

No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 1 of 28

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

Sample Name	:	LED FIRE RATED DOWNLIGHT						
Type No.	:	1) RAV*FHL*1	2)	RAV*FHK*1	3)	RAV*FHJ*1	4)	EFTTxxyyCC
		5) RAV*FHN*1	6)	RAV*FHH*1	7)	RAV*FHM*1		

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.

Test Required	:	Selected test(s) as requested by applicant
Date of Receipt	:	Aug.15, 2019
Testing Start Date	:	Aug.15, 2019
Testing End Date	:	Sep.04, 2019
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) ******** To be continued******

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

Bryan Hong

Authorized Signatory



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 2 of 28

Test Summary

To determine the fire resistance of a timber floor assembly protected by a plasterboard ceiling designed to provide 91 minutes fire resistance, incorporating seven LED 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".

Performance Criteria	Test Results
Loadbearing Capacity	91min (No failure)
Integrity	91min (No failure)
Insulation	91min (No failure)

Note: According to sponsor requirements, the test was discontinued after a period of 91 minutes.

Sample details and conditioning

The ceiling incorporated seven LED FIRE RATED DOWNLIGHT fittings referenced as follows:

Test Ref.	Product Name	Reference	Detail
А	LED FIRE RATED DOWNLIGHT	RAV*FHL*1	See Figure 2
В	LED FIRE RATED DOWNLIGHT	RAV*FHK*1	See Figure 3
С	LED FIRE RATED DOWNLIGHT	RAV*FHJ*1	See Figure 4
D	LED FIRE RATED DOWNLIGHT	EFTTxxyyCC	See Figure 5
E	LED FIRE RATED DOWNLIGHT	RAV*FHN*1	See Figure 6
F	LED FIRE RATED DOWNLIGHT	RAV*FHH*1	See Figure 7
G	LED FIRE RATED DOWNLIGHT	RAV*FHM*1	See Figure 8

The floor assembly had overall nominal dimensions of 4696 mm long by 3200 mm wide. The unexposed surface of the floor comprised 1 layer of 18mm thick Egger Chipboard, the layers was screw fixed to the upside of the floor joists.

The floor assembly was protected on its underside by a direct fixed ceiling, formed from two layers of 15mm thick plasterboard. Both layers were screw fixed to the underside of the floor joists.

One layers of 50mm thick rockwool was filled into the cavity between the floor and the ceiling.

The floor supported an evenly distributed load of 1106.1 N/m².

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 3 of 28

Test procedure

The ambient temperature at the beginning of the test was 28 °C.

The furnace temperature was measured by means of nine thermocouples distributed evenly in the furnace, with their measuring junctions 100 mm \pm 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 8. The photographs of the LED FIRE RATED DOWNLIGHTs are shown in Photo 1 to 14

Photographs of the test are shown in Photos 15 to 28. A summary of the observations made on the general behavior of the specimen is given in Appendix 3.

The mean furnace temperature records are shown in Appendix 4, and the actual time-temperature curve of furnace in relation to the specified time-temperature curve is shown in Figure 9.

The unexposed surface temperature records are shown in Appendix 5, and the individual temperatures recorded adjacent to the spotlight fittings at mid-height of the cavity are shown in Appendix 6. The unexposed surface maximum and mean temperature curve are shown in Figure 10.

The vertical deflection at the centre of the floor assembly was continuously measured during the test, and the data records are given in Appendix 7. The deflection curve is shown in Figure 11.

The Load Calculations is given in Appendix 1.

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 4 of 28

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:

Limiting deflection =
$$4500/20 = 225$$
 (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:

rate of deflection =
$$\frac{L^2}{9000d}$$

in this test:

Limiting rate of deflection =
$$\frac{(4500)^2}{9000 \times 238}$$
 = 9.5 (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). **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
 - 2) the 25 mm diameter gap gauge can penetrate a through gap such that the end of the gauge projects into the furnace.

