

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 7MR16DIM/930FL35**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ190400470

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

Review by:



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May 10, 2019

Approved by:



Manager: Jim Zhang  
May 10, 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: 7MR16DIM/930FL35

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
87.5	589.1	6.73	0.9318
CCT (K)	CRI	Stabilization Time (Light & Power)	
2970	92.5	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>	: Apr. 26, 2019
<b>Date of Test</b>	: Apr. 30, 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>	: 7MR16DIM/930FL35
<b>Electrical Ratings</b>	: 12V, 60Hz, 7W
<b>Product Description</b>	: 3000K
<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)	12.0
Voltage frequency (Hz)	60
Test Current (A)	0.603
Power Factor	0.9318
Test Power (W)	6.73
THD A%	19.48
Luminous Efficacy (lm/W)	87.5
Total Luminous Flux (lm)	589.1
Color Rendering Index (CRI)	92.5
R9	57.7
Correlated Color Temperature (CCT)(K)	2970
Chromaticity Chroma x	0.4389
Chromaticity Chroma y	0.4046
Chromaticity Chroma u	0.2516
Chromaticity Chroma v	0.3479
Duv	0.0003
Chromaticity Chroma u'	0.2516
Chromaticity Chroma v'	0.5219

Special Color Rendering Indices	
R1	92.6
R2	96.9
R3	98.7
R4	91.6
R5	92.2
R6	95.9
R7	91.3
R8	80.8
R9	57.7
R10	91.5
R11	92.1
R12	81.6
R13	93.8
R14	99.2

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 24.7°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)	12.0
Voltage frequency (Hz)	60
Test Current (A)	0.610
Power Factor	0.9323
Power (W)	6.80
Luminous Efficacy (lm/W)	87.6
Total Luminous Flux (lm)	595.3
Beam Angle (°)	32.2 (0°-180°) / 31.8 (90°-270°)
Center Beam Candle Power (cd)	1684
Maximum Beam Candle Power (cd)	1684 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.53 (0°-180°) / 0.52 (90°-270°)
Zonal Lumens in the 0°-60° Zone	97.06%
Zonal Lumens in the 60°-90° Zone	2.75%
Zonal Lumens in the 90°-120° Zone	0.16%
Zonal Lumens in the 120°-180° Zone	0.03%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

