

## 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: 13BR40DIM/940**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ21120007o

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

Review by:



Engineer: April Zou

Dec. 15, 2021

Approved by:



Manager: Jim Zhang

Dec. 15, 2021

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: **13BR40DIM/940**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
118.0	1427.2	12.10	0.9501
CCT (K)	CRI	Stabilization Time (Light & Power)	
3906	94.2	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>	: Dec. 03, 2021
<b>Date of Test</b>	: Dec. 09, 2021
<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>	: 13BR40DIM/940
<b>Electrical Ratings</b>	: 120V, 60Hz, 13W
<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 26.0 °C.

Base orientation was horizontal. 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)	0.106
Power Factor	0.9501
Test Power (W)	12.10
THD A%	12.11
Luminous Efficacy (lm/W)	118.0
Total Luminous Flux (lm)	1427.2
Color Rendering Index (CRI)	94.2
R9	70.8
Correlated Color Temperature (CCT)(K)	3906
Chromaticity Chroma x	0.3859
Chromaticity Chroma y	0.3840
Chromaticity Chroma u	0.2258
Chromaticity Chroma v	0.3370
Duv	0.0018
Chromaticity Chroma u'	0.2258
Chromaticity Chroma v'	0.5055

Special Color Rendering Indices	
R1	95.5
R2	96.3
R3	95.1
R4	94.9
R5	93.6
R6	94.1
R7	95.4
R8	89
R9	70.8
R10	88.8
R11	95
R12	71
R13	95.7
R14	96.3

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 25.1 °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)	0.106
Power Factor	0.9503
Power (W)	12.14
Luminous Efficacy (lm/W)	120.6
Total Luminous Flux (lm)	1464.5
Beam Angle ( ° )	106.9 (0°-180°) / 107.1 (90°-270°)
Center Beam Candle Power (cd)	482
Maximum Beam Candle Power (cd)	482.5 (At: C=180.0, Gamma=2.0)
Spacing Criteria	1.23 (0°-180°) / 1.22 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	70.00%
Zonal Lumens in the 60 °-90 °Zone	24.44%
Zonal Lumens in the 90 °-120 °Zone	4.83%
Zonal Lumens in the 120 °-180 °Zone	0.74%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

