

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 9.5PLO/830/DIR**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19120026f

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

Review by:



Engineer: April Zou  
Dec. 27, 2019

Approved by:



Manager: Jim Zhang  
Dec. 27, 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: **9.5PLO/830/DIR**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
108.1	1265.1	11.70	0.9948
CCT (K)	CRI	Stabilization Time (Light & Power)	
3034	81.8	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. 19, 2019
<b>Date of Test</b>	: Dec. 26, 2019
<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

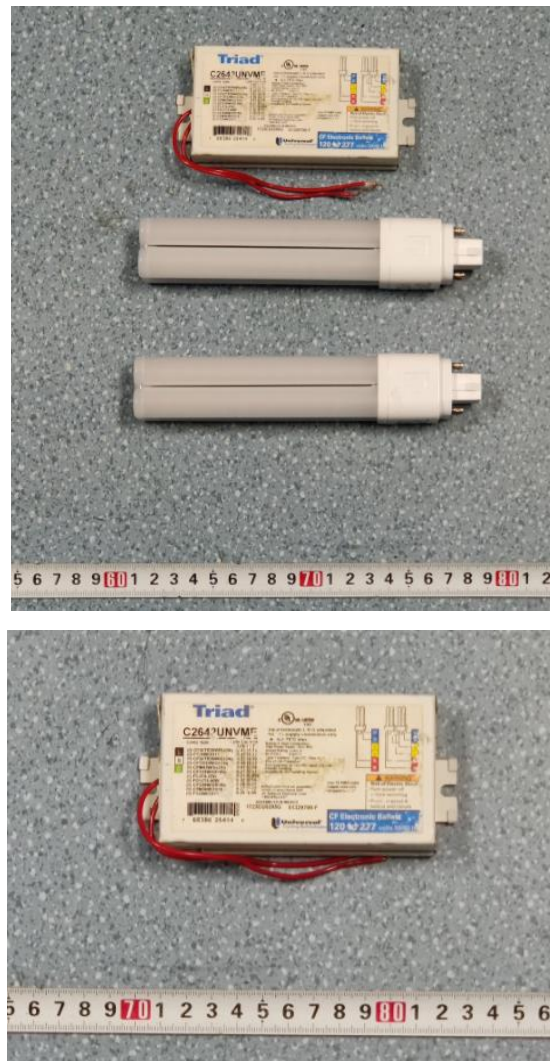


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Lamp
<b>Model</b>	: 9.5PLO/830/DIR
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 9.5W
<b>Product Description</b>	: 3000K LED lamps supplied by a high frequency fluorescent lamp ballast: C2642UNVME
<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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.196	0.087
Power Factor	0.9948	0.9776
Test Power (W)/2	11.70	11.79
THD A%	8.24	8.32
Luminous Efficacy (lm/W)	108.1	107.1
Total Luminous Flux (lm)	1265.1	1262.2
Color Rendering Index (CRI)	81.8	
R9	4.2	
Correlated Color Temperature (CCT)(K)	3034	
Chromaticity Chroma x	0.4346	
Chromaticity Chroma y	0.4037	
Chromaticity Chroma u	0.2493	
Chromaticity Chroma v	0.3473	
Duv	0.0002	
Chromaticity Chroma u'	0.2493	
Chromaticity Chroma v'	0.5209	

Special Color Rendering Indices	
R1	80.2
R2	91.1
R3	95.8
R4	78.6
R5	80.1
R6	88.8
R7	82
R8	57.6
R9	4.2
R10	79.2
R11	77.2
R12	68.2
R13	82.9
R14	98.5

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 °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)	0.197
Power Factor	0.9955
Power (W)/2	11.77
Luminous Efficacy (lm/W)	108.1
Total Luminous Flux (lm)	1271.9
Beam Angle ( °)	337.0 (0°-180°) / 329.7(90°-270°)
Center Beam Candle Power (cd)	10.0
Maximum Beam Candle Power (cd)	143.3 (At: C=330.0, Gamma=85.5)
Spacing Criteria	5.10 (0°-180°) / 5.17 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	19.53%
Zonal Lumens in the 60 °-90 °Zone	32.85%
Zonal Lumens in the 90 °-120 °Zone	31.45%
Zonal Lumens in the 120 °-180 °Zone	16.17%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

