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, Incorporating Eighteen Downlighter Light Fittings, Tested in Accordance with BS 476: Part 21: 1987, Clause 7

WF Report No:

349943 Issue 2

Prepared for:

Hong Kong Diaman International Lighting Co. Ltd

Unit 04,
7/F Bright Way Tower
No.33 Mong Kok Rd,
KL

Date:

30th April 2015

Notified Body No:

0833

UKAS TESTING
0249

Summary

Objective

To determine the fire resistance performance of a loadbearing timber floor assembly protected by a plasterboard ceiling, incorporating eighteen down lighter 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

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 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 0.87 kN/m^2.

The ceiling incorporated eighteen downlight light fittings referenced as follows:

Test Ref.	Model Ref.	Description
A	TC45xx.xxx	Round, fixed, Agate LED recessed downlight
B	TC45xx.xxx	Round, fixed, Agate LED recessed downlight
C	TC45xx.xxx	Round, fixed, Agate LED recessed downlight
D	TC45xx.xxx	Round, fixed, Agate LED recessed downlight
E	TC46xx.xxx	Round, fixed, Agate LED recessed downlight
F	TC46xx.xxx	Round, fixed, Agate LED recessed downlight
G	TC47xx.xxx	Round, adjustable, Agate LED recessed downlight
H	TC70xx.xxx	Round, fixed, Agate LED recessed downlight
I	TC71xx.xxx	Round, fixed, Agate LED recessed downlight
J	TC71xx.xxx	Round, fixed, Agate LED recessed downlight
K	TC71xx.xxx	Round, fixed, Agate LED recessed downlight
L	TC81xx.xxx	Round, fixed, Agate LED recessed downlight
M	TC81xx.xxx	Round, fixed, Agate LED recessed downlight
N	TC85xx.xxx	Round, fixed, Agate LED recessed downlight
O	TC86xx.xxx	Round, fixed, Agate LED recessed downlight
P	TC86xx.xxx	Round, fixed, Agate LED recessed downlight
Q	TC87xx.xxx	Round, fixed, Agate LED recessed downlight
R	DG42xx.xxx	Square adjustable, Agate LED recessed downlight

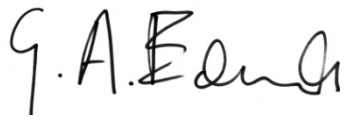
Test Results:

Loadbearing Capacity	70 minutes
Integrity	70 minutes
Insulation	70 minutes

The test was discontinued after a period of 70 minutes

Date of Test 24th March 2015

Signatories



Responsible Officer
G. Edmonds*
Senior Testing and Auditing Officer

Approved
S. Hankey*
Business Unit Head – Fire Resistance Department

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

Report Issued

Date: 30th April 2015

Issue 2 – Change of company name and address – 12th October 2015

CONTENTS **PAGE NO.**

Test Procedure

Introduction

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)'.

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.

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.

Fire Test Study Group/EGOLF

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

Instruction To Test

The test was conducted on the 24th March 2015 at the request of **Hong Kong Diaman International Lighting Co. Ltd,** the test sponsor.

Test Assembly Construction

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

Installation

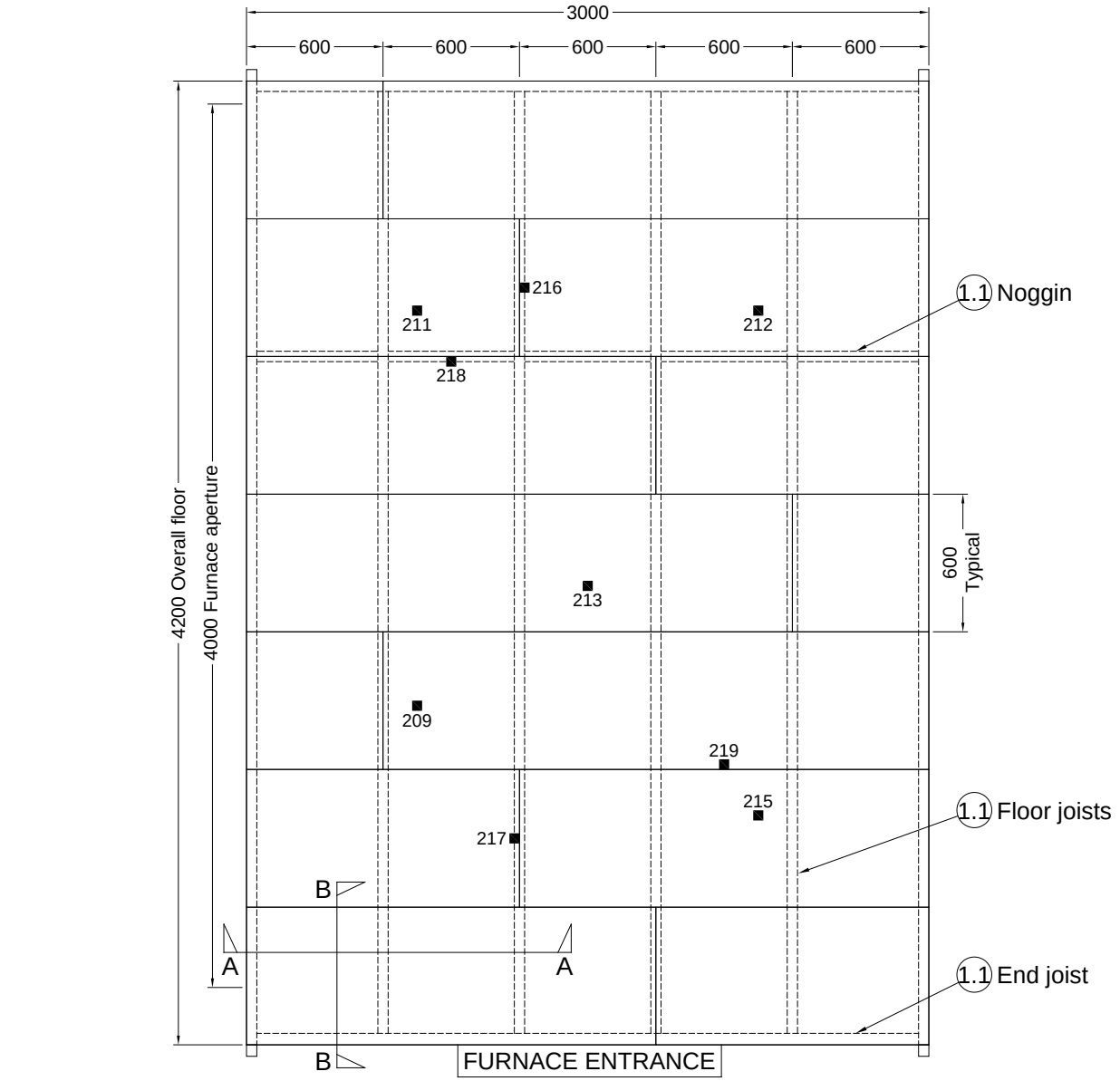
Representatives of Exova Warringtonfire assembled the floor construction and installed the down lighters between the 18th and 23rd March 2015.

