

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL,  
Hong Kong

### LED Lamp

**Model: 5GU10DIM/940FL35**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ20060049o

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

Review by:



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Oct. 21, 2020

Approved by:



Manager: Jim Zhang

Oct. 21, 2020

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: **5GU10DIM/940FL35**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
90.0	424.9	4.72	0.9223
CCT (K)	CRI	Stabilization Time (Light & Power)	
3950	97.3	60	

Table 1: Executive Data Summary

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

### Test specifications:

<b>Date of Receipt</b>	: Jun. 25, 2020
<b>Date of Test</b>	: Jun. 25, 2020
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

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## SAMPLE PHOTO



Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Lamp
<b>Model</b>	: 5GU10DIM/940FL35
<b>Electrical Ratings</b>	: 120Vac, 60Hz, 5W
<b>Product Description</b>	: 4000K
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

## TEST RESULTS

Test ambient temperature was 25.1 °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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.043
Power Factor	0.9223
Test Power (W)	4.72
THD A%	22.70
Luminous Efficacy (lm/W)	90.0
Total Luminous Flux (lm)	424.9
Color Rendering Index (CRI)	97.3
R9	97.2
Correlated Color Temperature (CCT)(K)	3950
Chromaticity Chroma x	0.3832
Chromaticity Chroma y	0.3802
Chromaticity Chroma u	0.2255
Chromaticity Chroma v	0.3357
Duv	0.0008
Chromaticity Chroma u'	0.2255
Chromaticity Chroma v'	0.5035

Special Color Rendering Indices	
R1	98.4
R2	99.3
R3	97.9
R4	96.6
R5	96.8
R6	96.9
R7	96.2
R8	96.3
R9	97.2
R10	98.8
R11	99
R12	74.4
R13	98.5
R14	98.1

Table 2: Test data per Sphere-Spectroradiometer Method

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

### Goniophotometer Method

Test ambient temperature was 25.2 °C.

The photometric distance is 2.47 m.

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)	0.043
Power Factor	0.9178
Power (W)	4.70
Luminous Efficacy (lm/W)	92.6
Total Luminous Flux (lm)	435.4
Beam Angle ( ° )	33.2 (0°-180°) / 32.3 (90°-270°)
Center Beam Candle Power (cd)	1305
Maximum Beam Candle Power (cd)	1305 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.52 (0°-180°) / 0.49 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	97.68%
Zonal Lumens in the 60 °-90 °Zone	1.72%
Zonal Lumens in the 90 °-120 °Zone	0.33%
Zonal Lumens in the 120 °-180 °Zone	0.28%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

