

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Lamp

**Model: 11PAR30SNDIM/930NF25**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19050046x

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

Review by:



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Jul. 05, 2019

Approved by:



Manager: Jim Zhang

Jul. 05, 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: 11PAR30SNDIM/930NF25

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
94.4	1026.4	10.87	0.9169
CCT (K)	CRI	Stabilization Time (Light & Power)	
3064	98.0	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>	: May 29, 2019
<b>Date of Test</b>	: Jul. 02, 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>	: 11PAR30SNDIM/930NF25
<b>Electrical Ratings</b>	: 120V, 60Hz, 11W
<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)	0.099
Power Factor	0.9169
Test Power (W)	10.87
THD A%	35.86
Luminous Efficacy (lm/W)	94.4
Total Luminous Flux (lm)	1026.4
Color Rendering Index (CRI)	98.0
R9	90.1
Correlated Color Temperature (CCT)(K)	3064
Chromaticity Chroma x	0.4323
Chromaticity Chroma y	0.4024
Chromaticity Chroma u	0.2483
Chromaticity Chroma v	0.3467
Duv	0.0002
Chromaticity Chroma u'	0.2483
Chromaticity Chroma v'	0.5200

Special Color Rendering Indices	
R1	99.3
R2	99.8
R3	98.2
R4	98.7
R5	98.4
R6	97.7
R7	96.9
R8	95.3
R9	90.1
R10	98.5
R11	99.3
R12	85.2
R13	99.5
R14	98.0

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)	0.100
Power Factor	0.9206
Power (W)	11.00
Luminous Efficacy (lm/W)	95.1
Total Luminous Flux (lm)	1045.9
Beam Angle ( ° )	20.0 (0°-180°) / 20.0 (90°-270°)
Center Beam Candle Power (cd)	5191
Maximum Beam Candle Power (cd)	5199 (At: C=220.0, Gamma=0.5)
Spacing Criteria	0.35 (0°-180°) / 0.35 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	95.25%
Zonal Lumens in the 60 °-90 °Zone	4.59%
Zonal Lumens in the 90 °-120 °Zone	0.04%
Zonal Lumens in the 120 °-180 °Zone	0.12%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