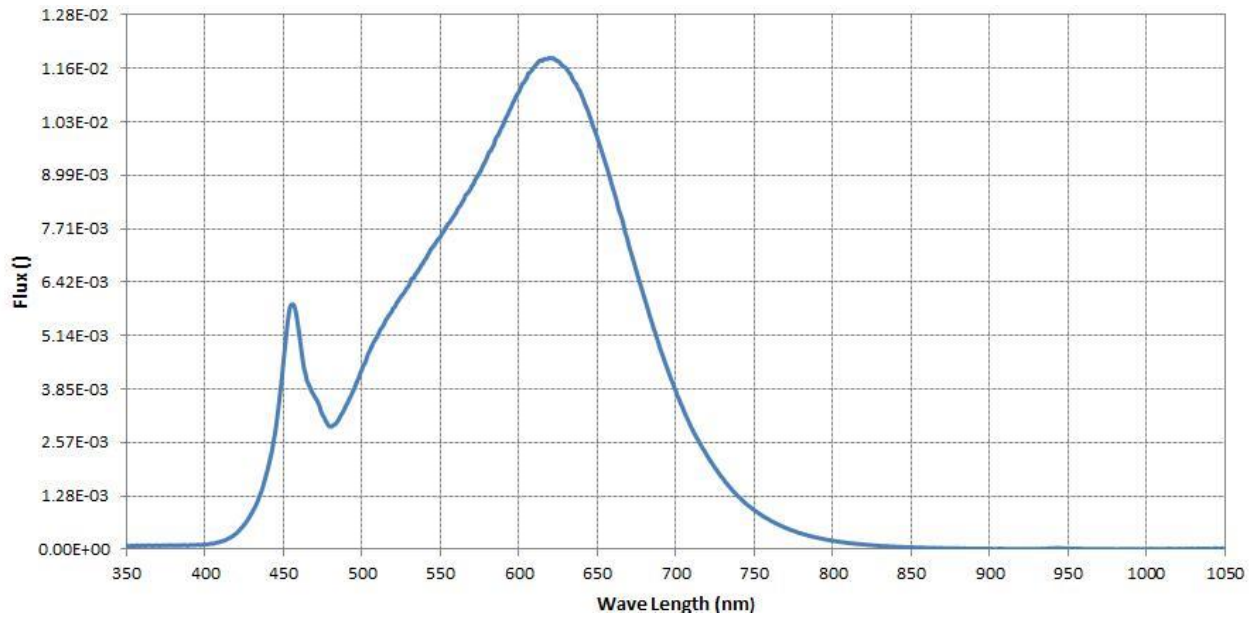


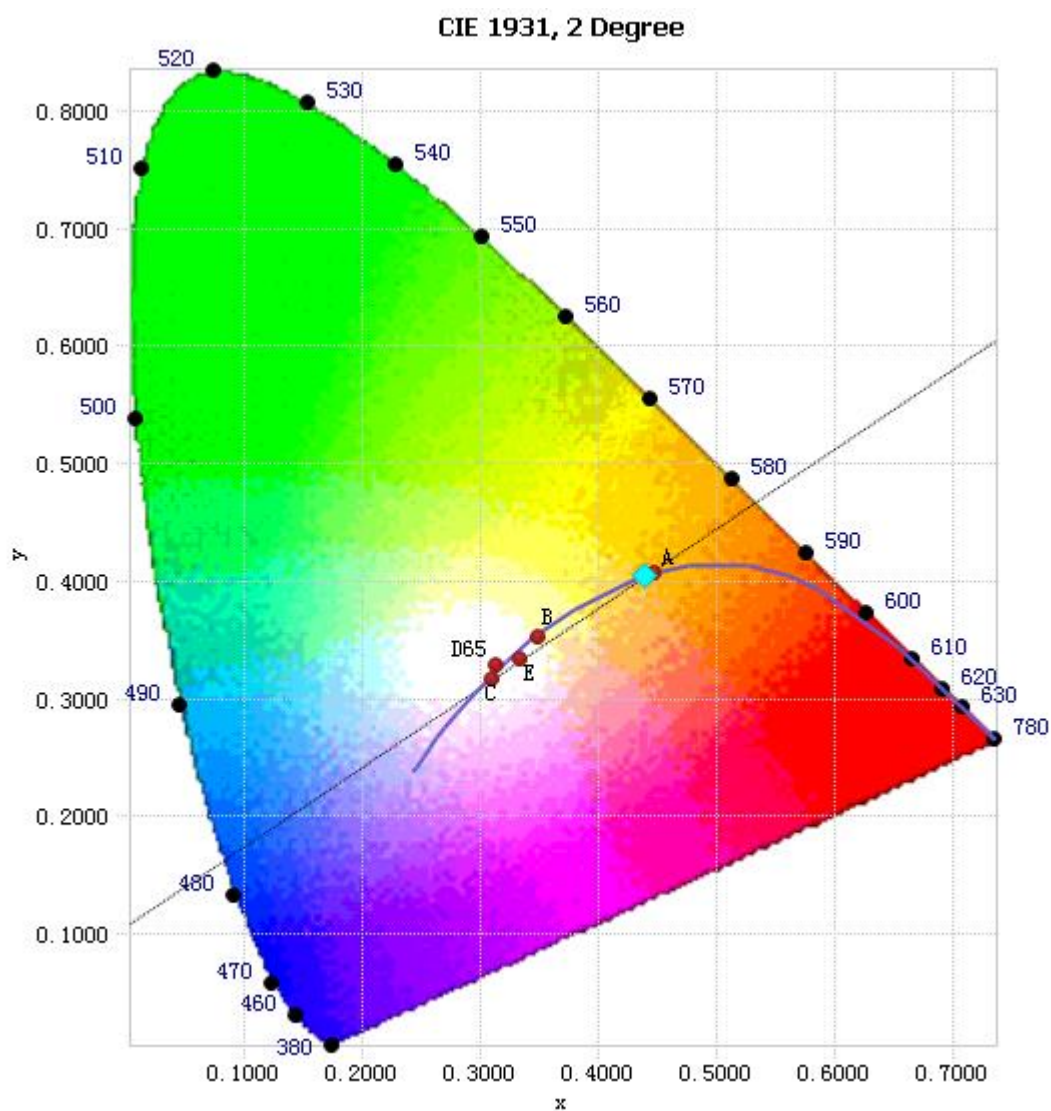
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	9.54E-05	485	3.10E-03	590	1.02E-02	695	4.30E-03
385	8.91E-05	490	3.46E-03	595	1.06E-02	700	3.81E-03
390	1.04E-04	495	3.85E-03	600	1.10E-02	705	3.35E-03
395	1.11E-04	500	4.32E-03	605	1.13E-02	710	2.92E-03
400	1.17E-04	505	4.77E-03	610	1.16E-02	715	2.57E-03
405	1.34E-04	510	5.13E-03	615	1.17E-02	720	2.25E-03
410	1.86E-04	515	5.50E-03	620	1.18E-02	725	1.96E-03
415	2.65E-04	520	5.79E-03	625	1.17E-02	730	1.71E-03
420	3.86E-04	525	6.07E-03	630	1.16E-02	735	1.47E-03
425	5.95E-04	530	6.34E-03	635	1.13E-02	740	1.27E-03
430	8.81E-04	535	6.65E-03	640	1.09E-02	745	1.09E-03
435	1.30E-03	540	6.96E-03	645	1.04E-02	750	9.43E-04
440	1.91E-03	545	7.26E-03	650	9.89E-03	755	8.14E-04
445	2.87E-03	550	7.51E-03	655	9.30E-03	760	7.01E-04
450	4.50E-03	555	7.83E-03	660	8.67E-03	765	6.09E-04
455	5.87E-03	560	8.09E-03	665	8.02E-03	770	5.17E-04
460	5.20E-03	565	8.41E-03	670	7.32E-03	775	4.46E-04
465	4.06E-03	570	8.73E-03	675	6.68E-03	780	3.84E-04
470	3.67E-03	575	9.05E-03	680	6.04E-03		
475	3.23E-03	580	9.45E-03	685	5.43E-03		
480	2.96E-03	585	9.84E-03	690	4.84E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4389, 0.4046)

