



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

### FILAMENT ST19

**Model: 4FST19DIM/820/A**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ18060021c

The laboratory that conducted the testing detailed in this report has been accredited for SSL by NVLAP.

Review by:

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Jun. 20, 2018

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Jun. 20, 2018

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

## Test Summary

Sample Tested: 4FST19DIM/820/A

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
94.0	339.5	3.61	0.7366
CCT (K)	CRI	Stabilization Time (Light & Power)	
2092	80.8	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

### Test specifications:

**Date of Receipt** : Jun. 14, 2018

**Date of Test** : Jun. 15, 2018

**Test item** : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

**Reference Standard** : IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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## Sample Photos



Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: FILAMENT ST19
<b>Model</b>	: 4FST19DIM/820/A
<b>Electrical Ratings</b>	: 120V, 60Hz, 4W
<b>Product Description</b>	: E26 base, 2000K
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

## TEST RESULTS

Test ambient temperature was 24.9°C.

Base orientation was base up. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 60 minutes, and the total operating time including stabilization was 70 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.041
Power Factor	0.7366
Test Power (W)	3.61
THD A%	87.71
Luminous Efficacy (lm/W)	94.0
Total Luminous Flux (lm)	339.5
Color Rendering Index (CRI)	80.8
R9	8.6
Correlated Color Temperature (CCT)(K)	2092
Chromaticity Chroma x	0.5186
Chromaticity Chroma y	0.4172
Chromaticity Chroma u	0.2976
Chromaticity Chroma v	0.3592
Duv	0.0008
Chromaticity Chroma u'	0.2976
Chromaticity Chroma v'	0.5388

Special Color Rendering Indices	
R1	79.3
R2	91.8
R3	93.7
R4	77.2
R5	79.1
R6	92.7
R7	79
R8	53.8
R9	8.6
R10	82.7
R11	77
R12	81.1
R13	81.9
R14	97.6
Rf	83
Rg	95

Table 2: Test data per Sphere-Spectroradiometer Method

Note: According to CIE 1976 (u',v') diagram,  $u' = u = 4x/(-2x+12y+3)$ ,  $v' = 3v/2 = 9y/(-2x+12y+3)$ .

### Goniophotometer Method

Test ambient temperature was 24.7°C.

The photometric distance is 2.47m.

Luminous data was taken at 0.5°vertical intervals and 10°horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.041
Power Factor	0.7374
Test Power (W)	3.59
Luminous Efficacy (lm/W)	93.3
Total Luminous Flux (lm)	335.1
Beam Angle (°)	326.8
Center Beam Candle Power (cd)	4.22
Spacing Criteria	4.30 (0°-180°)/ 4.06 (90°-270°)
Zonal Lumens in the 0°-60°Zone	20.93%
Zonal Lumens in the 60°-90°Zone	33.71%
Zonal Lumens in the 90°-120°Zone	29.85%
Zonal Lumens in the 120°-180°Zone	15.52%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

