

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/930FL35

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ20060049y

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/930FL35**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
89.2	425.4	4.77	0.9233
CCT (K)	CRI	Stabilization Time (Light & Power)	
3042	97.1	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. 25, 2020
Date of Test	: Jun. 26, 2020
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 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)

Name	: LED Lamp
Model	: 5GU10DIM/930FL35
Electrical Ratings	: 120Vac, 60Hz, 5W
Product Description	: 3000K
Manufacturer	: GREEN CREATIVE LTD
Address	: Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

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 65 minutes.

Sphere-Spectroradiometer Method

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.043
Power Factor	0.9233
Test Power (W)	4.77
THD A%	22.54
Luminous Efficacy (lm/W)	89.2
Total Luminous Flux (lm)	425.4
Color Rendering Index (CRI)	97.1
R9	85.4
Correlated Color Temperature (CCT)(K)	3042
Chromaticity Chroma x	0.4344
Chromaticity Chroma y	0.4042
Chromaticity Chroma u	0.2489
Chromaticity Chroma v	0.3474
Duv	0.0004
Chromaticity Chroma u'	0.2489
Chromaticity Chroma v'	0.5210

Special Color Rendering Indices	
R1	98.2
R2	98.3
R3	96.1
R4	98.1
R5	97.1
R6	97
R7	97.5
R8	94
R9	85.4
R10	94.1
R11	98
R12	82.6
R13	98.4
R14	96.9

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 25.0 °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	0.9188
Power (W)	4.76
Luminous Efficacy (lm/W)	91.3
Total Luminous Flux (lm)	434.4
Beam Angle (°)	33.1 (0°-180°) / 32.1 (90°-270°)
Center Beam Candle Power (cd)	1298
Maximum Beam Candle Power (cd)	1298 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.52 (0°-180°) / 0.51 (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

