

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED lamp

**Model: 15A21DIM/930/N**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, YuhangDist,  
Hangzhou, Zhejiang Province, China 311100

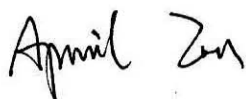
Tel: +86571 86376106

www.ledtestlab.com

Report No.: HZ19050042c

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

Review by:



Engineer: April Zou  
May 31, 2019

Approved by:



Manager: Jim Zhang  
May 31, 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: 15A21DIM/930/N

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
115.0	1785.0	15.52	0.9803
CCT (K)	CRI	Stabilization Time (Light & Power)	
3053	83.6	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>	: May 28, 2019
<b>Date of Test</b>	: May 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

## TABLE OF CONTENT

LM-79-08 TEST REPORT.....	1
TEST SUMMARY .....	2
SAMPLE PHOTO .....	4
TEST RESULTS .....	5
Sphere-Spectroradiometer Method.....	5
Goniophotometer Method .....	6
Spectral Power Distribution - Sphere Spectroradiometer Method .....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method .....	9
Color Rendition Report – Sphere Spectroradiometer Method .....	10
Zonal Lumen Tabulation- Goniophotometer Method .....	11
Illuminance Plots- Goniophotometer Method .....	12
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method .....	14
EQUIPMENT LIST .....	16
TEST METHODS .....	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method .....	17
Photometric and Electrical Measurements .....	17
Color Characteristics Measurements.....	17
Color Spatial Uniformity.....	17

## SAMPLE PHOTO



Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED lamp
<b>Model</b>	: 15A21DIM/930/N
<b>Electrical Ratings</b>	: 120V, 60Hz, 15W
<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 25.0 °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)	0.132
Power Factor	0.9803
Test Power (W)	15.52
THD A%	11.44
Luminous Efficacy (lm/W)	115.0
Total Luminous Flux (lm)	1785.0
Color Rendering Index (CRI)	94.4
R9	61.8
Correlated Color Temperature (CCT)(K)	3053
Chromaticity Chroma x	0.4310
Chromaticity Chroma y	0.3983
Chromaticity Chroma u	0.2492
Chromaticity Chroma v	0.3455
Duv	0.0015
Chromaticity Chroma u'	0.2492
Chromaticity Chroma v'	0.5182

Special Color Rendering Indices	
R1	97.8
R2	97
R3	94.2
R4	95.7
R5	96.7
R6	96.2
R7	93.2
R8	84.5
R9	61.8
R10	90.4
R11	93.7
R12	81.4
R13	98.2
R14	95.3

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)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.133
Power Factor	0.9807
Power (W)	15.62
Luminous Efficacy (lm/W)	115.5
Total Luminous Flux (lm)	1803.4
Beam Angle ( ° )	229.4 (0°-180°) / 229.7 (90°-270°)
Center Beam Candle Power (cd)	218
Maximum Beam Candle Power (cd)	218.2 (At: C=350.0, Gamma=5.5)
Spacing Criteria	1.47 (0°-180°) / 1.49 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	36.09%
Zonal Lumens in the 60 °-90 °Zone	30.27%
Zonal Lumens in the 90 °-120 °Zone	22.14%
Zonal Lumens in the 120 °-180 °Zone	11.50%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

