

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 10PAR30DIM/830NF25/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.: HZ19070039a

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

Review by:



Engineer: April Zou

Aug. 01, 2019

Approved by:



Manager: Jim Zhang

Aug. 01, 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: 10PAR30DIM/830NF25/N

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
104.6	1012.7	9.68	0.7275
CCT (K)	CRI	Stabilization Time (Light & Power)	
2966	82.7	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>	: Jul. 25, 2019
<b>Date of Test</b>	: Jul. 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>	: 10PAR30DIM/830NF25/N
<b>Electrical Ratings</b>	: 120V, 60Hz, 10W
<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)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.111
Power Factor	0.7275
Test Power (W)	9.68
THD A%	68.04
Luminous Efficacy (lm/W)	104.6
Total Luminous Flux (lm)	1012.7
Color Rendering Index (CRI)	82.7
R9	5.7
Correlated Color Temperature (CCT)(K)	2966
Chromaticity Chroma x	0.4396
Chromaticity Chroma y	0.4055
Chromaticity Chroma u	0.2516
Chromaticity Chroma v	0.3482
Duv	0.0003
Chromaticity Chroma u'	0.2516
Chromaticity Chroma v'	0.5223

Special Color Rendering Indices	
R1	81.5
R2	92.8
R3	93.9
R4	80.3
R5	82.3
R6	92.1
R7	81.3
R8	57.3
R9	5.7
R10	84.2
R11	80.2
R12	76.6
R13	84.4
R14	97.2

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 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)	0.110
Power Factor	0.7334
Power (W)	9.65
Luminous Efficacy (lm/W)	106.4
Total Luminous Flux (lm)	1026.3
Beam Angle ( ° )	21.9 (0°-180°) / 21.6 (90°-270°)
Center Beam Candle Power (cd)	4178
Maximum Beam Candle Power (cd)	4344 (At: C=150.0, Gamma=3.0)
Spacing Criteria	0.40 (0°-180°) / 0.37 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	96.10%
Zonal Lumens in the 60 °-90 °Zone	3.68%
Zonal Lumens in the 90 °-120 °Zone	0.09%
Zonal Lumens in the 120 °-180 °Zone	0.13%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

