



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Lamp

Model: 4FG25DIM/820/A

### Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18120038b

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

Review by:

Engineer: April Zou  
Jan. 04, 2019

Approved by:



Manager: Jim Zhang  
Jan. 04, 2019

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: **4FG25DIM/820/A**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
98.0	362.6	3.70	0.7267
CCT (K)	CRI	Stabilization Time (Light & Power)	
2074	81.5	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** : Dec. 27, 2018

**Date of Test** : Jan. 02, 2019

**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>	: LED Lamp
<b>Model</b>	: 4FG25DIM/820/A
<b>Electrical Ratings</b>	: 120V, 60Hz, 4W
<b>Product Description</b>	: 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 26.0°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)	0.043
Power Factor	0.7267
Test Power (W)	3.70
THD A%	91.18
Luminous Efficacy (lm/W)	98.0
Total Luminous Flux (lm)	362.6
Color Rendering Index (CRI)	81.5
R9	12.2
Correlated Color Temperature (CCT)(K)	2074
Chromaticity Chroma x	0.5200
Chromaticity Chroma y	0.4163
Chromaticity Chroma u	0.2990
Chromaticity Chroma v	0.3591
Duv	0.0006
Chromaticity Chroma u'	0.2990
Chromaticity Chroma v'	0.5387

Special Color Rendering Indices	
R1	79.9
R2	91.9
R3	94.2
R4	78
R5	79.8
R6	92.8
R7	79.7
R8	55.4
R9	12.2
R10	83
R11	78
R12	81.9
R13	82.4
R14	97.8
Rf	83
Rg	96

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 24.8°C.

The photometric distance is 30m.

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)	0.042
Power Factor	0.7310
Test Power (W)	3.68
Luminous Efficacy (lm/W)	97.7
Total Luminous Flux (lm)	359.6
Beam Angle ( ° )	324.0
Center Beam Candle Power (cd)	4.68
Spacing Criteria	4.25(0 °-180 °)/ 4.46 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	18.49%
Zonal Lumens in the 60 °-90 °Zone	29.22%
Zonal Lumens in the 90 °-120 °Zone	31.98%
Zonal Lumens in the 120 °-180 °Zone	20.32%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

