

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 6.5B13DIM/827/E26**

### 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](http://www.ledtestlab.com)

Report No.: HZ19120032h

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

Review by:



Engineer: April Zou

Jan. 07, 2020

Approved by:



Manager: Jim Zhang

Jan. 07, 2020

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: **6.5B13DIM/827/E26**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
85.8	524.3	6.11	0.9386
CCT (K)	CRI	Stabilization Time (Light & Power)	
2749	83.2	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. 31, 2019
<b>Date of Test</b>	: Jan. 07, 2020
<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>	: 6.5B13DIM/827/E26
<b>Electrical Ratings</b>	: 120V, 60Hz, 6.5W
<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)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.054
Power Factor	0.9386
Test Power (W)	6.11
THD A%	21.31
Luminous Efficacy (lm/W)	85.8
Total Luminous Flux (lm)	524.3
Color Rendering Index (CRI)	83.2
R9	9.9
Correlated Color Temperature (CCT)(K)	2749
Chromaticity Chroma x	0.4555
Chromaticity Chroma y	0.4093
Chromaticity Chroma u	0.2603
Chromaticity Chroma v	0.3508
Duv	0.0002
Chromaticity Chroma u'	0.2603
Chromaticity Chroma v'	0.5262

Special Color Rendering Indices	
R1	82.6
R2	94
R3	92.8
R4	80.4
R5	83.2
R6	94.1
R7	80.6
R8	57.6
R9	9.9
R10	86.9
R11	80.7
R12	78.5
R13	85.6
R14	96.7

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 24.9 °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)	0.054
Power Factor	0.9379
Power (W)	6.12
Luminous Efficacy (lm/W)	86.5
Total Luminous Flux (lm)	529.3
Beam Angle ( ° )	234.5 (0°-180°) / 233.0 (90°-270°)
Center Beam Candle Power (cd)	25.6
Maximum Beam Candle Power (cd)	163.9 (At: C=240.0, Gamma=35.0)
Spacing Criteria	2.98 (0°-180°) / 3.01 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	53.70%
Zonal Lumens in the 60 °-90 °Zone	30.14%
Zonal Lumens in the 90 °-120 °Zone	14.78%
Zonal Lumens in the 120 °-180 °Zone	1.38%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

