

## 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 Lamp

**Model: 5GU10DIM/927NF25**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ20060049m

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

Review by:



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Oct. 21, 2020

Approved by:



Manager: Jim Zhang

Oct. 21, 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: **5GU10DIM/927NF25**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
81.2	385.6	4.75	0.9242
CCT (K)	CRI	Stabilization Time (Light & Power)	
2722	97.3	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>	: Jun. 25, 2020
<b>Date of Test</b>	: Jun. 25, 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>	: 5GU10DIM/927NF25
<b>Electrical Ratings</b>	: 120Vac, 60Hz, 5W
<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 25.1 °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)	0.043
Power Factor	0.9242
Test Power (W)	4.75
THD A%	22.55
Luminous Efficacy (lm/W)	81.2
Total Luminous Flux (lm)	385.6
Color Rendering Index (CRI)	97.3
R9	90.4
Correlated Color Temperature (CCT)(K)	2722
Chromaticity Chroma x	0.4560
Chromaticity Chroma y	0.4067
Chromaticity Chroma u	0.2618
Chromaticity Chroma v	0.3502
Duv	-0.0011
Chromaticity Chroma u'	0.2618
Chromaticity Chroma v'	0.5253

Special Color Rendering Indices	
R1	98.3
R2	98.1
R3	99.4
R4	98.8
R5	98
R6	95.2
R7	95.6
R8	94.8
R9	90.4
R10	97.9
R11	97.6
R12	86.1
R13	97.8
R14	98.5

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 25.2 °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)	0.043
Power Factor	0.9201
Power (W)	4.74
Luminous Efficacy (lm/W)	83.4
Total Luminous Flux (lm)	395.2
Beam Angle ( ° )	20.2 (0°-180°) / 20.9 (90°-270°)
Center Beam Candle Power (cd)	2382
Maximum Beam Candle Power (cd)	2382 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.32 (0°-180°) / 0.35 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	98.08%
Zonal Lumens in the 60 °-90 °Zone	1.53%
Zonal Lumens in the 90 °-120 °Zone	0.22%
Zonal Lumens in the 120 °-180 °Zone	0.16%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