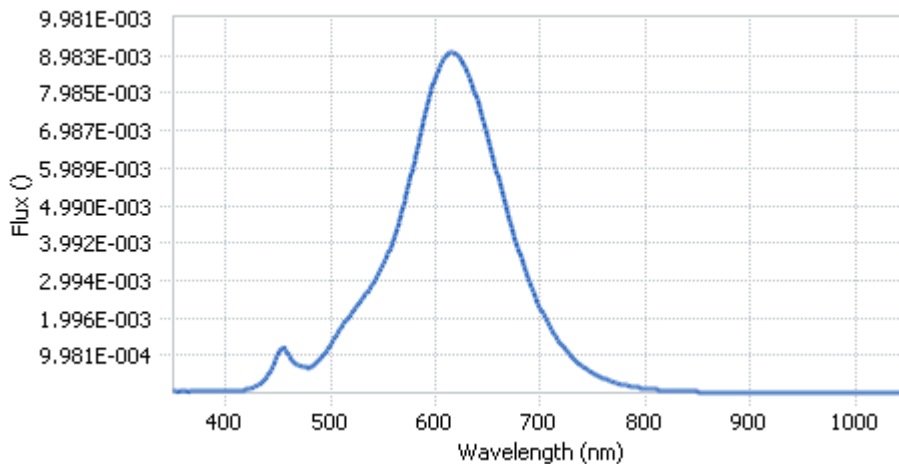
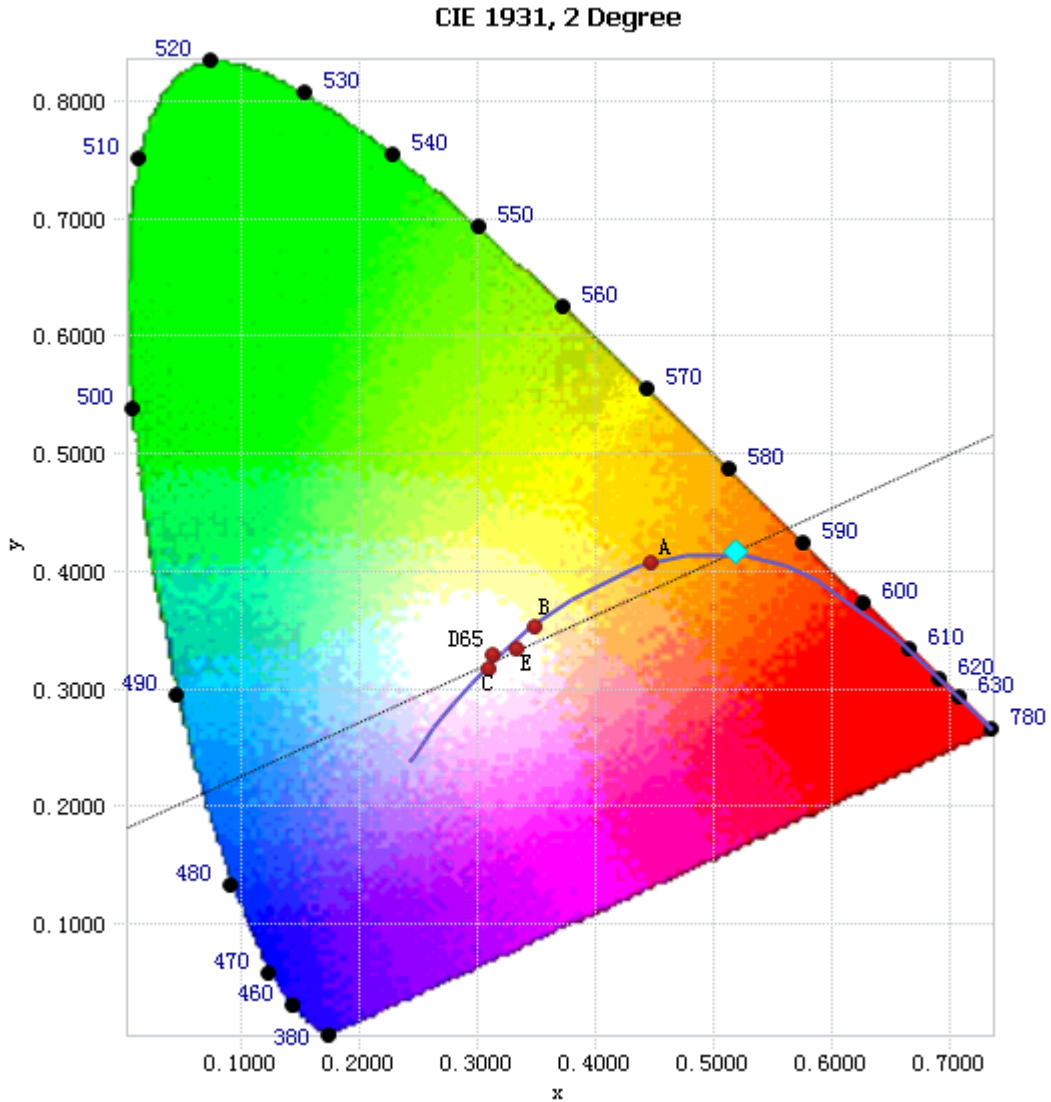


