

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 7MR16DIM/927FL35**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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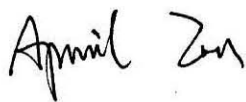
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Report No.: HZ19040014g

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

Review by:



Engineer: April Zou  
Apr. 18, 2019

Approved by:



Manager: Jim Zhang  
Apr. 18, 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/927FL35

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
84.8	545.2	6.43	0.9196
CCT (K)	CRI	Stabilization Time (Light & Power)	
2705	92.1	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. 09, 2019
<b>Date of Test</b>	: Apr. 17, 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/927FL35
<b>Electrical Ratings</b>	: 12V, 60Hz, 7W
<b>Product Description</b>	: 2700K
<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)	0.583
Power Factor	0.9196
Test Power (W)	6.43
THD A%	22.39
Luminous Efficacy (lm/W)	84.8
Total Luminous Flux (lm)	545.2
Color Rendering Index (CRI)	92.1
R9	54
Correlated Color Temperature (CCT)(K)	2705
Chromaticity Chroma x	0.4615
Chromaticity Chroma y	0.4145
Chromaticity Chroma u	0.2618
Chromaticity Chroma v	0.3527
Duv	0.0010
Chromaticity Chroma u'	0.2618
Chromaticity Chroma v'	0.5291

Special Color Rendering Indices	
R1	91.8
R2	96.2
R3	99.3
R4	91.6
R5	91.6
R6	96.4
R7	90.9
R8	78.9
R9	54
R10	90.6
R11	92.6
R12	84.2
R13	92.9
R14	99.1
Rf	92
Rg	97

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)	12.0
Voltage frequency (Hz)	60
Test Current (A)	0.584
Power Factor	0.9211
Power (W)	6.48
Luminous Efficacy (lm/W)	85.5
Total Luminous Flux (lm)	554.1
Beam Angle ( ° )	31.6 ( 0°-180° ) / 31.2 ( 90°-270° )
Center Beam Candle Power (cd)	1661
Maximum Beam Candle Power (cd)	1661 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.52 ( 0°-180° ) / 0.50 ( 90°-270° )
Zonal Lumens in the 0 °-60 °Zone	96.76%
Zonal Lumens in the 60 °-90 °Zone	2.94%
Zonal Lumens in the 90 °-120 °Zone	0.17%
Zonal Lumens in the 120 °-180 °Zone	0.14%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

