: 883.7 kg/m <sup>3</sup>
Thickness	: 30 mm, 2 layers of 15 mm thick, nominal
Fixing	
i. method	: The boards were screw fixed to the soffit of the joists with all joints staggered
ii. fixings	: Drywall self-drill and tapping screws 38 mm and 45 mm long for the 1 <sup>st</sup> and 2 <sup>nd</sup> board layers respectively
iii. frequency	: 150 mm centers along joints and 150 mm to the perimeter of the ceiling
<b>2. Specimen A</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: TC26XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. heat sink	: Die casting Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5 mm thick fire proofing on the top of casing
Overall dimensions and construction	: See Figure 3 for details
Cut out size	: 73 mm
Driver	: None

<u>Item</u>	<u>Description</u>
<b>3. Specimen B</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: TC27XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5 mm thick fire proofing on top of casing
Overall dimensions and construction	: See Figure 4 for details
Cut out size	: 64 mm
Driver	: None
<b>4. Specimen C</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable model, LED recessed downlight
Reference	: TC28XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Die cast Aluminium
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5 mm thick fire proofing on the top of casing
Overall dimensions and construction	: See Figure 5 for details
Cut out size	: 85 mm
Driver	: None
<b>5. Specimen D</b>	
Manufacturer	: Integral LED
Type	: Round, fixed, LED recessed downlight
Reference	: ILDLFR60FXXX
Materials	
i. inner ring	: Steel
ii. diffuser	: Pyrex glass
iii. front cover	: Steel
Overall dimensions and construction	: See Figure 6 for details
Cut out size	: 60 mm
Driver	: None
Lamp	: GU10/MR16
<b>6. Specimen E</b>	
Manufacturer	: Integral LED
Type	: Round, fixed, LED recessed downlight
Reference	: ILDLFR70EXXX
Materials	
i. front cover	: Steel
ii. diffuser	: Pyrex glass
iii. inner ring	: Steel
Overall dimensions and construction	: See Figure 7 for details
Cut out size	: 70 mm
Driver	: None
Lamp	: GU10/MR16

<u>Item</u>	<u>Description</u>
<b>7. Specimen F</b>	
Manufacturer	: Integral LED
Type	: Round, fixed, LED recessed downlight
Reference	: ILDLFR70DXXX with bracket
Materials	
i. front cover	: Steel
ii. diffuser	: Pyrex glass
iii. spring	: Stainless steel
iv. bracket	: Steel
Overall dimensions and construction	: See Figure 8 for details
Cut out size	: 70mm
Driver	: None
Lamp	: GU10/MR16
<b>8. Specimen G</b>	
Manufacturer	: Integral LED
Type	: Round, fixed, LED recessed downlight
Reference	: ILDLFR70DXXX without bracket
Materials	
i. front cover	: Steel
ii. diffuser	: Pyrex glass
iii. spring	: Stainless steel
Overall dimensions and construction	: See Figure 9 for details
Cut out size	: 70 mm
Driver	: None
Lamp	: GU10/MR16
<b>9. Specimen H</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable, LED recessed downlight
Reference	: TC36XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Die cast Aluminium
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5 mm thick fire proofing fitted inside around the casing and on the top casing
Overall dimensions and construction	: See Figure 10 for details
Cut out size	: 83 mm
Driver	: None
<b>10. Specimen I</b>	
Manufacturer	: Integral LED
Type	: Round, fixed, LED recessed downlight
Reference	: ILDLFR70DXXX (accessory of slim fire )
Materials	
i. front cover	: Steel
ii. diffuser	: Pyrex glass
iii. front cover insert and spring clip plate	: Powder coated mild steel Aluminium
iv. spring clip	: Stainless steel
Cut out size	: 70-100 mm
Driver	: None
Lamp	: GU10/MR16

<b><u>Item</u></b>	<b><u>Description</u></b>
<b>11. Specimen J</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable, LED recessed downlight
Reference	: TC70XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5mm thick fire proofing fitted inside around the casing and on the top of casing
Overall dimensions and construction	: See Figure 12 for details
Cut out size	: 75 mm
Driver	: None
<b>12. Specimen K</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: TC77XXX.XXX
Materials	
i. driver	: Plastics
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Pyrex glass
vi. fire proof material	: 1.5mm fire proofing fitted inside around the heat sink and casing
Overall dimensions and construction	: See Figure 13 for details
Cut out size	: 68 mm diameter
Driver	: None
<b>13. Specimen L</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable, LED recessed downlight
Reference	: TC80XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: lens
vi. fire proof material	: 1.5mm thick fire proofing fitted between the inner ring and outer ring ,as well as the top of casing .
Overall dimensions and construction	: See Figure 14 for details
Cut out size	: 75 mm
Driver	: None

