LCTECH

NVLAP LAB CODE 500080-0

IESNA SUSTAINING MEMBER

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LCTECH(ZHONGSHAN) TESTING SERVICE CO.,LTD. *LABORATORY*

Test report of

In Situ Temperature Measurement

And Lumen Maintenance Projection

Rendered to:
LIGHT EFFICIENT DESIGN, DIV OF TADD LLC.
188 S. Northwest Highway Cary, IL 60013

For products:
LED Lamp

Models:
LED-8035E50-MHBC

Test date:	Sep. 16, 2016
Test laboratory:	LCTECH (Zhongshan) Testing Service Co.,Ltd 2/F.,Technology and Enterprise Development Center, Guangyuan Road, Xiaolan, Zhongshan, Guangdong, China
Laboratory note:	

Complied by:	**Reviewed by:**
Bowen Pang	**Richard Li**
Project Engineer	**Technical Manager**
Sep. 27, 2016	**Sep. 27, 2016**

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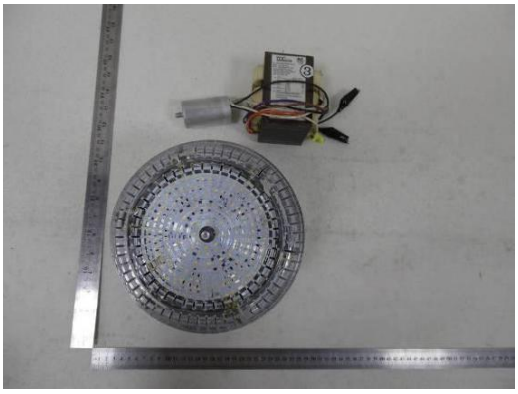
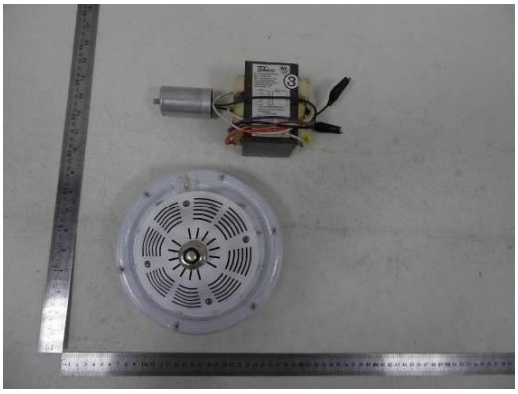
1 General

1.1 Products Information

Brand Name	-
Lamp Type	LED Lamp
Model Number	LED-8035E50-MHBC
Rated Inputs	277V, 60Hz
Rated Power	78 W
Rated Initial Lamp Lumens	N/A
Declared CCT	5000K
Ballast	M57
LED Package, Array or Module	Model: SPMWHX1228FXXXXXXXX, manufactured by SAMSUNG ELECTRONICS CO., LTD
Date of Receipt Samples	Sep. 7, 2016
Quantity of Receipt Samples	1 units
Photo	



Picture 1



Picture 2

1.2 Reference standards or methods

The following standards are partly or totally used or referenced for test:

No.	Name
IEC 62560-2011#	Self-ballasted LED-lamps for general lighting services by voltage>50V- Safety specifications
IES LM-80-08	Approved Method for Measuring Lumen Maintenance of LED Light Sources
IES TM-21-2011	Projecting Long Term Lumen Maintenance of LED Sources
IES LM-84-14 Annex A	Recommendations for measurement of In-situ conditions LED case Temperature, Ts

#*Note: Standard IEC 62560-2011 only clause 10 cap temperature rise was tested. For reference only and IEC 62560-2011 is not in the scope of NVLAP recognition.*

1.3 Equipment list

ID	Instrument	Model name	Cal. Date	Next cal. Date
AC Power supply	LC-I-923	CHP-500	2016-02-04	2017-02-03
AC Power supply	LC-I-987	APW-110N	2016-02-04	2017-02-03
Power analyzer	LC-I-954	WT210	2016-02-04	2017-02-03
Multimeter	LC-I-972	Fluke 17B	2016-08-10	2017-08-09
J thermocouple	LC-I-096	TT-J-30-SLE(200m/r)	2016-03-01	2017-02-28
Data acquisition/Switch unit	LC-I-098	34970A	2016-03-01	2017-02-28
Wireless T&H Transmitter	LC-I-978	DWRF-B	2016-02-03	2017-02-28

2 Test conducted and method

2.1 Ambient Condition

Test was conducted in an ambient temperature of 25 ± 5 °C. Ambient temperature variations above or below 25 °C was subtracted from or added to temperatures recorded at points on the luminaire.