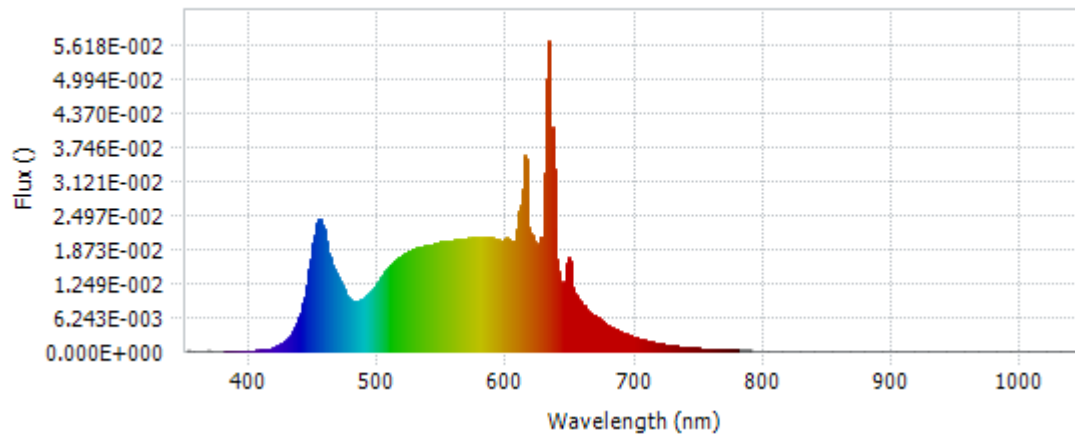
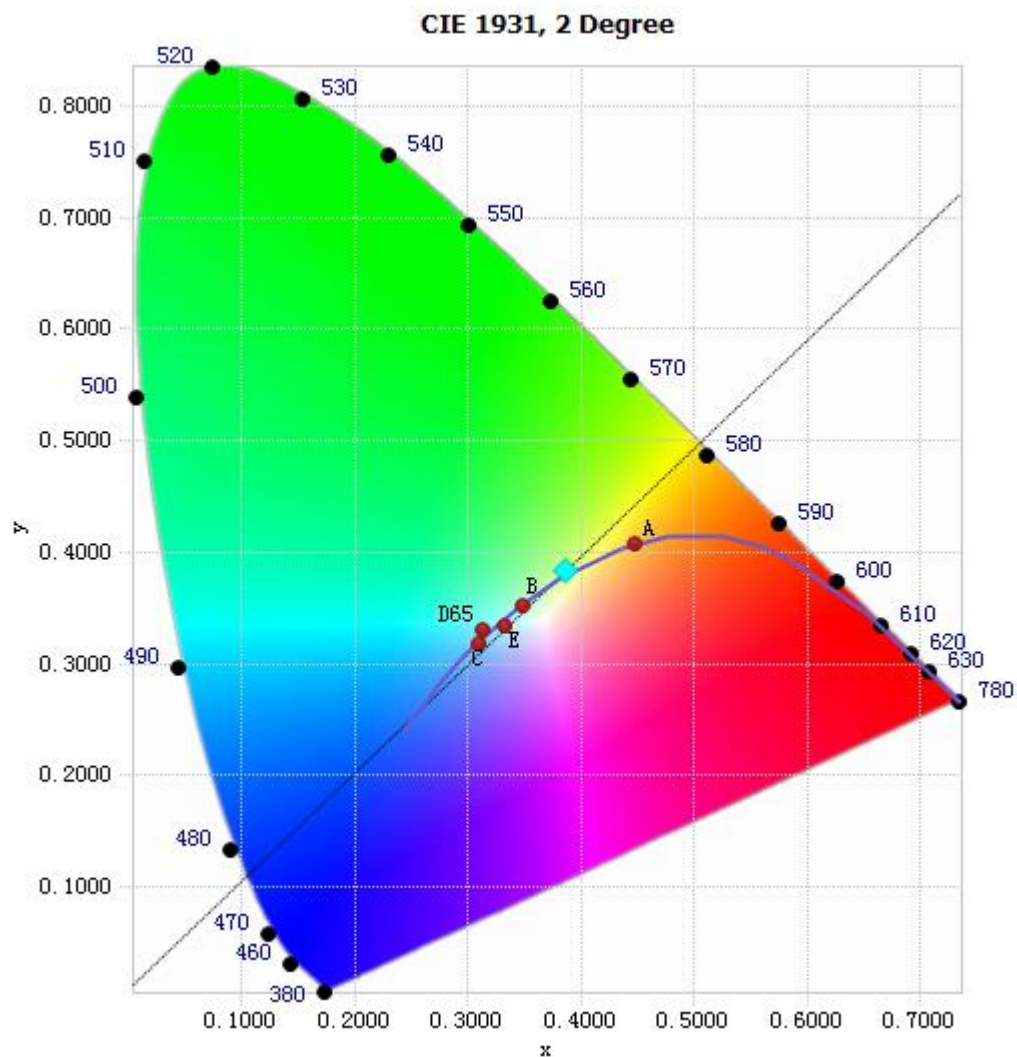


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.08E-04	485	9.26E-03	590	2.06E-02	695	2.91E-03
385	9.33E-05	490	1.01E-02	595	2.03E-02	700	2.49E-03
390	1.02E-04	495	1.12E-02	600	2.08E-02	705	2.11E-03
395	1.07E-04	500	1.29E-02	605	2.02E-02	710	1.81E-03
400	1.24E-04	505	1.45E-02	610	2.67E-02	715	1.56E-03
405	1.83E-04	510	1.59E-02	615	3.52E-02	720	1.34E-03
410	2.53E-04	515	1.70E-02	620	2.13E-02	725	1.16E-03
415	4.88E-04	520	1.79E-02	625	1.99E-02	730	9.87E-04
420	7.99E-04	525	1.84E-02	630	3.25E-02	735	8.35E-04
425	1.51E-03	530	1.89E-02	635	3.70E-02	740	7.15E-04
430	2.60E-03	535	1.92E-02	640	1.47E-02	745	6.10E-04
435	4.45E-03	540	1.96E-02	645	1.27E-02	750	5.17E-04
440	7.78E-03	545	1.98E-02	650	1.36E-02	755	4.54E-04
445	1.36E-02	550	2.00E-02	655	9.75E-03	760	3.73E-04
450	2.14E-02	555	2.02E-02	660	8.27E-03	765	3.32E-04
455	2.39E-02	560	2.04E-02	665	6.97E-03	770	2.89E-04
460	1.91E-02	565	2.05E-02	670	6.39E-03	775	2.44E-04
465	1.52E-02	570	2.07E-02	675	5.36E-03	780	2.12E-04
470	1.27E-02	575	2.08E-02	680	4.55E-03		
475	1.03E-02	580	2.07E-02	685	3.93E-03		
480	9.20E-03	585	2.09E-02	690	3.38E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3859, 0.3840)