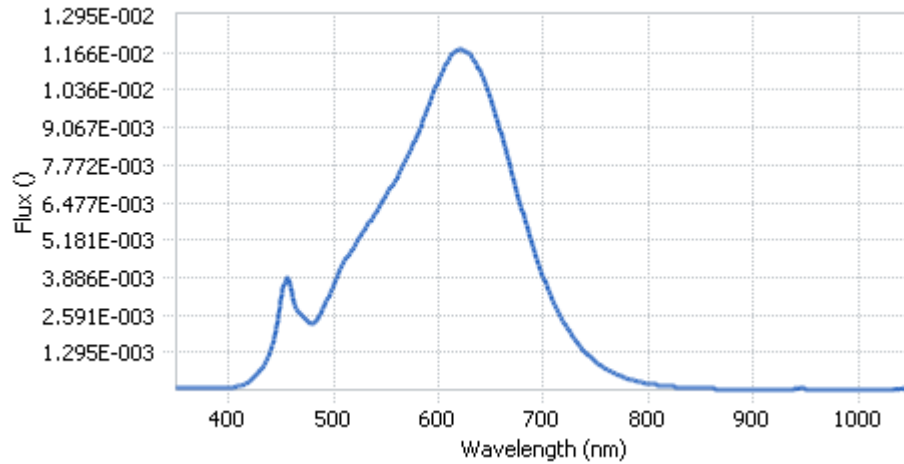


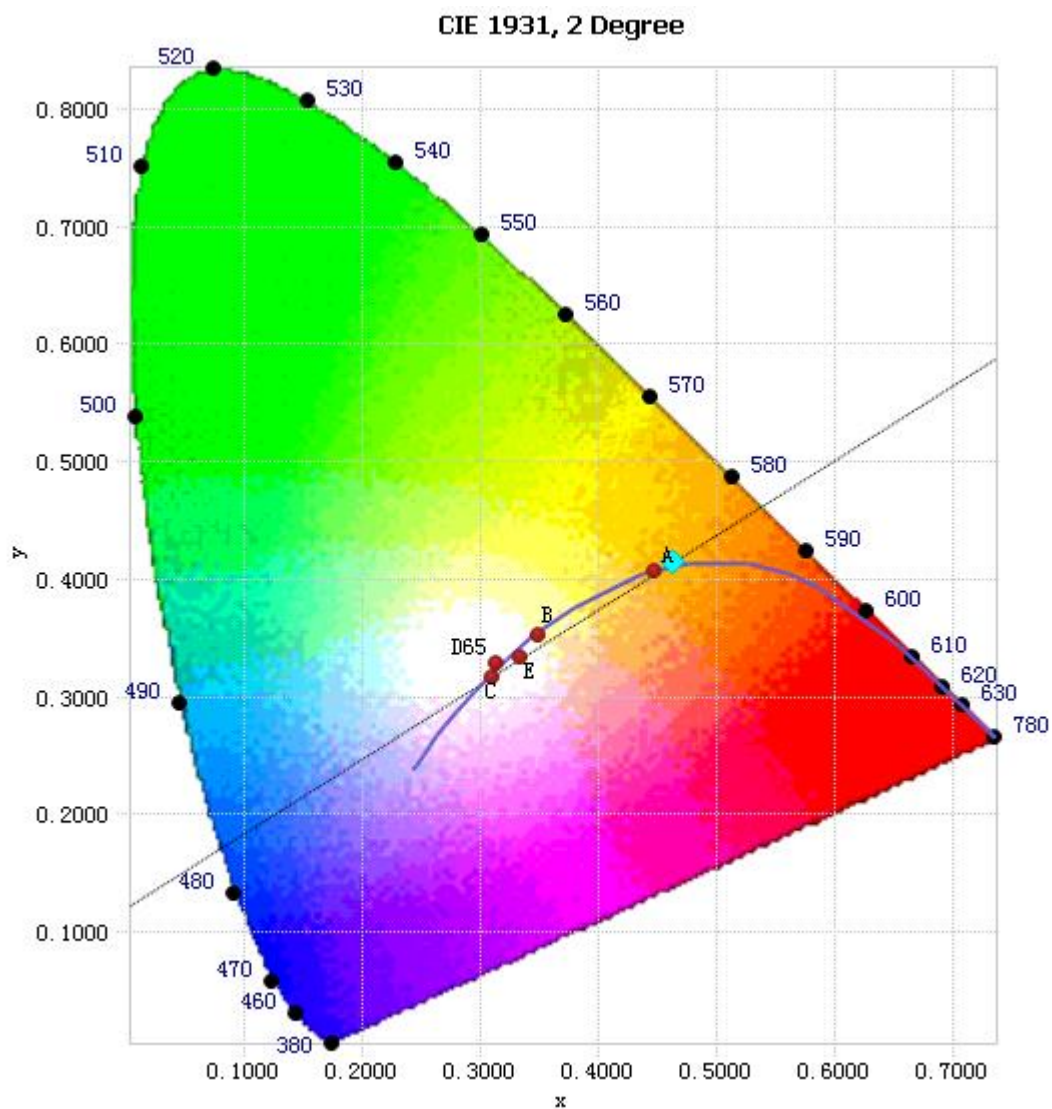
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.58E-05	485	2.45E-03	590	9.76E-03	695	4.39E-03
385	6.49E-05	490	2.82E-03	595	1.03E-02	700	3.89E-03
390	6.77E-05	495	3.21E-03	600	1.07E-02	705	3.40E-03
395	7.19E-05	500	3.64E-03	605	1.11E-02	710	2.99E-03
400	7.82E-05	505	4.06E-03	610	1.15E-02	715	2.62E-03
405	9.48E-05	510	4.43E-03	615	1.17E-02	720	2.29E-03
410	1.33E-04	515	4.73E-03	620	1.18E-02	725	2.00E-03
415	2.00E-04	520	5.02E-03	625	1.17E-02	730	1.73E-03
420	3.04E-04	525	5.27E-03	630	1.16E-02	735	1.50E-03
425	4.58E-04	530	5.57E-03	635	1.13E-02	740	1.29E-03
430	6.73E-04	535	5.84E-03	640	1.10E-02	745	1.11E-03
435	9.67E-04	540	6.12E-03	645	1.05E-02	750	9.63E-04
440	1.39E-03	545	6.42E-03	650	1.00E-02	755	8.31E-04
445	2.06E-03	550	6.70E-03	655	9.44E-03	760	7.17E-04
450	3.09E-03	555	7.02E-03	660	8.83E-03	765	6.16E-04
455	3.86E-03	560	7.31E-03	665	8.14E-03	770	5.27E-04
460	3.37E-03	565	7.66E-03	670	7.45E-03	775	4.55E-04
465	2.79E-03	570	8.04E-03	675	6.79E-03	780	3.93E-04
470	2.58E-03	575	8.40E-03	680	6.16E-03		
475	2.36E-03	580	8.83E-03	685	5.53E-03		
480	2.27E-03	585	9.32E-03	690	4.93E-03		

