

Exova Warringtonfire
Holmesfield Road
Warrington
WA1 2DS
United Kingdom

T : +44 (0) 1925 655 116
F : +44 (0) 1925 655 419
E : warrington@exova.com
W: www.exova.com



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

WF Report No:

371967



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 30 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-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 4380 mm long by 2950 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 a single layer of 12.5 mm thick British Gypsum Fireline plasterboard, the ceiling was screw fixed to the underside of the floor joists.

The floor supported an evenly distributed load of 0.88 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, with bracket
D	ILD LFR70DXXX	Round, fixed, Agate LED recessed downlight, 70 mm diameter cut-out, without bracket
E	ILD LFR70DXXX	Round, fixed, Agate LED recessed downlight, 100 mm diameter cut-out, Slim Fire accessory
F	ILD LFR70DXXX	Square, fixed, LED recessed downlight, 70 mm diameter cut-out, with slim fire square bezel
G	ILD LFR70DXXX	Square, fixed, LED recessed downlight, 70 mm diameter cut-out, with slim fire square bezel with bracket
H	ILD LFR70EXXX	Square, fixed down light, 70 mm by 70 mm cut-out, with slim fire square bezel
I	ILD LFR70FXXX	Square, fixed down light, 70 mm by 70 mm cut-out, with trimless fire square bezel

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

Test Results:

Loadbearing Capacity 36 minutes*

Integrity 36 minutes*

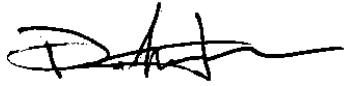
Insulation 36 minutes*

*The test was discontinued after a period of 36 minutes

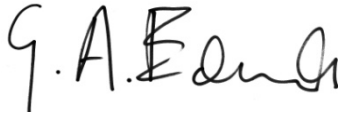
Date of Test 22nd October 2016

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Signatories



Responsible Officer
D. Fitzsimmons*
Technical Officer



Approved
G. Edmonds*
Senior Technical Officer

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

Report Issued

Date: 14th March 2017

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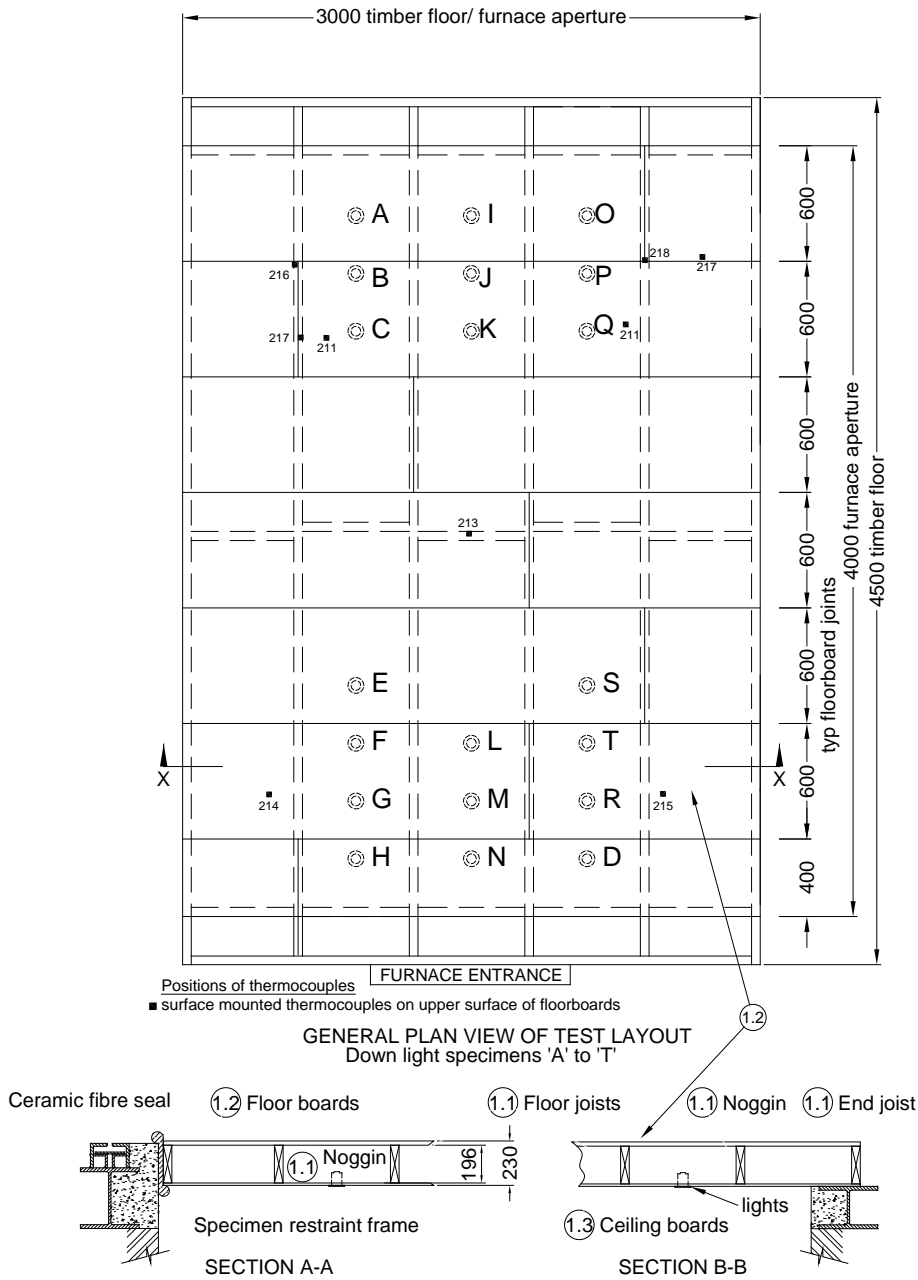
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Test Procedure

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 22nd 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 20th October 2016.</p>
Conditioning	<p>The specimens' storage, construction, and test preparation took place in the test laboratory over a total combined time of 3 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 11°C to 16°C and 62% to 81% respectively.</p>

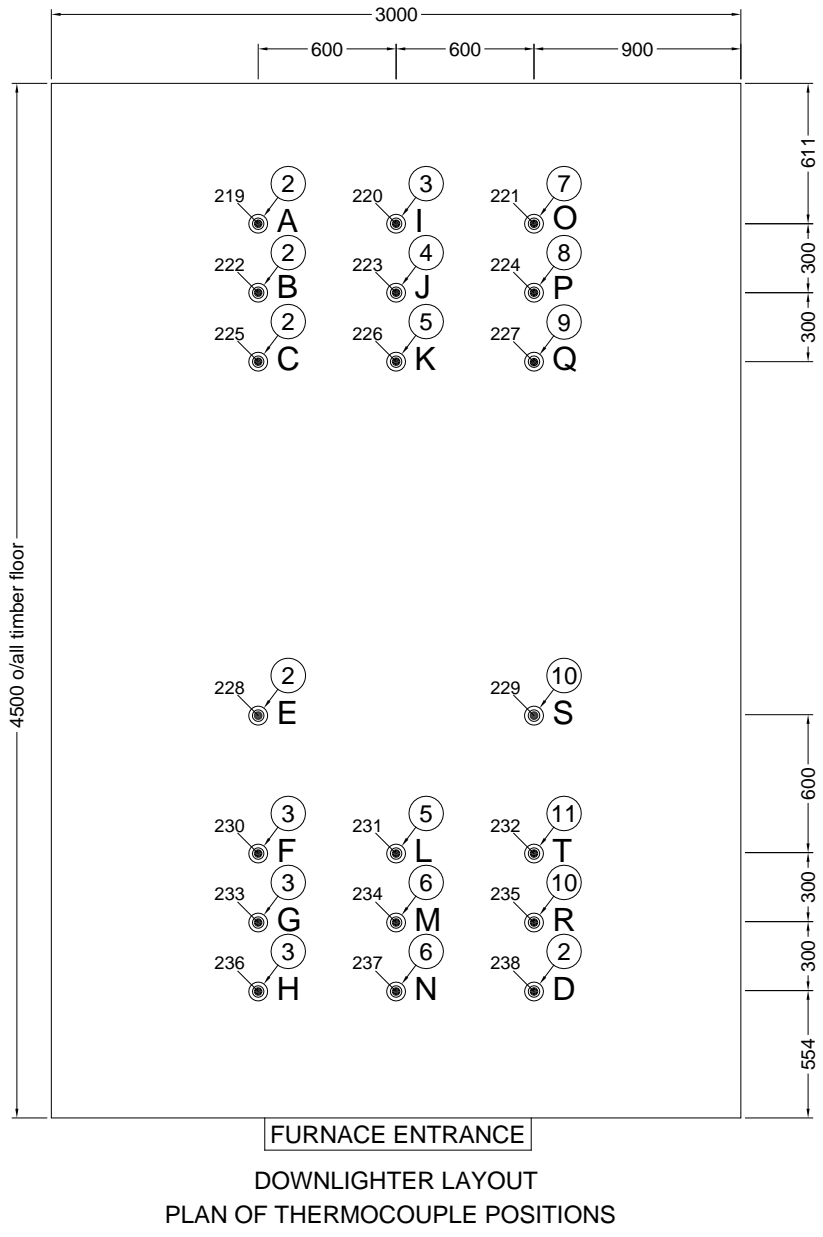
Test Specimens

Figure 1- General Elevation of Test Specimens



Do not scale. All dimensions are in mm

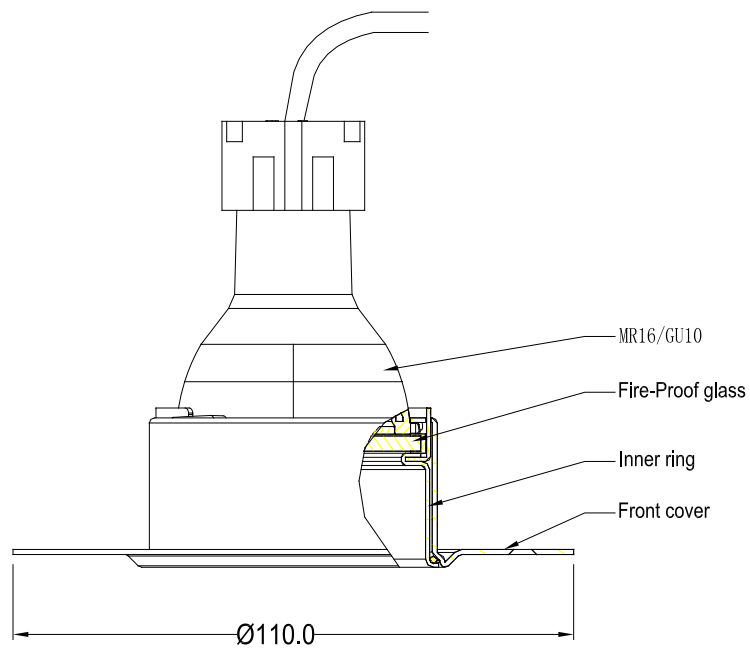
Figure 2 – Details of Downlighter Positions