<b><u>Item</u></b>	<b><u>Description</u></b>
<b>14. Specimen M</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: TC85XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Die cast Aluminium
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5mm thick fire proofing fitted inside the heat sink and casing
Overall dimensions and construction	: See Figure 15 for details
Cut out size	: 75 mm
Driver	: None
<b>15. Specimen N</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: TC86XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. spring clip	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proof material	: 1.5 mm thick fire proofing fitted on the top of casing
Overall dimensions and construction	: See Figure 16 for details
Cut out size	: 73 mm
Driver	: None
<b>16. Specimen O</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: FHT-086
Materials	
i. driver	: Plastics
ii. casing	: Steel
iii. front cover	: Steel
iv. heat sink	: Die cast Aluminium
v. spring clip	: Stainless steel
vi. diffuser	: Clear PMMA
vii. fire proof material	: 1.5mm fire proofing fitted inside the casing and on the top of casing
Overall dimensions and construction	: See Figure 17 for details
Cut out size	: 72 mm

<b><u>Item</u></b>	<b><u>Description</u></b>
<b>17. Specimen P</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: DC10XXX.XXX
Materials	
i. inner ring	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. diffuser	: Pyrex glass
v. fire proof material	: 1.5mm fire proofing fitted inside the heat sink
Overall dimensions and construction	: See Figure 18 for details
Cut out size	: 70 mm
Driver	: None
<b>18. Specimen Q</b>	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, LED recessed downlight
Reference	: DC11XXX.XXX
Materials	
i. inner right	: Steel
ii. front cover	: Steel
iii. heat sink	: Die cast Aluminium
iv. plastic cover	: PC
v. diffuser	: Pyrex glass
vi. fire proof material	: 1.5mm fire proofing fitted inside the heat sink
Overall dimensions and construction	: See Figure 19 for details
Cut out size	: 74 mm
Driver	: None



# Instrumentation

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<b>General</b>	The instrumentation was provided in accordance with the requirements of the Standard.
<b>Furnace</b>	The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1. using eight mineral insulated thermocouples distributed over a plane 100 mm from the underside of the ceiling.
<b>Thermocouple Allocation</b>	<p>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:</p> <p>The locations and reference numbers of the various unexposed surface and internal thermocouples are shown in Figure 1.</p>
<b>Roving Thermocouple</b>	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.
<b>Integrity criteria</b>	Cotton pads and gap gauges were available to evaluate the impermeability of the test construction to hot gases.
<b>Furnace Pressure</b>	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 476: Part 20: 1987, Clause 3.2.2. The calculated pressure differential relative to the laboratory atmosphere at a position 100 mm below the underside of the assembly was 20 (+0, -2) Pa.

## Test Observations

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Time		All observations are from the unexposed face unless noted otherwise.
<b>mins</b>	<b>secs</b>	The ambient air temperature in the vicinity of the test construction was 18°C at the start of the test with a maximum variation of +2°C during the test.
<b>00</b>	<b>00</b>	<b>The test commences.</b>
<b>05</b>	<b>00</b>	No visible significant change.
<b>09</b>	<b>01</b>	Small amount of smoke is released from underneath the floorboard at furnace entry end.
<b>10</b>	<b>00</b>	<b>Viewed from exposed face.</b>  All specimens have discoloured black. Plasterboard to exposed face have buckled and deflected towards the heating conditions. Temperature in the cavity exceeds 100°C at approximately the centre of the floor/ceiling assembly.
<b>13</b>	<b>58</b>	<b>Viewed from exposed face.</b>  Tape on the joints on the plasterboard is detaching from the exposed face surface.
<b>15</b>	<b>00</b>	No visible significant changes to the unexposed face.
<b>21</b>	<b>11</b>	<b>Viewed from exposed face.</b>  Downlighters M and P have detached from the ceiling/floor assembly.
<b>30</b>	<b>00</b>	No visible significant changes to both faces.
<b>45</b>	<b>00</b>	No visible significant changes to both faces.
<b>60</b>	<b>00</b>	No visible significant changes to both faces.
<b>75</b>	<b>00</b>	No visible significant changes to both faces.
<b>84</b>	<b>05</b>	Joints in the first layer of plasterboard to exposed face have widened.
<b>90</b>	<b>00</b>	Cracking noises can be heard. Smoke releases through the ends of the specimen assembly increase in volume. Cavity temperature is in excess of 300°C. Deflection ratio increases. Specimen continues to satisfy the loadbearing capacity, integrity and insulation, allowing the test to continue.
<b>91</b>	<b>00</b>	<b>Viewed from exposed face.</b>  Plasterboard on the exposed face begins to detach from the joists.
<b>94</b>	<b>13</b>	<b>Viewed from exposed face.</b>  Large areas of plasterboard have detached from the floor assembly.