Conditioning

The specimens' storage, construction, and test preparation took place in the test laboratory over a total combined time of 6 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 22°C and 58% to 82% respectively.

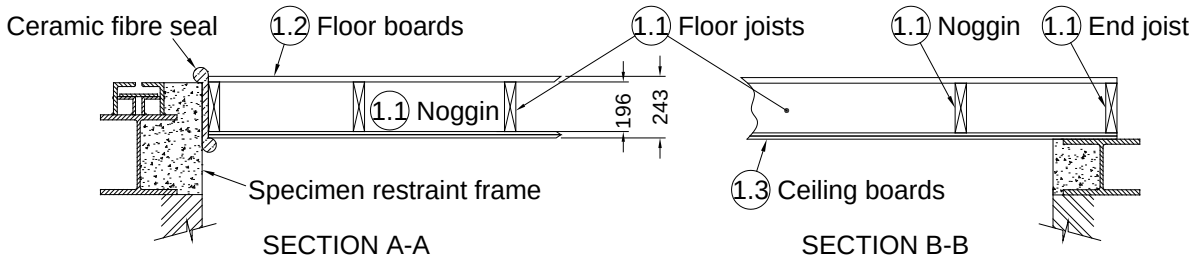
Test Specimens

Figure 1- General Elevation of Test Specimens



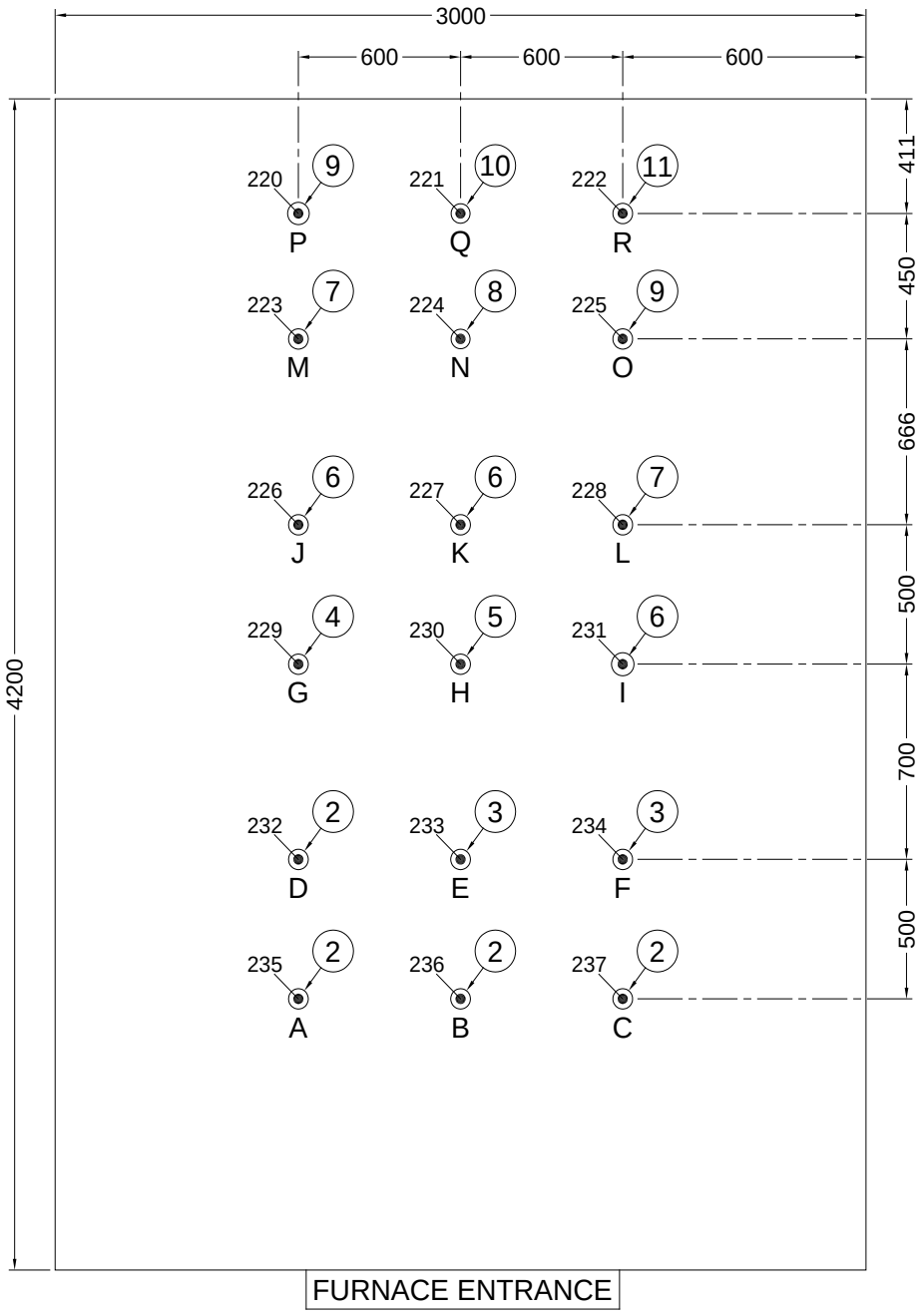
PLAN OF THERMOCOUPLE POSITIONS

■ Upper face of floor boards



Do not scale. All dimensions are in mm

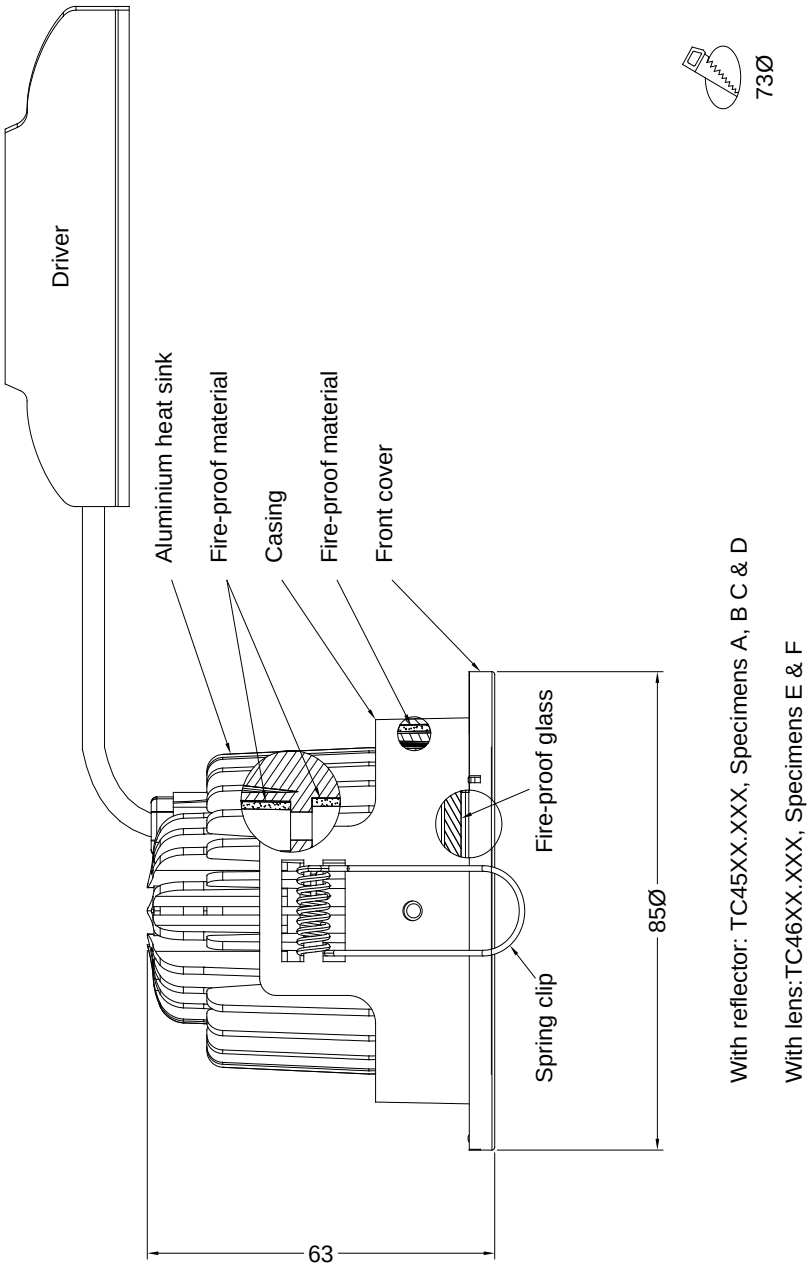
Figure 2 – Details of Downlighter Positions