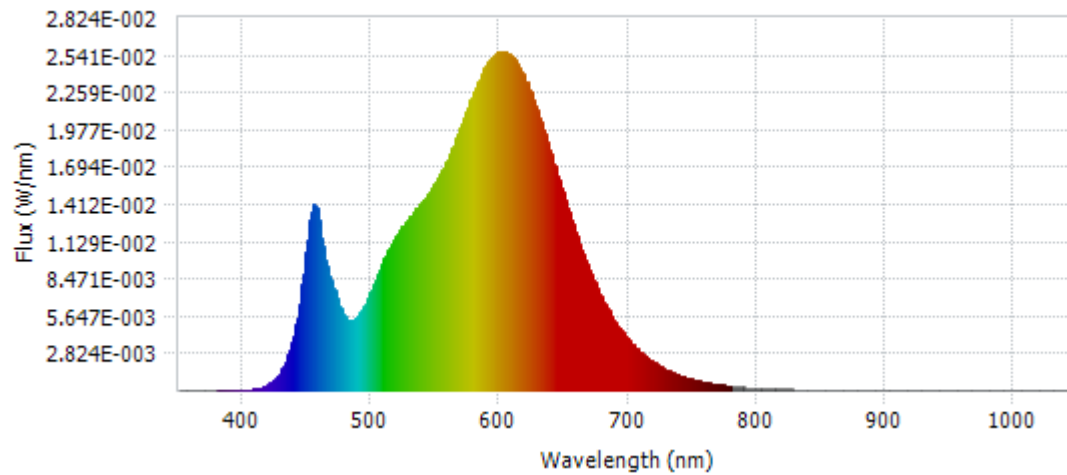


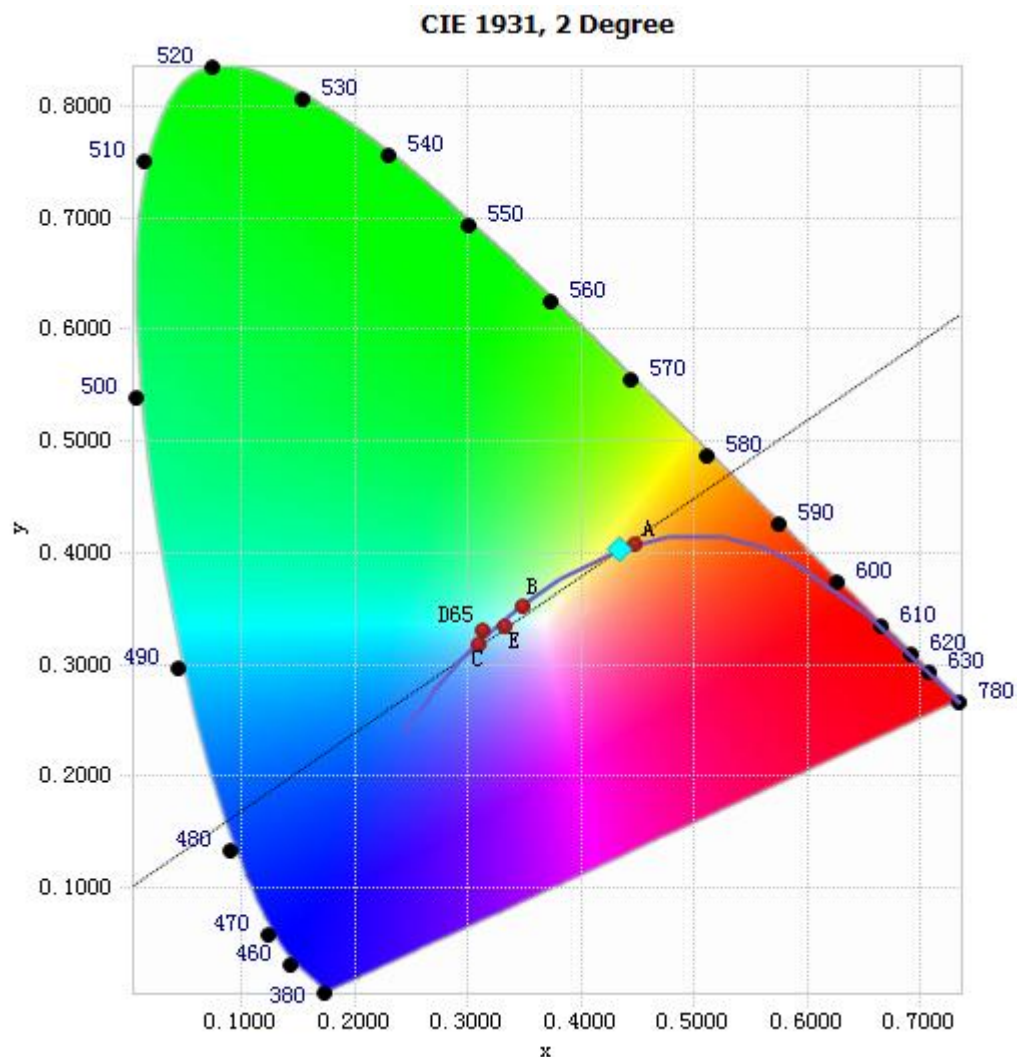
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.90E-05	485	5.31E-03	590	2.47E-02	695	4.52E-03
385	6.51E-05	490	5.76E-03	595	2.53E-02	700	3.88E-03
390	6.18E-05	495	6.54E-03	600	2.57E-02	705	3.33E-03
395	6.37E-05	500	7.64E-03	605	2.56E-02	710	2.86E-03
400	6.06E-05	505	8.86E-03	610	2.53E-02	715	2.46E-03
405	7.24E-05	510	1.00E-02	615	2.45E-02	720	2.12E-03
410	1.29E-04	515	1.10E-02	620	2.35E-02	725	1.82E-03
415	2.46E-04	520	1.18E-02	625	2.24E-02	730	1.55E-03
420	4.75E-04	525	1.25E-02	630	2.10E-02	735	1.32E-03
425	9.00E-04	530	1.32E-02	635	1.94E-02	740	1.13E-03
430	1.60E-03	535	1.38E-02	640	1.79E-02	745	9.71E-04
435	2.74E-03	540	1.44E-02	645	1.63E-02	750	8.32E-04
440	4.49E-03	545	1.51E-02	650	1.47E-02	755	7.13E-04
445	7.25E-03	550	1.58E-02	655	1.31E-02	760	6.11E-04
450	1.14E-02	555	1.67E-02	660	1.17E-02	765	5.22E-04
455	1.42E-02	560	1.77E-02	665	1.03E-02	770	4.49E-04
460	1.22E-02	565	1.89E-02	670	9.08E-03	775	3.83E-04
465	9.41E-03	570	2.02E-02	675	7.97E-03	780	3.30E-04
470	7.81E-03	575	2.14E-02	680	6.95E-03		
475	6.45E-03	580	2.27E-02	685	6.03E-03		
480	5.45E-03	585	2.38E-02	690	5.22E-03		

