

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 12PAR38DIM/840FL40/N**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19070039m

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

Review by:



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Aug. 01, 2019

Approved by:



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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: 12PAR38DIM/840FL40/N

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
111.7	1338.9	11.99	0.7490
CCT (K)	CRI	Stabilization Time (Light & Power)	
3928	82.2	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>	: Jul. 25, 2019
<b>Date of Test</b>	: Jul. 31, 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>	: 12PAR38DIM/840FL40/N
<b>Electrical Ratings</b>	: 120V, 60Hz, 12W
<b>Product Description</b>	: 4000K
<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)	0.133
Power Factor	0.7490
Test Power (W)	11.99
THD A%	65.72
Luminous Efficacy (lm/W)	111.7
Total Luminous Flux (lm)	1338.9
Color Rendering Index (CRI)	82.2
R9	4.8
Correlated Color Temperature (CCT)(K)	3928
Chromaticity Chroma x	0.3854
Chromaticity Chroma y	0.3852
Chromaticity Chroma u	0.2250
Chromaticity Chroma v	0.3373
Duv	0.0025
Chromaticity Chroma u'	0.2250
Chromaticity Chroma v'	0.5060

Special Color Rendering Indices	
R1	80.5
R2	91.4
R3	95.7
R4	77.4
R5	79.8
R6	87.4
R7	83.9
R8	61.4
R9	4.8
R10	78.5
R11	75.4
R12	61.1
R13	83.6
R14	98.1

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 24.8 °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)	0.131
Power Factor	0.7627
Power (W)	12.03
Luminous Efficacy (lm/W)	111.3
Total Luminous Flux (lm)	1339.0
Beam Angle ( ° )	37.1 (0°-180°) / 37.2 (90°-270°)
Center Beam Candle Power (cd)	2603
Maximum Beam Candle Power (cd)	2610(At: C=0.0, Gamma=1.0)
Spacing Criteria	0.58 (0°-180°) / 0.60 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	95.37%
Zonal Lumens in the 60 °-90 °Zone	4.37%
Zonal Lumens in the 90 °-120 °Zone	0.13%
Zonal Lumens in the 120 °-180 °Zone	0.13%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

