LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED lamp

Model: 3.8FB11DIM/827/FR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18110032f

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

Review by: April Zou

Engineer: April Zou
Nov. 27, 2018

Approved by: Jim Zhang

Manager: Jim Zhang
Nov. 27, 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: **3.8FB11DIM/827/FR**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
120.2	382.3	3.18	0.7533

CCT (K)	CRI	Stabilization Time (Light & Power)
2745	82.6	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	: Nov. 20, 2018
Date of Test	: Nov. 23, 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)	
Name	: LED lamp
Model	: 3.8FB11DIM/827/FR
Electrical Ratings	: 120V, 60Hz, 3.8W
Product Description	: E12 Base, 2700K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.0℃.

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)	0.035
Power Factor	0.7533
Test Power (W)	3.18
THD A%	84.43
Luminous Efficacy (lm/W)	120.2
Total Luminous Flux (lm)	382.3
Color Rendering Index (CRI)	82.6
R9	7.5
Correlated Color Temperature (CCT)(K)	2745
Chromaticity Chroma x	0.4540
Chromaticity Chroma y	0.4060
Chromaticity Chroma u	0.2608
Chromaticity Chroma v	0.3498
Duv	0.0014
Chromaticity Chroma u ’	0.2608
Chromaticity Chroma v’	0.5247

Special Color Rendering Indices	
R1	81.8
R2	93.4
R3	93
R4	80
R5	82.6
R6	93.3
R7	80.1
R8	56.5
R9	7.5
R10	85.7
R11	80.1
R12	79.7
R13	84.8
R14	96.8
Rf	84
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 25.1℃.

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)	0.035
Power Factor	0.7609
Test Power (W)	3.17
Luminous Efficacy (lm/W)	120.9
Total Luminous Flux (lm)	383.2
Beam Angle (°)	322.5
Center Beam Candle Power (cd)	11.5
Spacing Criteria	3.02 (0°-180°)/ 3.06 (90°-270°)
Zonal Lumens in the 0°-60°Zone	21.50%
Zonal Lumens in the 60°-90°Zone	31.93%
Zonal Lumens in the 90°-120°Zone	30.52%
Zonal Lumens in the 120°-180°Zone	16.05%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