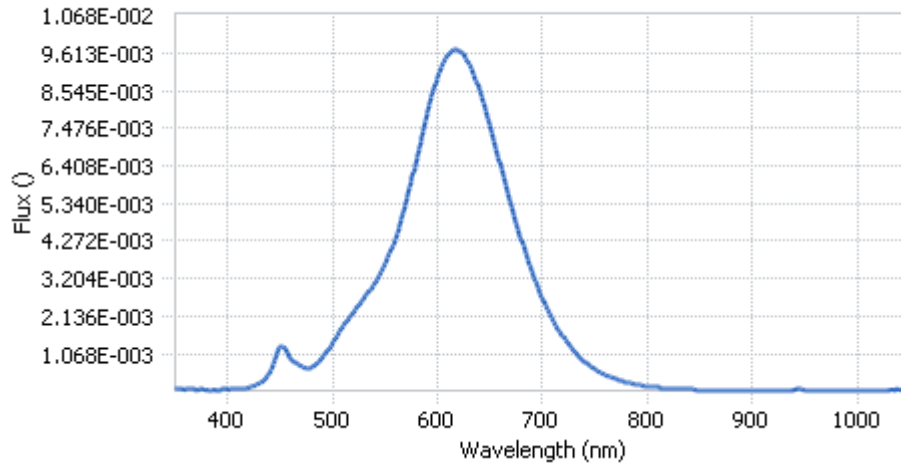
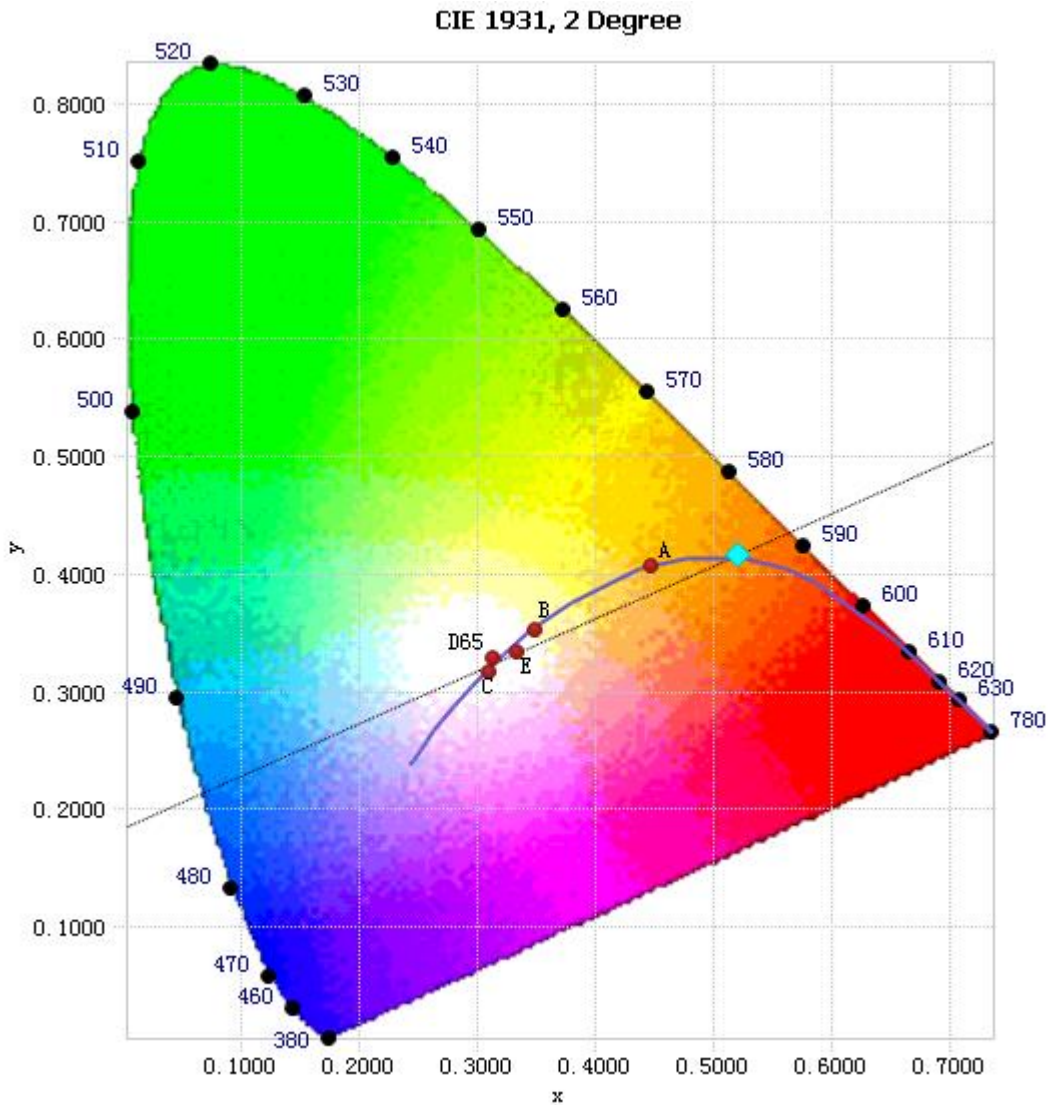


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.03E-05	485	7.84E-04	590	7.89E-03	695	3.01E-03
385	3.99E-05	490	9.35E-04	595	8.46E-03	700	2.63E-03
390	3.70E-05	495	1.14E-03	600	8.96E-03	705	2.30E-03
395	4.13E-05	500	1.38E-03	605	9.33E-03	710	2.01E-03
400	4.00E-05	505	1.62E-03	610	9.57E-03	715	1.75E-03
405	4.73E-05	510	1.85E-03	615	9.70E-03	720	1.53E-03
410	5.35E-05	515	2.07E-03	620	9.69E-03	725	1.32E-03
415	7.15E-05	520	2.27E-03	625	9.60E-03	730	1.14E-03
420	1.01E-04	525	2.46E-03	630	9.30E-03	735	9.76E-04
425	1.48E-04	530	2.65E-03	635	8.98E-03	740	8.40E-04
430	2.25E-04	535	2.85E-03	640	8.53E-03	745	7.24E-04
435	3.49E-04	540	3.07E-03	645	8.05E-03	750	6.19E-04
440	5.42E-04	545	3.33E-03	650	7.53E-03	755	5.36E-04
445	8.87E-04	550	3.62E-03	655	6.99E-03	760	4.59E-04
450	1.25E-03	555	3.96E-03	660	6.42E-03	765	3.95E-04
455	1.19E-03	560	4.36E-03	665	5.85E-03	770	3.35E-04
460	9.03E-04	565	4.85E-03	670	5.30E-03	775	2.88E-04
465	8.04E-04	570	5.38E-03	675	4.78E-03	780	2.51E-04
470	7.24E-04	575	5.98E-03	680	4.28E-03		
475	6.53E-04	580	6.62E-03	685	3.83E-03		
480	6.77E-04	585	7.26E-03	690	3.39E-03		