<b>Time</b>		All observations are from the unexposed face unless noted otherwise.
<b>mins</b>	<b>secs</b>	
<b>95</b>	<b>00</b>	<b>Viewed from exposed face.</b>  Approximately 60% of the first layer of plasterboards to exposed face have detached from the assembly.
<b>96</b>	<b>00</b>	<b>Test discontinued</b> for healthy and safety reasons as the deflection rapidly increases and a risk of a collapse of the assembly occurs.

## Test Photographs

The exposed face of the assembly prior to testing



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

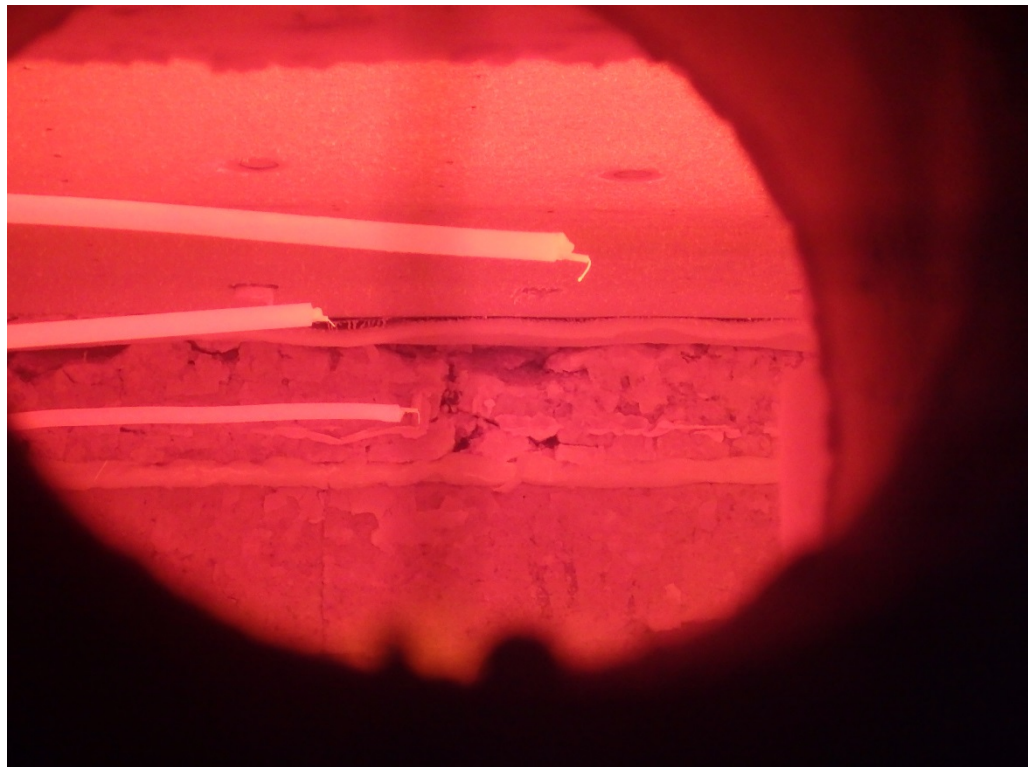




The unexposed face of the assembly after 60 minutes of testing



The exposed face of the assembly after a test duration of 60 minutes



The unexposed  
face of the  
assembly after 90  
minutes of testing



## 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	26
3	502	465
6	603	639
9	663	654
12	706	734
15	739	733
18	766	780
21	789	787
24	809	804
27	826	832
30	842	843
33	856	855
36	869	870
39	881	880
42	892	890
45	902	904
48	912	912
51	921	920
54	930	928
57	938	941
60	945	952
63	953	955
66	960	960
69	966	968
72	973	975
75	979	979
78	985	981
81	990	990
84	996	998
87	1001	1003
90	1006	1010
93	1011	1012
96	1016	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	22	22	22	22	19	21
3	22	22	22	22	19	21
6	22	22	22	22	19	21
9	22	22	22	22	19	21
12	22	22	22	22	19	21
15	22	22	22	22	20	22
18	23	24	22	23	21	23
21	25	25	23	25	23	24
24	27	27	24	28	25	26
27	29	30	25	30	28	28
30	32	32	27	33	31	31
33	34	34	29	36	34	33
36	36	36	31	38	36	35
39	38	38	33	40	39	38
42	40	40	34	42	41	39
45	42	42	36	44	43	41
48	43	44	38	46	44	43
51	45	45	40	47	46	45
54	46	47	41	49	47	46
57	47	49	43	50	48	47
60	49	50	44	51	49	49
63	50	51	45	52	50	50
66	51	52	46	53	51	51
69	52	53	47	54	52	52
72	53	54	48	54	52	52
75	55	56	49	55	53	54
78	58	59	50	57	55	56
81	62	63	51	59	57	58
84	66	67	52	62	59	61
87	70	70	54	64	61	64
90	73	73	56	67	63	66
93	75	76	58	69	65	69
96	77	77	61	72	67	71



