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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 60 minutes Fire Resistance, Incorporating Twenty Downlight Light Fittings, Tested in Accordance with BS 476: Part 21: 1987, Clause 7

WF Report No:

371969



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:

14th 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 60 minutes fire resistance, incorporating twenty 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-Sponsors **Integral LED**
Unit 6, Iron Bridge Close, Iron Bridge Business Park, London, NW10 0UF, U

Summary of Tested Assembly The timber floor had overall nominal dimensions of 4500 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 two layers of 12.5 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 0.746 kN/m².

The ceiling incorporated twenty downlight light fittings.

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

Test Ref.	Model Ref.	Description
A	ILD LFR60FXXX	Round, fixed, Agate LED recessed downlight, 60 mm diameter cut-out.
B	ILD LFR70EXXX	Round, fixed, Agate LED recessed downlight, 70 mm diameter cut-out.
C	ILD LFR70DXXX	Round, fixed, Agate LED recessed downlight, 70 mm diameter cut-out.
D	ILD LFR70DXXX	Round, fixed, Agate LED recessed downlight, 70 mm diameter cut-out.
E	ILD LFR70DXXX	Round, fixed, Agate LED recessed downlight with accessory of slim fire, 100 mm diameter cut-out.
F	ILD LFR70DXXX	Square, fixed, LED recessed downlight, 70 mm diameter cut-out
G	ILD LFR70DXXX	Square, fixed, LED recessed downlight, 70 mm diameter cut-out
H	ILD LFR70EXXX	Square, fixed, LED recessed downlight, 70 mm x 70 mm cut-out
I	ILD LFR70FXXX	Square, fixed, LED recessed downlight, 70 mm x 70 mm cut-out

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

Test Ref.	Model Ref.	Description
J	TC27XXX.XXX	Round, fixed, Agate LED recessed downlight, 60 mm nominal diameter (64 mm diameter tested) cut-out
K	TC80XXX.XXX	Round, tiltable, Agate LED recessed downlight, 75 mm diameter cut-out
L	TC70XXX.XXX	Round, tiltable, Agate LED recessed downlight, 75 mm diameter cut-out
M	TC36XXX.XXX	Round, tiltable, Agate LED recessed downlight, 83 mm diameter cut-out
N	TC28XXX.XXX	Round, tiltable, Agate LED recessed downlight, 85 mm diameter cut-out
O	DC11XXX.XXX	Round, fixed, Agate LED recessed downlight, 74 mm diameter cut-out
P	DC10XXX.XXX	Round, fixed, Agate LED recessed downlight, 70 mm diameter cut-out
Q	TC85XXX.XXX	Round, fixed, Agate LED recessed downlight, 85 mm diameter cut-out
R	TC26XXX.XXX	Round, fixed, Agate LED recessed downlight, 73 mm diameter cut-out
S	TC33XXX.XXX	Round, fixed, Agate LED recessed downlight, 73 mm diameter cut-out
T	FHT-086	Round, fixed, Agate LED recessed downlight, 72 mm diameter cut-out

Test Results:

Loadbearing Capacity	66 minutes*
Integrity	66 minutes*
Insulation	66 minutes*

*The test was discontinued after a period of 66 minutes

Date of Test 23rd October 2016

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Signatories



Responsible Officer
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Approved
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Technical Officer

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

Report Issued

Date: 14th March 2017

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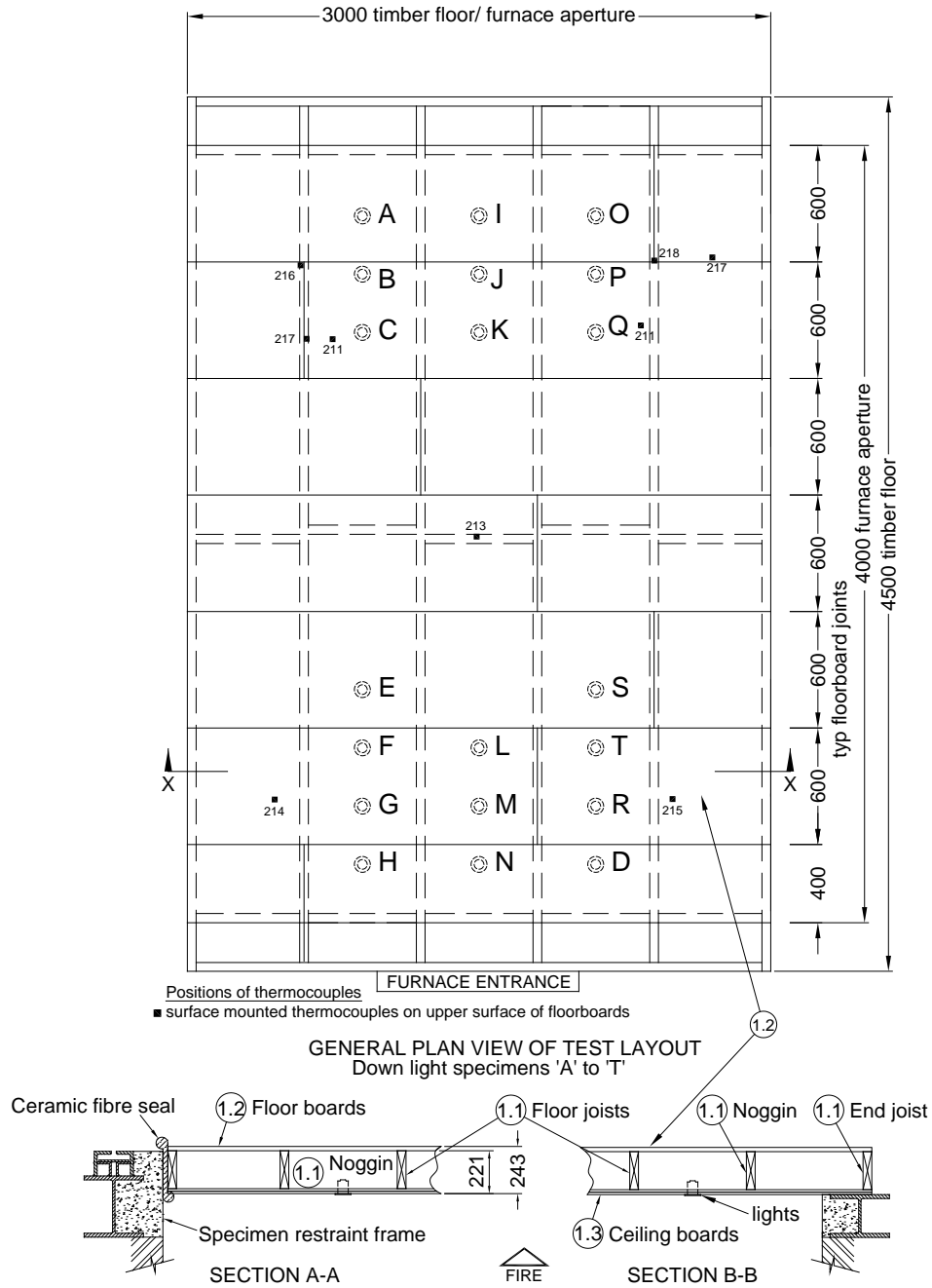
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Test Procedure

Introduction	<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>
Fire Test Study Group/EGOLF	<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>
Instruction To Test	<p>The test was conducted on the 24th October 2016 at the request of the test sponsors.</p> <p>Mr. A. Gooding a representative of the test sponsors witnessed the test.</p>
Test Assembly Construction	<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>
Installation	<p>Representatives of Exova Warringtonfire assembled the floor construction and installed the down lighters on the 17th October 2016.</p>
Conditioning	<p>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 8°C to 16°C and 47% to 65% respectively.</p>