******** To be continued********



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 5 of 28

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 seven LED 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 91 minutes, the maximum deflection was 67.1 mm; the maximum rate of deflection was 6.4 mm/min. The loadbearing capacity was satisfied.

At the heating period of 91 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 91 minutes, the mean temperature rise of the unexposed face was 42.0 °C, the

maximum temperature rise of the unexposed face was 48.2°C. The insulation requirement was satisfied.

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

Performance Criteria	Test Results
Loadbearing Capacity	91min (No failure)
Integrity	91min (No failure)
Insulation	91min (No failure)

Note: According to sponsor requirements, the test was discontinued after a period of 91 minutes.

Remark:

The test results relate only to the specimen tested. Appendix A of BS 476-20 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.

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 6 of 28

Appendix 1: Schedule of components

1. Floor Joists	
Material	: Softwood timber joists
Overall section size	: 45 mm thick×190 mm deep
Density of Joist:	: 600 kg/m³
2.Floorboards	
Manufacturer	: Egger
Material	: Egger Chipboard, E1
Thickness	: 1 no. layer, 18mm thick
Density	: 700 kg/m³
Fixing method	: All board joints staggered with respect to adjacent layer and
	screw fixed to all joists using drywall steel screws, 35 mm long
	x 3.9 mm diameter screws for the layer, at 200 mm centers
	along joists and 150 mm centers along perimeter of floor.
3.Ceiling boards	
Manufacturer	: Knauf
Material	: Gypsum plasterboard
Thickness	: 2 no. layers, each 15mm thick
Density	: 727 kg/m³
Fixing method	: All board joints staggered with respect to adjacent layer and
	screw fixed to all joists using drywall steel screws, 35 mm long
	x 3.9 mm diameter screws for first layer and 55 mm long x 3.9 $$
	mm diameter screws for second layer, at 200 mm centers
	along joists and 150 mm centers along perimeter of ceiling.
4.Rockwool	
Manufacturer	: ROCKWOOL
Thickness	: 50mm
Density	: 80 kg/m ³
Fixing method	: filled into the cavity between the floor and the ceiling
	******* To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 7 of 28

5. Specimen A

Product Name
Reference
Manufacturer
Overall dimensions and construction
Hole size in ceiling boards
Materials

	:	LED FIRE RATED DOWNLIGHT
	:	RAV*FHL*1
	:	Foshan Rayven Lighting Co., Ltd
nstruction	:	φ85x48mm, See figure 2
	:	φ65-φ75mm
	:	i. Cover: plastic
		ii. Spring clip: carbon steel
		iii. Iron hoop: cold-rolled sheet

6. Specimen B

Product Name	:	LED FIRE RATED DOWNLIGHT
Reference	:	RAV*FHK*1
Manufacturer	:	Foshan Rayven Lighting Co., Ltd
Overall dimensions and construction	:	φ85x48mm, See figure 3
Hole size in ceiling boards	:	φ65-φ75mm
Materials	:	i. Cover: plastic
		ii. Spring clip: carbon steel

iii. Iron hoop: cold-rolled sheet

7. Specimen C

Product Name	:	LED FIRE RATED DOWNLIGHT
Reference	:	RAV*FHJ*1
Manufacturer	:	Foshan Rayven Lighting Co., Ltd
Overall dimensions and construction	:	φ85x48mm, See figure 4
Hole size in ceiling boards	:	φ65-φ75mm
Materials	:	i. Cover: plastic
		ii. Spring clip: carbon steel

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iii. Iron hoop: cold-rolled sheet

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 8 of 28

8. Specimen D

Product Name
Reference
Manufacturer
Overall dimensions and construction
Hole size in ceiling boards
Materials

: LED FIRE RATED DOWNLIGHT EFTTxxyyCC 1 Foshan Rayven Lighting Co., Ltd 2 φ90x48mm, See figure 5 1 φ65-φ75mm 2 : i. Cover: plastic ii. Spring clip: carbon steel iii. Iron hoop: cold-rolled sheet