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.45E-05	485	7.57E-04	590	7.41E-03	695	2.59E-03
385	3.21E-05	490	9.00E-04	595	7.97E-03	700	2.24E-03
390	3.27E-05	495	1.08E-03	600	8.43E-03	705	1.96E-03
395	3.87E-05	500	1.29E-03	605	8.75E-03	710	1.70E-03
400	4.46E-05	505	1.52E-03	610	8.98E-03	715	1.48E-03
405	4.31E-05	510	1.74E-03	615	9.05E-03	720	1.28E-03
410	5.16E-05	515	1.94E-03	620	9.01E-03	725	1.11E-03
415	6.64E-05	520	2.14E-03	625	8.84E-03	730	9.57E-04
420	8.94E-05	525	2.30E-03	630	8.55E-03	735	8.20E-04
425	1.30E-04	530	2.50E-03	635	8.23E-03	740	7.05E-04
430	2.02E-04	535	2.68E-03	640	7.78E-03	745	6.05E-04
435	3.10E-04	540	2.90E-03	645	7.27E-03	750	5.20E-04
440	4.71E-04	545	3.14E-03	650	6.78E-03	755	4.47E-04
445	7.12E-04	550	3.40E-03	655	6.23E-03	760	3.82E-04
450	1.03E-03	555	3.72E-03	660	5.70E-03	765	3.27E-04
455	1.20E-03	560	4.09E-03	665	5.17E-03	770	2.80E-04
460	1.00E-03	565	4.55E-03	670	4.65E-03	775	2.41E-04
465	8.02E-04	570	5.04E-03	675	4.18E-03	780	2.06E-04
470	7.43E-04	575	5.61E-03	680	3.72E-03		
475	6.86E-04	580	6.22E-03	685	3.30E-03		
480	6.72E-04	585	6.84E-03	690	2.91E-03		

Table 4: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

### Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.5186, 0.4172)

Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.