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

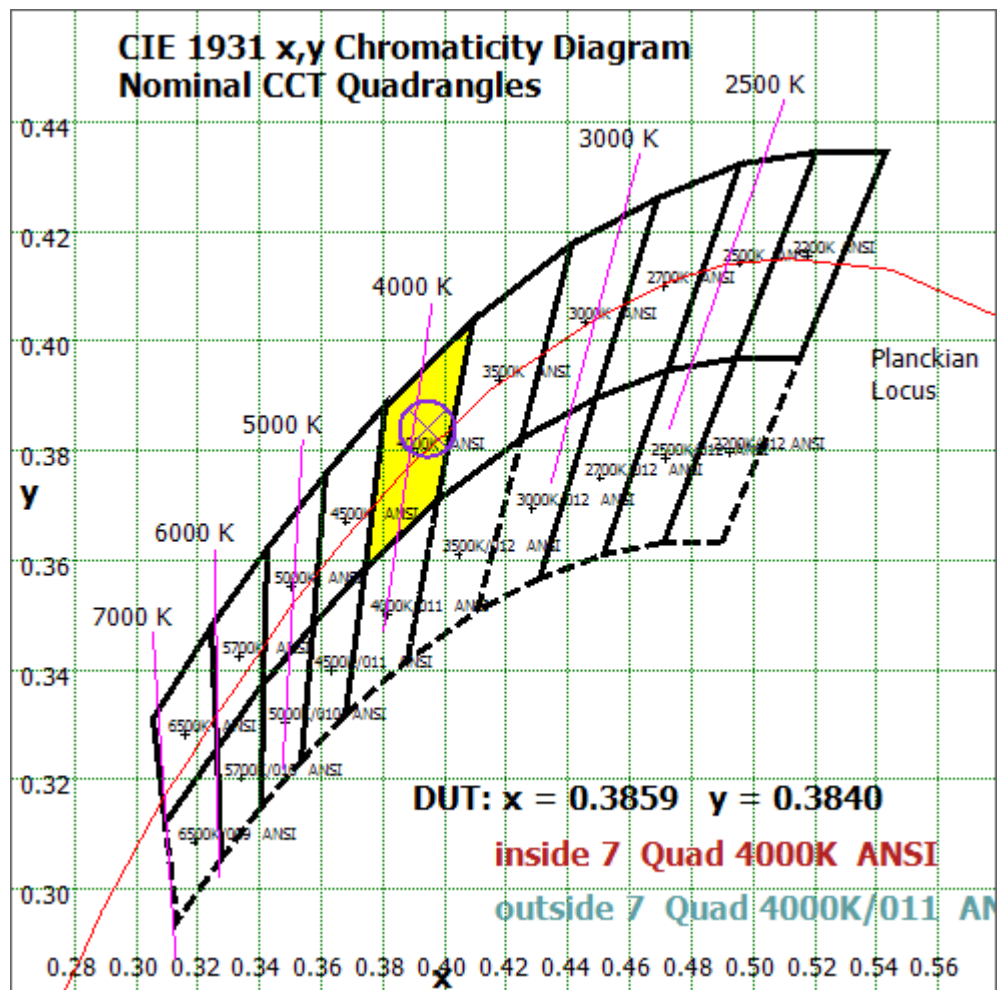


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method

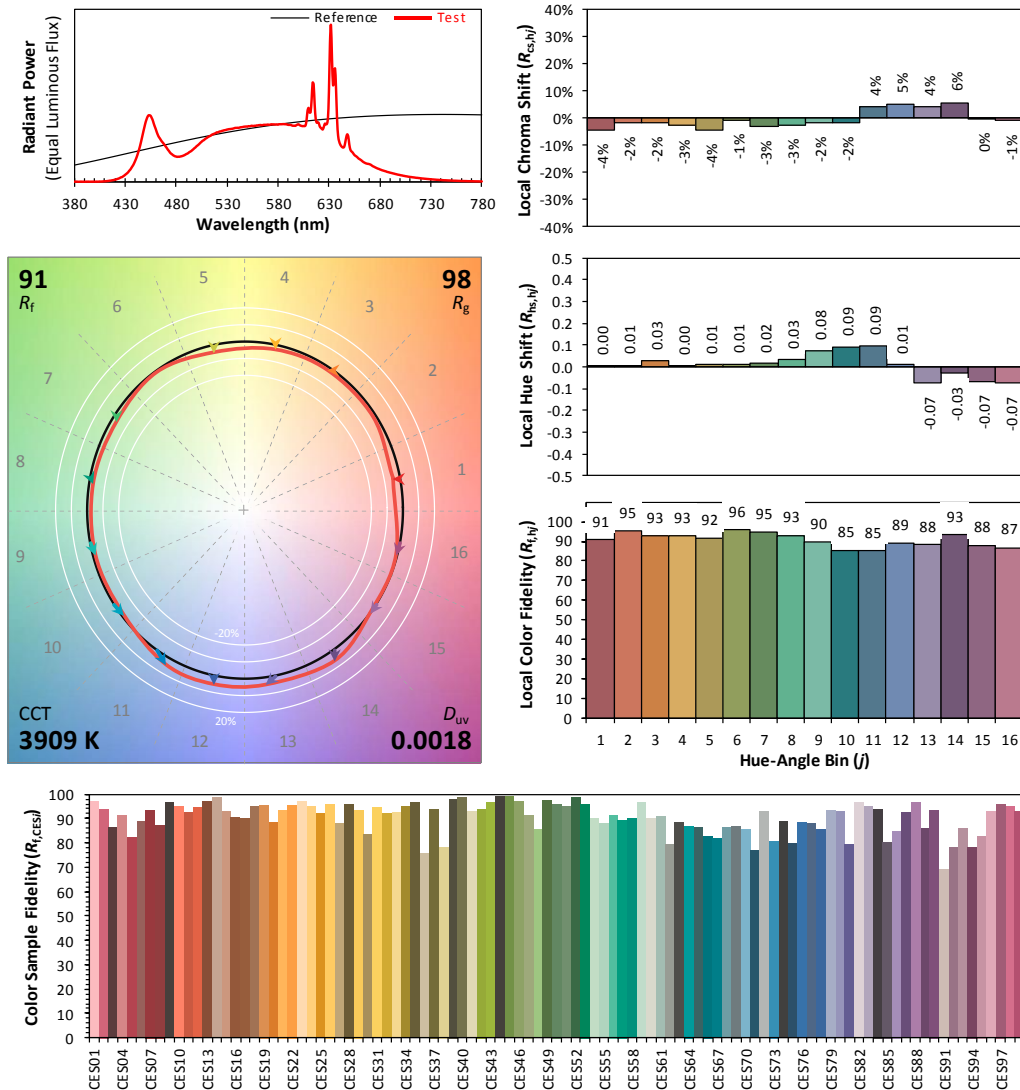
### ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2021/12/09

Model: 13BR40DIM/940



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

$x$  0.3859  
 $y$  0.3840  
 $u'$  0.2258  
 $v'$  0.5055

CIE 13.3-1995  
(CRI)  
 $R_a$  94  
 $R_9$  71

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	45.417	3.10%
10- 20	128.512	8.78%
20- 30	190.647	13.02%
30- 40	224.316	15.32%
40- 50	228.684	15.62%
50- 60	207.589	14.18%
60- 70	167.425	11.43%
70- 80	118.291	8.08%
80- 90	72.13	4.93%
90-100	38.969	2.66%
100-110	20.681	1.41%
110-120	11.02	0.75%
120-130	5.77	0.39%
130-140	2.938	0.20%
140-150	1.348	0.09%
150-160	0.507	0.03%
160-170	0.163	0.01%
170-180	0.049	0.00%
Total	1464.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1025.17	70.00%
60- 90	357.846	24.44%
0-90	1383.01	94.44%
90- 180	81.445	5.56%
0- 180	1464.5	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