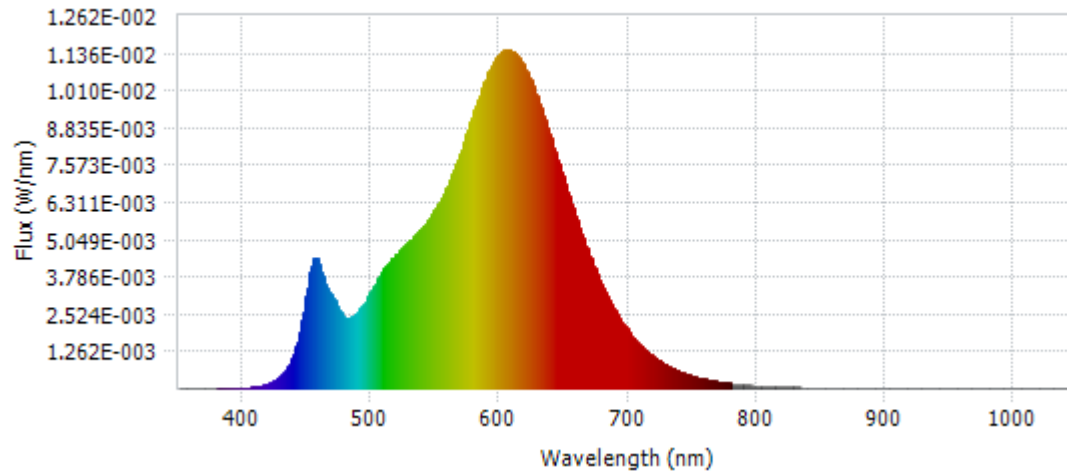
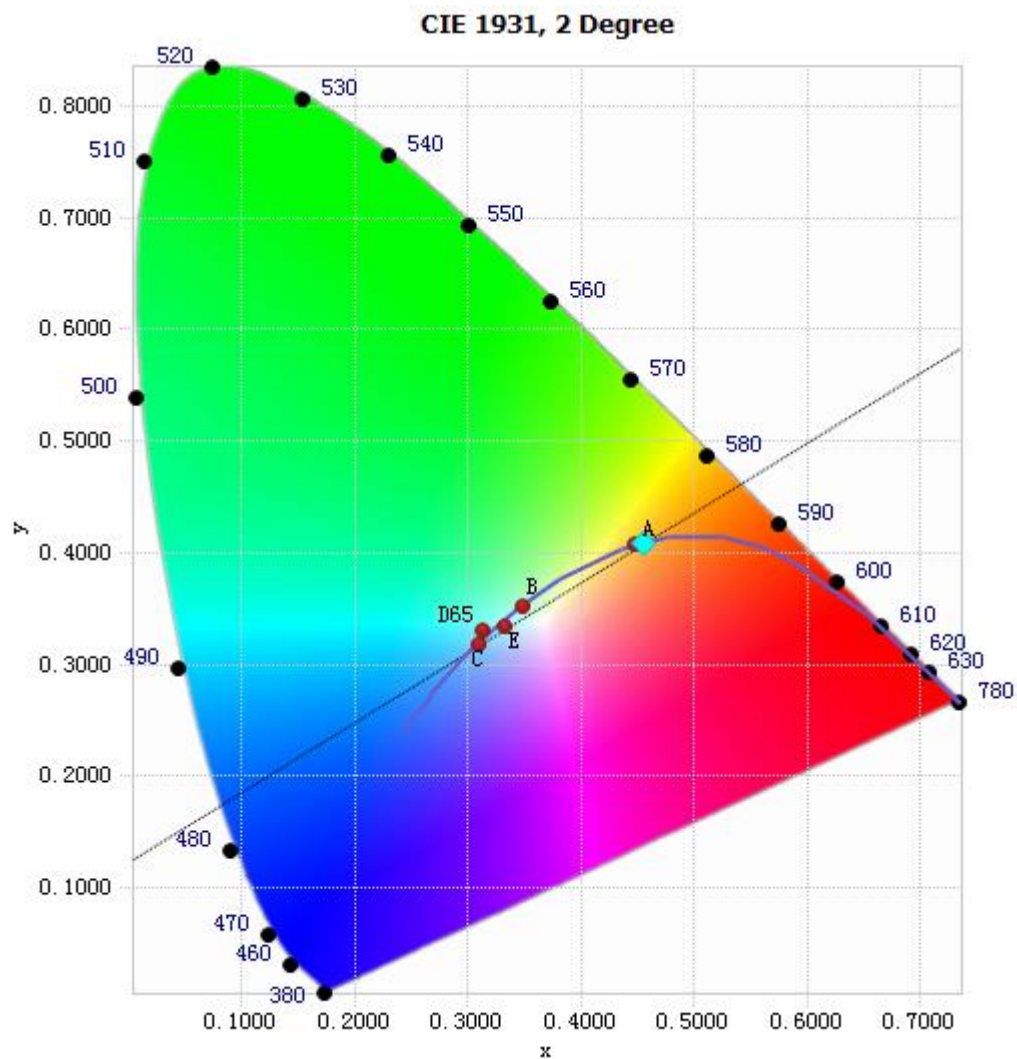


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.53E-05	485	2.42E-03	590	1.06E-02	695	2.27E-03
385	2.22E-05	490	2.64E-03	595	1.10E-02	700	1.95E-03
390	2.30E-05	495	2.95E-03	600	1.13E-02	705	1.67E-03
395	1.85E-05	500	3.33E-03	605	1.15E-02	710	1.44E-03
400	2.52E-05	505	3.71E-03	610	1.14E-02	715	1.24E-03
405	3.21E-05	510	4.04E-03	615	1.12E-02	720	1.07E-03
410	5.58E-05	515	4.34E-03	620	1.08E-02	725	9.19E-04
415	9.89E-05	520	4.58E-03	625	1.03E-02	730	7.82E-04
420	1.70E-04	525	4.80E-03	630	9.76E-03	735	6.67E-04
425	2.89E-04	530	5.01E-03	635	9.11E-03	740	5.71E-04
430	4.66E-04	535	5.22E-03	640	8.45E-03	745	4.89E-04
435	7.64E-04	540	5.47E-03	645	7.76E-03	750	4.21E-04
440	1.26E-03	545	5.76E-03	650	7.06E-03	755	3.60E-04
445	2.10E-03	550	6.08E-03	655	6.38E-03	760	3.11E-04
450	3.42E-03	555	6.48E-03	660	5.72E-03	765	2.65E-04
455	4.43E-03	560	6.94E-03	665	5.08E-03	770	2.29E-04
460	4.07E-03	565	7.47E-03	670	4.50E-03	775	1.95E-04
465	3.42E-03	570	8.10E-03	675	3.95E-03	780	1.66E-04
470	3.04E-03	575	8.73E-03	680	3.46E-03		
475	2.64E-03	580	9.41E-03	685	3.02E-03		
480	2.37E-03	585	1.01E-02	690	2.62E-03		