**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
0	20	20	20	20	21
3	20	20	20	20	21
6	20	20	20	20	21
9	20	20	20	20	21
12	20	20	20	20	21
15	21	20	20	20	21
18	22	21	21	20	22
21	23	23	21	21	23
24	25	25	22	22	25
27	27	28	24	24	26
30	30	31	25	26	29
33	31	34	26	28	31
36	34	37	28	31	34
39	36	41	29	33	37
42	38	43	31	35	40
45	40	46	32	37	43
48	42	49	34	39	47
51	44	50	35	41	49
54	46	52	37	43	52
57	48	53	38	46	54
60	49	54	40	47	55
63	51	55	41	49	56
66	52	56	42	51	58
69	54	56	43	52	59
72	57	56	43	53	61
75	60	57	44	54	63
78	63	59	46	55	66
81	66	61	47	57	69
84	69	63	49	59	71
87	71	65	51	63	74
90	73	66	54	66	76
93	74	67	56	70	79
96	75	69	59	75	81

**Individual temperatures recorded adjacent to the light fittings at mid height of the cavity**

Time	T/C	T/C	T/C	T/C	T/C	T/C	T/C	T/C
Mins	Number	Number	Number	Number	Number	Number	Number	Number
	225	226	227	228	229	230	231	232
	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
0	25	24	24	25	23	23	24	24
3	25	24	25	25	23	27	24	25
6	26	27	29	31	26	46	32	30
9	31	36	43	45	38	71	50	43
12	42	49	63	57	54	83	74	61
15	58	68	81	69	85	96	87	81
18	70	99	108	79	156	98	92	88
21	98	112	109	85	154	110	107	97
24	105	130	115	86	184	115	120	101
27	91	93	115	87	193	113	108	102
30	94	103	147	88	191	120	137	107
33	100	95	146	92	164	130	136	110
36	102	99	140	96	182	135	146	112
39	108	99	133	102	152	121	144	116
42	103	102	132	103	191	121	123	118
45	119	107	130	114	215	122	138	122
48	118	106	138	127	199	120	131	121
51	111	107	137	112	191	122	115	127
54	103	105	140	124	159	124	116	129
57	103	105	139	136	134	129	119	136
60	109	109	139	132	133	138	124	136
63	108	111	122	120	132	163	139	154
66	117	121	133	127	145	194	162	176
69	129	133	150	139	159	215	180	199
72	143	147	162	154	178	225	194	207
75	155	158	174	165	191	239	207	222
78	165	169	183	175	205	249	217	230
81	175	177	194	186	216	256	232	246
84	183	187	203	197	227	272	243	257
87	194	196	212	205	238	282	254	267
90	203	204	220	216	251	294	265	279
93	211	212	251	225	261	318	276	329
96	219	221	281	240	276	571	286	642