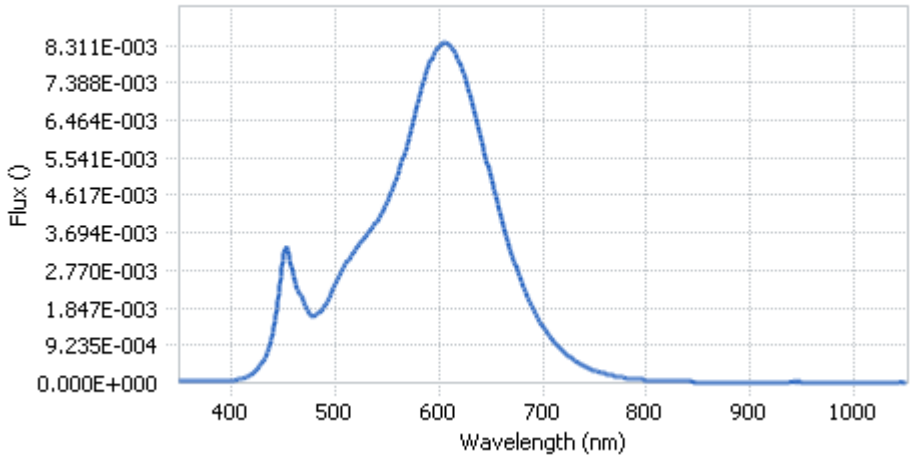

Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.24E-05	485	1.73E-03	590	7.79E-03	695	1.64E-03
385	4.41E-05	490	1.90E-03	595	8.10E-03	700	1.39E-03
390	5.07E-05	495	2.13E-03	600	8.29E-03	705	1.20E-03
395	5.21E-05	500	2.41E-03	605	8.39E-03	710	1.04E-03
400	5.62E-05	505	2.68E-03	610	8.34E-03	715	8.92E-04
405	7.40E-05	510	2.91E-03	615	8.18E-03	720	7.64E-04
410	9.74E-05	515	3.12E-03	620	7.89E-03	725	6.53E-04
415	1.40E-04	520	3.31E-03	625	7.54E-03	730	5.62E-04
420	2.06E-04	525	3.45E-03	630	7.10E-03	735	4.79E-04
425	3.22E-04	530	3.62E-03	635	6.63E-03	740	4.05E-04
430	5.06E-04	535	3.79E-03	640	6.12E-03	745	3.48E-04
435	7.93E-04	540	3.96E-03	645	5.59E-03	750	2.99E-04
440	1.25E-03	545	4.18E-03	650	5.06E-03	755	2.55E-04
445	2.01E-03	550	4.42E-03	655	4.57E-03	760	2.20E-04
450	3.02E-03	555	4.73E-03	660	4.09E-03	765	1.89E-04
455	3.27E-03	560	5.07E-03	665	3.62E-03	770	1.63E-04
460	2.61E-03	565	5.48E-03	670	3.19E-03	775	1.39E-04
465	2.22E-03	570	5.94E-03	675	2.81E-03	780	1.19E-04
470	1.99E-03	575	6.43E-03	680	2.46E-03		
475	1.71E-03	580	6.91E-03	685	2.14E-03		
480	1.63E-03	585	7.40E-03	690	1.86E-03		

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

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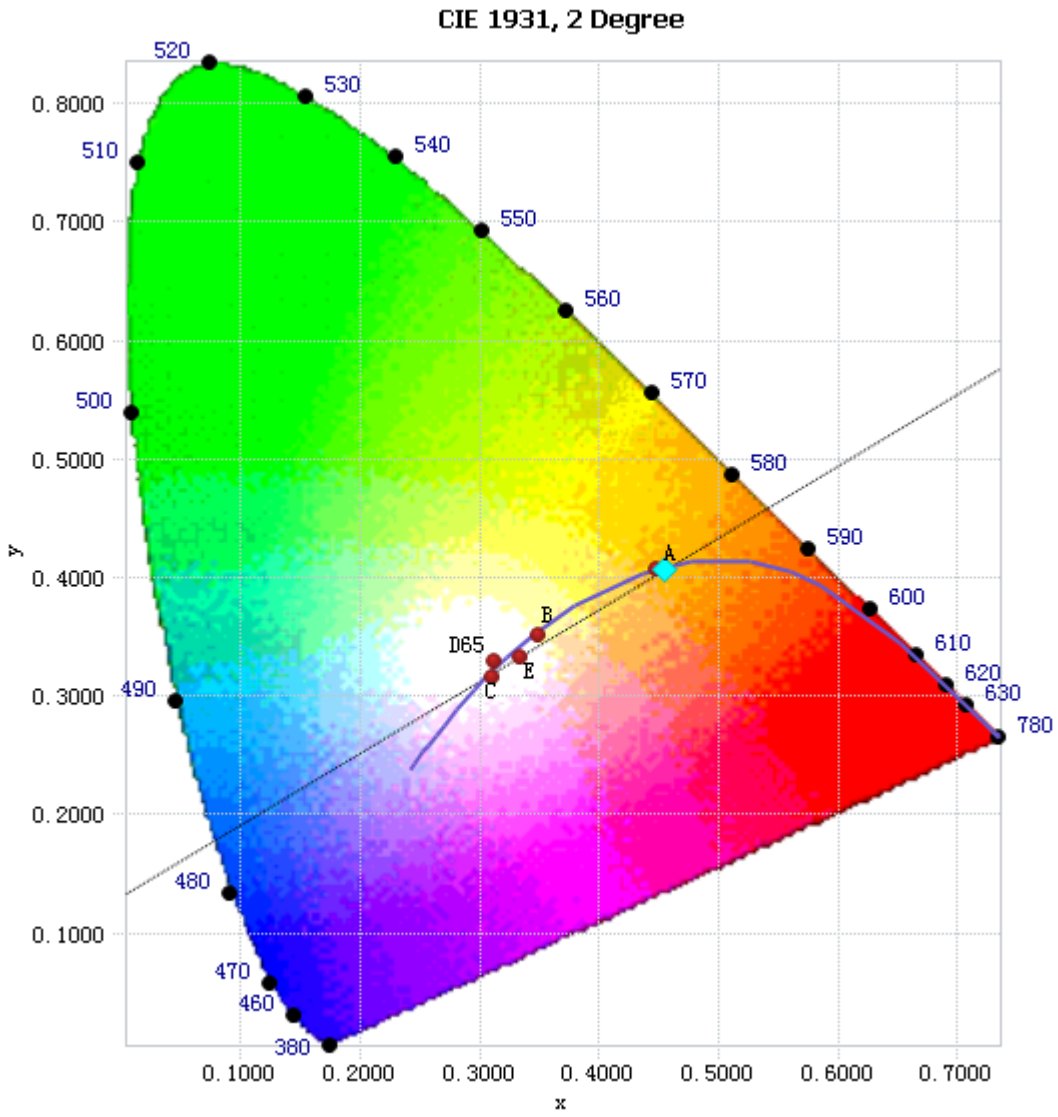
Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4540, 0.4060)