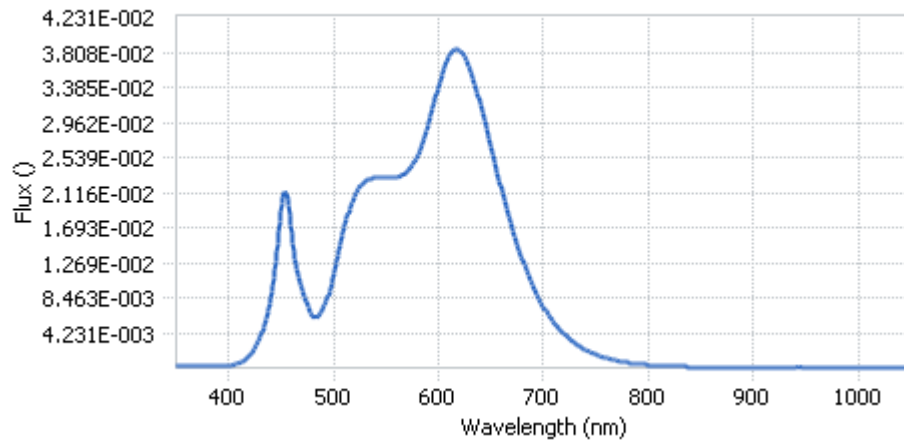
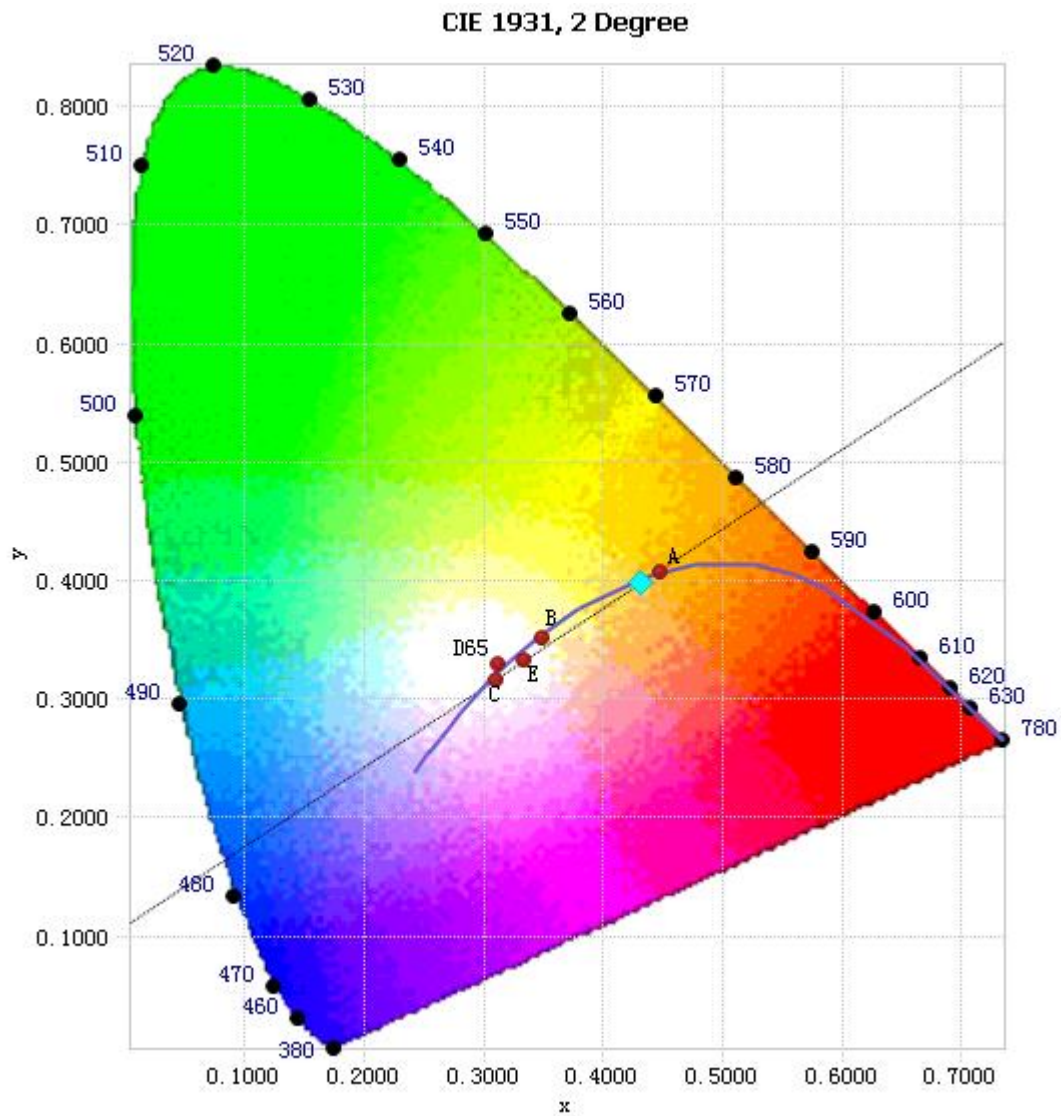