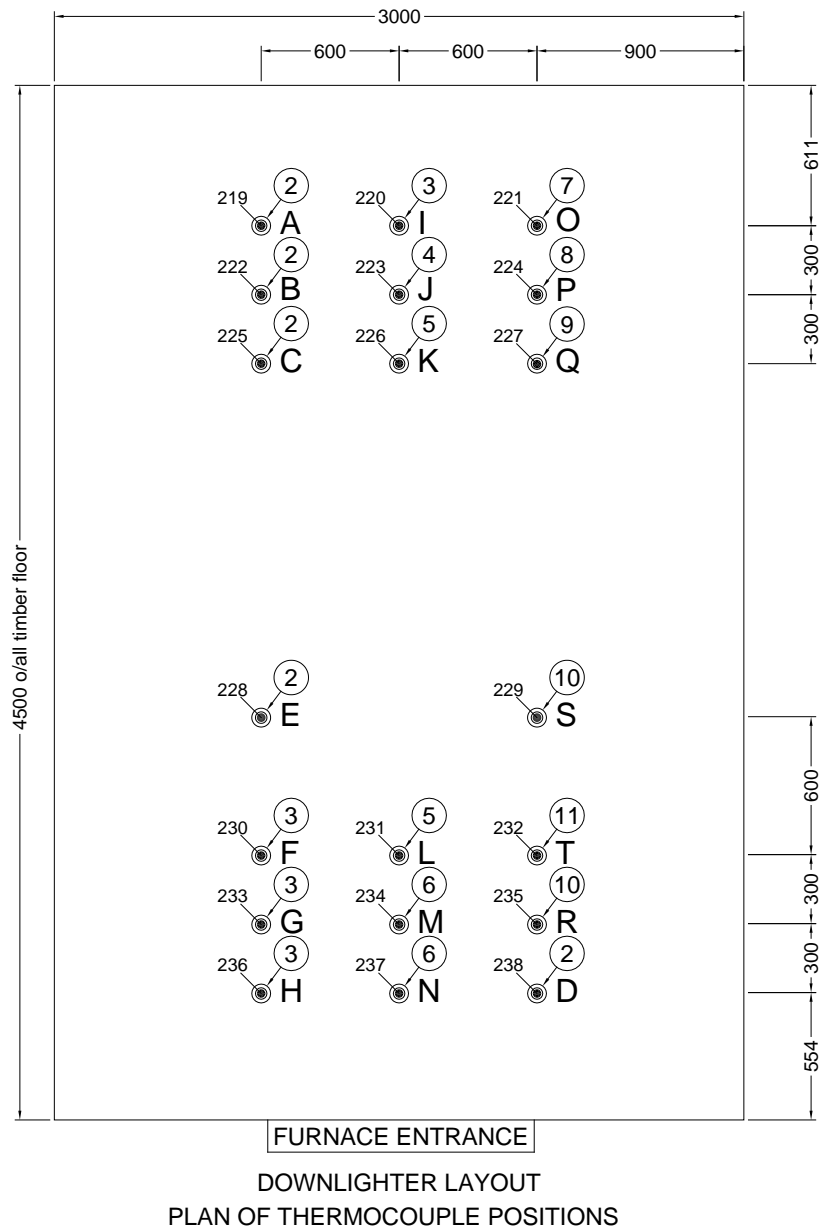
Test Specimens

Figure 1- General Elevation of Test Specimens



Do not scale. All dimensions are in mm

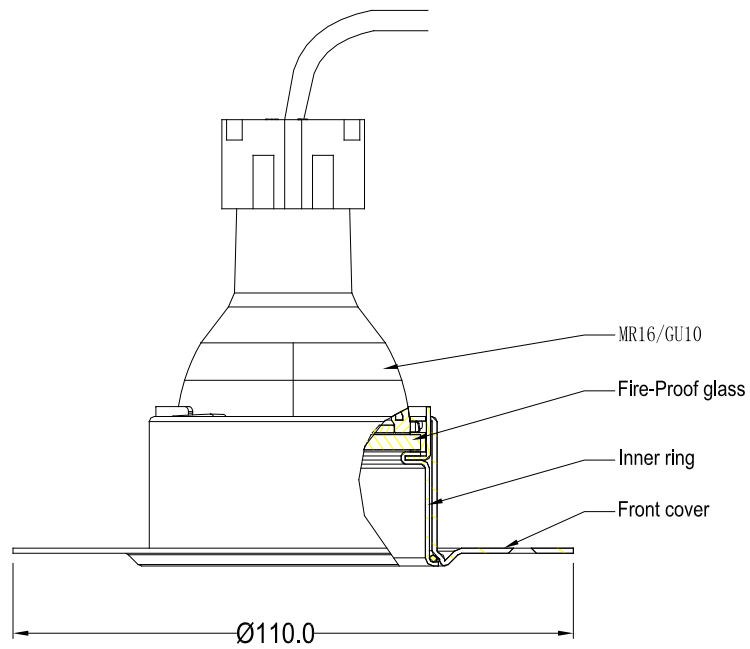
Figure 2 – Details of Downlighter Positions



- Mineral insulated thermocouples at mid-cavity height

Do not scale. All dimensions are in mm

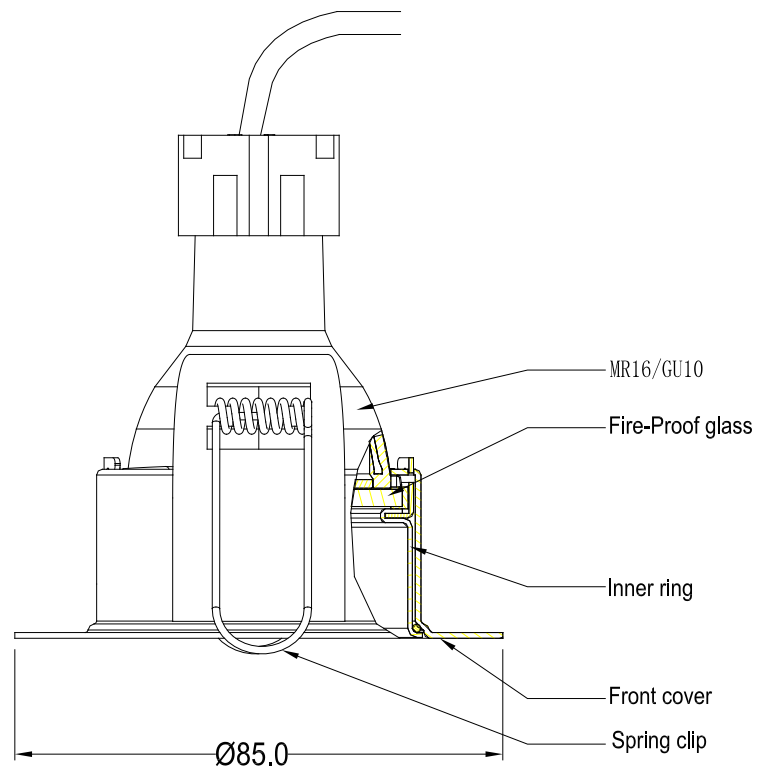
Figure 3 – Details of Downlighter Specimen A



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

Do not scale. All dimensions are in mm

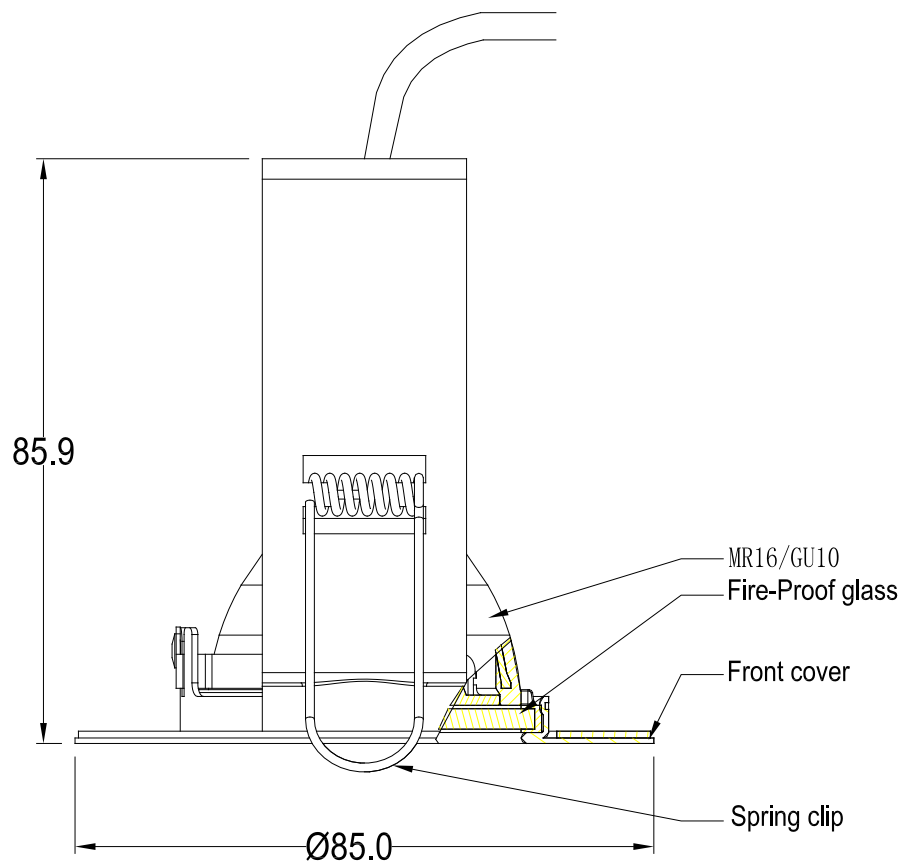
Figure 4 – Details of Downlighter Specimen B



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

Do not scale. All dimensions are in mm

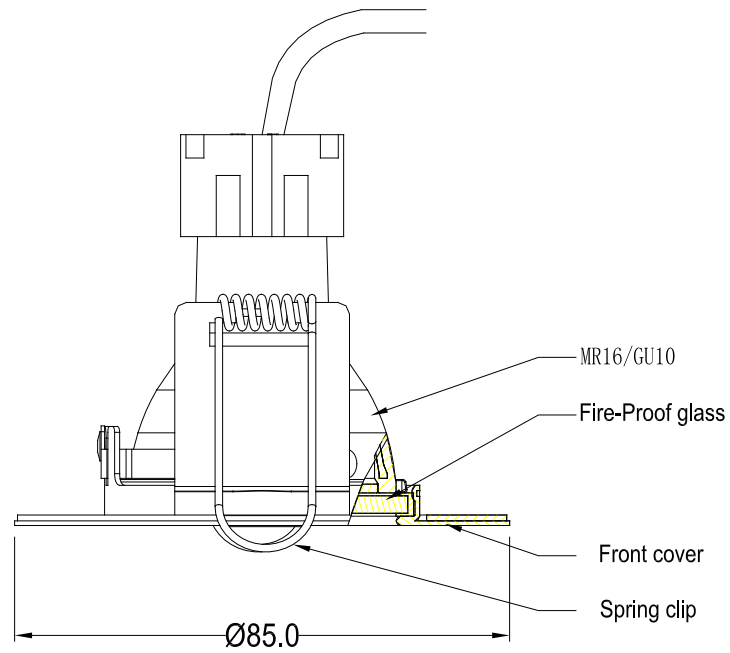
Figure 5 – Details of Downlighter Specimen C



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

Do not scale. All dimensions are in mm

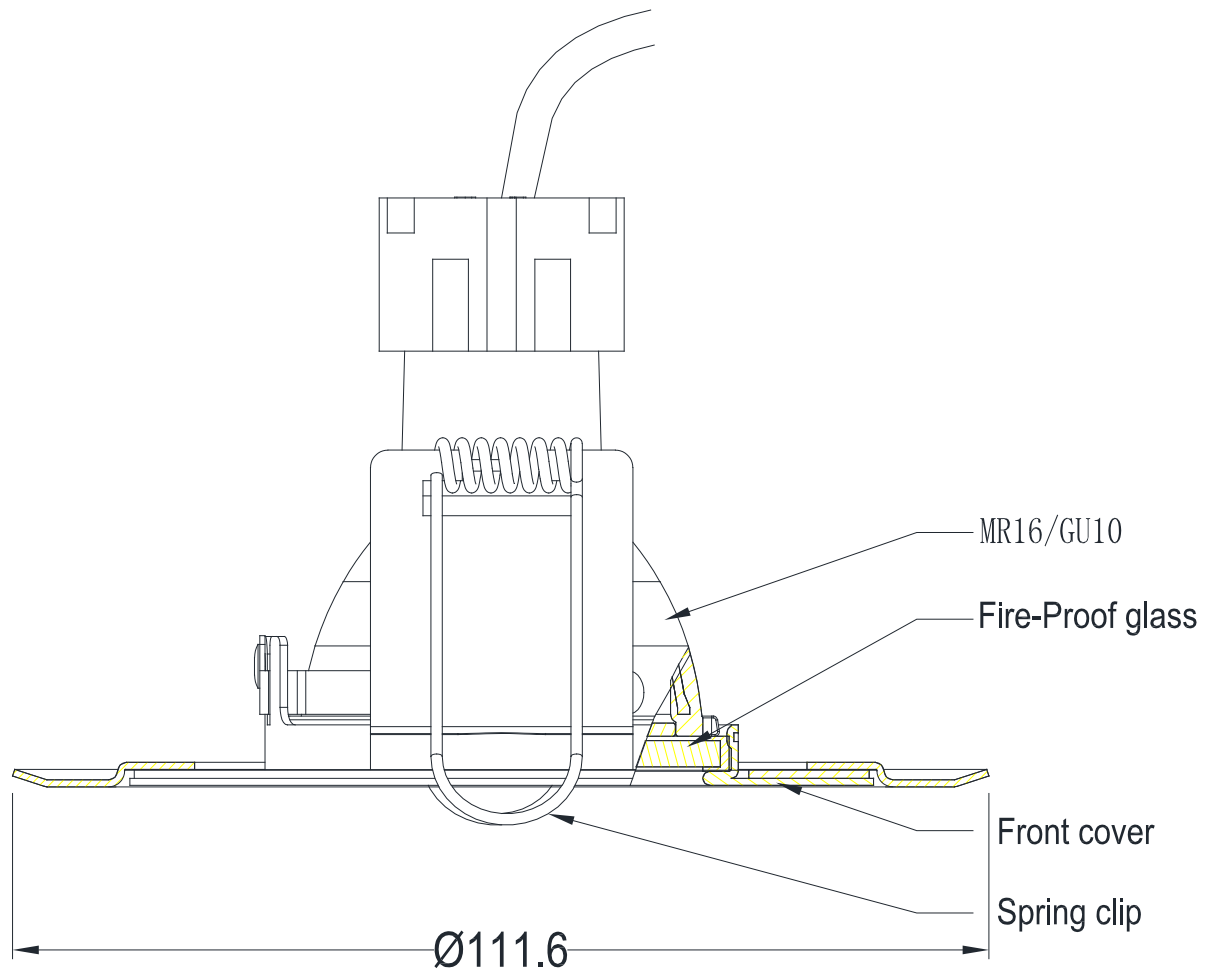
Figure 6 – Details of Downlighter Specimen D