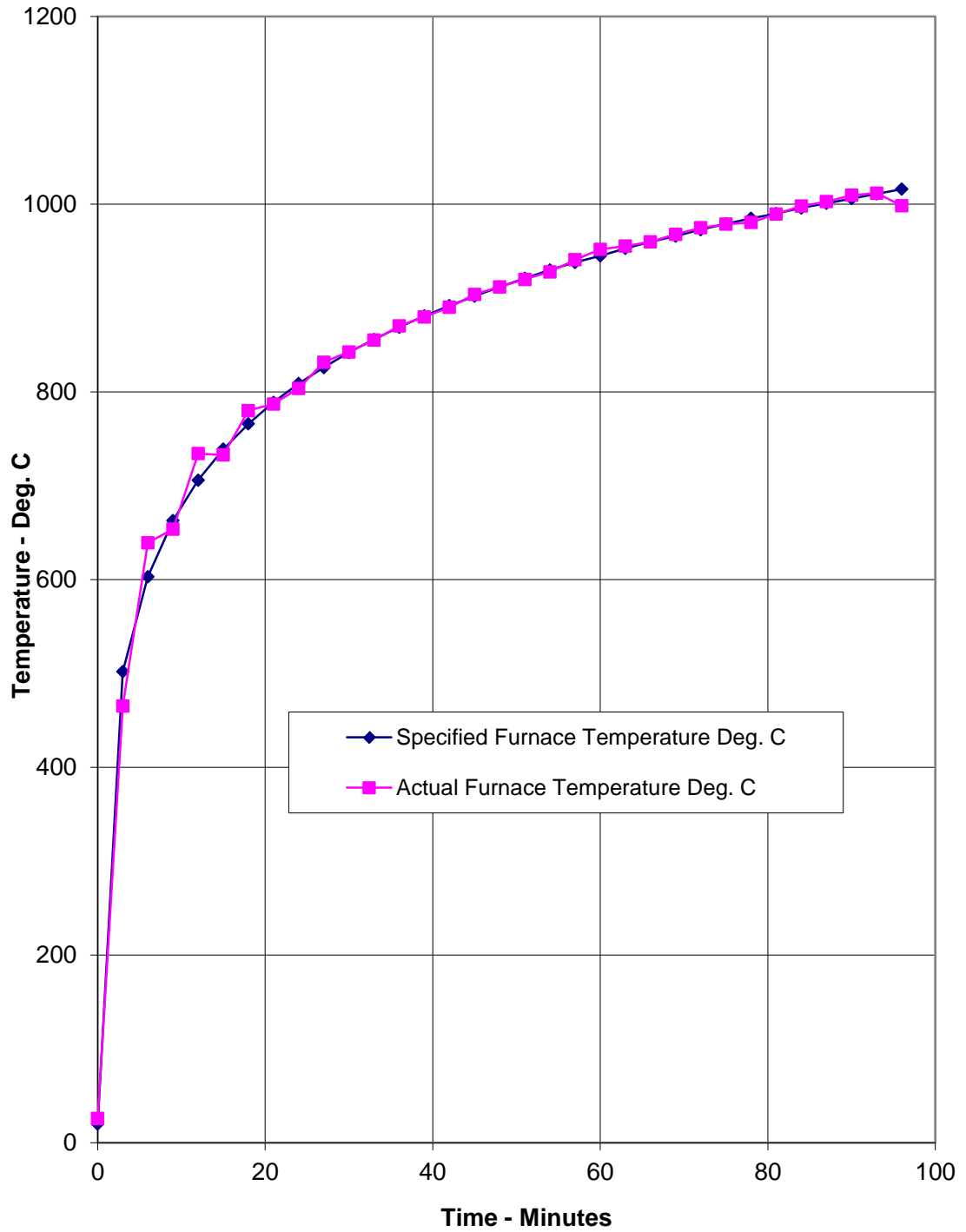
**Individual temperatures recorded adjacent to the light fittings at mid height of the cavity**

Time	T/C	T/C	T/C	T/C	T/C	T/C	T/C	T/C	T/C
Mins	Number	Number	Number	Number	Number	Number	Number	Number	Number
	233	234	235	236	237	238	239	240	241
	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
0	25	24	24	27	27	28	28	28	28
3	27	24	25	28	28	30	29	28	32
6	28	32	30	47	47	46	38	62	51
9	42	45	43	72	97	67	47	92	93
12	61	72	66	92	111	104	64	104	123
15	100	88	83	95	135	126	78	125	150
18	113	91	84	107	84	103	88	104	153
21	123	100	101	101	145	95	108	114	141
24	136	108	101	99	102	95	114	129	143
27	142	125	100	101	109	101	118	178	179
30	153	124	136	104	101	112	111	200	188
33	154	127	124	105	109	113	113	209	203
36	135	125	129	107	235	139	115	213	204
39	135	118	129	107	201	179	114	236	201
42	133	135	132	109	220	177	120	241	189
45	124	131	127	110	218	173	116	282	144
48	134	115	124	110	217	183	118	255	129
51	118	111	122	114	172	164	122	238	132
54	117	111	123	114	207	163	119	227	138
57	117	113	124	119	227	168	116	219	155
60	123	119	132	132	234	195	122	181	161
63	135	133	152	147	220	218	135	157	170
66	153	146	170	169	232	237	152	160	163
69	175	168	201	183	248	255	170	171	180
72	189	182	215	199	264	272	188	182	192
75	203	198	231	207	264	273	200	195	203
78	216	213	246	221	276	285	214	205	211
81	227	225	260	227	300	306	232	215	219
84	241	241	265	242	299	318	242	227	228
87	252	251	287	252	314	314	261	235	236
90	266	266	295	269	338	337	280	243	249
93	273	278	302	296	337	322	288	274	260
96	286	481	341	325	810	771	714	308	299

