

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL,  
Hong Kong

### LED Track Light

**Model: ORB/M/927/FL/DIM120V/xx/yy**

Where xx mean different type of Adaptor, could be J, H, L, CM, GES, TEK.

Where yy mean different color of product, could be WH, SV, BL.

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ20120037u

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

Review by:



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Feb. 03, 2021

Approved by:



Manager: Jim Zhang

Feb. 03, 2021

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: **ORB/M/927/FL/DIM120V/H/BL**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
93.5	1913.2	20.47	0.9821
CCT (K)	CRI	Stabilization Time (Light & Power)	
2726	92.8	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. 23, 2020
<b>Date of Test</b>	: Jan. 08, 2021
<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 Track Light
<b>Model</b>	: ORB/M/927/FL/DIM120V/H/BL
<b>Electrical Ratings</b>	: 120V, 60Hz, 20W
<b>Product Description</b>	: 2700K
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

## TEST RESULTS

Test ambient temperature was 26.0 °C.

Base orientation was light down. 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)	0.174
Power Factor	0.9821
Test Power (W)	20.47
THD A%	11.22
Luminous Efficacy (lm/W)	93.5
Total Luminous Flux (lm)	1913.2
Color Rendering Index (CRI)	92.8
R9	61.8
Correlated Color Temperature (CCT)(K)	2726
Chromaticity Chroma x	0.4601
Chromaticity Chroma y	0.4146
Chromaticity Chroma u	0.2609
Chromaticity Chroma v	0.3526
Duv	0.0014
Chromaticity Chroma u'	0.2609
Chromaticity Chroma v'	0.5289

Special Color Rendering Indices	
R1	92.8
R2	95.5
R3	97.1
R4	93.4
R5	92.2
R6	94.9
R7	93.3
R8	83.1
R9	61.8
R10	88.8
R11	94.3
R12	81.2
R13	93.4
R14	97.5

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)	0.175
Power Factor	0.9830
Power (W)	20.67
Luminous Efficacy (lm/W)	97.3
Total Luminous Flux (lm)	2011.0
Beam Angle ( ° )	33.0 (0°-180°) / 32.6 (90°-270°)
Center Beam Candle Power (cd)	6492
Maximum Beam Candle Power (cd)	6498 (At: C=80.0, Gamma=1.0)
Spacing Criteria	0.50 (0°-180°) / 0.51 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	99.01%
Zonal Lumens in the 60 °-90 °Zone	0.92%
Zonal Lumens in the 90 °-120 °Zone	0.00%
Zonal Lumens in the 120 °-180 °Zone	0.07%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