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

# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values (x, y): (0.4555, 0.4093)

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

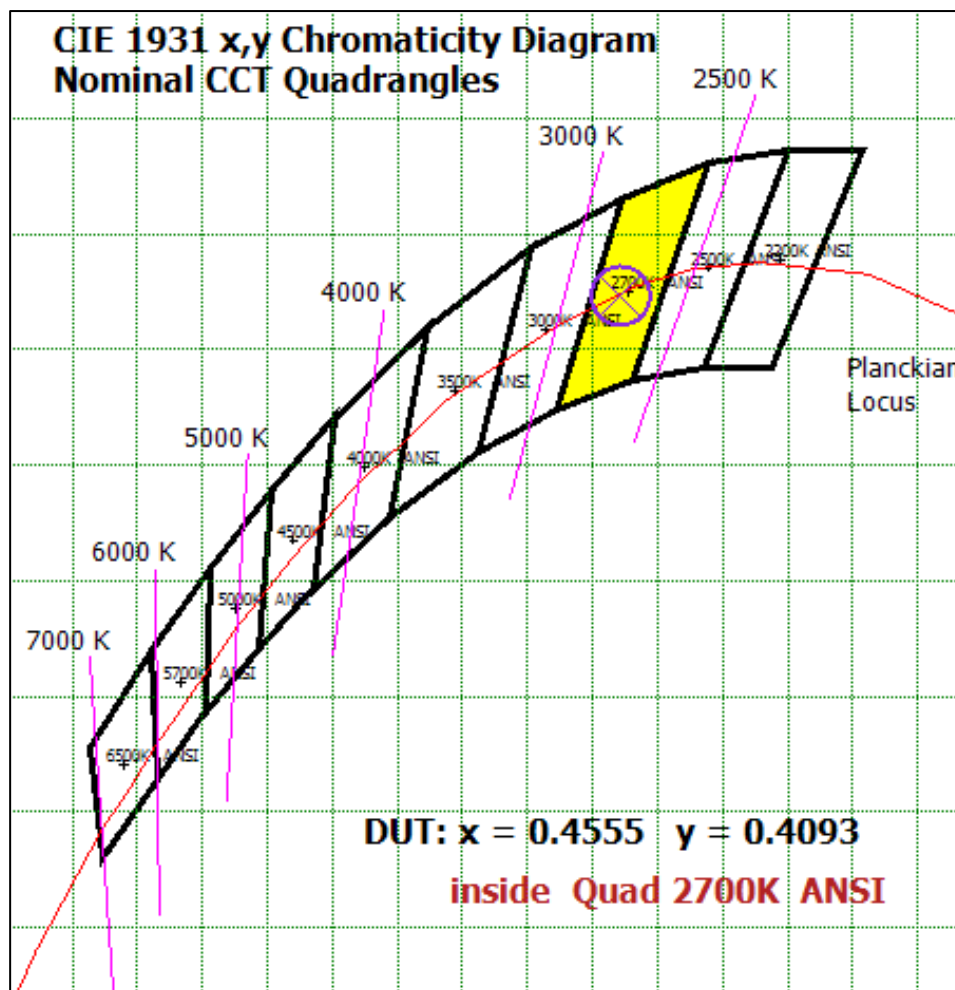
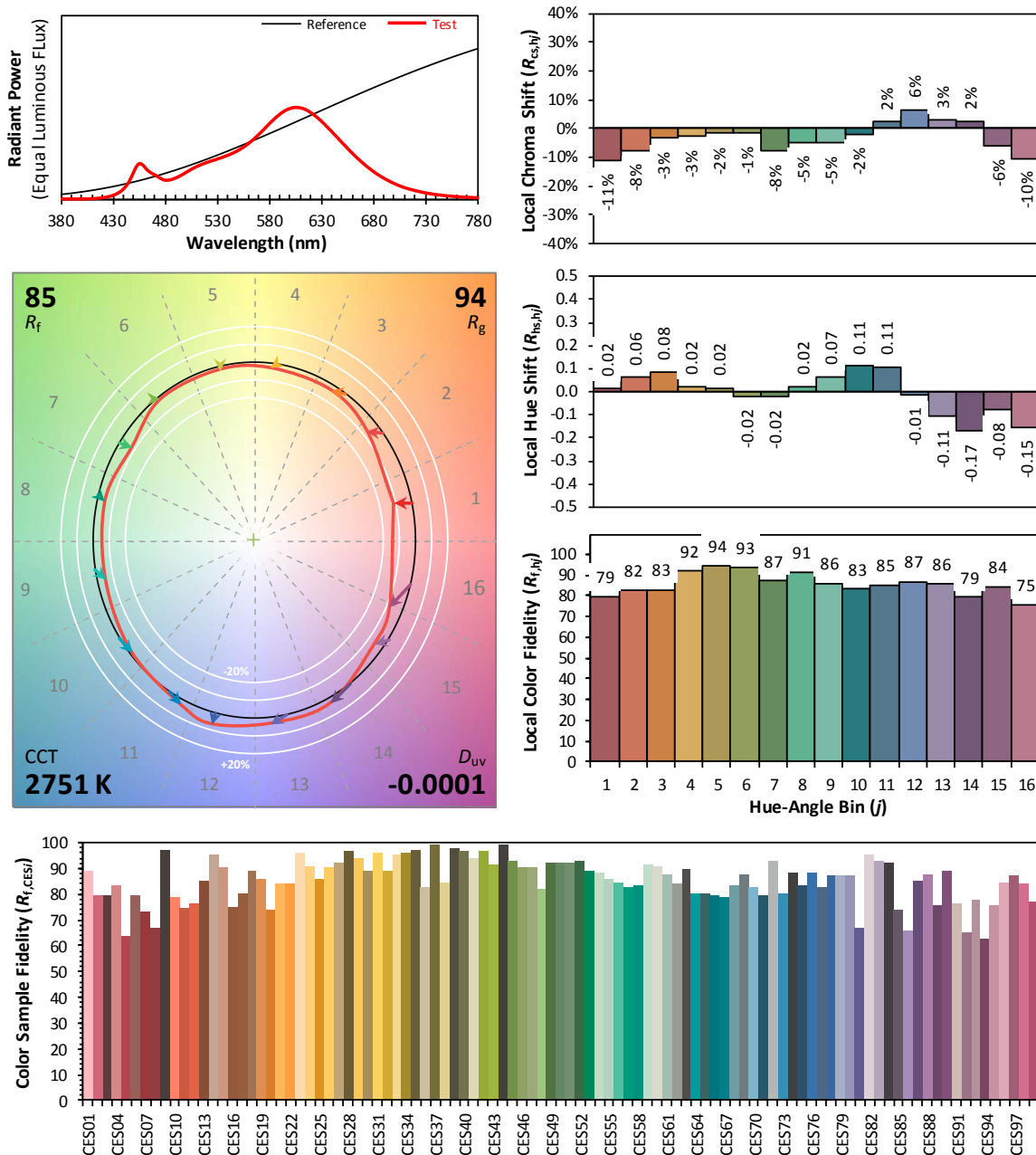