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

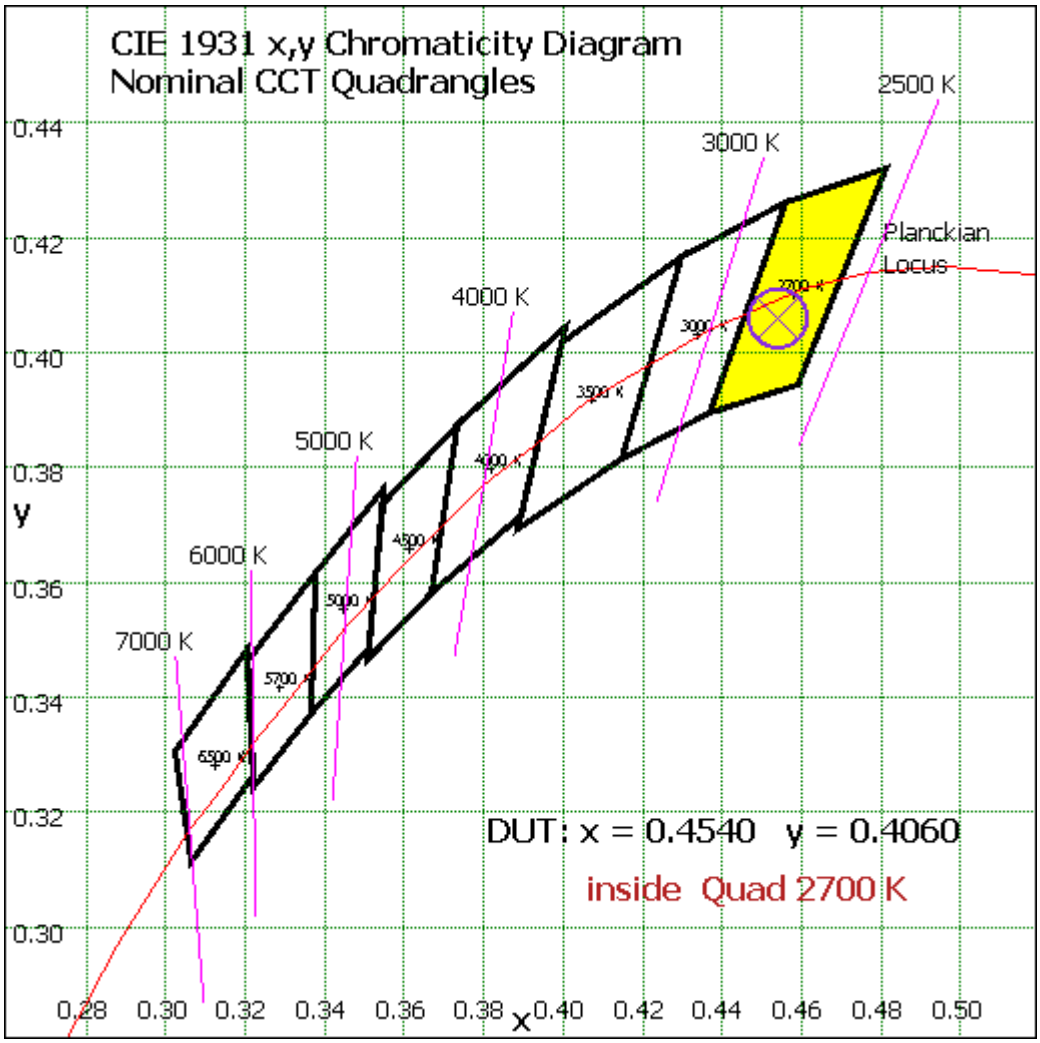


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	1.16	0.30%
10- 20	4.183	1.09%
20- 30	8.863	2.31%
30- 40	15.237	3.98%
40- 50	22.693	5.92%
50- 60	30.254	7.90%
60- 70	36.878	9.62%
70- 80	41.637	10.87%
80- 90	43.84	11.44%
90-100	43.21	11.28%
100-110	39.781	10.38%
110-120	33.967	8.86%
120-130	26.591	6.94%
130-140	18.592	4.85%
140-150	10.887	2.84%
150-160	4.683	1.22%
160-170	0.741	0.19%
170-180	0.003	0.00%
Total	383.2	100%