The ambient temperature was measured by a thermocouple which was immersed in 15 ml of mineral oil in a glass container.

2.2 Temperature Stabilization

Temperatures were measured after they have stabilized when the temperature were changing at a rate less than 1°C per hour and would not rise.

2.3 Thermocouples

Type J thermocouple was used for temperature measurement. The diameter of thermocouple conductor was 0.05mm^2.

2.4 Draught-free test enclosure

The lamp was positioned in a rectangular draught-proof enclosure with a double skin on the top and on at least three sides, and with a solid base. The double skins were of perforated metal, spaced apart approximately 150mm, with regular perforations of 1 mm to 2 mm diameter, occupying about 40% of the whole area of each skin. The internal surfaces of enclosure are painted with a matt paint.

2.5 Suspension methods

The luminaire was suspended in the ceiling of draught-free test enclosure.

2.6 Thermocouples contact

Thermocouples were in contact with the TMP_{LED} location described in LM-80 test report. In order to gain the maximum temperature, if appropriate, more than one thermocouple was contact in these locations. For details information, please refer to clause 3.3 for the photo of thermocouple contact.

3 Test Result

3.1 Electrical data

Criteria Item	Result
Input voltage	277.05V~60Hz
Input current	0.440 A
Total power	83.16 W
Power factor	0.682

3.2 Temperature data

Criteria Item	Result
Total operated period	8.0 hours
Ambient temperature	25.2°C
Measured maximum Temperature @TMP_{LED}	52.9°C
Maximum Temperature @TMP_{LED}(Normalized to 25°C)	**52.7°C**

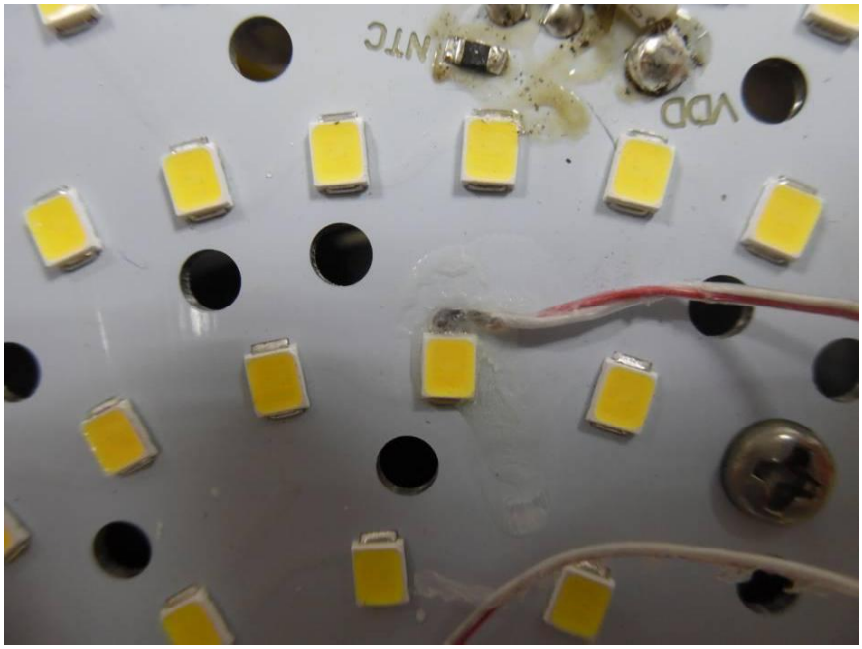
Note: TMP_{LED} was the maximum temperature LED which was selected based on the method of Annex A of IES LM-84-14