DOWNLIGHTER LAYOUT

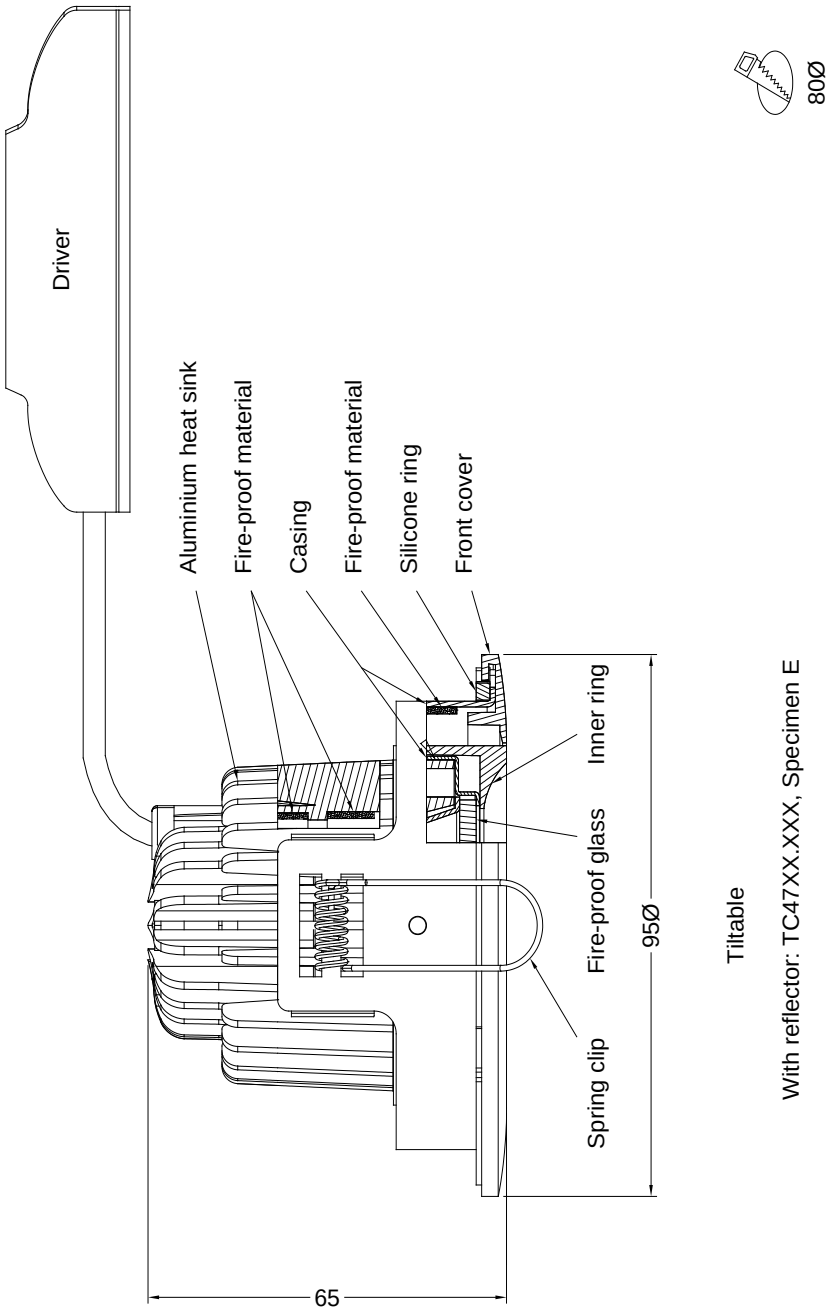
Do not scale. All dimensions are in mm

Figure 3 – Details of Downlighters



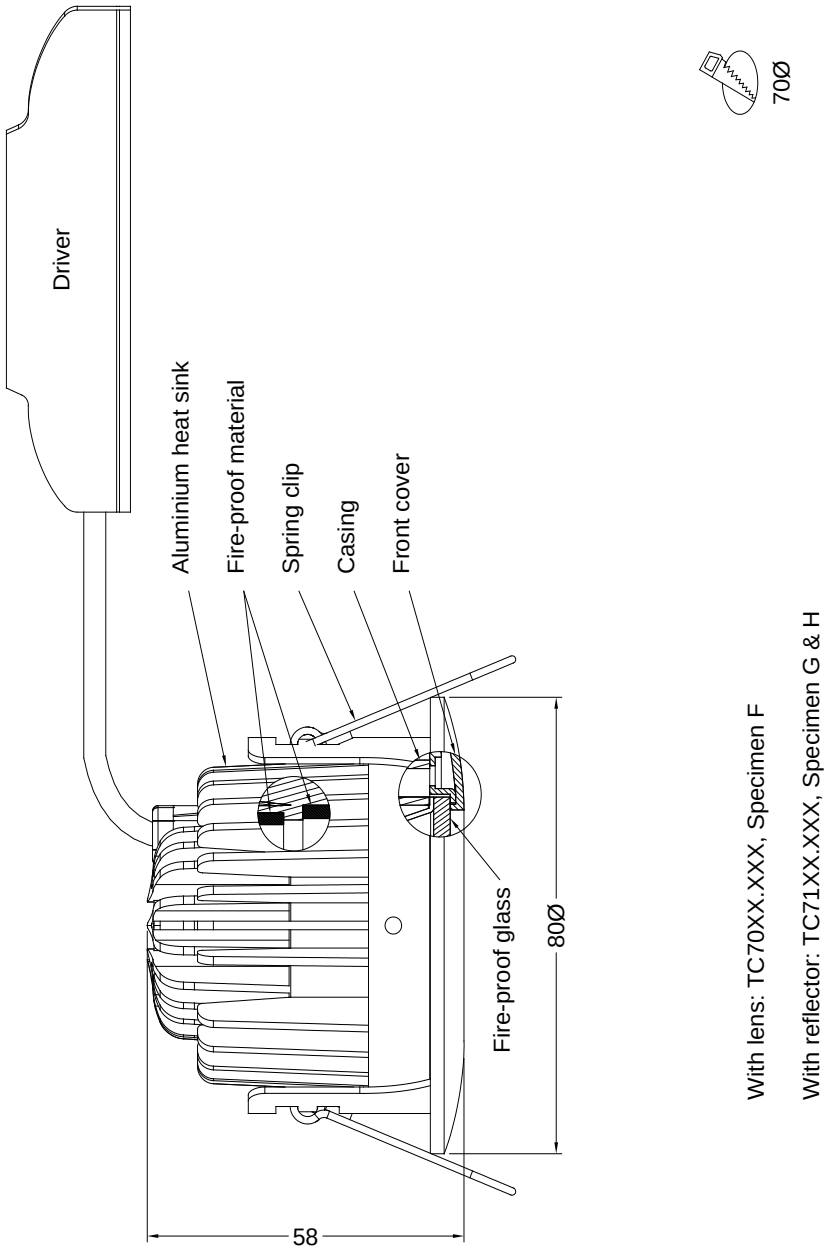
Do not scale. All dimensions are in mm

Figure 4 – Details of Downlighters



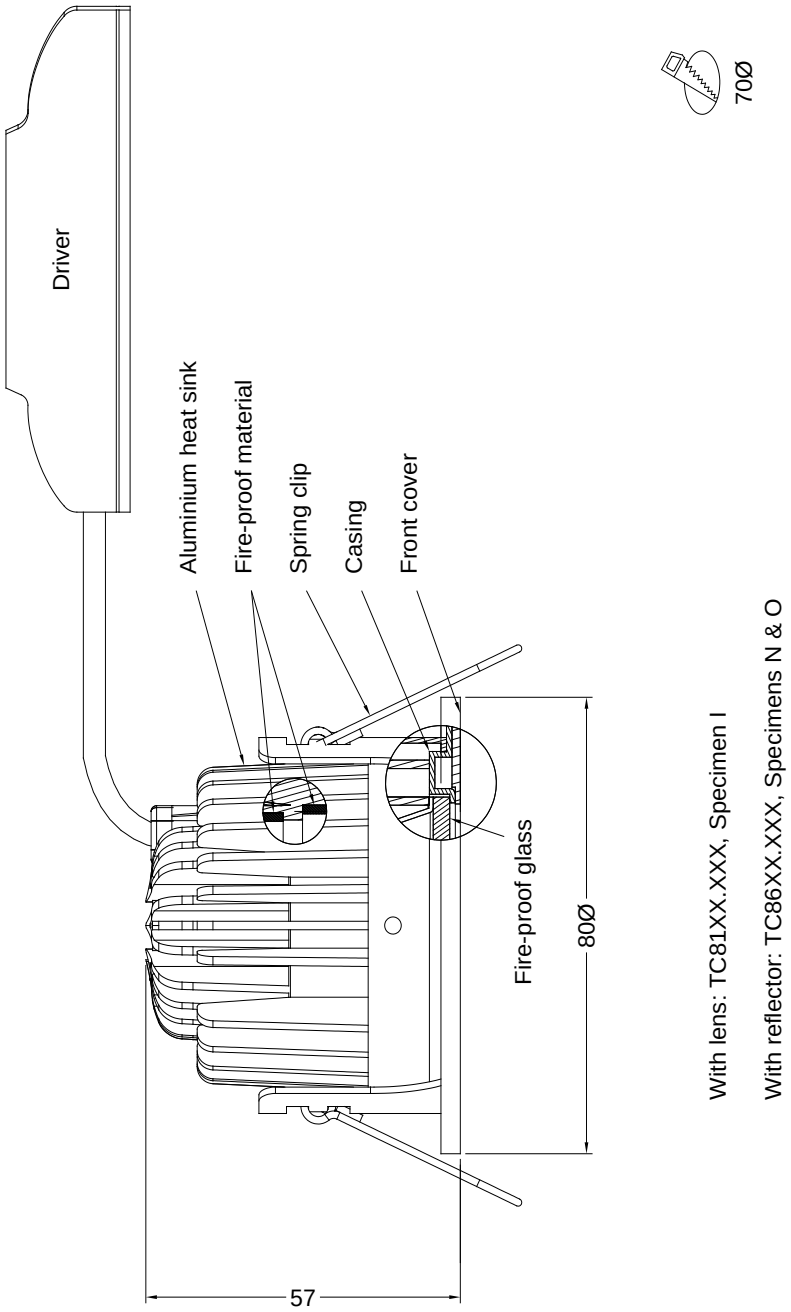
Do not scale. All dimensions are in mm

Figure 5 – Details of Downlighters



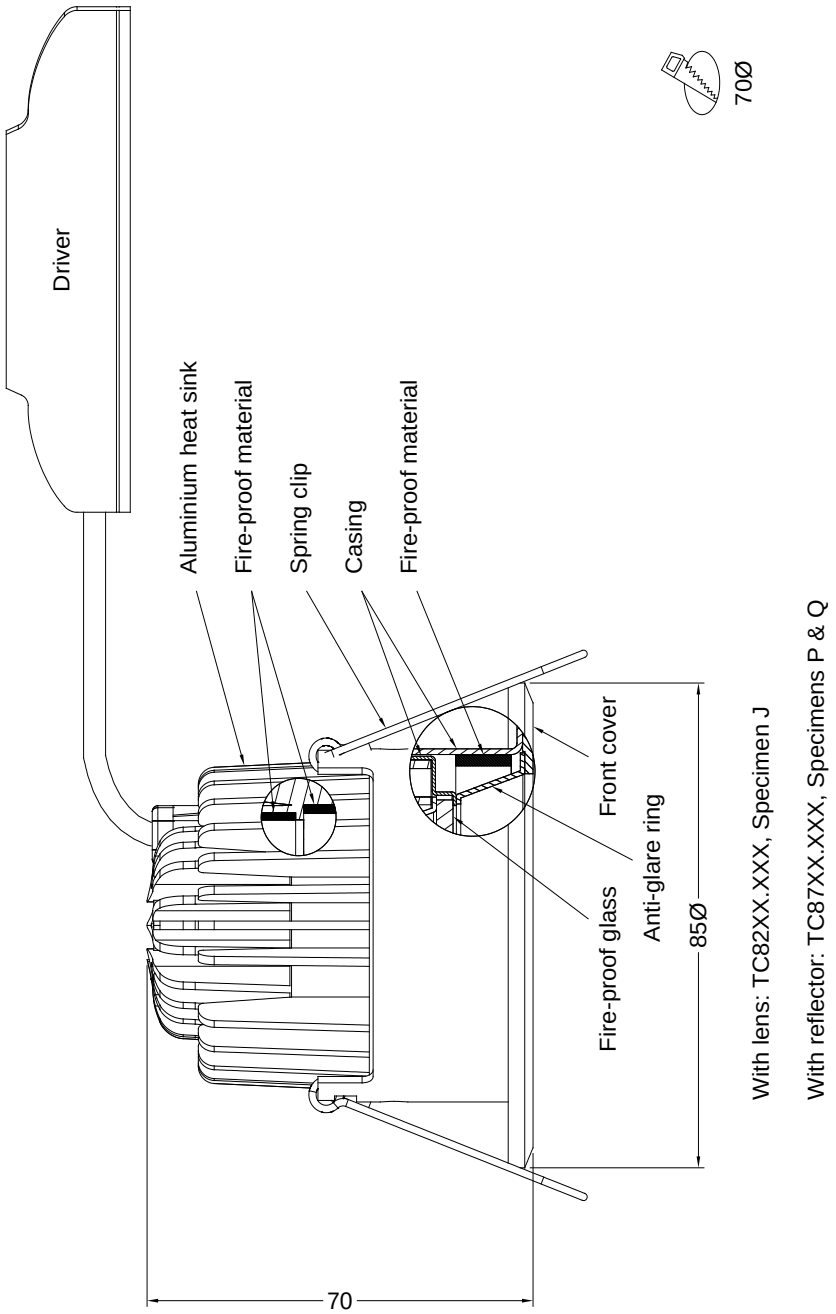
Do not scale. All dimensions are in mm

Figure 6 – Details of Downlighters



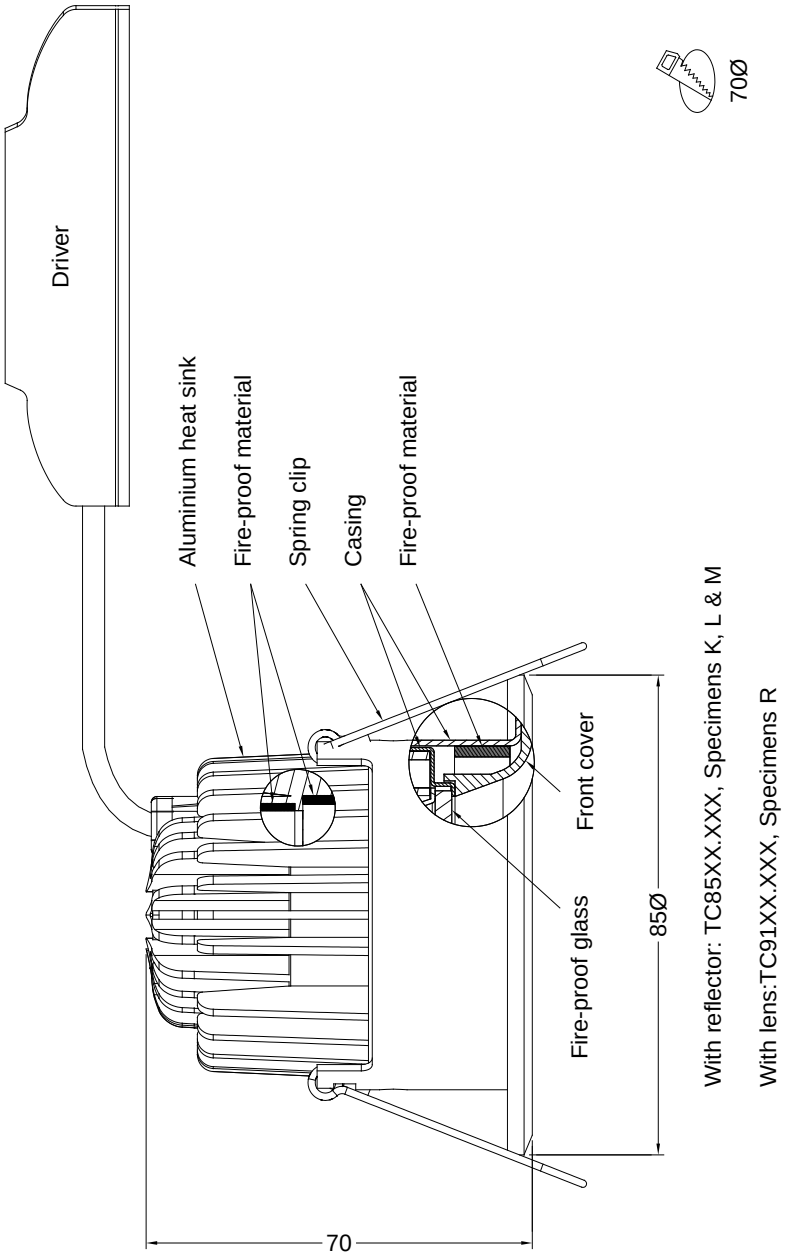
Do not scale. All dimensions are in mm

Figure 7 – Details of Downlighters



Do not scale. All dimensions are in mm

Figure 8 – Details of Downlighters



Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 8)
(All values are nominal unless stated otherwise)
(All other details are as stated by the sponsor)

Item		Description
1. Timber Floor		
1.1 Floor Joists		
Material	:	British Home-grown, rough sawn softwood, kiln dried
Grade	:	C24, to BS EN 519
Density	:	406 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
Density	:	734 kg/m^3
Thickness	:	25 mm, 2 layers of 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 and 45 mm long for the 1st and 2nd board layers respectively
iii. frequency	:	150 mm centres along joints and 150 mm to the perimeter of the ceiling
2. Specimens A, B, C & D		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC45xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 3
Cut out size	:	73 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver

Item		Description
2. Specimens A, B, C & D (Continued)		
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 3
3. Specimen E & F		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC46xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 3
Cut out size	:	73 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 3
4. Specimen G		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, adjustable, Agate LED recessed downlight
Reference	:	TC47xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 4
Cut out size	:	83 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	4 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 4
5. Specimen H		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC70xx.xxx