γ(°)	Lumens	% Total
0-110	287.736	75.09%
110-180	95.464	24.91%
0-180	383.2	100%

Table 5: Zonal Lumen Data

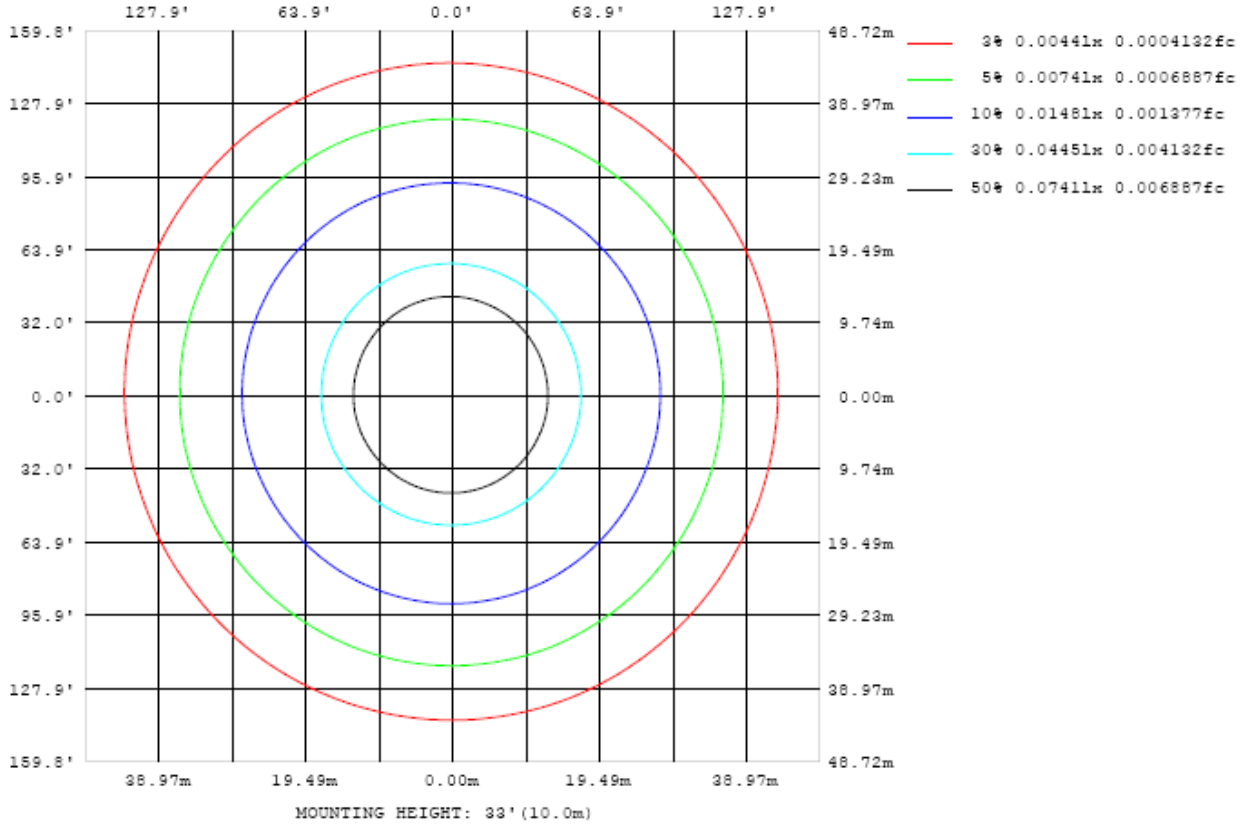


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

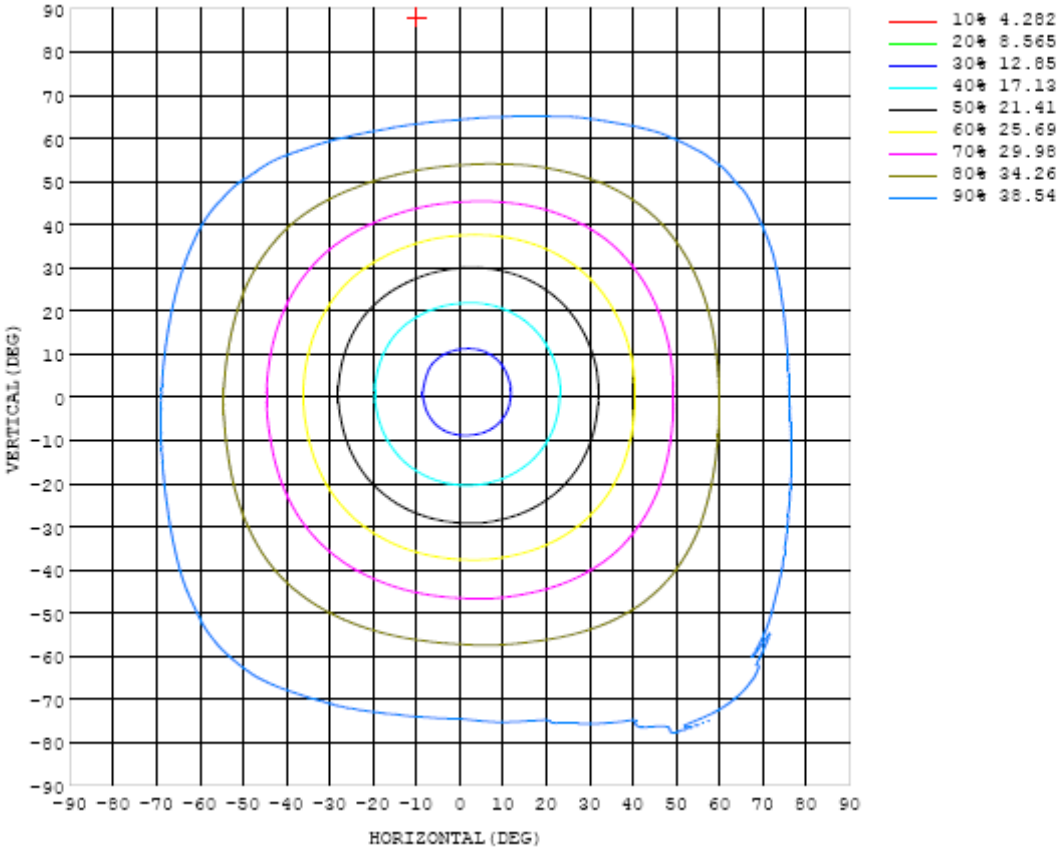


Chart 5: Isocandela Plot

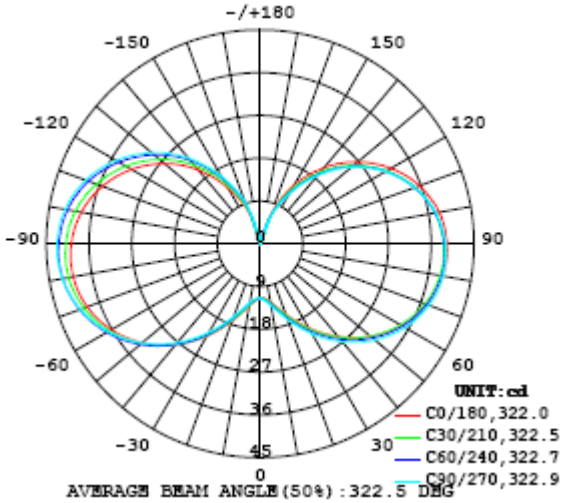


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
5	11.6	11.6	11.6	11.7	11.7	11.8	11.9	11.9	12.0	12.0	12.0	12.0	12.1	12.1	12.1	12.1	12.1	12.1	12.1
10	12.4	12.5	12.5	12.6	12.7	12.8	12.9	13.1	13.1	13.2	13.2	13.3	13.3	13.3	13.3	13.4	13.3	13.3	13.3
15	13.9	13.9	14.0	14.1	14.3	14.4	14.5	14.7	14.8	14.9	15.0	15.0	15.1	15.1	15.1	15.2	15.2	15.2	15.1
20	15.8	15.9	16.0	16.1	16.2	16.4	16.6	16.7	16.8	17.0	17.1	17.2	17.3	17.3	17.4	17.4	17.4	17.4	17.3
25	18.0	18.1	18.2	18.3	18.5	18.7	18.9	19.1	19.2	19.4	19.5	19.6	19.7	19.8	19.8	19.9	19.9	19.9	19.8
30	20.4	20.5	20.6	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.0	22.1	22.2	22.3	22.4	22.4	22.5	22.5	22.4
35	23.0	23.0	23.1	23.2	23.4	23.6	23.8	24.0	24.2	24.4	24.5	24.7	24.8	24.9	25.0	25.0	25.1	25.2	25.1
40	25.5	25.5	25.5	25.6	25.8	26.0	26.3	26.5	26.7	26.9	27.1	27.2	27.3	27.4	27.5	27.5	27.6	27.7	27.7
45	28.0	27.9	27.9	28.0	28.2	28.4	28.6	28.9	29.0	29.3	29.4	29.5	29.7	29.8	29.8	29.9	30.0	30.2	30.1
50	30.3	30.2	30.2	30.3	30.4	30.6	30.8	31.1	31.3	31.5	31.6	31.7	31.8	31.9	32.0	32.1	32.2	32.4	32.4
55	32.4	32.3	32.2	32.3	32.5	32.7	32.8	33.1	33.2	33.5	33.6	33.7	33.8	33.9	34.0	34.0	34.2	34.4	34.4
60	34.3	34.2	34.1	34.1	34.3	34.4	34.6	34.9	35.0	35.2	35.3	35.4	35.5	35.5	35.6	35.7	35.9	36.1	36.2