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



# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4615, 0.4145)

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

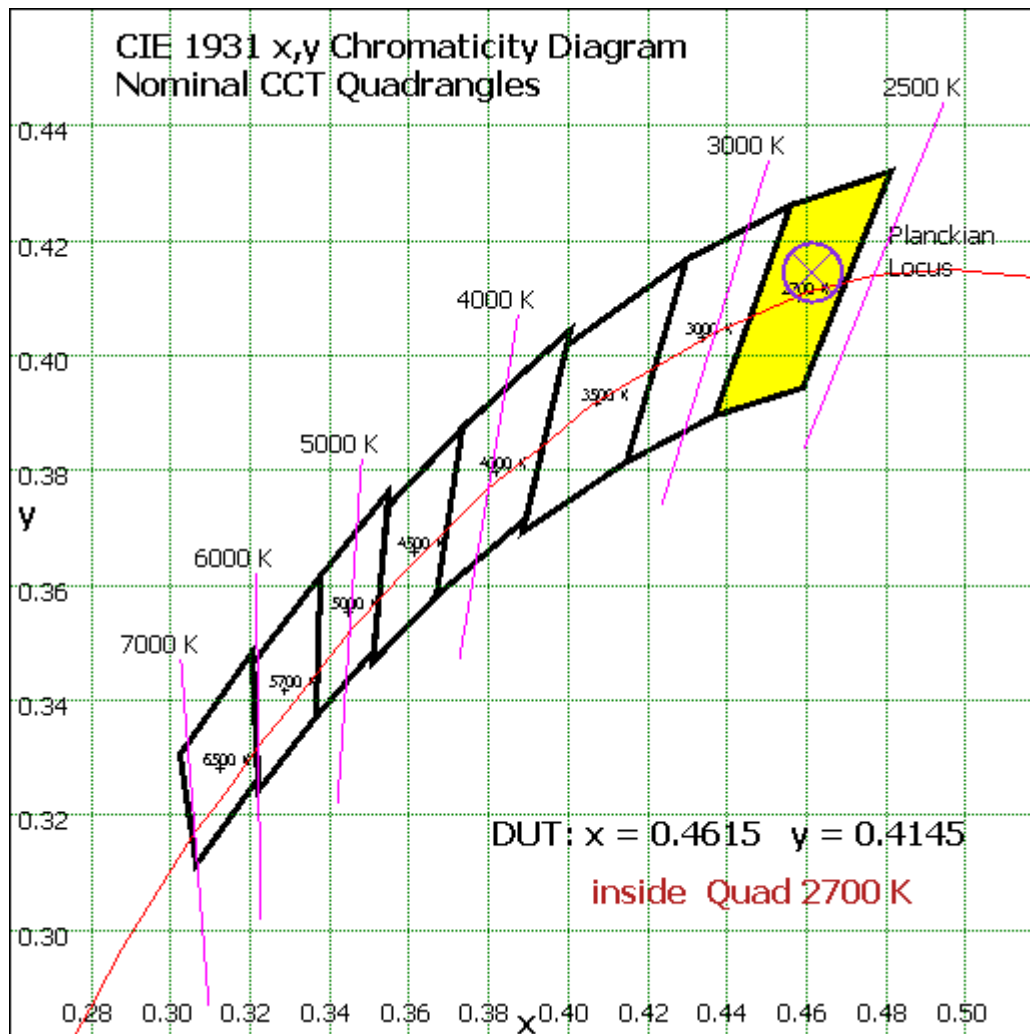
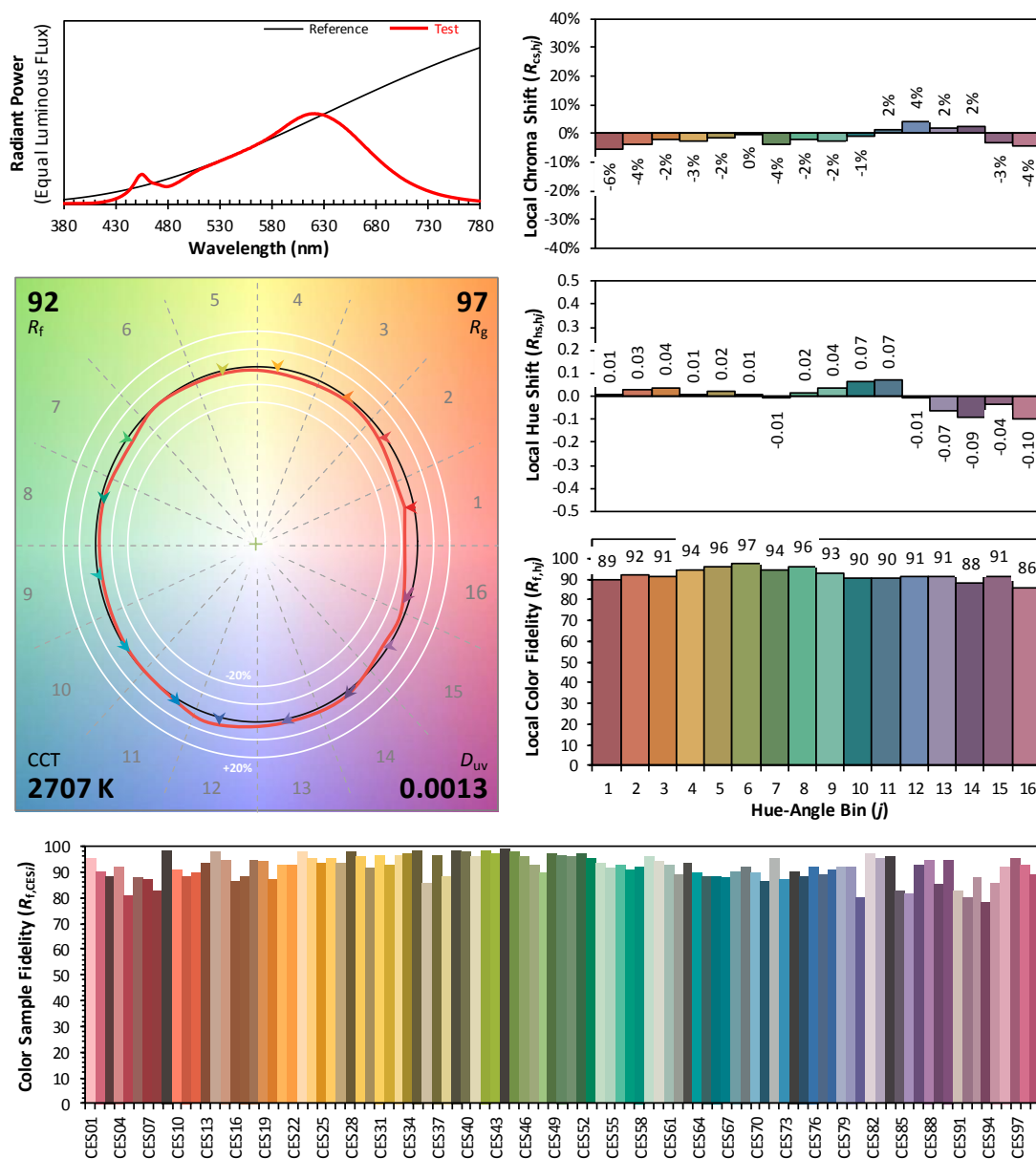