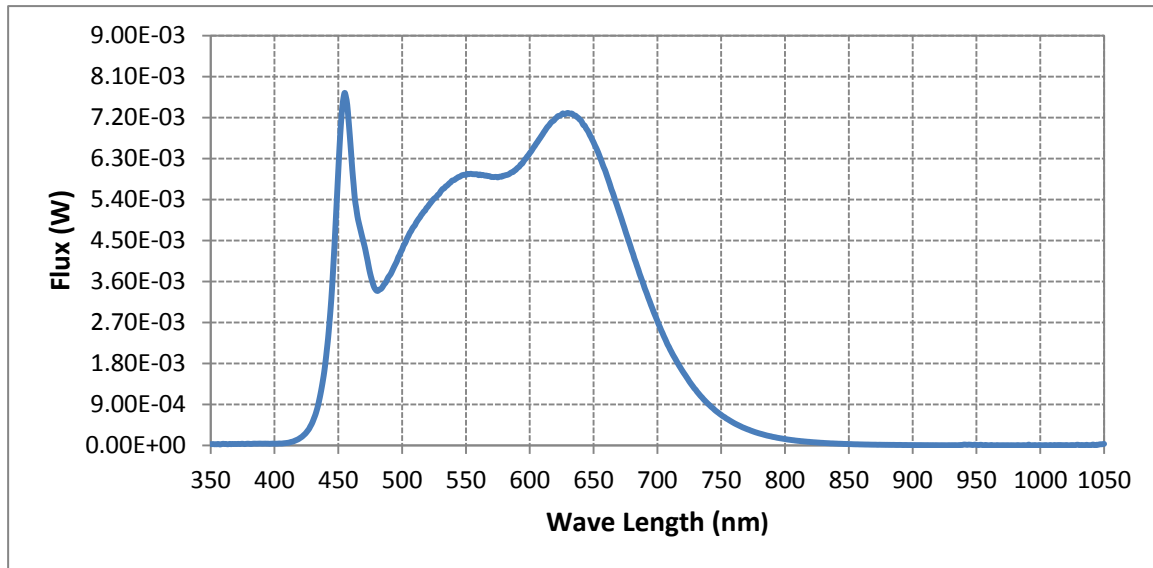
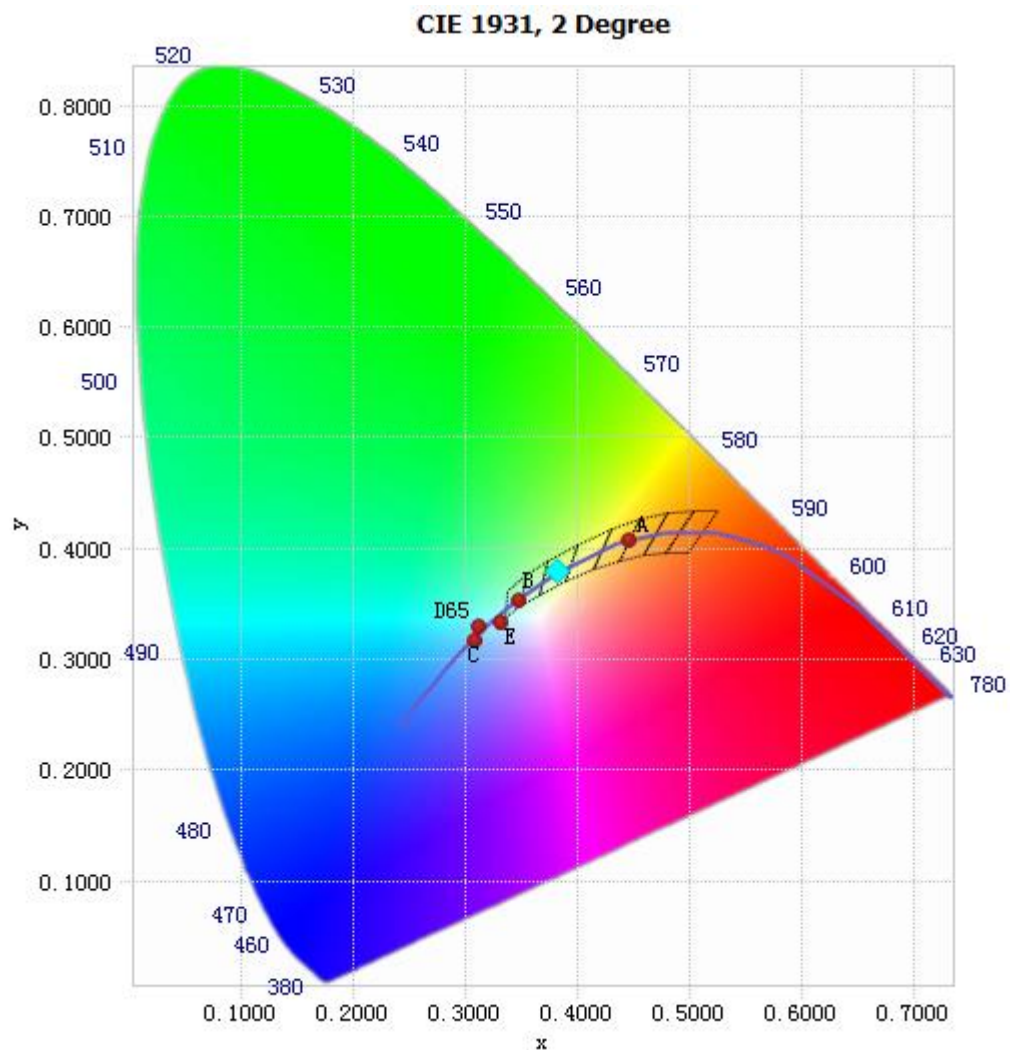