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

### Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.5200, 0.4163)

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

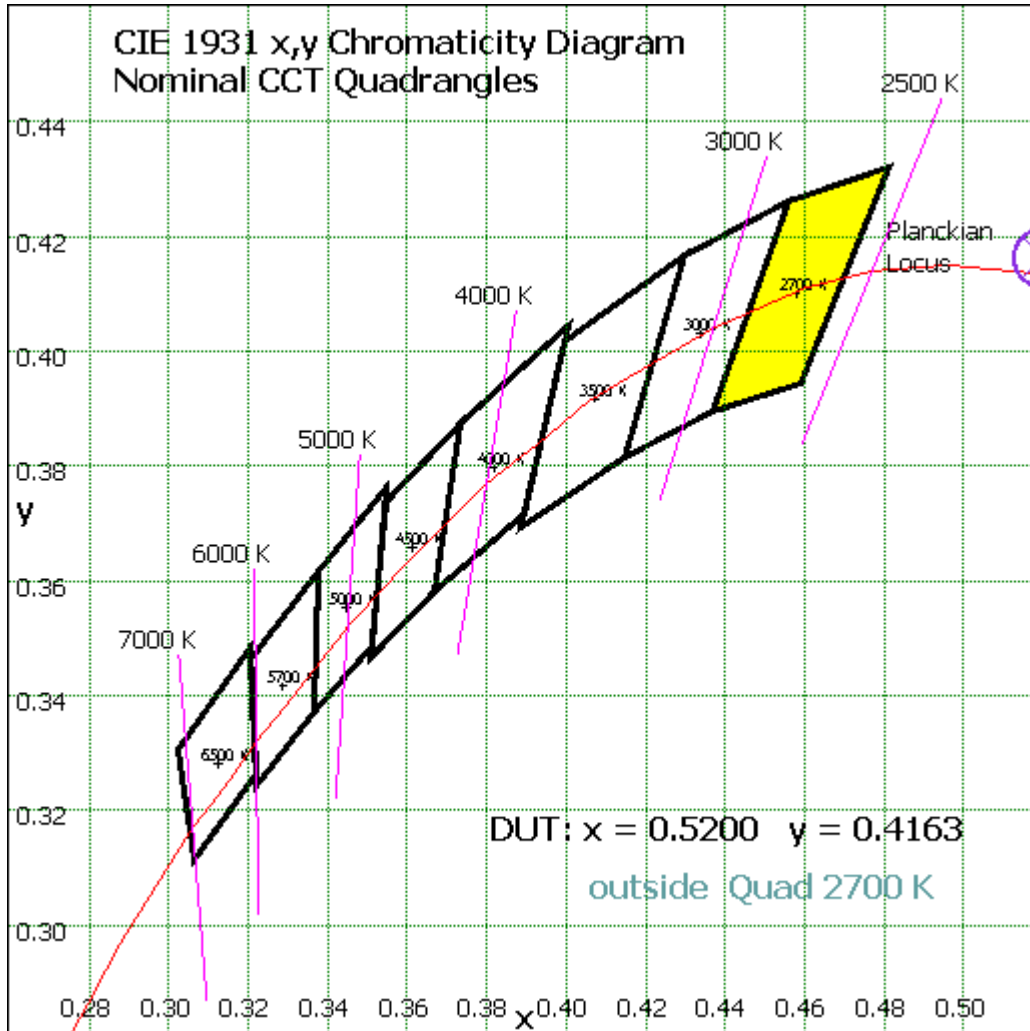


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	0.538	0.15%
10- 20	2.588	0.72%
20- 30	6.668	1.85%
30- 40	12.329	3.43%
40- 50	18.862	5.25%
50- 60	25.509	7.09%
60- 70	31.191	8.67%
70- 80	35.487	9.87%
80- 90	38.391	10.68%
90-100	39.581	11.01%
100-110	39.186	10.90%
110-120	36.225	10.07%
120-130	30.78	8.56%
130-140	22.947	6.38%
140-150	14.218	3.95%
150-160	4.702	1.31%
160-170	0.399	0.11%
170-180	0.01	0.00%
Total	359.6	100%