65	36.0	35.8	35.7	35.7	35.8	35.9	36.1	36.3	36.5	36.7	36.7	36.8	36.9	36.9	37.0	37.1	37.3	37.5	37.7
70	37.3	37.2	36.9	36.9	37.0	37.1	37.3	37.5	37.6	37.8	37.9	37.9	37.9	38.0	38.0	38.1	38.3	38.6	38.8
75	38.3	38.2	37.9	37.8	37.9	38.0	38.1	38.4	38.5	38.6	38.7	38.7	38.7	38.8	38.8	38.9	39.0	39.3	39.5
80	39.0	38.8	38.5	38.4	38.4	38.6	38.7	38.9	39.0	39.1	39.1	39.2	39.1	39.2	39.3	39.2	39.4	39.7	40.0
85	39.4	39.1	38.8	38.7	38.7	38.7	39.1	39.2	39.1	39.2	39.2	39.1	39.4	39.2	39.2	39.3	39.4	40.0	40.0
90	39.3	39.1	38.7	38.6	38.6	38.7	38.8	39.0	38.9	39.1	38.9	38.9	38.9	38.9	38.9	39.0	39.2	39.4	39.7
95	39.0	38.7	38.3	38.2	38.2	38.1	38.3	38.4	38.4	38.4	38.4	38.2	38.4	38.3	38.3	38.4	38.7	38.8	39.1
100	38.3	37.9	37.6	37.4	37.3	37.3	37.5	37.6	37.5	37.6	37.4	37.4	37.4	37.4	37.3	37.4	37.5	37.9	38.2
105	37.1	36.7	36.4	36.1	36.1	36.2	36.1	36.3	36.2	36.2	36.1	36.1	36.2	36.2	36.1	36.1	36.4	36.6	36.9
110	35.6	35.3	34.9	34.6	34.6	34.5	34.6	34.6	34.7	34.6	34.5	34.5	34.5	34.5	34.5	34.5	34.7	35.1	35.4
115	33.9	33.5	33.1	33.0	32.8	32.7	32.7	32.7	32.6	32.7	32.6	32.5	32.6	32.5	32.6	32.6	32.7	33.1	33.5
120	31.8	31.3	31.0	30.7	30.6	30.4	30.4	30.4	30.5	30.4	30.3	30.3	30.3	30.3	30.3	30.4	30.6	30.9	31.3
125	29.4	29.0	28.6	28.3	28.1	28.0	28.0	28.0	27.9	28.0	27.9	27.7	27.8	27.8	27.8	28.0	28.3	28.6	28.9
130	26.8	26.4	26.0	25.7	25.5	25.3	25.2	25.2	25.2	25.1	25.1	25.0	25.0	25.2	25.2	25.4	25.6	25.8	26.3
135	24.0	23.6	23.2	22.9	22.5	22.4	22.3	22.2	22.1	22.1	22.0	22.0	22.1	22.2	22.2	22.4	22.7	23.0	23.4