### Nominal CCT Quadrangles – Sphere Spectroradiometer Method

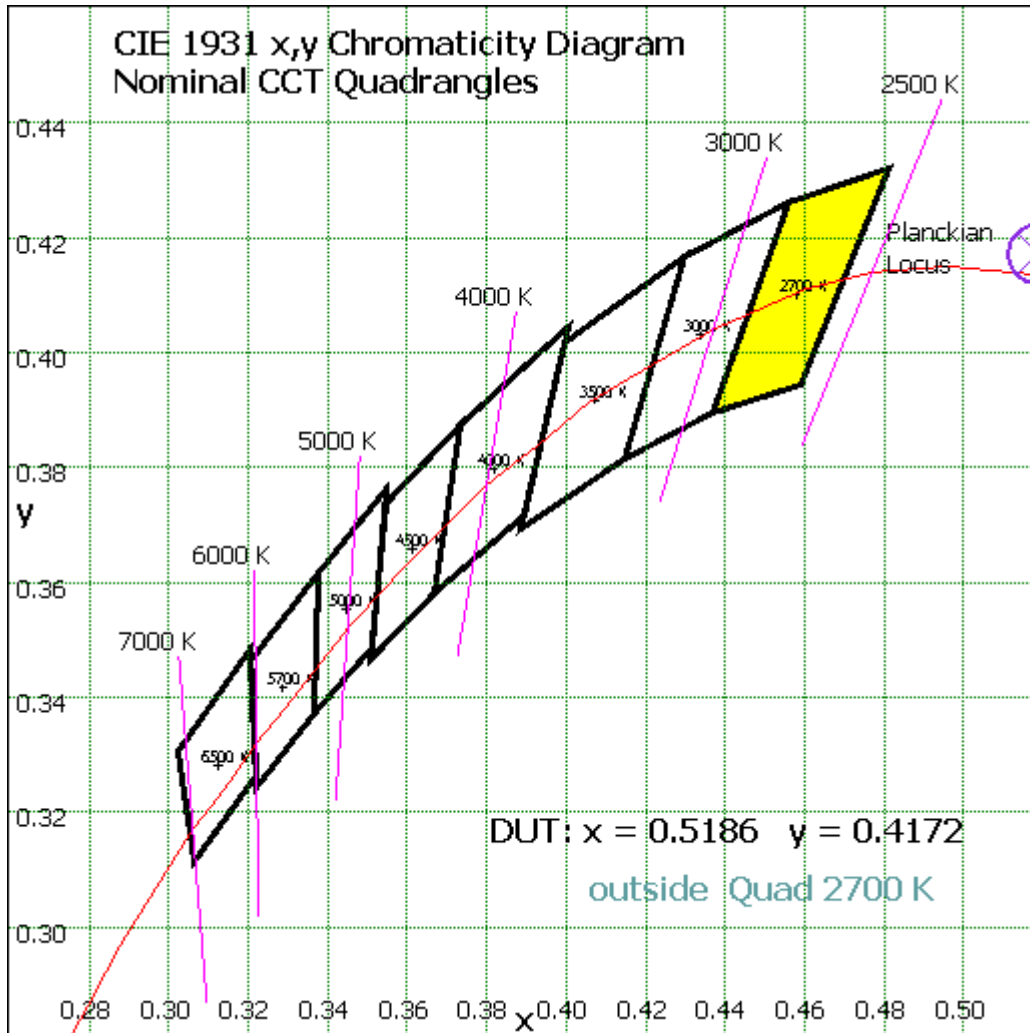


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	0.52	0.16%
10- 20	2.425	0.72%
20- 30	6.229	1.86%
30- 40	12.155	3.63%
40- 50	20.109	6.00%
50- 60	28.674	8.56%
60- 70	35.186	10.50%
70- 80	38.595	11.52%
80- 90	39.152	11.69%
90-100	37.374	11.15%
100-110	33.777	10.08%
110-120	28.86	8.61%
120-130	22.259	6.64%
130-140	14.87	4.44%
140-150	9.586	2.86%
150-160	4.637	1.38%
160-170	0.634	0.19%
170-180	0.006	0.00%
Total	335.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0-130	305.315	91.13%
130-180	29.733	8.87%
0-180	335.0	100%

Table 5: Zonal Lumen Data

Note: The Flux in this table might be a little different from the total flux in Table 2 due to rounding.