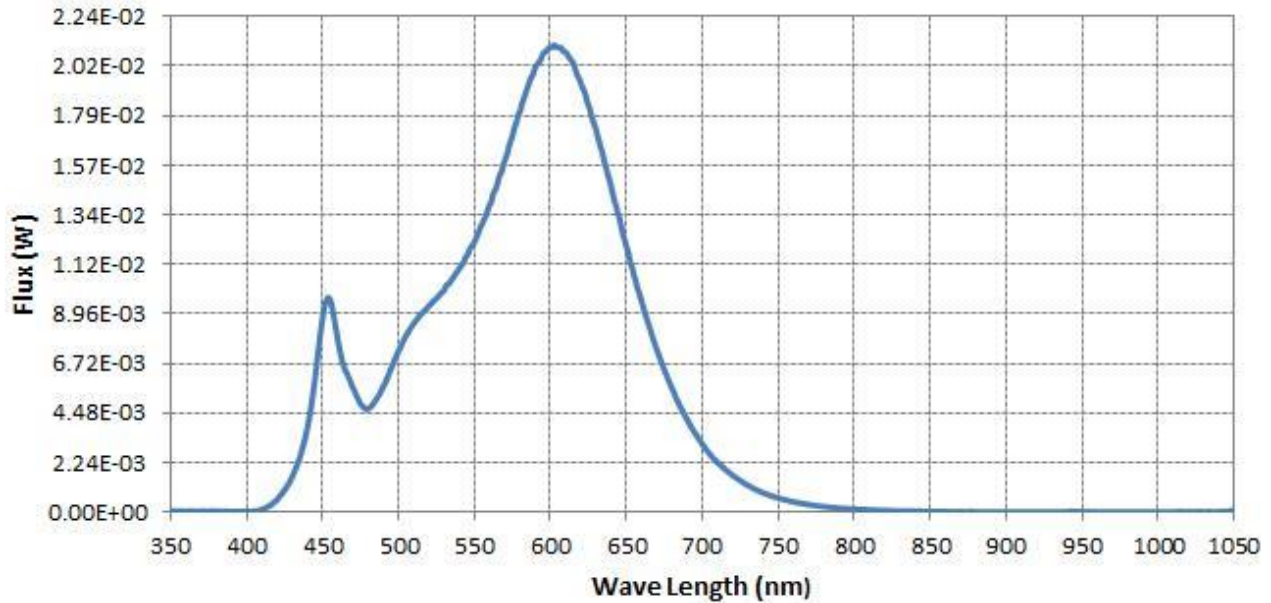


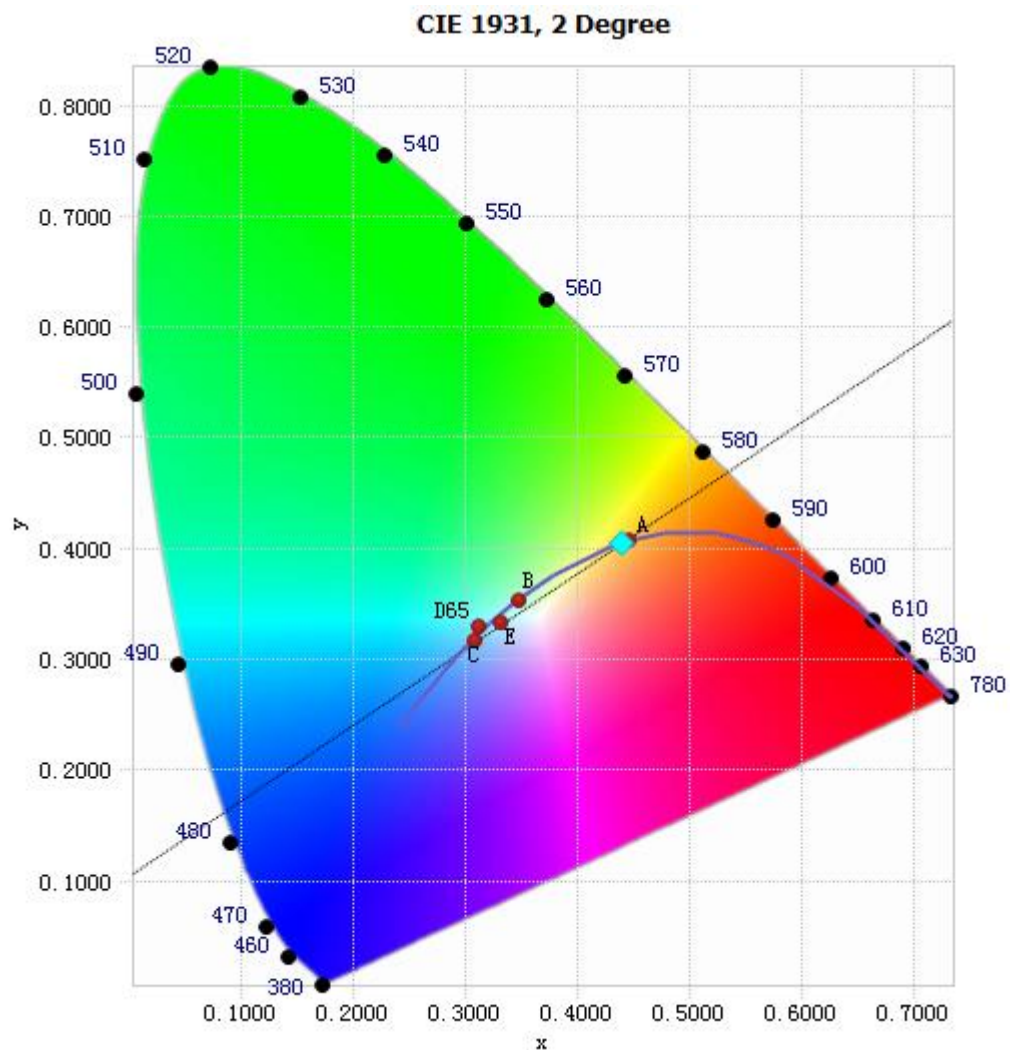
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.31E-05	485	5.05E-03	590	2.01E-02	695	3.58E-03
385	4.26E-05	490	5.67E-03	595	2.07E-02	700	3.08E-03
390	4.09E-05	495	6.46E-03	600	2.10E-02	705	2.62E-03
395	2.66E-05	500	7.28E-03	605	2.10E-02	710	2.24E-03
400	2.72E-05	505	7.98E-03	610	2.08E-02	715	1.93E-03
405	5.72E-05	510	8.53E-03	615	2.03E-02	720	1.66E-03
410	1.23E-04	515	8.95E-03	620	1.94E-02	725	1.43E-03
415	2.79E-04	520	9.33E-03	625	1.84E-02	730	1.22E-03
420	5.60E-04	525	9.66E-03	630	1.73E-02	735	1.03E-03
425	9.97E-04	530	1.00E-02	635	1.60E-02	740	8.71E-04
430	1.60E-03	535	1.05E-02	640	1.47E-02	745	7.51E-04
435	2.45E-03	540	1.10E-02	645	1.34E-02	750	6.41E-04
440	3.79E-03	545	1.16E-02	650	1.20E-02	755	5.48E-04
445	5.98E-03	550	1.22E-02	655	1.07E-02	760	4.71E-04
450	8.74E-03	555	1.30E-02	660	9.54E-03	765	4.04E-04
455	9.61E-03	560	1.39E-02	665	8.40E-03	770	3.47E-04
460	7.84E-03	565	1.48E-02	670	7.35E-03	775	2.92E-04
465	6.40E-03	570	1.59E-02	675	6.42E-03	780	2.52E-04
470	5.64E-03	575	1.70E-02	680	5.60E-03		
475	4.90E-03	580	1.81E-02	685	4.84E-03		
480	4.68E-03	585	1.92E-02	690	4.18E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4396, 0.4055)