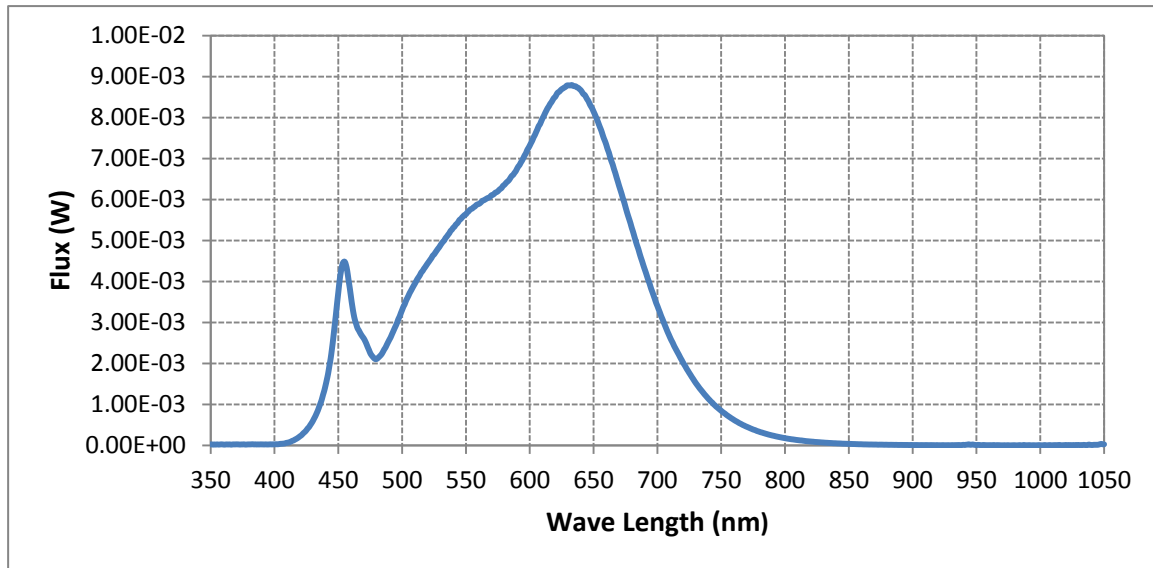
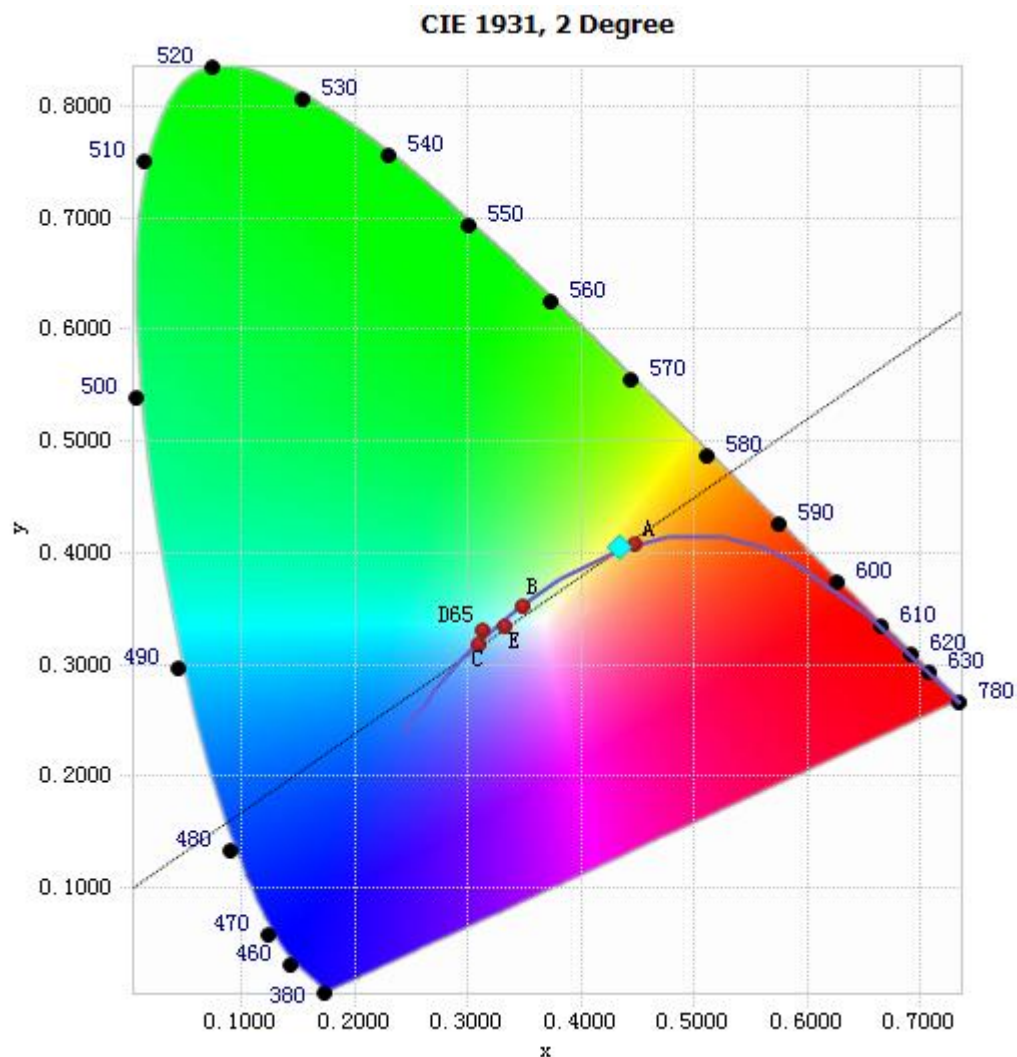


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.64E-05	485	2.29E-03	590	6.75E-03	695	3.84E-03
385	2.77E-05	490	2.58E-03	595	7.02E-03	700	3.41E-03
390	2.69E-05	495	2.92E-03	600	7.32E-03	705	3.00E-03
395	2.47E-05	500	3.31E-03	605	7.65E-03	710	2.63E-03
400	2.70E-05	505	3.66E-03	610	7.98E-03	715	2.32E-03
405	4.06E-05	510	3.95E-03	615	8.28E-03	720	2.03E-03
410	6.72E-05	515	4.22E-03	620	8.51E-03	725	1.77E-03
415	1.25E-04	520	4.44E-03	625	8.69E-03	730	1.53E-03
420	2.26E-04	525	4.66E-03	630	8.79E-03	735	1.32E-03
425	3.73E-04	530	4.89E-03	635	8.77E-03	740	1.14E-03
430	5.95E-04	535	5.10E-03	640	8.67E-03	745	9.82E-04
435	9.43E-04	540	5.31E-03	645	8.45E-03	750	8.47E-04
440	1.47E-03	545	5.51E-03	650	8.15E-03	755	7.28E-04
445	2.35E-03	550	5.64E-03	655	7.77E-03	760	6.23E-04
450	3.74E-03	555	5.78E-03	660	7.33E-03	765	5.34E-04
455	4.48E-03	560	5.89E-03	665	6.85E-03	770	4.58E-04
460	3.61E-03	565	6.00E-03	670	6.34E-03	775	3.90E-04
465	2.87E-03	570	6.11E-03	675	5.82E-03	780	3.34E-04
470	2.61E-03	575	6.20E-03	680	5.30E-03		
475	2.26E-03	580	6.36E-03	685	4.80E-03		
480	2.11E-03	585	6.54E-03	690	4.31E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4344, 0.4042)