$\gamma(^{\circ})$	Lumens	% Total
0-110	250.33	69.61%
110-180	109.281	30.39%
0-180	359.6	100%

Table 5: Zonal Lumen Data

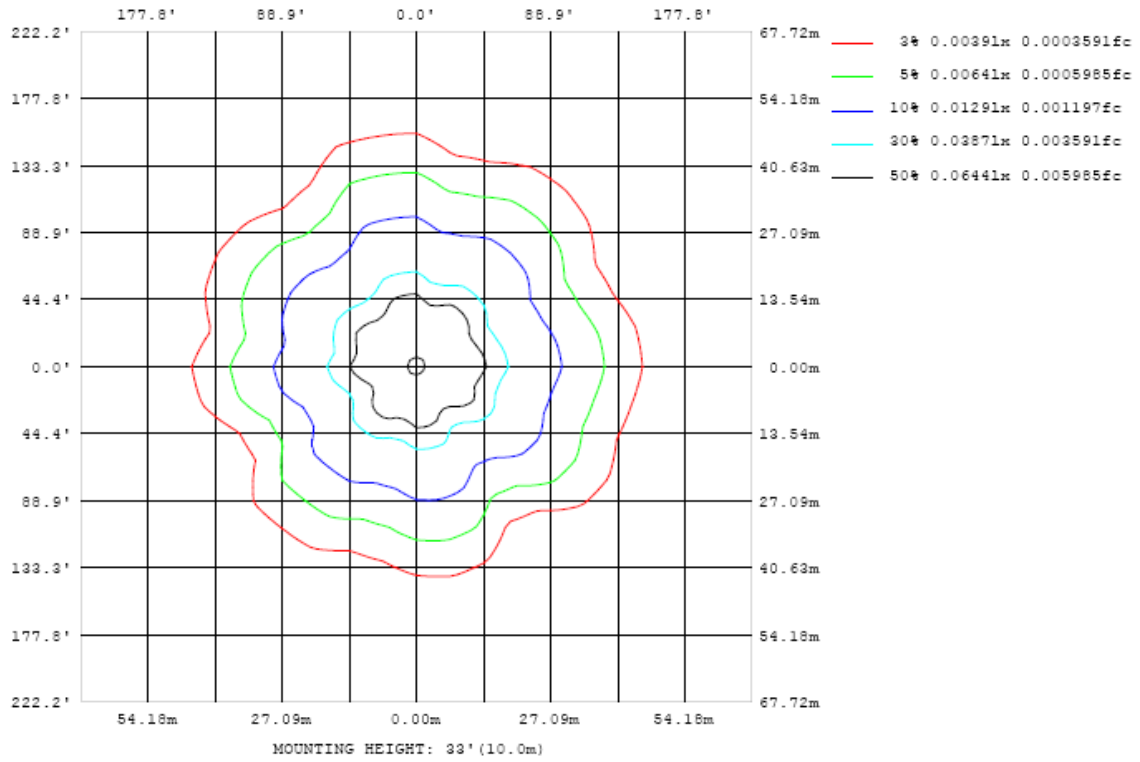


Chart 4: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots- Goniophotometer Method