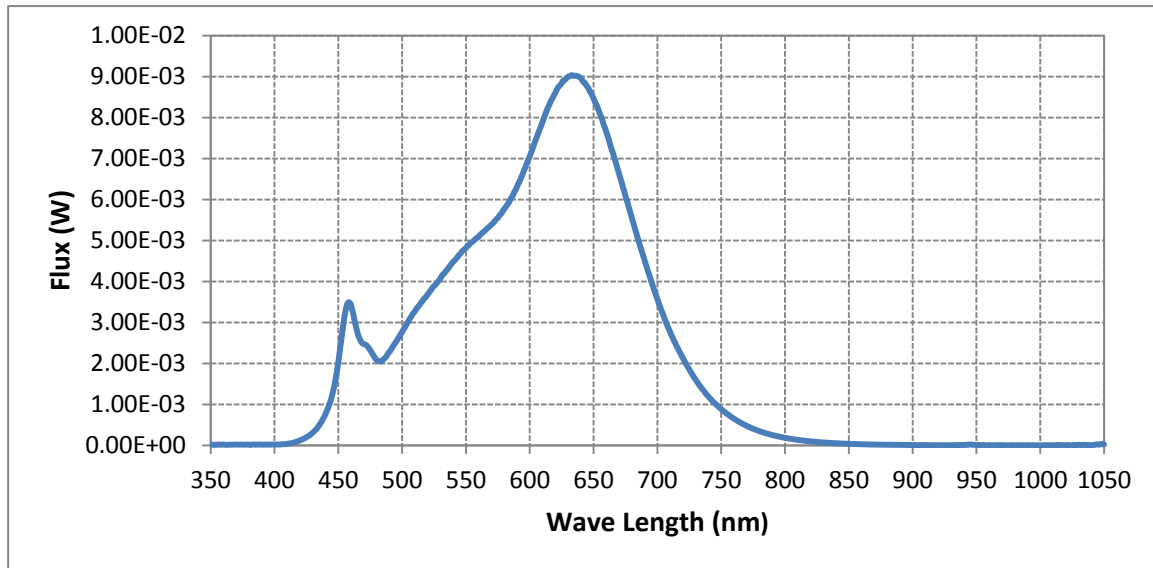
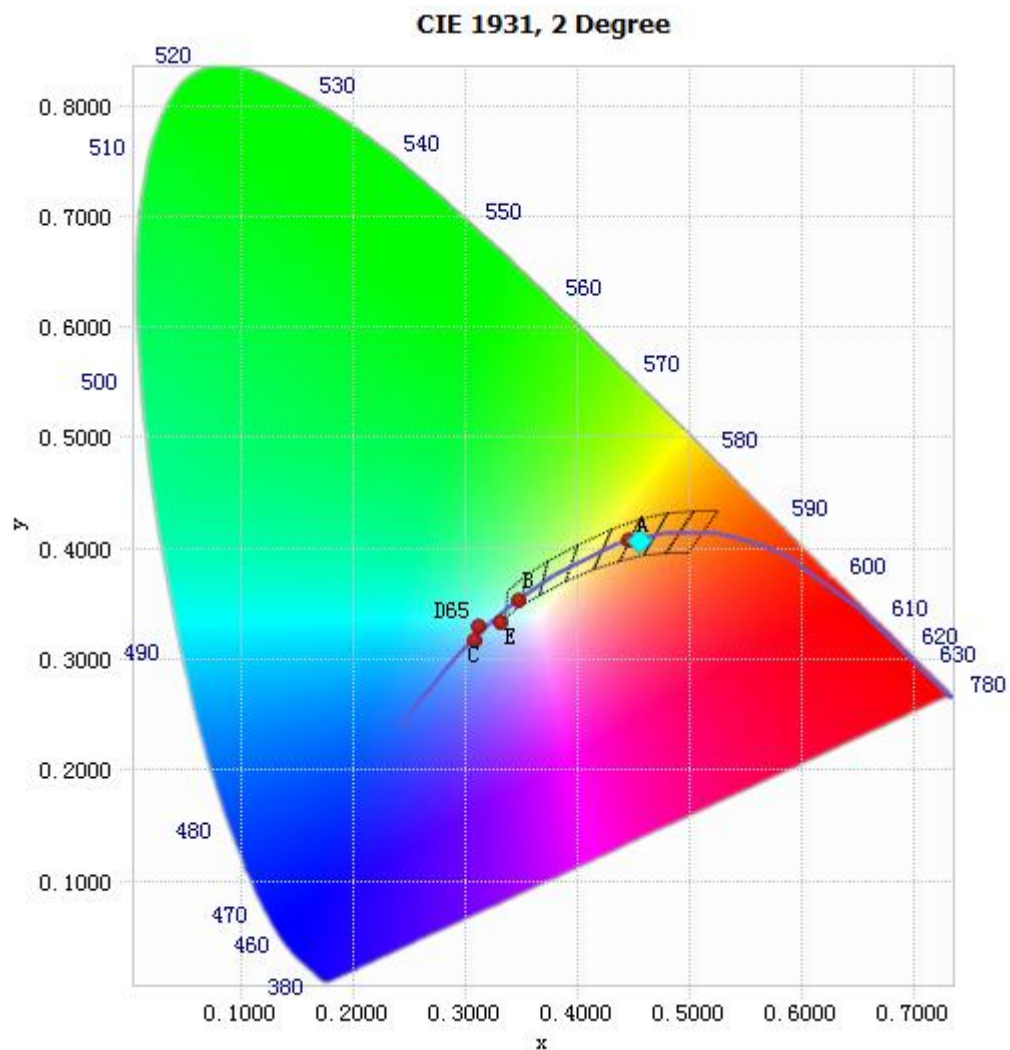