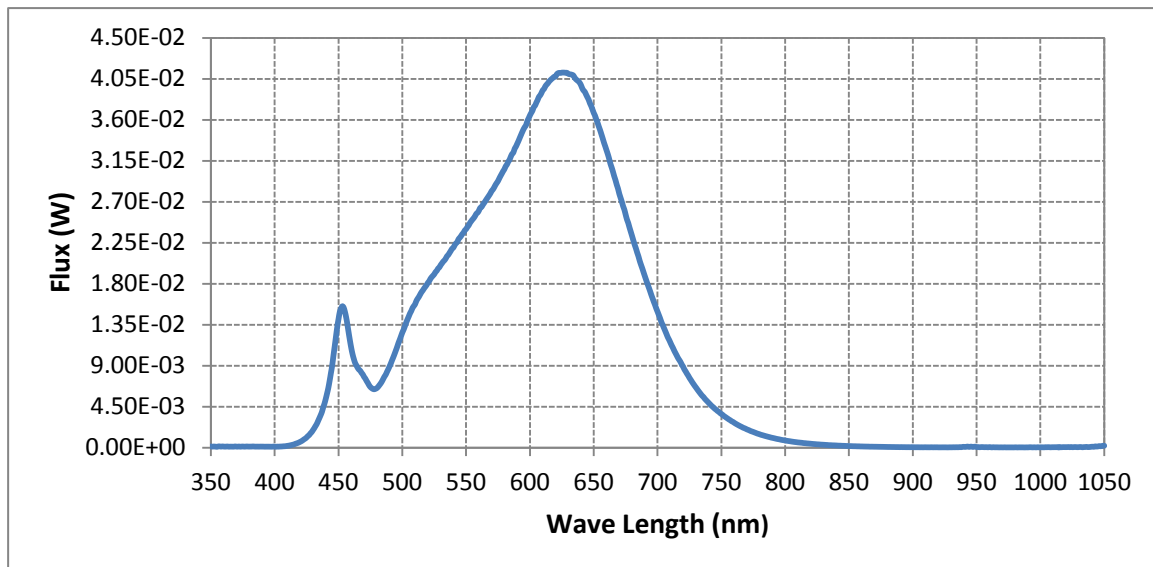
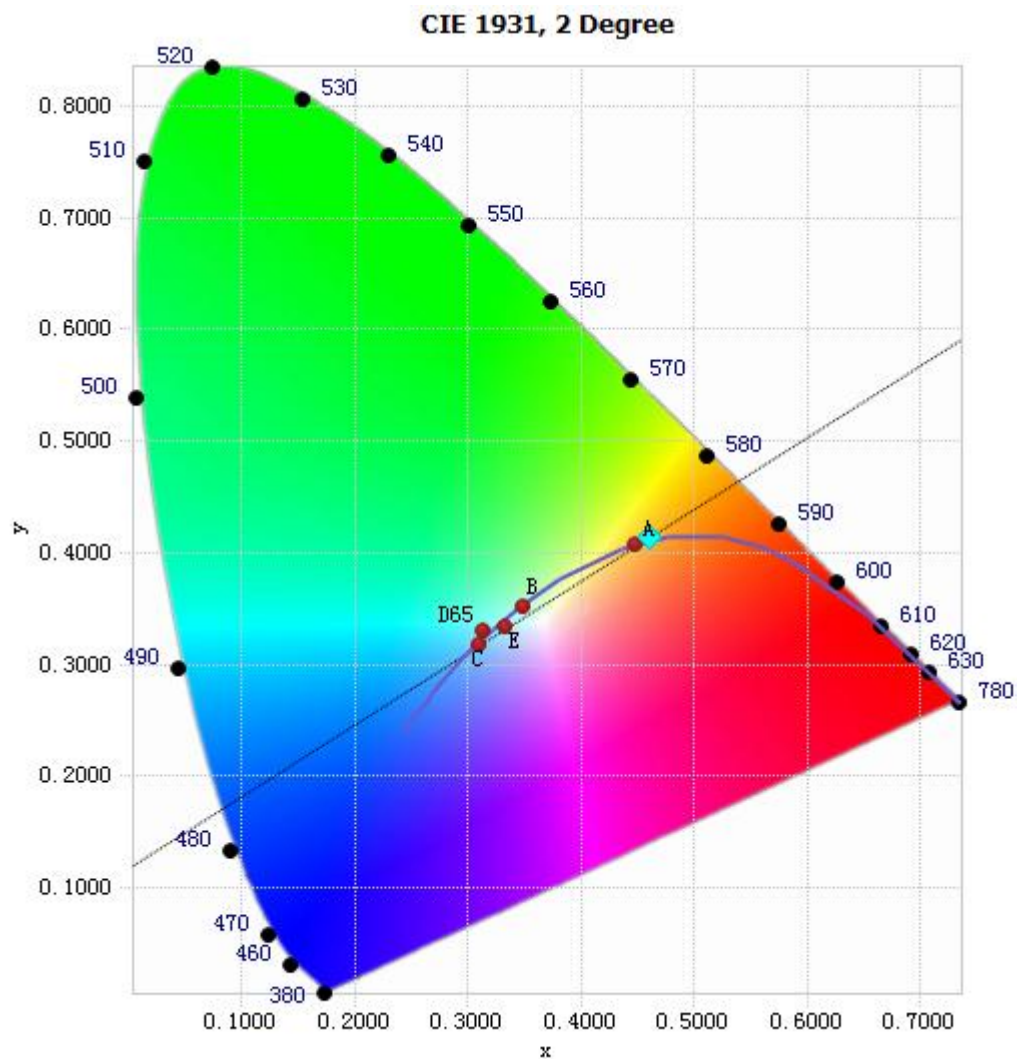