- Mineral insulated thermocouples at mid-cavity height

Do not scale. All dimensions are in mm

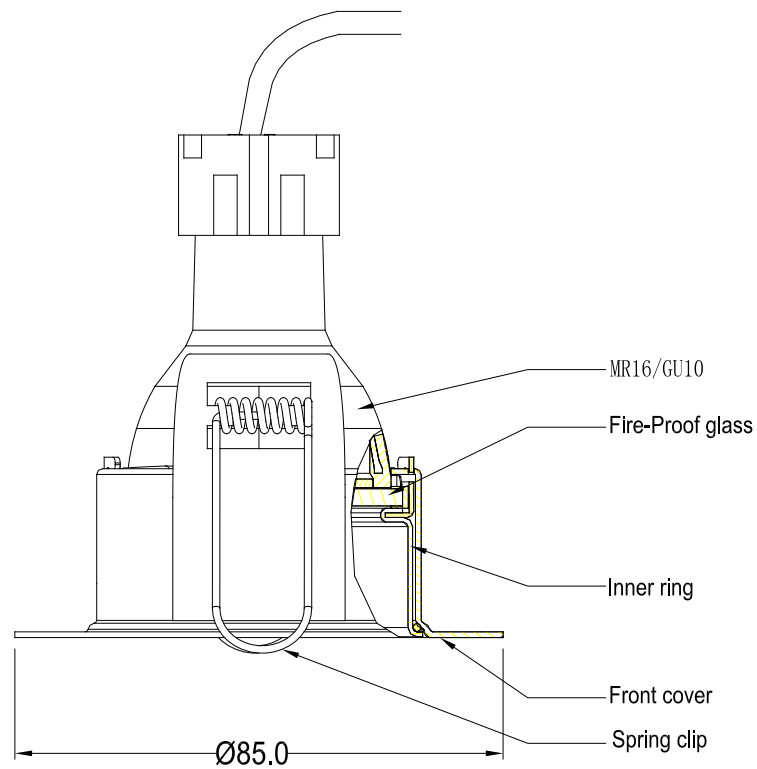
Figure 3 – Details of Downlighters Specimen A



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

Do not scale. All dimensions are in mm

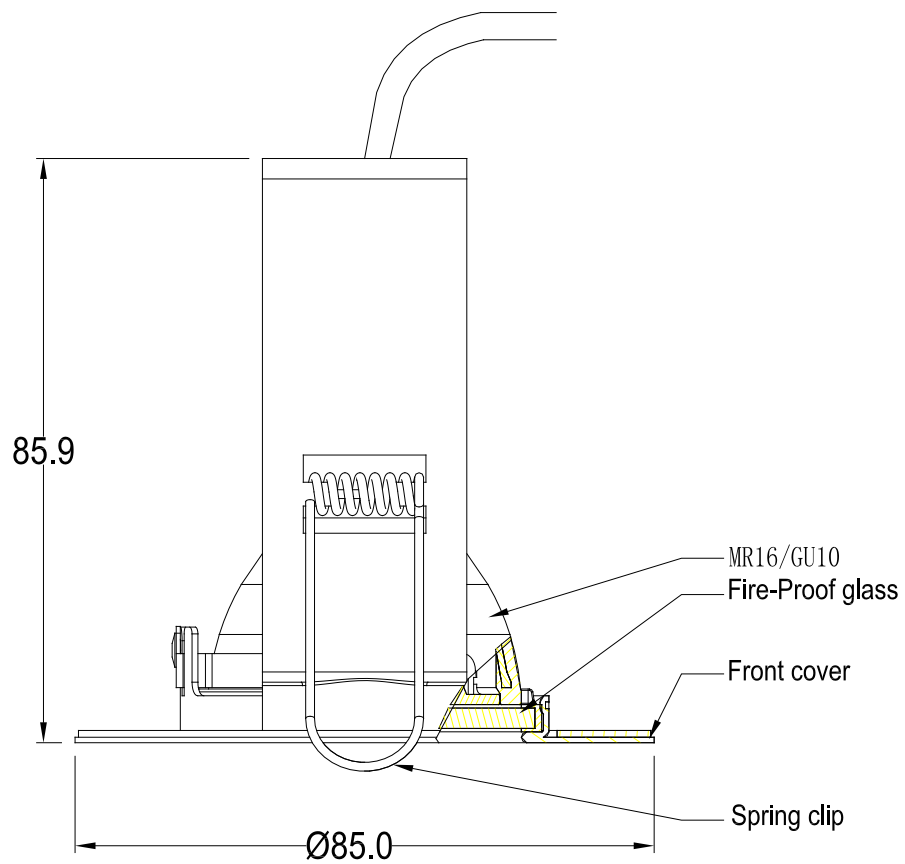
Figure 4 – Details of Downlighters Specimen B



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

Do not scale. All dimensions are in mm

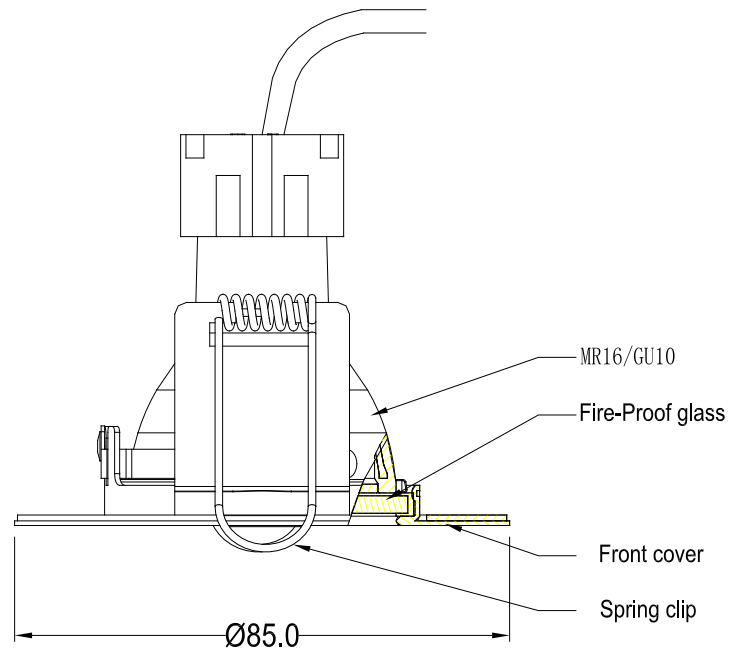
Figure 5 – Details of Downlighters Specimen C