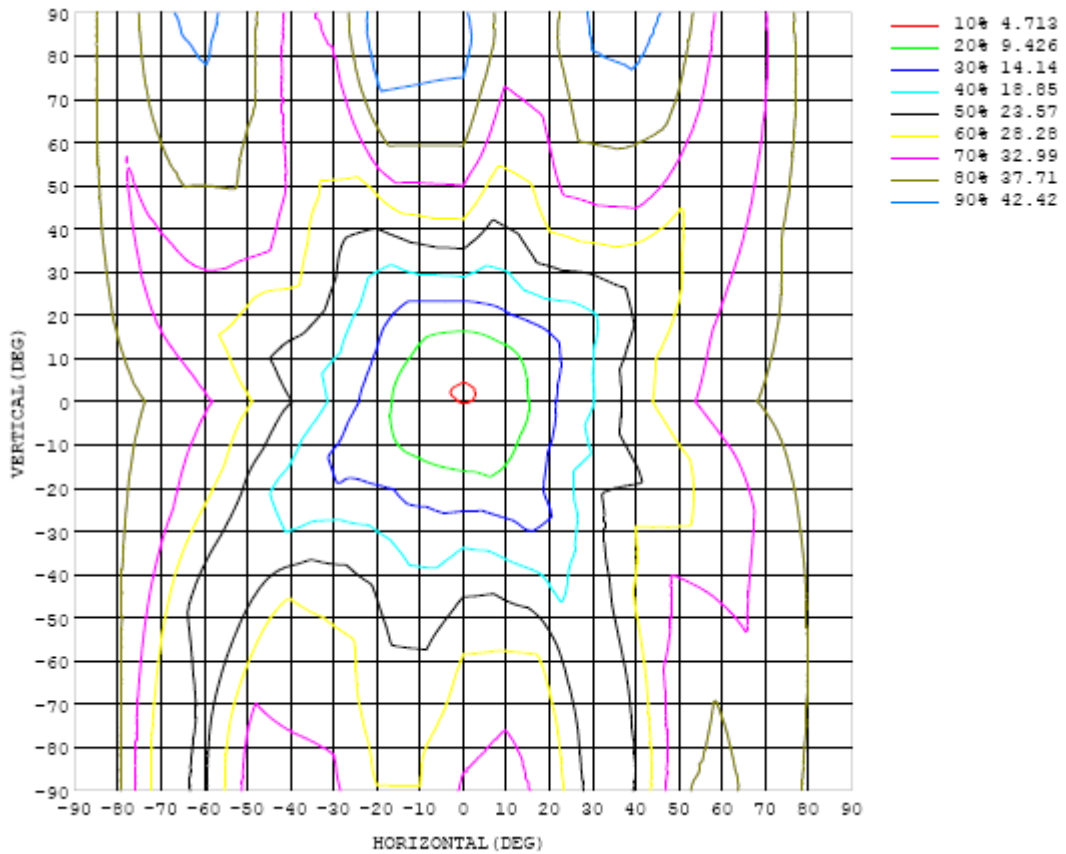


Chart 5: Isocandela Plot

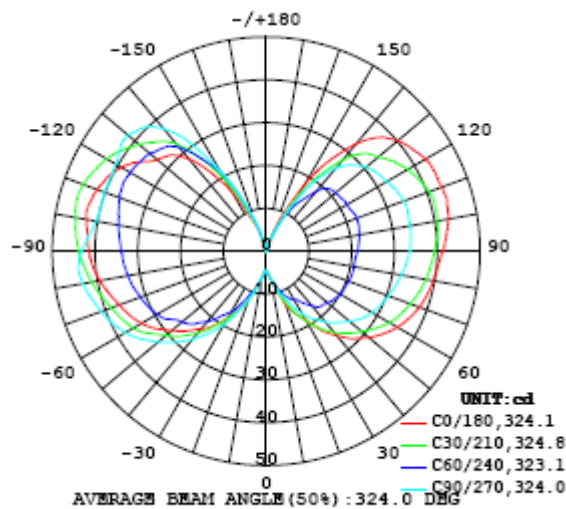


Chart 6: Polar Candela Distribution

**Luminous Intensity Data- Goniophotometer Method**

Table--1 UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
5	5.17	5.22	5.28	5.36	5.36	5.39	5.39	5.37	5.36	5.33	5.30	5.28	5.28	5.27	5.24	5.22	5.18	5.19	5.13
10	6.78	6.81	6.88	6.92	6.94	6.89	6.79	6.86	6.85	6.73	6.68	6.63	6.56	6.62	6.66	6.61	6.68	6.65	6.56
15	9.33	9.24	9.22	9.29	9.05	8.61	8.31	8.31	8.79	8.99	9.02	8.97	8.87	8.72	8.53	8.28	8.53	8.65	8.65
20	13.1	12.9	12.8	12.3	11.0	10.8	10.3	10.1	11.2	11.2	11.5	11.5	10.9	11.1	10.4	10.2	10.2	10.4	11.6
25	16.0	16.3	15.6	15.8	14.1	12.3	11.9	12.6	13.9	14.0	13.7	13.9	13.2	13.8	12.8	12.2	11.9	12.9	14.7
30	18.5	19.9	18.0	19.0	16.9	13.5	13.2	15.0	16.5	16.9	15.8	16.0	16.1	16.4	14.9	13.6	13.3	15.5	17.9
35	22.5	22.8	20.2	22.0	18.8	15.2	14.6	17.3	18.9	19.4	17.6	17.6	18.5	18.7	17.1	14.3	14.7	17.9	21.1
40	25.7	24.8	22.0	24.7	21.0	17.9	16.6	19.2	21.5	21.6	19.2	19.0	20.8	21.2	19.4	16.4	17.1	20.0	23.7
45	28.8	25.9	23.6	27.1	23.6	19.4	18.1	21.7	23.6	23.5	20.4	20.1	23.0	23.5	21.8	17.8	17.9	22.5	26.3
50	31.3	27.3	25.2	29.2	25.7	20.0	18.7	23.9	25.4	25.4	21.6	21.4	25.1	25.6	24.0	19.0	19.3	24.8	28.8
55	33.5	28.6	27.1	31.3	27.8	21.2	19.4	26.5	27.3	27.3	23.0	22.9	27.2	27.6	26.9	21.0	21.4	27.4	31.5
60	35.4	30.0	29.0	33.3	29.7	21.9	20.0	28.3	28.9	28.6	23.9	23.9	28.5	29.0	29.3	21.8	22.6	29.7	33.7
65	36.9	31.3	30.7	34.7	31.2	22.4	20.3	29.2	30.2	29.6	24.5	24.4	29.5	29.8	30.6	22.1	23.0	31.6	35.3
70	38.1	33.1	31.9	35.9	32.7	22.7	20.6	29.8	31.5	30.4	25.3	25.1	30.3	30.6	31.5	22.3	23.3	33.2	36.5
75	39.0	35.0	32.8	37.0	34.1	23.2	20.8	30.5	32.8	31.3	26.6	26.0	31.4	31.7	32.6	22.6	23.9	34.8	38.1
80	39.7	36.5	33.7	37.9	35.3	23.5	20.8	30.9	33.7	32.0	27.8	27.0	32.6	33.1	33.7	22.9	24.6	36.4	39.5