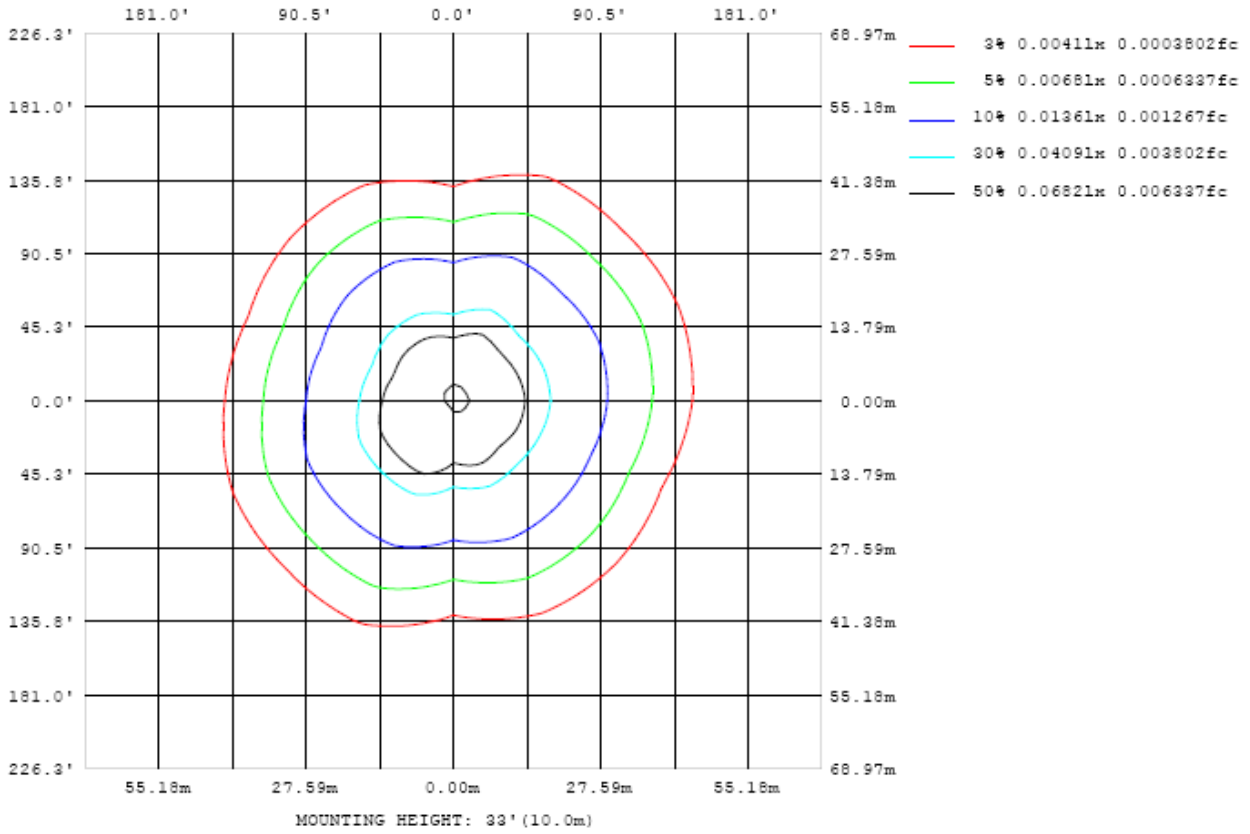


Chart 4: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots- Goniophotometer Method