Item		Description
5. Specimen H (Continued)		
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 5
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 5
6. Specimens I, J & K		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC71xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 5
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 5
7. Specimen L & M		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC81xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 6
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver

Item		Description
7. Specimen L & M (Continued)		
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 6
8. Specimens N		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC85xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 8
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 8
9. Specimens O & P		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC86xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 6
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 6

Item		Description
10. Specimens Q		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Round, fixed, Agate LED recessed downlight
Reference	:	TC87xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 7
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	1.5 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 7
11. Specimen R		
Manufacturer	:	Dongguan Diaman Lighting Company Limited
Type	:	Square adjustable, Agate LED recessed downlight
Reference	:	DG42xx.xxx
Materials		
i. casing	:	Pressed steel
ii. heat sink	:	Die cast aluminium
iii. inner cover	:	Die cast aluminium
iv. front cover	:	Pressed steel
v. spring	:	Stainless steel
vi. diffuser	:	Pyrex glass
Overall dimensions and construction	:	Please see Figure 8
Cut out size	:	70 mm
Driver	:	Model; GC-2898B260, constant current dimmable LED driver
Fireproof material		
i. manufacturer	:	Qinghe Lijia
ii. type	:	60mine fire resistance
iii. thickness	:	4 mm, stated
iv. location	:	Around the inside of the casing, please see Figure 8

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

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:

The locations and reference numbers of the various unexposed surface and internal thermocouples are shown in Figure 1.

Roving Thermocouple

A roving thermocouple was available to measure temperatures on the unexposed surface of the specimen at any position which might appear to be hotter than the temperatures indicated by the fixed thermocouples.

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 12ºC at the start of the test with a maximum variation of -1ºC during the test.
00	**00**	**The test commences.**
05	**00**	Paper face of the plasterboard ignites and burns away
15	**00**	There are no visible significant changes to the test assembly
20	**00**	Smoke has started to be released from the upper surface of the assembly
25	**00**	The plasterboard ceiling is deforming slightly on the exposed face.
30	**00**	The test specimen assembly is maintaining its loadbearing capacity, integrity and insulations
32	**00**	Steam/smoke release increases from the test assembly.
35	**00**	No visible evidence of any of the light fittings falling away or any loss of ceiling material on the exposed face.
40	**00**	The ceiling is radiating an orange colour and has deformed more on the exposed face.
50	**00**	Smoke release increases. No evidence of any loss of the ceiling material on the exposed face.
60	**00**	The test specimen assembly is maintaining its loadbearing capacity, integrity and insulations
70	**00**	The test specimen assembly maintains its loadbearing capacity, integrity and insulations.
		The test is discontinued.

Test Photographs

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

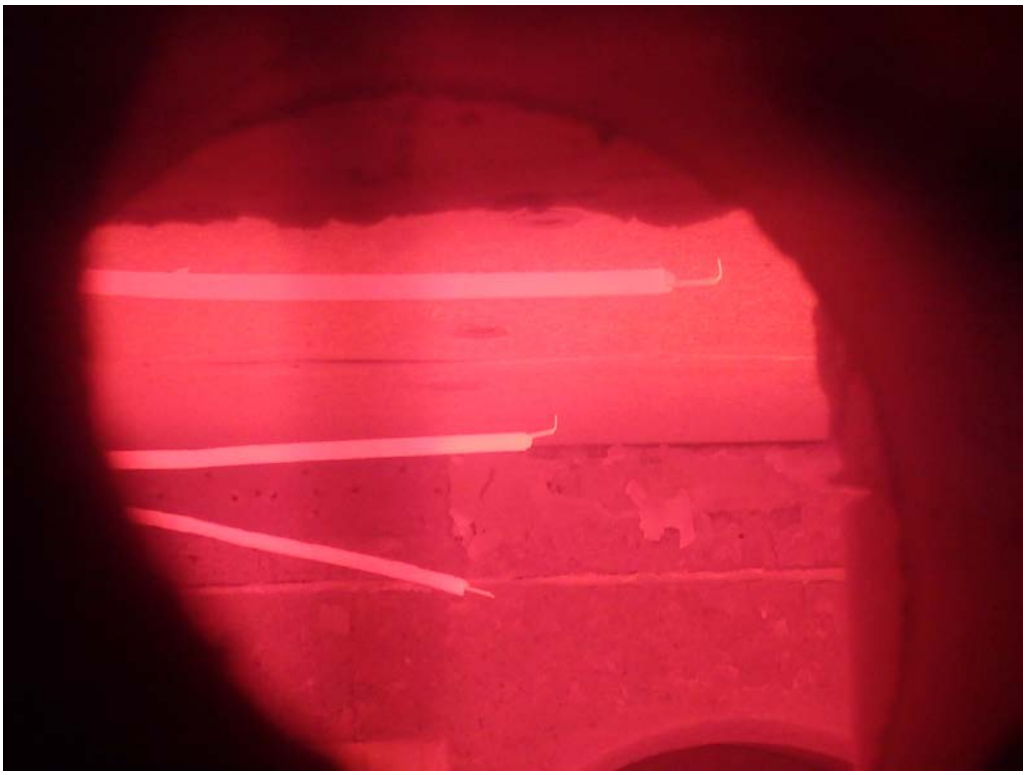
The unexposed face of the assembly prior to the start of the test

The unexposed surface of the assembly after a test duration of 15 minutes

The unexposed surface of the assembly after a test duration of 30 minutes

The exposed surface of the assembly after a test duration of approximately 45 minutes.

The exposed surface of the assembly after a test duration of approximately 45 minutes.



The unexposed surface of the assembly after a test duration of approximately 60 minutes.

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	17
3	502	540
6	603	591
9	663	640
12	706	667
15	739	718
18	766	756
21	789	779
24	809	799
27	826	826
30	842	832
33	856	861
36	869	868
39	881	878
42	892	894
45	902	899
48	912	913
51	921	920
54	930	928
57	938	941
60	945	948
63	953	954
66	960	959
69	966	965
70	968	968

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	17	18	18	17	16	17
3	17	18	18	17	16	17
6	17	18	18	17	16	17
9	17	18	18	17	16	17
12	17	18	18	17	16	17
15	18	19	19	18	17	18
18	19	20	21	19	18	19
21	21	21	23	20	20	21
24	23	24	25	22	23	23
27	25	26	27	24	26	26
30	27	28	29	27	28	28
33	29	30	31	29	30	30
36	31	33	33	32	32	32
39	33	34	35	34	34	34
42	35	36	37	36	36	36
45	37	39	39	38	38	38
48	39	40	41	40	40	40
51	41	41	44	42	43	42
54	42	43	46	44	45	44
57	44	44	50	46	48	46
60	47	45	55	50	51	50
63	52	48	62	56	57	55
66	58	52	66	63	63	60
69	64	58	70	70	68	66
70	66	60	72	72	70	68