85	40.4	37.4	34.4	38.6	36.3	23.4	21.0	31.2	34.3	32.9	28.1	27.6	33.2	34.2	34.2	23.0	25.0	37.6	40.6
90	41.4	38.1	35.0	39.2	37.1	23.7	21.4	31.7	34.6	33.7	28.4	28.6	33.8	35.4	34.6	22.8	25.2	38.5	41.5
95	42.2	38.8	35.7	40.1	38.3	24.3	21.8	31.9	34.9	33.9	28.7	29.5	34.8	37.2	35.8	23.0	25.6	39.1	41.8
100	43.2	39.0	36.4	40.5	38.8	25.0	22.2	32.1	35.2	34.1	29.1	30.0	35.8	38.4	36.9	23.9	26.6	40.1	42.7
105	43.7	39.2	36.8	40.8	39.3	26.1	22.5	32.1	35.1	34.2	29.4	30.1	36.3	39.1	37.4	24.6	26.8	40.2	42.8
110	43.7	38.7	36.7	40.5	39.7	26.4	22.5	31.7	34.6	34.2	29.3	29.9	36.5	39.3	37.6	25.0	26.7	40.0	42.0
115	43.6	38.2	36.4	39.5	39.4	26.6	22.2	30.9	33.8	33.6	28.8	29.7	36.0	38.5	36.9	25.1	26.1	39.3	41.0
120	42.9	37.6	36.3	38.3	38.7	26.5	21.8	29.5	32.9	32.5	28.3	29.5	34.7	36.8	35.7	24.8	25.4	37.7	39.1
125	41.6	36.0	35.4	36.6	36.8	26.3	21.5	28.1	31.8	31.7	27.8	29.5	33.6	34.7	34.1	24.4	24.6	35.0	36.3
130	40.1	35.0	35.4	34.2	34.6	25.7	21.1	26.7	30.0	30.4	26.8	29.0	32.7	31.9	32.2	24.5	23.9	32.0	33.3
135	37.6	34.1	35.8	32.2	31.7	24.7	20.6	24.9	28.2	28.4	26.2	27.8	31.3	29.1	29.6	23.4	22.7	29.9	31.8
140	32.7	30.5	31.8	27.8	27.1	21.9	18.3	22.5	24.9	25.4	23.4	24.5	27.6	25.4	25.6	20.1	20.5	26.0	28.1
145	25.9	23.4	24.2	21.6	21.3	17.0	14.6	17.4	20.0	20.1	18.6	19.1	21.6	20.9	19.2	15.7	16.1	21.2	22.3
150	17.9	16.5	16.7	14.5	13.4	11.7	11.2	11.3	12.9	13.1	12.4	12.9	14.3	13.6	12.7	11.6	11.7	14.9	15.9
155	10.0	8.61	7.64	7.23	6.93	6.77	6.53	6.57	6.47	6.41	7.20	7.38	7.43	7.05	7.50	7.07	7.57	8.32	8.75
160	3.45	4.79	3.92	4.11	3.57	3.29	2.74	2.56	2.50	2.75	2.80	1.66	1.90	2.95	2.99	3.28	3.79	4.76	5.95
165	0.30	0.27	0.27	0.26	0.26	0.26	0.25	0.24	0.24	0.23	0.23	0.22	0.23	0.23	0.24	0.26	0.28	0.33	0.37
170	0.16	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.13	0.14	0.17
175	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.06
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	0.01	0.01	0.01