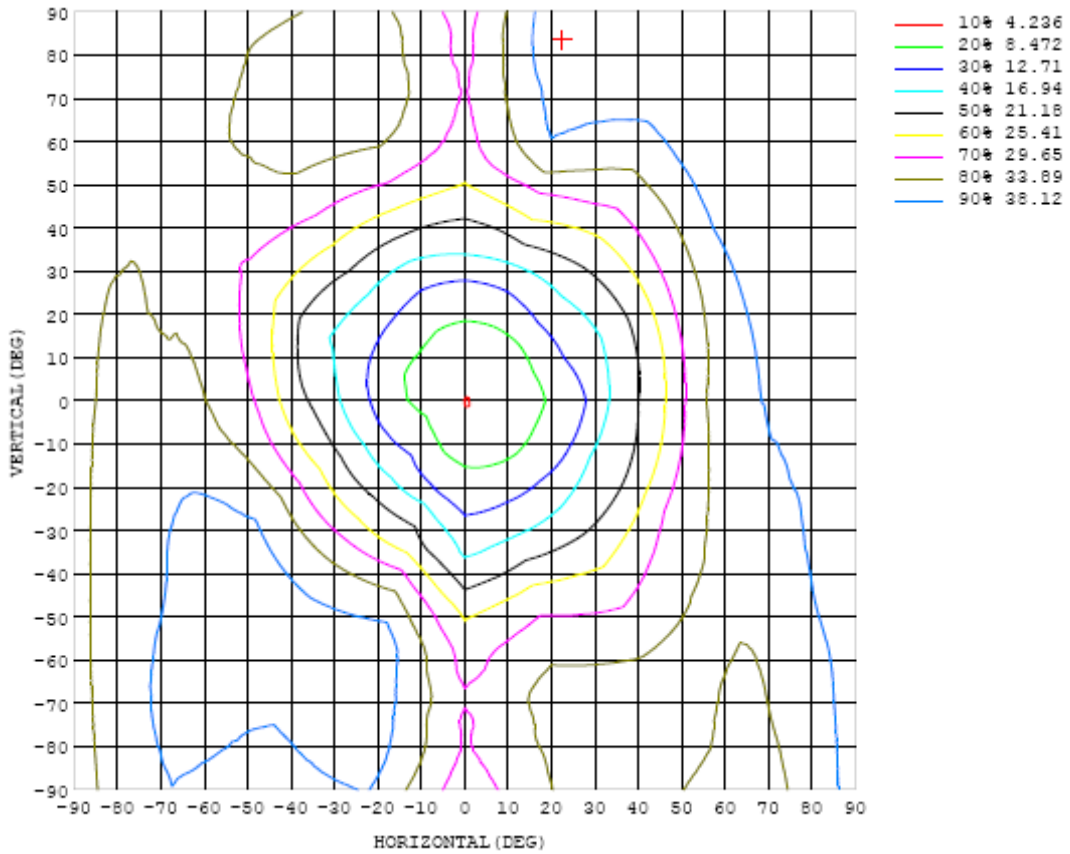


Chart 5: Isocandela Plot

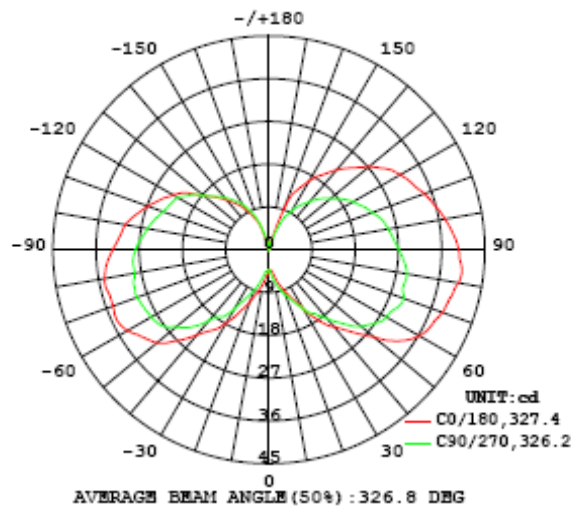


Chart 6: Polar Candela Distribution

**Luminous Intensity Data- Goniophotometer Method**

Table--1 UNIT: cd

C (DEG) y (DEG)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5			
0	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22	4.22			
5	4.70	4.91	4.89	4.95	5.03	5.37	6.03	5.94	5.40	5.10	5.27	5.08	4.69	4.58	4.69	4.29			
10	5.13	5.61	6.07	6.13	6.80	7.32	8.35	8.73	7.31	6.57	6.50	5.85	5.09	4.94	5.46	5.02			
15	7.09	7.26	7.71	8.02	8.40	9.41	11.2	11.2	9.52	8.42	8.37	7.73	7.03	6.97	7.43	7.16			
20	9.08	10.0	9.96	10.0	10.2	12.3	13.9	13.0	11.7	10.2	10.3	9.64	9.08	9.15	9.54	10.0			
25	11.2	11.9	12.6	12.6	12.0	16.5	17.4	16.8	14.4	13.4	12.8	12.0	11.2	11.6	13.1	12.8			
30	14.2	15.8	15.3	15.2	14.4	20.7	21.0	20.3	17.7	15.6	15.3	14.1	14.4	14.6	15.9	15.3			
35	18.2	19.3	18.5	18.2	16.3	23.1	24.6	24.1	20.7	17.2	18.3	17.3	17.2	18.4	18.1	17.3			
40	21.2	20.8	21.0	21.7	19.0	28.4	28.7	28.2	23.4	19.8	21.7	20.8	19.4	22.5	21.0	20.1			
45	24.4	24.7	23.5	25.5	22.0	32.8	32.7	32.4	27.0	23.3	24.8	24.4	23.1	25.9	23.9	23.7			
50	28.6	28.9	26.3	28.7	25.1	36.2	35.7	36.1	30.4	26.3	28.2	27.9	25.3	29.4	27.2	28.0			
55	33.4	31.3	28.5	31.2	27.0	38.8	38.0	38.6	32.1	28.6	30.8	30.8	27.6	33.9	30.0	31.5			
60	36.1	33.2	30.9	33.1	28.3	40.5	39.7	40.6	34.0	30.0	33.1	33.4	28.3	37.1	32.5	34.6			
65	37.5	34.3	32.9	34.6	29.2	40.7	40.5	41.7	35.0	31.0	34.9	35.7	28.8	38.7	35.3	37.9			
70	38.5	34.6	34.6	35.7	29.8	40.9	40.6	41.8	34.6	31.8	35.9	36.6	29.2	39.6	37.5	40.4			
75	39.1	34.1	35.5	35.7	29.0	41.0	39.4	39.9	34.7	32.1	36.0	37.0	29.1	40.7	39.6	41.8			
80	40.1	33.0	35.5	35.3	29.2	40.6	38.0	39.6	34.8	31.5	35.3	36.9	28.5	42.0	39.7	41.9			
85	40.3	32.5	35.4	34.9	28.3	39.9	36.8	39.4	33.9	31.3	34.5	36.7	28.5	42.3	38.8	42.0			
90	39.5	31.4	34.7	34.6	27.1	38.4	35.8	38.0	32.6	30.8	32.8	36.0	27.8	42.2	39.1	41.9			
95	38.5	30.1	34.3	33.8	26.1	36.9	34.5	36.6	31.3	30.1	31.8	35.3	26.8	41.4	39.7	41.5			
100	37.3	28.8	33.4	32.5	25.3	35.1	32.8	34.5	30.4	29.8	30.8	34.9	25.7	40.5	39.1	40.6			
105	35.8	27.4	32.3	31.3	24.4	33.1	30.7	32.4	28.7	29.1	29.4	33.8	24.6	39.5	38.3	39.8			
110	34.5	26.2	30.7	30.1	22.9	31.6	29.2	30.7	26.9	28.1	28.0	32.5	23.5	37.8	37.8	38.9			