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
0	15	16	16	17
3	14	16	15	17
6	15	16	15	17
9	14	16	15	17
12	14	16	15	17
15	15	16	16	17
18	15	17	16	18
21	16	18	17	20
24	17	19	18	23
27	18	21	19	25
30	20	22	21	27
33	21	24	22	30
36	23	26	24	32
39	25	28	26	34
42	27	29	28	36
45	29	31	31	38
48	31	33	34	39
51	33	34	36	41
54	35	36	38	42
57	37	37	40	45
60	39	39	41	50
63	41	41	42	58
66	46	45	43	65
69	54	50	44	70
70	56	52	45	71

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

Time Mins	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	T/C Number 226 Deg. C	T/C Number 227 Deg. C	T/C Number 228 Deg. C
0	16	16	18	18	18	18	18	19	19
3	17	17	18	19	18	19	19	19	19
6	22	23	23	26	25	25	27	28	25
9	33	41	32	39	42	36	38	42	38
12	46	66	44	49	60	48	47	54	45
15	54	73	56	56	67	62	55	61	54
18	60	77	64	62	70	73	68	66	63
21	67	78	70	70	72	77	75	70	72
24	73	80	74	74	83	85	80	80	78
27	80	88	80	80	94	92	88	88	88
30	88	107	86	89	111	104	92	93	94
33	94	110	90	98	112	109	95	94	96
36	99	110	93	104	113	115	97	96	98
39	102	112	95	105	115	113	100	97	100
42	104	114	97	110	109	115	102	99	102
45	106	115	100	113	109	125	105	101	105
48	110	120	104	119	117	131	112	109	113
51	118	131	113	127	133	137	124	127	131
54	135	157	130	146	167	154	147	150	154
57	155	184	150	171	201	178	171	168	173
60	176	206	166	195	226	190	189	183	190
63	192	223	181	215	241	199	205	200	207
66	206	243	194	229	261	215	216	214	233
69	221	259	206	242	271	227	228	229	251
70	225	264	211	250	275	230	232	230	257

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

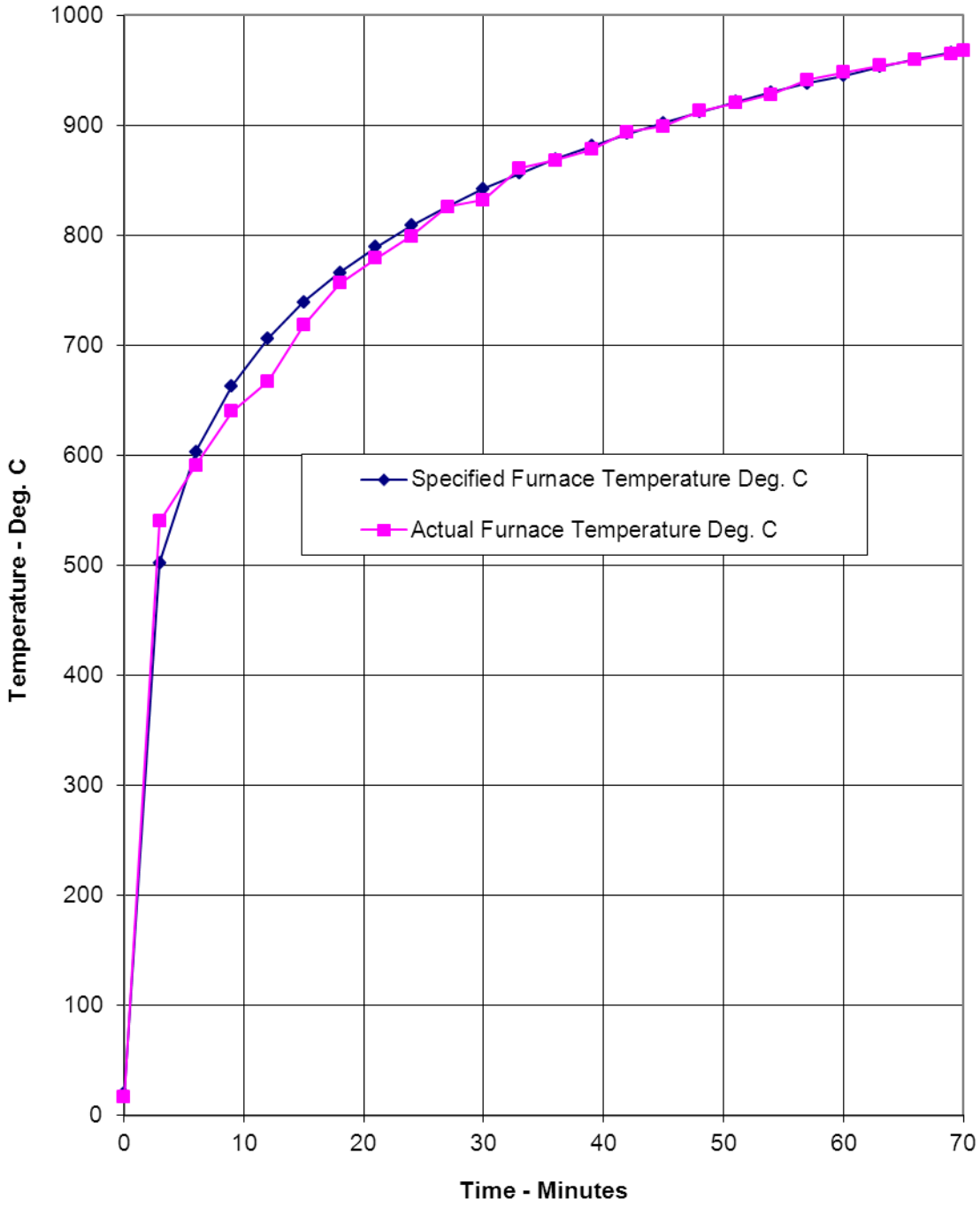
Time Mins	T/C Number 229 Deg. C	T/C Number 230 Deg. C	T/C Number 231 Deg. C	T/C Number 232 Deg. C	T/C Number 233 Deg. C	T/C Number 234 Deg. C	T/C Number 235 Deg. C	T/C Number 236 Deg. C	T/C Number 237 Deg. C
0	16	17	17	16	17	17	17	21	20
3	17	17	17	17	17	17	17	21	20
6	26	29	25	24	*	24	23	27	25
9	42	49	40	40		37	33	43	36
12	53	65	50	57		52	43	58	65
15	72	76	68	58		64	69	74	76
18	81	81	78	67		73	99	75	80
21	112	84	84	75		80	110	81	86
24	108	94	98	82		85	141	91	94
27	109	102	144	96		92	142	101	118
30	147	110	125	105		102	136	108	141
33	144	115	137	111		108	157	114	137
36	172	112	149	127		113	161	121	130
39	185	115	163	126	118	116	196	125	143
42	175	116	155	144	120	119	190	125	161
45	181	122	147	130	124	122	169	130	186
48	183	133	151	150	133	130	152	133	240
51	220	162	172	180	159	151	165	153	235
54	243	193	198	213	190	180	223	178	250
57	262	213	215	244	213	200	238	210	255
60	276	232	231	261	234	218	282	232	250
63	285	252	249	268	251	235	309	252	258
66	293	266	264	289	268	253	314	271	274
69	306	286	280	294	286	269	321	290	289
70	309	291	286	297	290	273	324	294	293