Fixed
ILD LFR70DXXX
with bracket
Cut out: $\phi 70$

Do not scale. All dimensions are in mm

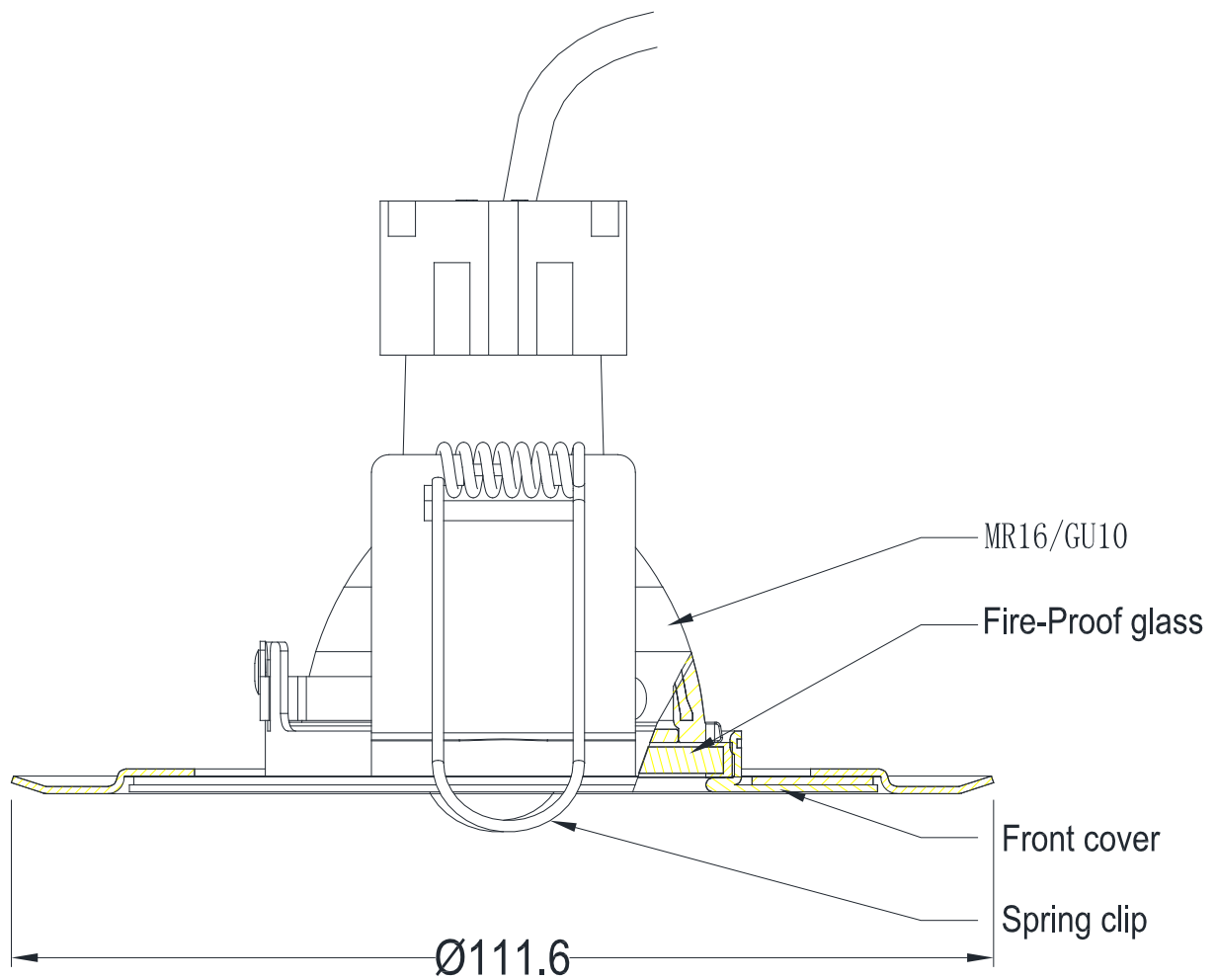
Figure 6 – Details of Downlighters Specimen D



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

Do not scale. All dimensions are in mm

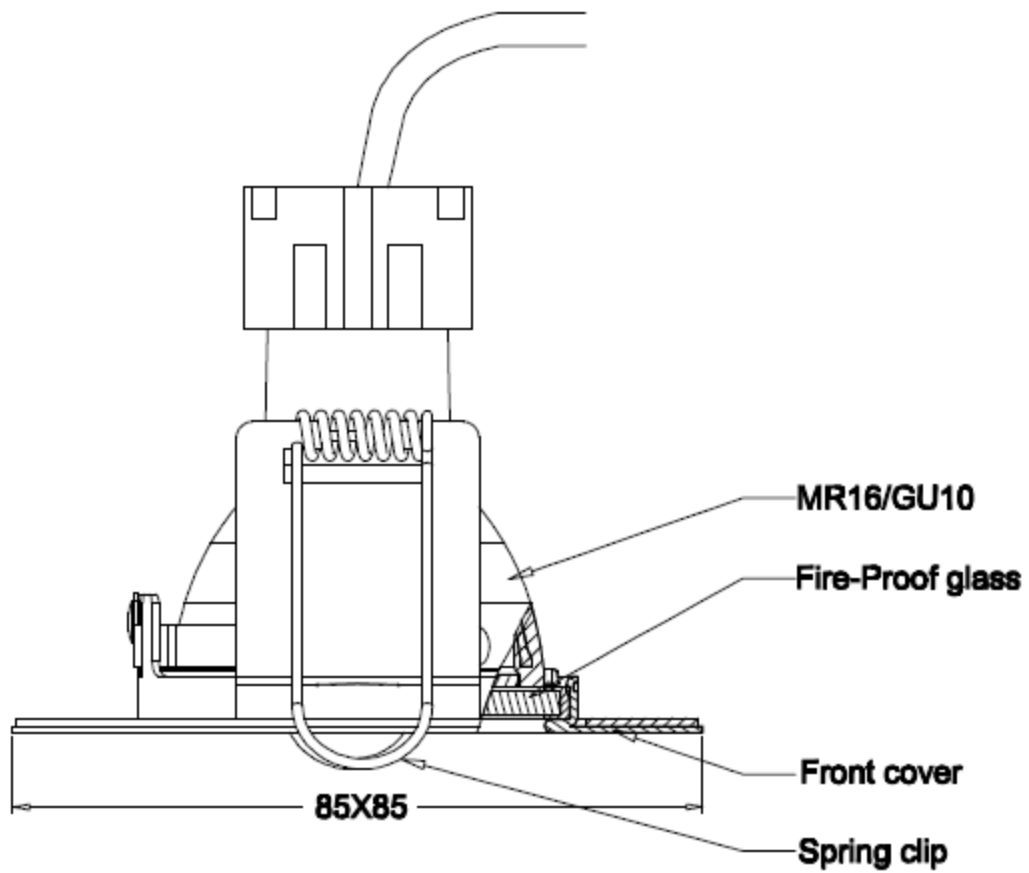
Figure 7 – Details of Downlighters Specimen E



Fixed
ILD LFR70DXXX
accessory of Slim Fire
Cut out: Ø100mm

Do not scale. All dimensions are in mm

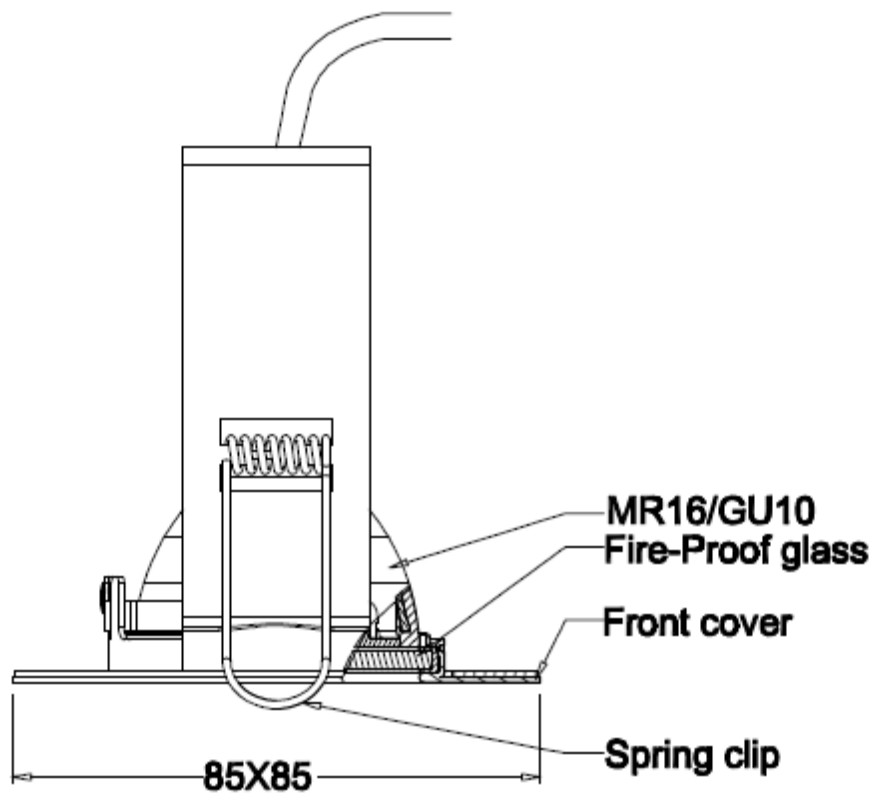
Figure 8 – Details of Downlighters Specimen F



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

Do not scale. All dimensions are in mm

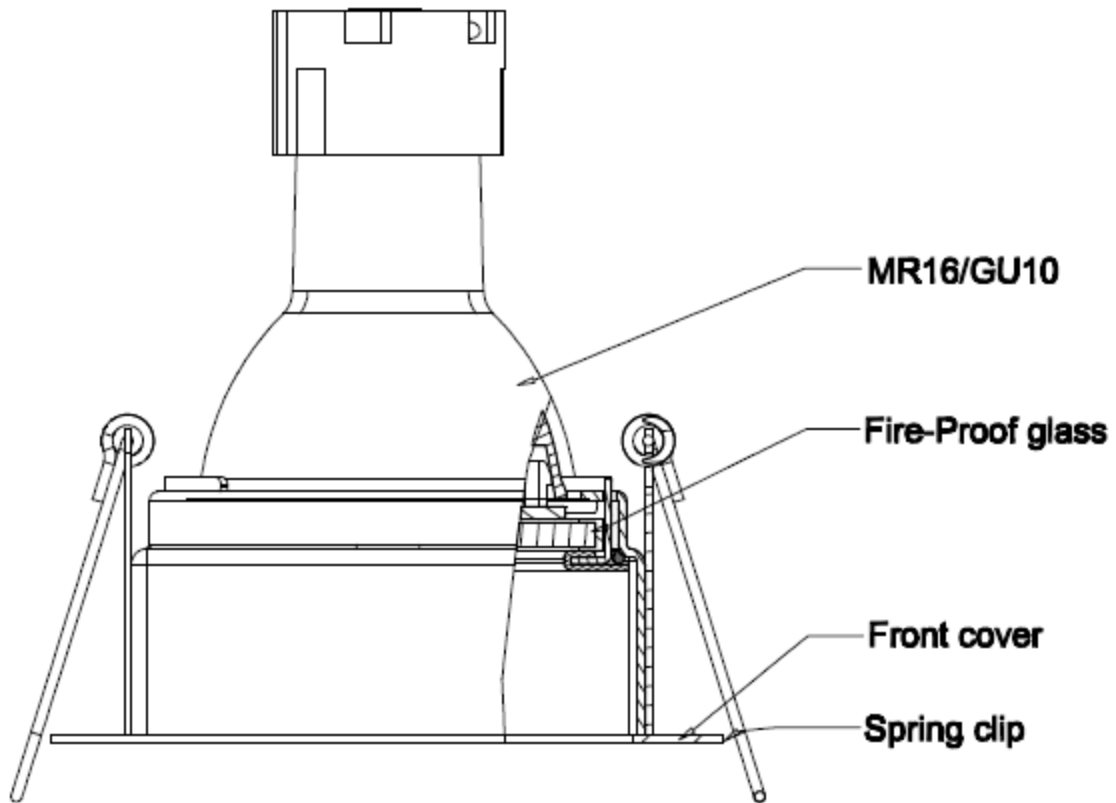
Figure 9 – Details of Downlighters Specimen G