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

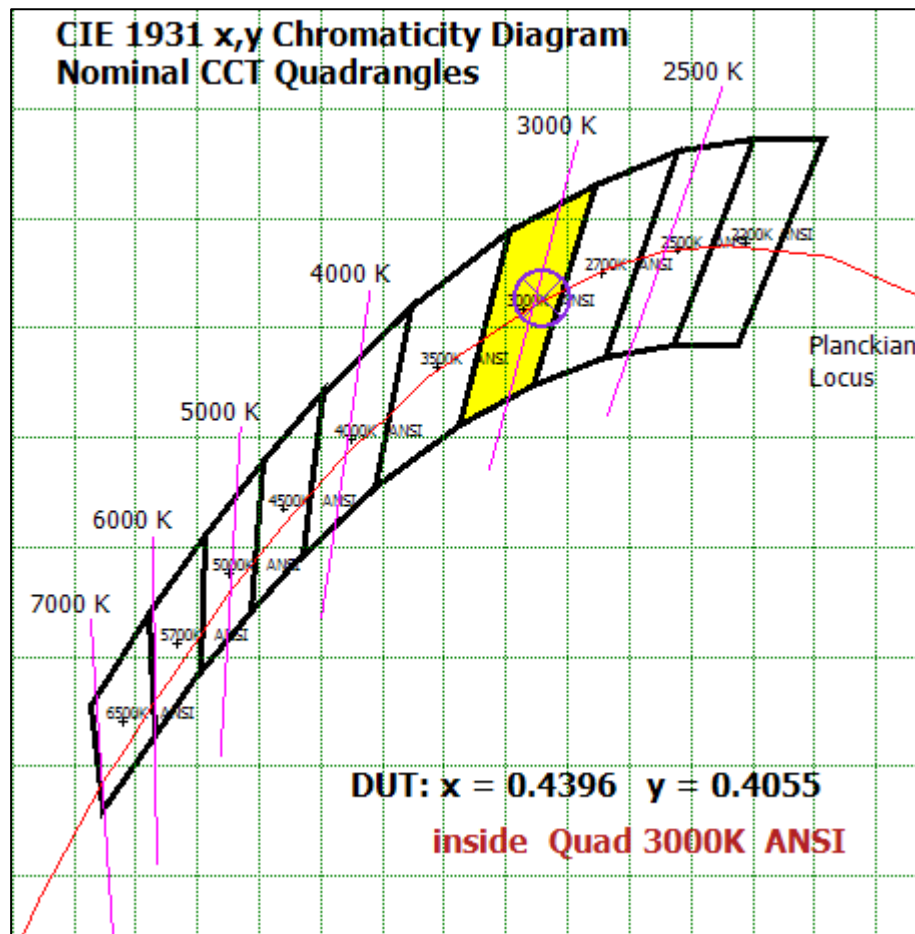


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method

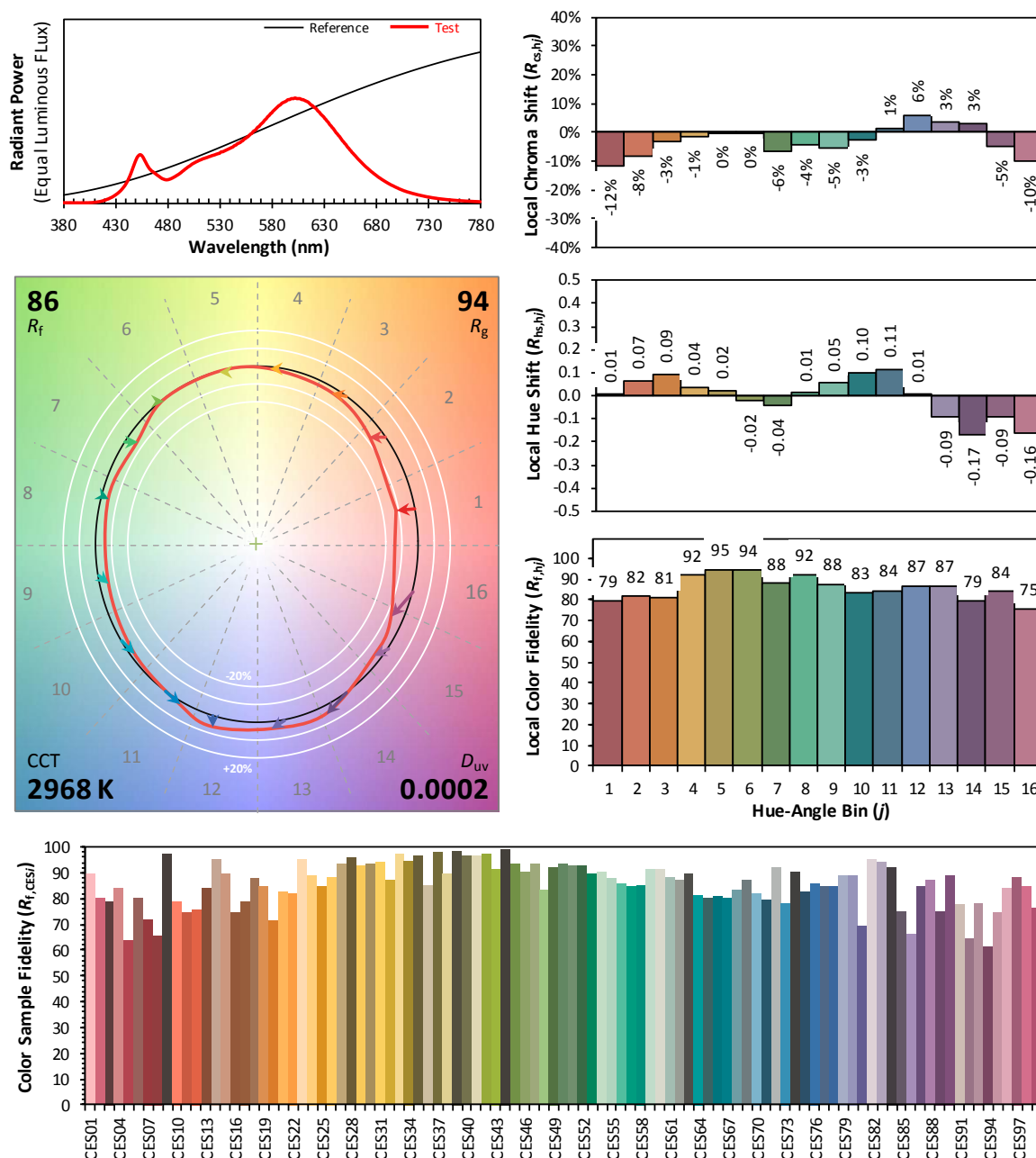


Chart 4: Full Report Created with the IES TM-30 Calculator

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	313.403	30.54%
10- 20	332.063	32.36%
20- 30	177.075	17.25%
30- 40	91.7	8.94%
40- 50	43.273	4.22%
50- 60	28.701	2.80%
60- 70	21.108	2.06%
70- 80	12.136	1.18%