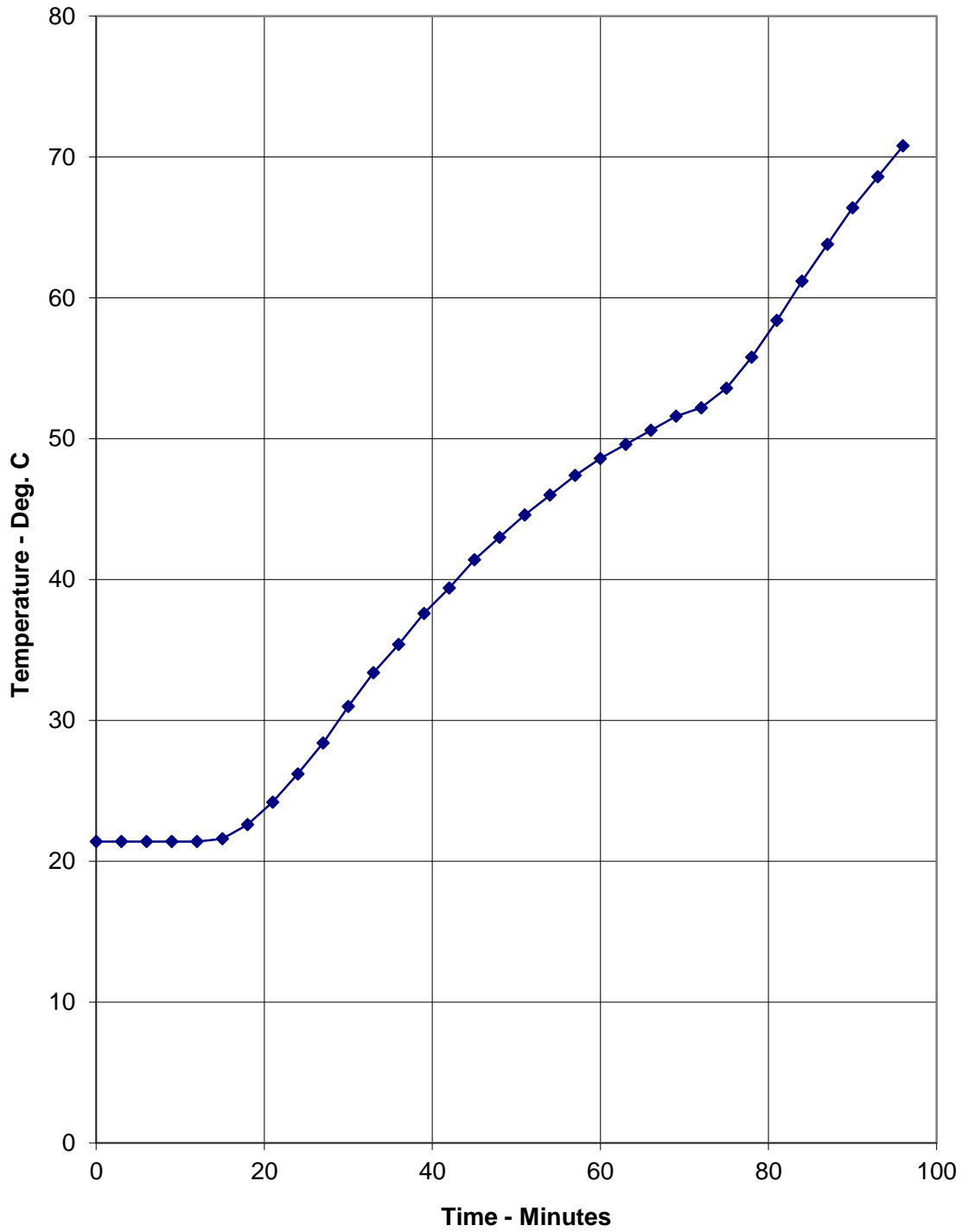
**Deflection and rate of deflection of the floor assembly during the test**