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

Do not scale. All dimensions are in mm

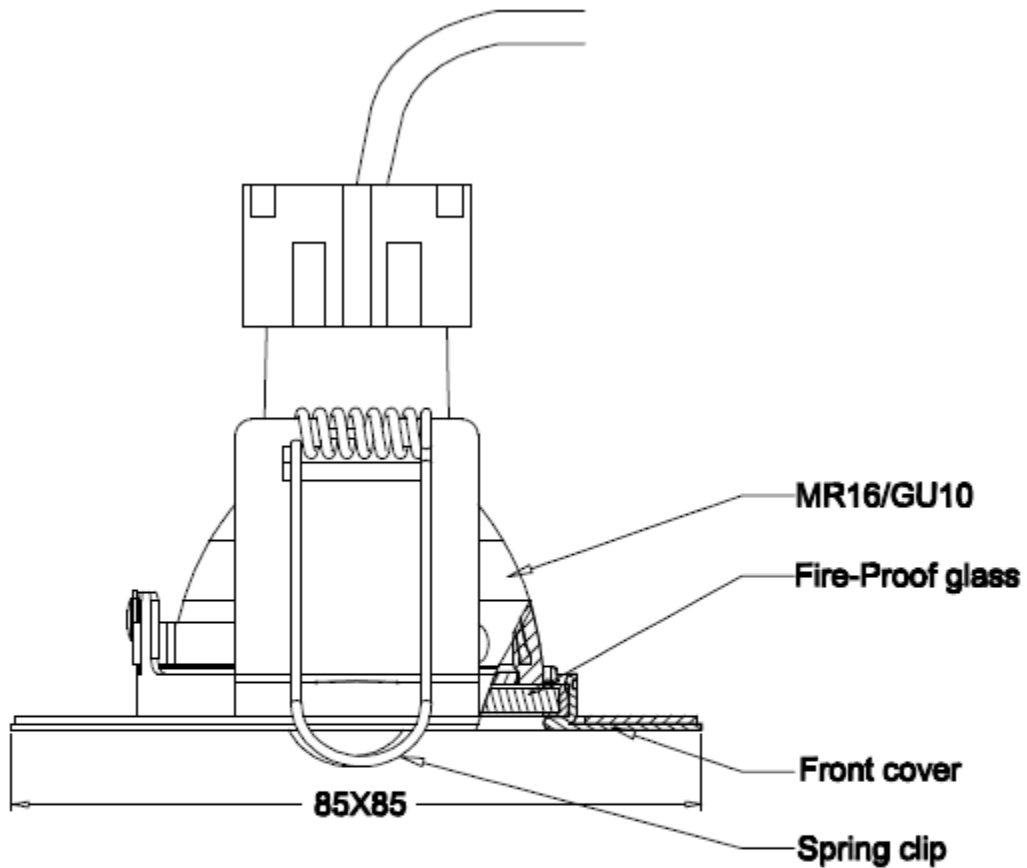
Figure 7 – Details of Downlighter Specimen E



Fixed
ILD LFR70DXXX
accessory of Slim Fire
Cut out: $\text{Ø}100\text{mm}$

Do not scale. All dimensions are in mm

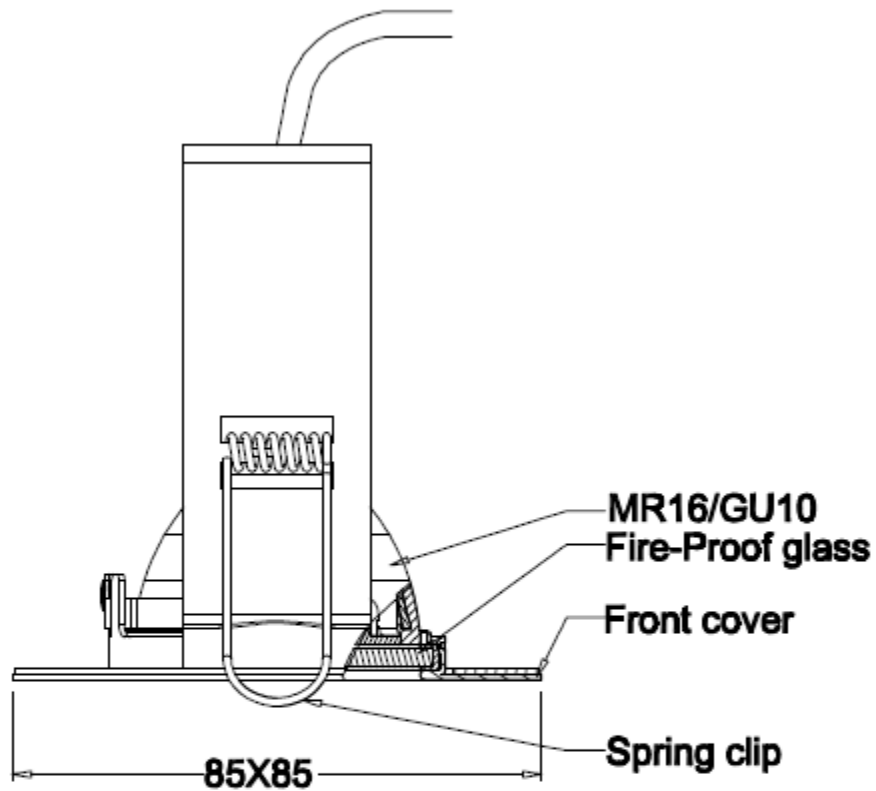
Figure 8 – Details of Downlighter Specimen F



**Fixed model
ILDLFR70DXXX
Slim fire square bezel
Cut out:Ø70mm**

Do not scale. All dimensions are in mm

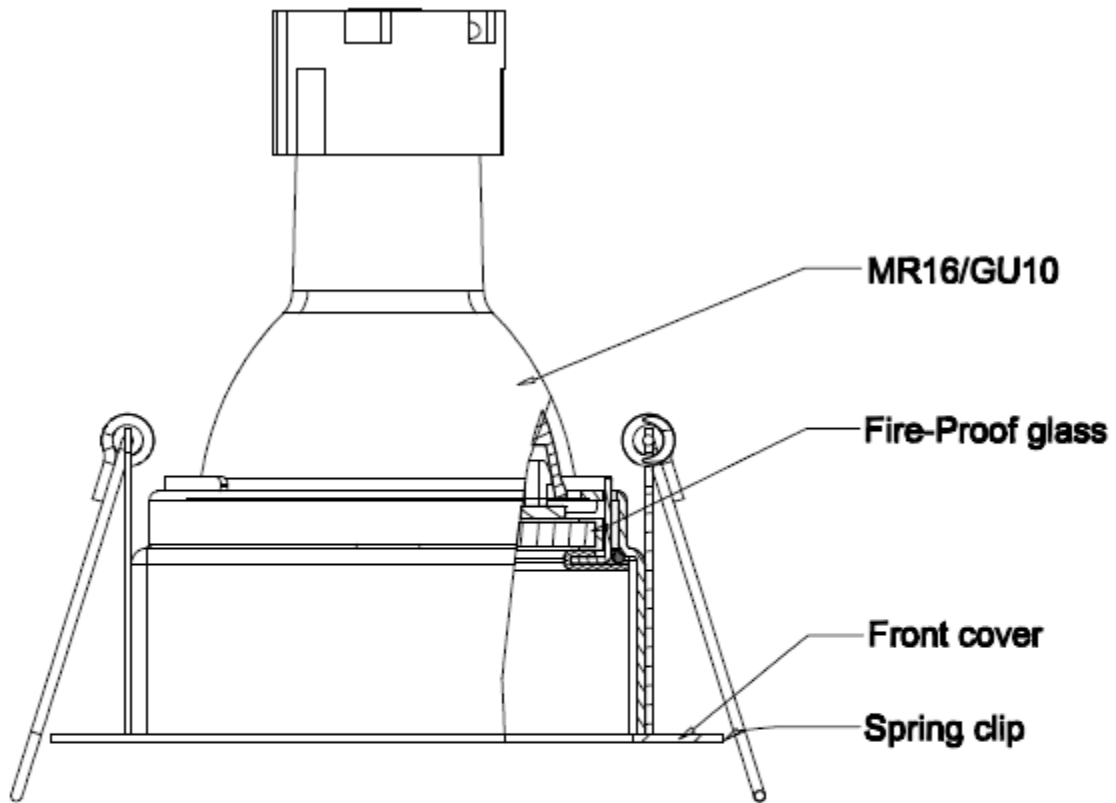
Figure 9 – Details of Downlighter Specimen G