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

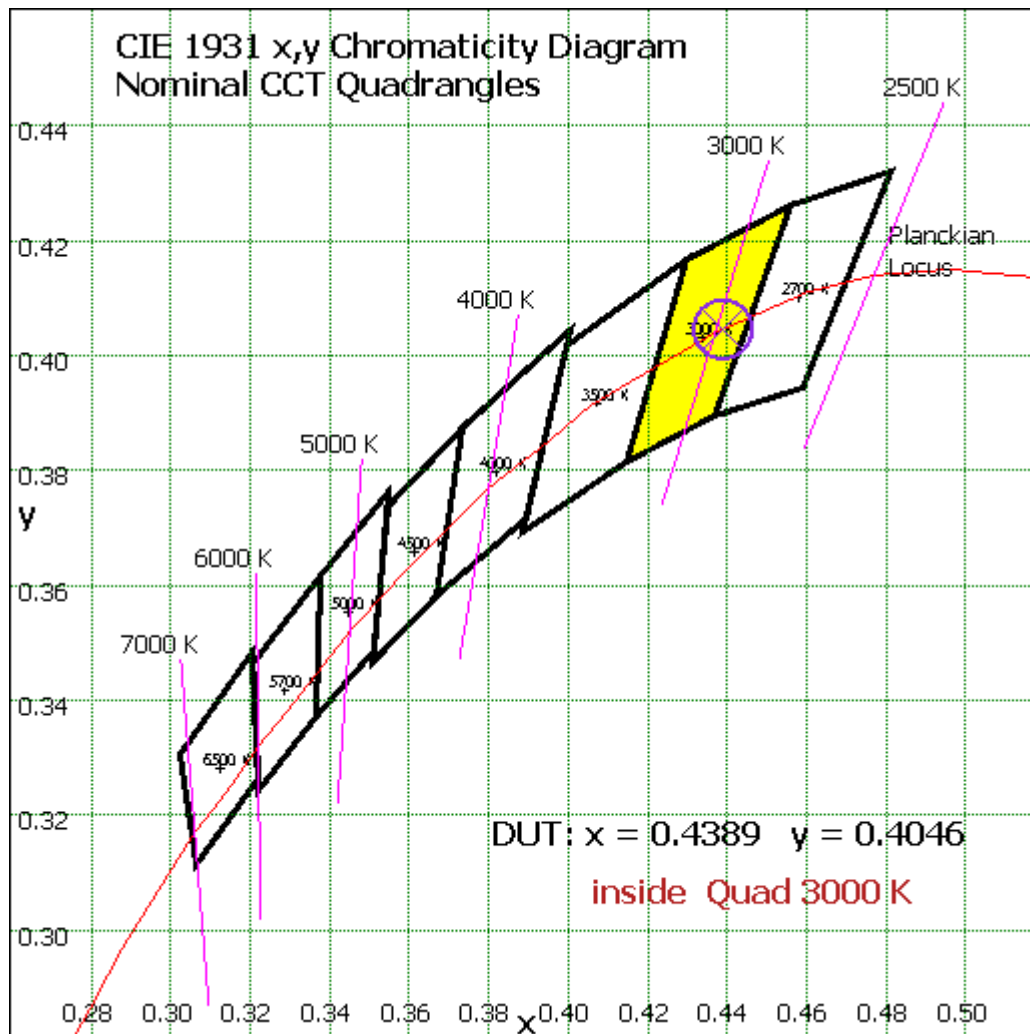
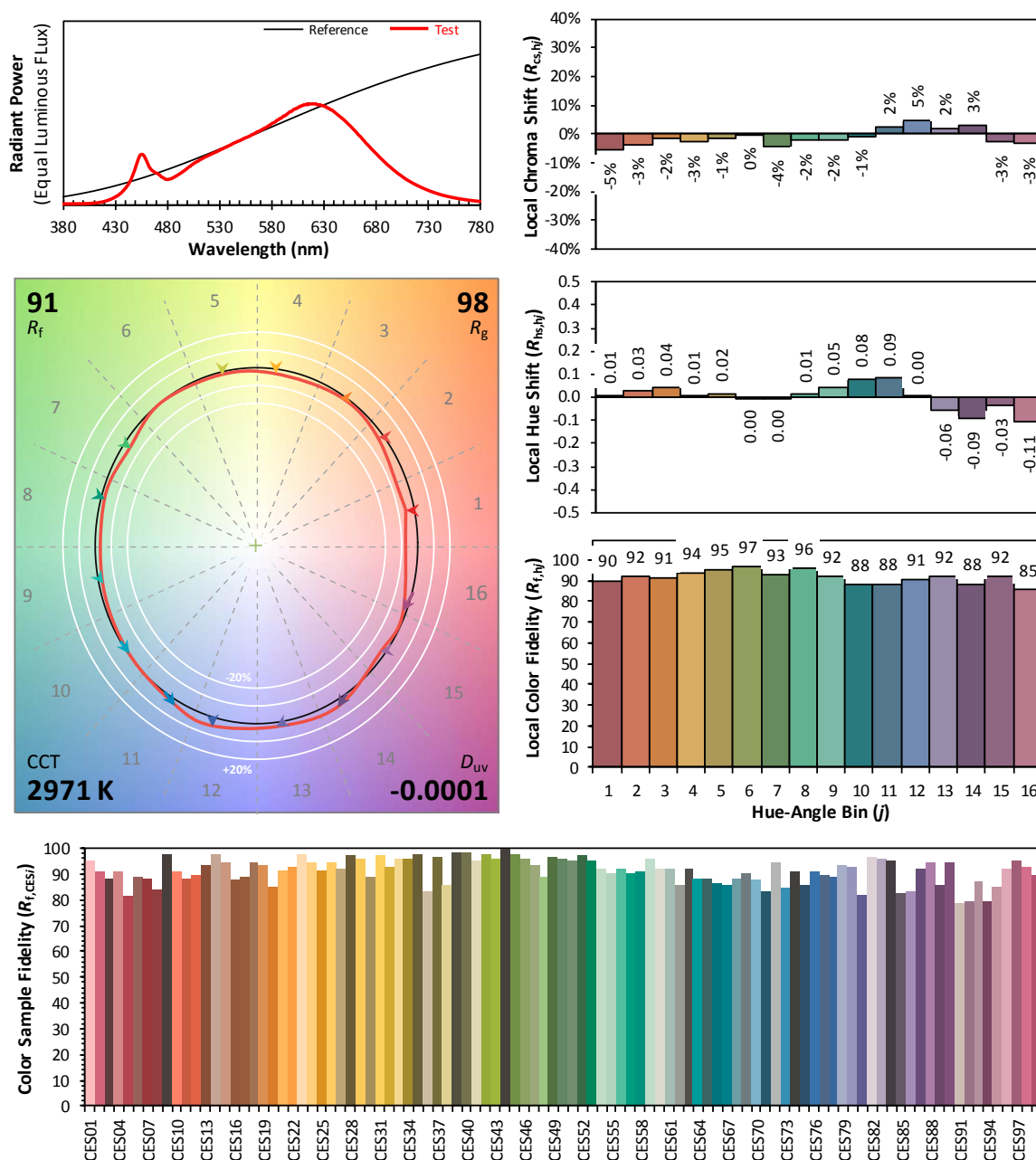