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4615

$y$  0.4145

$u'$  0.2618

$v'$  0.5291

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	143.143	25.83%
10- 20	240.639	43.43%
20- 30	106.15	19.16%
30- 40	27.314	4.93%
40- 50	10.838	1.96%
50- 60	8.097	1.46%
60- 70	7.639	1.38%
70- 80	5.689	1.03%
80- 90	2.945	0.53%
90-100	0.824	0.15%
100-110	0.092	0.02%
110-120	0	0.00%
120-130	0.01	0.00%
130-140	0.076	0.01%
140-150	0.185	0.03%
150-160	0.242	0.04%
160-170	0.189	0.03%
170-180	0.06	0.01%
Total	554.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	536.181	96.76%
60- 90	16.273	2.94%
0-90	552.454	99.70%
90- 180	1.678	0.30%
0- 180	554.1	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

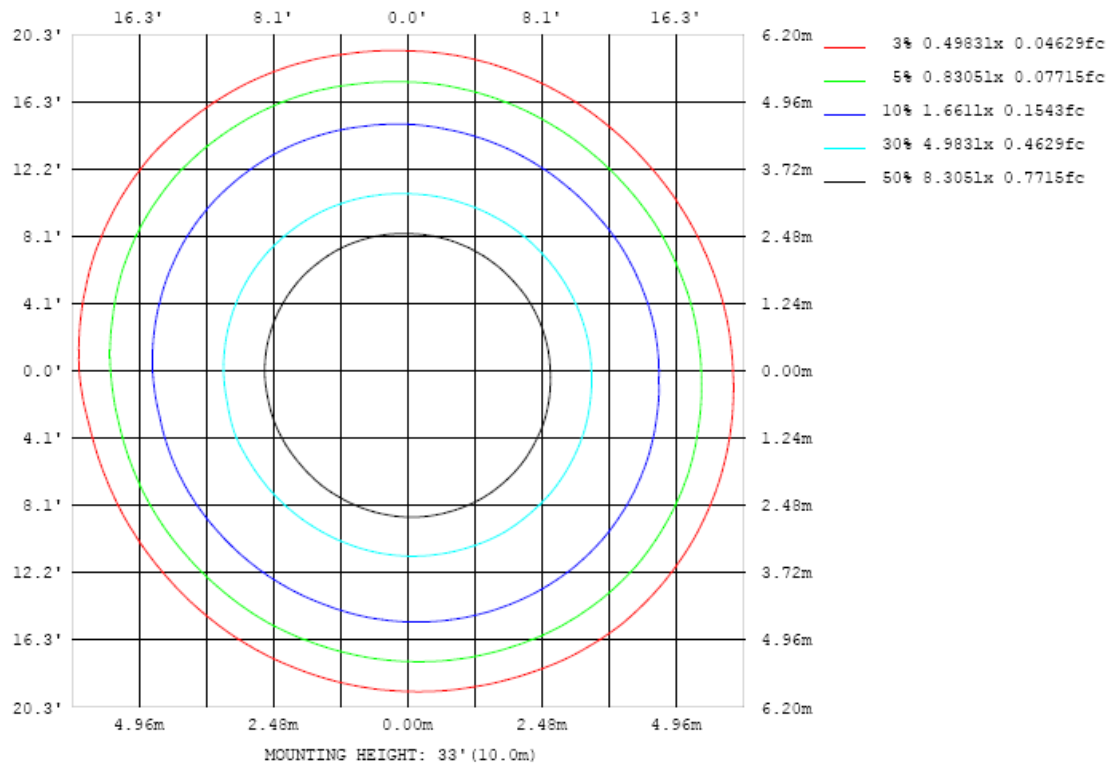


Chart 5: Illuminance Plot (Footcandles)