**Fixed model
ILD LFR70DXXX
Slim fire square bezel with bracket
Cut out: Ø70mm**

Do not scale. All dimensions are in mm

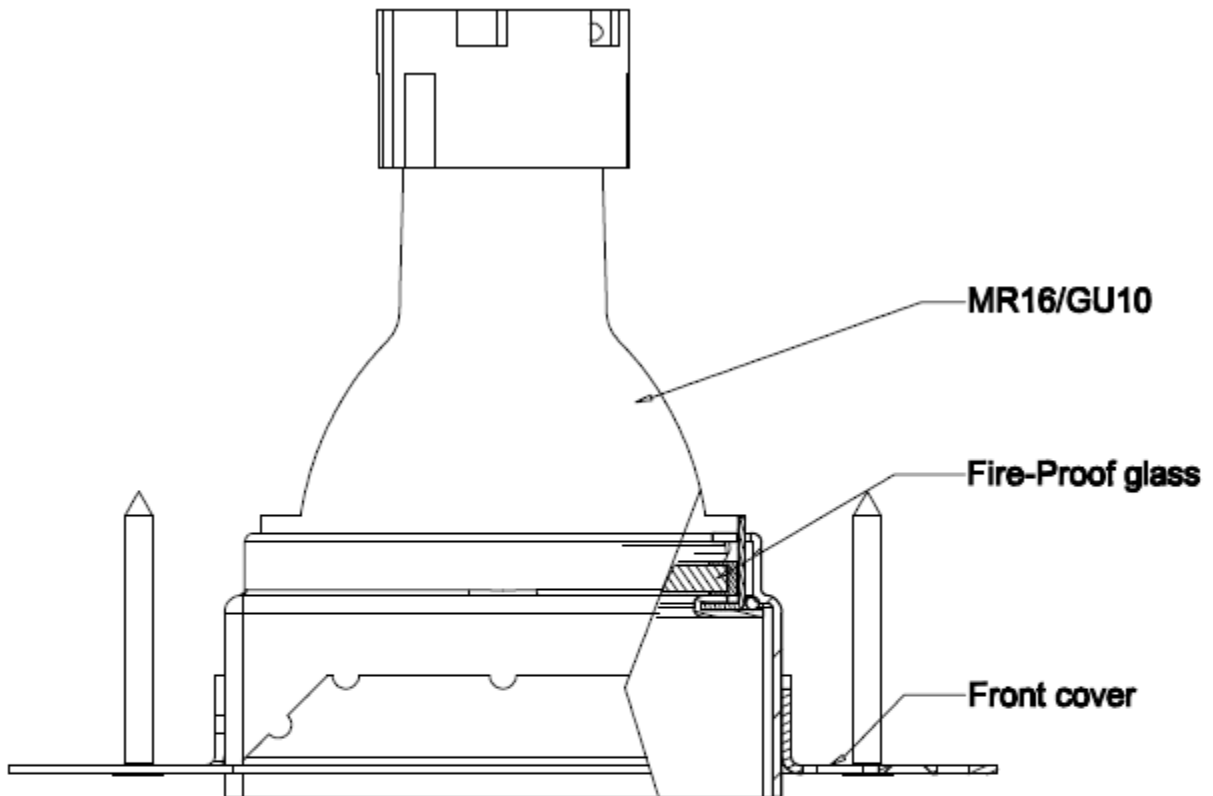
Figure 10 – Details of Downlighters Specimen H



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

Do not scale. All dimensions are in mm

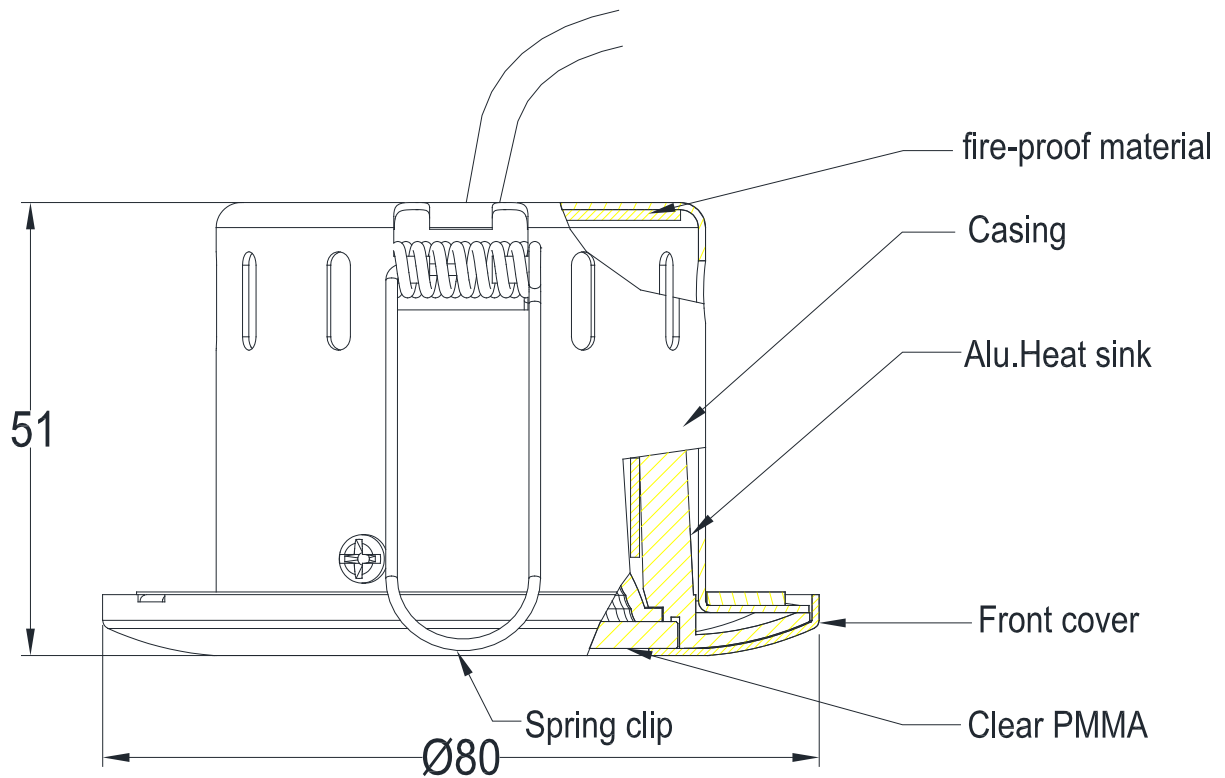
Figure 11 – Details of Downlighters Specimen I



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

Do not scale. All dimensions are in mm

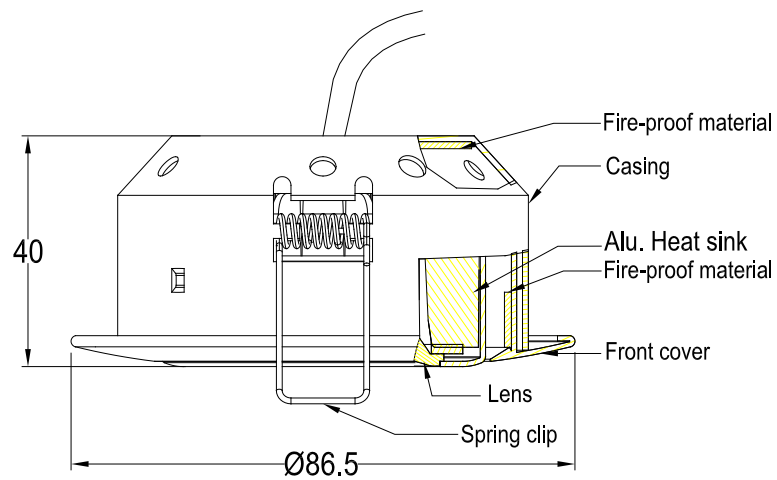
Figure 12 – Details of Downlighters Specimen J



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

Do not scale. All dimensions are in mm

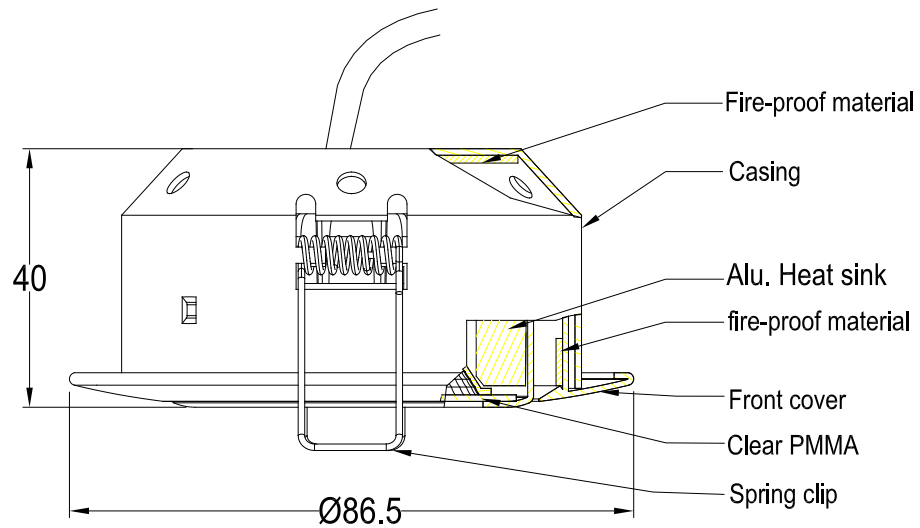
Figure 13 – Details of Downlighters Specimen K