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.73E-05	485	3.50E-03	590	6.09E-03	695	3.08E-03
385	3.97E-05	490	3.73E-03	595	6.23E-03	700	2.74E-03
390	3.94E-05	495	4.00E-03	600	6.42E-03	705	2.40E-03
395	3.98E-05	500	4.30E-03	605	6.63E-03	710	2.11E-03
400	3.75E-05	505	4.61E-03	610	6.83E-03	715	1.85E-03
405	4.22E-05	510	4.84E-03	615	7.03E-03	720	1.62E-03
410	5.69E-05	515	5.06E-03	620	7.18E-03	725	1.41E-03
415	9.28E-05	520	5.24E-03	625	7.27E-03	730	1.22E-03
420	1.63E-04	525	5.42E-03	630	7.30E-03	735	1.05E-03
425	2.87E-04	530	5.57E-03	635	7.25E-03	740	9.07E-04
430	5.27E-04	535	5.70E-03	640	7.14E-03	745	7.79E-04
435	9.90E-04	540	5.82E-03	645	6.93E-03	750	6.71E-04
440	1.85E-03	545	5.90E-03	650	6.66E-03	755	5.78E-04
445	3.42E-03	550	5.94E-03	655	6.33E-03	760	4.93E-04
450	6.04E-03	555	5.96E-03	660	5.96E-03	765	4.24E-04
455	7.74E-03	560	5.94E-03	665	5.55E-03	770	3.62E-04
460	6.43E-03	565	5.93E-03	670	5.13E-03	775	3.09E-04
465	5.03E-03	570	5.90E-03	675	4.70E-03	780	2.64E-04
470	4.44E-03	575	5.89E-03	680	4.28E-03		
475	3.77E-03	580	5.93E-03	685	3.87E-03		
480	3.40E-03	585	5.99E-03	690	3.46E-03		

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

# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3832, 0.3802)