# Luminous Intensity Distribution Plots- Goniophotometer Method

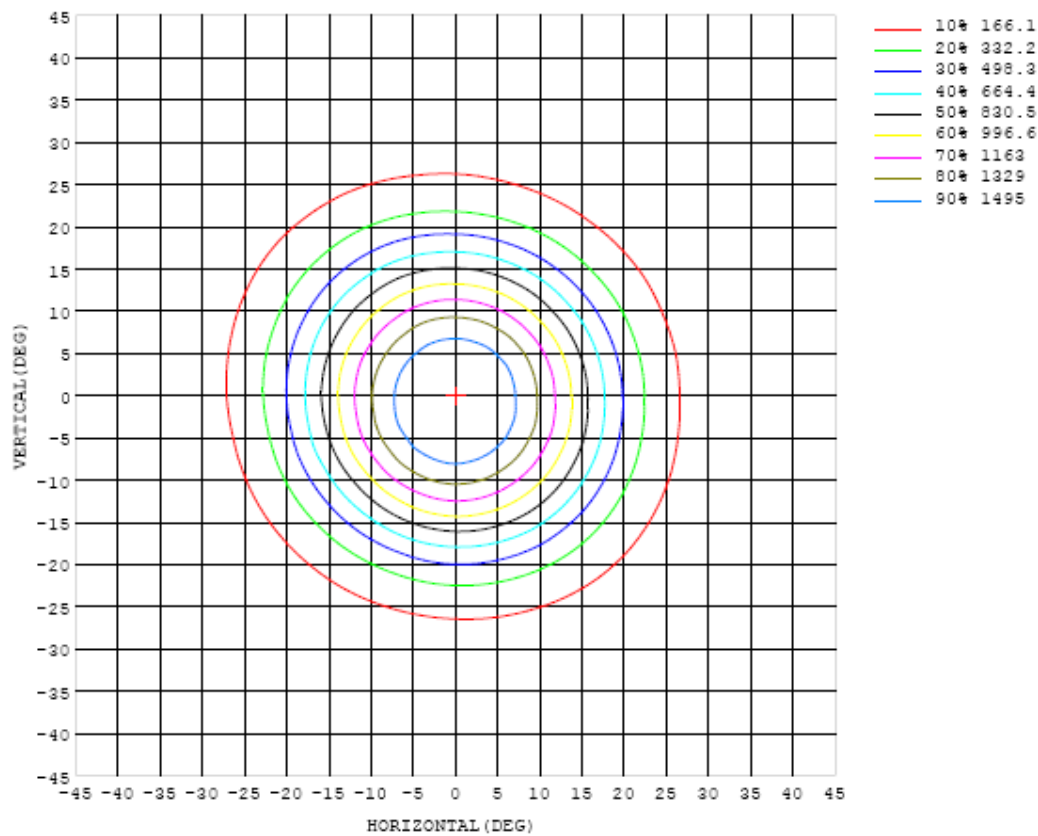


Chart 6: Isocandela Plot

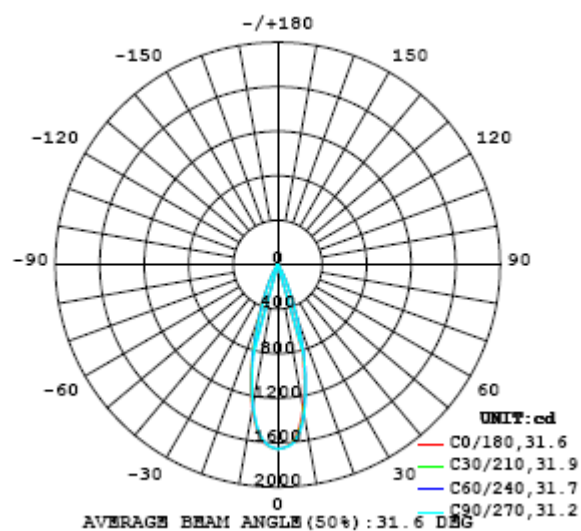


Chart 7: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DBG) y (DBG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661
5	1583	1590	1597	1597	1599	1603	1607	1608	1608	1611	1613	1608	1608	1607	1600	1604	1597	1589	1589
10	1303	1317	1331	1337	1347	1354	1358	1361	1365	1368	1364	1357	1354	1353	1339	1338	1334	1323	1322
15	889	905	920	926	935	939	943	938	937	933	924	914	909	905	897	902	904	901	907
20	483	495	507	514	519	517	518	508	504	497	487	473	471	472	474	482	491	492	503
25	215	223	231	236	239	238	234	227	222	216	210	206	206	207	210	216	221	224	235
30	92.5	96.5	101	103	104	102	99.0	93.2	89.3	86.6	84.7	83.2	82.9	82.4	82.9	85.6	87.9	92.2	100
35	41.1	42.7	43.7	44.3	44.2	43.3	41.2	39.3	38.1	36.5	35.1	33.8	33.2	33.2	33.6	34.3	35.2	36.3	40.0
40	23.5	24.1	25.0	25.1	24.2	23.1	22.2	20.8	20.3	19.0	18.2	17.3	16.7	16.5	16.7	16.9	17.1	17.8	19.3
45	16.2	16.9	17.4	17.2	16.7	15.7	14.7	13.5	12.7	12.1	11.5	11.0	10.7	10.8	10.8	11.1	11.2	11.5	11.9
50	12.0	12.5	12.8	12.7	12.3	11.4	10.7	9.86	9.51	9.14	8.76	8.56	8.48	8.68	8.89	9.23	9.32	9.48	9.56
55	9.69	10.1	10.3	10.3	10.0	9.39	8.83	8.59	8.34	8.15	7.94	7.86	7.82	8.01	8.25	8.54	8.80	8.75	8.80
60	8.99	9.18	9.26	9.31	9.17	8.78	8.50	8.39	8.25	8.02	7.97	7.81	7.90	7.99	8.21	8.58	8.68	8.62	8.51
65	8.18	8.33	8.48	8.52	8.40	8.03	7.94	7.83	7.90	7.73	7.57	7.33	7.44	7.65	7.79	7.90	7.90	7.81	7.76
70	6.84	6.85	7.02	7.00	7.00	6.86	6.82	6.70	6.74	6.61	6.48	6.35	6.41	6.64	6.53	6.72	6.54	6.60	6.63
75	5.32	5.35	5.58	5.49	5.55	5.48	5.59	5.46	5.54	5.39	5.39	5.35	5.37	5.57	5.36	5.46	5.39	5.60	5.62
80	4.08	4.08	4.21	4.18	4.28	4.23	4.36	4.15	4.31	4.18	4.20	4.15	4.12	4.32	4.18	4.28	4.28	4.31	4.16
85	2.66	2.76	2.84	2.90	2.79	2.81	2.87	2.80	2.90	2.91	2.84	2.75	2.82	2.87	2.78	2.85	2.81	2.80	2.68
90	1.33	1.40	1.45	1.56	1.50	1.43	1.52	1.46	1.52	1.57	1.45	1.31	1.35	1.36	1.36	1.33	1.23	1.26	1.33