**Fixed model
ILDLFR70DXXX
Slim fire square bezel with bracket
Cut out: Ø70mm**

Do not scale. All dimensions are in mm

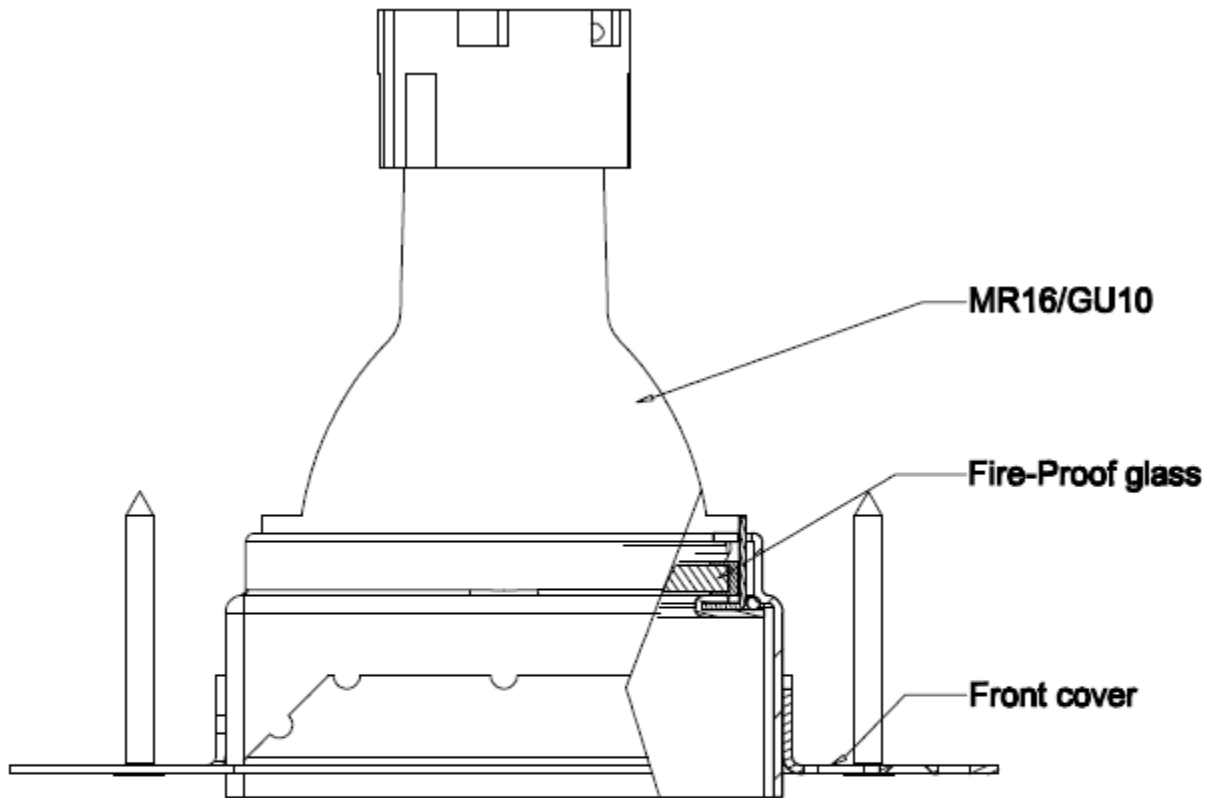
Figure 10 – Details of Downlighter Specimen H



**Fixed model
ILD LFR70EXXX
Slim fire square bezel
Cut out: Ø70X70mm**

Do not scale. All dimensions are in mm

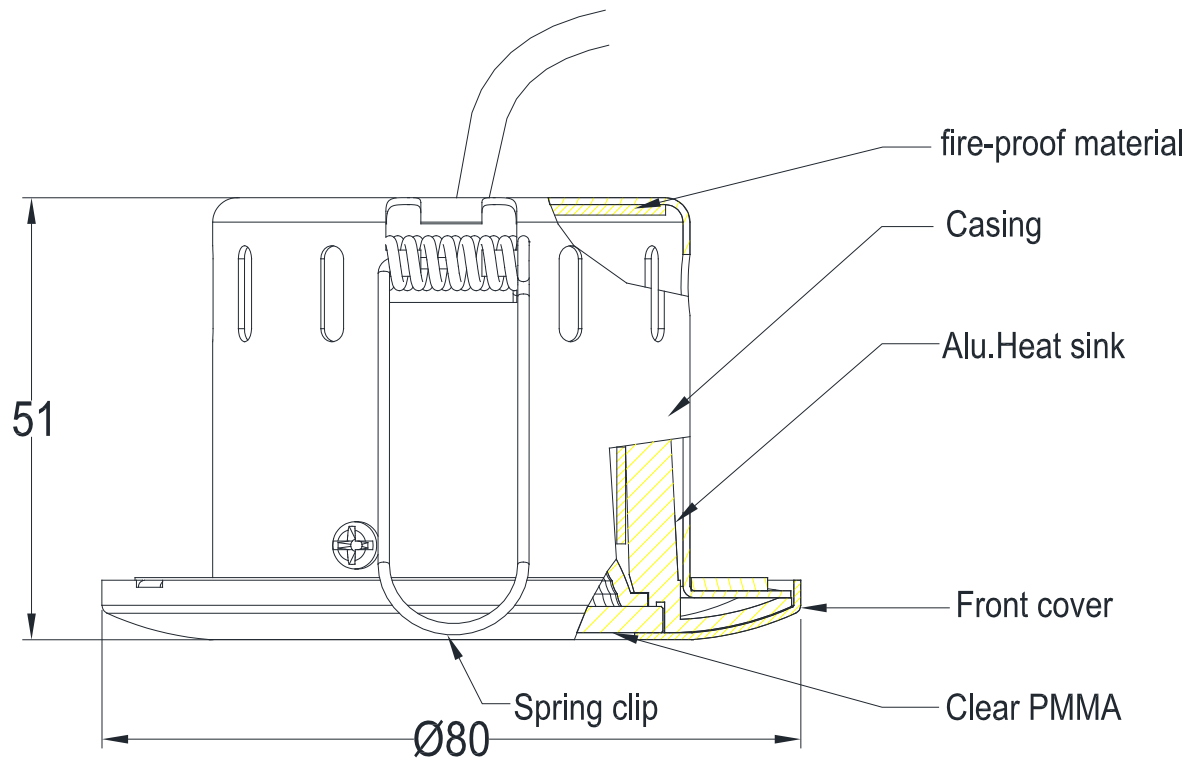
Figure 11 – Details of Downlighter Specimen I



**Fixed model
ILD LFR70FXXX
Trimless fire square bezel
Cut out: Ø70X70mm**

Do not scale. All dimensions are in mm

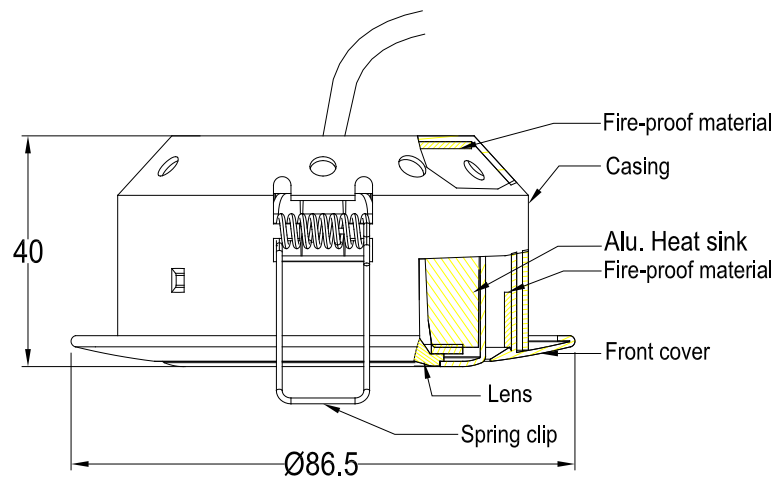
Figure 12 – Details of Downlighter Specimen J



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

Do not scale. All dimensions are in mm

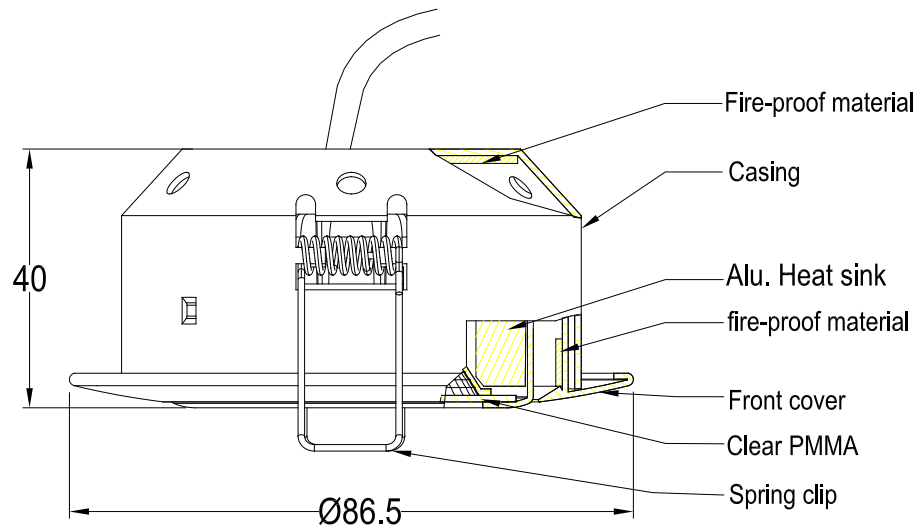
Figure 13 – Details of Downlighter Specimen K



Tiltable
With lens: TC80XXX. XXX
Cut out: $\varnothing 75$

Do not scale. All dimensions are in mm

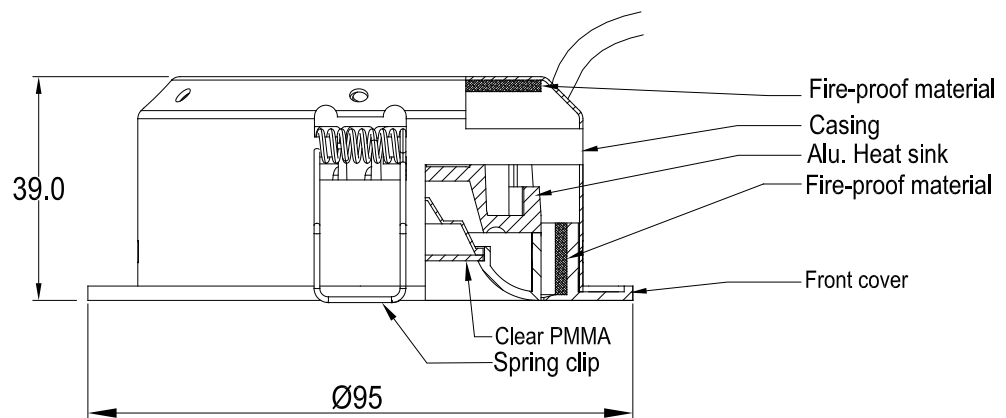
Figure 14 – Details of Downlighter Specimen L