3.3 Lumen Maintenance Projection (IESNA TM-21 Method)

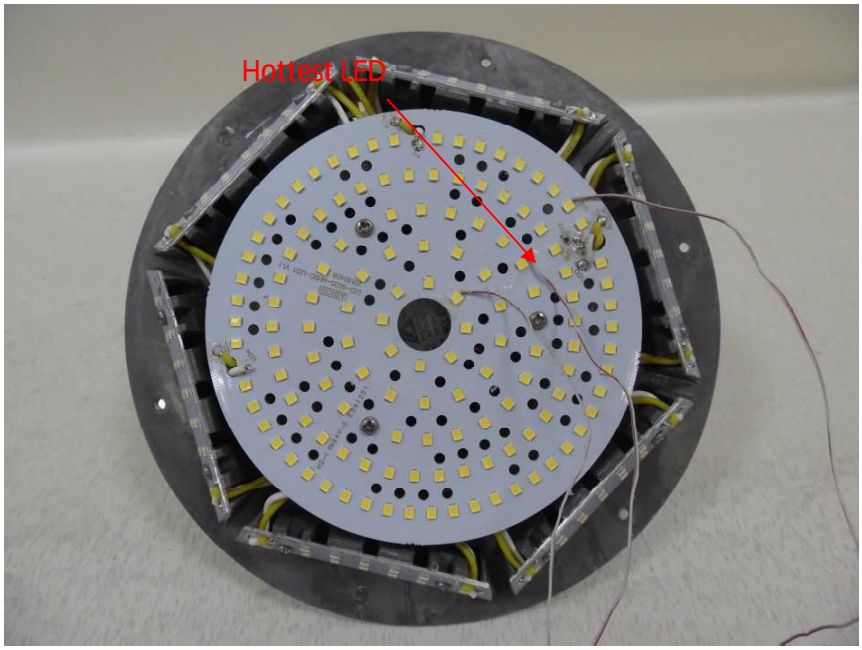
Criteria Item	Result
10000 hours lumen maintenance of LED light source	94.66%
forward current on each LED light source	150 mA
Projected L_{70} lumen maintenance life	**52000 hours**
Reported L_{70} lumen maintenance life	**52000 hours**

Note: Please refer to appendix 2 and 3 for details of TM-21 inputs and results.

3.4 Thermocouple contact photo



Picture 1 Part view of hottest LED



Picture 2 Over view

Appendix 1 LM-80 report summary

Report originated by	Shenzhen BST Technology Co., Ltd.		
Manufactured by	SAMSUNG ELECTRONICS CO., LTD		
LM-80 report No.	BST1510440900002Y- 1SR- 2		
LED Model	SPMWHX1228FXXXXXXXX		
LED Part Number	SPMWHX1228FXXXXXXXX		
Number of LED light source tested	20 units		
Drive Current	150 mA		
Case temperature	55°C	75°C	85°C
10000 hours lumen maintenance	94.20%	94.04%	90.57%
10000 hours color maintenance(Δu'v')	0.0042	0.0052	0.0059

Appendix 2 TM-21 inputs

TM-21 Inputs

Instructions
Yellow fields are completed by the user. Fields not used should be left blank. Cyan fields are calculated based on user entries. First, enter a description of the LED light source tested. Then complete the fields labeled "LM-80 Testing Details". Test duration must be at least 6,000 hours. If only one case temperature data set is to be used (no interpolation), complete only "Tested case temperature 1". For only two case temperature data sets, complete 1 and 2. Next, further to the right, in the corresponding box(es) for each tested case temperature, enter the test data along with the time (in hours) at which each measurement was taken. Data entered must be normalized then averaged measured data (per TM-21 sections 5.2.1 and 5.2.2). Enter drive current, *in-situ* temperature data and the percentage of initial lumens to project to in the fields labeled "*In-Situ* Inputs". Results can be tailored to estimate lumen maintenance at a specific time by entering a value (t) in the yellow field. A complete TM-21 report will appear on the next tab labeled "Report".