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.15E-04	485	7.53E-03	590	3.34E-02	695	1.68E-02
385	1.12E-04	490	8.92E-03	595	3.50E-02	700	1.49E-02
390	1.14E-04	495	1.07E-02	600	3.65E-02	705	1.31E-02
395	1.10E-04	500	1.26E-02	605	3.79E-02	710	1.15E-02
400	1.08E-04	505	1.44E-02	610	3.92E-02	715	1.01E-02
405	1.27E-04	510	1.58E-02	615	4.02E-02	720	8.88E-03
410	2.01E-04	515	1.71E-02	620	4.08E-02	725	7.66E-03
415	3.52E-04	520	1.81E-02	625	4.12E-02	730	6.62E-03
420	6.42E-04	525	1.90E-02	630	4.11E-02	735	5.69E-03
425	1.12E-03	530	2.00E-02	635	4.06E-02	740	4.92E-03
430	1.93E-03	535	2.10E-02	640	3.98E-02	745	4.25E-03
435	3.25E-03	540	2.20E-02	645	3.85E-02	750	3.70E-03
440	5.35E-03	545	2.31E-02	650	3.67E-02	755	3.18E-03
445	8.98E-03	550	2.40E-02	655	3.48E-02	760	2.74E-03
450	1.41E-02	555	2.51E-02	660	3.27E-02	765	2.34E-03
455	1.49E-02	560	2.60E-02	665	3.03E-02	770	2.01E-03
460	1.09E-02	565	2.71E-02	670	2.79E-02	775	1.72E-03
465	8.77E-03	570	2.82E-02	675	2.56E-02	780	1.46E-03
470	7.78E-03	575	2.93E-02	680	2.32E-02		
475	6.65E-03	580	3.06E-02	685	2.10E-02		
480	6.54E-03	585	3.20E-02	690	1.88E-02		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4601, 0.4146)