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



# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4346, 0.4037)

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

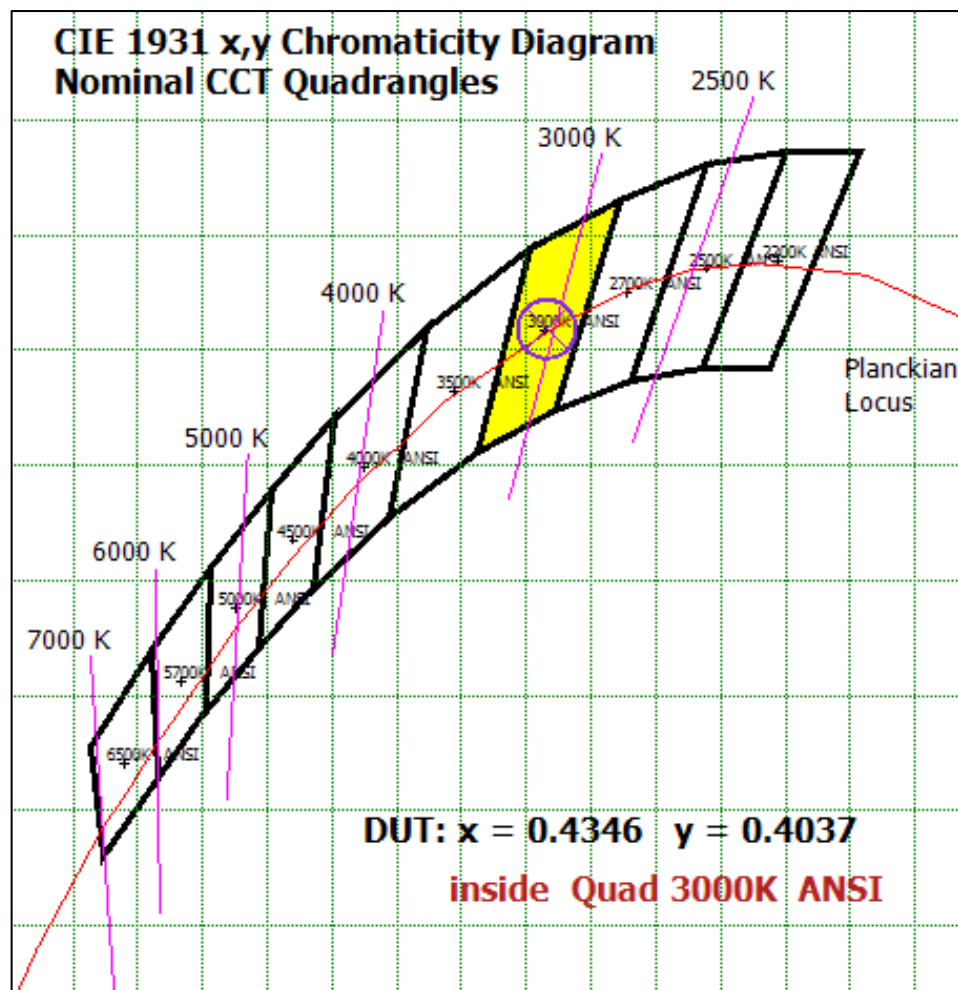
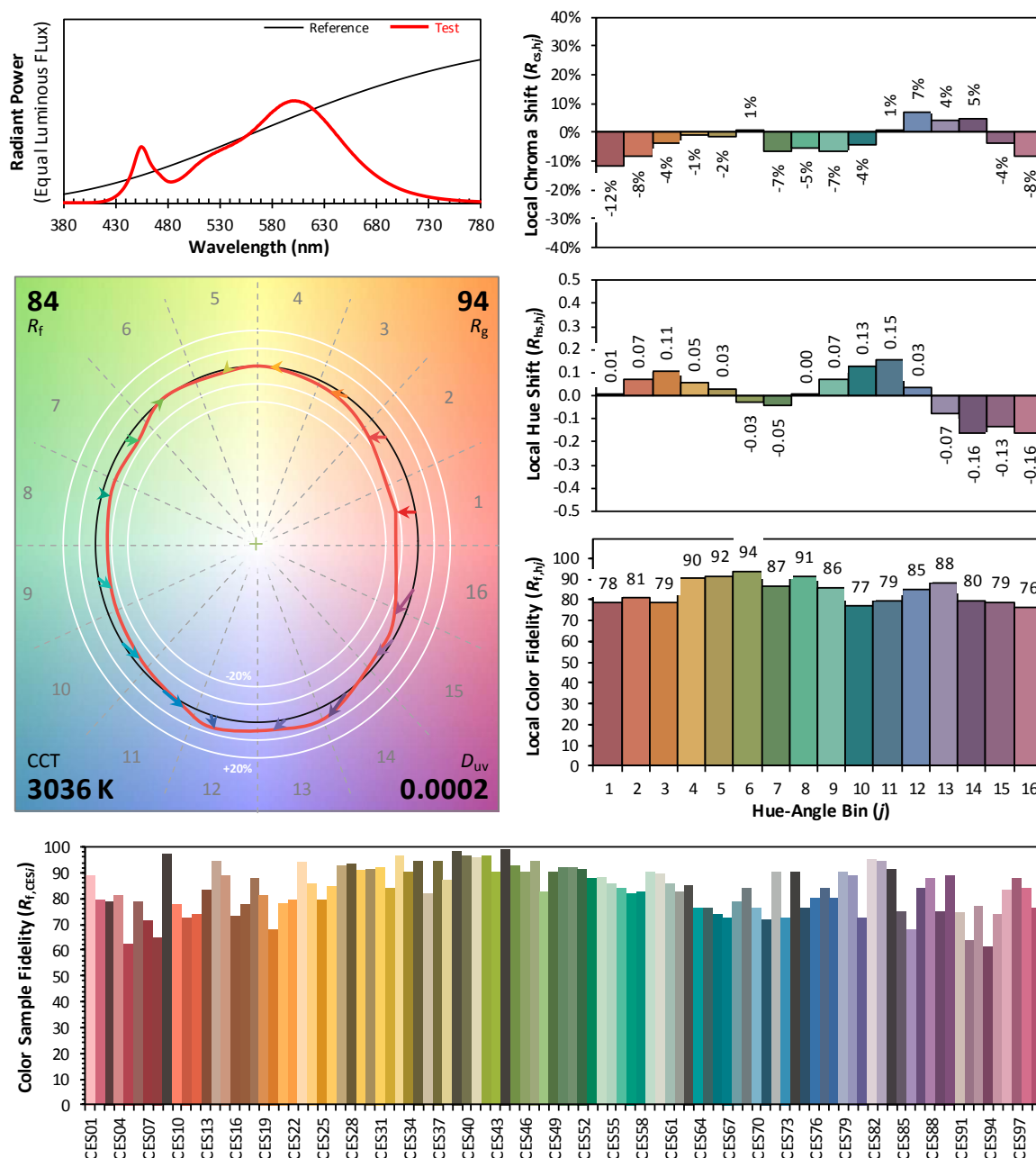


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4346  
 $y$  0.4037  
 $u'$  0.2493  
 $v'$  0.5209