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

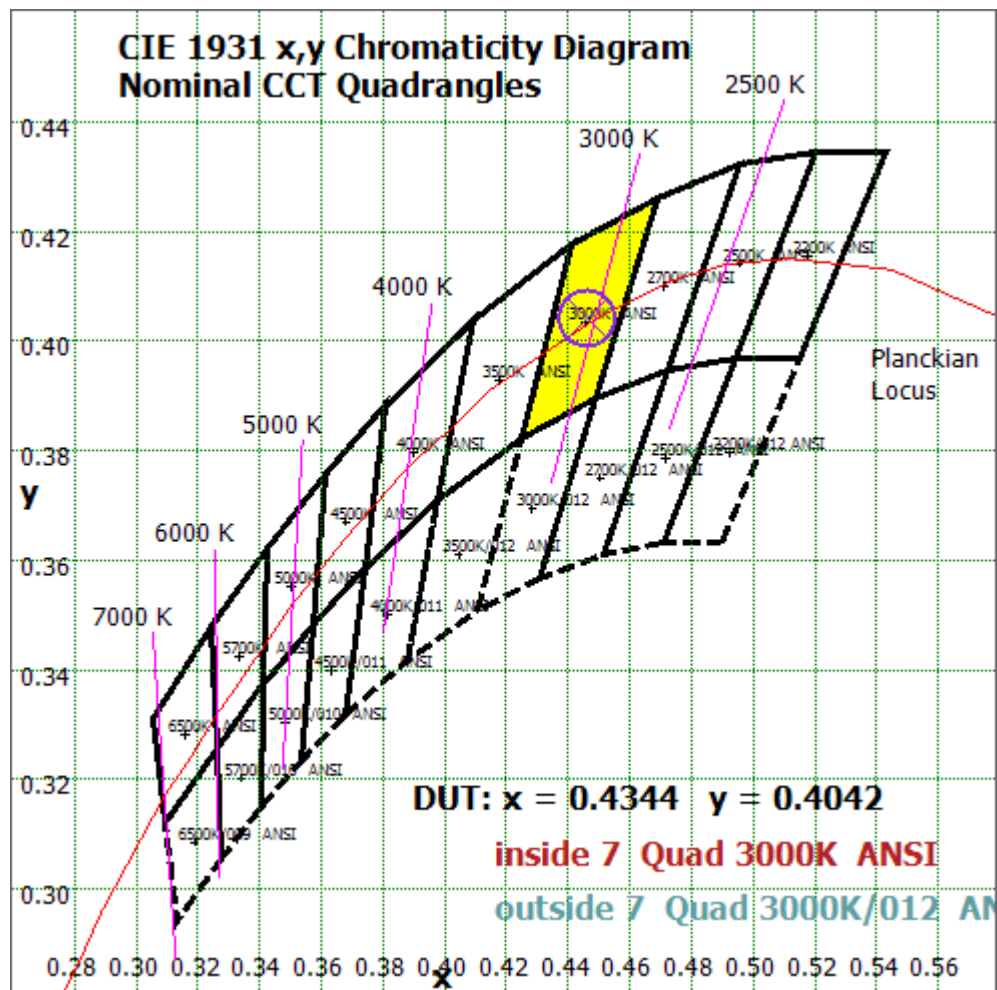


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method

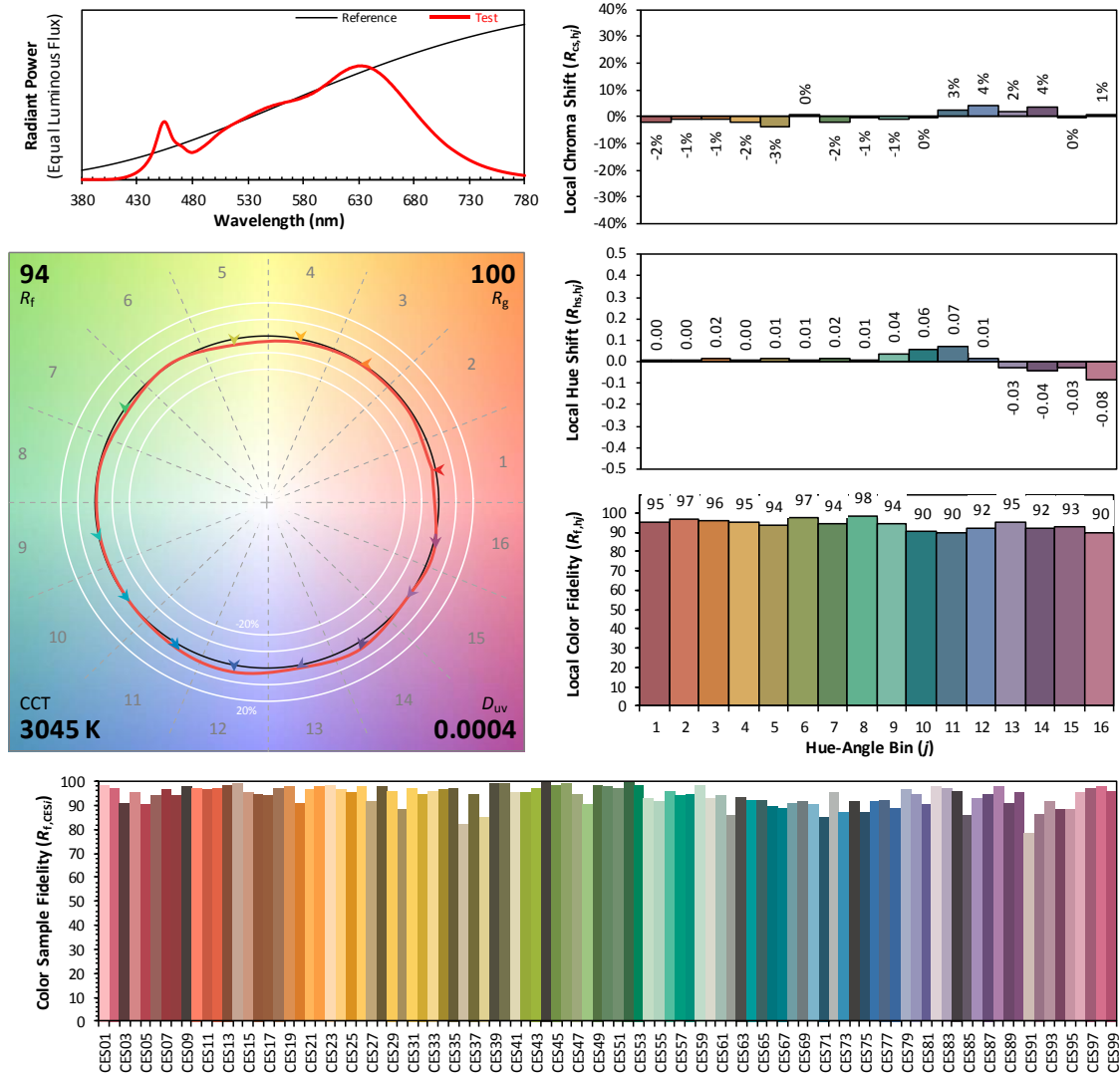
ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2020/06/26

Model: 5GU10DIM/930FL35



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

x 0.4344
 y 0.4042
 u' 0.2489
 v' 0.5210

CIE 13.3-1995
(CRI)