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.03E-05	485	2.09E-03	590	6.31E-03	695	4.03E-03
385	2.07E-05	490	2.28E-03	595	6.67E-03	700	3.57E-03
390	1.98E-05	495	2.52E-03	600	7.06E-03	705	3.15E-03
395	2.24E-05	500	2.77E-03	605	7.48E-03	710	2.76E-03
400	2.29E-05	505	3.04E-03	610	7.89E-03	715	2.43E-03
405	2.57E-05	510	3.27E-03	615	8.29E-03	720	2.13E-03
410	4.06E-05	515	3.49E-03	620	8.60E-03	725	1.86E-03
415	7.09E-05	520	3.69E-03	625	8.84E-03	730	1.61E-03
420	1.25E-04	525	3.89E-03	630	9.00E-03	735	1.38E-03
425	2.02E-04	530	4.08E-03	635	9.02E-03	740	1.19E-03
430	3.15E-04	535	4.28E-03	640	8.96E-03	745	1.03E-03
435	4.95E-04	540	4.48E-03	645	8.76E-03	750	8.87E-04
440	7.72E-04	545	4.66E-03	650	8.47E-03	755	7.64E-04
445	1.21E-03	550	4.82E-03	655	8.09E-03	760	6.54E-04
450	2.03E-03	555	4.97E-03	660	7.65E-03	765	5.59E-04
455	3.18E-03	560	5.10E-03	665	7.15E-03	770	4.76E-04
460	3.42E-03	565	5.24E-03	670	6.63E-03	775	4.09E-04
465	2.75E-03	570	5.39E-03	675	6.09E-03	780	3.48E-04
470	2.47E-03	575	5.55E-03	680	5.55E-03		
475	2.33E-03	580	5.77E-03	685	5.03E-03		
480	2.09E-03	585	6.02E-03	690	4.51E-03		

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

# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4560, 0.4067)