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4555  
 $y$  0.4093  
 $u'$  0.2603  
 $v'$  0.5262

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	3.1	0.59%
10- 20	14.15	2.67%
20- 30	32.814	6.20%
30- 40	78.144	14.76%
40- 50	80.28	15.17%
50- 60	75.746	14.31%
60- 70	76.912	14.53%
70- 80	47.864	9.04%
80- 90	34.767	6.57%
90-100	38.161	7.21%
100-110	26.241	4.96%
110-120	13.829	2.61%
120-130	5.283	1.00%
130-140	1.565	0.30%
140-150	0.284	0.05%
150-160	0.122	0.02%
160-170	0.047	0.01%
170-180	0.009	0.00%
Total	529.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0-110	508.179	96.01%
110-180	21.139	3.99%
0-180	529.3	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

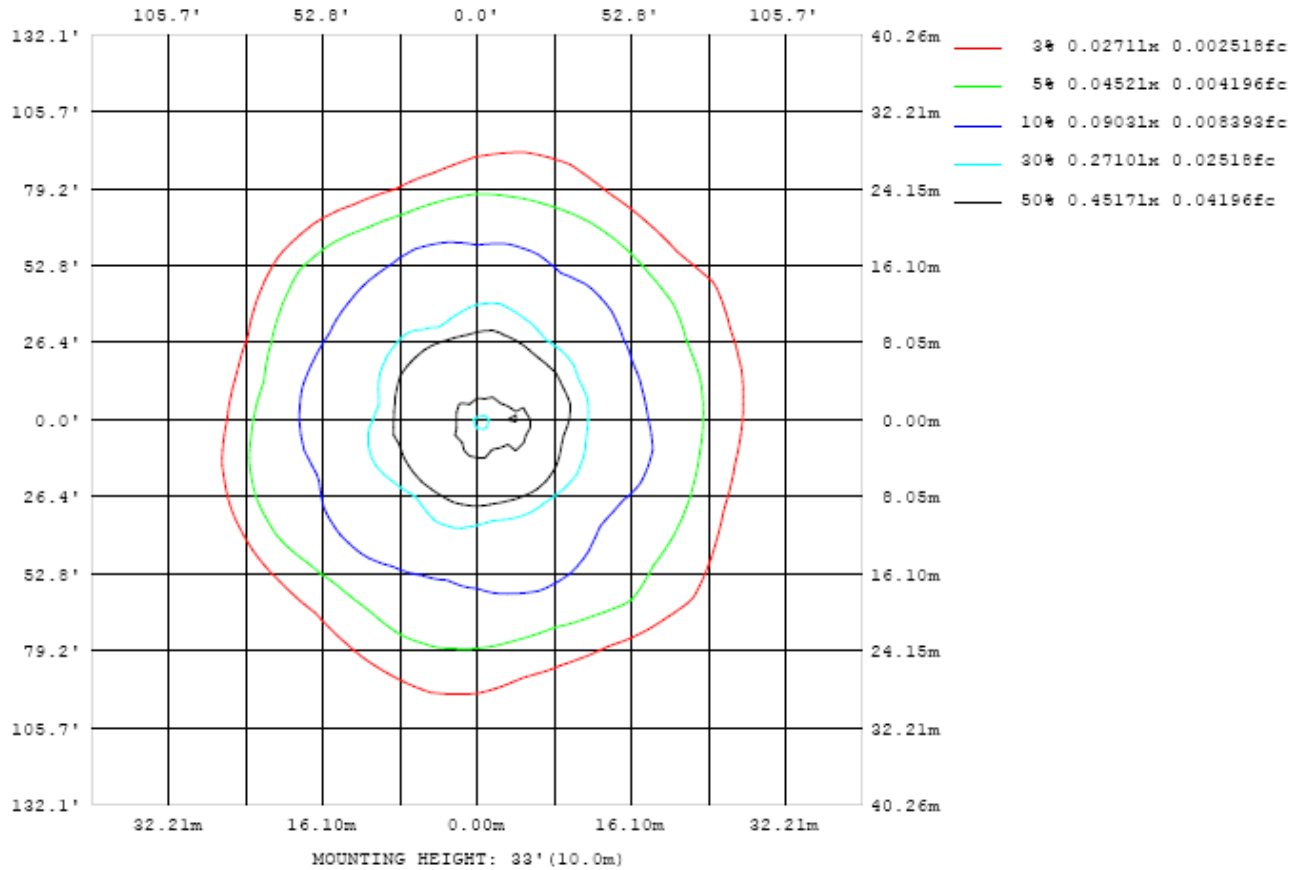


Chart 5: Illuminance Plot (Footcandles)