Tiltable
With reflector:TC70XXX. XXX
Cut out:Ø75

Do not scale. All dimensions are in mm

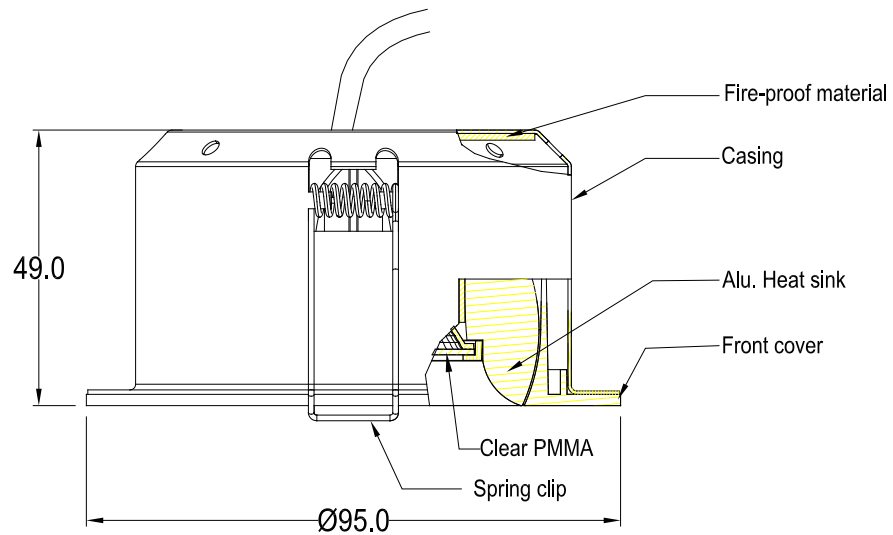
Figure 15 – Details of Downlighter Specimen M



Tiltable
With reflector:TC36XXX. XXX
Cut out:Ø83

Do not scale. All dimensions are in mm

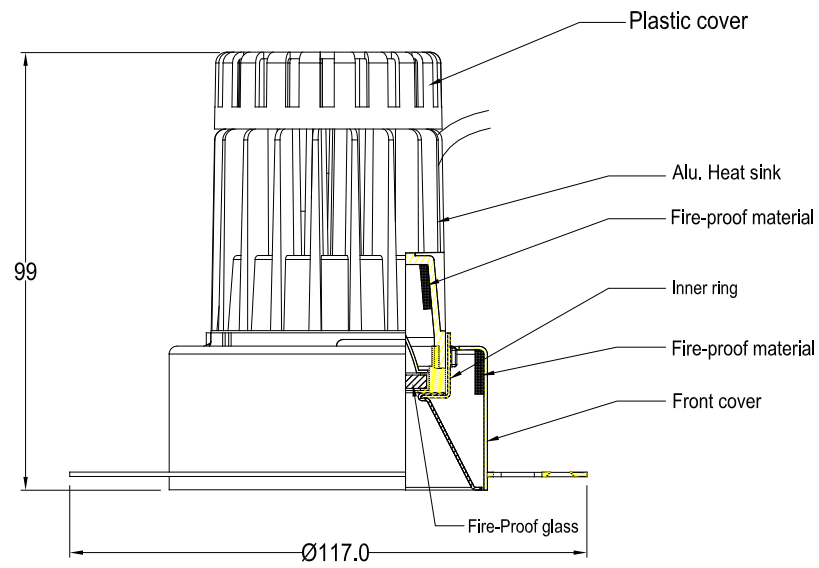
Figure 16 – Details of Downlighter Specimen N



Tiltable
With reflector:TC28XXX.XXX
Cut out:Ø85

Do not scale. All dimensions are in mm

Figure 17 – Details of Downlighter Specimen O



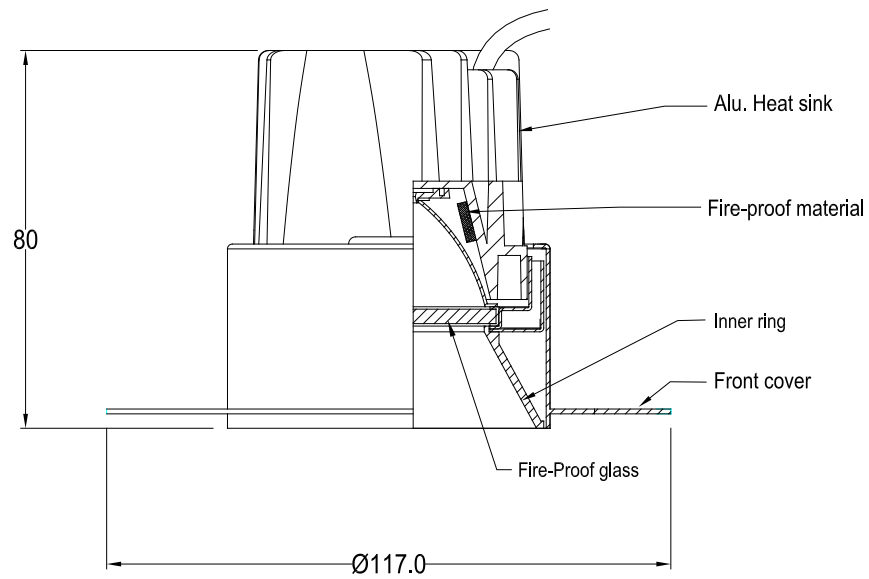
Fixed

With reflector:DC11XXX.XXX

Cut out: $\text{Ø}74$

Do not scale. All dimensions are in mm

Figure 18 – Details of Downlighter Specimen P



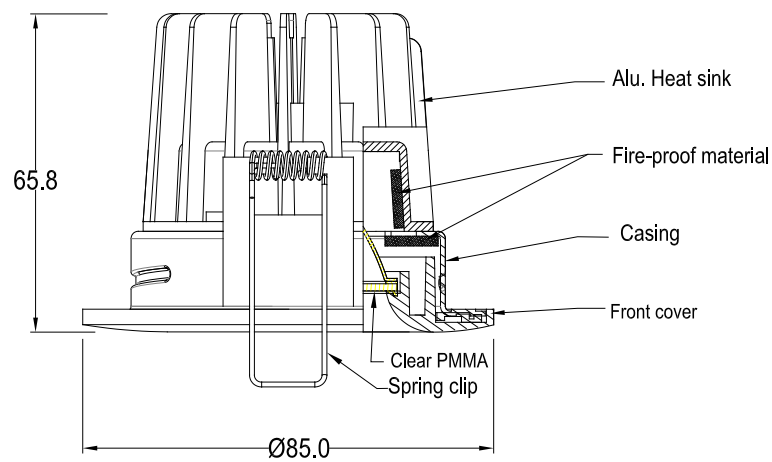
Fixed

With reflector:DC10XXX.XXX

Cut out: $\text{Ø}70$

Do not scale. All dimensions are in mm

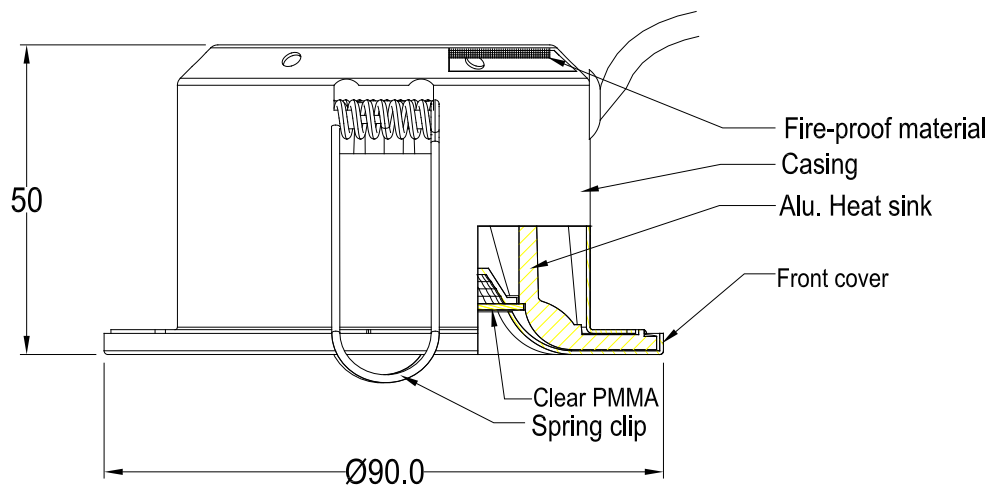
Figure 19 – Details of Downlighter Specimen Q



Fixed
With reflector:TC85XXX. XXX
Cut out:Ø75

Do not scale. All dimensions are in mm

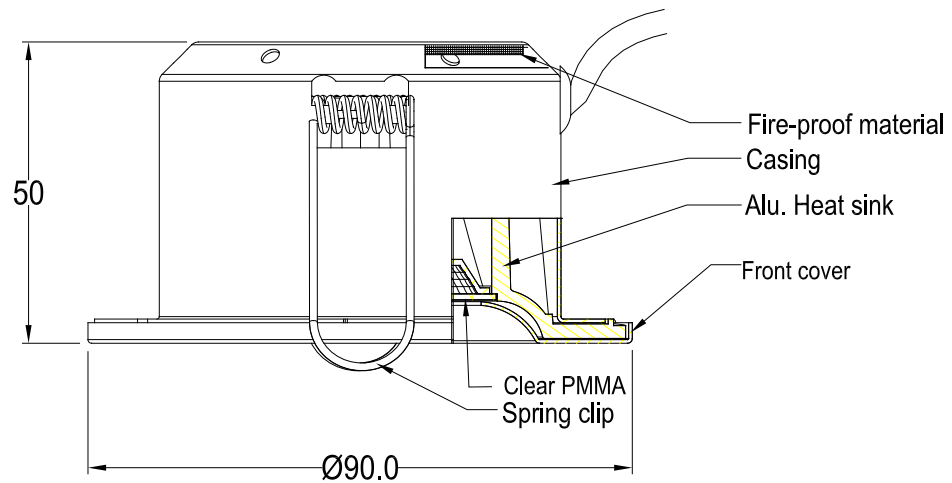
Figure 20 – Details of Downlighter Specimen R