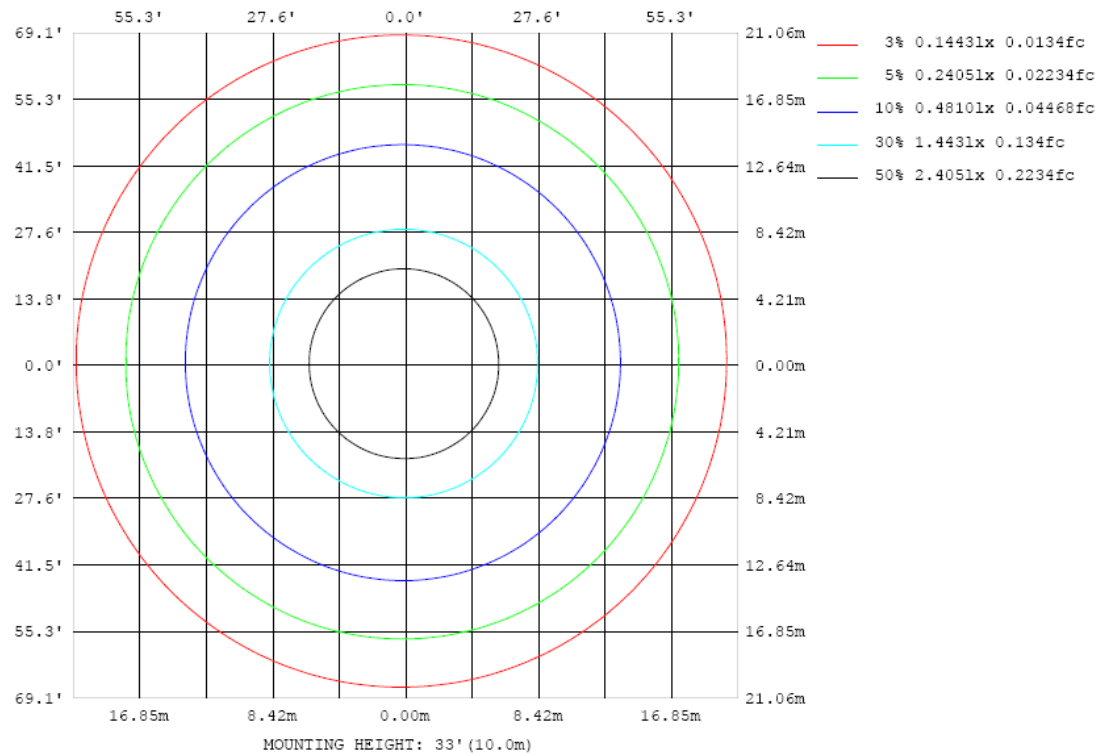


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

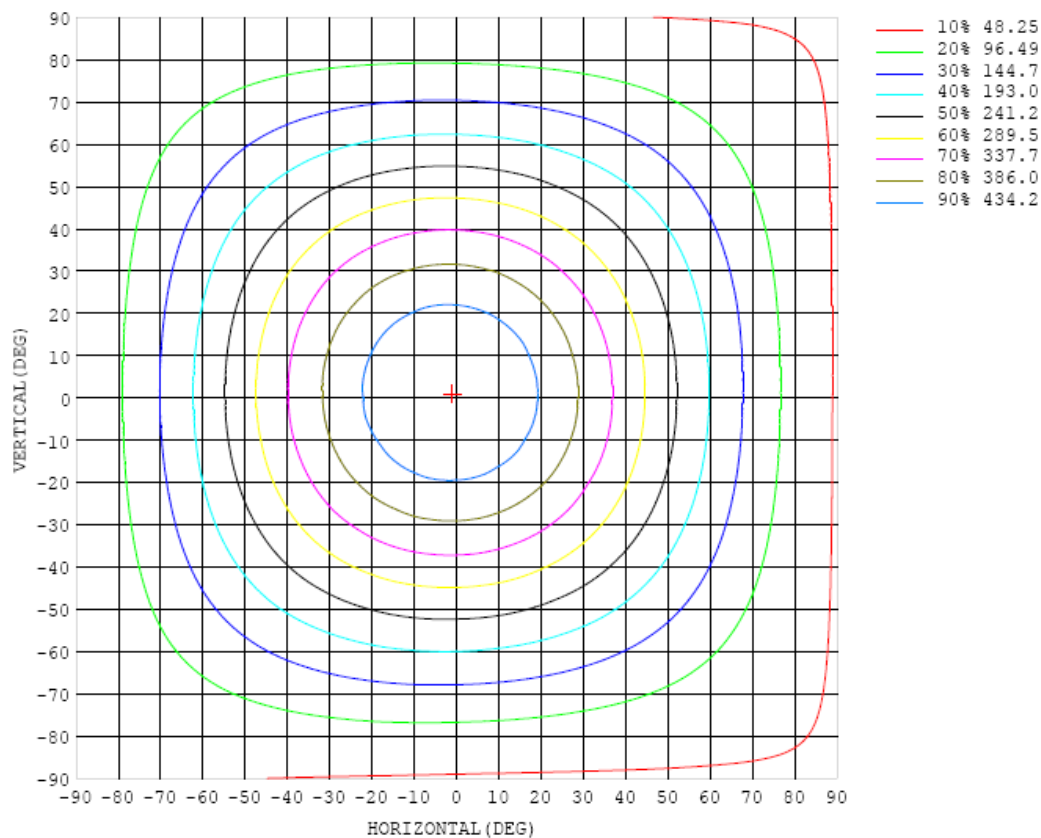


Chart 6: Isocandela Plot

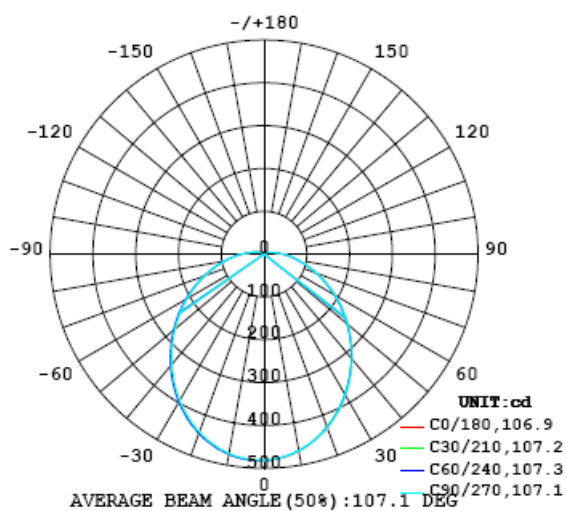


Chart 7: Polar Candela Distribution

## 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	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482
5	477	477	476	477	476	476	477	477	478	477	477	478	478	479	479	480	480	480	481
10	467	466	466	466	465	466	466	467	468	467	469	468	468	470	470	471	472	473	474
15	451	451	450	450	449	450	450	451	452	451	453	454	455	455	457	458	459	460	461
20	431	430	429	429	430	429	430	430	432	432	433	434	435	437	437	440	441	442	444
25	407	405	405	405	405	405	406	406	408	407	409	410	412	413	415	416	418	420	421
30	379	378	378	377	378	377	379	379	381	380	381	383	385	387	388	391	392	394	396
35	350	349	349	348	348	348	349	350	351	351	353	354	355	357	360	362	364	366	368
40	319	318	317	316	317	317	318	319	320	319	321	323	325	327	329	331	333	335	337
45	287	286	285	285	285	285	286	287	288	288	290	291	293	295	297	300	301	304	305
50	255	254	253	253	253	253	254	255	256	256	258	260	261	263	265	268	269	271	273
55	223	222	221	220	221	221	222	223	224	224	226	228	229	231	233	235	237	238	240