# Luminous Intensity Distribution Plots- Goniophotometer Method

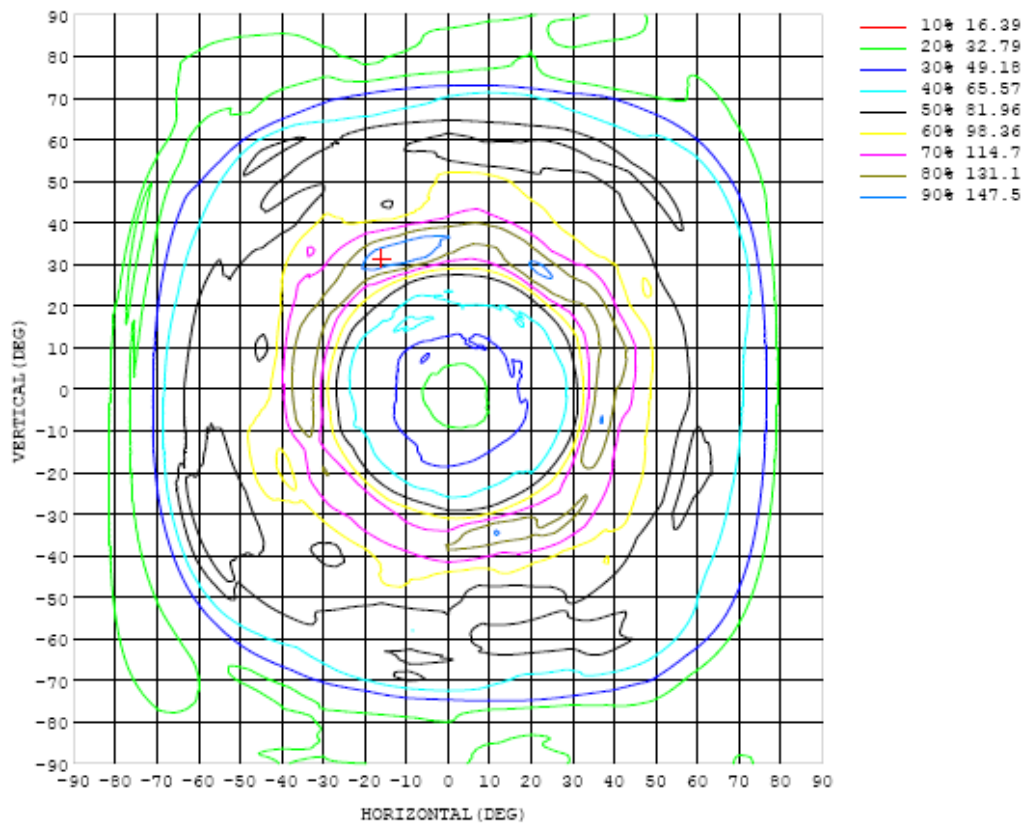


Chart 6: Isocandela Plot

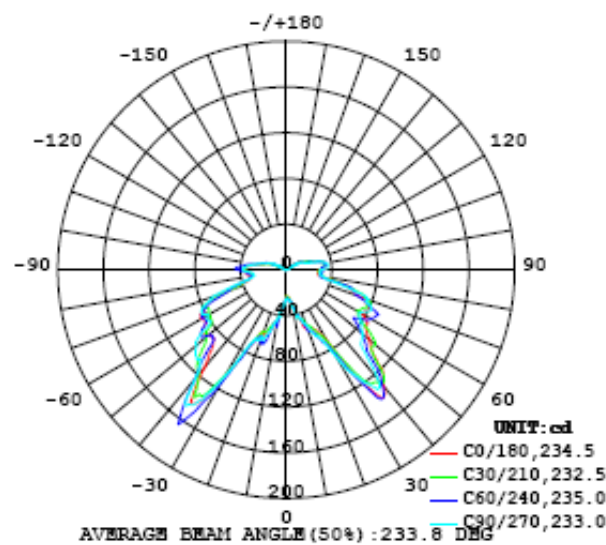


Chart 7: Polar Candela Distribution

## 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	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
5	24.3	24.0	24.0	24.6	25.0	26.9	26.5	26.0	26.3	26.7	27.3	27.5	27.2	27.7	28.7	29.1	29.2	29.3	29.0
10	37.0	36.7	32.6	32.5	29.2	29.7	32.4	33.0	33.3	34.9	37.3	38.7	39.2	40.4	42.2	44.3	45.9	41.6	40.1
15	42.5	41.2	39.3	44.1	44.5	44.8	41.6	42.4	44.7	42.4	43.1	46.8	48.8	48.8	48.8	50.1	51.8	54.9	56.9
20	52.8	53.1	50.5	51.4	54.0	55.1	56.9	53.4	52.3	51.4	52.1	53.8	58.1	58.9	59.1	58.3	62.2	60.4	58.2
25	57.3	58.9	58.8	57.8	60.3	63.0	62.9	63.7	64.2	63.8	65.9	66.6	68.5	68.9	70.1	73.1	68.1	70.6	71.3
30	72.9	70.0	72.4	74.4	76.8	80.7	83.6	83.8	86.9	89.1	96.2	99.1	98.4	103	104	103	101	108	107
35	126	131	131	118	112	117	130	144	137	120	119	120	127	129	130	132	126	144	144
40	133	128	128	130	128	133	130	121	125	125	116	113	111	110	110	107	102	110	111
45	112	107	107	110	116	110	100	102	90.9	92.7	102	102	90.6	81.5	91.2	99.4	99.7	107	90.3
50	95.1	92.7	100	102	94.5	89.4	86.2	78.2	75.8	87.3	96.3	91.5	87.1	82.1	83.1	90.6	97.7	96.5	89.3
55	85.3	82.6	85.2	82.9	96.2	89.4	73.4	70.5	78.2	80.0	73.3	74.7	86.8	91.5	90.8	80.5	78.1	79.5	87.4
60	77.7	85.1	82.6	71.9	68.1	77.6	85.6	91.4	85.7	74.7	71.4	72.3	76.1	83.7	85.5	83.0	75.3	81.3	86.0
65	81.2	82.0	78.7	78.0	80.8	87.2	86.1	81.6	79.1	82.4	83.2	79.6	72.5	73.1	75.9	82.5	77.3	82.1	79.7
70	70.1	66.2	67.3	75.2	81.8	77.7	66.5	64.9	66.7	76.6	84.1	74.5	64.8	56.9	60.0	64.3	66.1	62.2	53.3
75	55.9	53.1	55.5	55.9	55.9	56.3	57.4	54.4	49.8	46.8	46.2	43.9	41.2	35.3	32.8	36.2	37.7	34.1	33.2
80	30.5	28.7	29.8	30.6	33.3	32.0	30.7	26.2	29.0	32.7	31.7	30.2	32.6	32.8	35.4	33.6	28.4	31.2	32.4
85	28.5	27.5	29.8	30.2	30.8	31.0	30.7	34.0	32.3	29.7	26.9	26.3	32.4	36.0	34.9	35.2	31.3	33.2	35.6