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.61E-04	485	6.31E-03	590	2.93E-02	695	8.48E-03
385	2.45E-04	490	7.16E-03	595	3.17E-02	700	7.34E-03
390	2.58E-04	495	8.83E-03	600	3.40E-02	705	6.31E-03
395	2.80E-04	500	1.13E-02	605	3.62E-02	710	5.42E-03
400	3.23E-04	505	1.42E-02	610	3.76E-02	715	4.69E-03
405	4.03E-04	510	1.69E-02	615	3.84E-02	720	4.04E-03
410	5.76E-04	515	1.92E-02	620	3.83E-02	725	3.48E-03
415	9.35E-04	520	2.08E-02	625	3.75E-02	730	2.98E-03
420	1.50E-03	525	2.19E-02	630	3.60E-02	735	2.56E-03
425	2.44E-03	530	2.25E-02	635	3.40E-02	740	2.17E-03
430	3.75E-03	535	2.27E-02	640	3.18E-02	745	1.87E-03
435	5.74E-03	540	2.30E-02	645	2.92E-02	750	1.61E-03
440	8.51E-03	545	2.30E-02	650	2.66E-02	755	1.37E-03
445	1.28E-02	550	2.30E-02	655	2.41E-02	760	1.19E-03
450	1.88E-02	555	2.30E-02	660	2.16E-02	765	1.03E-03
455	2.10E-02	560	2.30E-02	665	1.91E-02	770	8.85E-04
460	1.61E-02	565	2.31E-02	670	1.69E-02	775	7.55E-04
465	1.19E-02	570	2.37E-02	675	1.49E-02	780	6.46E-04
470	9.62E-03	575	2.45E-02	680	1.30E-02		
475	7.55E-03	580	2.56E-02	685	1.14E-02		
480	6.27E-03	585	2.73E-02	690	9.83E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4310, 0.3983)