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	1.478	0.12%
10- 20	8.676	0.68%
20- 30	23.474	1.85%
30- 40	44.99	3.54%
40- 50	71.095	5.59%
50- 60	98.667	7.76%
60- 70	123.804	9.73%
70- 80	142.504	11.20%
80- 90	151.437	11.91%
90-100	149.174	11.73%
100-110	136.086	10.70%
110-120	114.796	9.03%
120-130	88.631	6.97%
130-140	61.374	4.83%
140-150	36.605	2.88%
150-160	16.086	1.26%
160-170	2.842	0.22%
170-180	0.134	0.01%
Total	1271.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	248.38	19.53%
60- 90	417.745	32.85%
0-90	666.125	52.37%
90- 180	605.728	47.63%
0- 180	1271.9	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

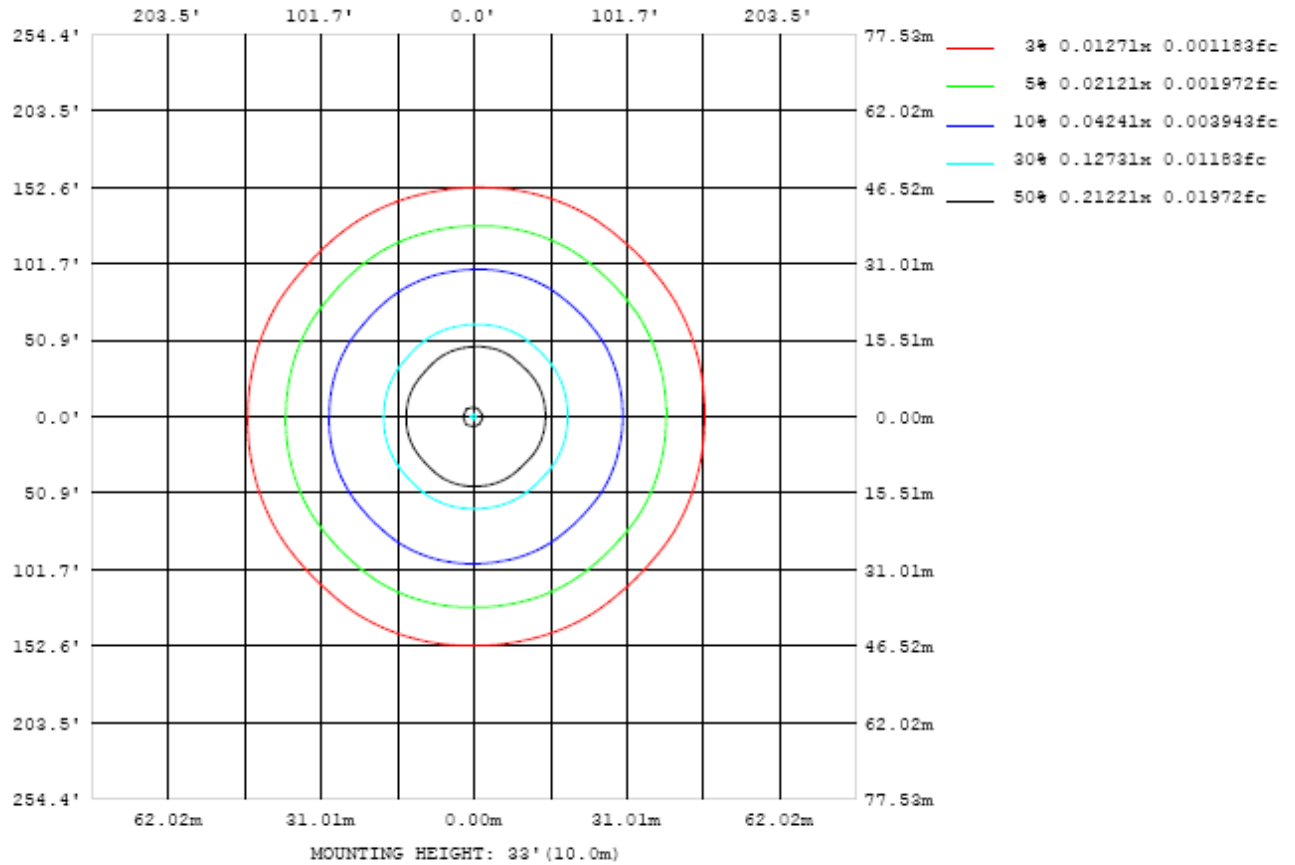


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

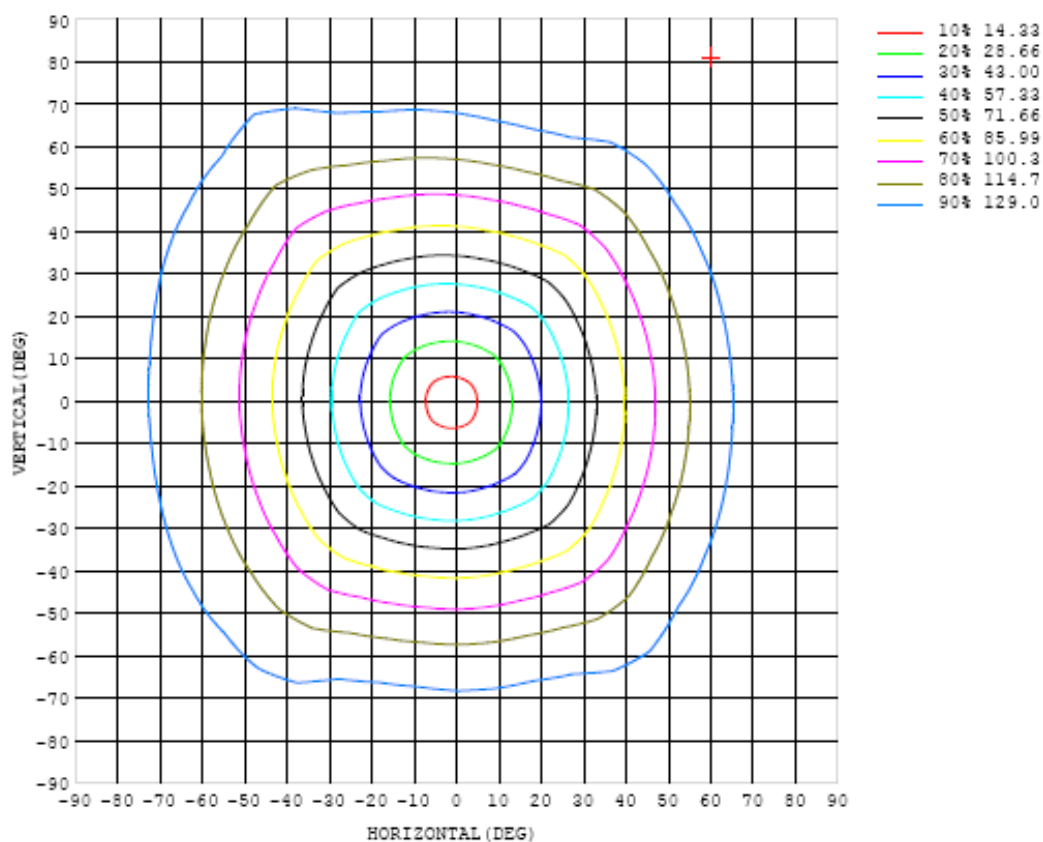


Chart 6: Isocandela Plot

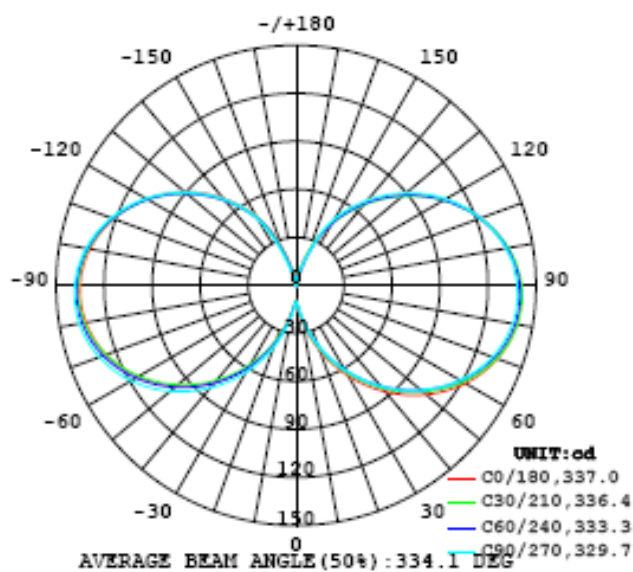


Chart 7: Polar Candela Distribution

# 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	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	10.0	10.0	10.0	10.0	10.0	10.0
5	14.5	14.5	14.3	14.1	13.8	13.5	13.3	13.1	12.9	12.7	12.6	12.4	12.2	12.0	11.8	11.7	11.7	11.8	11.7
10	22.6	22.5	22.2	21.7	21.2	20.6	20.4	20.3	20.1	19.9	19.6	19.2	18.7	18.3	17.9	18.0	18.2	18.3	18.2
15	32.5	32.3	31.9	31.2	30.2	29.5	29.6	29.7	29.5	29.2	28.9	28.3	27.6	26.9	26.4	26.8	27.1	27.3	27.1
20	43.2	42.9	42.3	41.4	40.1	39.2	39.7	40.0	39.9	39.5	39.2	38.5	37.6	36.4	36.0	36.6	37.1	37.3	37.2