115	33.0	25.2	29.0	28.4	21.6	30.2	27.7	29.0	25.0	26.7	26.2	30.9	22.7	35.9	36.9	37.6			
120	31.6	23.4	27.2	26.5	20.2	28.3	25.7	26.4	23.1	24.9	24.4	29.5	22.0	34.1	33.6	35.5			
125	29.8	21.5	24.5	24.0	18.7	25.1	22.6	23.9	20.9	22.8	22.0	27.1	20.1	32.0	30.7	32.7			
130	27.2	18.7	21.7	21.6	16.8	21.1	20.4	21.5	17.8	20.3	19.7	24.1	17.8	28.8	23.3	29.3			
135	24.4	16.7	19.6	19.5	15.2	18.6	18.8	19.5	15.7	17.8	18.8	21.8	15.9	25.0	9.84	26.5			
140	22.0	15.0	17.6	16.8	13.3	16.0	17.5	17.6	13.7	15.7	17.8	19.9	14.3	22.3	7.37	24.2			
145	19.2	13.5	15.1	14.2	11.5	13.4	16.0	15.6	11.8	13.1	16.1	17.7	12.7	19.6	12.2	22.1			
150	16.7	11.7	12.3	12.4	9.45	10.8	13.9	13.0	9.95	10.6	13.8	15.1	11.0	16.1	14.9	16.1			
155	13.8	9.72	9.85	8.38	7.37	8.05	9.89	9.98	7.68	8.16	10.9	11.2	8.88	11.5	13.5	10.9			
160	9.05	6.36	5.48	3.82	3.70	3.02	2.67	3.43	5.66	5.86	5.47	5.61	6.28	8.04	10.6	8.93			
165	1.65	1.47	0.75	0.54	0.68	0.57	0.46	0.55	0.98	1.13	1.26	1.42	1.48	2.83	2.92	2.41			
170	0.21	0.19	0.16	0.10	0.07	0.08	0.06	0.11	0.17	0.19	0.23	0.27	0.29	0.24	0.26	0.30			
175	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.02	0.03	0.03			
180	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01			

Table 6: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	PF2010A	HZTE028-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	DPS1060	HZTE001-06	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	WY12010	HZTE004-03	Aug. 10, 2017	Aug. 09, 2018
Temperature recorder	JM624U	HZTE018-08	Aug. 17, 2017	Aug. 16, 2018
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 16, 2017	Aug. 15, 2018
Standard source	D908	HZTE012-01	Aug. 20, 2017	Aug. 19, 2018
Integrate Sphere system	2M	HZTE015-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	WT210	HZTE008-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	PCR 500L	HZTE001-07	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	IT6154	HZTE004-04	Aug. 10, 2017	Aug. 09, 2018
Standard source	SCL-1400	HZTE012-02	Aug. 20, 2017	Aug. 19, 2018
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 16, 2017	Aug. 15, 2018
Temperature Meter	TES1310	HZTE017-01	Aug. 17, 2017	Aug. 16, 2018

Table 7: Test Equipment List

## TEST METHODS

### Seasoning of SSL Product

For the purpose of rating new SSL products, SSL products shall be tested with no seasoning. Therefore, no seasoning was performed.