80- 90	4.565	0.44%
90-100	0.832	0.08%
100-110	0.033	0.00%
110-120	0.02	0.00%
120-130	0.048	0.00%
130-140	0.137	0.01%
140-150	0.317	0.03%
150-160	0.424	0.04%
160-170	0.32	0.03%
170-180	0.1	0.01%
Total	1026.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	986.215	96.10%
60- 90	37.809	3.68%
0-90	1024.024	99.78%
90- 180	2.231	0.22%
0- 180	1026.3	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

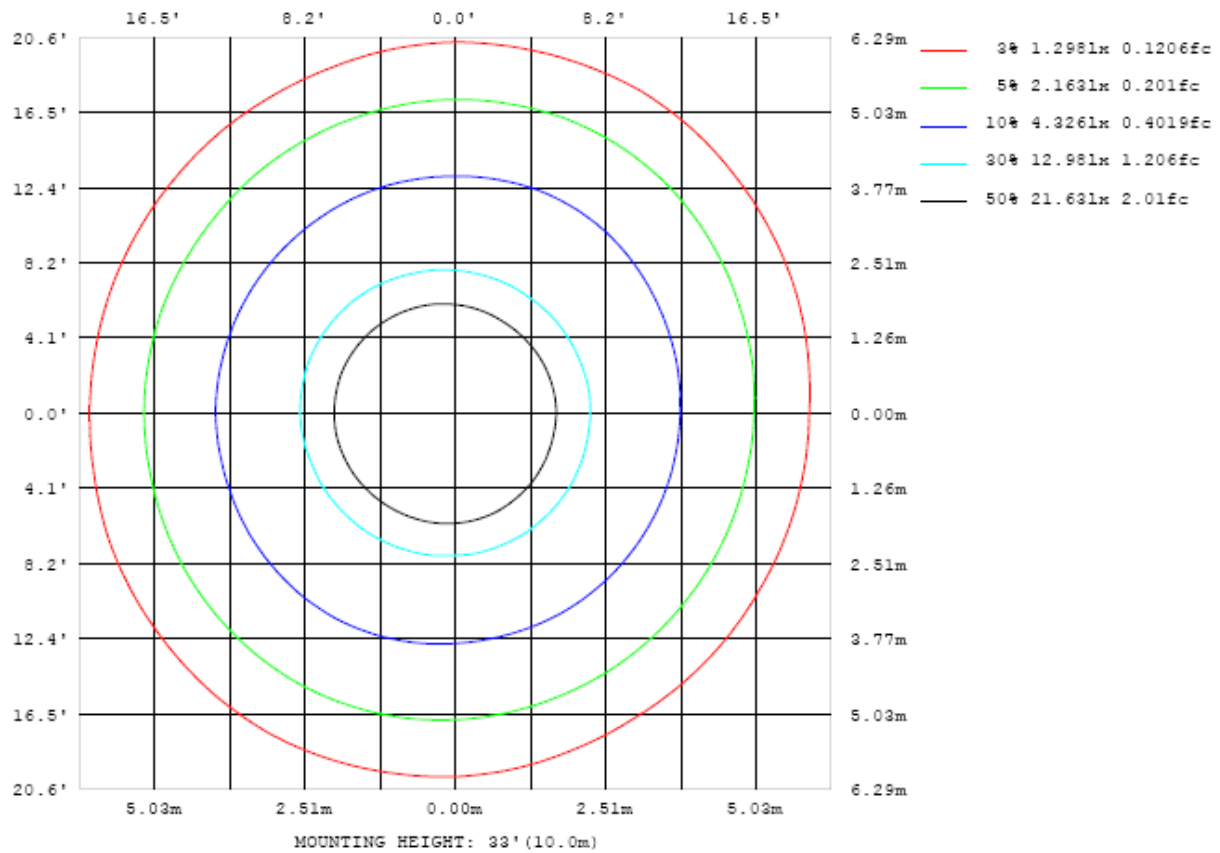


Chart 5: Illuminance Plot (Footcandles)