25	54.2	53.9	53.2	52.0	50.3	49.4	50.2	50.7	50.6	50.3	49.9	49.1	48.0	46.5	46.0	46.9	47.5	47.9	47.6
30	65.2	64.8	64.0	62.7	60.6	59.7	60.9	61.5	61.4	61.2	60.8	59.9	58.6	56.7	56.2	57.4	58.2	58.5	58.2
35	76.0	75.7	74.8	73.3	71.0	70.1	71.5	72.2	72.2	71.9	71.6	70.6	69.2	66.9	66.4	67.8	68.7	69.1	68.7
40	86.6	86.2	85.4	83.8	81.2	80.3	82.0	82.7	82.7	82.4	82.2	81.2	79.7	77.0	76.6	78.2	79.0	79.3	78.9
45	96.6	96.3	95.5	93.9	91.1	90.3	92.1	92.9	92.7	92.5	92.4	91.4	89.8	87.0	86.5	88.2	89.0	89.2	88.7
50	106	106	105	104	101	99.8	102	103	102	102	102	101	99.6	96.5	96.1	97.8	98.5	98.6	97.9
55	115	114	114	113	109	109	111	111	111	111	111	110	109	106	105	107	107	107	106
60	122	122	122	121	117	117	119	119	119	118	119	118	117	114	113	115	115	115	114
65	129	129	129	128	124	124	126	126	125	125	126	126	125	121	121	122	122	122	121
70	134	134	134	133	130	130	132	132	131	131	131	132	131	127	127	128	128	127	126
75	138	138	138	138	134	134	136	136	135	135	136	136	136	132	132	133	133	132	131
80	140	140	141	140	137	137	139	139	137	137	139	139	139	135	135	136	136	135	134
85	141	141	142	142	138	138	140	140	139	139	140	141	140	137	137	138	137	136	135
90	140	141	141	141	138	138	140	139	139	138	140	141	140	137	137	138	137	136	135
95	138	138	139	139	136	136	138	137	137	137	138	139	139	136	136	137	136	135	134
100	134	134	135	135	132	132	134	134	133	133	135	136	135	133	133	134	133	132	131
105	129	130	130	129	127	127	129	129	128	128	130	131	130	128	128	129	129	128	127