90	32.5	32.0	33.2	30.2	26.3	27.0	32.3	35.4	35.4	30.7	29.4	32.9	33.8	32.6	35.5	39.5	44.8	42.1	37.7
95	34.0	32.9	32.6	31.6	35.4	34.6	33.5	31.9	32.1	36.5	42.7	42.8	41.3	38.7	41.5	35.7	33.2	34.4	35.5
100	34.7	32.5	32.9	34.0	35.8	35.6	35.4	35.8	36.2	36.0	36.2	33.1	32.0	28.0	28.4	26.9	25.2	25.7	25.0
105	29.9	30.9	31.0	30.5	28.5	27.0	27.7	28.5	27.9	25.8	24.1	22.1	21.6	21.9	22.3	18.1	17.6	19.0	19.8
110	22.4	24.6	24.8	22.9	21.0	20.1	19.7	19.9	18.8	17.7	17.4	17.1	16.4	17.0	15.8	15.8	14.1	16.0	16.7
115	17.7	18.4	19.1	17.7	17.3	17.1	15.8	14.9	14.9	15.6	13.7	12.9	12.2	11.7	10.7	10.7	9.69	10.0	10.5
120	13.5	13.3	14.2	14.3	13.9	13.4	13.1	11.7	10.9	9.59	8.82	8.35	7.33	6.91	6.63	6.67	6.63	7.10	6.73
125	7.64	7.80	8.11	7.80	7.31	7.02	6.94	6.22	5.47	5.41	4.96	4.61	4.56	4.42	4.25	4.08	4.18	4.49	4.16
130	4.01	3.85	4.00	4.44	4.34	4.40	4.34	3.86	3.49	3.49	3.31	3.25	3.03	2.71	2.48	2.55	2.70	2.76	2.33
135	2.52	2.49	2.41	2.45	2.48	2.38	2.26	2.18	2.16	2.04	1.93	1.84	1.69	1.62	1.70	1.64	1.54	1.55	1.25
140	1.45	1.46	1.39	1.34	1.31	1.28	1.22	1.12	0.98	0.88	0.79	0.71	0.66	0.63	0.58	0.56	0.58	0.55	0.48
145	0.45	0.44	0.43	0.43	0.44	0.44	0.43	0.42	0.42	0.41	0.40	0.39	0.38	0.37	0.35	0.34	0.33	0.33	0.34
150	0.37	0.36	0.33	0.33	0.35	0.36	0.35	0.35	0.34	0.33	0.33	0.32	0.31	0.30	0.29	0.28	0.27	0.27	0.28
155	0.30	0.29	0.28	0.27	0.28	0.29	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.25	0.25	0.24	0.24	0.23	0.24
160	0.25	0.24	0.24	0.23	0.23	0.23	0.24	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.19	0.19	0.19	0.19	0.20
165	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.16	0.16	0.15	0.15	0.15	0.14	0.13	0.13	0.13	0.14
170	0.09	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	0.09	0.09	0.09	0.09	0.09
175	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	0.09	0.09	0.09	0.09
180	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