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

Do not scale. All dimensions are in mm

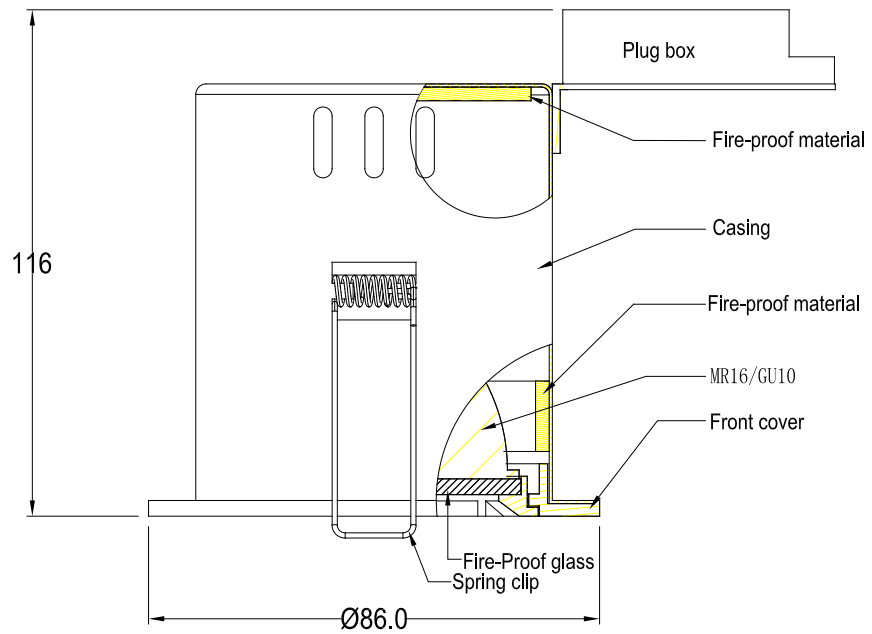
Figure 21 – Details of Downlighter Specimen S



Fixed
With reflector:TC33XXX.XXX
Cut out: $\text{Ø}73$

Do not scale. All dimensions are in mm

Figure 22 – Details of Downlighter Specimen T



Fixed

With reflector:FHT-086

Cut out: $\phi 72$

Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 22)
 (All values are nominal unless stated otherwise)
 (All other details are as stated by the sponsors)

<u>Item</u>	<u>Description</u>
1. Timber Floor	
1.1 Floor Joists	
Material	: British Home-grown, rough sawn softwood, kiln dried
Grade	: C16, to BS EN 519
Density	: 438 kg/m ³
Size	: 45 mm x 196 mm
Joist centres	: 600 mm
1.2 Floor Boards	
Material	: Flooring grade tongue and groove chipboards
Reference	: FSC E1 P5
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	: 761 kg/m ³
Thickness	: 2 off layers 12.5 mm thick
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
iii. frequency	: 150 mm centres along joints and 150 mm to the perimeter of the ceiling
2. Specimens A, B, C, D, E	
Manufacturer	: Integral LED
Type	: Round, fixed, Agate LED recessed downlight
Reference	: See Figures 3 to 7.
Materials	
i. front cover	: Steel
ii. inner ring	: Steel
iii. spring	: Stainless steel
iv. diffuser	: Pyrex glass
Overall dimensions and construction	: See Figures 3 to 7.
Cut out size	: Varies see relevant figure.
Driver	: None
Lamp	: GU10/MR16

<u>Item</u>	<u>Description</u>
3. Specimen F, G, H, I	
Manufacturer	: Integral LED
Type	: Square, fixed, LED recessed downlight
Reference	: See Figures 8 to 11.
Materials	
i. front cover	: Steel
ii. spring	: Stainless steel
iii. diffuser	: Pyrex glass
Overall dimensions and construction	: Please see Figures 8 to 11
Cut out size	: Various see relevant figures
Driver	: None
Lamp	: GU10/MR16
4. Specimen J	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: TC27XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. front cover	: Steel
iv. spring	: Stainless steel
v. diffuser	: Clear PMMA
vi. heat sink	: Die cast Aluminium
Overall dimensions and construction	: See figure 12
Cut out size	: 64 mm
Driver	: None
5. Specimen K, L	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable, Agate LED recessed downlight
Reference	: See Figures 13 and 14
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. inner ring	: Steel
iv. front cover	: Steel
v. spring	: Stainless steel
vi. diffuser	: Lens / Clear PMMA
vii. heat sink	: Die cast Aluminium
viii. fire proofing	: 1.5 mm thick fire proofing between inner and outer ring and the top of the casing.
Overall dimensions and construction	: See Figures 13 and 14.
Cut out size	: 75 mm
Driver	: None

<u>Item</u>	<u>Description</u>
6. Specimen M, N	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, tiltable, Agate LED recessed downlight
Reference	: See Figures 15 and 16
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. inner ring	: Steel
iv. front cover	: Steel
v. spring	: Stainless steel
vi. diffuser	: Clear PMMA
vii. heat sink	: Die cast Aluminium
viii. fire proofing (specimen 15)	: 1.5 mm thick fire proofing fitted inside around the casing and on the top casing
ix. fire proofing (specimen 16)	: 1.5 mm thick fire proofing fitted on the top of casing
Overall dimensions and construction	: See Figures 15 and 16
Cut out size	: Varies
Driver	: None
7. Specimens O	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: DC11XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. inner ring	: Steel
iv. diffuser	: Pyrex glass
v. plastic cover	: PC
vi. fire proofing	: 1.5 mm thick fire proofing fitted inside around the heat sink
Overall dimensions and construction	: 74 mm
Cut out size	: See Figure 17
Driver	: None
8. Specimens P	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: DC10XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. inner ring	: Steel
iv. diffuser	: Pyrex glass
v. fire proofing	: 1.5 mm thick fire proofing fitted inside around the heat sink
Overall dimensions and construction	: See Figure 18
Cut out size	: 70 mm
Driver	: None

<u>Item</u>	<u>Description</u>
9. Specimen Q	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: TC85XXX.XXX
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. front cover	: Die cast Aluminium
iv. spring	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proofing	: 1.5 mm thick fire proofing fitted inside around the heat sink and casing
Overall dimensions and construction	: See Figure 19
Cut out size	: 75 mm
Driver	: None
	:
10. Specimens R, S	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: See Figures 20 and 21
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. front cover	: Steel
iv. spring	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proofing	: 1.5 mm thick fire proofing fitted on the top of casing
Overall dimensions and construction	: See Figures 20 and 21
Cut out size	: 73 mm
Driver	: None
	:
11. Specimen T	
Manufacturer	: Dongguan Diaman Lighting Company Limited
Type	: Round, fixed, Agate LED recessed downlight
Reference	: FHT-086
Materials	
i. casing	: Steel
ii. front cover	: Steel
iii. inner ring	: Steel
iv. spring	: Stainless steel
v. diffuser	: Clear PMMA
vi. fire proofing	: 1.5 mm thick fire proofing fitted inside around the casing and on the top of casing
Overall dimensions and construction	: See Figure 22
Cut out size	: 72 mm
Driver	: None

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 476: Part 20: 1987, Clause 3.1. using eight mineral insulated thermocouples distributed over a plane 100 mm from the underside of the ceiling.
Thermocouple Allocation	<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>
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.
Integrity criteria	Cotton pads and gap gauges were available to evaluate the impermeability of the test construction to hot gases.
Furnace Pressure	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

Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	The ambient air temperature in the vicinity of the test construction was 12°C at the start of the test with a maximum variation of -1°C during the test.
00	00	The test commences.
05	00	Paper face of the ceiling ignites.
10	00	No visible significant change to the unexposed surface of the specimen.
15	00	Slight amount of smoke/steam is being released from the ends of the floor.
20	00	The light fittings appear to be remaining in place in the ceiling.
25	00	The ceiling is radiating a dull orange colour on the exposed face.
30	00	The test specimen is maintaining its loadbearing capacity, integrity, and insulation.
40	00	The ceiling is radiating an orange colour on the exposed face.
42	00	Smoke/steam is being released from the ends of the specimen.
45	00	Small section of the ceiling is falling away on the exposed face.
48	00	No visible significant changes to the unexposed surface of the specimen.
55	00	The gaps between the joints in the ceiling are widening on the exposed face.
60	00	The test specimen is maintaining its loadbearing capacity, integrity, and insulation.
66	00	The test specimen is maintaining its loadbearing capacity, integrity, and insulation. The test is discontinued.

Test Photographs

The exposed face of the assembly prior to testing



The unexposed face of the assembly after 10 minutes of testing



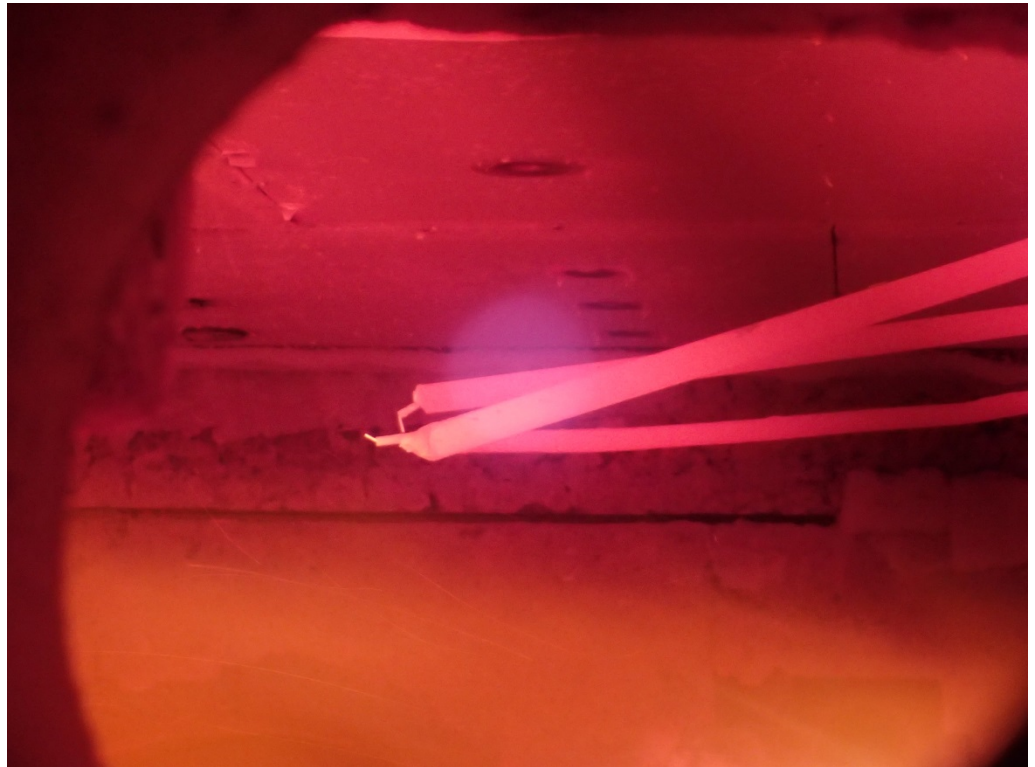
The unexposed face of the assembly after 20 minutes of testing