Description of LED Light Source Tested (manufacturer, model, catalog number)
Model: SPMWHX1228FXXXXXXXX, manufactured by SAMSUNG ELECTRONICS CO., LTD

LM-80 Testing Details	
Total number of units tested per case temperature:	20
Number of failures:	0
Number of units measured:	20
Test duration (hours):	10000
Tested drive current (mA):	150
Tested case temperature 1 (T_c, ^{0}C):	55
Tested case temperature 2 (T_c, ^{0}C):	85
Tested case temperature 3 (T_c, ^{0}C):	105

LM-80 Test Inputs

Test Data for 55^{0}C Case Temperature		Test Data for 85^{0}C Case Temperature		Test Data for 105^{0}C Case Temperature	
Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)
0	100.00%	0	100.00%	0	100.00%
1000	100.00%	1000	99.90%	1000	99.50%
2000	99.61%	2000	98.84%	2000	98.33%
3000	98.81%	3000	98.26%	3000	97.35%
4000	98.35%	4000	97.77%	4000	96.44%
5000	97.79%	5000	97.36%	5000	95.63%
6000	97.34%	6000	96.72%	6000	94.81%
7000	97.00%	7000	95.74%	7000	92.70%
8000	96.42%	8000	94.69%	8000	92.22%
9000	95.49%	9000	94.51%	9000	91.44%
10000	94.20%	10000	94.04%	10000	90.57%

In-Situ Inputs

Drive current for each LED package/array/module (mA):	150
In-situ case temperature (T_c, ^{0}C):	52.7
Percentage of initial lumens to project to (e.g. for L_{70}, enter 70):	70

Results

Time (t) at which to estimate lumen maintenance (hours):	10,000
Lumen maintenance at time (t) (%):	94.66%
Calculated L70 (hours):	52,000
Reported L70 (hours):	52,000

Appendix 3 TM-21 Results

TM-21 Report

Table 1: Report at each LM-80 Test Condition					
Description of LED Light Source Tested (manufacturer, model, catalog number)	Model: SPMWHX1228FXXXXXXXX, manufactured by SAMSUNG ELECTRONICS C				
Test Condition 1 - 55°C Case Temp		**Test Condition 2 - 85°C Case Temp**		**Test Condition 3 - 105°C Case Temp**	
Sample size	20	Sample size	20	Sample size	20
Number of failures	0	Number of failures	0	Number of failures	0
DUT drive current used in the test (mA)	150	DUT drive current used in the test (mA)	150	DUT drive current used in the test (mA)	150
Test duration (hours)	10,000	Test duration (hours)	10,000	Test duration (hours)	10,000
Test duration used for projection (hour to hour)	5,000 - 10,000	Test duration used for projection (hour to hour)	5,000 - 10,000	Test duration used for projection (hour to hour)	5,000 - 10,000
Tested case temperature (°C)	55	Tested case temperature (°C)	85	Tested case temperature (°C)	105
α	7.159E-06	α	7.253E-06	α	1.102E-05
B	1.017	B	1.008	B	1.009
Calculated L70(10k) (hours)	52,000	Calculated L70(10k) (hours)	50,000	Calculated L70(10k) (hours)	33,000
Reported L70(10k)	52,000	Reported L70(10k)	50,000	Reported L70(10k)	33,000

Table 2: Interpolation Report (projection based on *in-situ* temperature entered)	
$T_{s,1}$ (°C)	55.00
$T_{s,1}$ (K)	328.15
α_1	7.159E-06
B_1	1.017
$T_{s,2}$ (°C)	-
$T_{s,2}$ (K)	-
α_2	-
B_2	-
E_a/k_b	-
A	-
B_0	1.017
$T_{s,i}$ (°C)	52.70
$T_{s,i}$ (K)	325.85
α_i	7.159E-06
Projected L70(10k) at 52.7°C (hours)	52,000
Reported L70(10k) at 52.7°C (hours)	52,000

Report Generated By: Bowen Pang	Notes: N.A
Company: LCTECH (Zhongshan) Testing Service Co.,Ltd.	
Date:Sep. 22, 2016	

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