R_a 97

R_g 86

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	108.186	24.91%
10- 20	193.309	44.50%
20- 30	85.724	19.74%
30- 40	23.565	5.43%
40- 50	8.176	1.88%
50- 60	5.339	1.23%
60- 70	4.037	0.93%
70- 80	2.35	0.54%
80- 90	1.063	0.24%
90-100	0.411	0.09%
100-110	0.516	0.12%
110-120	0.485	0.11%
120-130	0.871	0.20%
130-140	0.068	0.02%
140-150	0.078	0.02%
150-160	0.087	0.02%
160-170	0.074	0.02%
170-180	0.027	0.01%
Total	434.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	424.299	97.68%
60- 90	7.45	1.72%
0-90	431.749	99.40%
90- 180	2.617	0.60%
0- 180	434.4	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

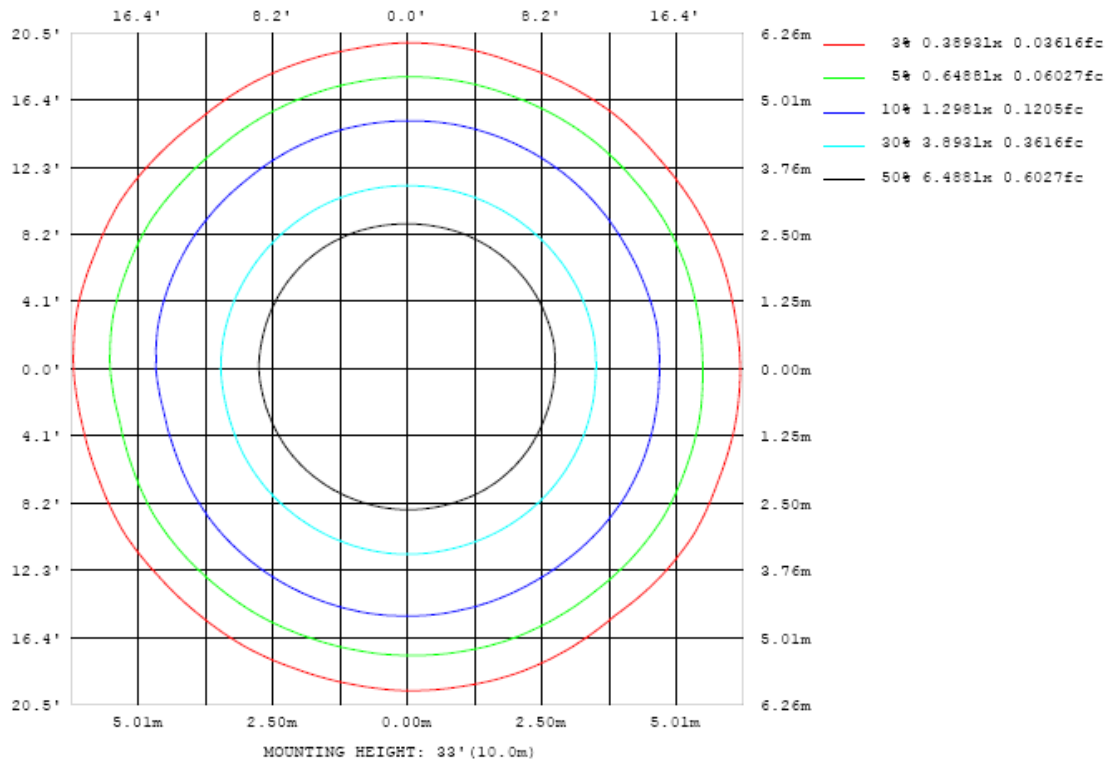


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

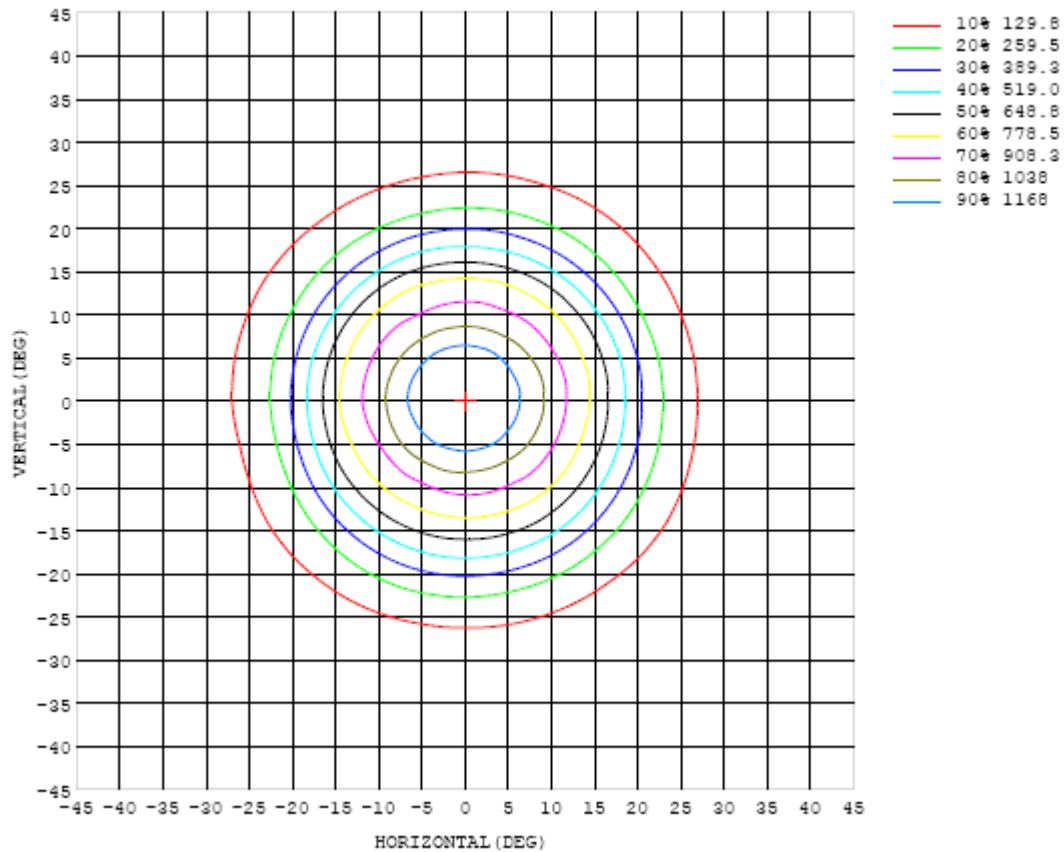


Chart 6: Isocandela Plot

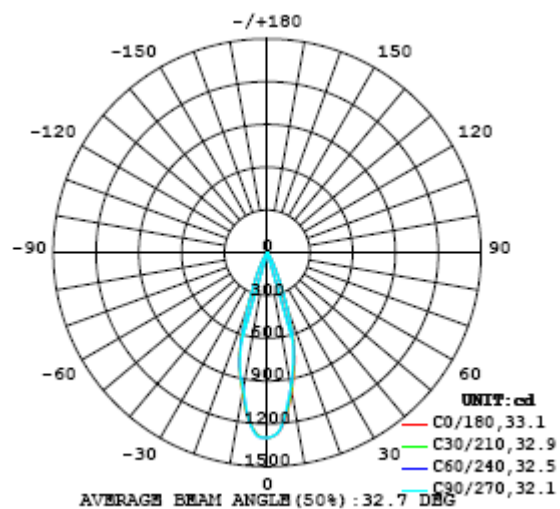


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298
5	1219	1215	1215	1212	1213	1212	1210	1207	1204	1204	1202	1203	1206	1208	1207	1207	1211	1219	1223
10	993	992	985	979	976	966	956	956	958	954	953	949	948	959	963	968	976	987	996
15	747	741	734	732	729	724	717	709	705	702	703	704	708	713	721	727	733	744	757
20	420	422	420	420	417	414	410	406	404	405	403	402	401	399	399	398	395	397	405
25	179	181	182	181	176	169	166	165	164	165	165	165	166	167	168	167	164	166	178