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

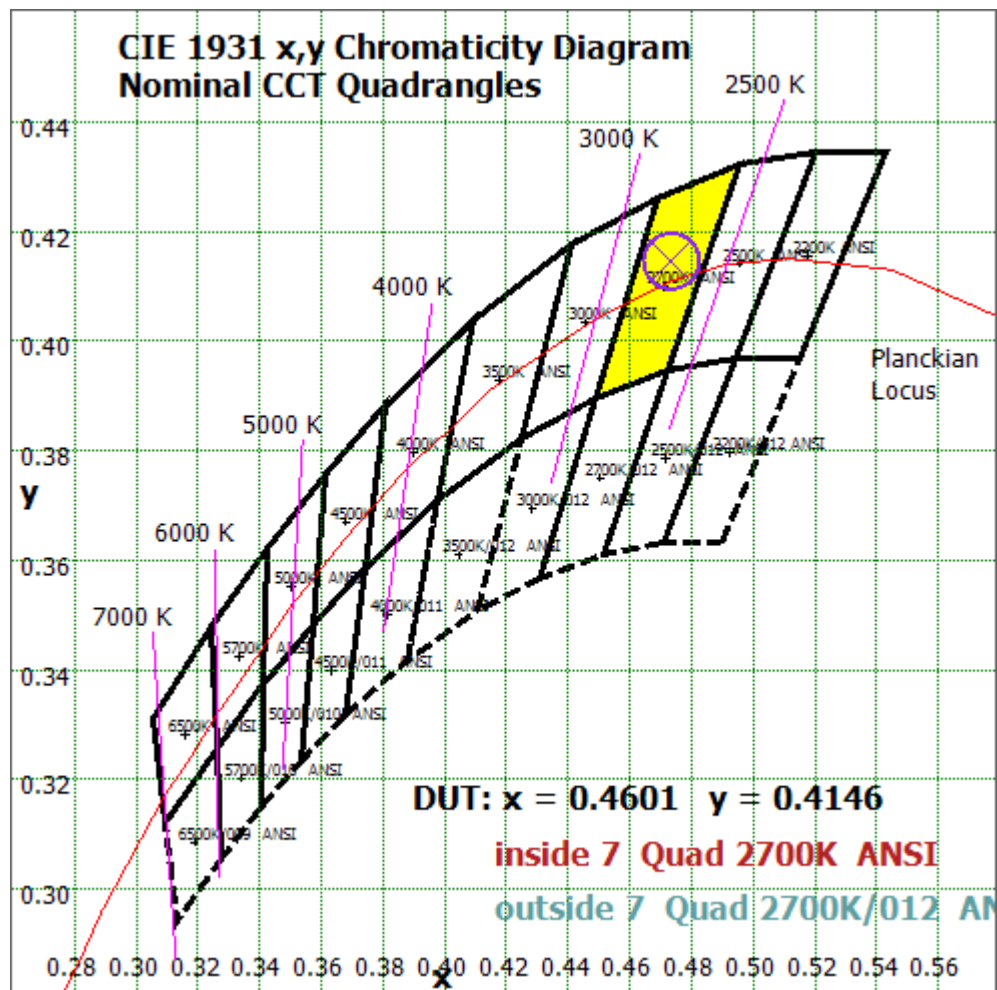


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

# Color Rendition Report – Sphere Spectroradiometer Method

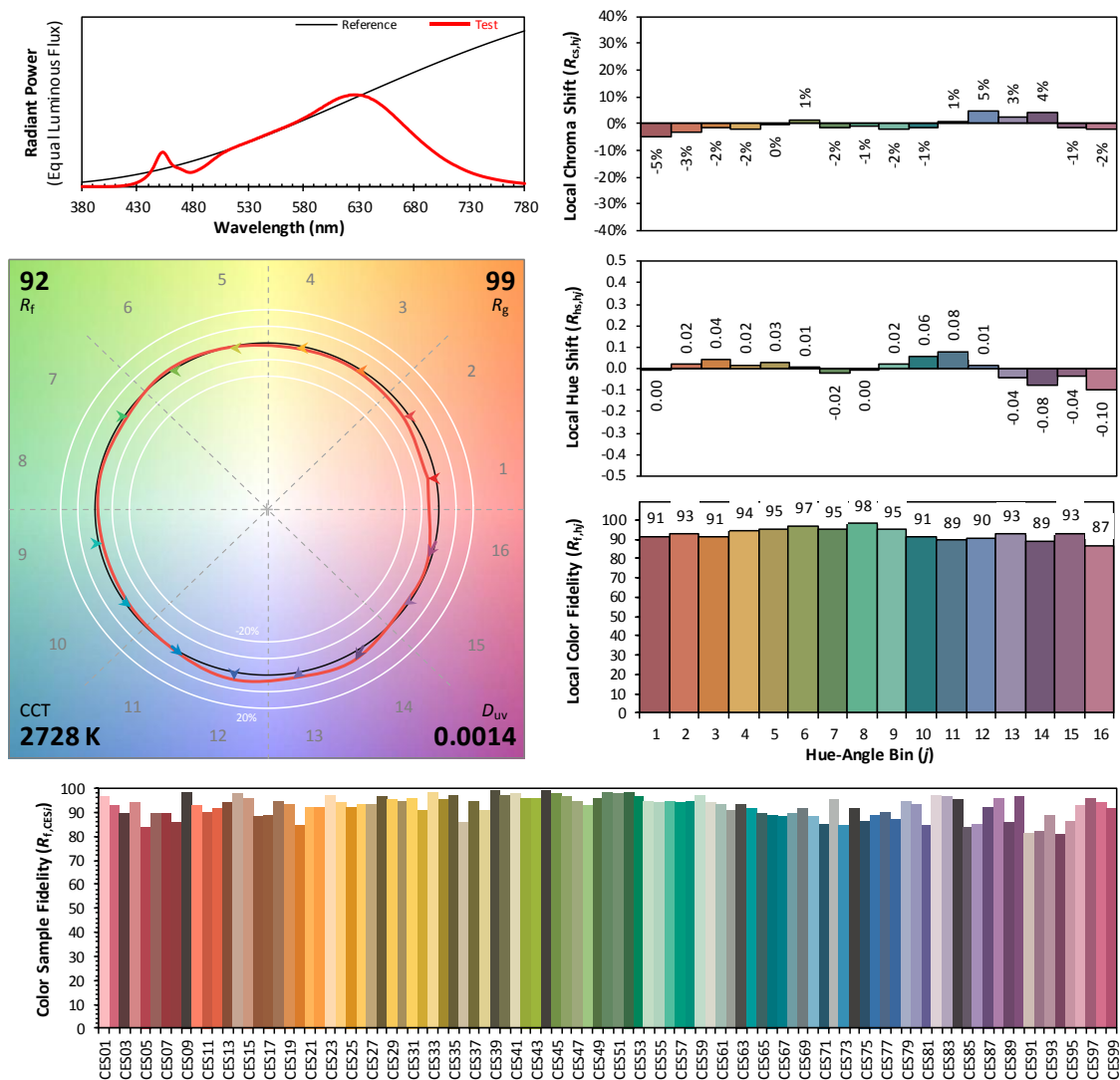
## ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2021/01/08

