

TEST REPORT

No. : XMIN2103002767CM

Date : May 14, 2021

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CUSTOMER NAME: FOSHAN RAYVEN LIGHTING CO., LTD
ADDRESS: A1 NEW LIGHTING SOURCE INDUSTRY ZONE, LUOCUN, NANHAI DISTRICT, FOSHAN, GUANGDONG, CHINA, 528200

Sample Name : FIRE RATED DOWNLIGHT

Other Information : Type No.:

- A) RAVxFHB21;
- B) RAVxFHC21;
- C) RAVxFHF21;
- D) RAVxFHG21;
- E) RAVxFHJ21;
- F) RAVxFHM31;
- G) TWIST RAVXFHJ21

Above information and sample(s) was/were submitted and confirmed by the client. SGS, however, assumes no responsibility to verify the accuracy, adequacy and completeness of the sample information provided by client.

Date of Receipt : Mar 26, 2021

Testing Start Date : Mar 26, 2021

Testing End Date : Apr 26, 2021

Test result(s) : For further details, please refer to the following page(s)
(Unless otherwise stated the results shown in this test report refer only to the sample(s) tested)

Signed for
SGS-CSTC Standards Technical
Services Co., Ltd Xiamen Branch
Testing Center



Civi Huang
Authorized signatory



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SUMMARY

To determine the fire resistance of a timber floor assembly protected by a plasterboard ceiling designed to provide 30 minutes fire resistance, incorporating 14 Fire rated Downlight fittings, when tested in accordance with Clause 7 of BS 476-21:1987 "Fire tests on building materials and structures – Part 21: Methods for determination of the fire resistance of loadbearing elements of construction".

Test Results:

Loadbearing Capacity: 31 min (No failure)

Integrity: 31 min (No failure)

Insulation: 31 min (No failure)

Note: According to sponsor requirements, the test was discontinued after a period of 31 minutes.

Summary of Tested Assembly

The timber floor assembly had overall nominal dimensions of 4800 mm long by 3230 mm wide and comprised joists at 600mm centres. The depth of I joist was 240mm. The upper surface of the floor comprised nominally 18mm thick OSB board, and screwed fixed to the upside of the floor joists. The floor assembly was protected on its underside by a direct fixed ceiling, formed from one layer of 15mm thick Standard Gypsum Boards, the ceiling was screw fixed to the underside of the floor joists. The floor supported a uniformly distributed load of 1.0kN/m². This load was specified by the sponsor of the test.



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The ceiling incorporated 14 fire rated downlight fittings referenced as follows:

Test Ref.	Product Name	Reference
A	Fire rated Downlight	RAVxFHB21
B	Fire rated Downlight	RAVxFHC21
C	Fire rated Downlight	RAVxFHF21
D	Fire rated Downlight	RAVxFHG21
E	Fire rated Downlight	RAVxFHJ21
F	Fire rated Downlight	RAVxFHM31
G	Fire rated Downlight	TWIST RAVXFHJ21



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SCHEDULE OF COMPONENTS

(Refer to Figures 1 to 17)

(All values are nominal unless stated otherwise, all other details are as stated by the sponsor)

<u>Item</u>	<u>Description</u>
1. Floor Joists	
Material	: I-Joist, 2 rectangular timber flanges and OSB web
Size	: 240mm Depth; Timber flanges: 47mmx47mm
Centres:	: 600 mm
2. Floorboards	
Material	: OSB Board
Thickness	: 1 layer, 18mm thick
Fixing method	: All board joints staggered with respect to adjacent layer and screw fixed to all joists
3. Ceiling boards	
Material	: Standard Gypsum Board
Thickness	: 1 layer, 15mm thick
Fixing method	: All board fixed to joists with Drywall screws at max.230mm c/c. The joints between the boards were filled with joint filler with was also used to cover the heads of the screws.
4. End Joists	
Material	: Glulam
Size	: 240mm high x 50mm thick
Fixing method	: Fitted across the ends of the joists and through screwed to each joist.



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5.Specimen 'A'

Product Name : FIRE RATED DOWNLIGHT
Reference : RAVxFHB21
Manufacturer : Foshan Rayven Lighting Co.,Ltd
Overall dimensions and construction : See figure 4
Hole size in ceiling boards : $\phi 72-\phi 75\text{mm}$
Materials :
i:Casing: die-casting Aluminum
ii:Cover: die-casting Aluminum
iii:Spring clip: carbon steel
iv: iron hoop: cold-rolled sheet

6.Specimen 'B'

Product Name : FIRE RATED DOWNLIGHT
Reference : RAVxFHC21
Manufacturer : Foshan Rayven Lighting Co.,Ltd
Overall dimensions and construction : See figure 5
Hole size in ceiling boards : $\phi 72-\phi 75\text{mm}$
Materials :
i:Casing: die-casting Aluminum
ii:Cover: die-casting Aluminum
iii:Spring clip: carbon steel
iv: iron hoop: cold-rolled sheet



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7.Specimen 'C'

Product Name : FIRE RATED DOWNLIGHT
 Reference : RAVxFHF21
 Manufacturer : Foshan Rayven Lighting Co.,Ltd
 Overall dimensions and construction : See figure 6
 Hole size in ceiling boards : $\phi 72\text{-}\phi 75\text{mm}$
 Materials :
 i:Casing: die-casting Aluminum
 ii:Cover: cold-rolled sheet
 iii:Spring clip: carbon steel
 iv: iron hoop: cold-rolled sheet

8.Specimen 'D'

Product Name : FIRE RATED DOWNLIGHT
 Reference : RAVxFHG21
 Manufacturer : Foshan Rayven Lighting Co.,Ltd
 Overall dimensions and construction : See figure 7
 Hole size in ceiling boards : $\phi 72\text{-}\phi 75\text{mm}$
 Materials :
 i:Casing: die-casting Aluminum
 ii:Cover: die-casting Aluminum
 iii:Spring clip: carbon steel
 iv: iron hoop: cold-rolled sheet



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9.Specimen 'E'

Product Name : FIRE RATED DOWNLIGHT
Reference : RAVxFHJ21
Manufacturer : Foshan Rayven Lighting Co.,Ltd
Overall dimensions and construction : See figure 8
Hole size in ceiling boards : $\phi 65-\phi 75\text{mm}$
Materials :
i:Cover: plastic
ii:Spring clip: carbon steel
iii: iron hoop: cold-rolled sheet

10.Specimen 'F'

Product Name : FIRE RATED DOWNLIGHT
Reference : RAVxFHM31
Manufacturer : Foshan Rayven Lighting Co.,Ltd
Overall dimensions and construction : See figure 9
Hole size in ceiling boards : $\phi 90\text{mm}$
Materials :
i:Cover: plastic
ii:Spring clip: carbon steel
iii: iron hoop: cold-rolled sheet



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11.Specimen'G'

Product Name : FIRE RATED DOWNLIGHT
 Reference : TWIST RAVXFHJ21
 Manufacturer : Foshan Rayven Lighting Co.,Ltd
 Overall dimensions and construction : See figure 10
 Hole size in ceiling boards : $\phi 78\text{mm}$
 Materials :
 i:Cover: plastic
 ii:Spring clip: carbon steel
 iii: iron hoop: cold-rolled sheet



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TEST PROCEDURE

The ambient temperature at the beginning of the test was 22 °C.