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4389  
 $y$  0.4046  
 $u'$  0.2516  
 $v'$  0.5219

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	146.291	24.57%
10- 20	251.295	42.21%
20- 30	114.796	19.28%
30- 40	35.635	5.99%
40- 50	18.316	3.08%
50- 60	11.53	1.94%
60- 70	8.556	1.44%
70- 80	5.263	0.88%
80- 90	2.528	0.42%
90-100	0.838	0.14%
100-110	0.112	0.02%
110-120	0	0.00%
120-130	0.004	0.00%
130-140	0.012	0.00%
140-150	0.026	0.00%
150-160	0.054	0.01%
160-170	0.064	0.01%
170-180	0.025	0.00%
Total	595.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	577.863	97.06%
60- 90	16.347	2.75%
0-90	594.21	99.81%
90- 180	1.135	0.19%
0- 180	595.3	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

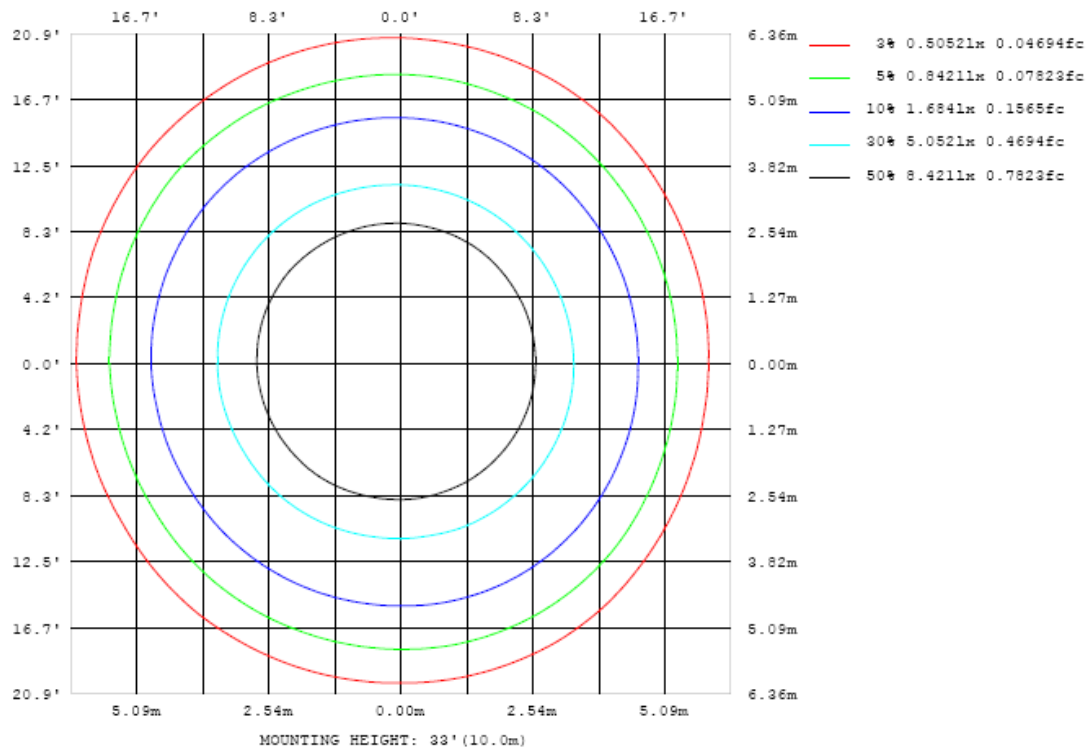


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

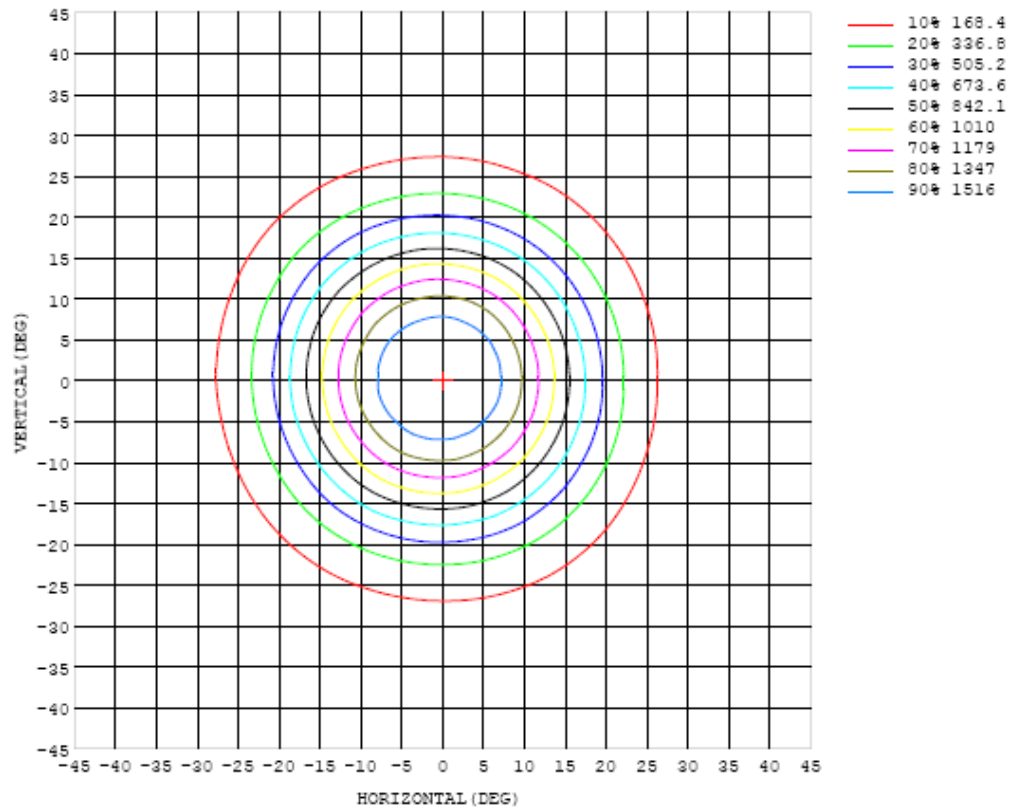


Chart 6: Isocandela Plot

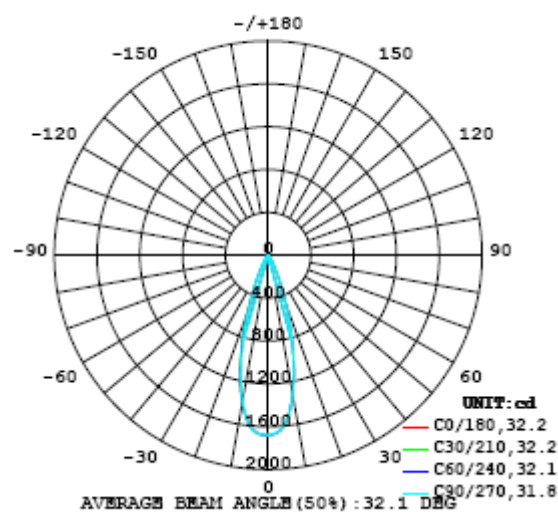


Chart 7: Polar Candela Distribution

## 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	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684
5	1613	1611	1609	1609	1603	1608	1612	1607	1611	1609	1609	1613	1613	1616	1620	1622	1624	1626	1631
10	1321	1321	1320	1316	1318	1314	1323	1317	1328	1327	1334	1343	1356	1361	1369	1377	1385	1393	1397
15	887	886	887	885	887	888	897	892	900	901	906	915	931	943	949	961	969	978	986
20	473	478	479	479	485	484	488	486	486	485	491	497	506	519	525	530	541	554	561
25	207	211	213	217	222	225	228	228	229	227	228	230	233	236	238	241	246	251	259
30	87.8	87.9	89.6	92.9	97.0	101	103	103	104	104	104	105	106	107	107	107	109	110	114
35	43.8	43.5	43.1	43.8	45.9	48.4	51.5	51.3	52.2	52.0	52.4	52.9	53.5	54.4	54.5	53.5	53.3	53.4	54.4
40	29.5	29.1	29.2	29.3	30.1	31.1	31.7	32.1	31.9	31.9	31.6	31.6	31.9	32.4	32.3	32.2	32.4	32.2	32.9
45	21.9	21.4	21.1	21.5	22.2	22.3	22.0	21.7	21.8	21.7	21.5	21.2	21.2	21.2	21.6	22.0	22.6	22.9	23.5
50	16.2	15.7	15.6	15.6	15.7	15.7	15.7	15.3	15.2	15.1	14.9	14.7	14.5	14.7	14.9	15.5	16.0	16.5	16.9