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

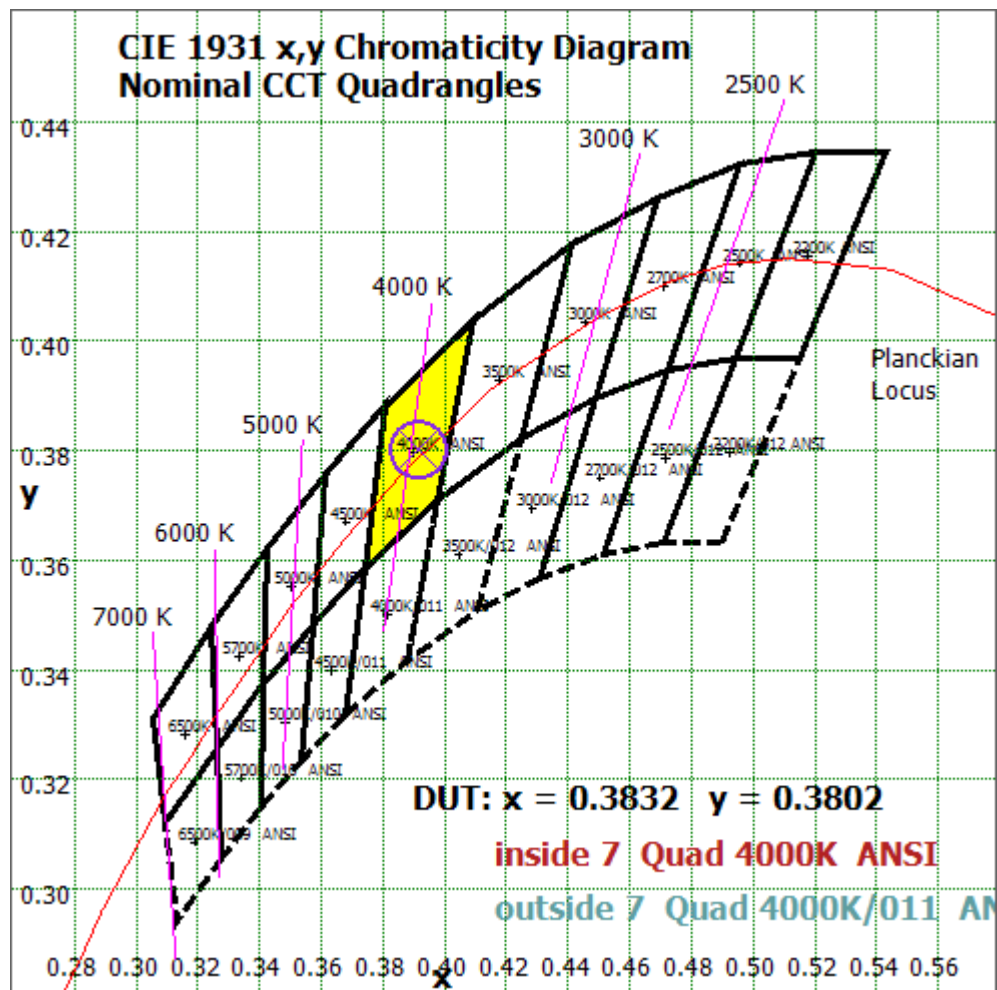


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

# Color Rendition Report – Sphere Spectroradiometer Method

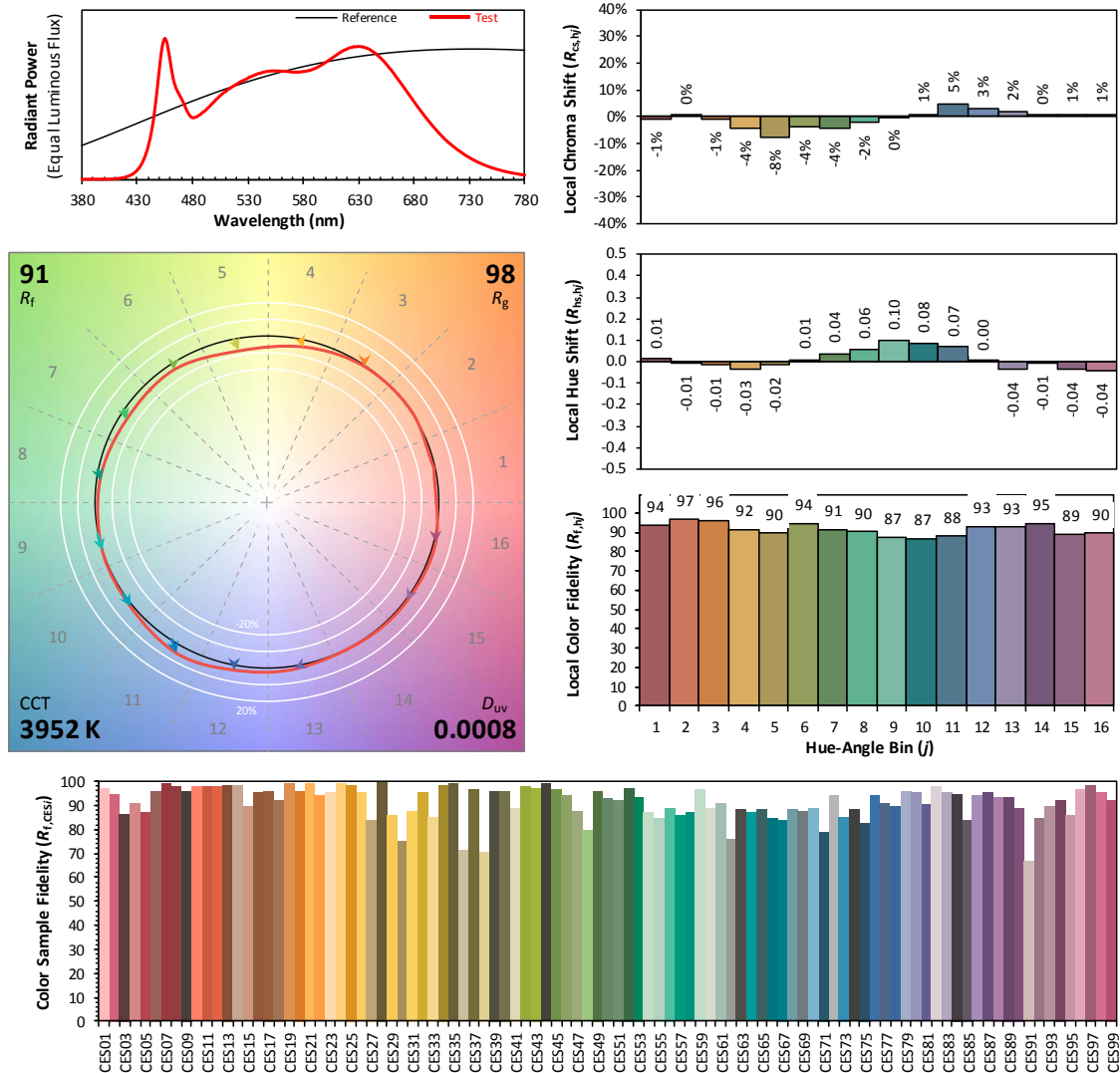
## ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2020/06/25

Model: 5GU10DIM/940FL35



**Notes:** This is a recommended method for displaying ANSI/IES TM-30-18 information.

$x$  0.3832  
 $y$  0.3802  
 $u'$  0.2255  
 $v'$  0.5035

CIE 13.3-1995  
(CRI)