The furnace temperature was measured by means of nine thermocouples distributed evenly in the furnace, with their measuring junctions 100 mm ± 10 mm from the exposed surface of the specimen.

The furnace was controlled so that the mean of the nine thermocouple readings followed as closely as possible the time/temperature relationship specified in Clause 3.1 of BS 476-20:1987.

After the first five minutes of the test, the furnace pressure was maintained at 0±2 Pa at 1,000 mm from the notional floor level.

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

TEST DATA AND INFORMATION

Details of the specimen structure are shown in Figure 1 to 17. The photographs of the fire rated downlights are shown in Photo 1 to 28.

Photographs of the test are shown in Photos 29 to 35. A summary of the observations made on the general behavior of the specimen is given in Appendix 1.

The mean furnace temperature records are shown in Appendix 2, and the actual time-temperature curve of furnace in relation to the specified time-temperature curve is shown in Figure 18.

The unexposed surface temperature records are shown in Appendix 3, and the individual temperatures recorded adjacent to the spotlight fittings at mid-height of the cavity are shown in Appendix 4. The unexposed surface maximum and mean temperature curve are shown in Figure 19.

The vertical deflection at the centre of the floor assembly was continuously measured during the test, and the data records are given in Appendix 5. The deflection curve is shown in Figure 20.



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PERFORMANCE CRITERIA

This test was according to performance criteria which specified in BS 476-21:1987, section 7.6 to determine the loadbearing capacity, integrity and insulation of the specimen:

Loadbearing capacity: A failure of the test construction to maintain its loadbearing capacity shall be deemed to have occurred when any of the requirements specified in given as follow are exceeded.

a) a deflection of $L/20$, in this test:

$$\text{Limiting deflection} = 4500 / 20 = 225 \text{ (mm); or}$$

b) where the rate of deflection (in mm/min), calculated over 1 min intervals, starting at 1 min from the commencement of the heating period, exceeds the limit set by the following equation:

$$\text{Rate of deflection} = \frac{L^2}{9000d},$$

in this test:

$$\text{Limiting rate of deflection} = \frac{(4500)^2}{9000 \times 273} = 8.2 \text{ (mm/min);}$$

Where

L is the clear span of specimen (in mm);

d is the distance from the top of the structural section to the bottom of the design tension zone (in mm).

However, this rate of deflection limit shall not apply before a deflection of $L/30$ is exceeded.

Integrity: A failure of the test construction to maintain integrity shall be deemed to have occurred when collapse or sustained flaming on the unexposed face occurs or the criteria given as follow for impermeability are exceeded.

a) For situations where the cotton pad is suitable, failure shall be deemed to have occurred when flames and/or hot gases cause flaming or glowing of the cotton fiber pad.

b) For situations where the use of the cotton pad is not suitable, failure shall be deemed to have occurred when either:

1) the 6 mm diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace and the gauge can be moved in the gap for a distance of at least 150 mm; or



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2) the 25 mm diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace.

Insulation: Failure shall be deemed to have occurred when one of the following occurs:

- a) When the mean unexposed face temperature increases by more than 140°C above its initial value;
- b) When the temperature recorded at any positions on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature;
- c) When integrity failure occurs.

CONCLUSIONS

A specimen of a timber floor assembly protected by a plasterboard ceiling incorporating 14 Fire rated downlight fittings has been subjected to a fire resistance test in accordance with BS 476-21:1987, Clause 7.

At the heating period of 31 minutes, the maximum deflection was 16.2mm; the rate of deflection was 1.7 mm/min. The loadbearing capacity was satisfied.

At the heating period of 31 minutes, there was no collapse of the specimen, no sustained flaming on the unexposed surface and no loss of impermeability. The integrity requirement was satisfied.

At the heating period of 31 minutes, the mean temperature rise of the unexposed face was 53.1°C, the maximum temperature rise of the unexposed face was 75.4°C. The insulation requirement was satisfied.

The floor assemblies satisfied the performance requirements specified in Clause 7 of BS 476-21:1987, for the following periods:

Loadbearing Capacity: 31 min (No failure)

Integrity: 31 min (No failure)

Insulation: 31 min (No failure)

Note:

According to sponsor requirements, the test was discontinued after a period of 31 minutes.

The above test project/method was carried out by subcontractors.



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TEST PHOTOGRAPHS



Photo 1: Front view of specimen 'A'



Photo 2: Side view of specimen 'A'



Photo 3: Front view of specimen 'B'



Photo 4: Side view of specimen 'B'



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Photo 5: Front view of specimen 'C'



Photo 6: Side view of specimen 'C'



Photo 7: Front view of specimen 'D'



Photo 8: Side view of specimen 'D'



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Photo 9: Front view of specimen 'E'



Photo 10: Side view of specimen 'E'



Photo 11: Front view of specimen 'F'



Photo 12: Side view of specimen 'F'



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Photo 13: Front view of specimen 'G'



Photo 14: Side view of specimen 'G'



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Photo 29: The exposed surface of the specimen before the test



Photo 30: The unexposed surface of the specimen before the test.



Photo 31: The exposed surface of the specimen after test duration of 3 minutes, showing the bezel of specimen 'D' fused.



Photo 32: The exposed surface of the specimen after test duration of 5 minutes, showing the lens of specimen 'E' fell away.

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Photo 33: The unexposed surface of the specimen after test duration of 15 minutes.



Photo 34: The unexposed surface of the specimen after test duration of 30 minutes.



Photo 35: The unexposed surface of the specimen after the test.