140	20.9	20.5	20.0	19.7	19.5	19.2	19.1	19.0	18.8	18.8	18.7	18.7	18.7	18.8	19.0	19.1	19.4	19.8	20.3
145	17.6	17.2	16.8	16.5	16.2	15.9	15.7	15.6	15.5	15.4	15.3	15.4	15.5	15.5	15.7	15.9	16.2	16.5	17.0
150	14.3	13.9	13.5	13.1	12.9	12.6	12.4	12.2	12.1	12.0	12.0	12.0	12.1	12.2	12.4	12.6	12.9	13.2	13.6
155	10.5	10.6	10.2	9.75	9.60	9.35	9.10	8.95	8.79	8.71	8.58	8.70	8.83	8.97	9.11	9.39	9.67	9.99	10.4
160	6.17	6.61	5.98	5.72	5.88	5.70	5.48	5.33	5.16	5.10	4.77	4.41	4.66	4.76	5.18	5.88	6.23	6.60	7.14
165	1.08	0.72	0.54	0.66	0.54	0.38	0.27	0.19	0.15	0.13	0.14	0.13	0.05	0.22	0.46	0.63	0.86	1.14	1.69
170	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.03	0.04	0.04
175	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
180	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5		
5	12.0	12.0	11.9	11.9	11.8	11.8	11.7	11.7	11.6	11.6	11.6	11.5	11.5	11.6	11.6	11.6	11.6		
10	13.3	13.2	13.1	13.0	12.8	12.8	12.7	12.6	12.5	12.4	12.4	12.3	12.3	12.3	12.3	12.3	12.4		
15	15.0	15.0	14.8	14.7	14.5	14.4	14.3	14.3	14.2	14.1	13.9	13.8	13.7	13.7	13.7	13.7	13.8		
20	17.2	17.1	17.0	16.8	16.7	16.6	16.6	16.4	16.3	16.1	16.0	15.8	15.7	15.7	15.7	15.7	15.7		
25	19.7	19.6	19.5	19.4	19.3	19.2	19.1	18.9	18.8	18.5	18.4	18.2	18.1	18.0	18.0	17.9	17.9		
30	22.4	22.3	22.2	22.1	22.0	22.0	21.9	21.7	21.5	21.2	21.0	20.8	20.7	20.5	20.4	20.4	20.3		
35	25.0	25.0	24.9	24.9	24.9	24.8	24.7	24.5	24.3	24.0	23.8	23.5	23.3	23.2	23.0	22.9	22.9		
40	27.7	27.7	27.6	27.6	27.7	27.7	27.5	27.3	27.1	26.8	26.5	26.3	26.0	25.8	25.6	25.5	25.4		