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

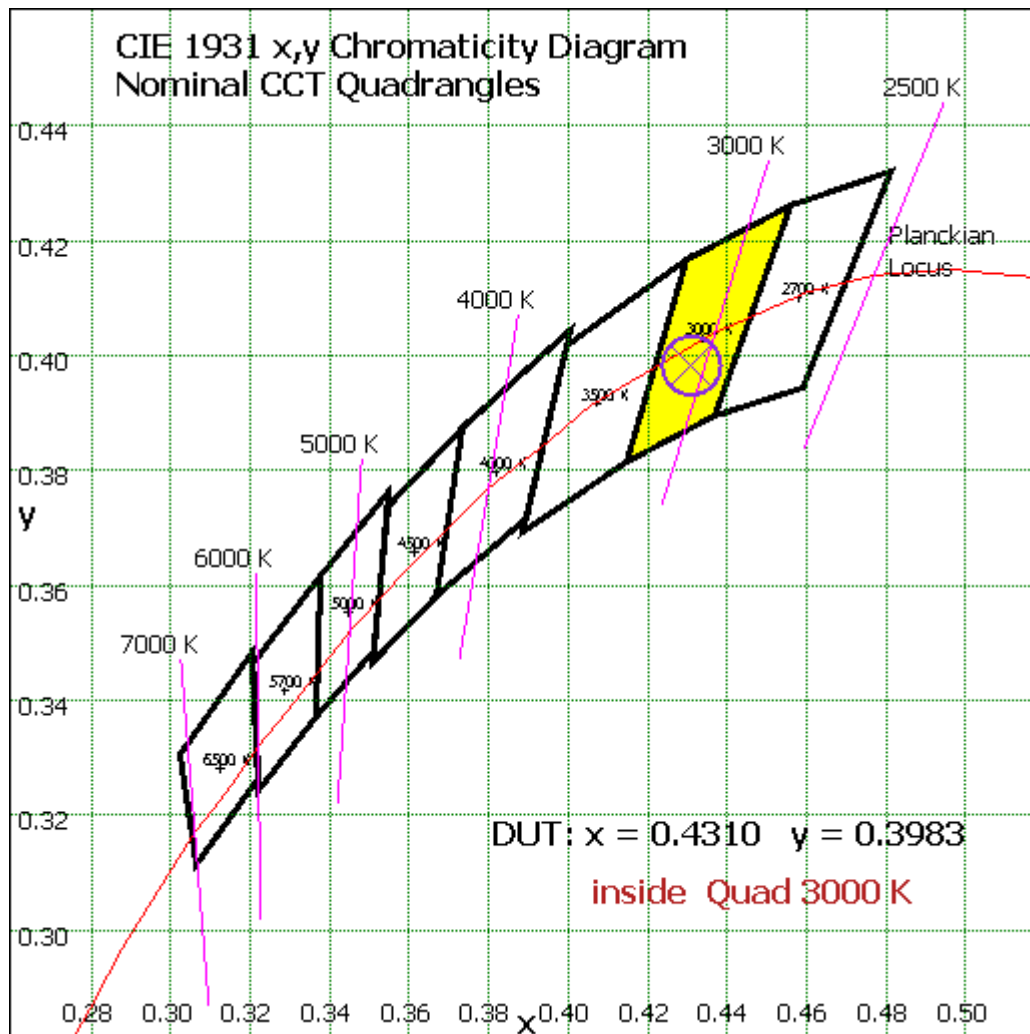
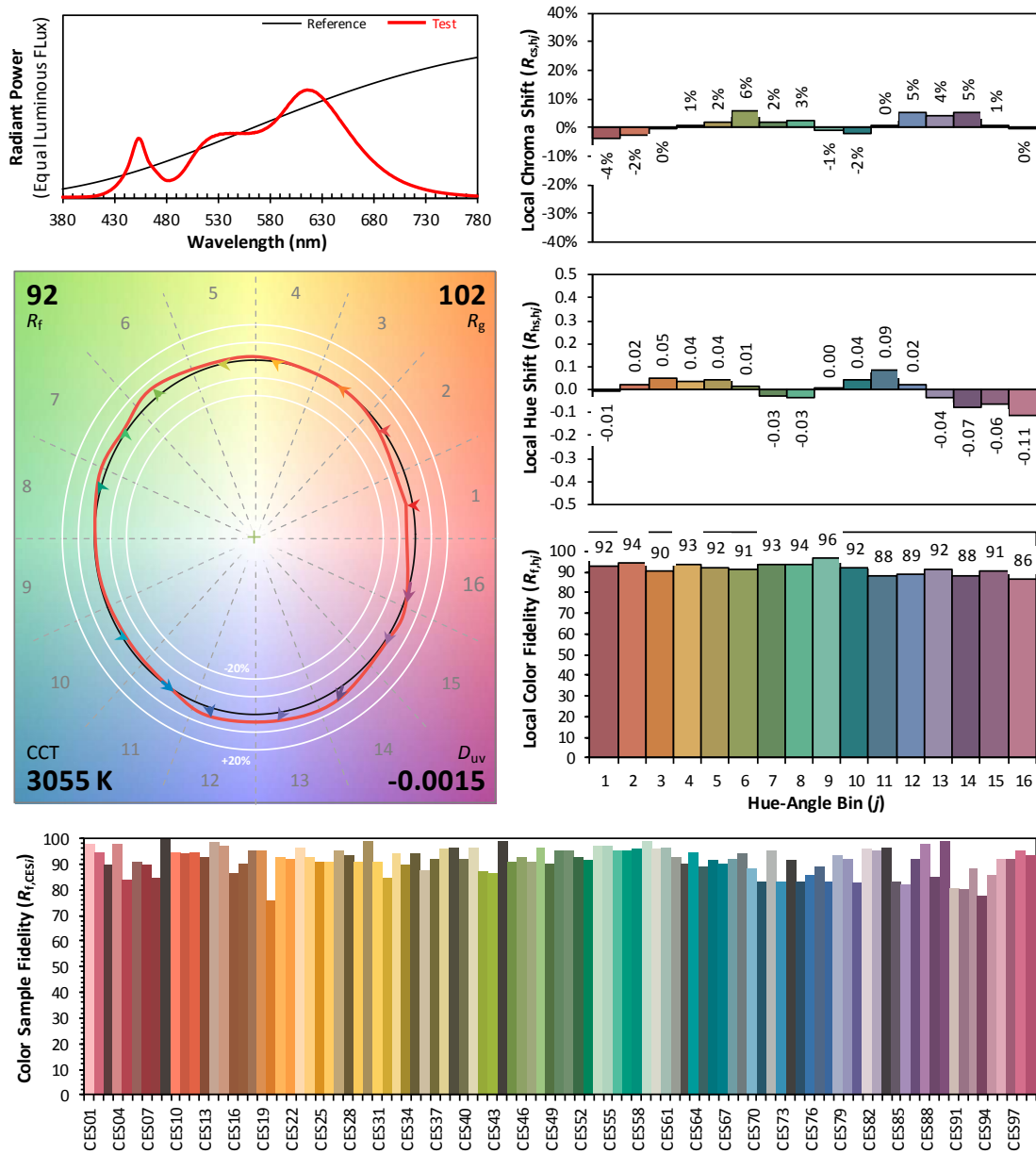


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4310  
 $y$  0.3983  
 $u'$  0.2492  
 $v'$  0.5182