### Sphere-Spectroradiometer Method- Photometric and Electrical Measurements

A Labsphere Model CDS 2100 Spectroradiometer and Two Meter Sphere was used to measure correlated color temperature, chromaticity coordinates, and the color rendering index for each SSL unit. The coating reflectance of each sphere is 98%. The measure geometry is  $4\pi$ . Self-absorption correction is conducted in testing. Bandwidth of spectroradiometer is 350nm-1050nm.

Ambient temperature was measured at a position inside the sphere. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated Filament ST19s) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Yokogawa Power Analyzer.

The standard reference of the integrated sphere system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Standards and Technology.

The uncertainty of integrating sphere system reported in this document is expanded uncertainty is 2.1% with a coverage factor  $k=2$ .

## **Goniophotometer Method**

### **Photometric and Electrical Measurements**

An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.

Ambient temperature was measured at the same height of the sample mounted on the Goniophotometer equipment. Each SSL unit was operated on the client provided driver at the rated input voltage in its designated orientation.

The stabilization time typically ranges from 30 min (small integrated Filament ST19s) to 2 or more hours for large SSL luminaires). It can be judged that stability is reached when the variation (maximum – minimum) of at least 3 readings of the light output and electrical power over a period of 30 min, taken 15 minutes apart, is less than 0.5 %.

Electrical measurements including voltage, current, and power were measured using the Everfine Digital Power Meter.

Some graphics were created with Photometric Plus software.

The standard reference of the Goniophotometer system is halogen incandescent lamp, the intensity distribution type is omni-directional, and is traceable to the National Institute of Metrology P.R. China.

The uncertainty of goniophotometer system reported in this document is expanded uncertainty is 2.3% with a coverage factor  $k=2$ .

### **Color Characteristics Measurements**

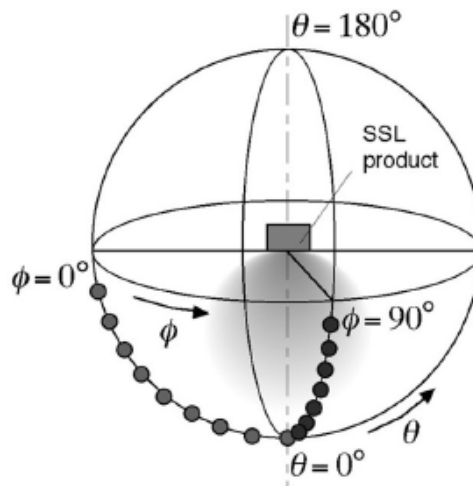
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as values that are spatially average, weighted to intensity, over the angular range where light is intentionally emitted from the SSL product. The color characteristics measurements are using gonio-spectroradiometer.

### **Color Spatial Uniformity**

The characteristics of SSL products may be spatially non-uniform, the chromaticity coordinate shall be measured at two vertical planes ( $C=0^\circ/180^\circ$  and  $C=90^\circ/270^\circ$ ) and at  $10^\circ$  or less intervals for vertical angle until the light output dropped to below 10% of the peak intensity. The averaged weighted chromaticity coordinate

was calculated from these points. The data was then analyzed to check for delta color differences of the  $u'$ ,  $v'$  chromaticity coordinates. The spatial non-uniformity of chromaticity,  $\Delta u'v'$ , is determined as the maximum deviation (distance on the CIE ( $u'$ ,  $v'$ ) diagram) among all measured points from the spatially averaged chromaticity coordinate.

The geometry for the chromaticity measurement using gonio-spectroradiometer is shown as following.



\*\*\* End of Report \*\*\*

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