60	192	190	189	189	189	189	190	191	192	193	194	196	197	199	201	203	204	206	208
65	161	160	159	158	158	158	159	160	161	162	163	165	166	168	170	171	173	174	176
70	132	131	130	129	129	129	130	130	132	132	134	135	137	138	140	141	143	144	146
75	105	104	103	103	102	102	103	104	104	105	107	108	109	111	112	113	114	115	118
80	81.0	80.0	79.3	78.9	78.8	78.7	79.2	79.7	80.5	81.3	82.5	83.6	84.7	85.7	86.6	87.7	88.9	89.6	91.7
85	61.5	60.6	60.1	59.8	59.8	59.6	60.0	60.4	61.1	61.7	62.6	63.4	64.2	65.0	65.6	66.6	68.0	67.8	69.4
90	45.1	44.5	44.1	43.8	43.7	43.7	44.0	44.3	44.8	45.2	46.0	46.5	47.3	47.9	48.5	49.1	49.8	50.5	51.2
95	32.7	32.3	32.0	31.8	31.8	31.8	32.0	32.3	32.6	32.9	33.4	33.8	34.3	34.8	35.2	35.8	36.2	36.7	37.2
100	24.1	23.8	23.6	23.4	23.4	23.5	23.6	23.8	24.0	24.3	24.7	24.9	25.2	25.6	25.8	26.2	26.5	26.8	27.1
105	18.0	17.8	17.7	17.6	17.6	17.8	17.8	17.9	18.1	18.3	18.6	18.8	19.0	19.3	19.4	19.6	19.8	20.1	20.3
110	13.6	13.4	13.4	13.3	13.3	13.3	13.4	13.5	13.7	13.8	14.0	14.2	14.3	14.5	14.7	14.8	14.9	15.1	15.3
115	10.3	10.2	10.1	10.1	10.1	10.1	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.3	11.4	11.5
120	7.79	7.71	7.68	7.65	7.64	7.65	7.71	7.78	7.89	7.97	8.09	8.18	8.26	8.37	8.44	8.52	8.59	8.67	8.73