The unexposed face of the assembly after 40 minutes of testing



The exposed ceiling assembly after a test duration of approximately 40 minutes



The unexposed face of the assembly after 60 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	35
2	445	474
4	544	526
6	603	600
8	646	638
10	678	674
12	706	694
14	728	718
16	748	742
18	766	778
20	781	792
22	796	795
24	809	807
26	820	806
28	832	833
30	842	845
32	852	850
34	860	862
36	869	865
38	877	875
40	885	886
42	892	897
44	899	903
46	906	913
48	912	916
50	918	920
52	924	924
54	930	935
56	935	939
58	940	942
60	945	944
62	950	949
64	955	955
66	960	964

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	21	21	21	20	19	20
2	21	21	21	20	18	20
4	21	21	21	20	18	20
6	21	21	21	20	18	20
8	21	21	21	20	18	20
10	21	21	21	20	18	20
12	21	21	21	20	19	20
14	22	22	21	21	19	21
16	23	23	21	22	20	22
18	24	25	22	23	21	23
20	26	26	23	25	23	25
22	27	28	24	27	24	26
24	29	30	25	29	26	28
26	31	32	26	31	28	30
28	33	34	28	34	30	32
30	34	36	29	35	31	33
32	36	38	30	38	33	35
34	37	40	31	40	35	37
36	39	41	33	41	36	38
38	40	43	34	43	37	39
40	42	45	35	44	39	41
42	44	46	36	46	40	42
44	45	47	37	47	41	43
46	46	49	39	48	42	45
48	48	50	39	49	43	46
50	49	52	41	50	43	47
52	51	53	41	51	44	48
54	52	55	42	51	45	49
56	54	59	43	52	46	51
58	57	63	44	53	47	53
60	61	67	44	54	47	55
62	65	72	45	56	48	57
64	70	74	46	58	50	60
66	73	77	47	61	51	62

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
0	20	20	20
2	20	20	20
4	20	20	20
6	20	20	20
8	19	20	20
10	19	20	20
12	19	20	20
14	20	21	21
16	20	21	22
18	20	22	23
20	21	23	25
22	21	25	27
24	22	26	29
26	23	29	31
28	24	31	34
30	25	34	37
32	26	36	39
34	28	39	41
36	29	41	44
38	30	43	46
40	32	45	48
42	33	46	50
44	34	48	51
46	36	49	52
48	37	50	54
50	39	51	55
52	40	52	55
54	42	53	56
56	43	55	59
58	45	57	61
60	47	60	64
62	50	64	67
64	55	69	69
66	59	76	72

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
Mins	Number	Number	Number	Number	Number	Number	Number
	219	220	221	222	223	224	225
	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
0	20	21	21	23	23	23	23
2	20	21	21	23	23	23	23
4	22	24	25	24	26	25	29
6	31	38	38	35	41	45	36
8	45	52	52	51	53	64	48
10	59	71	65	65	64	82	56
12	71	83	76	72	73	85	65
14	75	93	83	89	76	90	72
16	79	98	94	97	80	113	76
18	83	109	104	82	81	132	80
20	85	108	111	103	85	121	81
22	87	103	111	98	89	139	86
24	93	107	107	103	95	171	91
26	98	113	105	110	101	163	92
28	101	152	107	120	100	143	95
30	103	147	113	122	100	155	98
32	105	139	114	144	100	149	99
34	105	134	132	143	103	151	102
36	105	123	130	146	105	153	102
38	106	116	120	133	106	141	102
40	107	113	118	124	106	159	103
42	108	114	118	120	107	158	104
44	110	116	121	126	109	151	105
46	113	121	125	125	114	153	109
48	119	131	136	123	123	160	115
50	130	148	152	131	138	175	127
52	148	164	169	148	154	179	143
54	166	177	183	163	167	185	159
56	180	190	197	178	180	195	173
58	194	200	210	190	190	205	185
60	205	210	220	200	199	216	199
62	215	222	231	211	207	225	208
64	227	229	242	218	216	236	218
66	235	238	250	227	224	245	228

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
Mins	Number	Number	Number	Number	Number	Number	Number
	226	227	228	229	230	231	232
	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
0	24	23	22	19	25	19	19
2	24	23	23	19	24	19	19
4	27	26	34	21	21	21	21
6	48	40	49	39	*	37	30
8	55	51	58	50		59	42
10	63	63	72	57		71	52
12	70	81	75	66		73	64
14	75	83	83	74		76	75
16	79	84	83	81		85	83
18	82	88	93	121		88	90
20	82	96	88	127		90	96
22	86	104	103	99		91	103
24	89	112	107	112		94	101
26	91	116	130	102		97	107
28	93	122	134	105		101	111
30	94	120	140	108		103	124
32	95	122	123	106	133	106	119
34	97	118	137	107	130	106	122
36	98	122	127	107	139	106	125
38	99	145	125	110	142	107	130
40	100	132	160	112	146	111	133
42	102	116	160	115	138	115	134
44	105	118	131	123	134	114	132
46	110	120	118	127	132	114	133
48	119	125	127	132	129	117	135
50	134	137	135	140	137	127	144
52	152	158	145	153	149	139	149
54	168	172	158	168	162	156	158
56	177	185	169	192	183	173	174
58	190	197	179	201	202	188	188
60	199	206	189	210	214	201	201
62	209	217	199	224	226	212	208
64	218	224	209	231	238	224	218
66	226	234	216	241	251	236	229

*Thermocouple Malfunction

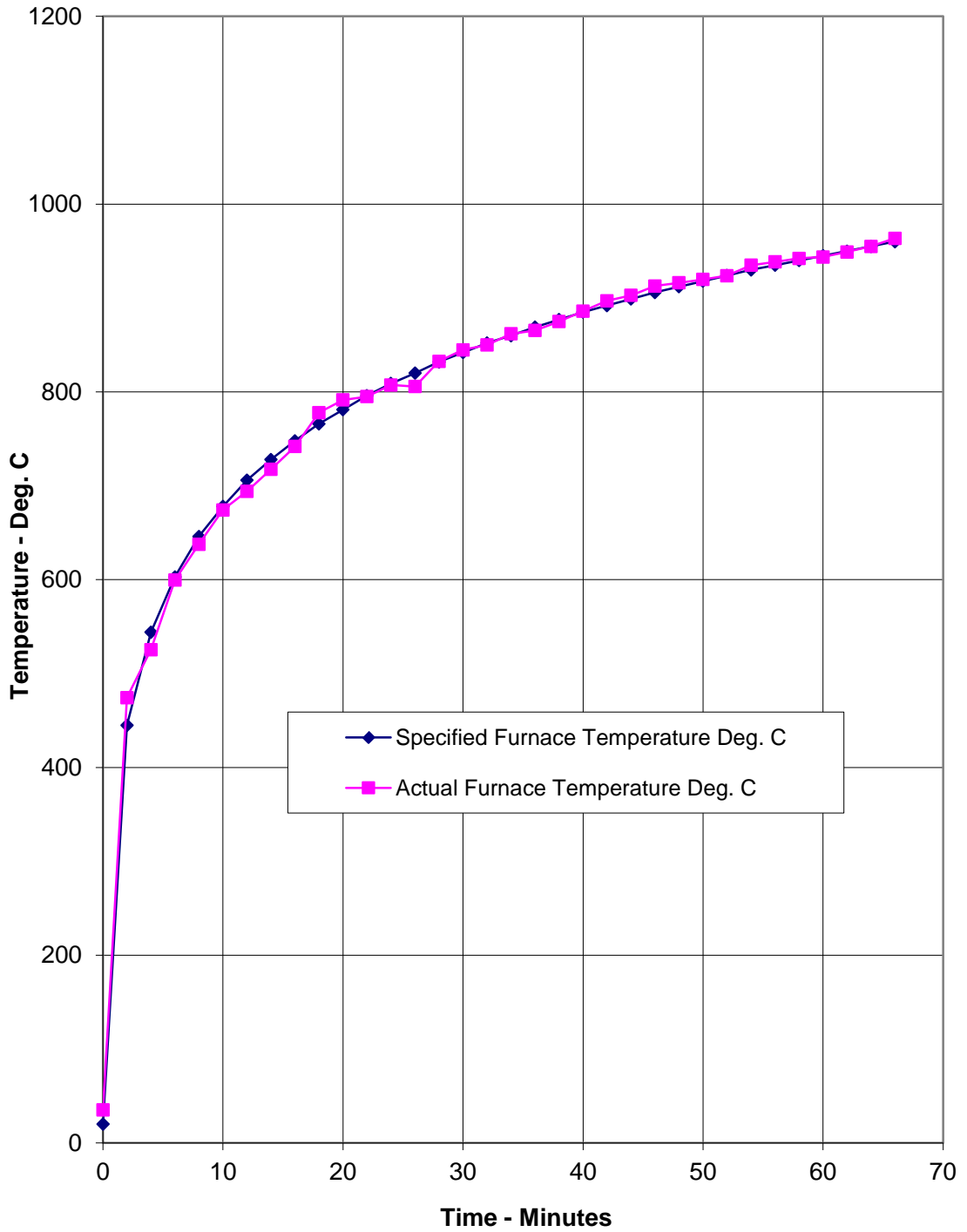
Individual temperatures recorded adjacent to the light fittings at mid height of the cavity

Time Mins	T/C Number 233 Deg. C	T/C Number 234 Deg. C	T/C Number 235 Deg. C	T/C Number 236 Deg. C	T/C Number 237 Deg. C	T/C Number 238 Deg. C
0	20	20	20	22	23	38
2	21	20	20	23	23	38
4	24	22	21	25	25	39
6	37	35	30	41	36	37
8	49	47	41	65	46	39
10	62	69	52	91	59	44
12	76	107	63	103	69	56
14	87	124	73	115	77	65
16	92	124	84	127	83	76
18	96	116	95	100	87	83
20	106	116	107	110	96	88
22	123	113	123	134	106	90
24	118	114	126	123	105	93
26	127	145	127	116	102	95
28	143	144	139	119	107	98
30	1400	138	147	124	110	103
32	148	123	152	144	114	109
34	153	112	154	158	113	112
36	146	111	160	165	112	114
38	150	112	130	147	112	119
40	155	115	140	127	113	115
42	154	120	132	122	113	116
44	153	122	135	123	114	114
46	153	130	137	125	116	114
48	154	129	139	125	118	116
50	150	133	140	129	122	118
52	154	139	142	135	127	124
54	165	149	152	145	136	132
56	181	165	166	157	149	145
58	196	182	181	172	163	159
60	210	198	195	184	177	174
62	223	210	208	196	188	183
64	235	222	218	206	198	195
66	244	234	228	217	208	204