# Luminous Intensity Distribution Plots- Goniophotometer Method

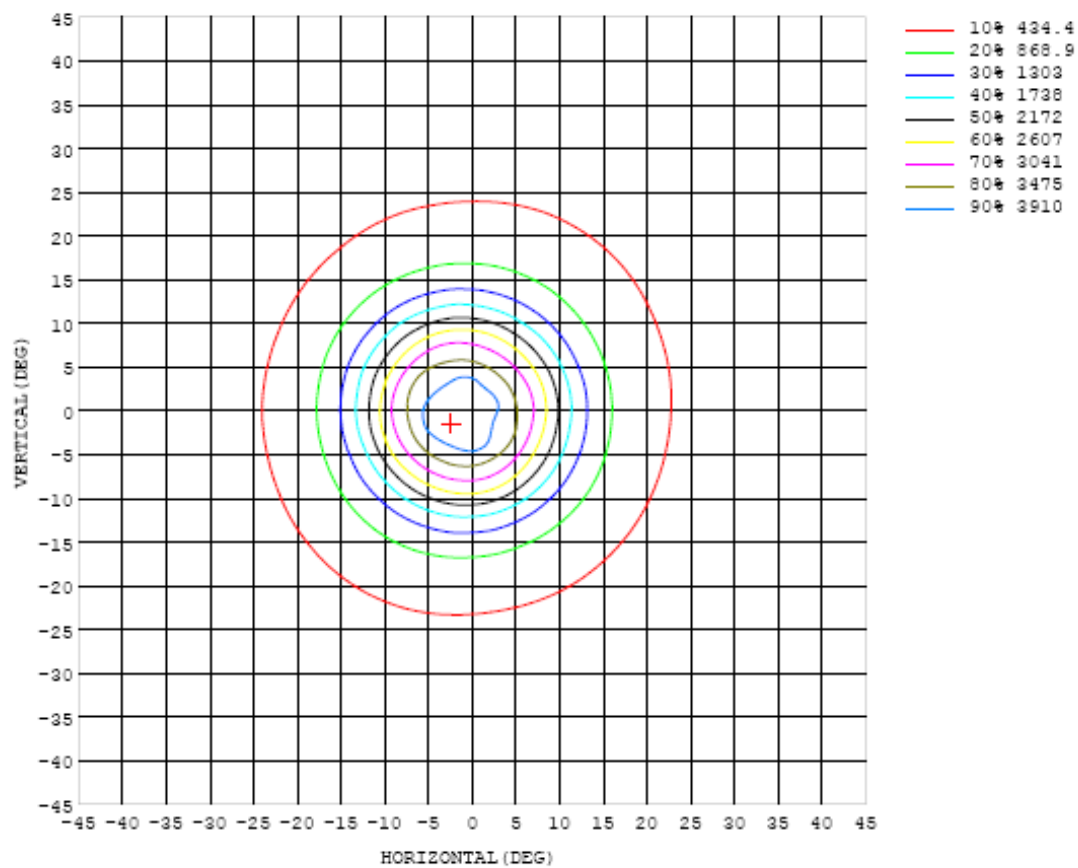


Chart 6: Isocandela Plot

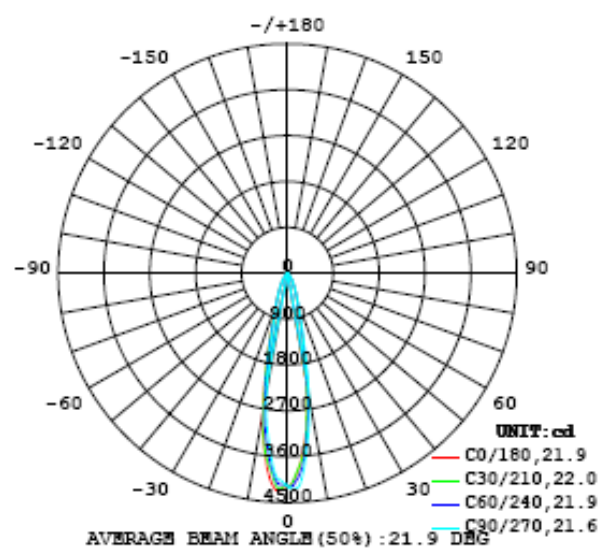


Chart 7: Polar Candela Distribution

## 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	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178
5	3510	3516	3542	3572	3597	3634	3685	3734	3773	3817	3818	3825	3832	3867	3925	3999	4063	4072	4033
10	2121	2111	2127	2154	2187	2215	2269	2327	2377	2428	2468	2500	2548	2599	2656	2723	2757	2802	2812
15	989	989	997	1006	1019	1026	1043	1061	1086	1106	1142	1167	1196	1224	1245	1270	1281	1308	1325
20	557	555	554	554	558	564	567	571	584	597	612	634	646	655	656	662	665	660	660
25	350	345	343	344	346	348	354	359	363	371	381	389	393	395	396	396	393	394	397
30	216	215	214	212	213	215	216	222	228	235	239	245	251	251	250	249	248	243	241
35	132	128	126	125	125	125	129	134	138	143	147	149	150	151	152	151	149	146	145
40	79.4	76.7	74.6	73.2	73.7	74.0	76.0	79.5	82.8	85.6	88.7	89.4	89.6	91.0	91.1	90.1	87.8	85.4	83.6
45	52.6	50.3	48.3	47.2	47.3	48.5	50.3	52.0	53.4	54.6	55.5	56.6	57.0	56.5	56.1	55.5	54.8	53.6	52.3
50	39.0	37.3	36.4	35.9	35.9	36.4	37.5	38.5	38.8	39.2	39.7	40.3	40.3	40.2	40.0	39.5	39.0	38.7	38.3
55	31.6	30.7	30.3	30.0	30.1	30.3	31.2	31.9	32.2	32.7	33.1	33.4	33.2	33.1	33.1	32.6	32.2	32.3	32.0
60	25.5	24.9	24.8	24.5	24.6	24.6	25.2	25.6	25.8	26.1	26.5	26.8	26.7	26.7	26.8	26.5	26.3	26.3	26.3
65	20.4	20.2	20.0	20.0	20.0	20.1	20.5	20.9	21.1	21.5	21.7	22.0	22.0	22.0	22.1	22.0	21.8	21.8	21.9
70	15.1	15.0	15.0	14.9	15.0	15.2	15.6	15.9	16.2	16.5	16.8	17.0	17.1	17.1	17.2	17.2	17.0	17.0	17.2
75	10.3	10.3	10.3	10.4	10.4	10.6	10.8	11.1	11.3	11.6	11.8	12.0	12.1	12.2	12.3	12.4	12.3	12.3	12.4