95	0.74	0.73	0.78	0.88	0.84	0.80	0.77	0.78	0.83	0.86	0.84	0.78	0.72	0.77	0.75	0.75	0.74	0.76	0.76
100	0.25	0.25	0.26	0.29	0.29	0.31	0.30	0.32	0.30	0.31	0.27	0.31	0.34	0.33	0.28	0.31	0.29	0.26	0.25
105	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.08	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	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	0.01	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
130	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	0.05
135	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	0.06	0.06	0.06	0.06	0.06	0.12
140	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.12	0.12	0.12	0.24
145	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.40
150	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.26	0.55
155	0.36	0.37	0.37	0.36	0.37	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.35	0.36	0.35	0.69
160	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.44	0.78
165	0.51	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.51	0.82
170	0.53	0.53	0.53	0.53	0.54	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.79
175	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.66
180	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DGG) y (DGG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661	1661		
5	1589	1583	1581	1577	1575	1574	1572	1572	1572	1572	1573	1578	1581	1579	1587	1586	1582		
10	1317	1309	1302	1296	1288	1290	1284	1280	1277	1277	1276	1279	1281	1287	1296	1301	1300		
15	907	902	895	889	878	872	859	849	839	836	835	839	844	848	864	872	882		
20	507	507	503	497	487	477	464	449	437	431	429	433	435	442	454	464	476		
25	241	244	245	242	235	228	218	207	201	194	190	188	189	193	200	206	212		
30	105	110	111	110	104	100	94.9	89.2	85.3	83.5	81.6	81.0	80.2	80.8	83.1	85.7	89.2		
35	42.7	44.5	45.4	45.3	43.4	41.7	39.0	37.4	36.5	36.3	36.2	36.3	35.9	36.3	37.5	38.5	39.9		
40	20.7	21.6	22.3	21.7	21.2	20.8	19.9	19.6	19.8	20.2	20.3	20.5	20.6	21.5	22.6	23.0	23.3		
45	12.7	13.5	13.7	13.9	13.3	13.0	12.5	12.4	12.6	13.0	13.2	13.4	13.8	14.2	14.8	15.4	15.7		