125	5.92	5.87	5.84	5.82	5.82	5.83	5.86	5.93	6.01	6.08	6.17	6.25	6.31	6.38	6.43	6.47	6.54	6.59	6.68
130	4.54	4.51	4.50	4.47	4.47	4.47	4.51	4.56	4.62	4.68	4.76	4.82	4.87	4.92	4.94	4.99	5.03	5.07	5.14
135	3.47	3.45	3.44	3.43	3.42	3.42	3.44	3.48	3.54	3.59	3.65	3.70	3.74	3.78	3.79	3.83	3.86	3.90	3.98
140	2.60	2.59	2.59	2.58	2.57	2.56	2.58	2.61	2.66	2.71	2.76	2.80	2.83	2.86	2.86	2.89	2.92	2.95	3.04
145	1.91	1.91	1.90	1.90	1.89	1.88	1.88	1.90	1.95	1.99	2.04	2.07	2.10	2.11	2.11	2.13	2.15	2.20	2.29
150	1.34	1.35	1.35	1.34	1.33	1.32	1.32	1.34	1.38	1.42	1.46	1.48	1.50	1.51	1.51	1.51	1.54	1.58	1.67
155	0.91	0.91	0.92	0.91	0.91	0.90	0.91	0.92	0.94	0.97	1.00	1.02	1.03	1.04	1.04	1.05	1.07	1.10	1.19
160	0.59	0.59	0.59	0.59	0.60	0.61	0.63	0.63	0.63	0.65	0.67	0.68	0.69	0.70	0.71	0.72	0.74	0.75	0.83
165	0.45	0.44	0.45	0.46	0.46	0.47	0.48	0.49	0.48	0.47	0.47	0.48	0.49	0.51	0.52	0.53	0.54	0.54	0.61
170	0.46	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.46	0.47	0.47	0.47	0.48	0.48	0.48	0.55
175	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.55
180	0.53	0.53	0.55	0.55	0.55	0.54	0.54	0.55	0.55	0.55	0.54	0.54	0.55	0.54	0.54	0.55	0.54	0.53	0.53