Tiltable
With lens: TC80XXX. XXX
Cut out: Ø75

Do not scale. All dimensions are in mm

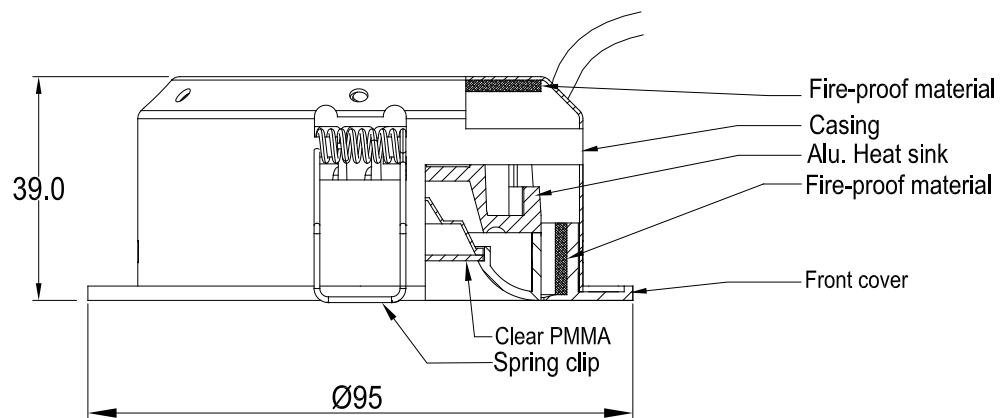
Figure 14 – Details of Downlighters Specimen L



Tiltable
With reflector:TC70XXX. XXX
Cut out:Ø75

Do not scale. All dimensions are in mm

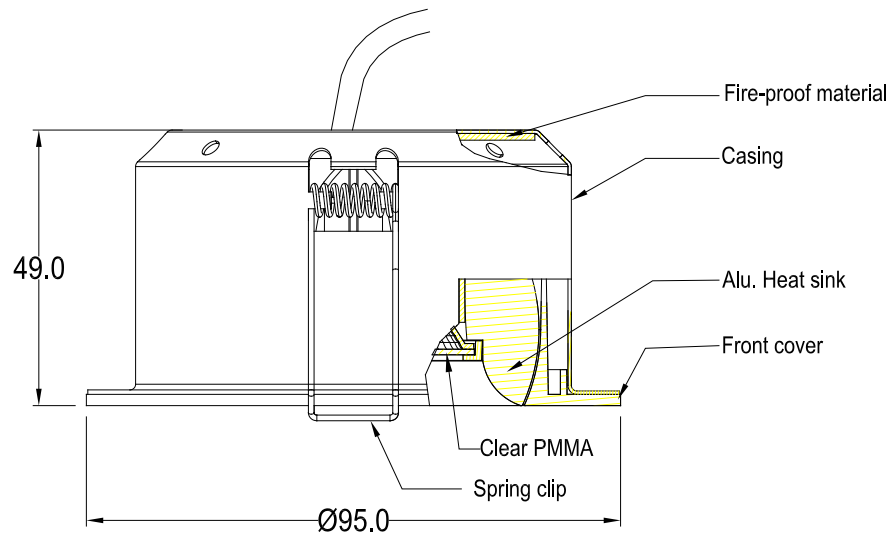
Figure 15 – Details of Downlighters Specimen M



Tiltable
With reflector:TC36XXX. XXX
Cut out: $\text{Ø}83$

Do not scale. All dimensions are in mm

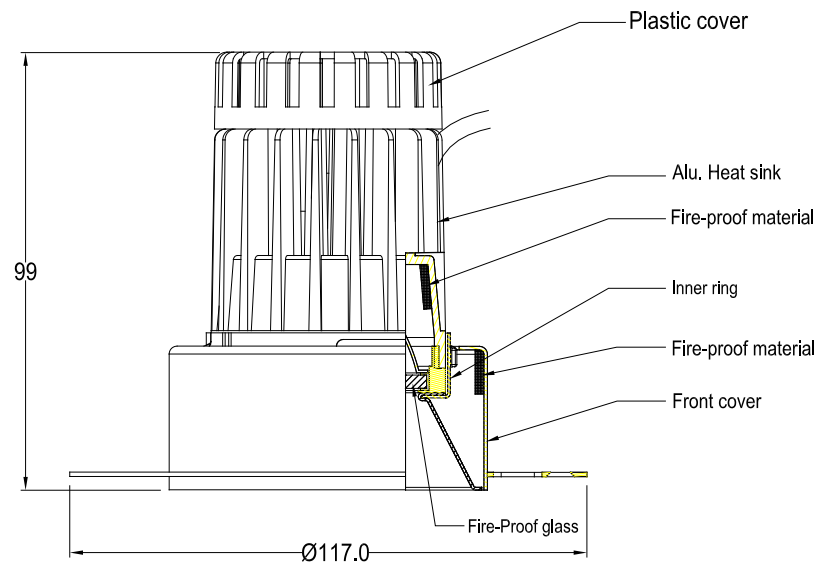
Figure 16 – Details of Downlighters Specimen N



Tiltable
With reflector:TC28XXX. XXX
Cut out: $\text{Ø}85$

Do not scale. All dimensions are in mm

Figure 17 – Details of Downlighters Specimen O



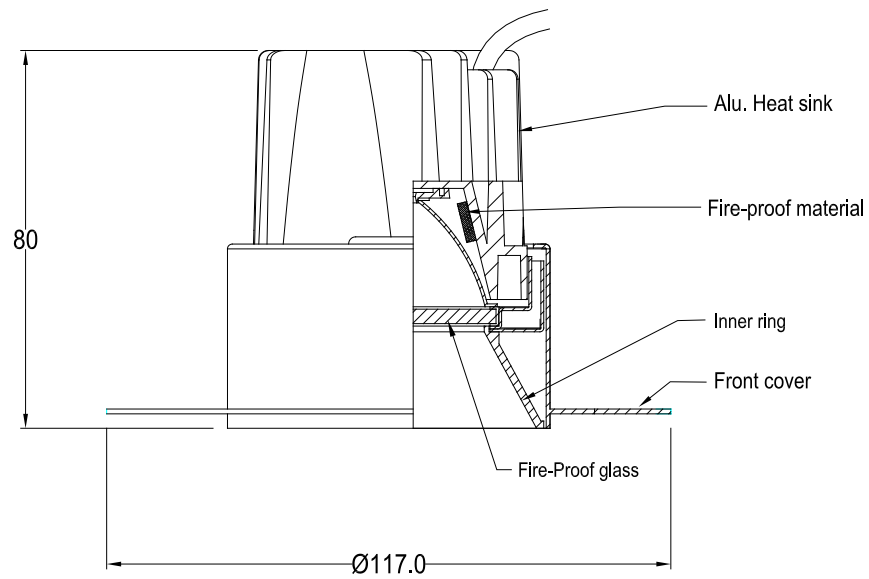
Fixed

With reflector:DC11XXX.XXX

Cut out:Ø74

Do not scale. All dimensions are in mm

Figure 18 – Details of Downlighters Specimen P



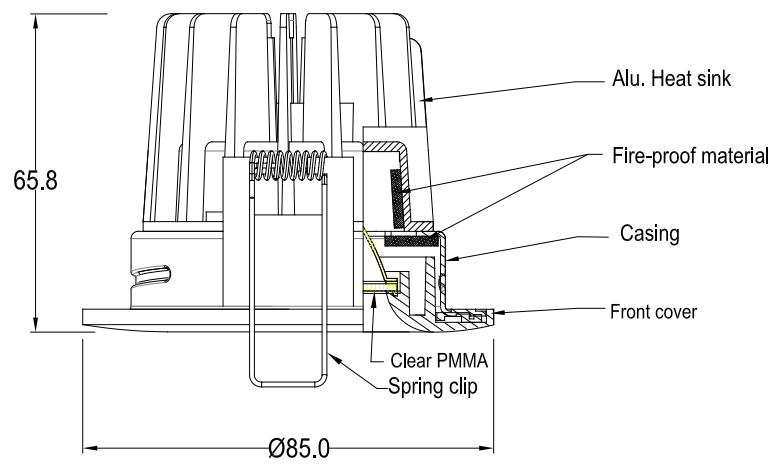
Fixed

With reflector:DC10XXX.XXX

Cut out:Ø70

Do not scale. All dimensions are in mm

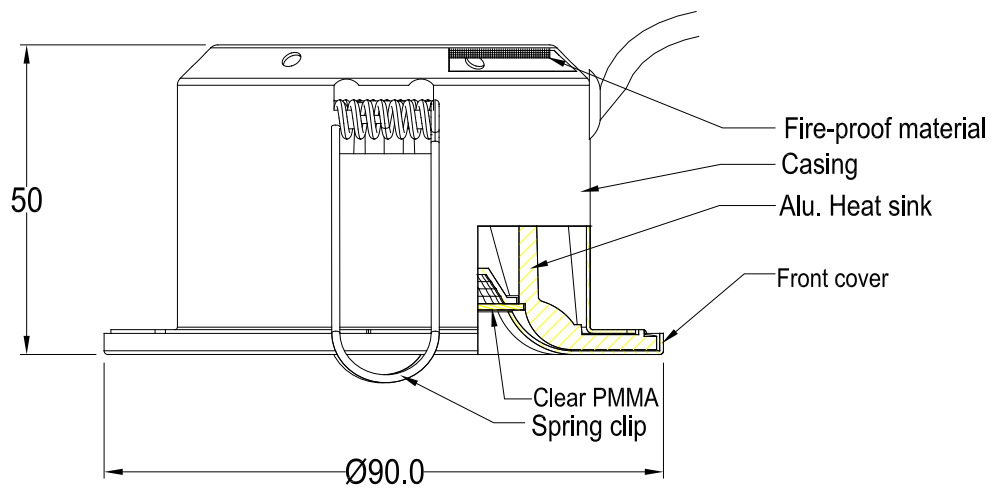
Figure 19 – Details of Downlighters Specimen Q