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	20.776	1.15%
10- 20	61.329	3.40%
20- 30	99.14	5.50%
30- 40	132.573	7.35%
40- 50	159.383	8.84%
50- 60	177.647	9.85%
60- 70	186.226	10.33%
70- 80	184.905	10.25%
80- 90	174.856	9.70%
90-100	157.234	8.72%
100-110	134.065	7.43%
110-120	108	5.99%
120-130	81.678	4.53%
130-140	57.485	3.19%
140-150	36.927	2.05%
150-160	20.786	1.15%
160-170	9.014	0.50%
170-180	1.422	0.08%
Total	1803.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0-130	1677.812	93.03%
130-180	125.634	6.97%
0-180	1803.4	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

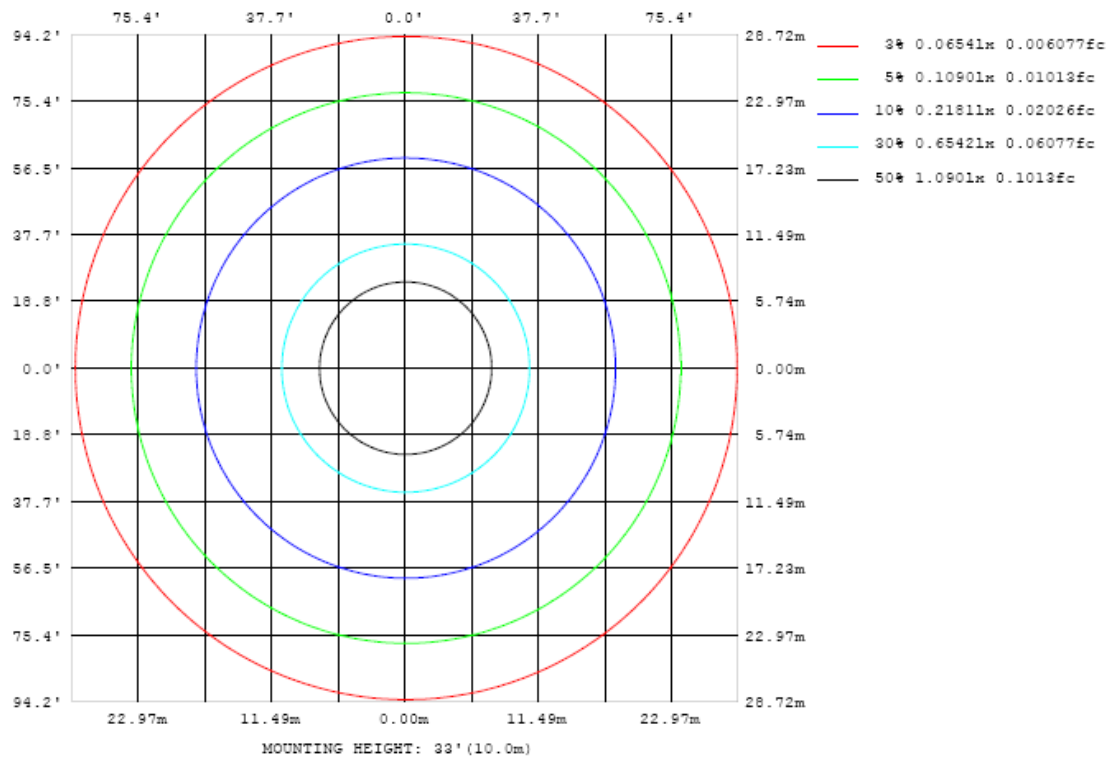


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

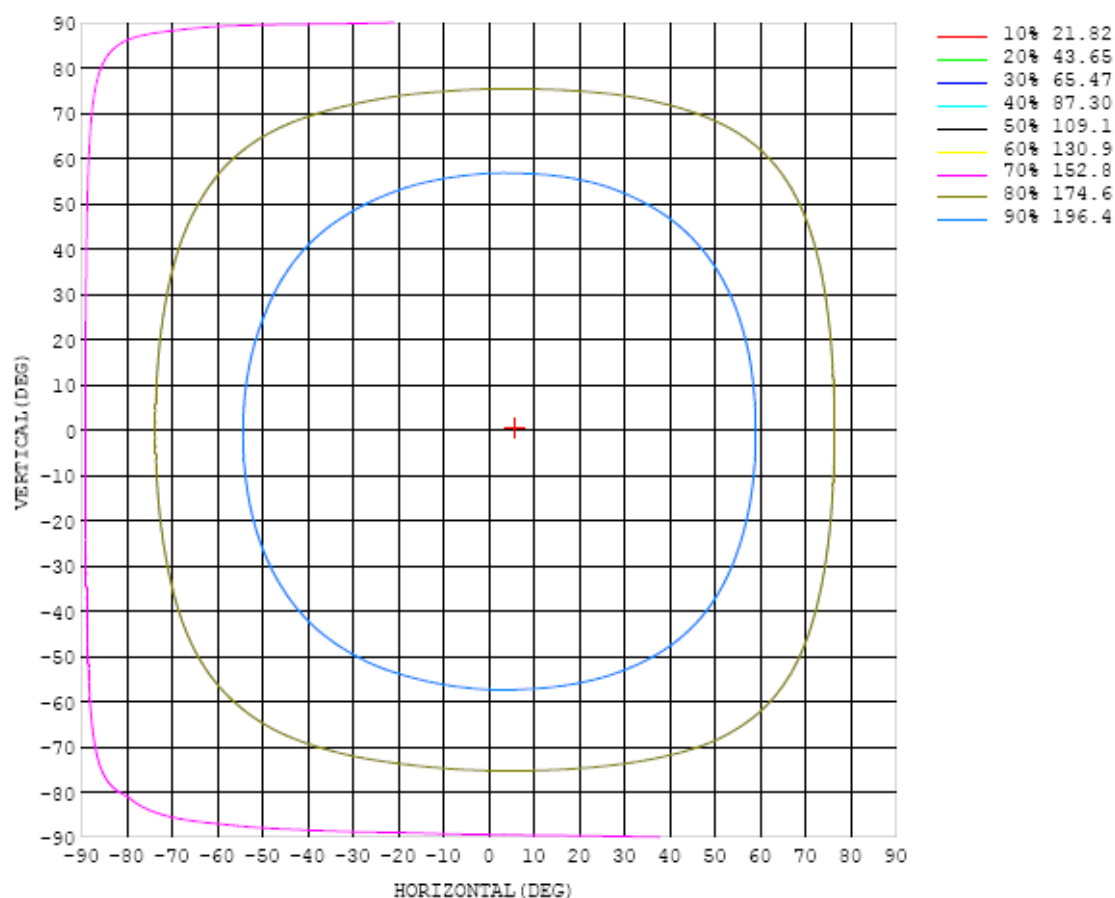


Chart 6: Isocandela Plot

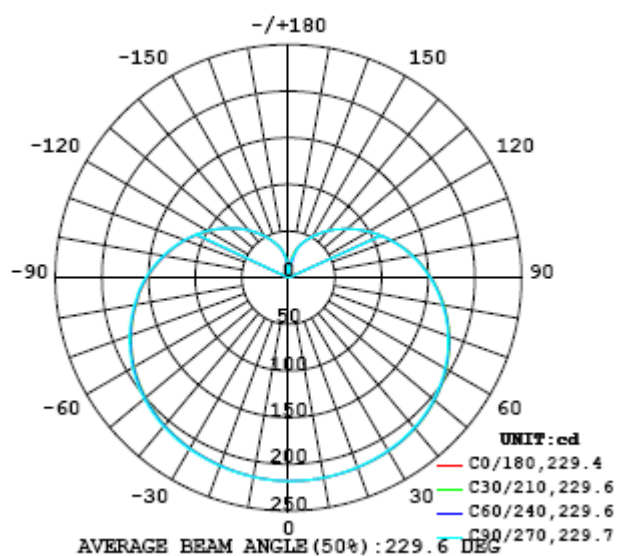


Chart 7: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
5	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
10	218	218	218	218	218	218	218	218	218	218	217	217	217	217	217	217	217	217	217
15	217	217	217	217	217	217	217	217	217	217	217	217	216	216	216	216	216	216	216
20	217	217	217	217	217	217	217	216	216	216	216	215	215	215	215	215	215	214	214
25	216	216	216	216	216	216	215	215	215	215	214	214	214	214	213	213	213	213	213
30	215	215	215	215	215	215	214	214	214	214	213	213	213	212	212	212	212	211	211