45	30.2	30.2	30.2	30.3	30.4	30.4	30.3	30.1	29.8	29.5	29.2	28.9	28.7	28.4	28.2	28.0	27.9		
50	32.5	32.5	32.6	32.7	32.9	32.9	32.8	32.6	32.4	32.1	31.8	31.4	31.2	30.9	30.6	30.4	30.3		
55	34.6	34.6	34.8	34.9	35.1	35.2	35.2	35.0	34.8	34.5	34.1	33.7	33.4	33.1	32.8	32.6	32.4		
60	36.4	36.5	36.7	36.9	37.1	37.3	37.3	37.1	36.9	36.6	36.2	35.8	35.5	35.1	34.9	34.6	34.4		
65	37.8	38.0	38.2	38.5	38.8	39.1	39.1	39.0	38.8	38.4	38.0	37.7	37.3	36.9	36.6	36.2	36.0		
70	39.0	39.2	39.5	39.8	40.1	40.4	40.5	40.5	40.3	40.0	39.6	39.2	38.8	38.4	38.1	37.7	37.5		
75	39.8	40.1	40.3	40.7	41.2	41.5	41.6	41.6	41.5	41.1	40.8	40.3	39.9	39.6	39.2	38.8	38.5		
80	40.3	40.6	40.9	41.4	41.9	42.2	42.4	42.4	42.3	42.0	41.6	41.2	40.8	40.3	39.9	39.6	39.2		
85	40.4	40.7	41.1	41.4	42.0	42.5	42.8	42.8	42.7	42.3	42.1	41.6	41.2	40.8	40.4	40.0	39.6		
90	40.1	40.4	40.9	41.4	42.0	42.4	42.7	42.8	42.7	42.6	42.2	41.8	41.3	40.8	40.4	40.0	39.5		
95	39.5	39.7	40.6	40.9	41.3	42.0	42.3	42.4	42.4	42.2	41.7	41.4	41.0	40.6	40.1	39.7	39.2		
100	38.6	39.1	39.5	40.0	40.7	41.2	41.6	41.7	41.7	41.5	41.3	40.7	40.4	40.0	39.4	39.0	38.5		
105	37.3	37.8	38.3	38.7	39.1	39.9	40.4	40.6	40.6	40.4	40.1	39.8	39.3	38.9	38.4	37.9	37.5		
110	35.8	36.1	36.6	37.3	37.9	38.5	38.9	39.0	39.1	39.0	38.6	38.2	37.9	37.4	37.0	36.5	36.0		
115	33.8	34.4	34.7	35.2	36.0	36.6	37.0	37.2	37.2	37.2	36.8	36.5	36.0	35.7	35.2	34.7	34.2		
120	31.7	32.2	32.7	33.2	33.8	34.4	34.8	35.0	35.0	34.9	34.6	34.3	33.9	33.5	33.1	32.6	32.2		
125	29.3	29.8	30.2	30.8	31.4	31.9	32.3	32.5	32.5	32.5	32.3	31.9	31.5	31.1	30.7	30.2	29.8		