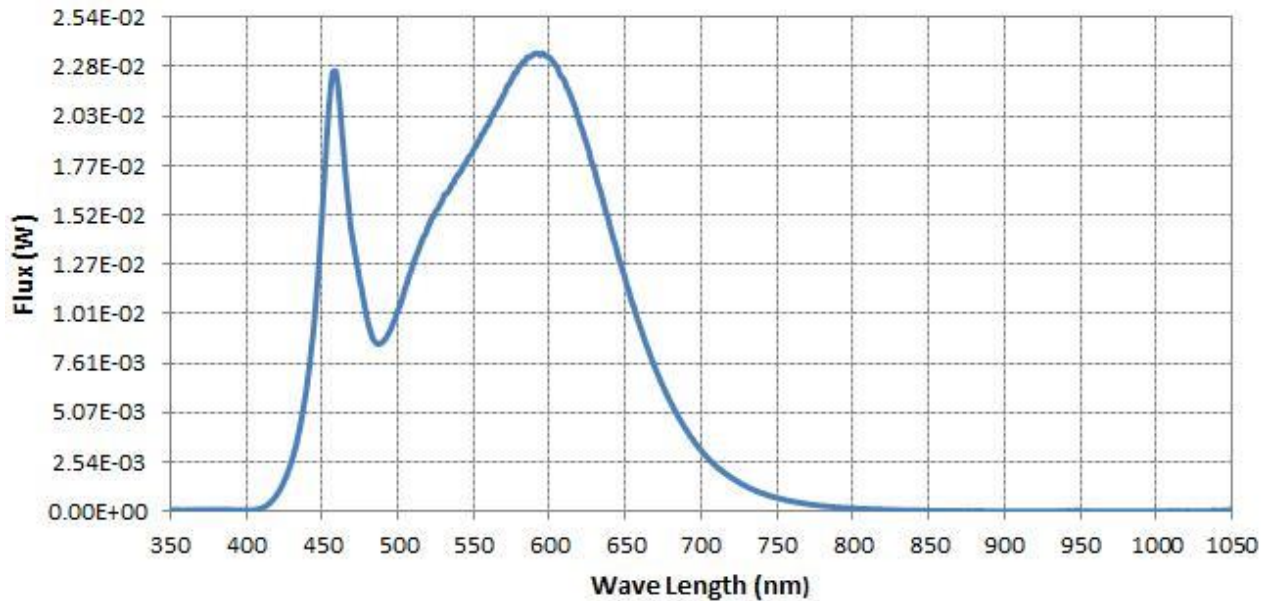


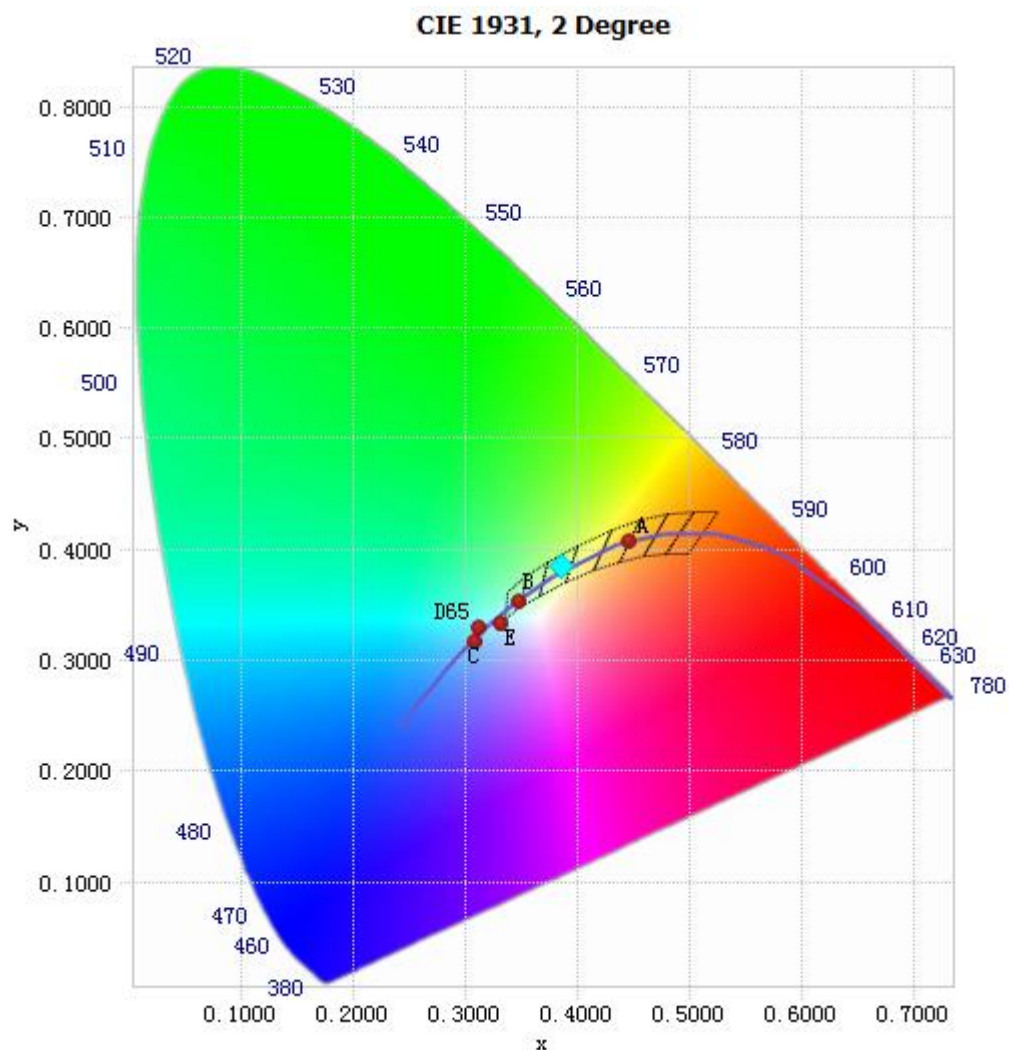
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	9.22E-05	485	8.72E-03	590	2.35E-02	695	3.63E-03
385	8.15E-05	490	8.68E-03	595	2.35E-02	700	3.13E-03
390	8.55E-05	495	9.28E-03	600	2.33E-02	705	2.69E-03
395	7.56E-05	500	1.03E-02	605	2.28E-02	710	2.32E-03
400	7.03E-05	505	1.15E-02	610	2.21E-02	715	1.99E-03
405	8.36E-05	510	1.27E-02	615	2.11E-02	720	1.73E-03
410	1.60E-04	515	1.37E-02	620	1.99E-02	725	1.49E-03
415	3.84E-04	520	1.46E-02	625	1.87E-02	730	1.28E-03
420	8.43E-04	525	1.54E-02	630	1.74E-02	735	1.10E-03
425	1.55E-03	530	1.61E-02	635	1.60E-02	740	9.39E-04
430	2.58E-03	535	1.67E-02	640	1.46E-02	745	8.05E-04
435	4.13E-03	540	1.73E-02	645	1.32E-02	750	6.97E-04
440	6.41E-03	545	1.79E-02	650	1.19E-02	755	5.99E-04
445	9.79E-03	550	1.86E-02	655	1.06E-02	760	5.20E-04
450	1.51E-02	555	1.93E-02	660	9.40E-03	765	4.48E-04
455	2.11E-02	560	1.99E-02	665	8.30E-03	770	3.85E-04
460	2.22E-02	565	2.07E-02	670	7.28E-03	775	3.38E-04
465	1.78E-02	570	2.14E-02	675	6.39E-03	780	2.91E-04
470	1.41E-02	575	2.22E-02	680	5.57E-03		
475	1.18E-02	580	2.28E-02	685	4.85E-03		
480	9.81E-03	585	2.33E-02	690	4.20E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3854, 0.3852)