35	213	213	213	213	213	213	213	212	212	212	211	211	210	210	210	210	209	209	209
40	211	211	211	211	211	211	210	210	210	209	209	209	208	208	208	207	207	207	207
45	208	208	208	208	208	208	207	207	207	206	206	206	205	205	205	204	204	204	204
50	205	205	205	205	205	204	204	204	203	203	203	202	202	201	201	201	201	200	200
55	200	200	201	201	200	200	200	199	199	199	198	198	198	197	197	196	196	196	196
60	195	196	196	196	195	195	195	194	194	194	193	193	193	192	192	192	191	191	191
65	190	190	190	190	190	189	189	189	188	188	188	187	187	187	186	186	186	186	186
70	184	184	184	184	184	183	183	183	182	182	181	181	181	180	180	180	180	180	179
75	177	177	177	177	177	176	176	176	175	175	175	174	174	174	173	173	173	173	173
80	169	169	169	169	169	169	169	168	168	168	167	167	167	166	166	166	166	166	166
85	161	161	161	161	161	161	161	160	160	160	160	159	159	159	159	158	158	158	159
90	153	153	153	153	153	153	153	152	152	152	152	151	151	151	151	150	150	150	151
95	145	145	144	145	145	144	144	144	144	143	143	143	143	143	142	142	142	142	143
100	136	136	136	136	136	136	135	135	135	135	134	134	134	134	134	134	134	134	135
105	127	127	127	127	127	127	126	126	126	126	126	126	125	125	125	125	125	125	126
110	118	118	118	118	117	117	117	117	117	117	117	117	117	116	116	116	116	116	117