Fixed
With reflector:TC85XXX. XXX
Cut out:Ø75

Do not scale. All dimensions are in mm

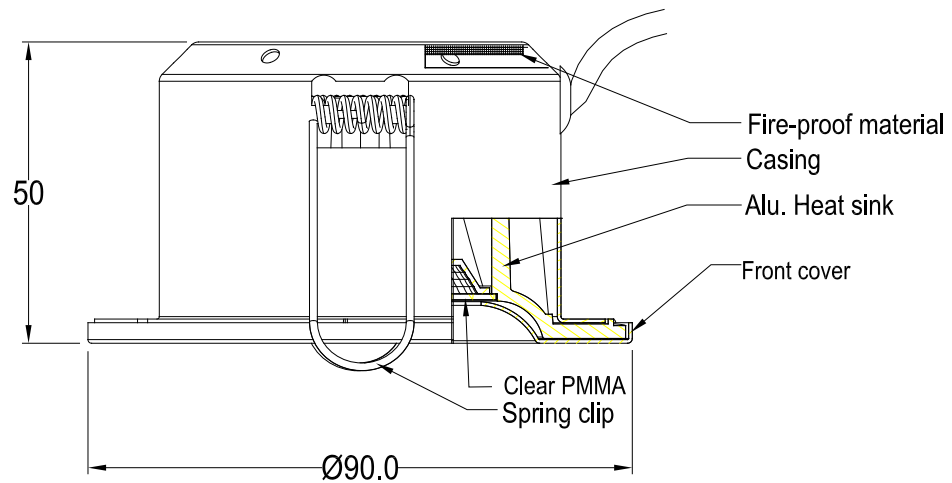
Figure 20 – Details of Downlighters Specimen R



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

Do not scale. All dimensions are in mm

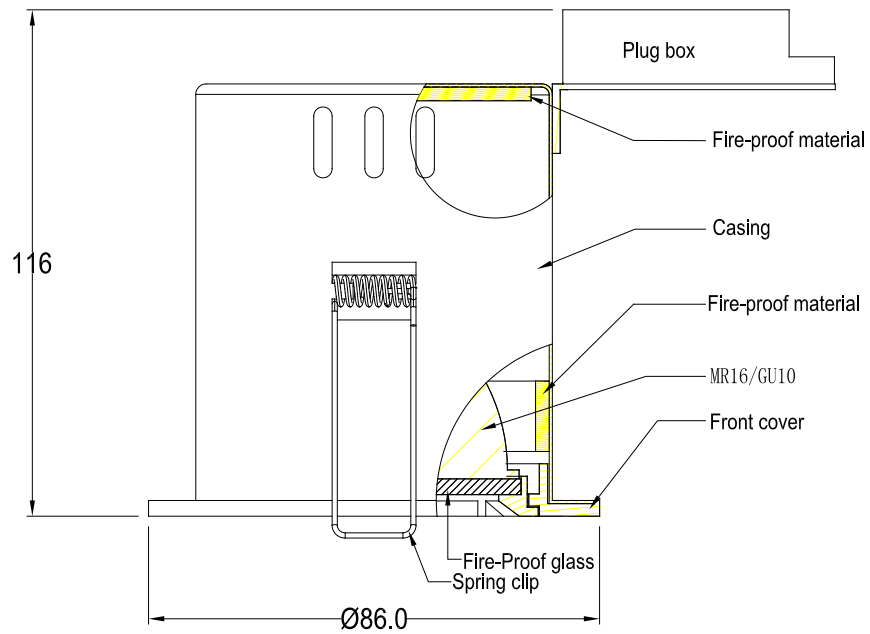
Figure 21 – Details of Downlighters Specimen S



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

Do not scale. All dimensions are in mm

Figure 22 – Details of Downlighters Specimen T



Fixed

With reflector:FHT-086

Cut out:Ø72

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	: 511 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	: 803 kg/m ³
Thickness	: 1 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 Figs 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 Figs 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 Figs 8 to 11.
Materials	
i. front cover	: Steel
ii. spring	: Stainless steel
iii. diffuser	: Pyrex glass
Overall dimensions and construction	: Please see Figs. 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
vi. diffuser	: Clear PMMA
vi. heat sink	: Die cast Aluminium
Overall dimensions and construction	: See fig. 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 Fig. 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 Fig. 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 Fig. 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 Fig. 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 fig. 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 Fig.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 Fig.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 Fig. 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	: C
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 Fig.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 13°C at the start of the test with a maximum variation of +1°C during the test.
00	00	The test commences.
01	00	When viewed from the exposed face, flames are seen spreading across the face of the ceiling.
05	00	When viewed from the exposed face the paper face of the specimen has ignited and is observed charring.
07	00	Very light steam/smoke release is observed from the joints of the timber joists.
10	00	When viewed from the exposed face, the paper face of the specimen has now completely discoloured black, all light fixings appear to be still in place.
15	00	No significant changes are observed on the unexposed face.
18	00	When viewed from the exposed face, the joints between the boards are observed expanding. All light fixings continue to appear in place.
24	00	When viewed from the exposed face, the boards are glowing bright orange as the joints continue to expand. All light fixings appear to be still in place.
30	00	When viewed from the exposed face, the boards are glowing bright orange as the joints continue to expand. All light fixings appear to be still in place.
32	00	When viewed from the exposed face flames are seen spreading along the board joints.
36	00	The test is discontinued.

Test Photographs

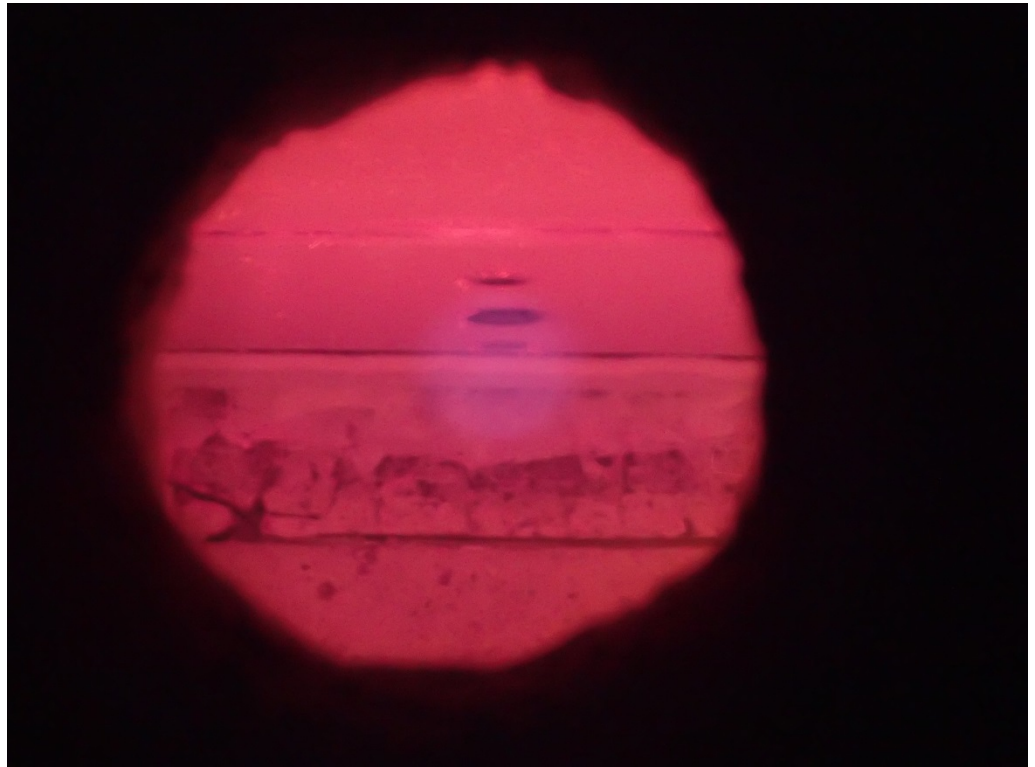
The exposed face of the assembly prior to testing



The unexposed face of the assembly after 10 minutes of testing



View of the exposed ceiling after a test duration of approximately 30 minutes



The unexposed face of the assembly after 36 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
1	349	515
2	445	485
3	502	516
4	544	531
5	576	604
6	603	618
7	626	618
8	646	634
9	663	645
10	678	665
11	693	677
12	706	705
13	717	718
14	728	724
15	739	727
16	748	730
17	757	734
18	766	764
19	774	766
20	781	772
21	789	788
22	796	801
23	802	796
24	809	801
25	815	807
26	820	824
27	826	829
28	832	834
29	837	836
30	842	839
31	847	843
32	852	846
33	856	856
34	860	859
35	865	867
36	869	869