$R_a$  97  
 $R_g$  97

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	107.794	24.76%
10- 20	194.412	44.66%
20- 30	85.381	19.61%
30- 40	23.834	5.47%
40- 50	8.423	1.93%
50- 60	5.407	1.24%
60- 70	4.046	0.93%
70- 80	2.376	0.55%
80- 90	1.063	0.24%
90-100	0.41	0.09%
100-110	0.493	0.11%
110-120	0.512	0.12%
120-130	0.86	0.20%
130-140	0.071	0.02%
140-150	0.079	0.02%
150-160	0.087	0.02%
160-170	0.074	0.02%
170-180	0.028	0.01%
Total	435.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	425.251	97.68%
60- 90	7.485	1.72%
0-90	432.736	99.40%
90- 180	2.614	0.60%
0- 180	435.4	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

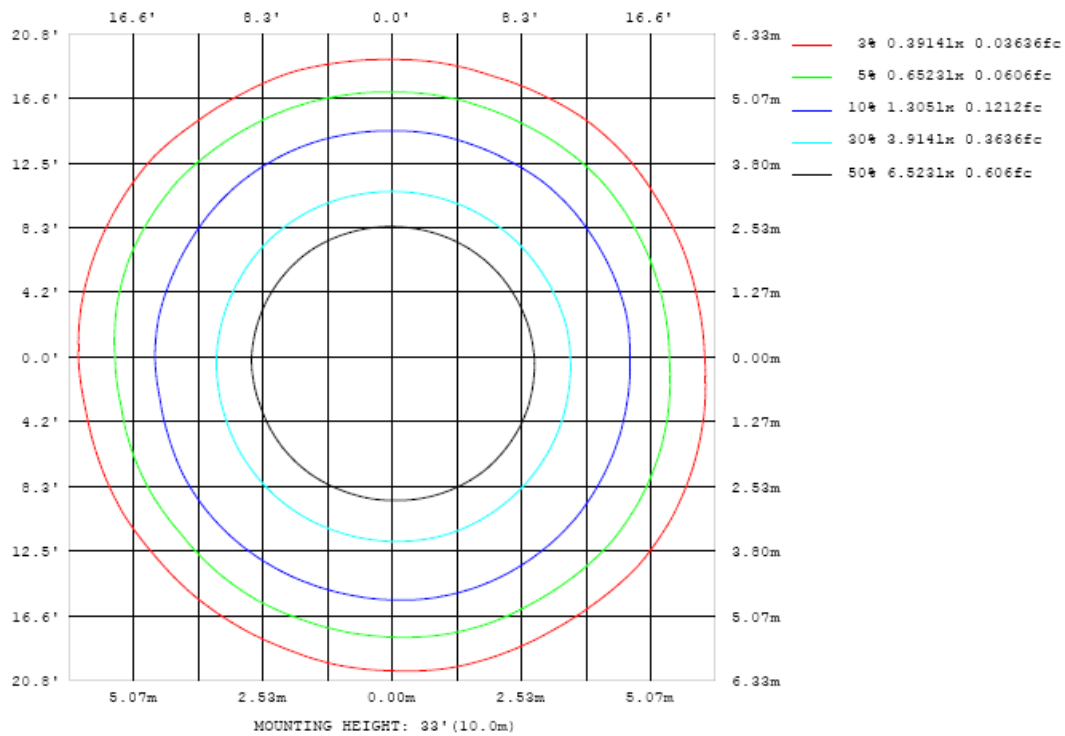


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

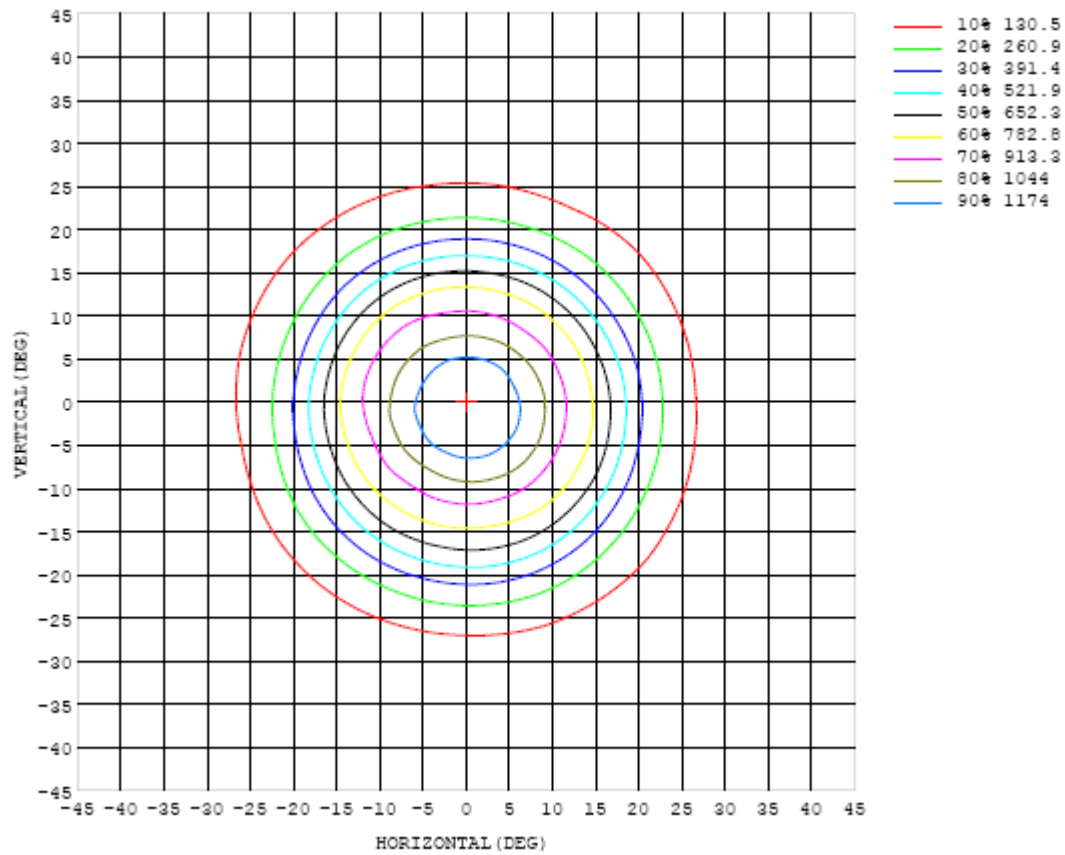


Chart 6: Isocandela Plot

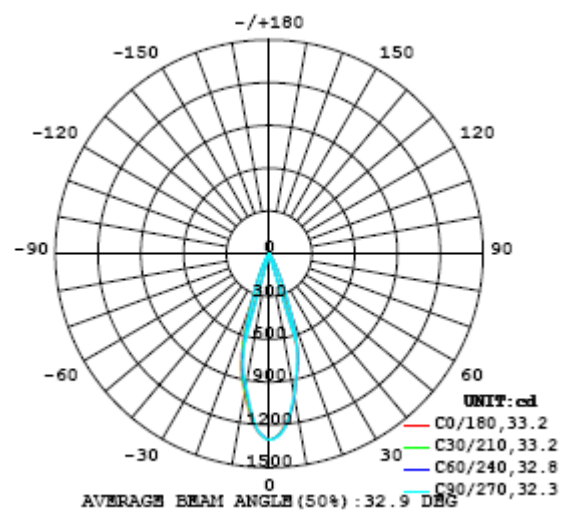


Chart 7: Polar Candela Distribution

## 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	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305
5	1212	1218	1220	1224	1226	1227	1231	1233	1234	1232	1230	1228	1227	1226	1221	1215	1214	1214	1208
10	997	1000	1010	1021	1024	1024	1021	1012	1010	1007	1000	995	986	986	995	992	991	1000	995
15	763	772	779	781	784	785	779	772	767	765	764	763	763	764	764	761	755	758	758
20	415	424	436	447	454	461	467	470	467	461	454	450	447	442	433	425	412	402	395
25	176	179	184	189	196	199	200	201	199	193	188	186	187	187	187	183	174	169	174
30	78.1	82.3	86.2	88.7	88.7	85.8	82.7	83.4	82.1	79.3	77.2	75.2	75.6	75.0	74.1	75.3	75.3	75.6	79.9
35	36.1	38.8	39.9	40.2	41.8	40.9	39.4	39.2	37.8	36.0	35.4	34.1	34.3	34.6	34.5	35.7	35.6	36.1	37.7
40	17.2	18.1	18.5	19.2	19.9	20.1	19.9	19.5	19.2	18.7	18.3	17.5	17.1	16.8	16.5	16.6	16.5	16.9	17.4
45	10.3	10.5	11.0	11.7	11.9	12.2	12.3	12.3	12.3	12.0	11.6	11.2	10.8	10.6	10.5	10.4	10.3	10.1	10.1
50	7.41	7.33	7.52	7.76	7.93	8.11	8.22	8.33	8.32	8.10	7.87	7.67	7.58	7.49	7.42	7.47	7.46	7.40	7.43
55	5.94	5.89	5.97	6.07	6.24	6.36	6.44	6.53	6.47	6.39	6.27	6.17	6.10	5.98	5.91	5.92	5.98	6.02	6.04