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

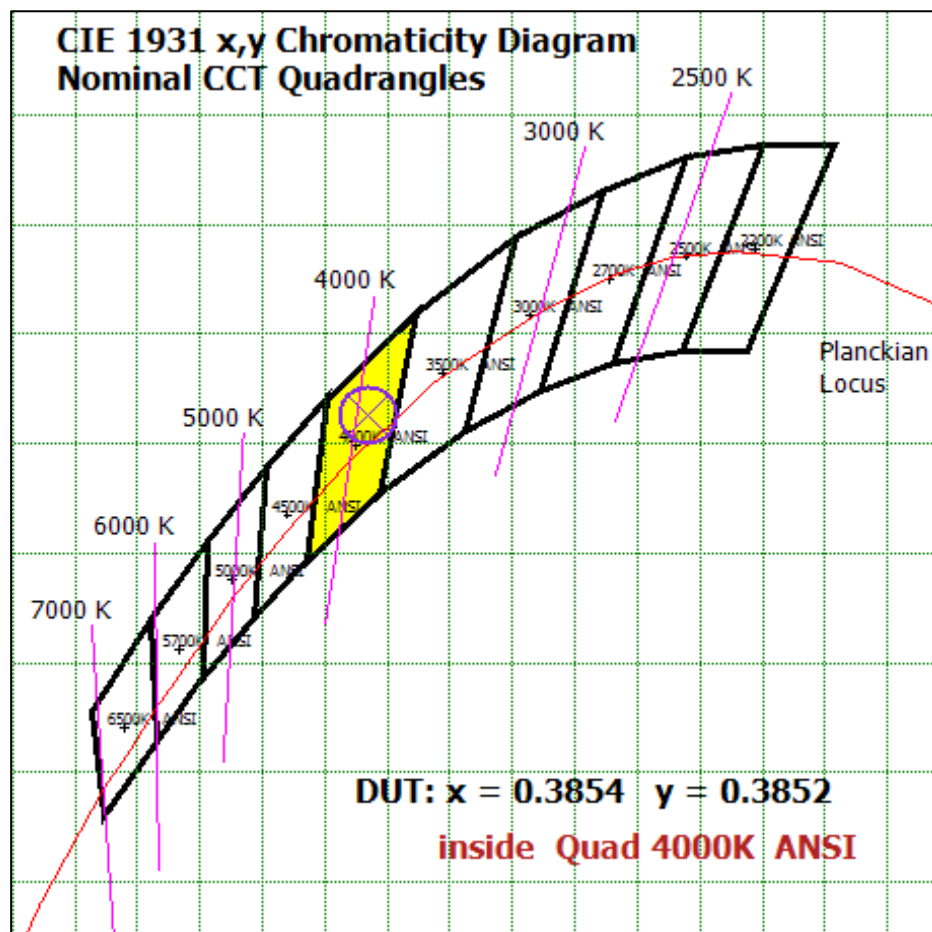
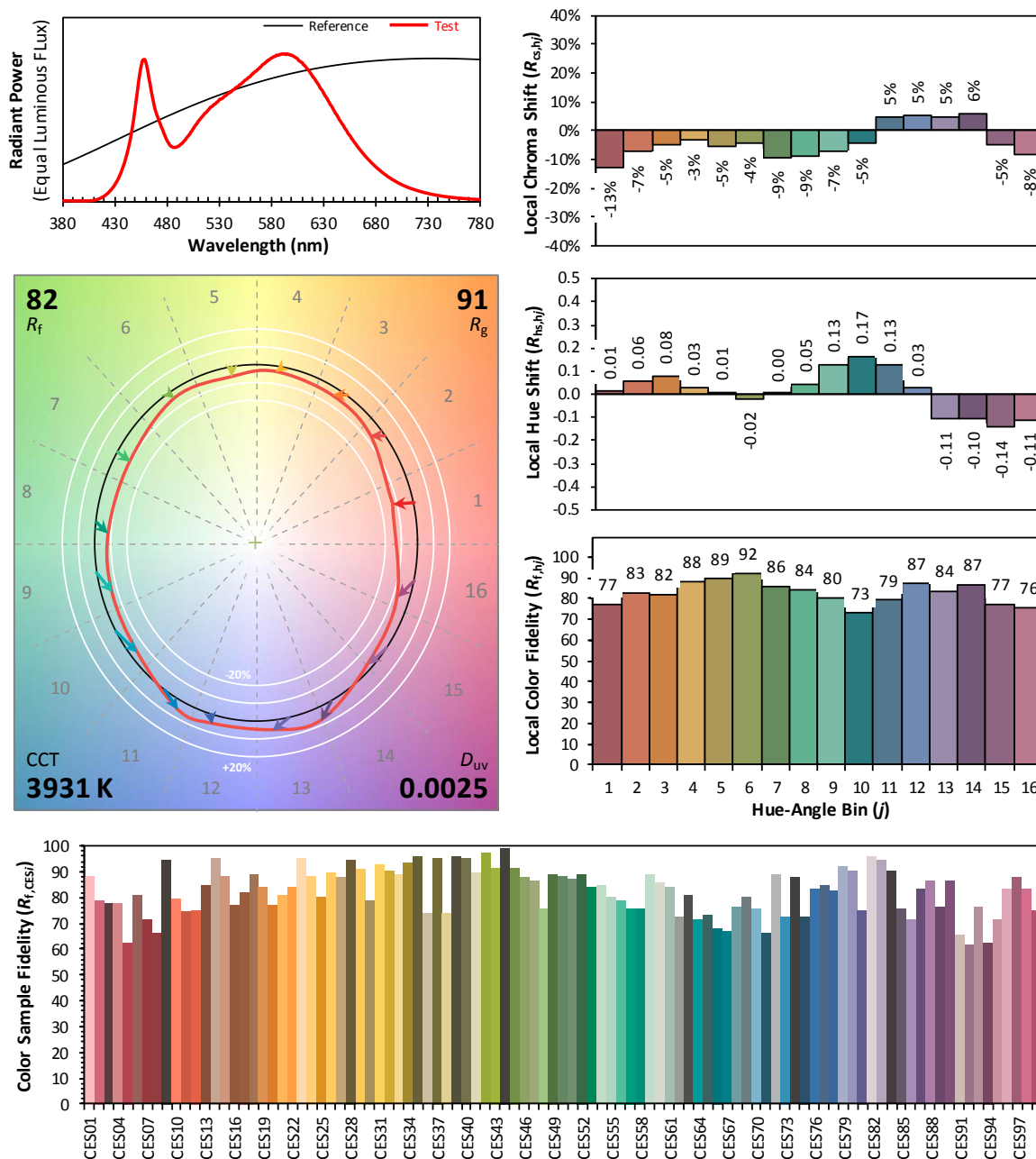


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.3854  
 $y$  0.3852  
 $u'$  0.2250  
 $v'$  0.5060