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

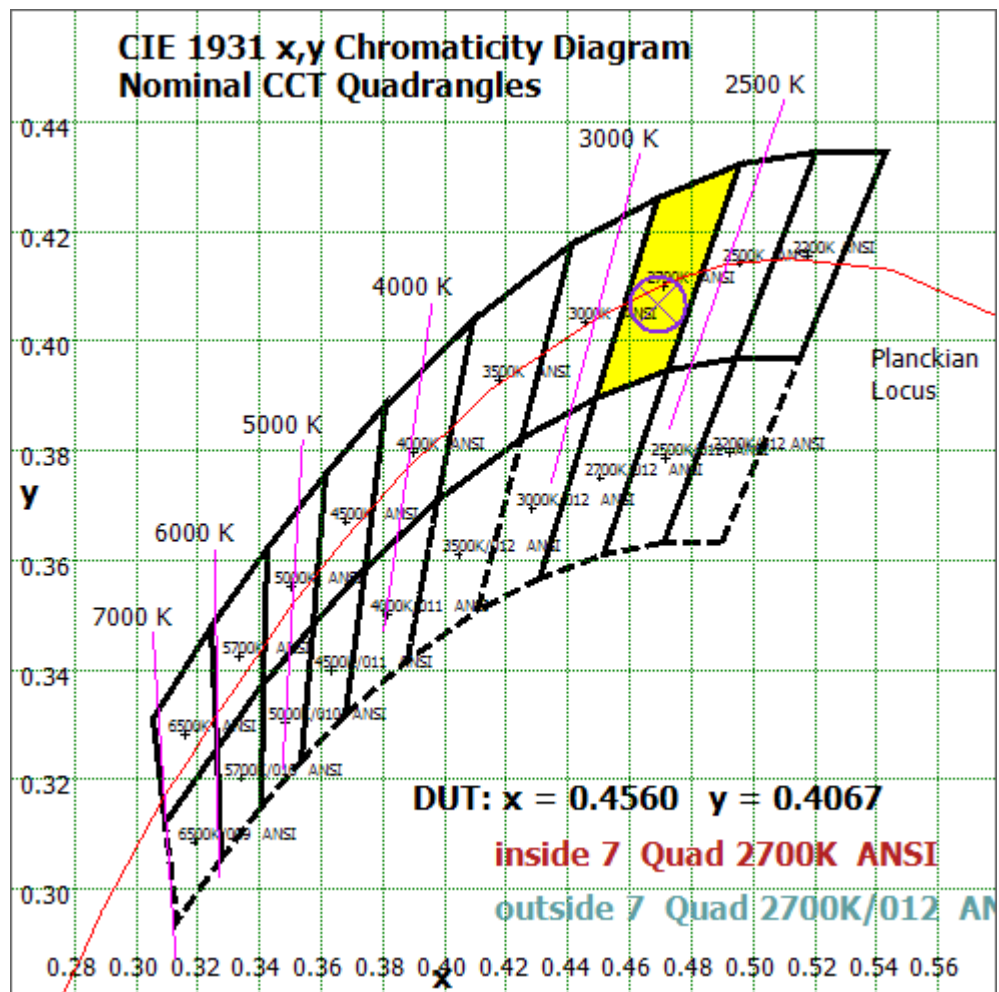


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

# Color Rendition Report – Sphere Spectroradiometer Method

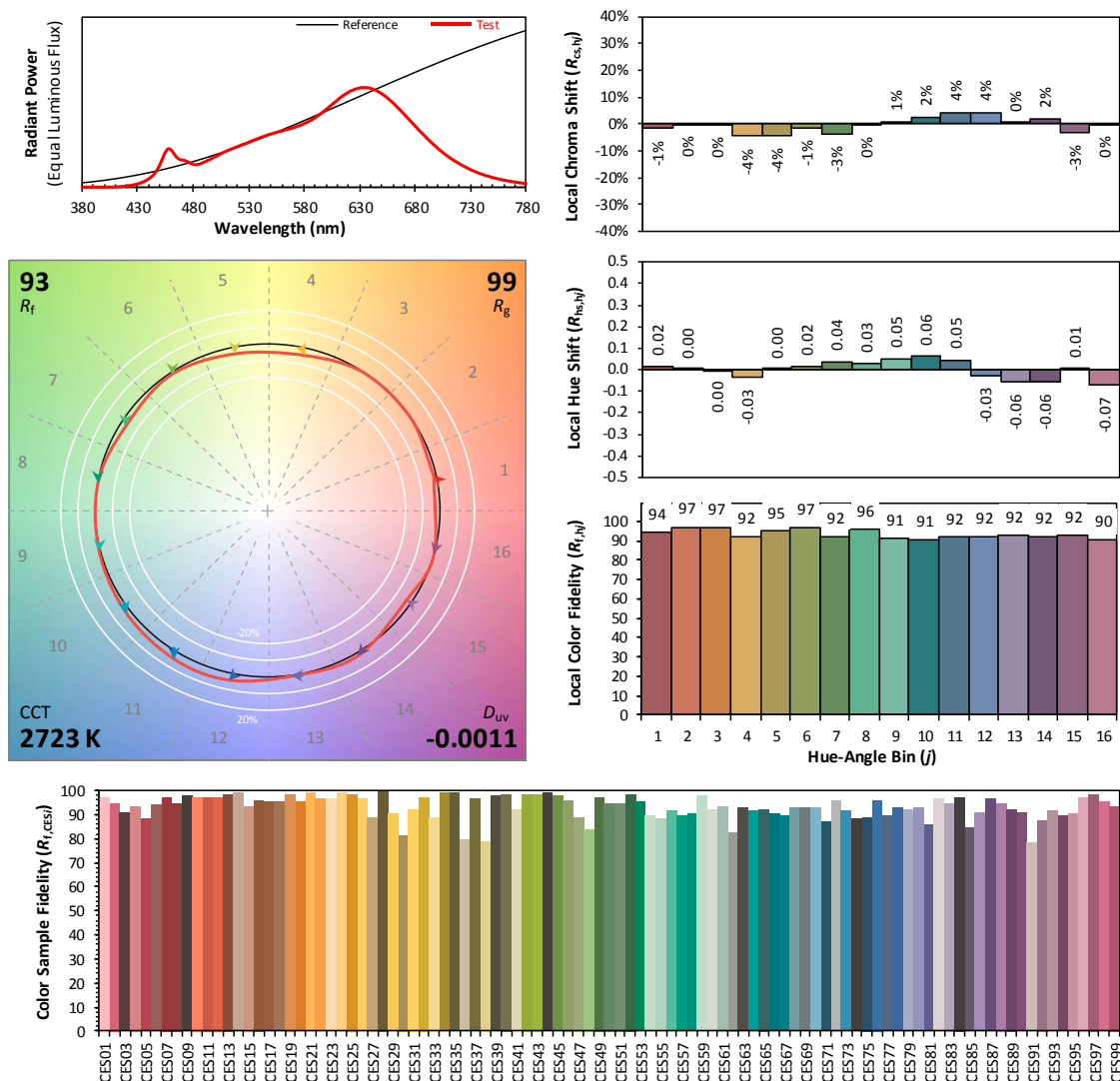
## ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2020/06/25

Model: 5GU10DIM/927NF25



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

$x$  0.4560  
 $y$  0.4067  
 $u'$  0.2618  
 $v'$  0.5253

CIE 13.3-1995  
(CRI)