60	4.88	4.90	4.95	5.03	5.07	5.11	5.17	5.20	5.16	5.10	5.03	5.02	5.00	4.99	5.00	5.00	5.01	5.03	5.07
65	4.05	4.12	4.12	4.19	4.24	4.25	4.32	4.35	4.29	4.28	4.30	4.25	4.27	4.28	4.24	4.24	4.27	4.23	4.24
70	3.03	3.23	3.09	3.17	3.33	3.26	3.34	3.45	3.28	3.30	3.41	3.24	3.26	3.31	3.17	3.18	3.23	3.08	3.17
75	2.17	2.28	2.26	2.32	2.48	2.42	2.46	2.61	2.41	2.44	2.55	2.37	2.39	2.43	2.33	2.30	2.28	2.21	2.20
80	1.43	1.47	1.52	1.54	1.58	1.62	1.62	1.60	1.60	1.59	1.59	1.59	1.58	1.55	1.53	1.50	1.46	1.44	1.43
85	0.99	1.03	1.01	1.08	1.07	1.02	1.07	1.02	0.99	1.06	1.05	1.04	1.10	1.06	0.99	1.04	1.00	0.91	0.99
90	0.59	0.66	0.61	0.67	0.69	0.60	0.64	0.66	0.56	0.63	0.69	0.63	0.68	0.66	0.57	0.62	0.62	0.52	0.63
95	0.34	0.37	0.34	0.37	0.39	0.35	0.37	0.39	0.34	0.37	0.41	0.35	0.37	0.37	0.31	0.33	0.34	0.31	0.34
100	0.31	0.31	0.30	0.31	0.30	0.27	0.27	0.28	0.27	0.27	0.27	0.27	0.28	0.28	0.26	0.31	0.31	0.30	0.36
105	1.75	0.71	0.34	1.09	0.41	0.32	0.63	0.39	0.32	0.38	0.36	0.33	0.48	0.38	0.27	1.33	0.69	0.28	1.72
110	0.33	0.36	0.32	0.36	0.45	0.31	0.38	0.48	0.32	0.36	0.42	0.33	0.33	0.36	0.31	0.32	0.34	0.36	0.33
115	0.30	0.28	0.26	0.26	0.28	0.26	0.28	0.29	0.26	0.26	0.27	0.27	0.26	0.26	0.25	0.27	0.27	0.31	0.29
120	2.31	1.21	1.08	2.08	1.07	0.83	1.75	1.36	0.61	1.94	1.45	0.64	1.56	1.67	0.41	1.86	1.67	1.03	2.41
125	1.28	1.18	0.31	2.09	1.72	0.23	2.68	2.34	0.41	2.37	2.60	0.44	1.55	2.30	0.28	1.15	0.74	0.15	1.02
130	0.09	0.09	0.09	0.09	0.09	0.10	0.13	0.12	0.11	0.12	0.12	0.11	0.09	0.09	0.08	0.08	0.08	0.08	0.08
135	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.11	0.10	0.09	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09
140	0.11	0.10	0.11	0.11	0.10	0.12	0.11	0.10	0.11	0.11	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10
145	0.13	0.13	0.12	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13
150	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
155	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
160	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.23
165	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.27
170	0.30	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.28