Time Mins	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0	0
3	2	0
6	3	0
9	3	0
12	3	0
15	3	0
18	4	0
21	4	0
24	4	0
27	5	0
30	5	0
33	6	0
36	7	0
39	7	0
42	8	0
45	9	0
48	9	0
51	10	1
54	10	0
57	10	0
60	11	0
63	11	0
66	12	1
69	12	0
72	13	0
75	14	0
78	15	0
81	18	1
84	20	1
87	22	1
90	25	1
93	28	1
96	32	2

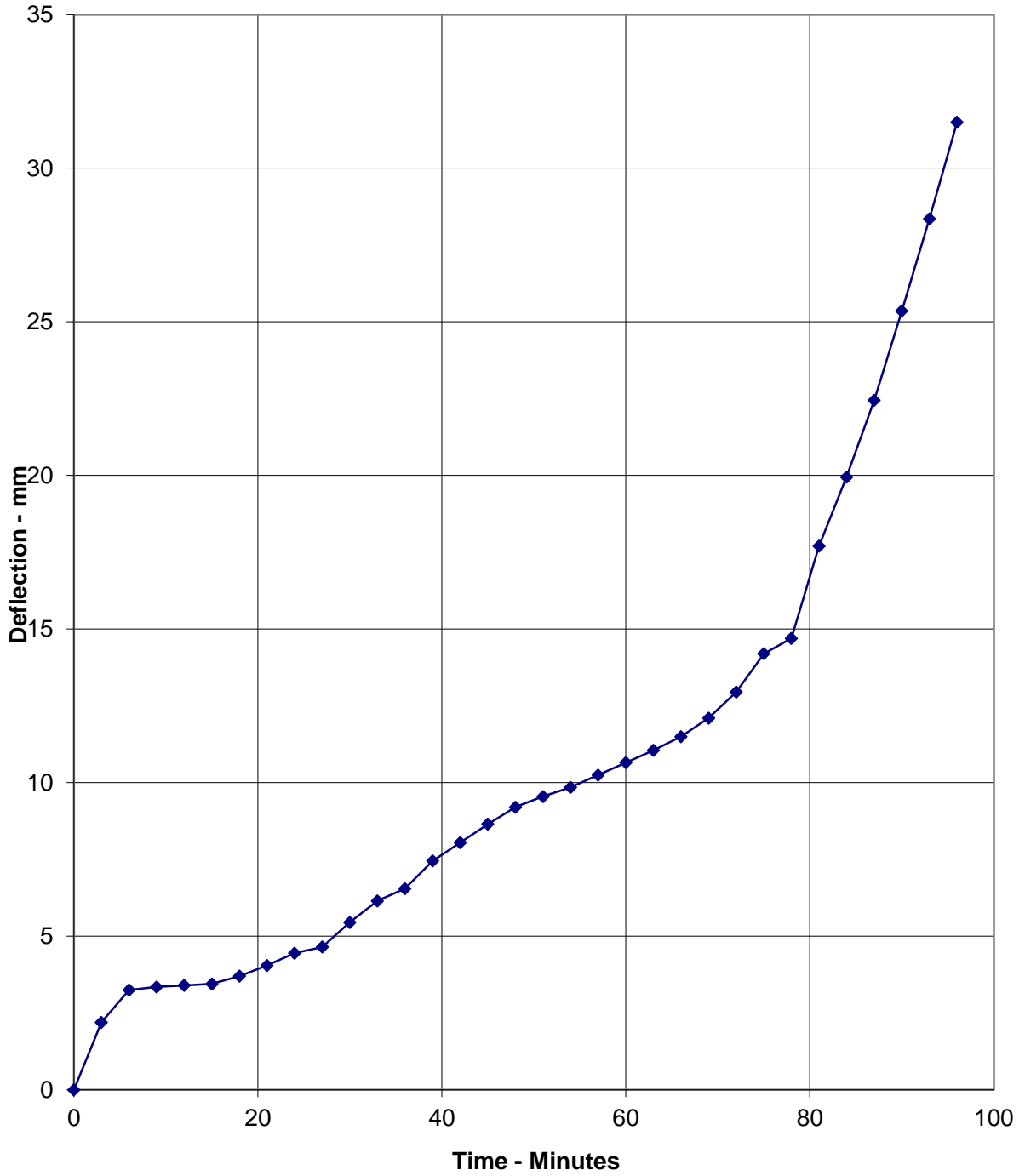
Graph showing specified and actual furnace temperatures