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	16	17	17	17	14	16
1	16	17	16	17	14	16
2	16	17	16	17	14	16
3	16	17	16	17	14	16
4	16	17	16	17	14	16
5	16	17	16	17	13	16
6	17	17	16	17	14	16
7	17	17	16	17	14	16
8	17	17	17	17	14	16
9	17	17	17	18	14	17
10	18	18	17	18	14	17
11	18	19	17	19	15	18
12	19	19	17	20	15	18
13	20	20	18	21	16	19
14	21	21	18	21	17	20
15	22	22	18	22	17	20
16	23	23	19	23	18	21
17	24	24	19	24	19	22
18	25	25	20	25	20	23
19	26	26	20	26	21	24
20	27	27	21	27	22	25
21	28	28	22	28	22	26
22	29	29	22	29	23	26
23	30	30	23	30	24	27
24	31	31	24	31	25	28
25	32	33	24	32	26	29
26	34	34	25	33	27	31
27	35	36	26	33	27	31
28	37	38	26	34	28	33
29	40	42	27	36	29	35
30	44	45	28	37	30	37
31	48	50	29	38	31	39
32	53	54	29	40	32	42
33	58	58	30	43	34	45
34	63	63	31	45	36	48
35	68	66	32	49	38	51
36	72	70	33	52	41	54

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	15	15	15
1	15	15	15
2	15	15	15
3	15	15	15
4	15	15	15
5	15	15	15
6	15	15	15
7	15	15	15
8	15	15	15
9	15	16	15
10	15	16	16
11	16	17	16
12	16	17	16
13	16	18	17
14	16	19	17
15	17	20	18
16	17	21	18
17	18	22	19
18	19	23	20
19	19	24	20
20	20	26	21
21	20	27	22
22	21	28	23
23	22	29	24
24	23	30	25
25	23	32	27
26	24	34	28
27	25	35	29
28	26	38	30
29	27	41	32
30	28	44	33
31	29	48	35
32	30	51	36
33	31	55	37
34	33	58	39
35	35	61	40
36	37	64	42

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

Time Mins	T/C Number 219 Deg. C	T/C Number 220 Deg. C	T/C Number 221 Deg. C	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	17	18	17	20	20	19	20
1	18	18	18	20	20	20	20
2	24	27	23	28	30	24	26
3	37	43	38	40	45	41	42
4	48	53	49	49	52	49	51
5	55	59	57	55	57	56	59
6	60	63	62	59	60	63	64
7	64	69	67	65	64	72	70
8	71	78	75	72	72	81	78
9	79	85	81	76	79	85	84
10	83	91	86	81	83	98	88
11	86	95	90	83	86	107	91
12	90	98	92	86	88	110	92
13	92	103	96	89	92	112	91
14	94	105	99	91	95	110	94
15	97	110	103	94	98	113	93
16	100	113	106	96	102	116	94
17	102	114	109	99	108	125	95
18	106	118	113	105	123	141	98
19	111	131	120	113	135	152	102
20	123	148	134	131	154	160	114
21	143	167	152	147	175	166	137
22	159	182	169	164	188	181	158
23	174	193	184	180	200	191	172
24	185	203	197	192	209	203	182
25	195	211	205	200	220	216	192
26	204	217	214	206	225	222	202
27	210	225	220	211	228	223	211
28	216	232	229	216	233	237	218
29	223	240	239	222	240	240	226
30	229	248	247	228	243	247	237
31	234	255	252	234	249	250	244
32	244	261	262	241	257	256	253
33	248	272	269	245	263	261	259
34	255	277	275	250	268	266	265
35	261	285	280	256	276	276	271
36	270	291	289	262	282	288	277

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

Time Mins	T/C Number 226 Deg. C	T/C Number 227 Deg. C	T/C Number 228 Deg. C	T/C Number 229 Deg. C	T/C Number 230 Deg. C	T/C Number 231 Deg. C	T/C Number 232 Deg. C	T/C Number 233 Deg. C
0	20	20	20	17	18	18	18	24
1	20	20	20	18	18	18	18	24
2	27	26	31	22	31	21	22	33
3	41	42	46	38	46	35	32	49
4	50	51	54	47	57	48	44	61
5	58	57	57	56	62	56	50	66
6	61	62	60	62	65	61	58	69
7	67	68	61	64	73	64	62	74
8	77	77	70	71	81	72	69	83
9	81	85	75	78	85	77	76	89
10	83	92	79	83	90	82	81	94
11	86	97	83	87	93	86	86	97
12	88	106	84	90	96	89	90	101
13	89	108	89	93	98	92	94	103
14	92	118	88	98	101	95	98	107
15	94	121	94	100	107	97	102	110
16	95	130	95	100	108	99	105	112
17	97	131	98	102	108	101	108	115
18	101	125	97	106	110	103	112	119
19	110	121	99	113	116	106	111	120
20	128	135	109	113	124	109	113	126
21	149	155	129	122	132	113	127	131
22	168	179	146	135	148	119	128	142
23	181	196	157	162	169	133	134	159
24	190	207	168	184	189	158	146	176
25	197	212	180	197	204	178	171	190
26	203	220	190	213	216	187	189	201
27	211	223	194	220	224	199	210	211
28	219	237	199	227	230	210	217	218
29	227	238	211	234	242	220	221	225
30	235	250	217	239	251	227	230	234
31	240	256	224	250	260	236	240	240
32	245	266	227	253	265	242	248	248
33	252	272	238	262	270	250	256	253
34	258	282	243	269	274	256	262	261
35	265	285	244	286	282	264	272	268
36	271	288	252	285	288	270	278	274

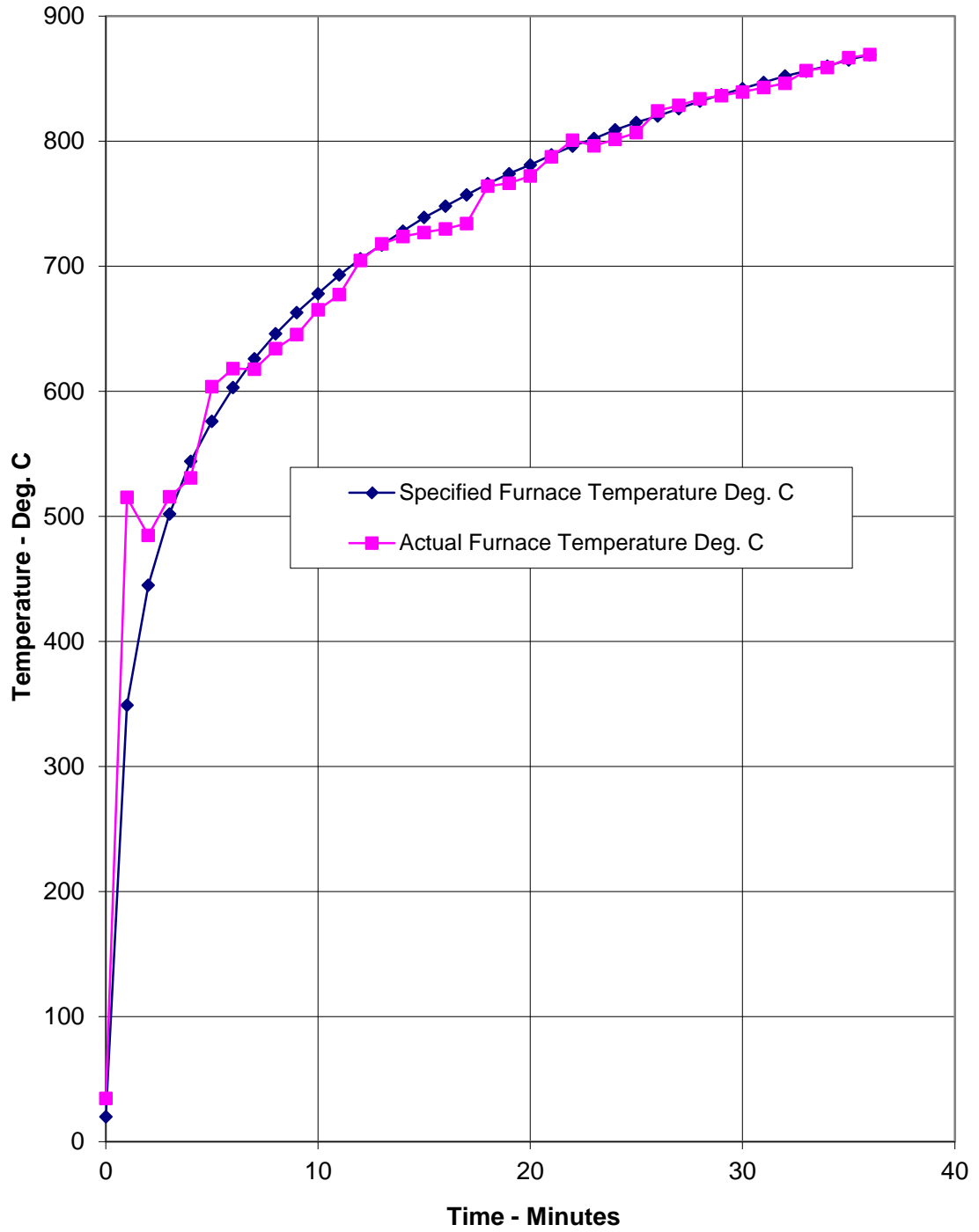
Individual temperatures recorded adjacent to the light fittings at mid height of the cavity