55	12.4	12.4	11.9	11.8	11.8	11.6	11.6	11.5	11.3	11.2	11.2	11.1	10.9	11.1	11.2	11.4	11.9	12.4	12.8
60	10.3	10.4	10.4	9.97	9.52	9.59	9.79	9.62	9.36	9.11	9.16	9.04	8.91	9.06	9.17	9.39	9.73	10.1	10.3
65	8.75	9.09	9.15	8.83	8.78	8.69	8.61	8.44	8.24	8.12	8.11	8.17	8.01	8.22	8.22	8.18	8.35	8.57	8.82
70	6.51	6.71	6.87	6.83	6.87	6.88	6.81	6.65	6.57	6.48	6.44	6.64	6.73	6.80	6.75	6.77	6.74	6.89	7.05
75	4.52	4.61	4.72	4.71	4.86	4.90	4.88	4.77	4.79	4.80	4.75	4.95	4.95	5.03	4.97	5.02	4.88	4.98	5.05
80	3.14	3.10	3.30	3.26	3.50	3.52	3.56	3.41	3.46	3.53	3.48	3.74	3.64	3.66	3.51	3.57	3.53	3.53	3.62
85	1.97	2.00	2.23	2.21	2.35	2.34	2.32	2.23	2.30	2.34	2.43	2.56	2.59	2.54	2.41	2.40	2.46	2.50	2.56
90	1.08	1.14	1.07	1.14	1.10	1.14	1.13	1.11	1.14	1.17	1.20	1.20	1.25	1.16	1.31	1.25	1.30	1.32	1.33
95	0.72	0.76	0.64	0.74	0.69	0.67	0.66	0.67	0.67	0.72	0.73	0.68	0.76	0.77	0.78	0.75	0.81	0.79	0.80
100	0.28	0.29	0.30	0.29	0.29	0.29	0.27	0.28	0.28	0.29	0.31	0.31	0.31	0.33	0.34	0.34	0.35	0.35	0.36
105	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.08	0.08	0.09	0.09	0.09
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
125	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00
130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
135	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01
140	0.02	0.02	0.02	0.02	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	0.02
145	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.04
150	0.06	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07
155	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11
160	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.17
165	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	0.22	0.22	0.22	0.21	0.23
170	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	0.27	0.27	0.26	0.26	0.26	0.26
175	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.25	0.25	0.24	0.24	0.24
180	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22