$R_a$  97  
 $R_g$  91

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	164.567	41.65%
10- 20	142.161	35.98%
20- 30	47.947	12.13%
30- 40	18.493	4.68%
40- 50	9.335	2.36%
50- 60	5.082	1.29%
60- 70	3.306	0.84%
70- 80	2.005	0.51%
80- 90	0.747	0.19%
90-100	0.258	0.07%
100-110	0.284	0.07%
110-120	0.339	0.09%
120-130	0.34	0.09%
130-140	0.05	0.01%
140-150	0.067	0.02%
150-160	0.082	0.02%
160-170	0.069	0.02%
170-180	0.024	0.01%
Total	395.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	387.585	98.08%
60- 90	6.058	1.53%
0-90	393.643	99.62%
90- 180	1.513	0.38%
0- 180	395.2	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

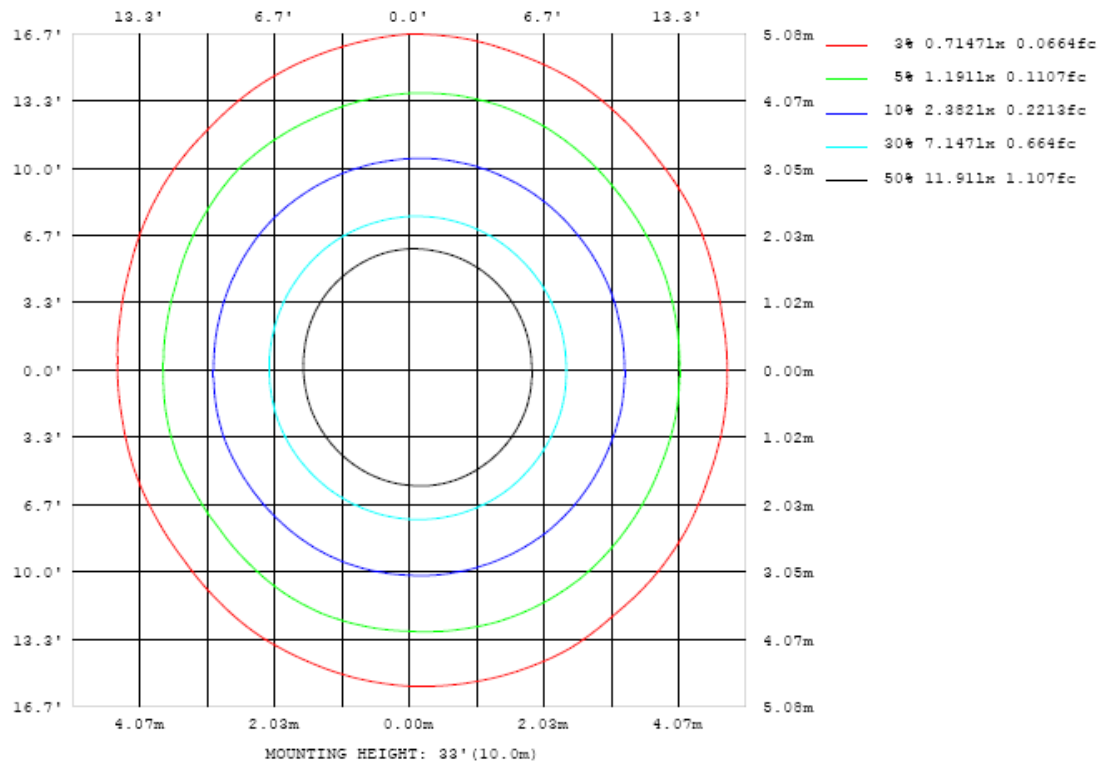


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

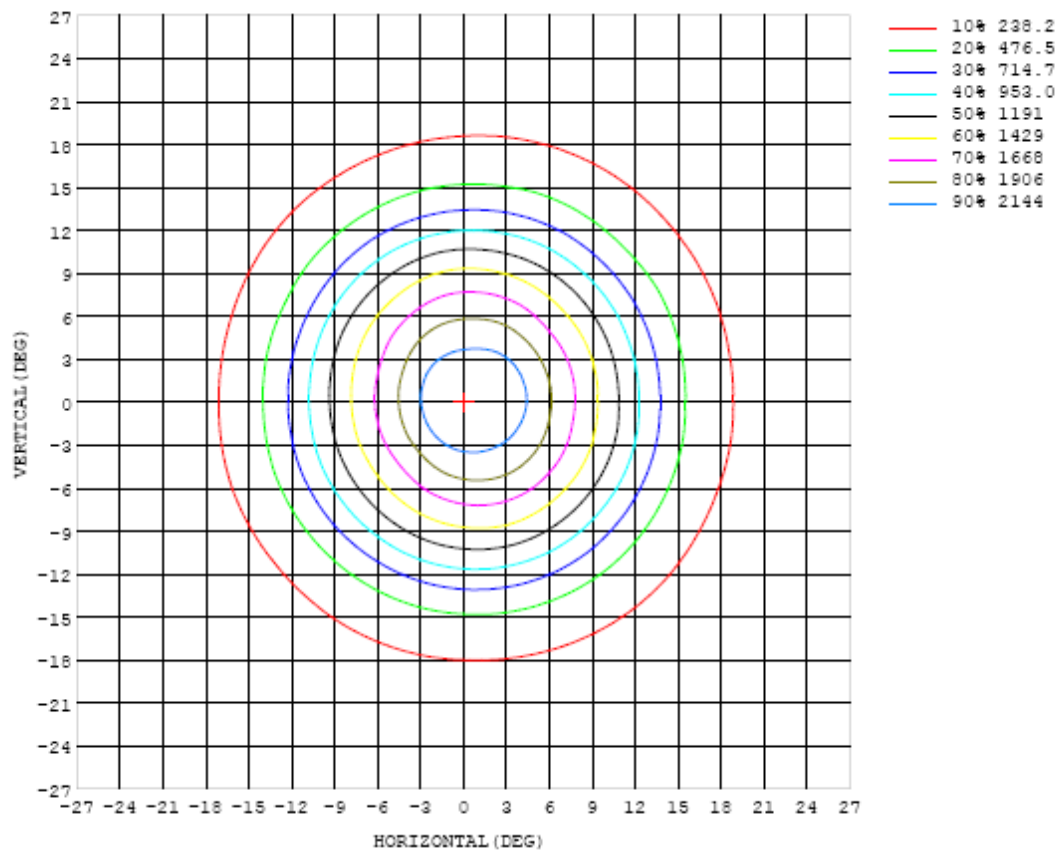


Chart 6: Isocandela Plot

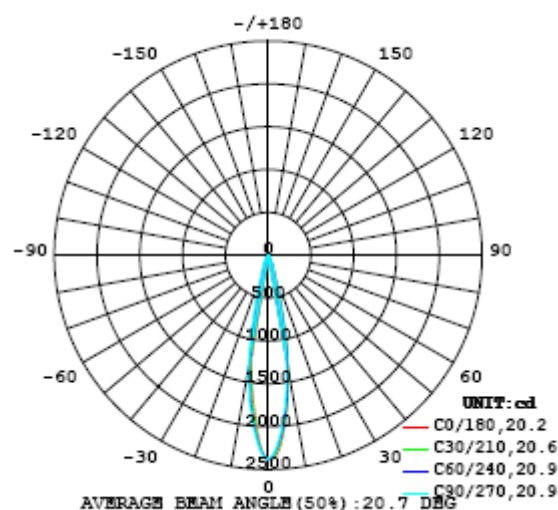


Chart 7: Polar Candela Distribution

## 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	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382
5	2069	2060	2053	2047	2037	2024	2012	1994	1975	1953	1933	1910	1882	1858	1843	1839	1832	1832	1837
10	1332	1340	1342	1336	1325	1314	1300	1284	1258	1228	1203	1173	1145	1123	1107	1095	1088	1082	1088
15	541	539	535	529	521	513	499	484	469	451	437	423	410	398	390	385	385	376	371
20	200	198	195	194	194	193	190	187	183	179	176	174	170	163	156	154	156	155	152
25	106	107	106	107	108	107	109	107	105	103	99.9	95.6	92.4	87.5	83.1	81.3	79.8	78.4	80.1