115	108	108	108	108	108	108	108	108	108	108	108	108	108	108	107	107	107	108	109
120	99.4	99.3	99.3	99.2	99.2	99.2	99.1	99.1	99.1	99.0	98.9	98.7	98.8	98.8	98.7	98.6	98.6	98.7	99.7
125	90.4	90.4	90.3	90.2	90.2	90.2	90.2	90.2	90.2	90.2	90.1	90.0	90.0	90.0	90.0	89.9	90.0	90.0	91.0
130	81.7	81.7	81.6	81.5	81.5	81.5	81.5	81.5	81.5	81.6	81.5	81.4	81.5	81.5	81.4	81.4	81.5	81.5	82.5
135	73.4	73.1	73.5	73.3	73.3	73.3	73.3	73.3	73.4	73.4	73.4	73.3	73.4	73.4	73.4	73.4	73.7	73.5	74.2
140	65.7	65.7	65.6	65.5	65.6	65.6	65.6	65.6	65.7	65.7	65.7	65.7	65.8	65.8	65.8	65.8	65.9	65.9	66.3
145	58.0	58.0	57.9	57.8	57.9	57.9	57.9	58.0	58.0	58.1	58.1	58.1	58.2	58.2	58.2	58.2	58.3	58.4	58.8
150	50.8	50.8	50.7	50.6	50.6	50.7	50.7	50.8	50.8	50.9	50.9	50.9	51.0	51.0	51.1	51.1	51.2	51.3	51.6
155	44.0	44.0	43.9	43.9	43.9	43.9	44.0	44.1	44.2	44.2	44.2	44.3	44.4	44.4	44.4	44.4	44.5	44.6	44.9
160	37.6	37.6	37.6	37.6	37.6	37.1	37.3	37.7	37.6	37.2	37.9	38.0	38.1	38.1	38.2	38.2	38.3	38.3	38.6
165	31.0	30.9	30.9	31.2	30.7	27.9	24.5	30.7	29.4	27.8	29.9	30.9	31.8	32.1	32.2	32.1	32.2	32.3	32.6
170	22.1	22.1	22.9	21.6	22.9	23.3	21.0	13.6	16.1	18.4	19.8	20.6	21.4	22.8	23.2	23.3	23.3	23.3	24.3
175	11.4	13.2	13.3	13.6	12.6	10.7	10.9	12.4	13.0	11.3	9.43	8.06	8.30	7.68	7.70	8.99	10.5	12.2	12.9
180	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29