*Thermocouple malfunction

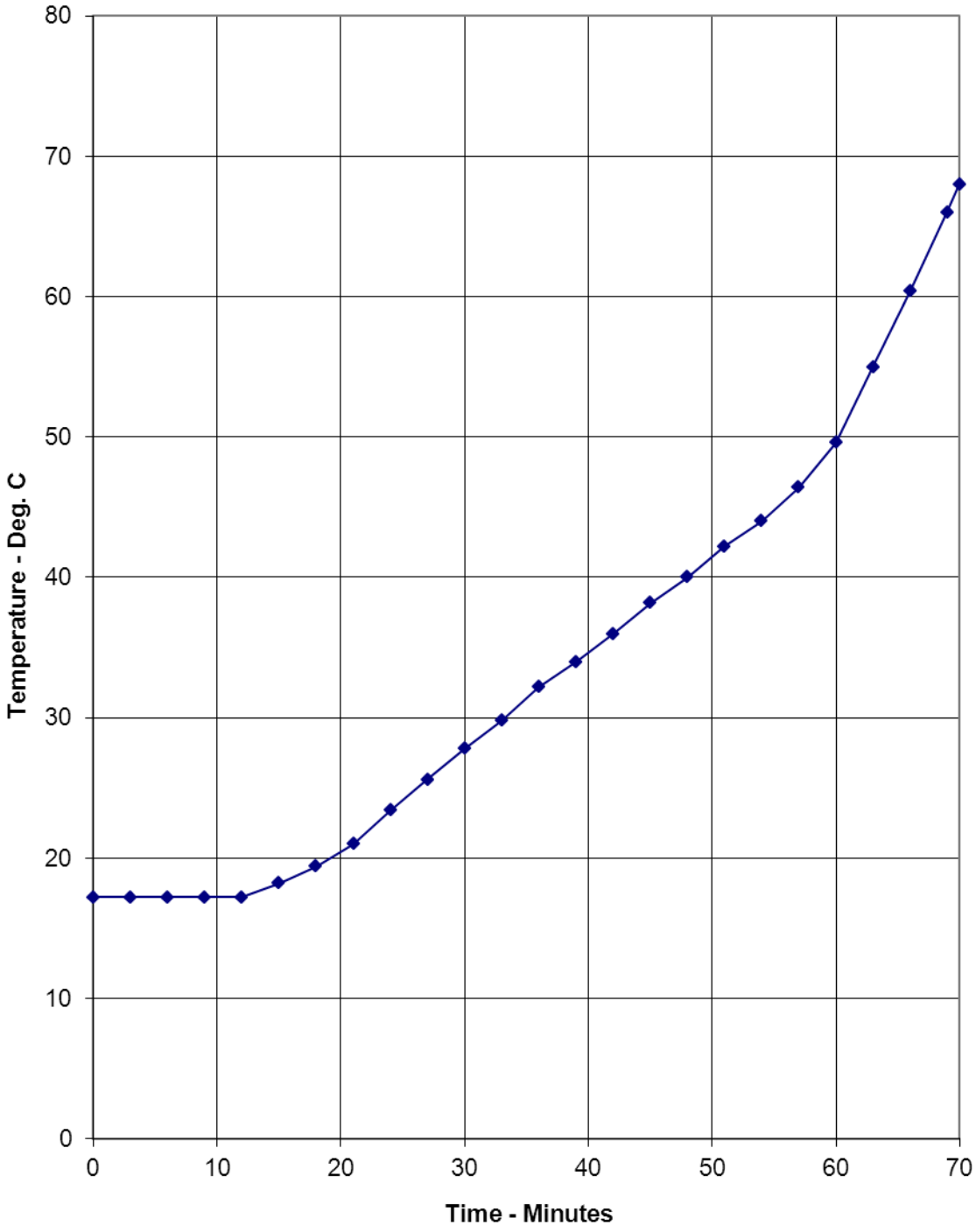
Deflection and rate of deflection of the floor assembly during the test

Time Mins	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0.9	0.0
3	3.0	0.8
6	3.9	0.5
9	4.3	0.1
12	4.2	0.2
15	4.3	0.0
18	4.3	0.0
21	4.3	0.0
24	4.4	0.1
27	4.6	0.1
30	5.1	0.1
33	4.9	0.0
36	6.0	0.1
39	5.6	0.0
42	6.0	0.0
45	5.6	0.0
48	5.7	0.0
51	6.3	0.1
54	6.5	0.1
57	6.6	-0.2
60	7.4	0.4
63	9.0	0.5
66	11.3	0.8
69	14.2	1.1
70	15.3	1.0

Graph showing specified and actual furnace temperatures



Graph showing mean unexposed surface temperature of the floor assembly



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	: FI/y
	: (5.83 x 2823570)/98
	: 1679739 N/mm^2
Also maximum bending stress	: $wL^2/8$
	: 1679739 N/mm^2
Where w	= Load per unit length
∴ w	= (1679739 x 8) / (4200 x 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	: 406 kg/m^3
Actual density of floor boarding	: 900 kg/m^3
Actual density of ceiling board	: 734 kg/m^3
Effective width of floor supported per joist (m)	: 0.6 m
weight of joist	: 15.5 kg
weight of floorboard	: 40.8 kg
weight of ceiling (two layers)	: 46 kg
Total dead weight per joist	: 102.3 kg

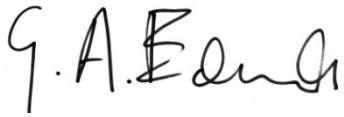
5. **Imposed Load**

Imposed load per joist required : total load per joist - dead weight per joist
: 325.8 – 102.3
: 223.8 kg

Assuming even distribution of loading

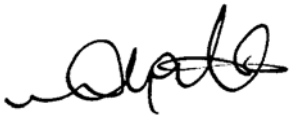
Maximum imposed load per metre square : (223.8 x 9.81) / (4.2 x 0.6)
: 871 N/m^2
: 0.871 kN/m^2
: 88.8 kg/m^2

Calculation made by



G. Edmonds
Senior Testing Officer
Fire Resistance Department

Checked by



D. Yates
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 10 mm per minute respectively. The allowable rate of deflection is not applicable until the deflection exceeds $^{1}/_{30}$ of the span (i.e. 140 mm). The test construction satisfied this requirement for the test duration of 70 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 test duration of 70 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 test duration of 70 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 on-going 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 eighteen 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	70 minutes
Integrity	70 minutes
Insulation	70 minutes

The test was discontinued after a period of 70 minutes.