30	81.2	81.1	80.2	80.7	76.5	71.6	73.2	73.6	71.9	71.4	70.2	70.1	70.9	71.7	73.5	76.9	77.3	78.4	84.1
35	37.4	38.4	36.5	37.3	35.6	33.6	32.3	31.8	31.2	31.3	31.1	31.0	32.4	32.6	33.3	34.8	36.1	37.8	40.3
40	17.6	17.6	17.4	17.4	17.3	16.9	16.3	16.0	16.0	15.9	15.9	16.1	16.1	16.1	16.5	16.7	17.0	17.4	18.0
45	10.1	10.3	10.5	10.5	10.5	10.6	10.5	10.4	10.2	10.1	10.1	10.2	10.1	9.88	9.88	9.81	9.82	9.82	9.91
50	7.39	7.49	7.60	7.72	7.90	7.87	7.81	7.66	7.54	7.42	7.37	7.29	7.16	7.10	7.00	6.99	7.00	7.02	7.15
55	5.98	5.96	6.08	6.20	6.23	6.24	6.21	6.05	5.95	5.97	5.86	5.77	5.73	5.63	5.63	5.66	5.70	5.72	5.82
60	4.99	5.05	5.13	5.12	5.09	5.10	5.07	5.05	5.02	4.97	4.96	4.92	4.89	4.85	4.82	4.82	4.85	4.88	4.93
65	4.24	4.21	4.25	4.29	4.27	4.31	4.28	4.24	4.24	4.22	4.13	4.12	4.11	4.06	4.06	4.08	4.08	4.08	4.15
70	3.20	3.10	3.16	3.24	3.14	3.15	3.20	3.07	3.08	3.16	3.00	3.00	3.02	2.91	2.96	3.01	2.93	3.01	3.12
75	2.30	2.28	2.31	2.39	2.33	2.33	2.36	2.29	2.28	2.30	2.23	2.24	2.23	2.19	2.19	2.20	2.19	2.18	2.24
80	1.49	1.51	1.50	1.50	1.51	1.50	1.49	1.49	1.48	1.48	1.47	1.43	1.41	1.40	1.41	1.41	1.42	1.42	1.45
85	1.08	1.03	1.07	1.03	0.94	0.99	1.00	0.97	1.05	1.02	0.95	0.99	0.96	0.90	0.99	0.99	0.96	1.02	1.02
90	0.74	0.69	0.74	0.72	0.61	0.64	0.68	0.63	0.69	0.68	0.60	0.63	0.60	0.54	0.60	0.63	0.56	0.62	0.63
95	0.36	0.34	0.35	0.37	0.32	0.35	0.35	0.32	0.34	0.35	0.31	0.35	0.33	0.30	0.32	0.32	0.30	0.34	0.34