110	123	123	123	123	120	120	122	123	123	123	124	125	124	122	122	123	123	123	122
115	116	116	116	115	112	113	115	116	116	116	117	118	117	115	115	117	117	116	115
120	107	107	107	106	104	104	107	108	108	108	109	110	109	107	107	109	109	109	108
125	98.2	98.3	98.0	96.9	94.5	95.1	97.3	98.6	98.8	99.3	100	101	100	97.5	98.0	99.8	100	100	99.9
130	88.6	88.4	88.0	87.0	84.5	85.4	87.7	88.9	89.1	89.9	90.8	90.9	90.2	88.1	88.5	90.4	91.2	91.2	90.9
135	78.3	78.0	77.5	76.4	74.2	75.1	77.5	78.7	79.2	79.9	80.5	80.7	80.0	78.0	78.7	80.4	81.2	81.5	81.4
140	67.6	67.4	66.9	65.8	63.9	64.7	66.8	68.1	68.7	69.5	70.1	70.1	69.3	67.7	68.5	70.1	70.8	71.2	70.9
145	56.7	56.5	55.9	55.0	53.4	54.2	56.1	57.3	58.1	58.8	59.4	59.4	58.7	56.9	58.2	59.7	58.7	59.6	60.5
150	44.5	45.0	45.1	44.4	43.2	43.3	45.2	46.2	46.4	48.1	48.6	48.6	48.2	45.7	47.9	49.2	46.4	47.4	49.7
155	31.2	32.2	34.1	33.8	33.1	31.2	32.5	34.0	33.0	33.2	35.5	37.3	37.6	35.5	37.2	38.7	34.3	35.1	37.5
160	21.2	21.8	21.9	21.3	17.6	15.1	16.7	20.1	19.3	18.6	16.2	25.2	25.5	25.6	26.0	28.1	23.2	22.4	23.1
165	12.3	12.7	13.2	12.3	9.58	7.59	6.87	5.70	5.78	9.75	11.3	14.1	14.2	15.4	13.5	15.1	12.4	9.84	9.68
170	4.35	5.21	5.80	6.21	6.31	5.08	3.32	2.30	0.70	0.49	1.96	3.82	6.01	6.50	5.14	4.98	3.45	2.22	2.33
175	0.78	0.77	0.76	0.72	0.71	0.64	0.29	0.15	0.15	0.15	0.15	0.13	0.13	0.13	0.13	0.14	0.15	0.23	0.18
180	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