9. Specimen E

Product Name	:	LED FIRE RATED DOWNLIGHT
Reference	:	RAV*FHN*1
Manufacturer	:	Foshan Rayven Lighting Co., Ltd
Overall dimensions and construction	:	φ84x105mm, See figure 6
Hole size in ceiling boards	:	φ68-φ75mm
Materials	:	i. Cover: die-casting Aluminum
		ii. Spring clip: carbon steel

iii. Iron hoop: cold-rolled sheet

10. Specimen F

Product Name	:	LED FIRE RA
Reference	:	RAV*FHH*1
Manufacturer	:	Foshan Rayve
Overall dimensions and construction	:	φ145x65mm,
Hole size in ceiling boards	:	φ125mm
Materials	:	i. Cover: die-c

:	LED FIRE RATED DOWNLIGHT
:	RAV*FHH*1
:	Foshan Rayven Lighting Co., Ltd
:	φ145x65mm, See figure 7
:	φ125mm
:	i. Cover: die-casting Aluminum
	ii. Spring clip: carbon steel
	iii Iron boon: cold-rolled sheet

- iii. Iron hoop: cold-rolled sheet
- iv. Casing: die-casting Aluminum

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 9 of 28

11. Specimen G

Product Name

Manufacturer

Overall dimensions and construction

Hole size in ceiling boards

Reference

Materials

- : LED FIRE RATED DOWNLIGHT
- : RAV*FHM*1
 - Foshan Rayven Lighting Co., Ltd
- : ϕ 110x53mm, See figure 8
- : φ90mm

1

- : i. Cover: plastic
 - ii. Spring clip: carbon steel
 - iii. Iron hoop: cold-rolled sheet
- ******** To be continued*******



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No. : XMIN190801970CCM

Date : Sep.29, 2019

Page: 10 of 28

Load Calculations			
1. Physical Parameters of Timber Joists			
Measured Joist dimensions	: 190 mm deep by 45 mm thick		
Mean spacing	: 640 mm		
Effective span	: 4500 mm		
Density of Joist	: 600 kg/m ³		
2. Physical Parameters of Rockwool			
Thickness	: 50 mm		
Density	: 80 kg/m ³		
3. Physical Parameters of Floorboards			
Thickness	: 1 layer, 18 mm thick		
Density	: 700 kg/m ³		
4. Physical Parameters of Ceiling boards			
Thickness	: 2 layers, each 15 mm thick		
Density	: 727 kg/m ³		
5. Weight of Actual Timber Joists			
Actual volume of Joist	: 0.286 m ³		
Actual weight of Joist	: 171.6 kg		
6. Weight of Actual Rockwool			
Actual volume of Rockwool	: 0.615 m ³		
Actual weight of Rockwool	: 49.2 kg		
7. Weight of Actual Floorboards			
Actual volume of Floorboards	: 0.243 m ³		
Actual weight of Floorboards	: 170.1 kg		
8. Weight of Actual Ceiling boards			
Actual volume of Floorboards	: 0.405 m ³		
Actual weight of Floorboards	: 294.4 kg		
9. Actual Dead Weight			
Actual Dead Weight of overall specimen	: 685.3 kg		
10. Actual Dead Load			
Actual Dead Load per meter square	: (685.3×9.81)/(4.5×3.0)		
	498.0 N/m², 50.8 kg/m²		
11. Imposed Load			
imposed Load per meter square	$(1522.1 \times 9.81)/(4.5 \times 3.0)$		
Pomark:	1106.1 N/m ⁻ , 112.7Kg/m ²		

1. All values are nominal unless stated otherwise.

All other details are as stated by the sponsor.