30	54.9	55.7	55.6	57.1	56.3	55.4	56.8	57.0	55.4	55.6	53.0	49.3	48.2	45.8	42.5	41.7	40.0	39.0	39.6
35	26.5	26.8	26.5	26.7	26.5	26.1	26.1	26.4	25.5	25.4	24.9	24.3	23.8	23.1	21.9	21.4	20.9	20.9	21.1
40	17.7	17.9	17.8	17.5	17.3	17.3	17.0	17.0	16.3	16.1	16.0	16.0	15.9	15.9	15.6	15.7	15.7	16.1	16.2
45	13.7	13.5	13.0	12.5	12.3	12.1	12.0	12.0	11.6	11.4	11.3	11.3	11.2	11.2	11.2	11.0	11.1	11.4	11.8
50	8.07	8.07	7.85	7.56	7.40	7.22	7.18	7.22	7.07	7.07	6.99	6.96	6.93	6.96	7.03	6.95	6.98	7.00	7.17
55	5.77	5.80	5.78	5.76	5.80	5.70	5.79	5.84	5.78	5.66	5.55	5.39	5.44	5.45	5.33	5.12	5.09	5.13	5.09
60	4.21	4.22	4.20	4.18	4.24	4.26	4.26	4.21	4.07	3.97	4.00	4.04	4.10	4.04	3.93	3.78	3.75	3.75	3.79
65	3.47	3.49	3.46	3.46	3.47	3.45	3.41	3.35	3.27	3.24	3.21	3.20	3.15	3.12	3.10	3.07	3.08	3.15	3.12
70	2.70	2.78	2.71	2.70	2.78	2.69	2.66	2.75	2.60	2.54	2.60	2.52	2.46	2.52	2.43	2.41	2.57	2.49	2.41
75	1.96	2.07	1.99	1.97	2.09	1.96	1.92	1.95	1.87	1.85	1.89	1.81	1.79	1.86	1.75	1.75	1.77	1.78	1.72
80	1.26	1.29	1.28	1.27	1.29	1.26	1.23	1.22	1.20	1.17	1.16	1.14	1.11	1.11	1.11	1.09	1.11	1.11	1.06
85	0.68	0.77	0.71	0.68	0.75	0.69	0.65	0.73	0.66	0.62	0.69	0.63	0.61	0.65	0.61	0.58	0.63	0.59	0.57
90	0.31	0.34	0.33	0.32	0.34	0.33	0.31	0.34	0.32	0.30	0.33	0.33	0.29	0.32	0.31	0.29	0.31	0.30	0.28
95	0.21	0.27	0.23	0.21	0.26	0.23	0.21	0.27	0.23	0.21	0.28	0.24	0.20	0.25	0.21	0.18	0.25	0.19	0.18