/

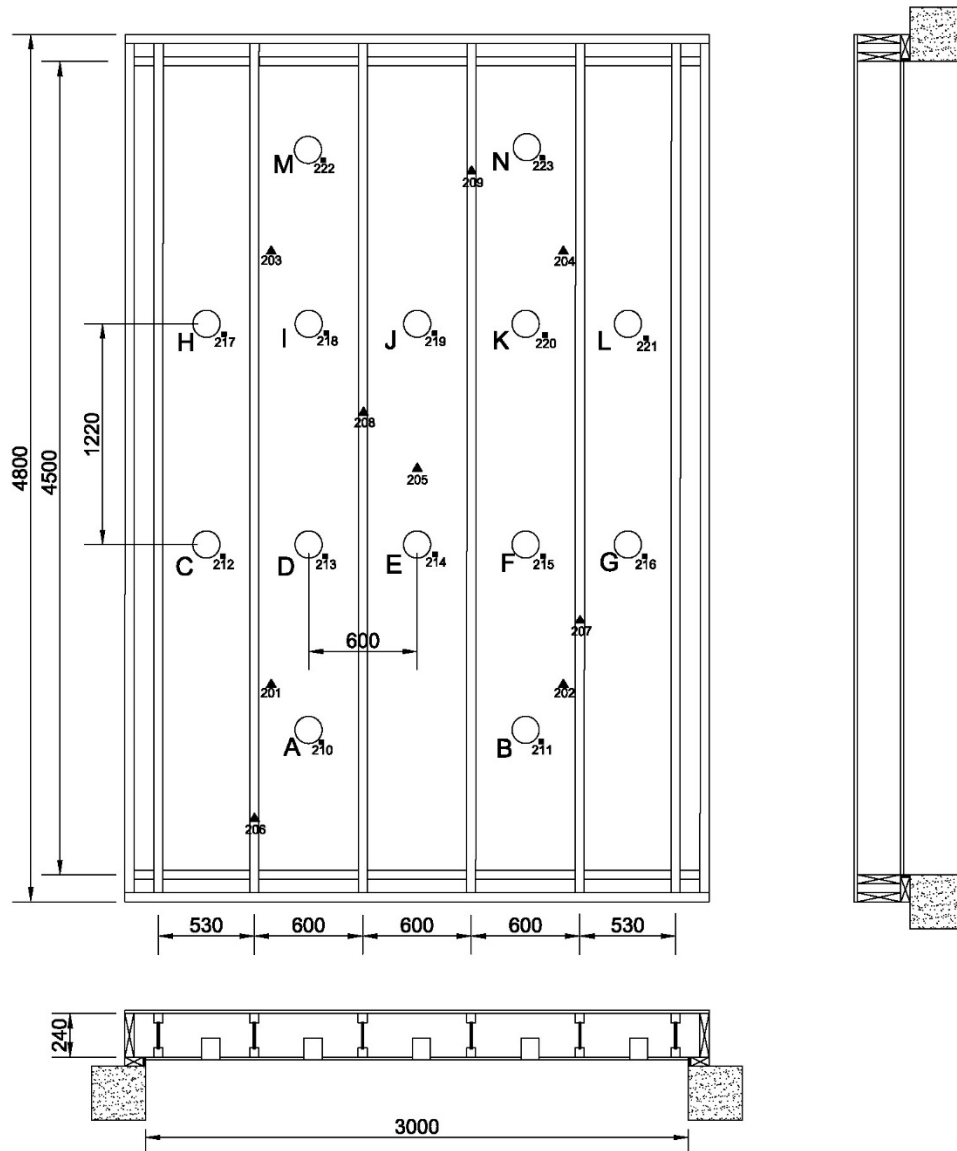
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DETAILS OF TEST SPECIMEN



Joists Layout

Figure 1 - Specimen General Plan



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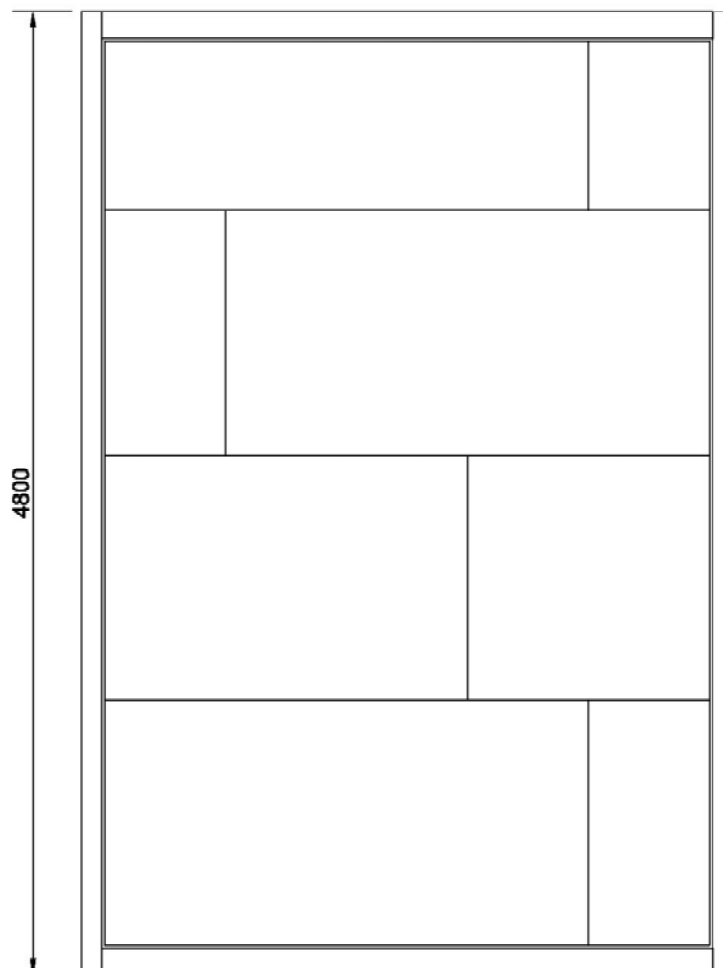
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Plasterboard Layout