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No. : XMIN190801970CCM

Date : Sep.29, 2019

Page: 11 of 28

Appendix 2: Details of test specimen



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 12 of 28





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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 13 of 28





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No. : XMIN190801970CCM

Date : Sep.29, 2019

Page: 14 of 28



Figure 9 - Furnace Temperature Curve



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 15 of 28

Unexposed Surface Maximum and Mean Temperature Curve ----- Time/Mean Unexposed Temperature Rise Curve Time/Maximum Unexposed Temperature Rise Curve 55.0 50.0 48.2 45.0 42.0 40.0 35.0 C) **TEMPERATURE** 30.0 25.0 I 20.0 15.0 I 10.0 5.0 0.0 90⁹¹ 100 0 30 40 50 60 70 80 10 20 TIME (min)

Figure 10- Unexposed Face Mean and Maximum Temperature Curve

******** To be continued*******

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No. : XMIN190801970CCM

Date : Sep.29, 2019

Page: 16 of 28



Figure 11- Deflection Curve



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 17 of 28

Time (min)	Observation (All observations are from the exposed face unless noted otherwise)
0	Test started.
2	The lens and faceplates of specimens 'A', 'B', 'C', 'D', and 'G' fused.
10	The lens of specimens 'F' fused.
12	The faceplate of specimens 'F' fused.
16	Coating of the plasterboard ceiling already fell away.
22	The lens and faceplate of specimens 'E' fused.
28	Smoke released from the perimeter of the specimen.
35	The first layer plasterboard ceiling started to sag slightly and joints began to open.
55	Part of first layer plasterboard ceiling fell into the furnace.
60	Most of the first layer of plasterboard ceiling fell away.
64	The second layer plasterboard ceiling started to sag slightly and joints began to open.
73	Part of second layer plasterboard ceiling fell into the furnace.
74	Lots of smoke release increased inside the furnace, resulted the observation from the exposed side discontinued.
78	Yellow smoke released from the joints of floorboards at the unexposed surface of the specimen.
91	Test terminated at sponsor's request.

******** To be continued********



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No. : XMIN190801970CCM Date : Sep.29, 2019

Page: 18 of 28

Time min	Specified Furnace Temperature $^{\circ}C$	Actual Furnace Mean Temperature C
0	20	35
5	576	615
10	678	693
15	739	738
20	781	761
25	815	804
30	842	830
35	865	857
40	885	877
45	902	897
50	918	910
55	932	922
60	945	934
65	957	953
70	968	980
75	979	992
80	988	998
85	997	1001
90	1006	1004
91	1008	1005

Appendix 4 – Furnace Temperature Records

******** To be continued*******



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 19 of 28

Max

Temp

Rise

°C

1.9

2.0

2.2

2.4

5.2

11.7

17.7

21.6

28.6

34.0

38.4

41.4

43.4

44.4

44.8

45.2

46.2

46.9

48.1

48.2

Mean TC TC TC TC тс тс TC TC тс Mean Temp Time No.201 No.202 No.203 No.204 No.205 No.206 No.207 No.208 No.209 Temp Rise min °C 26.2 0 27.3 26.4 24.2 27.5 24.2 27.8 27.9 26.4 0.0 25.9 26.6 24.3 27.5 27.9 27.9 26.5 5 27.3 24.6 26.2 26.1 0.2 26.7 10 27.5 26.9 24.5 27.7 25.0 28.0 26.4 28.1 26.3 0.4 27.7 27.6 28.2 15 24.8 27.9 25.5 26.6 28.3 26.9 26.7 0.8 20 29.0 31.1 25.5 28.4 26.5 28.6 27.3 29.4 27.0 28.1 2.2 32.0 27.2 29.8 27.6 25 37.6 29.8 29.6 29.3 33.4 31.3 5.4 30 35.7 43.6 29.4 31.8 34.3 32.1 33.1 39.6 29.4 34.9 9.0 35 39.6 47.5 32.3 40.4 36.0 47.3 33.3 39.0 35.3 37.8 13.1 40 43.7 49.6 36.0 40.7 45.0 41.5 43.3 38.6 43.0 54.5 17.1 45 47.9 52.9 40.3 47.6 49.6 47.3 48.3 59.9 44.9 47.7 21.8 45.9 52.6 50 52.3 55.2 55.0 54.3 52.3 64.3 50.6 52.5 26.6 51.6 57.0 55.5 55 56.1 57.9 59.8 56.9 55.7 67.3 56.5 30.6 60 59.3 60.5 56.7 62.6 58.6 60.2 58.2 69.3 58.8 59.6 33.7 60.1 62.2 70.3 61.3 65 61.8 62.1 65.6 59.5 60.0 61.8 35.9 70 62.6 63.2 61.3 66.8 60.3 63.0 60.8 70.7 62.4 62.8 36.9 75 63.0 63.7 61.8 69.2 61.7 63.7 61.2 71.1 63.9 63.9 38.0 80 64.0 64.8 62.7 70.9 63.2 65.2 62.3 72.1 65.4 39.2 65.1 65.8 64.5 64.3 66.5 72.8 66.8 40.5 85 65.6 72.1 63.3 66.4 65.7 67.8 68.1 90 67.2 66.9 73.3 65.6 64.2 74.0 67.7 41.8 91 67.4 67.0 66.0 73.5 65.7 67.9 64.3 74.1 68.3 67.9 42.0 ******** To be continued*******