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	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684	1684		
5	1634	1631	1638	1640	1636	1638	1627	1630	1635	1632	1629	1628	1625	1625	1621	1618	1614		
10	1404	1401	1399	1403	1395	1397	1381	1378	1376	1372	1369	1361	1352	1343	1335	1330	1323		
15	993	997	996	996	984	976	964	957	948	937	931	924	916	904	898	894	888		
20	568	571	571	569	562	555	541	531	522	514	506	500	493	485	481	477	474		
25	263	265	266	266	262	256	250	245	241	237	232	229	224	219	216	212	209		
30	115	118	119	121	118	117	114	112	111	109	106	105	101	97.7	94.5	91.7	89.8		
35	56.1	57.0	58.0	59.6	59.5	60.4	60.5	60.5	58.9	56.6	56.8	56.1	54.6	51.3	48.0	46.5	44.4		
40	33.7	34.1	35.0	35.5	36.2	37.3	37.6	37.9	36.9	36.0	35.4	36.0	35.4	33.1	31.6	30.6	29.7		
45	23.7	25.0	25.5	26.1	25.6	26.0	26.2	26.9	25.9	25.4	25.4	25.6	25.5	24.1	23.3	22.5	22.2		
50	17.6	18.4	18.8	19.2	19.0	19.2	19.4	19.3	18.9	18.8	18.9	18.9	18.7	18.0	17.4	16.9	16.7		
55	13.4	13.7	13.9	14.2	14.1	14.2	14.2	14.2	14.2	13.7	13.8	13.6	13.6	13.1	13.0	12.7	12.4		
60	10.8	11.0	11.0	11.1	11.2	11.3	11.3	11.2	11.1	10.8	10.8	10.7	10.7	10.5	10.3	10.2	10.0		
65	9.06	9.30	9.00	9.05	9.23	9.36	9.35	9.07	8.84	8.66	8.85	8.88	8.88	8.71	8.42	8.28	8.27		
70	7.24	7.28	7.14	7.07	7.26	7.33	7.28	7.03	6.77	6.66	6.85	6.86	6.79	6.65	6.43	6.27	6.32		
75	5.12	5.16	5.04	5.09	5.10	5.21	5.17	5.00	4.93	4.83	4.89	4.89	4.81	4.71	4.56	4.51	4.48		
80	3.54	3.59	3.42	3.59	3.51	3.50	3.51	3.42	3.52	3.43	3.52	3.39	3.40	3.27	3.19	3.19	3.09		
85	2.55	2.62	2.38	2.46	2.39	2.32	2.39	2.34	2.40	2.41	2.54	2.55	2.49	2.33	2.15	2.19	2.05		
90	1.37	1.30	1.28	1.24	1.27	1.23	1.23	1.22	1.23	1.28	1.30	1.34	1.23	1.20	1.17	1.16	1.11		
95	0.80	0.81	0.86	0.78	0.82	0.83	0.80	0.77	0.79	0.82	0.78	0.92	0.76	0.80	0.71	0.74	0.72		
100	0.37	0.38	0.38	0.40	0.39	0.38	0.39	0.39	0.37	0.36	0.38	0.35	0.36	0.35	0.33	0.33	0.31		
105	0.09	0.09	0.10	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.07		
110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01		
130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
135	0.01	0.01	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		
140	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03		
145	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.05	0.04		
150	0.07	0.07	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		
155	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.13		
160	0.18	0.19	0.18	0.19	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.19		
165	0.25	0.25	0.24	0.25	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.24		
170	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	0.29	0.29	0.29	0.28		
175	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25		
180	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22		

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	3M	HZTE015-04	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  $4\pi$ . 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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