100	0.35	0.32	0.34	0.34	0.31	0.32	0.30	0.29	0.32	0.32	0.30	0.33	0.32	0.29	0.32	0.34	0.32	0.36	0.36
105	0.72	0.35	1.44	0.56	0.33	1.19	0.70	0.34	1.15	0.96	0.37	1.32	1.47	0.34	1.81	1.46	0.35	1.69	1.50
110	0.35	0.38	0.34	0.34	0.35	0.33	0.32	0.33	0.33	0.31	0.35	0.31	0.31	0.34	0.30	0.31	0.38	0.31	0.31
115	0.28	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.24	0.25	0.25	0.24	0.30	0.27	0.27
120	1.94	0.33	2.34	1.92	0.32	2.29	2.16	0.33	2.12	2.09	0.45	1.82	2.63	0.40	1.75	2.36	0.33	2.43	2.00
125	1.34	0.16	1.92	1.76	0.17	2.12	1.63	0.18	1.70	1.58	0.22	1.19	1.35	0.17	0.93	0.89	0.15	0.80	0.58
130	0.09	0.09	0.09	0.09	0.09	0.08	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09
135	0.09	0.10	0.09	0.09	0.10	0.09	0.09	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.09
140	0.10	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
145	0.13	0.13	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	0.12	0.12
150	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	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	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23
165	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
170	0.29	0.29	0.29	0.29	0.29	0.30	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.28
175	0.27	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	0.27	0.27	0.27	0.27	0.26
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