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	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482		
5	481	481	481	481	481	481	482	481	480	480	479	479	479	478	478	478	477		
10	474	474	474	475	474	474	474	474	472	472	472	471	470	469	468	467	467		
15	462	462	462	462	463	462	463	461	459	459	458	457	456	454	454	452	451		
20	444	446	445	445	445	445	445	444	441	442	439	438	437	435	434	432	431		
25	422	424	424	424	424	424	423	422	420	418	417	415	413	411	410	408	407		
30	397	398	399	399	398	399	398	396	394	393	391	389	387	385	383	382	380		
35	368	370	371	371	370	371	369	368	366	364	362	360	358	356	354	352	350		
40	338	340	340	340	340	340	339	337	336	334	332	330	328	325	324	322	319		
45	306	308	308	309	308	308	308	306	303	302	300	298	296	294	292	290	288		
50	274	276	276	276	276	276	275	274	272	270	268	266	264	262	260	258	256		
55	241	243	244	244	244	244	243	242	239	238	237	234	233	231	229	226	225		
60	209	210	211	211	211	211	210	210	208	206	205	203	201	199	197	195	193		
65	177	178	179	179	180	179	179	178	176	175	173	172	170	168	166	164	162		
70	147	148	149	150	150	150	149	148	147	146	144	142	141	139	138	136	134		
75	118	119	120	121	121	120	120	119	118	117	116	114	113	111	110	108	107		
80	92.4	93.3	93.8	94.2	94.4	94.4	94.0	93.3	92.1	91.5	90.3	89.0	87.9	86.6	85.2	84.0	82.7		
85	70.0	70.7	71.1	71.4	71.6	71.4	71.1	70.7	69.9	69.3	68.2	67.4	66.2	65.3	64.2	63.2	62.1		
90	51.6	52.2	52.4	52.7	52.8	52.7	52.6	52.2	51.5	51.0	50.3	49.7	48.8	47.9	47.1	46.4	45.6		
95	37.4	37.8	38.0	38.2	38.2	38.3	38.0	37.8	37.3	36.9	36.5	36.0	35.4	34.8	34.2	33.6	33.1		
100	27.4	27.6	27.7	27.8	27.8	27.9	27.7	27.6	27.2	26.9	26.6	26.2	25.8	25.4	25.1	24.7	24.3		
105	20.4	20.6	20.7	20.7	20.8	20.7	20.6	20.5	20.3	20.1	19.8	19.6	19.3	19.0	18.8	18.5	18.3		
110	15.4	15.5	15.6	15.6	15.6	15.6	15.6	15.4	15.3	15.1	14.9	14.7	14.5	14.3	14.1	13.9	13.7		
115	11.5	11.6	11.7	11.7	11.7	11.7	11.6	11.6	11.4	11.3	11.2	11.0	10.9	10.7	10.6	10.4	10.3		
120	8.76	8.83	8.86	8.87	8.87	8.84	8.81	8.74	8.64	8.55	8.47	8.36	8.24	8.11	8.03	7.92	7.83		
125	6.71	6.75	6.78	6.77	6.77	6.75	6.70	6.66	6.58	6.51	6.45	6.37	6.28	6.19	6.11	6.03	5.97		
130	5.16	5.20	5.22	5.21	5.19	5.17	5.15	5.11	5.05	5.01	4.96	4.90	4.82	4.76	4.69	4.64	4.59		
135	4.00	4.02	4.03	4.02	4.00	3.99	3.96	3.93	3.89	3.86	3.82	3.77	3.71	3.65	3.60	3.55	3.51		
140	3.07	3.09	3.09	3.08	3.06	3.04	3.01	2.99	2.96	2.94	2.91	2.87	2.82	2.76	2.71	2.68	2.65		
145	2.31	2.33	2.33	2.32	2.30	2.27	2.25	2.23	2.21	2.20	2.18	2.14	2.10	2.04	2.00	1.97	1.95		
150	1.70	1.71	1.71	1.70	1.68	1.65	1.63	1.62	1.61	1.60	1.58	1.56	1.52	1.47	1.43	1.40	1.39		
155	1.21	1.22	1.22	1.21	1.19	1.17	1.15	1.14	1.14	1.14	1.12	1.10	1.07	1.03	0.99	0.95	0.94		
160	0.84	0.86	0.86	0.85	0.84	0.82	0.81	0.81	0.80	0.80	0.79	0.77	0.74	0.72	0.69	0.67	0.65		
165	0.61	0.62	0.61	0.61	0.61	0.62	0.63	0.63	0.62	0.60	0.59	0.57	0.56	0.55	0.54	0.54	0.53		
170	0.55	0.55	0.55	0.55	0.55	0.56	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.53		
175	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.54	0.54	0.54	0.54	0.54		
180	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 05, 2021	Aug. 04, 2022
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2021	Aug. 04, 2022
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2021	Aug. 04, 2022
Standard source	D908	HZTE012-01	Aug. 05, 2021	Aug. 04, 2022
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2021	Aug. 04, 2022
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2021	Aug. 04, 2022
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2021	Aug. 04, 2022
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2021	Aug. 04, 2022
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2021	Aug. 04, 2022
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2021	Aug. 04, 2022
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2021	Aug. 04, 2022

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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