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)	: 194 mm deep by 45 mm thick
Mean spacing (M)	: 450 mm
Effective span (L)	: 4200 mm
Timber grade of joists	: C24

## 2. Parameters - BS 5268 – Part 2:2002

Basic dry stress in bending	: 7.5 N/mm <sup>2</sup> (Table 8)
Modification factor for loading	: 1.1 (Table 2.9 (a))
Therefore working stress (F)	: 8.25 N/mm <sup>2</sup>
Nominal density	: 535 kg/m <sup>3</sup>

## 3. Total Loading Required Per Joist

Moment of Inertia (I)	: $bd^3/12$ : $(45 \times 194^3)/12$ : 27380190 mm <sup>4</sup>
Distance from neutral axis to base of joist (y)	: 97 mm
Maximum bending stress	: $Fl/y$ : $(8.25 \times 27380190)/97$ : 2328727.5 N/mm <sup>2</sup>
Also maximum bending stress	: $wL^2/8$ : 2328727.5 N/mm <sup>2</sup>
Where w	= Load per unit length
∴ w	= $(2328727.5 \times 8) / (4200 \times 4200)$ = 1.0561 N/mm = 1056.1 N/m
∴ Total loading (W)	: 4435.67 N : 452.2 kg

∴ Total loading with 0.6 ratio (Wt)	: 0.6x452.2 kg : 271.3 kg
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## 4. Dead Weight

Combined weight of overall specimen:

Actual density of joist	: 508.9 kg/m <sup>3</sup>
Actual density of floor boarding	: 467.4 kg/m <sup>3</sup>
Actual density of ceiling board	: 883.7 kg/m <sup>3</sup>

Effective width of floor supported per joist (m) : 0.45 m

Weight of joist	: 18.65 kg
Weight of floorboard	: 19.7 kg
Weight of ceiling	: 50.1 kg

Total dead weight per joist : 88.4 kg



5. **Imposed Load**

Imposed load per joist required : total load per joist - dead weight per joist  
: 271.3 – 88.4  
= 182.9 kg

Assuming even distribution of loading

Maximum imposed load per metre square :  $(182.9 \times 9.81) / (4.2 \times 0.45)$   
: 947,262 N/m<sup>2</sup>  
: **0.947 kN/m<sup>2</sup>**  
: 96.6 kg/m<sup>2</sup>

**Calculation made by**

**Checked by**

**W. Drazkiewicz**  
Technical Officer  
Fire Resistance Department

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

## Performance Criteria and Test Results

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### Loadbearing Capacity

The maximum allowable deflection and the maximum rate of deflection for the specimen, as specified by the Standard, are calculated as 210 mm and 8.9 mm per minute respectively. The allowable rate of deflection is not applicable until the deflection exceeds  $\frac{1}{30}$  of the span (i.e. 140 mm). The test construction satisfied this requirement for the total test duration of 96 minutes.

### Integrity

It is required that there is no collapse of the specimen floor assembly, no sustained flaming on the unexposed surface and no loss of impermeability. The test construction satisfied this requirement for the total test duration of 96 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 also occurs simultaneously with integrity failure. The test construction satisfied this requirement for the total test duration of 96 minutes.

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## Ongoing Implications

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### Limitations

The results relate only to the behaviour of the specimen of the element of construction under the particular conditions of test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, nor do they reflect the actual behaviour in fires.

The test results relate only to the specimen light fittings tested. Appendix A of BS 476: Part 20: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data. Application of the result to assemblies of different dimensions or supported in other manners or incorporating different components should be the subject of a design appraisal.

### Review

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 five 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.

# Conclusions

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**Evaluation against objective** A specimen of a loadbearing timber floor assembly, protected by a plasterboard ceiling incorporating seventeen down lighter fittings has been subjected to a fire resistance test in accordance with BS 476: Part 21: 1987, Clause 7.

The evaluation of the assembly against the requirements of BS 476: Part 21: 1987, Clause 7 showed that it satisfied the requirements the periods stated below:

## Test Results:

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<b>Loadbearing Capacity</b>	96 minutes*
<b>Integrity</b>	96 minutes*
<b>Insulation</b>	96 minutes*

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\*The test was discontinued after a period of 96 minutes.