Model: ORB/M/927/FL/DIM120V/H/BL



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

$x$  0.4601  
 $y$  0.4146  
 $u'$  0.2609  
 $v'$  0.5289

CIE 13.3-1995  
(CRI)

$R_a$  93  
 $R_g$  62

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

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	568.235	28.26%
10- 20	1001.961	49.82%
20- 30	340.589	16.94%
30- 40	42.055	2.09%
40- 50	19.713	0.98%
50- 60	18.435	0.92%
60- 70	14.669	0.73%
70- 80	3.749	0.19%
80- 90	0.143	0.01%
90-100	0	0.00%
100-110	0	0.00%
110-120	0	0.00%
120-130	0.01	0.00%
130-140	0.129	0.01%
140-150	0.318	0.02%
150-160	0.439	0.02%
160-170	0.385	0.02%
170-180	0.135	0.01%
Total	2011.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1990.988	99.01%
60- 90	18.561	0.92%
0-90	2009.549	99.93%
90- 180	1.416	0.07%
0- 180	2011.0	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

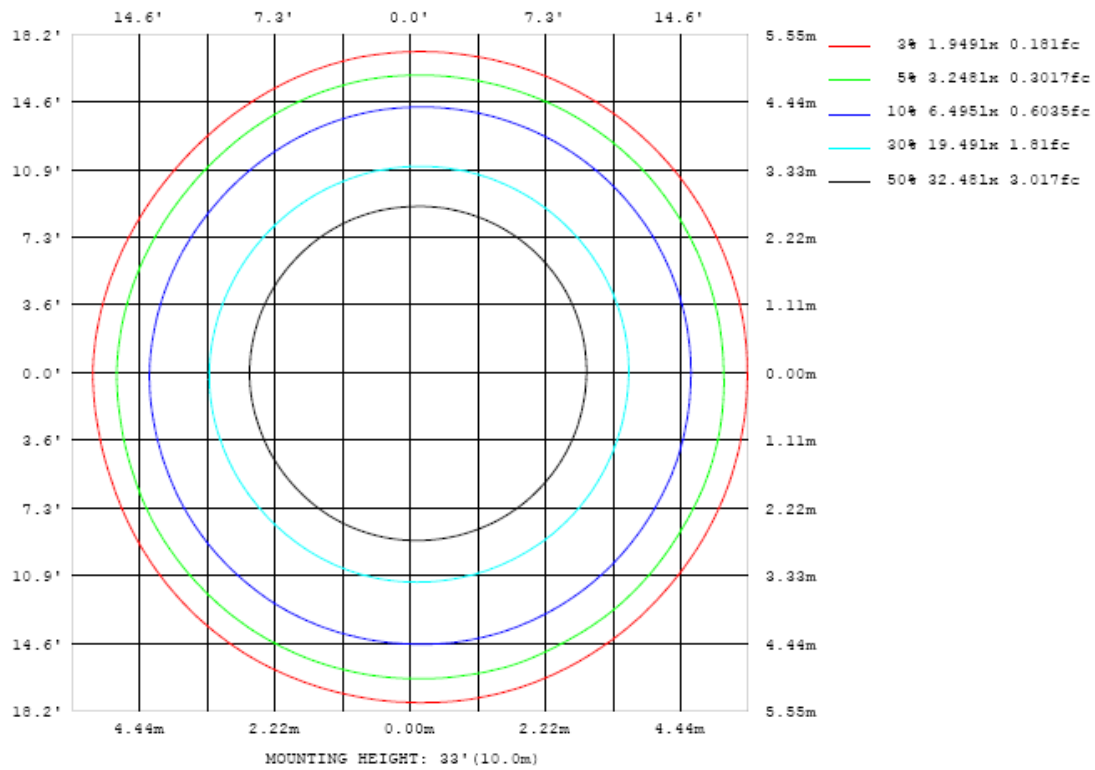


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

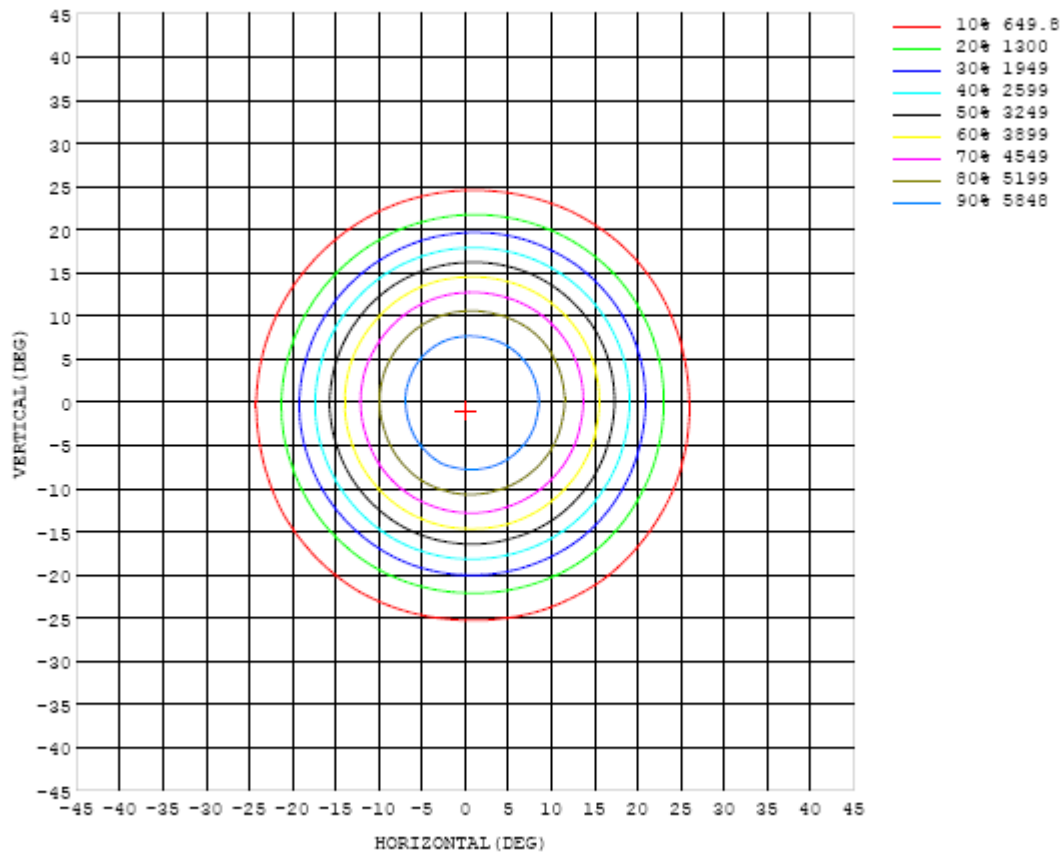


Chart 6: Isocandela Plot

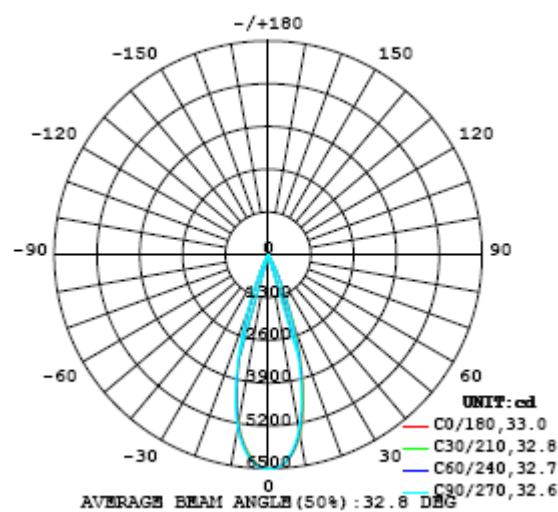


Chart 7: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492
5	6315	6310	6306	6308	6306	6294	6284	6277	6275	6258	6242	6228	6204	6184	6171	6161	6154	6150	6152
10	5565	5546	5539	5530	5506	5482	5453	5422	5393	5371	5341	5319	5298	5263	5231	5202	5177	5177	5180