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	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	10.0	10.0	10.0	10.0		
5	11.8	11.8	12.0	12.1	12.4	12.7	13.0	13.3	13.5	13.7	13.9	14.0	14.1	14.2	14.4	14.5	14.5		
10	18.2	18.3	18.3	18.4	19.0	19.6	20.2	20.7	21.1	21.4	21.6	21.6	21.6	21.9	22.3	22.5	22.6		
15	27.1	27.2	27.0	26.9	27.7	28.6	29.4	30.0	30.6	31.0	31.1	31.1	30.8	31.2	31.9	32.4	32.5		
20	37.1	37.0	36.7	36.2	37.3	38.5	39.6	40.3	41.0	41.5	41.5	41.3	40.7	41.4	42.3	43.0	43.3		
25	47.5	47.3	46.8	45.9	47.2	48.8	50.1	51.0	51.8	52.3	52.3	51.9	51.0	51.8	53.1	53.9	54.2		
30	58.1	57.7	57.1	55.8	57.2	59.2	60.7	61.7	62.6	63.2	63.2	62.7	61.5	62.3	63.9	64.9	65.3		
35	68.5	68.1	67.3	65.8	67.3	69.5	71.2	72.3	73.2	73.9	74.0	73.4	71.9	72.8	74.7	75.8	76.2		
40	78.7	78.3	77.4	75.7	77.2	79.7	81.5	82.6	83.6	84.5	84.5	84.0	82.3	83.2	85.2	86.5	86.8		
45	88.5	88.2	87.2	85.3	86.9	89.6	91.4	92.5	93.5	94.5	94.8	94.2	92.3	93.3	95.5	96.7	96.9		
50	97.8	97.6	96.7	94.5	96.1	99.0	101	102	103	104	104	104	102	103	105	106	106		
55	106	106	105	103	105	108	109	110	111	113	113	113	111	112	114	115	115		
60	114	114	114	111	113	116	117	118	119	121	121	121	119	120	122	123	123		
65	121	121	121	118	120	123	124	125	126	127	128	129	126	127	129	130	129		
70	127	127	127	124	126	128	130	130	131	133	134	134	132	133	135	135	135		
75	131	132	131	129	130	133	134	134	135	137	138	139	137	137	140	140	139		
80	134	135	134	132	133	136	137	137	138	140	141	142	140	140	142	142	141		
85	135	136	136	134	135	137	138	138	139	141	142	143	141	141	143	143	142		
90	135	136	136	134	135	137	138	138	138	140	142	143	140	141	143	143	141		
95	134	135	135	132	133	136	136	136	137	138	140	140	138	139	140	140	139		
100	131	132	132	129	130	132	133	133	133	135	136	137	135	135	137	136	135		
105	127	128	127	125	126	128	129	128	129	130	131	132	129	130	131	131	130		
110	122	122	122	119	120	122	123	123	123	124	125	125	123	123	125	125	124		
115	115	116	115	113	113	115	116	116	116	117	118	118	115	115	117	117	117		
120	108	108	107	105	105	107	108	108	109	109	109	109	107	107	108	109	108		
125	99.7	99.6	98.7	96.3	96.6	98.7	99.6	99.8	99.9	100	100	99.7	97.6	97.2	98.9	99.5	99.2		
130	90.7	90.4	89.4	87.1	87.2	89.3	90.3	90.4	90.6	90.9	90.5	89.7	87.5	87.1	88.8	89.4	89.3		
135	81.1	80.7	79.6	77.5	77.5	79.3	80.3	80.4	80.6	80.7	80.2	79.2	77.1	76.7	78.2	78.9	79.0		
140	71.1	70.6	69.5	67.5	67.4	69.1	69.9	70.1	70.2	70.2	69.5	68.5	66.5	66.1	67.4	68.1	68.2		
145	60.6	60.3	59.2	57.5	57.2	58.7	59.4	59.5	59.6	59.5	58.6	57.6	55.9	55.4	56.5	57.0	57.3		
150	49.9	49.6	48.9	47.5	47.1	48.1	48.2	48.2	47.7	47.9	47.2	46.7	45.5	44.8	45.5	45.6	44.1		
155	37.5	36.9	35.8	34.3	33.5	34.1	33.6	32.9	31.0	29.7	31.0	34.2	34.6	34.3	34.7	33.8	33.5		
160	23.0	22.0	21.0	20.0	19.1	18.8	18.0	16.3	11.9	8.37	9.50	13.6	16.0	18.8	21.4	21.6	22.4		
165	9.76	7.71	6.29	6.45	6.55	6.07	5.08	2.56	0.54	0.55	0.59	0.60	0.61	1.62	4.17	7.06	10.2		
170	2.32	1.90	1.80	1.50	1.35	1.23	1.12	1.09	1.11	1.07	0.94	0.92	0.92	0.90	0.78	0.72	1.75		
175	0.20	0.55	1.55	2.18	2.16	2.08	1.97	1.81	1.58	1.36	1.22	1.26	1.27	1.33	1.22	1.21	1.05		
180	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08		

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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