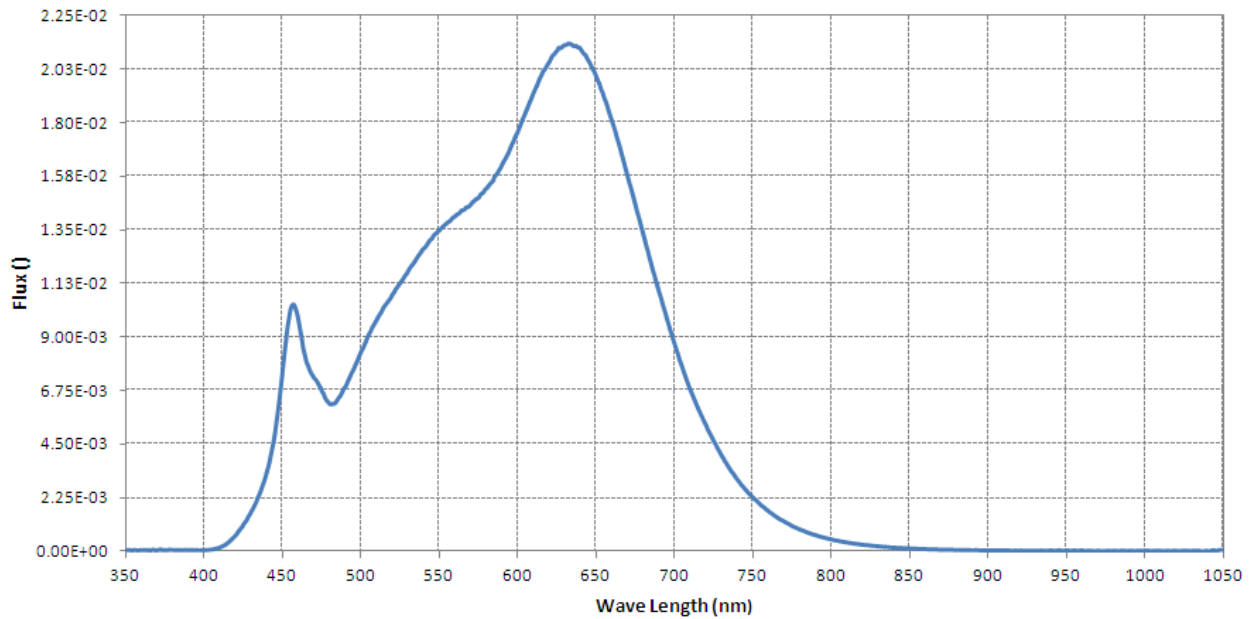
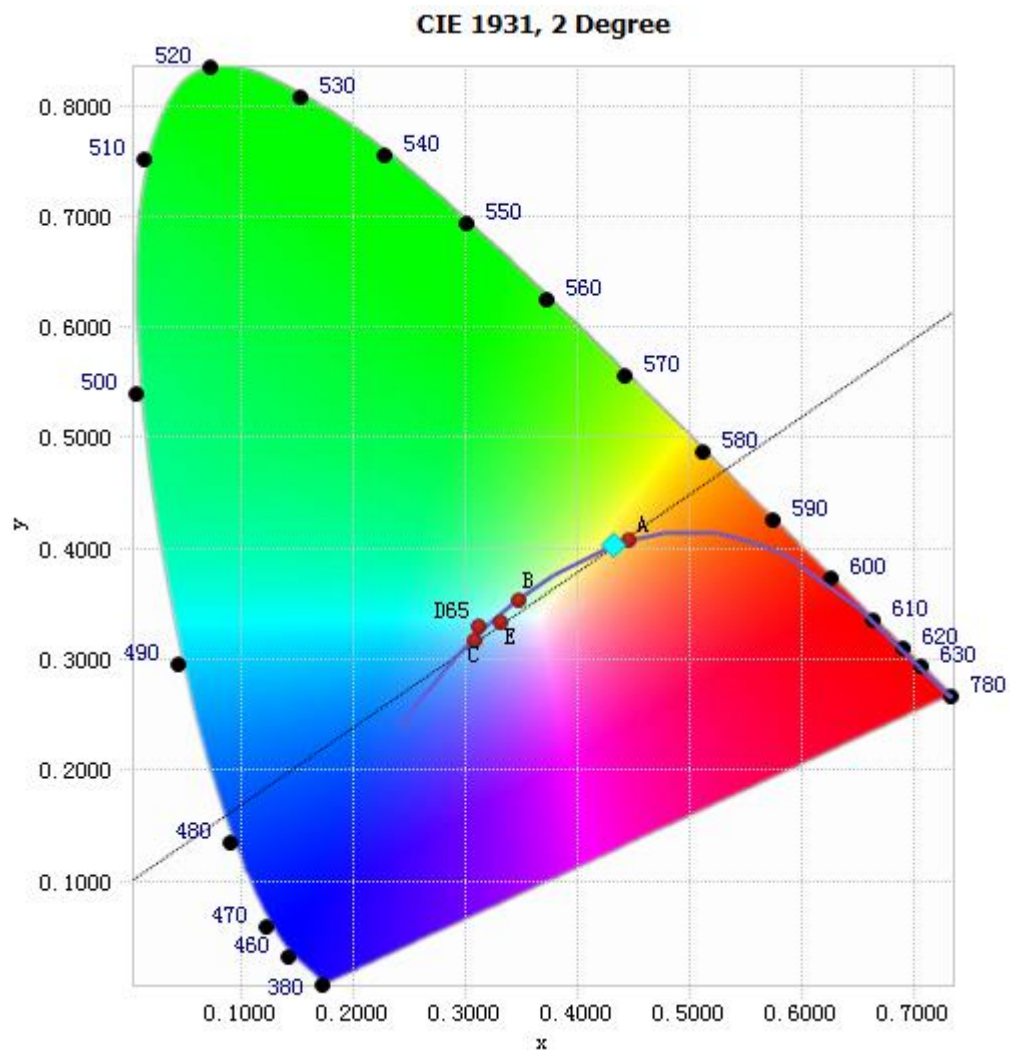