100	0.15	0.24	0.18	0.16	0.24	0.17	0.16	0.20	0.19	0.16	0.32	0.22	0.15	0.22	0.22	0.15	0.24	0.22	0.15
105	0.18	0.52	0.29	0.18	0.51	0.23	0.17	0.44	0.24	0.17	0.44	0.27	0.17	0.43	0.24	0.18	0.39	0.22	0.17
110	0.19	0.44	0.31	0.19	0.46	0.29	0.18	0.41	0.25	0.16	0.39	0.27	0.16	0.35	0.27	0.15	0.35	0.19	0.15
115	0.13	0.16	0.16	0.14	0.16	0.19	0.13	0.14	0.15	0.13	0.14	0.15	0.14	0.13	0.17	0.13	0.12	0.16	0.12
120	0.35	1.98	1.75	0.19	1.64	2.33	0.24	2.04	2.33	0.21	2.53	2.99	0.31	1.89	1.78	0.18	1.35	1.08	0.18
125	0.14	0.45	0.24	0.13	0.54	0.28	0.10	0.47	0.29	0.09	0.37	0.18	0.09	0.25	0.18	0.11	0.16	0.12	0.09
130	0.06	0.09	0.09	0.08	0.12	0.10	0.07	0.09	0.10	0.07	0.07	0.09	0.07	0.07	0.09	0.07	0.07	0.06	0.06
135	0.05	0.06	0.06	0.06	0.07	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	0.05
140	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08
145	0.10	0.09	0.07	0.10	0.11	0.11	0.11	0.11	0.12	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11
150	0.13	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.15	0.16	0.16	0.15	0.15	0.15
155	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
160	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23
165	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.26
170	0.25	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.27	0.27	0.27
175	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.24	0.25	0.29	0.30
180	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