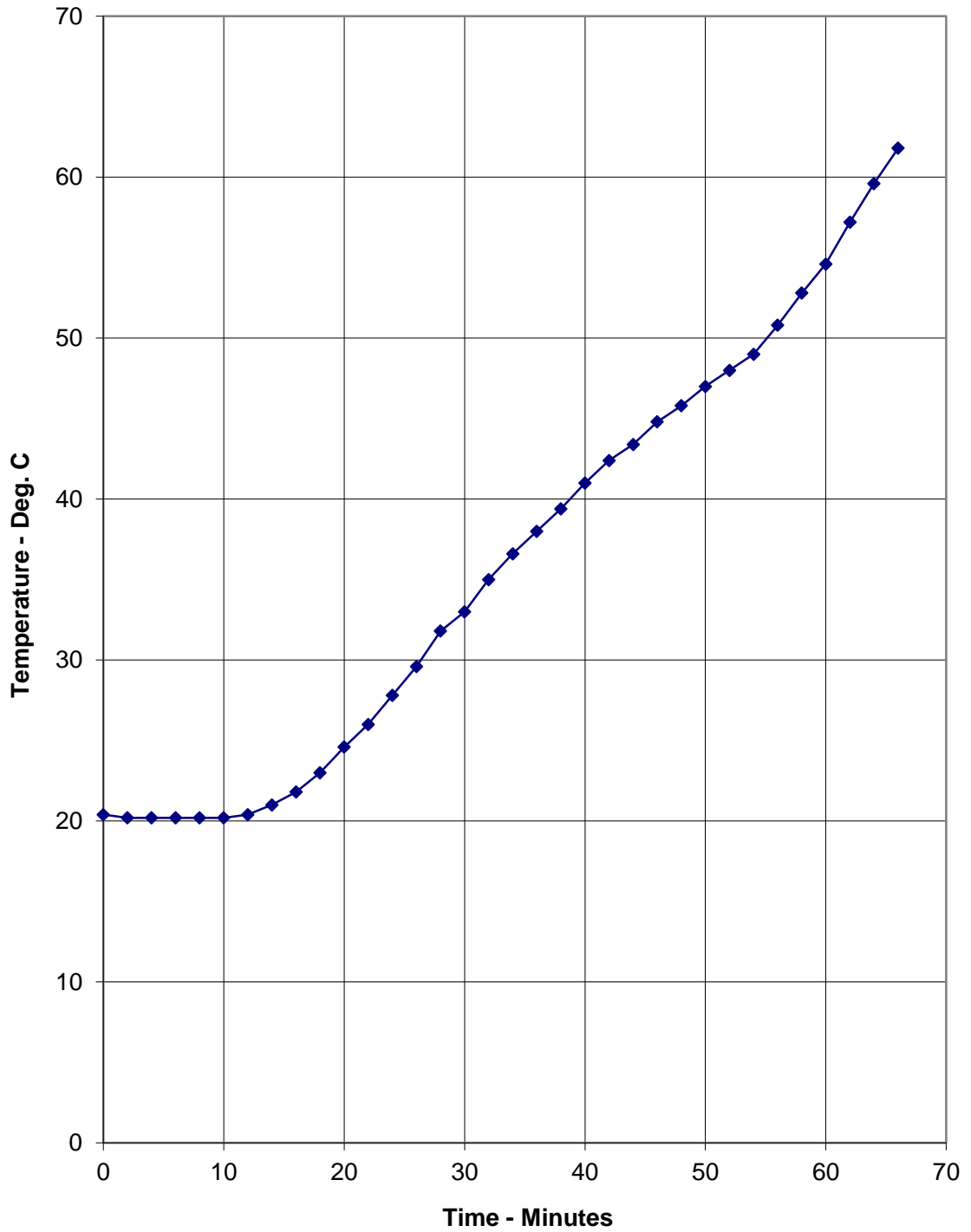
Deflection and rate of deflection of the floor assembly during the test

Time Mins	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0	0
2	5	1
4	6	0
6	6	0
8	6	0
10	7	1
12	7	0
14	7	0
16	6	0
18	7	0
20	8	1
22	8	1
24	8	0
26	9	0
28	8	-1
30	10	0
32	11	1
34	11	0
36	12	1
38	12	0
40	13	1
42	13	0
44	14	1
46	14	0
48	14	0
50	15	1
52	15	0
54	15	0
56	16	0
58	17	0
60	18	1
62	19	0
64	21	1
66	23	2

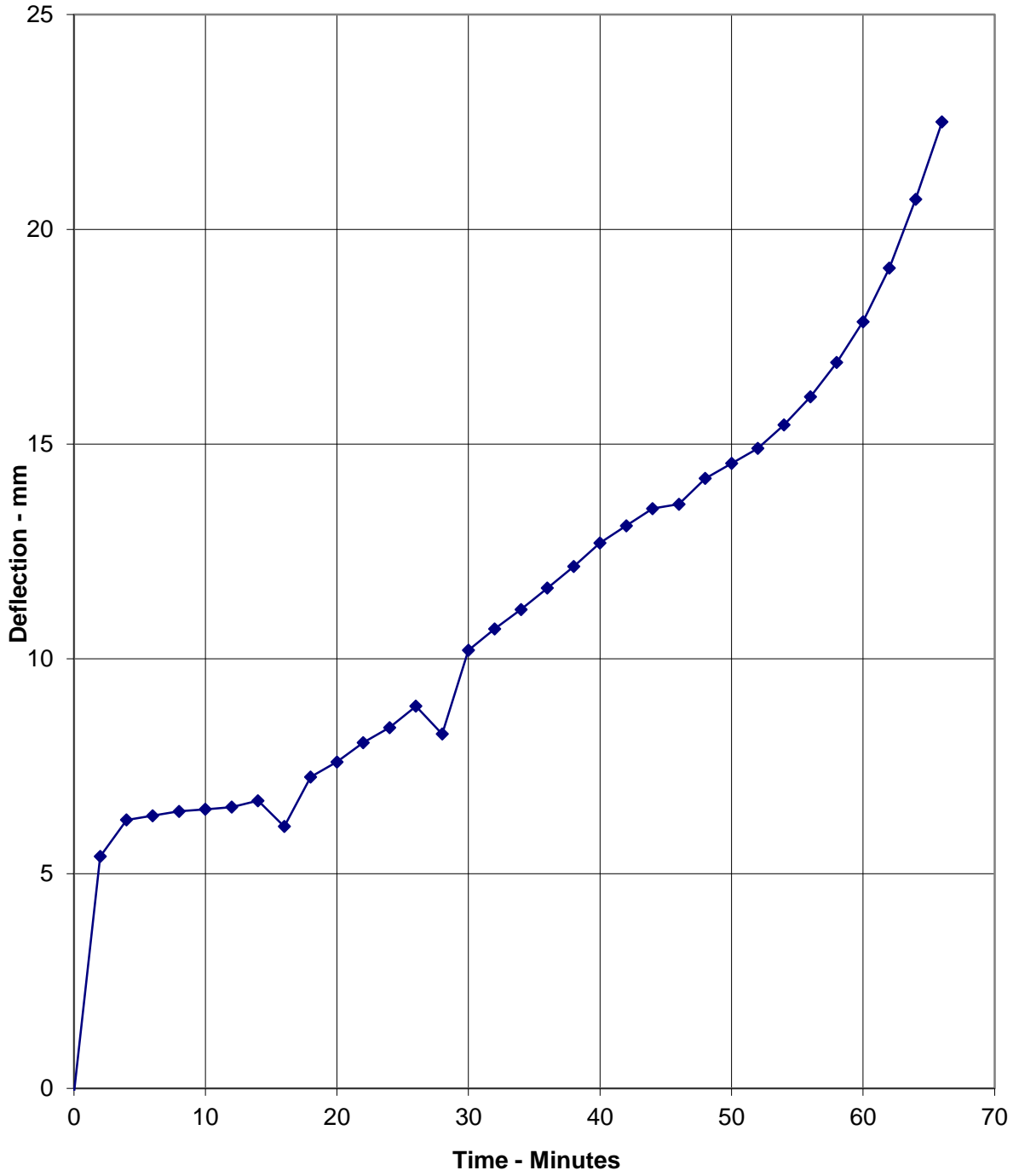
Graph showing specified and actual furnace temperatures



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)	: 196 mm deep by 45 mm thick
Mean spacing (M)	: 600 mm
Effective span (L)	: 4200 mm
Timber grade of joists	: C16

2. Parameters - BS 5268: Part 2: 2002

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	: 370 kg/m ³

3. Total Loading Required Per Joist

Moment of Inertia (I)	: $bd^3/12$: $(45 \times 196^3)/12$: 28235760 mm ⁴
Distance from neutral axis to base of joist (y)	: 98 mm
Maximum bending stress	: Fl/y : $(5.83 \times 28235760)/98$: 1679739 N/mm ²
Also maximum bending stress	: $wL^2/8$: 1679739 N/mm ²
Where w	= Load per unit length
∴ w	= $(1679739 \times 8) / (4200 \times 4200)$ = 0.76178 N/mm = 761 N/m
∴ Total loading (W)	: 3196.2 N : 325.8 kg

4. Dead Weight

Combined weight of overall specimen:

Actual density of joist	: 438 kg/m ³
Actual density of floor boarding	: 665 kg/m ³
Actual density of ceiling board - 12.5 mm thick:	761 kg/m ³

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

weight of joist	: 16.2 kg
weight of floorboard	: 36.9 kg
weight of ceiling (two layers)	: 81 kg

Total dead weight per joist : 134.1 kg

5. **Imposed Load**


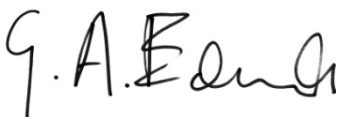
Imposed load per joist required : total load per joist - dead weight per joist
: 325.8 – 134.1
: 191.7 kg

Assuming even distribution of loading

Maximum imposed load per metre square : $(191.7 \times 9.81) / (4.2 \times 0.6)$
: 746 N/m²
: **0.746 kN/m²**
: 76 kg/m²

Calculation made by

Checked by



G. Edmonds
Senior Technical Officer
Fire Resistance Department

D. Fitzsimmons
Technical Officer
For and on behalf of
Exova Warringtonfire

Performance Criteria and Test Results

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 66 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 66 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 66 minutes.

Ongoing Implications

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

Evaluation against objective A specimen of a loadbearing timber floor assembly, protected by a plasterboard ceiling incorporating twenty 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:

Loadbearing Capacity	66 minutes*
Integrity	66 minutes*
Insulation	66 minutes*

*The test was discontinued after a period of 66 minutes.