Appendix 5 – Unexposed Surface Temperature Records



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Page: 20 of 28

Appendix 6 – Individual Temperatures Recorded Adjacent to the Spotlight Fittings at Mid-height of the Cavity

		-	-			-	-
Time min	TC No.210 ℃	TC No.211 ℃	TC No.212 ℃	TC No.213 ℃	TC No.214 ℃	TC No.215 ℃	TC No.216 ℃
0	28.7	28.7	28.7	29.4	28.4	28.8	28.9
5	30.0	29.0	28.9	28.5	29.3	30.6	29.3
10	48.6	52.2	38.6	18.2	56.2	65.8	44.1
15	60.7	71.3	68.1	57.9	75.9	85.6	69.2
20	69.1	80.7	77.4	76.5	84.5	92.5	86.5
25	75.0	85.6	83.1	83.7	88.2	92.9	90.6
30	78.3	90.9	89.9	89.0	93.0	94.3	93.2
35	84.0	93.6	92.6	92.0	94.3	94.7	94.4
40	86.9	95.0	94.3	93.8	96.1	96.0	96.7
45	89.5	96.2	95.3	95.6	96.7	96.5	97.6
50	91.7	96.5	95.4	95.8	96.7	96.2	97.6
55	92.0	96.4	95.1	95.2	96.5	96.4	97.5
60	91.8	95.3	94.3	94.4	97.1	97.3	98.7
65	99.2	97.3	94.2	95.6	99.7	100.6	101.4
70	131.4	109.6	94.2	98.7	105.2	106.8	104.8
75	195.5	126.7	108.5	111.4	109.6	137.8	115.7
80	209.5	199.6	169.3	150.3	132.2	263.1	142.2
85	233.6	226.9	230.6	187.6	179.1	289.0	174.9
90	272.1	251.7	290.9	250.4	231.0	338.0	227.1
91	276.9	260.6	305.6	263.5	256.6	345.2	246.7

******** To be continued*******



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Time min	Central Vertical Deflection mm	Rate of Deflection mm/min
0	0.0	0.0
5	6.8	0.2
10	7.9	0.2
15	8.4	0.0
20	8.7	0.1
25	9.7	0.2
30	10.5	0.2
35	11.4	0.2
40	12.4	0.2
45	13.3	0.3
50	14.3	0.2
55	15.2	0.2
60	16.3	0.2
65	17.7	0.3
70	19.1	0.3
75	21.3	0.4
80	25.3	1.7
85	38.2	3.7
90	60.7	4.8
91	67.1	6.4

Appendix 7 - Deflection of the floor assembly during the test

Note:

1. A positive value indicates deflection towards to the furnace

2. The above test was carried out by Guangzhou Building Materials Institute Limited Company.

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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 22 of 28

Photo Appendix:



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 24 of 28



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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 27 of 28





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No. : XMIN190801970CCM Date : Sep.29, 2019 Page: 28 of 28



Photo 27: The unexposed surface of the specimen after test duration of 75 minutes.

Photo 28: The unexposed surface of the specimen after test duration of 90 minutes.

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