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	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382	2382		
5	1848	1860	1880	1909	1937	1961	1978	1990	1999	2010	2025	2042	2054	2064	2068	2069	2071		
10	1101	1123	1151	1180	1208	1237	1270	1301	1320	1327	1335	1342	1343	1343	1345	1343	1338		
15	375	381	393	412	427	445	467	490	506	519	538	545	543	547	560	557	550		
20	153	156	164	172	180	185	188	194	198	202	205	205	204	202	202	202	200		
25	81.7	85.4	91.3	96.7	101	108	114	118	122	123	121	121	118	114	113	109	106		
30	40.5	42.9	47.3	49.7	52.6	59.2	62.8	66.9	70.3	69.8	68.0	68.4	66.1	62.5	60.8	57.2	54.5		
35	21.8	22.6	24.3	25.9	27.7	29.9	31.9	33.9	35.3	36.6	36.3	35.9	34.1	31.6	29.3	28.0	26.9		
40	16.6	16.9	17.1	17.4	17.8	18.3	18.7	19.3	19.3	19.6	20.0	20.1	20.0	19.9	18.9	18.2	17.7		
45	12.2	12.5	12.6	12.4	12.4	12.7	12.8	12.8	12.5	12.4	12.5	12.7	13.2	13.6	13.9	14.1	14.0		
50	7.31	7.34	7.40	7.46	7.61	7.71	7.83	7.94	8.01	8.13	8.11	8.01	8.05	7.96	7.86	7.89	7.92		
55	5.21	5.40	5.42	5.50	5.62	5.84	6.04	6.17	6.16	6.20	6.16	6.11	6.00	5.86	5.74	5.66	5.70		
60	3.82	3.87	3.91	4.03	4.12	4.20	4.21	4.22	4.24	4.28	4.25	4.24	4.21	4.15	4.13	4.11	4.15		
65	3.13	3.17	3.21	3.30	3.38	3.48	3.53	3.53	3.52	3.53	3.52	3.53	3.48	3.42	3.41	3.39	3.41		
70	2.52	2.46	2.46	2.64	2.58	2.63	2.87	2.73	2.71	2.85	2.76	2.73	2.78	2.66	2.64	2.83	2.70		
75	1.76	1.75	1.75	1.83	1.83	1.85	1.95	1.92	1.92	2.03	1.97	1.96	2.03	1.94	1.92	2.04	1.97		
80	1.09	1.09	1.08	1.12	1.14	1.15	1.21	1.21	1.21	1.24	1.24	1.24	1.25	1.24	1.24	1.26	1.26		
85	0.62	0.56	0.57	0.64	0.60	0.60	0.71	0.64	0.63	0.73	0.68	0.66	0.74	0.71	0.66	0.74	0.71		
90	0.30	0.30	0.26	0.30	0.30	0.28	0.32	0.31	0.29	0.32	0.31	0.30	0.33	0.33	0.31	0.33	0.32		
95	0.23	0.19	0.18	0.22	0.20	0.20	0.26	0.23	0.21	0.28	0.22	0.21	0.26	0.24	0.21	0.25	0.22		
100	0.25	0.23	0.14	0.20	0.21	0.15	0.26	0.22	0.17	0.21	0.21	0.17	0.29	0.22	0.16	0.24	0.19		
105	0.39	0.21	0.16	0.36	0.27	0.17	0.33	0.24	0.18	0.34	0.25	0.18	0.38	0.32	0.17	0.38	0.28		
110	0.28	0.18	0.14	0.23	0.19	0.16	0.35	0.25	0.17	0.25	0.26	0.17	0.31	0.29	0.18	0.34	0.27		
115	0.12	0.13	0.11	0.11	0.15	0.12	0.16	0.16	0.13	0.16	0.16	0.13	0.16	0.15	0.13	0.15	0.14		
120	1.91	1.35	0.17	2.48	2.02	0.27	3.31	2.45	0.24	2.84	1.83	0.32	2.84	1.88	0.23	1.91	1.36		
125	0.15	0.12	0.08	0.17	0.12	0.08	0.18	0.13	0.09	0.22	0.20	0.09	0.25	0.20	0.09	0.28	0.23		
130	0.07	0.06	0.05	0.07	0.07	0.06	0.08	0.07	0.06	0.10	0.10	0.06	0.09	0.08	0.06	0.09	0.08		
135	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06		
140	0.07	0.07	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07		
145	0.11	0.10	0.10	0.11	0.11	0.10	0.11	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10		
150	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14		
155	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		
160	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.22	0.21	0.21	0.21		
165	0.27	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.26	0.24		
170	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.26		
175	0.30	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.27	0.25	0.24		
180	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18		

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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