Figure 2 - Specimen Structural Drawing



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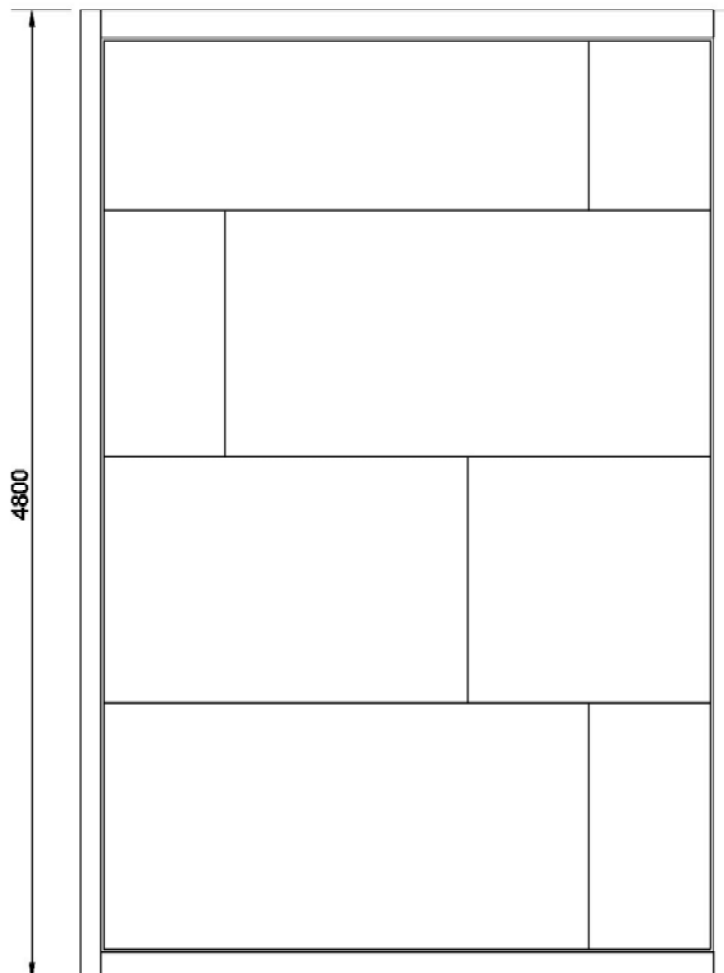
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Plasterboard Layout

Figure 3 - Specimen Structural Drawing

Note: the specimen details provided by the sponsor



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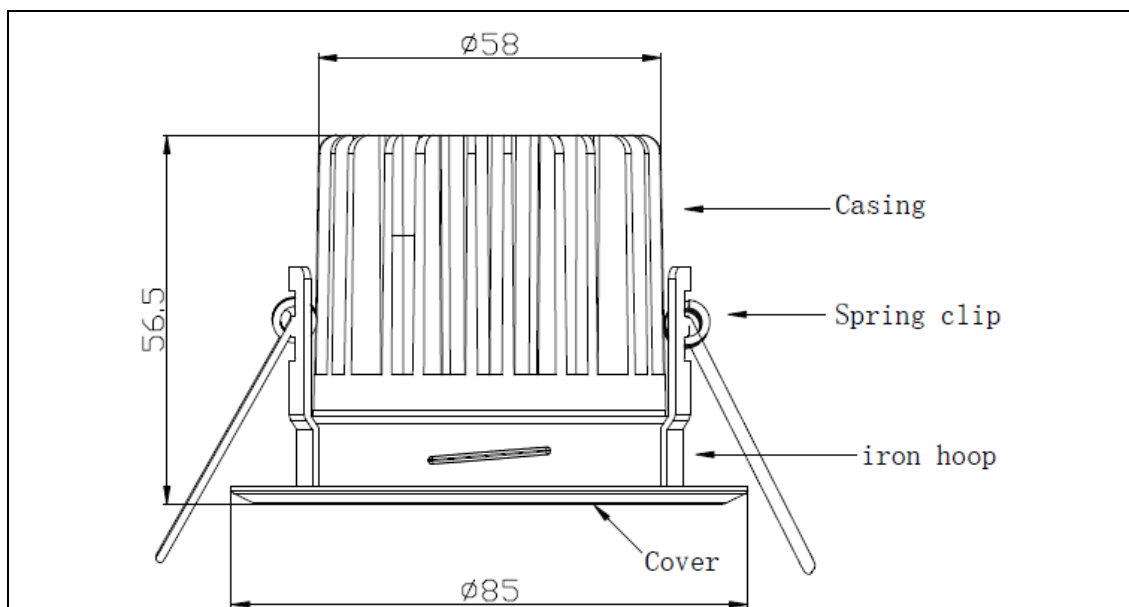


Figure 4 – Details of specimen 'A'

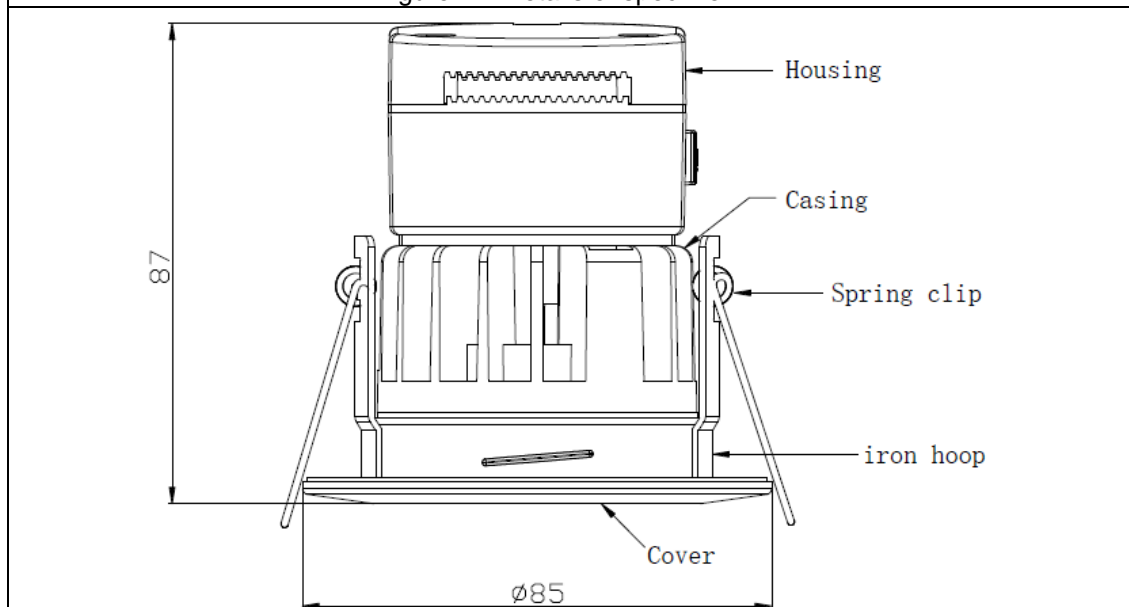


Figure 5 –Details of specimen 'B'