Time Mins	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	18	18	21	21	22
1	18	19	21	21	22
2	23	23	28	26	25
3	33	31	46	32	33
4	44	42	56	41	40
5	52	50	63	51	49
6	58	57	64	58	56
7	61	61	67	61	60
8	70	65	72	65	65
9	76	72	81	72	70
10	81	78	85	77	77
11	85	82	89	81	86
12	89	86	91	84	90
13	92	91	93	88	92
14	94	96	96	90	93
15	96	99	98	92	98
16	99	103	100	94	98
17	101	106	102	96	100
18	103	108	104	98	107
19	105	110	106	101	104
20	108	111	109	103	107
21	111	113	113	105	111
22	115	116	120	108	112
23	124	118	135	113	112
24	141	126	148	123	117
25	161	142	161	134	126
26	175	157	171	145	137
27	187	171	180	153	147
28	198	184	191	160	154
29	207	194	200	169	164
30	217	203	205	175	172
31	226	210	212	180	178
32	232	219	218	187	184
33	240	226	225	191	190
34	245	232	230	197	198
35	251	237	236	202	207
36	255	244	242	208	213

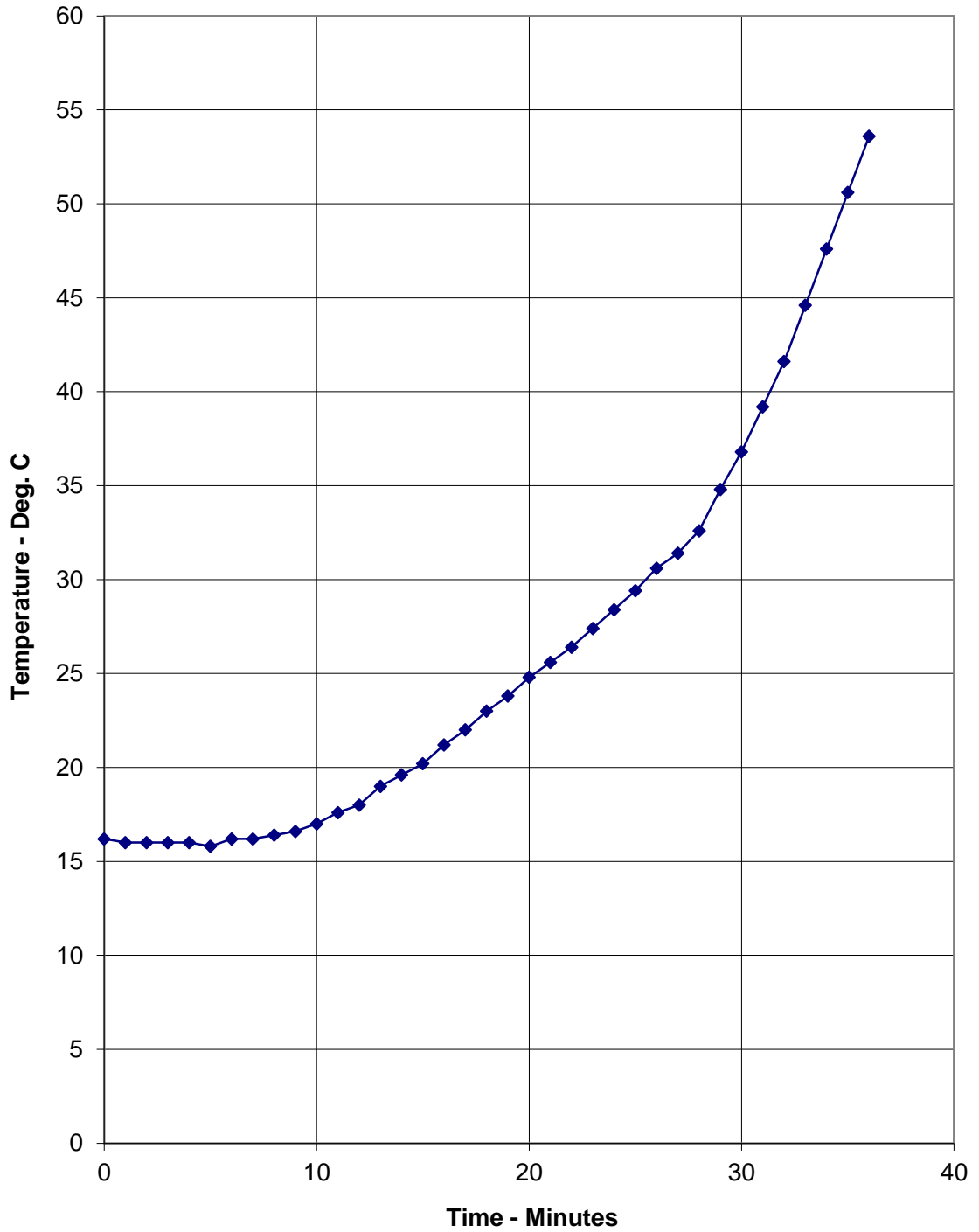
Deflection and rate of deflection of the floor assembly during the test

Time Minutes	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0	0
1	4	4
2	5	1
3	6	1
4	6	0
5	5	-1
6	5	0
7	5	0
8	5	0
9	5	0
10	5	0
11	5	0
12	5	0
13	5	0
14	5	0
15	5	0
16	5	0
17	5	0
18	5	0
19	5	0
20	5	0
21	5	0
22	5	0
23	5	0
24	5	0
25	5	0
26	5	0
27	5	0
28	5	0
29	6	1
30	6	0
31	7	1
32	7	0
33	8	1
34	9	1
35	9	0
36	11	2

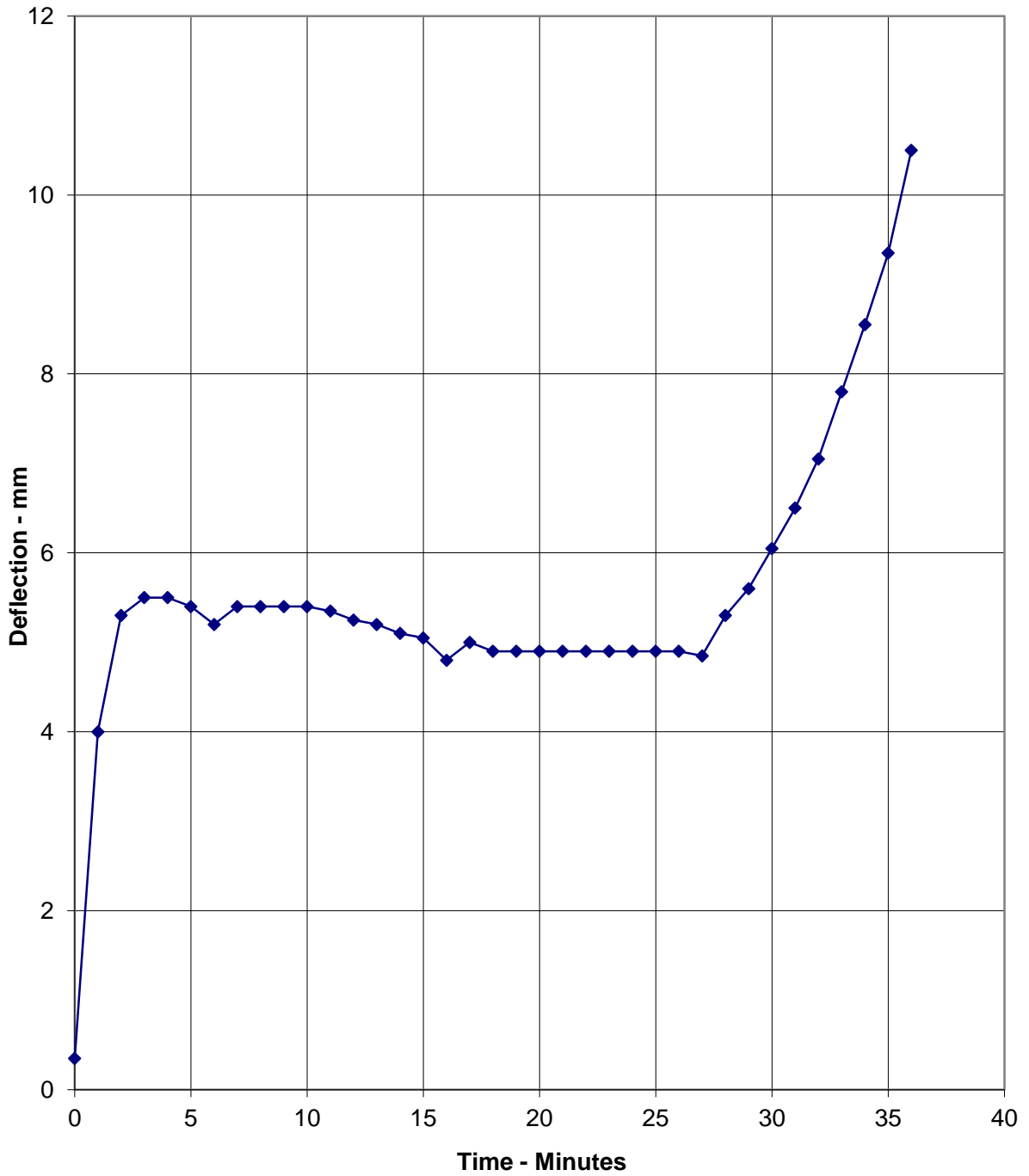
Graph showing specified and actual furnace temperatures



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	: 623 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)	: 47.1 kg

Total dead weight per joist : 100.2 kg

5. **Imposed Load**

Imposed load per joist required : total load per joist - dead weight per joist
: 325.8 – 100.2
: 225.6 kg

Assuming even distribution of loading

Maximum imposed load per metre square : $(225.6 \times 9.81) / (4.2 \times 0.6)$
: 878.23 N/m²
: **0.87823 kN/m²**
: 90 kg/m²

Calculation made by

Checked by

D. Fitzsimmons
Technical Officer
Fire Resistance Department

G. Edmonds
Senior Testing 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 36 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 36 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 36 minutes.

Ongoing Implications

Limitations	<p>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.</p> <p>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.</p>
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	36 minutes*
Integrity	36 minutes*
Insulation	36 minutes*

*The test was discontinued after a period of 36 minutes.