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	228.205	17.04%
10- 20	475.006	35.47%
20- 30	325.846	24.34%
30- 40	143.228	10.70%
40- 50	57.827	4.32%
50- 60	46.877	3.50%
60- 70	32.108	2.40%
70- 80	18.873	1.41%
80- 90	7.577	0.57%
90-100	1.556	0.12%
100-110	0.117	0.01%
110-120	0.038	0.00%
120-130	0.083	0.01%
130-140	0.228	0.02%
140-150	0.417	0.03%
150-160	0.493	0.04%
160-170	0.383	0.03%
170-180	0.129	0.01%
Total	1339.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1276.989	95.37%
60- 90	58.558	4.37%
0-90	1335.547	99.74%
90- 180	3.444	0.26%
0- 180	1339.0	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

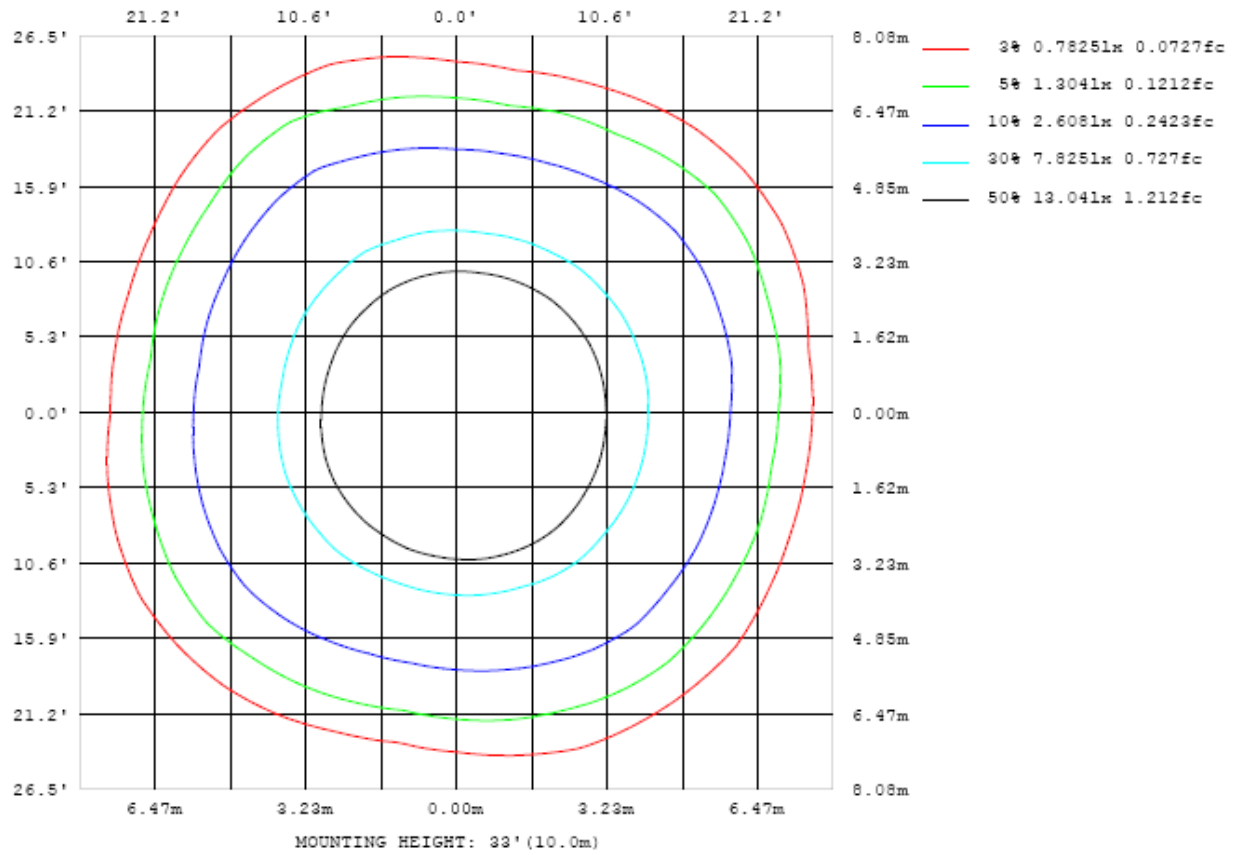


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

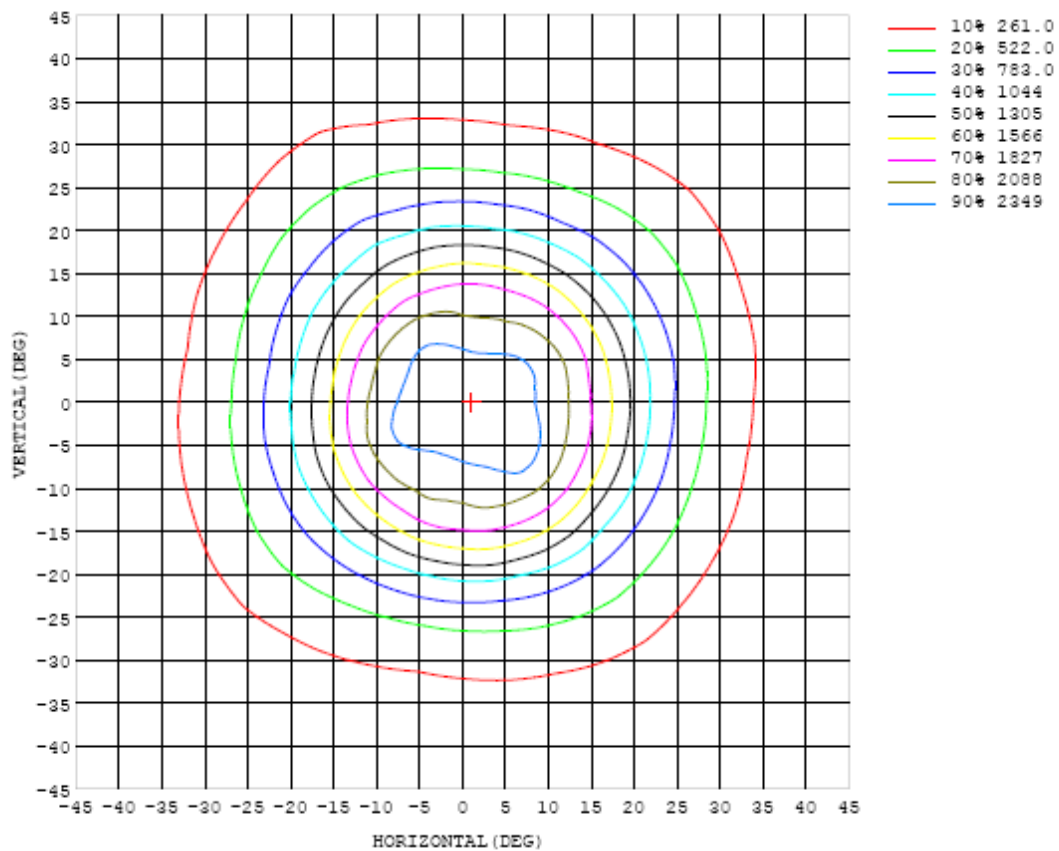


Chart 6: Isocandela Plot

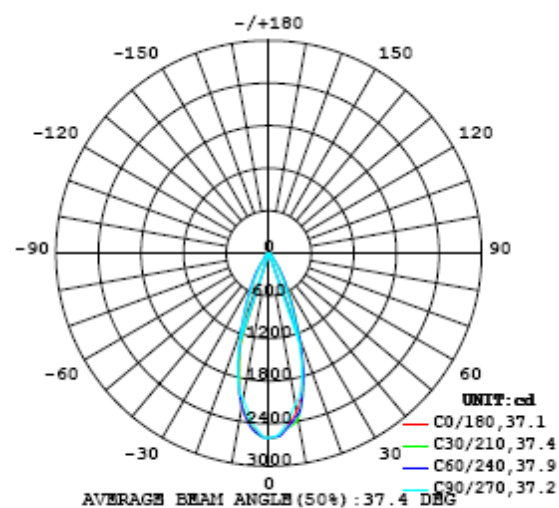


Chart 7: Polar Candela Distribution

## 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	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603
5	2494	2486	2495	2505	2526	2528	2518	2500	2486	2465	2441	2427	2430	2444	2460	2476	2479	2476	2470
10	2262	2288	2327	2368	2398	2380	2318	2269	2208	2164	2154	2167	2176	2206	2241	2263	2253	2213	2190
15	1818	1848	1874	1892	1919	1914	1885	1861	1842	1808	1803	1784	1749	1734	1729	1700	1682	1651	1615
20	1252	1250	1264	1265	1258	1278	1253	1203	1184	1149	1114	1103	1112	1124	1113	1098	1092	1060	1050
25	755	749	759	755	753	750	725	692	653	637	622	626	638	659	687	687	671	666	648
30	430	423	429	441	442	453	428	389	361	338	323	337	367	400	427	424	408	388	373
35	223	216	226	229	236	241	226	210	195	178	165	181	201	217	239	236	222	212	196
40	100	97.1	95.4	102	116	118	119	110	90.6	77.4	74.9	78.9	95.5	116	125	130	119	103	92.6
45	65.4	64.6	65.1	64.1	66.2	73.1	75.0	68.1	63.6	61.9	61.8	62.8	64.0	73.0	83.2	79.4	69.9	67.2	68.2
50	60.6	60.3	61.1	58.8	59.1	65.2	66.0	60.4	57.3	56.3	55.6	56.6	57.7	61.4	70.9	68.7	59.5	61.6	62.6