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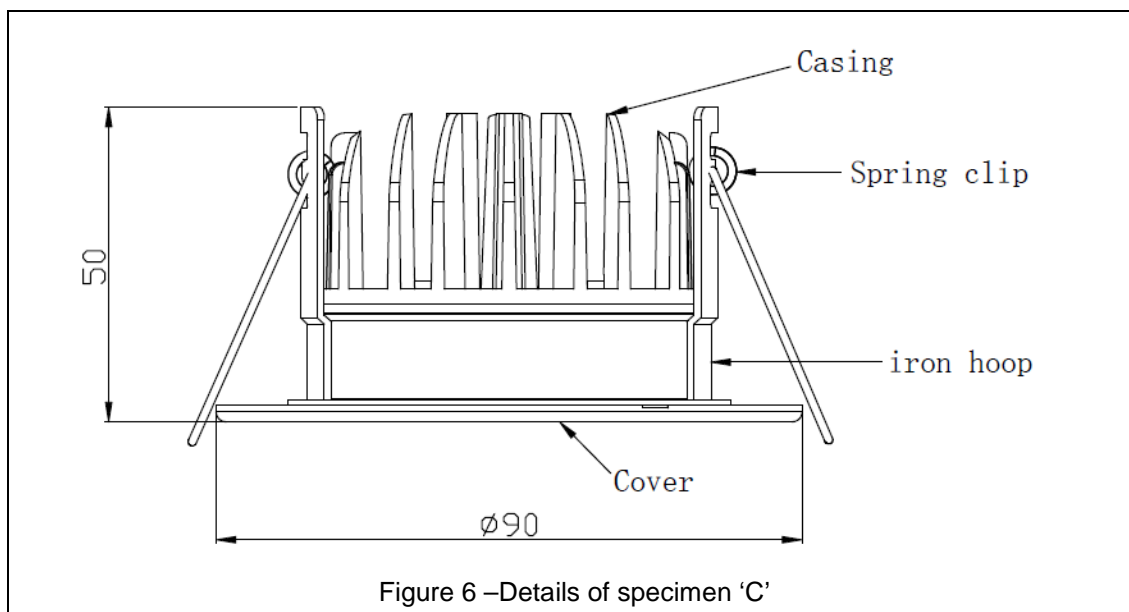


Figure 6 –Details of specimen 'C'

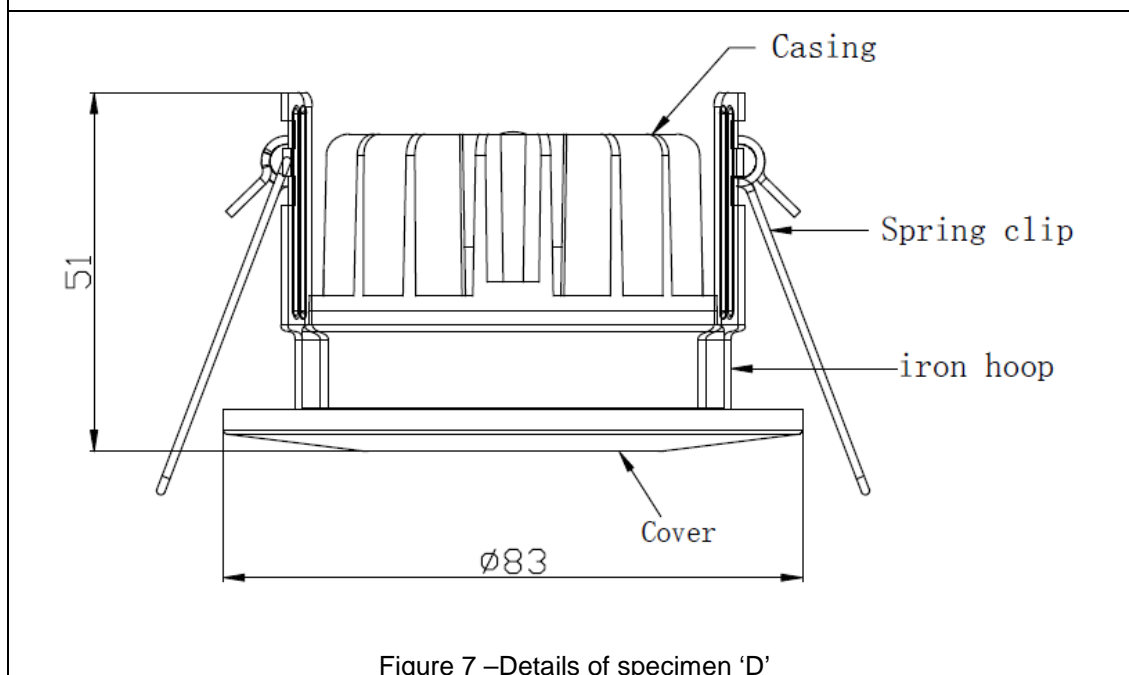


Figure 7 –Details of specimen 'D'



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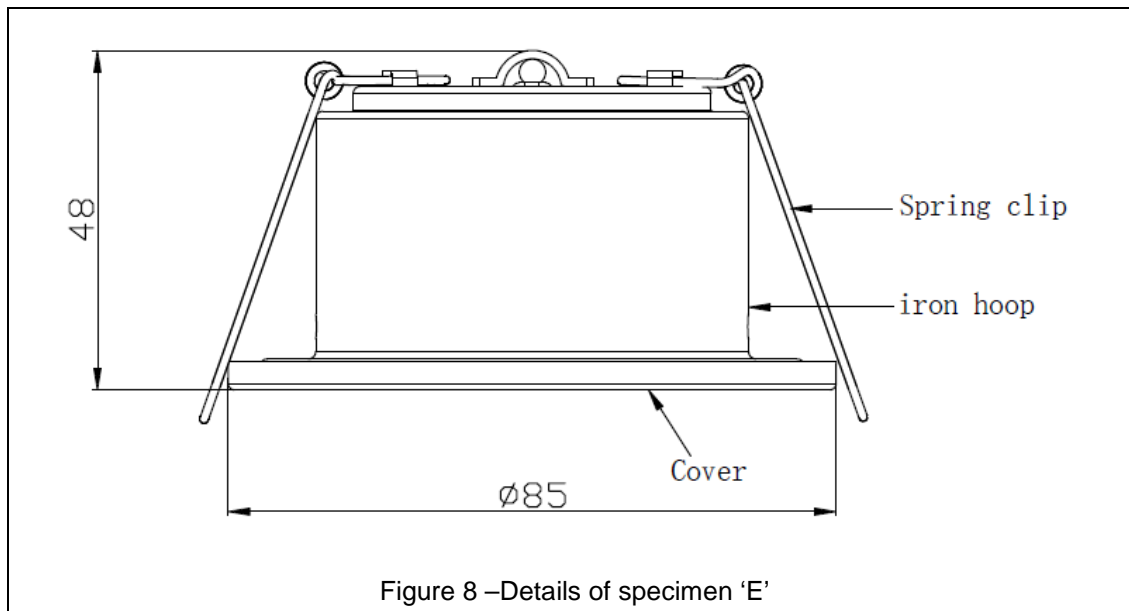


Figure 8 –Details of specimen 'E'