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

C (DEG) y (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68		
5	5.07	5.00	4.95	4.91	4.92	4.89	4.90	4.87	4.81	4.83	4.84	4.89	4.91	4.99	5.06	5.08	5.10		
10	6.52	6.50	6.53	6.51	6.57	6.47	6.34	6.27	6.24	6.25	6.26	6.32	6.43	6.58	6.71	6.77	6.83		
15	8.71	8.81	8.90	8.89	8.69	8.50	8.64	8.68	8.67	8.67	8.72	8.78	8.68	8.69	8.91	9.14	9.43		
20	11.9	11.9	12.1	11.6	11.0	10.7	11.1	11.6	11.8	12.0	12.1	11.9	11.4	11.1	11.2	11.7	12.6		
25	14.9	15.5	15.0	14.2	13.7	13.2	14.5	15.2	15.5	15.3	15.2	15.8	15.0	14.0	13.7	14.7	15.9		
30	17.2	18.6	18.1	17.5	16.3	16.5	18.2	19.1	19.7	17.9	18.0	19.5	18.8	17.0	16.1	17.5	18.6		
35	19.5	21.4	21.4	20.6	18.5	18.5	21.6	22.8	23.3	20.3	20.6	23.0	22.1	19.6	18.1	19.8	22.1		
40	21.5	23.7	24.9	23.5	20.5	21.4	24.3	26.3	26.8	22.6	23.3	26.1	25.3	22.7	21.2	22.3	25.5		
45	23.3	25.3	28.0	26.1	23.2	24.1	28.1	29.7	30.0	24.4	25.5	29.3	28.5	26.3	23.6	24.7	28.1		
50	25.2	26.8	30.6	28.3	25.2	25.7	31.4	32.5	33.0	26.1	27.3	32.1	31.3	29.2	25.0	26.6	29.8		
55	27.2	29.8	33.4	30.7	27.2	27.7	34.9	35.3	35.7	28.2	29.4	34.6	34.0	32.1	26.3	28.1	31.5		
60	28.8	32.8	35.9	33.2	28.5	29.4	37.4	37.8	38.0	29.9	31.0	36.6	36.0	34.2	27.5	29.6	33.3		
65	29.7	35.1	37.3	35.0	29.1	30.5	39.5	39.8	39.7	31.1	32.4	38.1	37.7	36.0	28.5	30.6	34.5		
70	30.2	36.6	38.5	36.0	29.7	31.3	41.5	41.4	41.0	32.2	33.6	39.6	39.3	37.2	29.3	31.0	35.8		
75	31.0	38.1	40.0	37.5	30.3	32.2	42.9	42.7	42.4	33.4	34.8	40.8	41.0	38.2	30.0	31.6	37.1		
80	32.2	39.6	41.4	38.3	30.9	32.8	44.0	43.8	43.5	34.5	36.0	41.9	42.5	39.0	30.5	32.0	38.2		
85	33.2	40.9	42.7	39.0	31.4	33.4	45.1	44.8	44.1	35.4	36.5	42.6	43.7	39.7	30.9	32.2	39.1		
90	34.0	41.8	43.9	39.3	31.8	33.8	45.1	44.8	43.2	35.5	36.1	43.3	44.7	40.8	31.4	32.8	40.2		
95	34.7	42.1	44.8	39.5	32.1	34.5	45.1	44.8	41.7	35.6	36.1	43.9	45.6	41.9	32.0	33.2	41.4		
100	35.5	42.4	45.3	39.5	32.4	35.1	45.4	44.6	40.4	35.7	35.6	44.3	46.5	42.8	32.7	33.6	42.1		
105	36.6	43.0	45.9	39.7	32.4	35.7	45.7	44.6	40.1	35.6	35.6	44.6	47.1	43.4	33.0	33.7	42.3		
110	36.9	42.2	45.4	39.5	32.6	36.5	46.7	45.7	40.2	35.6	35.9	44.8	44.4	43.8	33.0	33.5	41.8		
115	37.0	40.8	44.4	38.7	32.2	37.0	46.2	46.0	40.3	36.1	36.0	45.0	38.2	44.2	32.7	33.3	41.3		
120	37.7	39.2	43.0	37.3	31.3	36.7	45.8	45.8	40.6	36.7	36.3	44.6	33.4	44.2	32.5	33.2	40.8		
125	37.6	36.7	41.1	35.3	30.4	36.2	45.4	45.5	41.7	37.1	36.7	43.4	32.5	41.8	20.3	32.5	39.0		