15	4088	4076	4064	4032	3988	3954	3914	3872	3823	3779	3735	3692	3650	3596	3560	3538	3513	3520	3518
20	2251	2230	2215	2194	2172	2136	2076	2036	1993	1956	1915	1873	1822	1772	1740	1721	1698	1711	1710
25	819	820	819	799	783	771	751	730	706	684	671	661	650	626	605	592	566	544	536
30	220	221	221	217	214	211	208	205	199	191	185	180	177	171	162	152	144	144	146
35	63.0	63.4	64.2	65.3	65.1	64.4	62.8	62.6	62.2	60.4	58.9	57.4	55.5	52.5	50.7	49.9	47.2	46.7	47.6
40	32.4	31.9	32.5	32.5	32.2	32.2	32.3	32.6	32.9	32.7	32.1	31.6	31.1	30.7	30.6	30.5	30.7	31.2	31.3
45	25.9	25.6	25.7	26.7	26.9	26.3	26.2	26.8	26.6	26.7	26.3	25.5	25.3	25.3	25.2	25.0	25.4	25.6	25.5
50	23.2	23.1	23.2	23.6	23.4	23.3	23.4	23.9	24.1	24.1	23.5	22.9	22.8	22.7	22.6	22.5	22.6	22.7	22.6
55	21.8	21.9	21.6	21.4	21.3	21.2	21.6	22.2	22.5	22.5	22.1	21.4	21.2	20.8	20.8	20.8	20.8	20.8	20.7
60	20.9	20.8	20.5	20.2	20.2	20.1	20.1	20.4	20.5	20.7	20.4	19.6	19.1	18.6	18.4	18.5	18.6	18.4	18.4
65	17.2	17.4	17.1	16.9	16.8	16.7	16.6	16.6	15.8	16.5	16.3	15.6	15.1	14.6	14.4	14.6	14.5	13.5	14.3
70	10.8	11.0	10.8	10.5	10.4	10.2	10.00	9.95	8.24	9.66	9.31	8.78	8.26	7.95	7.77	7.89	7.82	6.88	8.03
75	3.45	3.47	3.34	3.25	3.37	3.19	3.25	3.25	3.23	3.16	3.06	2.80	2.58	2.47	2.49	2.62	2.71	2.76	2.83
80	1.06	1.07	1.12	1.22	1.48	1.18	1.10	1.02	0.98	0.92	0.83	0.77	0.75	0.71	0.68	0.67	0.66	0.65	0.69
85	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