130	26.6	27.1	27.6	28.1	28.7	29.1	29.5	29.7	29.8	29.7	29.5	29.2	28.8	28.4	28.0	27.6	27.2		
135	23.8	24.3	24.8	25.2	25.7	26.2	26.5	26.7	26.8	26.8	26.6	26.3	25.9	25.5	23.6	24.8	24.4		
140	20.7	21.1	21.6	22.1	22.5	22.9	23.3	23.5	23.6	23.5	23.4	23.1	22.8	22.2	18.1	20.7	21.3		
145	17.3	17.8	18.2	18.6	19.1	19.4	19.7	19.9	20.0	20.0	19.9	19.7	19.4	18.8	14.3	15.9	18.0		
150	13.9	14.3	14.8	15.2	15.6	16.0	16.2	16.4	16.5	16.6	16.4	15.2	11.6	8.51	7.61	10.4	13.6		
155	10.7	11.0	11.4	11.8	12.1	12.4	12.6	12.8	12.9	12.9	12.9	10.9	7.03	5.52	5.03	6.73	9.33		
160	7.40	7.76	8.05	8.11	8.50	8.96	9.17	9.13	9.33	9.51	9.49	8.92	5.84	2.84	2.71	5.12	5.30		
165	1.89	2.30	2.74	2.94	2.93	3.15	3.38	3.65	4.06	4.22	4.14	3.93	2.41	1.77	2.04	1.62	1.30		
170	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03		
175	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04		
180	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		

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	2M	HZTE015-01	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 4π. 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 expended 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 expended uncertainty is 2.3% with a coverage factor k=2.

Color Characteristics Measurements

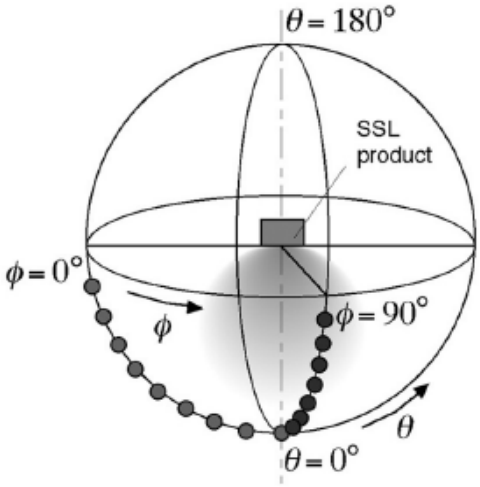
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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°/180° and C=90°/270°) and at 10° 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, Δu'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 ***