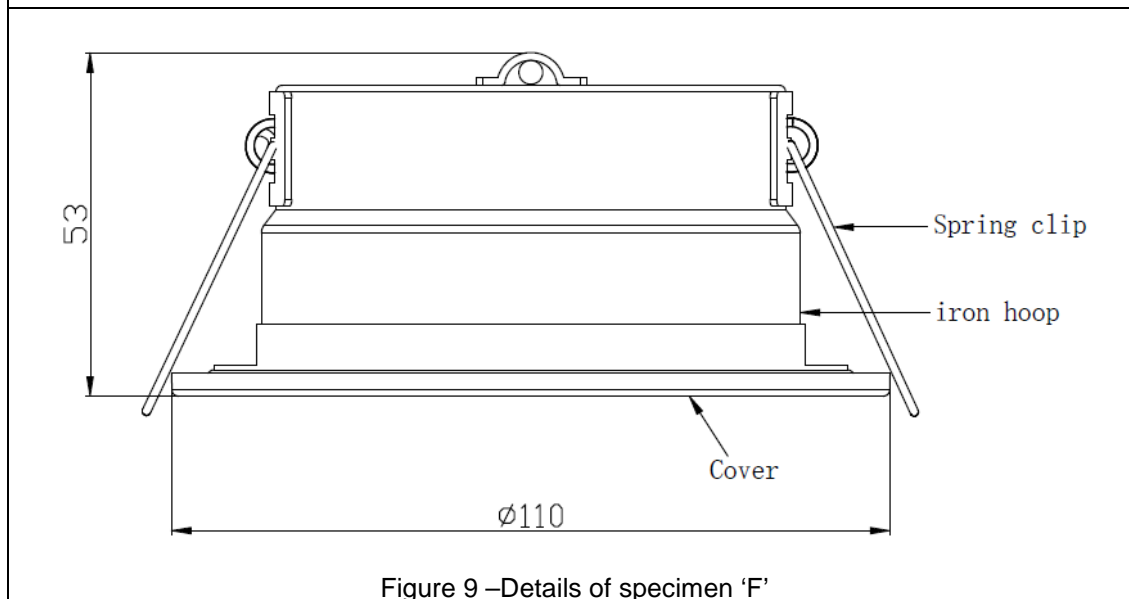


Figure 9 –Details of specimen 'F'



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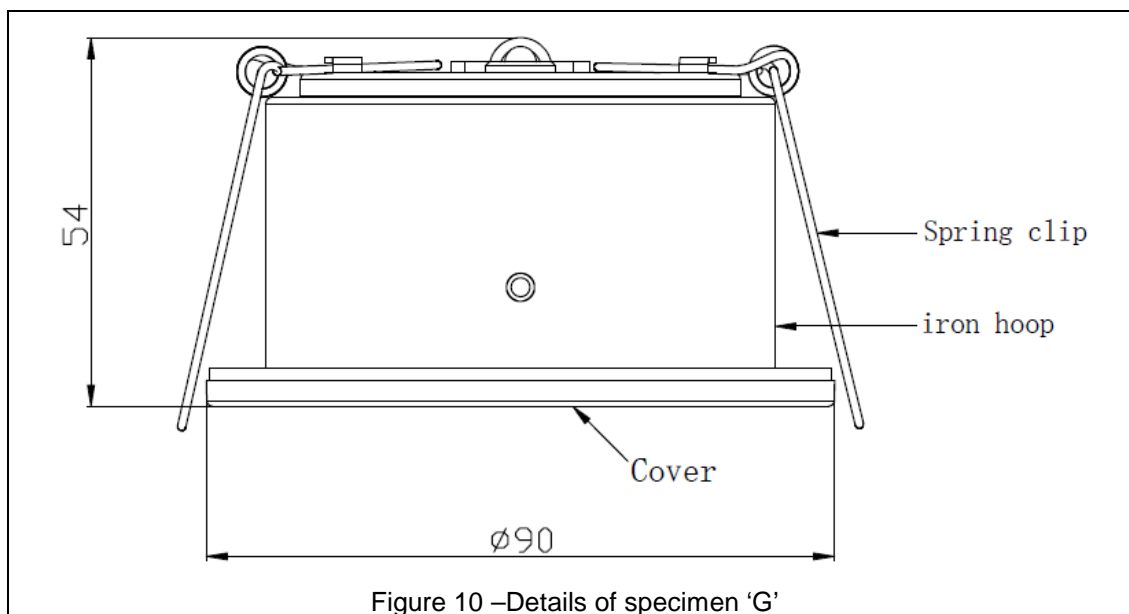
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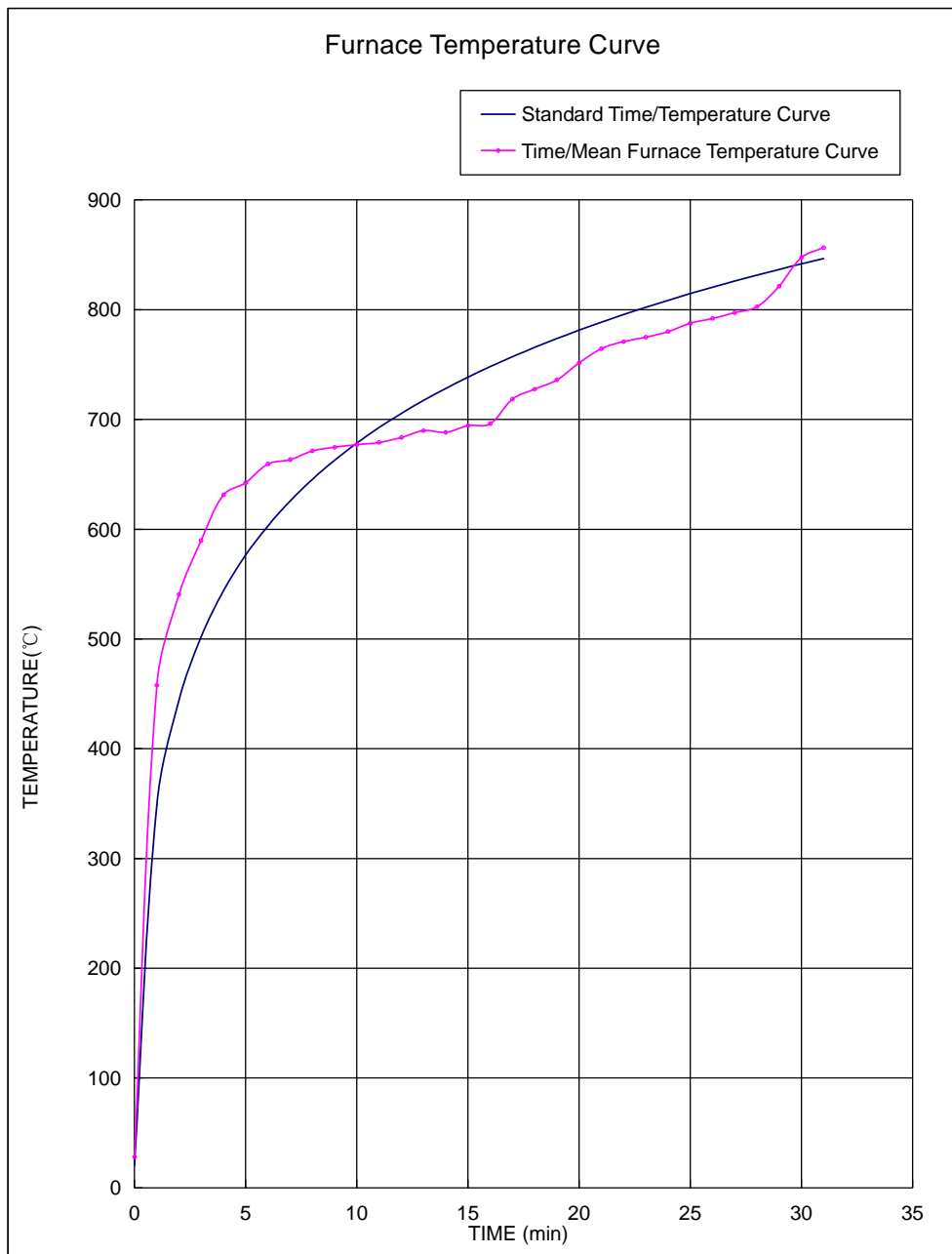