80	6.09	6.12	6.16	6.23	6.31	6.41	6.62	6.78	6.94	7.17	7.30	7.44	7.58	7.72	7.77	7.79	7.82	7.82	7.88
85	3.41	3.43	3.45	3.51	3.58	3.66	3.76	3.89	4.01	4.13	4.26	4.38	4.48	4.56	4.63	4.69	4.72	4.71	4.77
90	1.40	1.40	1.42	1.45	1.48	1.51	1.56	1.61	1.66	1.72	1.78	1.87	1.95	2.02	2.08	2.14	2.17	2.19	2.25
95	0.49	0.50	0.50	0.52	0.53	0.55	0.58	0.61	0.63	0.66	0.69	0.72	0.75	0.77	0.79	0.81	0.83	0.84	0.86
100	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.20
105	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
110	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
115	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	0.02	0.02	0.02	0.02
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
125	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	0.04	0.04	0.04	0.05
130	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.10
135	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	0.13	0.12	0.12	0.12	0.12	0.19
140	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.34
145	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.36	0.36	0.35	0.35	0.35	0.34	0.33	0.57
150	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.50	0.50	0.50	0.48	0.83
155	0.65	0.65	0.65	0.65	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.62	1.07
160	0.76	0.76	0.76	0.77	0.77	0.77	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.74	1.21
165	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.82	1.22
170	0.90	0.90	0.90	0.91	0.91	0.91	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.89	1.11
175	0.89	0.89	0.89	0.90	0.90	0.91	0.91	0.92	0.92	0.93	0.93	0.93	0.93	0.94	0.94	0.93	0.93	0.94	0.93
180	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92