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	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218		
5	218	217	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218		
10	217	217	217	217	217	217	217	217	217	217	217	217	217	217	218	218	218		
15	216	215	215	216	216	216	216	216	216	216	216	217	217	217	217	217	217		
20	214	214	214	214	214	214	215	215	215	215	215	216	216	216	216	216	217		
25	213	212	213	213	213	213	213	213	214	214	214	215	215	215	215	216	216		
30	211	211	211	211	211	211	212	212	212	213	213	213	214	214	214	214	215		
35	209	209	209	209	209	210	210	210	211	211	211	212	212	212	213	213	213		
40	207	206	207	207	207	207	208	208	208	209	209	210	210	210	210	210	211		
45	204	203	204	204	204	204	205	205	206	206	206	207	207	207	207	207	208		
50	200	200	200	200	200	201	201	202	202	202	203	203	203	204	204	204	205		
55	196	196	196	196	196	197	197	197	198	198	199	199	199	200	200	200	200		
60	191	191	191	191	191	192	192	193	193	193	194	194	194	194	195	195	195		
65	186	185	186	186	186	186	187	187	188	188	188	189	189	189	189	189	190		
70	179	179	180	180	180	180	181	181	182	182	182	183	183	183	183	183	184		
75	173	173	173	173	174	174	174	175	175	175	176	176	176	176	177	177	177		
80	166	166	166	167	167	167	167	168	168	168	168	169	169	169	169	169	169		
85	159	160	160	160	160	160	161	161	161	161	162	162	162	162	162	162	162		
90	152	152	152	152	152	152	153	153	153	154	154	154	154	154	154	154	154		
95	144	144	144	144	144	144	145	145	145	145	145	146	146	146	146	146	146		
100	135	135	136	136	136	136	136	136	136	137	137	137	137	137	137	137	137		
105	126	127	127	127	127	127	127	127	128	128	128	128	128	128	128	128	128		
110	118	118	118	118	118	118	118	118	119	119	119	119	119	119	119	119	119		
115	109	109	109	109	109	109	109	109	110	110	110	110	110	110	110	110	110		
120	99.8	99.9	100	100	100	100	100	101	101	101	101	101	101	101	101	101	100		
125	91.1	91.1	91.3	91.4	91.5	91.5	91.6	91.6	91.7	91.7	91.8	91.8	91.7	91.7	91.6	91.6	91.5		
130	82.6	82.6	82.7	82.8	82.9	82.9	83.0	83.0	83.0	83.0	83.0	82.9	82.9	82.9	82.9	82.8	82.7		
135	74.3	74.3	74.4	74.5	74.5	74.5	74.6	74.6	74.6	74.5	74.5	74.5	74.4	74.4	74.4	74.4	74.2		
140	66.4	66.4	66.5	66.5	66.5	66.5	66.6	66.5	66.5	66.4	66.4	66.4	66.3	66.3	66.3	66.2	66.1		
145	58.8	58.8	58.9	58.9	58.9	58.8	58.9	58.8	58.8	58.7	58.7	58.7	58.6	58.6	58.5	58.5	58.4		
150	51.7	51.7	51.7	51.7	51.7	51.6	51.6	51.6	51.5	51.4	51.4	51.4	51.3	51.3	51.3	51.2	51.1		
155	45.0	45.0	45.0	44.9	44.9	44.8	44.8	44.8	44.7	44.6	44.6	44.6	44.5	44.5	44.4	44.4	44.3		
160	38.7	38.7	38.7	38.6	38.6	38.5	38.5	38.4	38.4	38.3	38.3	38.2	38.1	38.1	38.0	38.0	37.9		
165	32.6	32.5	32.6	32.7	32.6	32.5	32.5	32.4	32.3	32.2	31.8	31.3	31.9	31.8	31.8	31.8	31.7		
170	25.1	25.3	25.5	25.5	25.4	24.9	25.2	25.1	24.9	24.2	23.2	23.0	24.1	24.5	24.7	24.8	24.2		
175	12.7	13.1	13.5	13.2	12.4	13.2	14.4	14.4	13.0	11.9	11.7	10.6	8.72	6.30	7.00	6.93	8.63		
180	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29		

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**

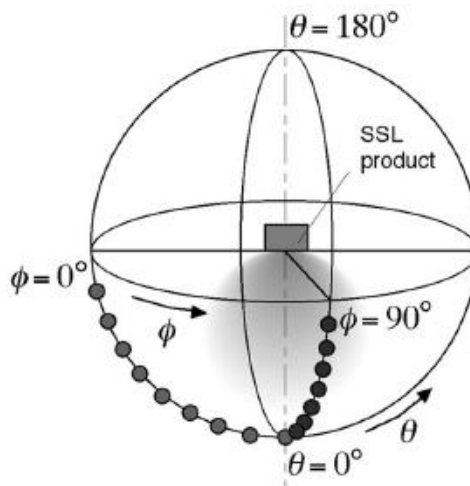
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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 \*\*\*

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.