Figure 18 - Furnace Temperature Curve



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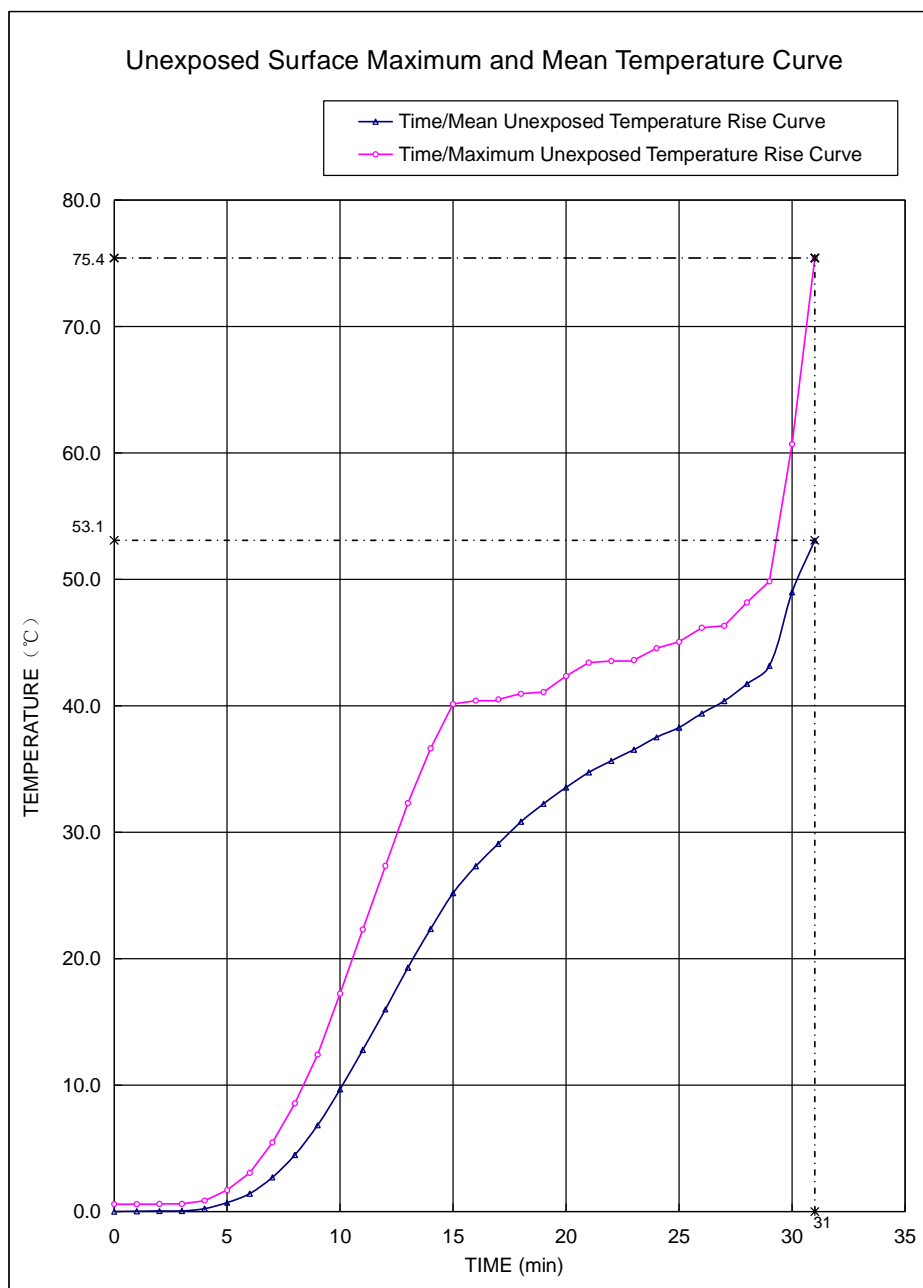