130	36.7	34.0	38.7	33.2	29.6	35.3	43.9	43.6	42.2	34.2	30.0	36.2	27.1	29.9	12.3	31.8	37.2		
135	36.3	32.6	36.2	30.9	28.7	34.1	41.2	40.9	40.8	24.2	13.1	17.9	19.7	20.2	24.7	30.8	34.5		
140	32.6	29.3	32.7	28.4	26.6	31.6	37.6	37.1	37.3	36.1	29.5	27.1	23.7	20.8	23.8	27.9	30.8		
145	25.5	23.2	26.4	25.1	22.7	26.4	31.6	31.2	30.6	29.9	29.6	26.6	24.2	20.4	17.7	18.7	26.0		
150	18.2	17.2	18.9	18.3	18.6	21.2	23.4	22.8	21.5	21.2	21.7	21.4	14.8	14.7	13.8	12.2	18.4		
155	9.68	9.97	11.3	12.0	12.7	13.2	13.9	14.5	13.5	13.5	13.9	13.1	12.3	5.22	10.6	9.07	11.5		
160	6.41	6.65	6.23	5.78	5.63	6.47	6.21	6.77	6.53	6.63	6.45	6.27	6.70	2.70	2.16	4.41	4.63		
165	0.38	0.41	0.49	0.60	0.75	0.45	0.46	0.75	0.81	0.63	0.50	0.48	0.48	0.36	0.27	0.23	0.34		
170	0.18	0.20	0.22	0.24	0.25	0.26	0.27	0.27	0.28	0.27	0.27	0.26	0.24	0.22	0.20	0.10	0.19		
175	0.06	0.08	0.11	0.13	0.14	0.15	0.15	0.15	0.16	0.15	0.15	0.15	0.14	0.13	0.08	0.07	0.05		
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	0.01		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 14, 2018	Aug. 13, 2019
Digital Power Meter	PF2010A	HZTE028-01	Sep. 12, 2018	Sep. 11, 2019
AC Power Supply	DPS1060	HZTE001-06	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	WY12010	HZTE004-03	Aug. 09, 2018	Aug. 08, 2019
Temperature recorder	JM624U	HZTE018-08	Aug. 09, 2018	Aug. 08, 2019
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 09, 2018	Aug. 08, 2019
Standard source	D908	HZTE012-01	Aug. 14, 2018	Aug. 13, 2019
Integrate Sphere system	3M	HZTE015-04	Aug. 16, 2018	Aug. 15, 2019
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2018	Aug. 01, 2019
AC Power Supply	PCR 500L	HZTE001-07	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	IT6154	HZTE004-04	Aug. 09, 2018	Aug. 08, 2019
Standard source	SCL-1400	HZTE012-02	Aug. 16, 2018	Aug. 15, 2019
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 09, 2018	Aug. 08, 2019
Temperature Meter	TES1310	HZTE017-01	Aug. 09, 2018	Aug. 08, 2019

Table 8: 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 LED lamps) 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 LED lamps) 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.

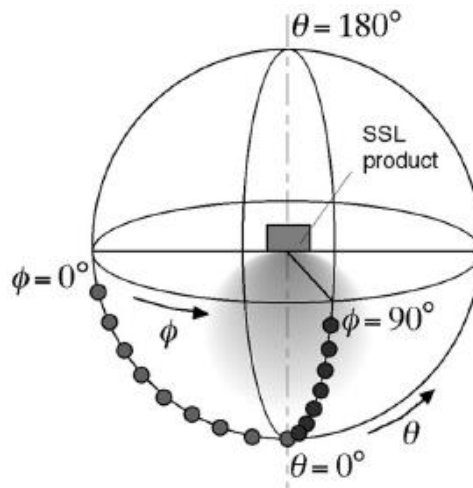
### **Color Spatial Uniformity**

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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