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	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6		
5	29.5	30.6	31.0	32.2	33.4	34.4	33.0	30.8	30.7	30.9	30.5	30.2	28.5	27.0	25.6	25.2	24.7		
10	41.3	42.3	43.7	44.5	47.8	48.6	46.5	41.4	40.7	42.0	45.8	42.5	41.1	41.0	40.8	37.4	35.4		
15	56.8	52.9	50.7	52.1	55.1	58.1	54.7	56.6	56.1	54.5	51.5	49.2	46.9	48.8	46.7	48.6	48.3		
20	56.2	55.9	58.0	60.8	63.8	62.3	62.9	61.0	61.7	65.9	63.2	60.9	61.1	58.1	55.8	56.7	53.4		
25	71.4	69.7	69.6	71.0	71.1	71.3	69.7	71.6	70.6	67.7	66.2	66.8	65.8	64.6	62.2	63.0	59.3		
30	110	109	106	107	108	115	122	118	107	102	98.8	94.8	92.6	88.8	80.4	76.6	76.0		
35	142	137	132	133	143	165	158	153	144	131	128	143	150	142	123	115	120		
40	116	123	119	119	122	124	119	120	123	133	134	127	118	127	138	142	143		
45	79.4	91.1	109	116	107	92.8	82.6	95.7	111	111	112	109	104	102	108	110	122		
50	90.0	90.0	92.1	91.8	97.5	90.2	86.7	90.9	103	113	102	91.3	83.7	91.6	94.6	94.4	97.3		
55	88.7	88.3	79.8	71.8	79.2	89.8	92.3	90.4	82.0	76.7	80.1	82.5	82.8	90.8	90.9	86.6	90.8		
60	88.3	81.6	78.6	84.3	85.7	84.3	88.7	82.6	78.9	82.4	80.3	74.9	80.8	80.4	73.6	71.9	75.0		
65	70.5	74.9	79.3	79.9	79.8	77.8	78.6	80.0	81.4	79.9	81.7	84.3	86.6	83.0	85.7	79.5	81.7		
70	51.5	52.2	54.3	59.6	57.8	53.5	50.8	54.7	68.1	76.5	74.3	67.0	65.0	66.2	74.4	71.0	73.0		
75	31.1	33.9	35.3	31.8	36.3	36.0	32.4	34.9	36.9	41.3	39.9	40.0	45.7	47.6	50.8	55.1	61.7		
80	33.3	33.7	30.3	29.8	29.4	30.8	33.6	31.8	28.5	30.8	33.6	28.4	24.5	27.1	33.4	33.6	33.2		
85	34.4	33.7	31.8	29.1	30.6	34.0	35.9	34.8	29.7	27.7	31.5	34.4	32.3	30.5	29.1	28.4	27.4		
90	38.7	38.0	37.6	39.5	43.2	42.6	39.3	37.0	38.4	35.3	32.9	31.9	34.2	32.3	26.1	23.6	28.2		
95	36.5	36.3	35.5	35.4	36.3	38.7	39.3	34.8	34.7	36.5	38.2	35.3	33.1	34.7	37.1	36.4	34.2		
100	26.7	25.8	27.6	29.4	27.6	29.9	30.8	28.1	28.2	30.3	33.1	37.1	38.3	36.0	38.3	38.2	37.6		
105	20.0	20.5	19.9	19.9	21.5	22.6	23.0	21.9	21.9	22.3	24.9	27.5	29.7	27.9	27.9	29.1	29.7		
110	16.0	15.6	14.6	14.4	16.6	18.6	18.9	19.6	17.4	16.8	17.3	19.6	21.0	19.1	18.4	19.0	20.7		
115	10.6	9.84	8.96	9.60	10.5	12.7	13.1	13.7	13.2	13.5	14.7	16.8	17.8	16.7	15.9	16.0	17.1		
120	5.67	5.68	5.96	6.21	6.38	6.53	7.29	8.44	8.11	8.58	10.0	10.6	11.2	11.6	11.6	11.6	12.9		
125	3.71	3.87	4.44	4.74	4.53	4.56	4.51	4.98	4.97	4.88	5.35	5.35	5.70	6.45	6.88	7.19	7.50		
130	2.16	2.28	2.45	2.52	2.49	2.50	2.70	2.97	3.26	3.48	3.43	3.24	3.55	4.28	4.65	4.34	4.41		
135	1.26	1.08	1.43	1.57	1.05	1.72	1.73	1.73	1.83	1.84	1.85	1.89	1.98	2.20	2.38	2.50	2.61		
140	0.46	0.40	0.32	0.54	0.47	0.54	0.56	0.59	0.64	0.69	0.75	0.88	1.01	1.16	1.35	1.45	1.48		
145	0.34	0.33	0.21	0.22	0.28	0.35	0.36	0.36	0.37	0.38	0.40	0.40	0.42	0.43	0.45	0.46	0.47		
150	0.28	0.27	0.23	0.15	0.19	0.27	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.35	0.36	0.37	0.37		
155	0.24	0.23	0.21	0.20	0.15	0.13	0.16	0.23	0.27	0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.31		
160	0.20	0.19	0.18	0.17	0.18	0.21	0.21	0.21	0.22	0.23	0.24	0.24	0.25	0.25	0.25	0.25	0.26		
165	0.14	0.13	0.13	0.12	0.12	0.14	0.15	0.15	0.17	0.18	0.18	0.19	0.20	0.20	0.20	0.20	0.20		
170	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		
175	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		
180	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		

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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