90	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
95	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
100	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
105	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
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
130	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	0.05	0.05	0.05	0.06	0.06
135	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.20
140	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.30	0.31	0.31	0.31	0.31	0.37
145	0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.45	0.45	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.50	0.49	0.58
150	0.63	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.66	0.66	0.67	0.68	0.69	0.70	0.70	0.71	0.71	0.70	0.80
155	0.88	0.88	0.88	0.88	0.88	0.89	0.89	0.90	0.91	0.91	0.92	0.93	0.94	0.94	0.95	0.96	0.96	0.96	1.01
160	1.11	1.12	1.12	1.12	1.12	1.13	1.13	1.13	1.14	1.14	1.15	1.16	1.17	1.18	1.18	1.19	1.19	1.19	1.22
165	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.32	1.32	1.32	1.33	1.34	1.35	1.35	1.36	1.36	1.37	1.37	1.39
170	1.41	1.41	1.42	1.43	1.43	1.43	1.43	1.44	1.44	1.44	1.45	1.45	1.46	1.46	1.46	1.46	1.46	1.45	1.44
175	1.35	1.35	1.34	1.34	1.34	1.35	1.36	1.38	1.39	1.38	1.37	1.36	1.36	1.36	1.35	1.35	1.36	1.37	1.37
180	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39