Figure 19 - Unexposed Face Mean and Maximum Temperature Curve



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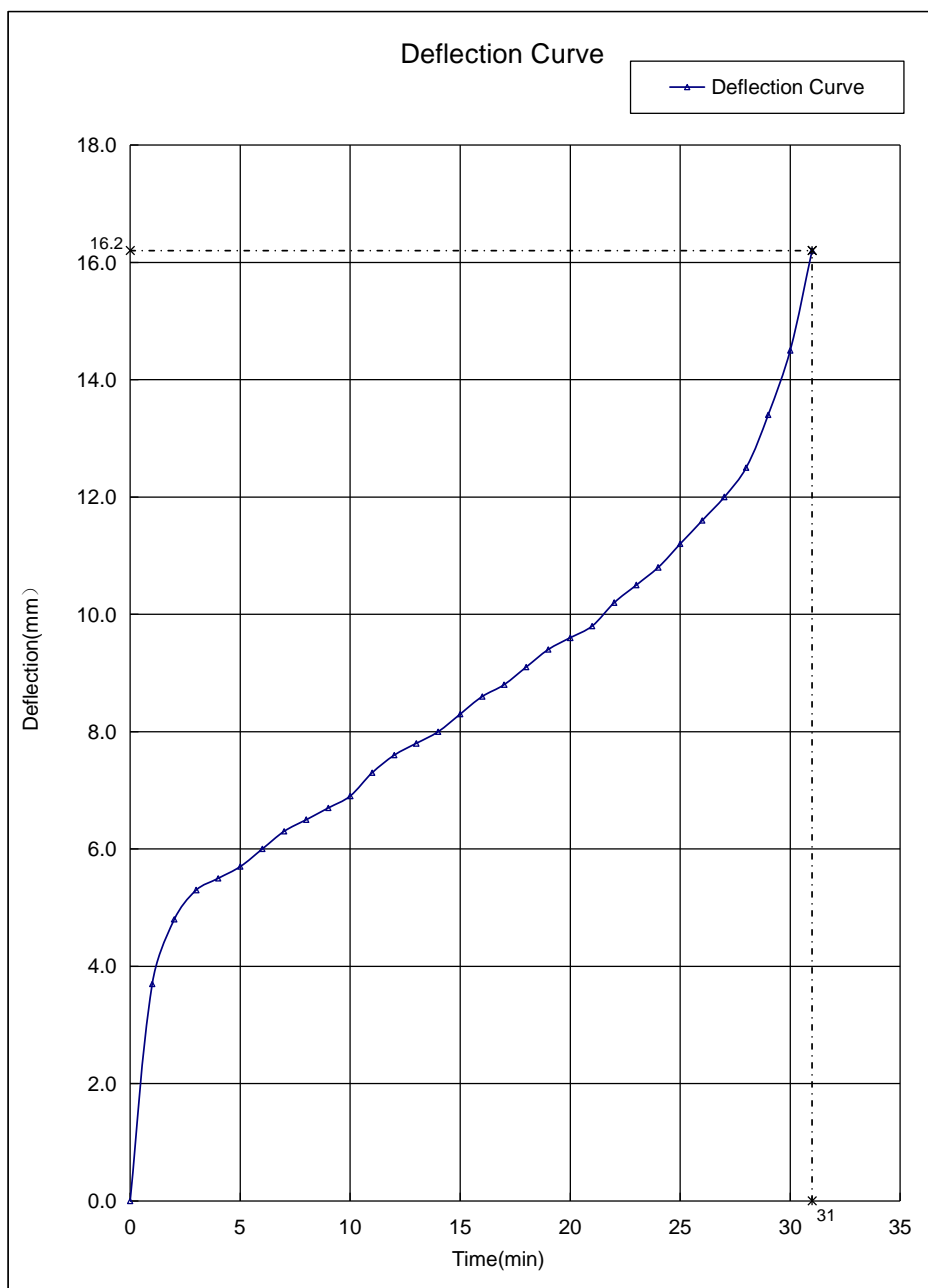


Figure 20 - Deflection Curve



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Time (min)	Observation (All observations are from the exposed face unless noted otherwise)
0	Test started.
3	The bezel of specimen 'D' started to fuse.
5	Some lens of specimen fused.
11	Coating of the plasterboard ceiling fell away.
24	The first layer plasterboard ceiling started to sag slightly and joints began to open.
30	Part of first layer plasterboard ceiling fell into the furnace.
31	Test terminated at sponsor's request.

Appendix 1 –Test Observations



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Time min	Specified Furnace Temperature °C	Actual Furnace Mean Temperature °C
0	20	28
5	576	642
10	678	677
15	739	694
20	781	751
25	815	788
30	842	847
31	847	856

Appendix 2 – Furnace Temperature Records

Time min	TC No.201 °C	TC No.202 °C	TC No.203 °C	TC No.204 °C	TC No.205 °C	TC No.206 °C	TC No.207 °C	TC No.208 °C	TC No.209 °C	Mean Temp °C	Mean Temp Rise °C	Max Temp Rise °C
0	19.7	21.0	21.3	21.3	21.4	21.1	21.2	21.1	21.5	20.9	0.0	0.6
5	20.2	22.5	21.4	21.4	22.6	21.2	21.4	21.2	21.6	21.6	0.7	1.7
10	28.6	38.2	26.1	26.2	34.0	25.0	25.8	26.2	26.7	30.6	9.7	17.2
15	42.5	61.1	37.4	37.0	52.6	34.5	36.2	36.9	37.9	46.1	25.2	40.1
20	52.1	63.3	48.4	47.3	61.4	43.9	45.9	46.8	48.3	54.5	33.6	42.4
25	56.1	66.0	56.1	54.5	63.5	51.4	53.0	53.1	55.6	59.2	38.3	45.1
30	61.7	72.7	62.5	81.6	71.1	58.1	58.9	60.0	61.4	69.9	49.0	60.7
31	63.5	72.7	64.5	96.4	73.0	59.7	60.3	62.1	62.7	74.0	53.1	75.4

Appendix 3 – Unexposed Surface Temperature Records



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Time min	TC No.210 ℃	TC No.211 ℃	TC No.212 ℃	TC No.213 ℃	TC No.214 ℃	TC No.215 ℃	TC No.216 ℃
0	22.3	22.1	22.2	22.3	22.3	22.2	22.2
5	67.7	67.5	75.6	69.3	78.5	74.2	70.0
10	93.0	92.7	94.2	93.9	109.9	99.3	93.9
15	109.2	104.9	103.0	109.0	140.6	106.8	105.6
20	119.9	116.1	107.8	117.0	143.6	117.0	117.4
25	179.1	183.8	157.2	196.9	211.5	214.4	186.3
30	228.0	232.6	207.8	262.5	275.0	260.0	249.3
31	248.7	244.6	215.3	293.3	278.4	270.9	259.1

Time min	TC No.217 ℃	TC No.218 ℃	TC No.219 ℃	TC No.220 ℃	TC No.221 ℃	TC No.222 ℃	TC No.223 ℃
0	22.5	22.8	22.1	22.5	22.5	22.1	22.5
5	67.2	85.3	75.3	92.1	74.5	66.4	67.4
10	87.9	97.9	94.7	106.1	96.2	92.9	92.6
15	100.3	111.9	100.6	114.7	111.9	106.8	109.1
20	109.8	128.4	108.2	121.2	114.6	112.5	113.2
25	177.9	254.5	166.5	202.0	176.4	141.1	156.6
30	215.7	327.7	219.3	813.0	230.6	196.1	497.9
31	226.8	339.5	229.7	801.8	239.2	206.8	526.2

Appendix 4 – Individual Temperatures Recorded Adjacent to the Spotlight Fittings at Mid-height of the Cavity



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Time min	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0	---
5	5.7	0.2
10	6.9	0.2
15	8.3	0.3
20	9.6	0.2
25	11.2	0.4
30	14.5	1.1
31	16.2	1.7

Note: A positive value indicates deflection towards to the furnace

Appendix 5 – Deflection of the floor assembly during the test

***** End of report*****



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