175	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.27	0.27	0.27	0.27	0.27	0.27
180	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305	1305		
5	1200	1195	1192	1189	1189	1189	1188	1186	1185	1187	1189	1196	1201	1204	1205	1206	1209		
10	986	982	975	964	961	952	940	935	936	936	936	939	940	951	963	970	984		
15	747	736	726	715	704	692	680	673	669	668	675	685	696	710	721	737	752		
20	383	373	365	358	351	344	335	330	328	329	332	339	350	360	370	385	404		
25	173	165	161	158	155	149	145	140	139	139	138	142	153	159	163	169	176		
30	81.9	82.0	80.6	78.0	72.3	68.5	67.2	64.0	62.7	63.1	63.5	68.0	73.1	74.1	73.8	75.4	76.9		
35	37.9	37.8	36.1	35.0	32.6	31.1	30.7	29.7	29.4	29.8	29.8	29.8	31.3	32.6	33.5	34.8	35.5		
40	17.2	17.1	16.7	16.3	15.9	15.6	15.8	15.7	15.6	15.5	15.9	16.0	16.2	16.5	16.7	17.2	17.3		
45	9.93	9.77	9.53	9.28	9.16	9.13	9.23	9.32	9.42	9.42	9.42	9.51	9.58	9.70	9.82	9.95	10.1		
50	7.42	7.32	7.19	7.06	7.04	7.02	6.99	6.97	6.98	7.00	7.03	7.07	7.15	7.17	7.25	7.37	7.38		
55	6.03	5.95	5.93	5.90	5.87	5.80	5.75	5.67	5.63	5.66	5.73	5.76	5.79	5.80	5.88	6.00	5.99		
60	5.05	5.02	5.00	4.97	4.94	4.89	4.86	4.80	4.78	4.79	4.78	4.81	4.82	4.82	4.83	4.85	4.87		
65	4.23	4.15	4.12	4.07	3.99	4.01	4.00	3.94	3.94	3.95	3.93	3.97	4.03	3.99	4.02	4.05	4.01		
70	3.19	3.05	3.07	3.12	2.95	2.98	3.05	2.90	2.95	3.03	2.90	2.97	3.10	2.95	2.99	3.11	2.98		
75	2.19	2.16	2.12	2.09	2.06	2.04	2.03	2.02	2.02	2.02	2.03	2.04	2.07	2.08	2.09	2.13	2.15		
80	1.42	1.42	1.38	1.36	1.34	1.32	1.30	1.30	1.30	1.30	1.33	1.33	1.34	1.36	1.36	1.37	1.41		
85	1.00	0.89	0.96	0.92	0.82	0.88	0.88	0.78	0.86	0.88	0.83	0.90	0.91	0.84	0.90	0.91	0.88		
90	0.65	0.53	0.57	0.57	0.48	0.53	0.55	0.46	0.50	0.53	0.46	0.51	0.54	0.49	0.52	0.56	0.52		
95	0.34	0.31	0.33	0.32	0.29	0.32	0.33	0.30	0.32	0.33	0.31	0.32	0.32	0.30	0.33	0.33	0.31		
100	0.36	0.34	0.36	0.35	0.31	0.36	0.37	0.33	0.37	0.36	0.34	0.36	0.34	0.31	0.33	0.31	0.28		
105	1.02	0.30	1.04	0.82	0.27	0.59	0.88	0.26	0.61	0.82	0.26	0.40	0.52	0.30	1.16	1.09	0.31		
110	0.32	0.38	0.30	0.32	0.34	0.28	0.31	0.31	0.27	0.30	0.30	0.32	0.29	0.32	0.29	0.33	0.33		