50	10.0	10.4	10.5	10.6	10.3	10.0	9.66	9.60	9.68	9.80	9.92	10.0	10.1	10.2	10.6	10.8	11.4		
55	9.18	9.37	9.34	9.17	8.92	8.67	8.57	8.49	8.59	8.63	8.54	8.57	8.72	8.73	8.89	9.03	9.37		
60	8.69	8.92	8.99	8.79	8.48	8.24	8.25	8.24	8.31	8.28	7.99	8.06	8.32	8.32	8.35	8.63	8.86		
65	7.92	8.12	8.12	8.20	7.90	7.80	7.65	7.63	7.62	7.52	7.44	7.41	7.60	7.67	7.76	7.87	7.99		
70	6.64	6.68	6.71	6.81	6.68	6.75	6.50	6.56	6.42	6.25	6.33	6.32	6.46	6.41	6.66	6.61	6.73		
75	5.51	5.46	5.43	5.45	5.42	5.49	5.37	5.46	5.14	5.08	5.18	5.15	5.30	5.13	5.33	5.26	5.28		
80	4.17	4.17	4.10	4.24	4.14	3.99	3.92	4.06	3.82	3.82	3.82	3.79	3.88	3.78	3.99	3.88	3.95		
85	2.64	2.66	2.67	2.67	2.67	2.62	2.52	2.65	2.61	2.61	2.68	2.68	2.66	2.65	2.62	2.54	2.57		
90	1.27	1.22	1.28	1.22	1.29	1.26	1.31	1.19	1.22	1.22	1.20	1.28	1.31	1.34	1.25	1.30	1.31		
95	0.77	0.70	0.66	0.71	0.72	0.71	0.67	0.59	0.67	0.65	0.66	0.66	0.68	0.70	0.72	0.68	0.67		
100	0.23	0.25	0.23	0.24	0.27	0.23	0.24	0.22	0.22	0.23	0.23	0.23	0.22	0.25	0.25	0.24	0.23		
105	0.07	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	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	0.01	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		
130	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		
135	0.13	0.13	0.13	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13		
140	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
145	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41		
150	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.56		
155	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.70	0.71	0.71	0.70		
160	0.81	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.80		
165	0.86	0.85	0.85	0.85	0.84	0.84	0.84	0.84	0.84	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.84		
170	0.83	0.83	0.82	0.82	0.81	0.81	0.81	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.80		
175	0.71	0.70	0.69	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.68	0.66		
180	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60		

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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