55	53.8	54.2	55.6	53.7	52.8	57.6	57.7	52.9	51.7	50.7	49.6	50.7	51.9	52.1	57.2	55.4	51.2	52.5	53.0
60	42.4	42.6	43.0	42.4	42.3	43.2	42.7	41.5	40.8	40.0	39.5	39.6	39.9	40.1	40.8	40.2	39.9	39.7	39.3
65	33.8	34.1	34.1	34.2	34.1	33.8	33.4	33.0	32.5	32.0	31.7	31.6	31.6	31.7	31.4	31.2	31.3	31.0	30.7
70	26.0	26.2	26.1	26.4	26.5	26.2	25.8	25.5	25.1	24.7	24.5	24.6	24.5	24.2	24.0	24.1	24.0	23.7	23.4
75	19.1	19.2	19.3	19.4	19.3	19.1	18.7	18.4	18.2	18.0	17.9	17.7	17.5	17.4	17.3	17.2	17.2	17.1	16.8
80	12.6	12.7	12.7	12.7	12.7	12.6	12.4	12.1	11.9	11.7	11.6	11.5	11.4	11.3	11.3	11.2	11.1	11.0	10.9
85	7.56	7.59	7.62	7.64	7.63	7.57	7.43	7.27	7.10	6.94	6.86	6.79	6.69	6.62	6.51	6.44	6.37	6.27	6.11
90	3.56	3.57	3.57	3.58	3.56	3.52	3.43	3.35	3.24	3.13	3.07	3.03	2.98	2.93	2.90	2.87	2.84	2.80	2.72
95	1.52	1.54	1.54	1.54	1.53	1.49	1.44	1.40	1.35	1.30	1.27	1.26	1.24	1.21	1.20	1.19	1.17	1.15	1.11
100	0.48	0.50	0.50	0.51	0.49	0.47	0.45	0.42	0.40	0.38	0.37	0.36	0.35	0.34	0.33	0.32	0.32	0.31	0.29
105	0.08	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03
110	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
115	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	0.03
120	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	0.06	0.06	0.05
125	0.10	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	0.11	0.11	0.11	0.11	0.08
130	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.21	0.21	0.21	0.14
135	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.38	0.38	0.39	0.40	0.25
140	0.58	0.58	0.58	0.58	0.57	0.57	0.57	0.57	0.58	0.58	0.59	0.60	0.60	0.61	0.61	0.62	0.63	0.65	0.40
145	0.85	0.84	0.84	0.84	0.83	0.83	0.83	0.84	0.84	0.85	0.86	0.87	0.87	0.88	0.88	0.89	0.89	0.92	0.57
150	1.11	1.09	1.10	1.10	1.09	1.09	1.09	1.10	1.11	1.12	1.13	1.14	1.14	1.14	1.15	1.15	1.15	1.19	0.77