115	0.28	0.37	0.31	0.27	0.48	0.29	0.31	0.72	0.28	0.32	0.45	0.24	0.23	0.23	0.27	0.27	0.23		
120	1.74	0.53	2.57	1.33	1.27	2.64	1.57	1.34	2.95	1.91	0.89	2.19	1.55	0.95	2.31	1.74	0.44		
125	0.59	0.16	0.41	0.32	0.14	0.18	0.25	0.14	0.18	0.25	0.16	0.34	0.36	0.16	0.72	1.17	0.13		
130	0.08	0.09	0.08	0.08	0.08	0.07	0.07	0.08	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.08	0.08		
135	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.09	0.08	0.09	0.09	0.08	0.09	0.09		
140	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.11		
145	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.13	0.12	0.13	0.13	0.12	0.13	0.13	0.12		
150	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.16	0.16	0.16	0.16	0.15	0.15	0.16		
155	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19		
160	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.23		
165	0.27	0.27	0.26	0.27	0.27	0.27	0.28	0.28	0.26	0.26	0.26	0.26	0.27	0.25	0.23	0.24	0.27		
170	0.28	0.28	0.30	0.31	0.31	0.31	0.33	0.32	0.28	0.31	0.30	0.30	0.31	0.27	0.24	0.29	0.30		
175	0.26	0.24	0.31	0.35	0.35	0.36	0.37	0.32	0.35	0.34	0.35	0.35	0.29	0.26	0.32	0.31	0.27		
180	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	PF2010A	HZTE028-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	DPS1060	HZTE001-06	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	WY12010	HZTE004-03	Aug. 02, 2019	Aug. 01, 2020
Temperature recorder	JM624U	HZTE018-08	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 02, 2019	Aug. 01, 2020
Standard source	D908	HZTE012-01	Aug. 02, 2019	Aug. 01, 2020
Integrate Sphere system	3M	HZTE015-04	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	PCR 500L	HZTE001-07	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	IT6154	HZTE004-04	Aug. 02, 2019	Aug. 01, 2020
Standard source	SCL-1400	HZTE012-02	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 02, 2019	Aug. 01, 2020
Temperature Meter	TES1310	HZTE017-01	Aug. 02, 2019	Aug. 01, 2020

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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