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	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298		
5	1225	1224	1226	1230	1232	1233	1233	1234	1234	1234	1231	1230	1226	1220	1218	1219	1219		
10	1000	994	987	983	976	964	968	968	969	971	969	974	983	985	991	1000	1000		
15	755	752	753	752	749	745	739	732	729	730	737	740	744	749	751	751	754		
20	404	401	398	394	390	387	387	386	386	389	390	395	400	407	414	420	425		
25	182	180	178	173	168	168	167	167	168	169	171	173	174	175	175	178	183		
30	85.9	82.9	82.2	77.6	74.5	75.5	74.7	75.4	77.8	76.8	74.8	76.6	78.0	78.5	81.5	83.3	82.6		
35	40.5	38.5	38.5	36.2	34.2	33.8	32.9	32.3	32.6	32.3	32.0	32.9	33.2	33.6	34.9	35.8	36.1		
40	18.1	18.0	18.0	17.4	16.9	16.8	16.6	16.5	16.4	16.4	16.5	16.4	16.4	16.2	16.7	17.1	17.3		
45	10.1	10.1	10.1	9.92	9.84	9.78	9.77	9.76	9.68	9.61	9.79	9.84	9.87	9.88	9.89	9.94	10.0		
50	7.22	7.22	7.25	7.18	7.07	7.03	7.04	7.09	7.12	7.17	7.25	7.28	7.34	7.36	7.36	7.37	7.38		
55	5.81	5.82	5.85	5.80	5.76	5.72	5.74	5.78	5.84	5.93	5.99	5.97	5.92	6.00	6.04	6.04	6.02		
60	4.96	4.96	4.97	4.93	4.91	4.89	4.89	4.87	4.88	4.94	5.00	4.99	4.99	5.01	5.06	5.05	5.02		
65	4.13	4.14	4.13	4.09	4.11	4.10	4.07	4.09	4.10	4.10	4.15	4.18	4.19	4.26	4.24	4.23	4.26		
70	3.04	3.10	3.08	2.96	3.02	3.03	2.93	3.02	3.05	2.95	3.05	3.06	3.02	3.11	3.13	3.08	3.14		
75	2.23	2.22	2.19	2.16	2.15	2.15	2.13	2.13	2.13	2.15	2.17	2.17	2.19	2.22	2.24	2.25	2.29		
80	1.46	1.43	1.40	1.38	1.37	1.37	1.39	1.39	1.38	1.39	1.40	1.40	1.41	1.42	1.44	1.47	1.49		
85	0.93	0.96	0.92	0.84	0.89	0.92	0.86	0.95	0.93	0.86	0.93	0.93	0.85	0.94	0.96	0.94	1.04		
90	0.53	0.56	0.55	0.45	0.50	0.55	0.48	0.56	0.58	0.49	0.55	0.56	0.49	0.56	0.60	0.58	0.68		
95	0.30	0.33	0.32	0.29	0.31	0.29	0.28	0.31	0.30	0.28	0.31	0.32	0.29	0.32	0.34	0.32	0.36		
100	0.32	0.36	0.34	0.31	0.34	0.32	0.30	0.33	0.33	0.31	0.35	0.34	0.30	0.33	0.34	0.32	0.36		
105	0.33	1.47	0.84	0.32	0.94	0.59	0.33	1.07	0.81	0.33	1.06	1.02	0.33	1.26	1.09	0.35	1.00		
110	0.37	0.31	0.31	0.35	0.29	0.29	0.31	0.28	0.29	0.35	0.28	0.31	0.38	0.30	0.32	0.39	0.33		
115	0.28	0.30	0.28	0.27	0.28	0.26	0.34	0.28	0.27	0.30	0.27	0.26	0.27	0.28	0.26	0.26	0.27		
120	0.25	2.89	1.49	0.60	2.41	1.18	1.21	2.65	1.27	1.22	2.57	2.09	0.43	2.11	1.55	0.34	2.31		
125	0.15	0.69	0.43	0.15	0.42	0.30	0.14	0.31	0.30	0.16	0.52	0.41	0.17	0.84	0.87	0.20	1.54		
130	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.09	0.09		
135	0.09	0.09	0.09	0.09	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.09	0.10	0.08		
140	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.10		
145	0.12	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	0.13	0.13	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	0.16	0.15		
155	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19		
160	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.22		
165	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.25	0.24	0.24	0.25	0.24	0.23	0.24	0.25		
170	0.28	0.28	0.27	0.30	0.31	0.31	0.30	0.30	0.30	0.28	0.27	0.28	0.28	0.25	0.26	0.26	0.27		
175	0.25	0.26	0.33	0.36	0.35	0.33	0.34	0.33	0.31	0.30	0.32	0.31	0.27	0.27	0.29	0.29	0.28		
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27		

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 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 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° 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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