155	1.34	1.32	1.32	1.32	1.32	1.32	1.32	1.33	1.34	1.35	1.36	1.37	1.37	1.37	1.37	1.37	1.37	1.41	0.98
160	1.53	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.51	1.52	1.52	1.53	1.53	1.53	1.53	1.53	1.53	1.57	1.20
165	1.64	1.61	1.62	1.62	1.62	1.62	1.61	1.62	1.62	1.62	1.63	1.63	1.63	1.63	1.62	1.62	1.62	1.65	1.39
170	1.64	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.62	1.62	1.61	1.60	1.62	1.50
175	1.45	1.46	1.46	1.47	1.47	1.47	1.47	1.47	1.46	1.46	1.45	1.45	1.44	1.43	1.42	1.42	1.41	1.40	1.40
180	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603	2603		
5	2467	2477	2498	2520	2516	2502	2481	2455	2431	2413	2414	2434	2466	2503	2522	2520	2511		
10	2166	2160	2174	2177	2183	2188	2162	2130	2094	2087	2105	2122	2178	2235	2272	2282	2267		
15	1601	1606	1623	1637	1651	1671	1672	1679	1701	1710	1730	1761	1794	1817	1838	1844	1819		
20	1036	1051	1077	1085	1098	1130	1107	1119	1102	1103	1138	1163	1201	1222	1245	1252	1248		
25	641	661	684	699	714	714	689	685	662	662	684	691	732	761	774	780	782		
30	362	381	398	427	449	455	422	393	367	366	380	411	452	482	488	470	456		
35	190	201	212	226	253	268	232	219	202	191	211	221	250	279	273	254	245		
40	94.8	94.7	106	123	135	133	137	116	92.0	86.1	94.5	118	136	144	142	127	102		
45	66.9	68.7	69.6	72.3	82.1	86.8	76.7	68.4	64.7	62.9	64.4	70.3	81.1	84.7	77.3	68.7	67.3		
50	60.3	62.4	63.8	61.5	67.7	72.0	65.2	62.5	59.8	58.0	59.8	60.9	67.8	72.5	65.6	60.8	62.0		
55	50.2	52.0	52.8	50.7	52.2	55.5	52.7	54.5	52.5	51.3	53.3	53.3	55.9	60.2	54.9	53.8	55.9		
60	39.2	39.6	39.6	39.7	39.7	40.5	40.8	41.1	40.7	40.5	41.0	41.4	42.2	43.4	42.3	42.0	42.9		
65	30.7	30.7	30.7	30.9	31.1	31.3	31.8	32.0	32.0	31.9	32.0	32.3	32.6	32.8	33.3	33.6	33.7		
70	23.3	23.2	23.2	23.2	23.5	23.7	23.9	24.1	24.1	24.2	24.3	24.5	24.8	25.0	25.3	25.6	25.8		
75	16.7	16.6	16.6	16.6	16.8	16.9	17.0	17.1	17.2	17.3	17.5	17.7	18.0	18.2	18.4	18.7	18.9		