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	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178	4178		
5	3962	3907	3857	3809	3782	3768	3742	3695	3640	3583	3543	3506	3484	3486	3479	3480	3489		
10	2787	2754	2709	2657	2609	2553	2491	2429	2361	2303	2235	2178	2149	2132	2128	2118	2118		
15	1324	1327	1302	1272	1244	1203	1165	1135	1104	1078	1058	1038	1023	1006	995	991	992		
20	662	661	657	651	645	639	633	627	625	624	625	622	611	598	585	574	566		
25	394	390	390	388	389	393	395	394	396	398	399	395	391	383	372	363	359		
30	243	244	241	241	243	242	243	248	251	251	252	253	249	242	236	231	223		
35	142	142	143	144	142	146	149	151	154	155	154	153	152	149	146	142	138		
40	81.8	80.7	80.9	81.7	82.6	85.2	87.7	89.9	91.7	93.1	93.1	91.3	91.0	91.0	89.0	86.4	83.8		
45	51.0	49.5	48.6	49.6	51.4	53.6	55.7	56.9	57.9	58.0	58.6	58.7	58.3	57.6	56.7	56.1	54.7		
50	37.5	36.8	36.6	36.8	37.6	39.1	40.4	40.8	40.8	41.1	41.6	41.4	41.3	41.1	40.5	40.2	39.9		
55	31.6	31.3	31.3	31.6	32.0	32.9	33.7	33.7	33.5	33.5	33.7	33.4	33.1	32.9	32.6	32.2	32.1		
60	25.9	25.8	25.8	26.0	26.1	26.6	27.1	27.0	26.9	26.8	26.9	26.7	26.4	26.1	26.1	25.9	25.7		
65	21.7	21.7	21.7	21.7	21.7	22.0	22.2	22.2	22.1	22.0	21.9	21.8	21.4	21.1	21.1	20.9	20.6		
70	17.1	17.1	17.1	17.1	17.0	17.1	17.1	17.0	16.9	16.7	16.5	16.3	16.0	15.8	15.8	15.7	15.4		
75	12.4	12.3	12.2	12.1	12.0	11.9	11.8	11.7	11.6	11.4	11.2	11.0	10.8	10.6	10.5	10.5	10.3		
80	7.86	7.78	7.66	7.54	7.42	7.34	7.25	7.13	7.00	6.86	6.71	6.55	6.42	6.32	6.26	6.22	6.16		
85	4.75	4.71	4.62	4.54	4.46	4.40	4.31	4.20	4.07	3.95	3.83	3.71	3.62	3.55	3.51	3.49	3.46		
90	2.24	2.21	2.15	2.07	1.99	1.92	1.84	1.78	1.72	1.66	1.61	1.55	1.50	1.47	1.45	1.44	1.43		
95	0.87	0.86	0.85	0.83	0.81	0.79	0.76	0.73	0.69	0.65	0.62	0.58	0.55	0.54	0.53	0.52	0.51		
100	0.20	0.20	0.20	0.19	0.19	0.17	0.16	0.14	0.13	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.09		
105	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
110	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
115	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	0.02	0.02		
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.03		
125	0.05	0.05	0.05	0.05	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		
130	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.11		
135	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.22		
140	0.36	0.36	0.36	0.37	0.37	0.38	0.38	0.39	0.40	0.41	0.41	0.42	0.42	0.43	0.43	0.44	0.42		
145	0.61	0.61	0.61	0.62	0.63	0.64	0.64	0.65	0.67	0.68	0.69	0.70	0.70	0.71	0.71	0.72	0.69		
150	0.91	0.90	0.91	0.91	0.92	0.93	0.94	0.95	0.97	0.98	0.99	1.00	1.01	1.01	1.02	1.04	0.97		
155	1.19	1.18	1.18	1.19	1.19	1.20	1.21	1.22	1.23	1.24	1.25	1.26	1.26	1.27	1.27	1.30	1.20		
160	1.40	1.38	1.38	1.39	1.39	1.40	1.40	1.41	1.41	1.41	1.42	1.42	1.43	1.43	1.43	1.46	1.31		
165	1.46	1.44	1.45	1.45	1.45	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.48	1.30		
170	1.39	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.36	1.36	1.35	1.35	1.35	1.38	1.15		
175	1.11	1.14	1.13	1.13	1.13	1.13	1.12	1.12	1.11	1.11	1.11	1.10	1.10	1.09	1.10	1.07	0.89		
180	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		

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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