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	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492	6492		
5	6155	6157	6168	6181	6196	6215	6229	6239	6246	6257	6268	6278	6287	6289	6297	6311	6316		
10	5187	5196	5203	5216	5239	5266	5296	5327	5348	5378	5410	5455	5496	5522	5543	5552	5559		
15	3509	3516	3519	3530	3554	3589	3628	3670	3701	3764	3824	3897	3963	4017	4063	4083	4089		
20	1677	1650	1631	1629	1639	1680	1729	1779	1838	1900	1949	2000	2063	2117	2176	2223	2250		
25	521	504	487	478	487	508	535	557	581	600	631	672	702	741	773	795	815		
30	135	128	123	124	124	127	135	150	156	160	174	186	197	208	212	219	224		
35	47.0	46.4	46.1	45.7	45.8	46.0	46.9	48.0	48.9	50.0	52.2	55.1	57.1	59.5	60.7	61.6	61.9		
40	30.7	30.5	30.0	29.6	29.2	29.1	29.7	30.0	30.4	30.2	30.3	30.6	30.7	31.0	31.5	32.1	32.6		
45	25.0	24.4	23.9	23.5	23.4	23.2	23.6	24.1	24.3	24.1	23.8	23.8	23.9	24.0	24.4	25.1	25.9		
50	22.1	21.4	20.9	20.6	20.3	20.3	20.6	21.0	21.3	21.2	20.8	20.8	21.1	21.2	21.5	22.2	22.9		
55	20.2	19.4	18.8	18.3	18.2	18.5	19.0	19.4	19.8	19.7	19.5	19.5	19.6	20.0	20.4	20.8	21.4		
60	18.0	17.5	17.1	16.9	16.8	16.9	17.3	17.5	18.0	18.2	18.0	18.0	18.1	18.6	19.2	19.8	20.5		
65	14.2	13.9	13.7	13.6	13.6	13.7	14.0	13.6	14.5	14.8	14.7	14.8	14.9	15.3	16.0	16.6	16.3		
70	7.97	7.89	7.71	7.73	7.83	8.18	8.47	7.36	9.00	9.26	9.37	9.49	9.67	9.94	10.4	10.8	9.18		
75	2.81	2.69	2.55	2.49	2.53	2.70	2.84	2.96	3.01	3.05	2.96	2.85	2.85	2.95	3.21	3.33	3.47		
80	0.68	0.70	0.72	0.72	0.70	0.70	0.74	0.77	0.79	0.81	0.85	0.90	0.93	0.96	1.01	1.05	1.11		
85	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		
90	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		
95	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		
100	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		
105	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		
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	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
130	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04		
135	0.21	0.21	0.20	0.20	0.20	0.20	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.15		
140	0.39	0.38	0.38	0.38	0.37	0.37	0.36	0.35	0.35	0.34	0.34	0.33	0.33	0.32	0.32	0.31	0.30		
145	0.61	0.60	0.60	0.59	0.59	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.53	0.53	0.53	0.53	0.50		
150	0.84	0.83	0.83	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.76	0.73		
155	1.05	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.01	1.00	1.00	1.00	0.99	0.99	0.98	0.99	0.95		
160	1.25	1.25	1.25	1.26	1.26	1.26	1.26	1.26	1.26	1.25	1.25	1.24	1.23	1.22	1.22	1.22	1.17		
165	1.45	1.44	1.45	1.46	1.46	1.47	1.48	1.48	1.48	1.47	1.47	1.46	1.45	1.44	1.44	1.43	1.35		
170	1.54	1.52	1.52	1.52	1.52	1.53	1.54	1.53	1.54	1.55	1.56	1.57	1.56	1.56	1.56	1.54	1.40		
175	1.37	1.33	1.26	1.25	1.25	1.25	1.27	1.29	1.31	1.33	1.34	1.35	1.36	1.37	1.37	1.35	1.35		
180	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 05, 2020	Aug. 04, 2021
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2020	Aug. 04, 2021
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2020	Aug. 04, 2021
Standard source	D908	HZTE012-01	Aug. 05, 2020	Aug. 04, 2021
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2020	Aug. 04, 2021
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2020	Aug. 04, 2021
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2020	Aug. 04, 2021
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2020	Aug. 04, 2021

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**

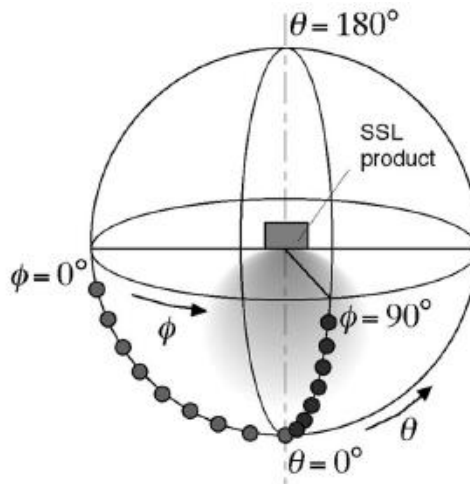
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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