80	10.9	10.8	10.8	10.8	10.9	11.0	11.0	11.0	11.0	11.2	11.3	11.5	11.7	12.0	12.2	12.4	12.6		
85	6.06	6.01	5.95	5.96	6.04	6.10	6.15	6.20	6.33	6.45	6.60	6.75	6.97	7.13	7.30	7.46	7.54		
90	2.69	2.67	2.65	2.63	2.65	2.69	2.72	2.76	2.81	2.89	2.97	3.06	3.15	3.23	3.33	3.42	3.48		
95	1.09	1.08	1.07	1.06	1.07	1.09	1.11	1.13	1.15	1.19	1.23	1.27	1.31	1.36	1.41	1.46	1.49		
100	0.30	0.30	0.30	0.31	0.32	0.33	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.41	0.43	0.44	0.46		
105	0.04	0.04	0.05	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.07		
110	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		
115	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.03	0.04		
120	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		
125	0.08	0.08	0.07	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08		
130	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13		
135	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22		
140	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.32	0.32	0.32	0.36		
145	0.50	0.50	0.49	0.49	0.48	0.48	0.48	0.48	0.48	0.47	0.46	0.46	0.45	0.45	0.45	0.44	0.51		
150	0.65	0.65	0.65	0.64	0.64	0.64	0.64	0.63	0.63	0.63	0.62	0.61	0.61	0.60	0.60	0.59	0.69		
155	0.82	0.82	0.82	0.82	0.81	0.81	0.81	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.75	0.89		
160	0.99	0.99	0.99	0.99	0.99	0.98	0.98	0.98	0.97	0.97	0.96	0.95	0.95	0.95	0.95	0.92	1.11		
165	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.11	1.11	1.10	1.10	1.09	1.09	1.09	1.05	1.31		
170	1.14	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.14	1.14	1.13	1.13	1.13	1.13	1.13	1.09	1.45		
175	1.26	1.18	1.19	1.19	1.20	1.20	1.19	1.19	1.19	1.19	1.18	1.18	1.17	1.16	1.14	1.24	1.45		
180	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28		

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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