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.37E-05	485	6.36E-03	590	1.62E-02	695	9.73E-03
385	3.42E-05	490	6.90E-03	595	1.69E-02	700	8.66E-03
390	3.89E-05	495	7.60E-03	600	1.76E-02	705	7.67E-03
395	4.35E-05	500	8.38E-03	605	1.84E-02	710	6.75E-03
400	3.54E-05	505	9.10E-03	610	1.92E-02	715	5.96E-03
405	6.12E-05	510	9.72E-03	615	2.00E-02	720	5.26E-03
410	1.45E-04	515	1.03E-02	620	2.05E-02	725	4.60E-03
415	3.43E-04	520	1.08E-02	625	2.10E-02	730	3.99E-03
420	6.61E-04	525	1.13E-02	630	2.12E-02	735	3.45E-03
425	1.11E-03	530	1.18E-02	635	2.12E-02	740	2.98E-03
430	1.66E-03	535	1.22E-02	640	2.11E-02	745	2.58E-03
435	2.36E-03	540	1.27E-02	645	2.06E-02	750	2.24E-03
440	3.37E-03	545	1.31E-02	650	1.99E-02	755	1.92E-03
445	4.94E-03	550	1.35E-02	655	1.90E-02	760	1.65E-03
450	7.62E-03	555	1.38E-02	660	1.80E-02	765	1.42E-03
455	1.02E-02	560	1.41E-02	665	1.69E-02	770	1.22E-03
460	9.69E-03	565	1.43E-02	670	1.57E-02	775	1.04E-03
465	7.96E-03	570	1.46E-02	675	1.45E-02	780	8.95E-04
470	7.26E-03	575	1.48E-02	680	1.33E-02		
475	6.69E-03	580	1.52E-02	685	1.20E-02		
480	6.17E-03	585	1.57E-02	690	1.09E-02		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4323, 0.4024)

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

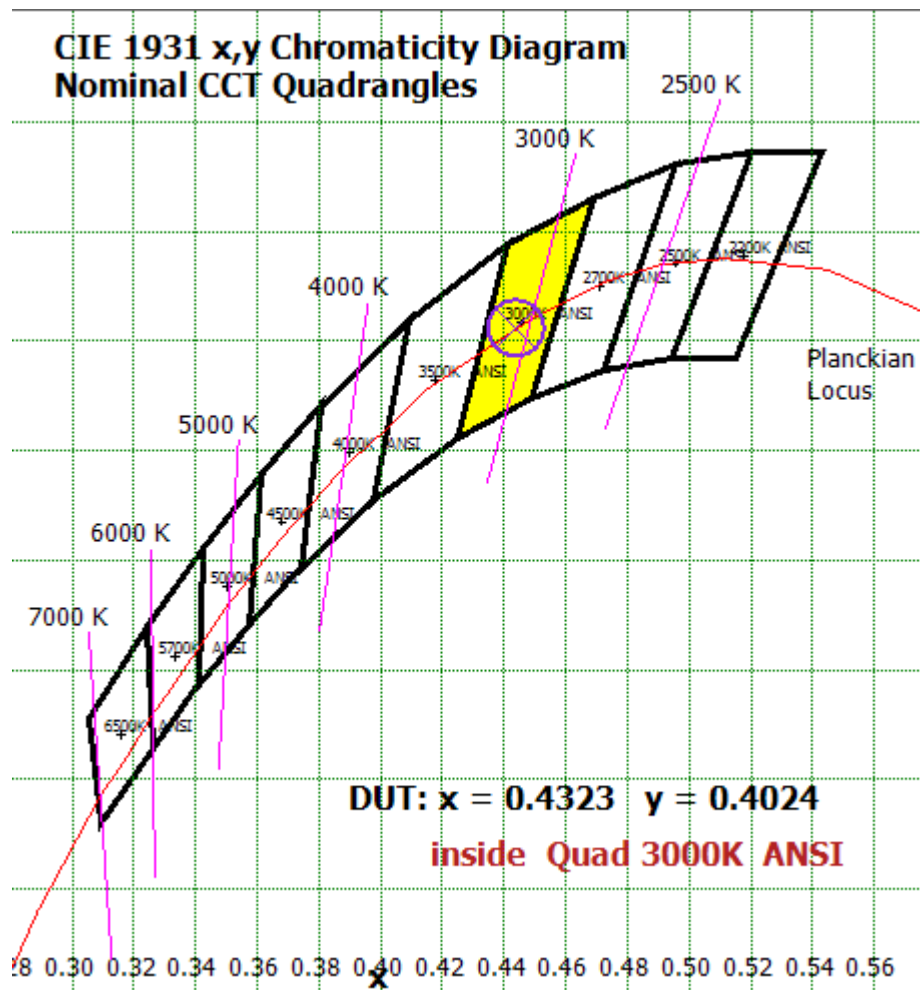
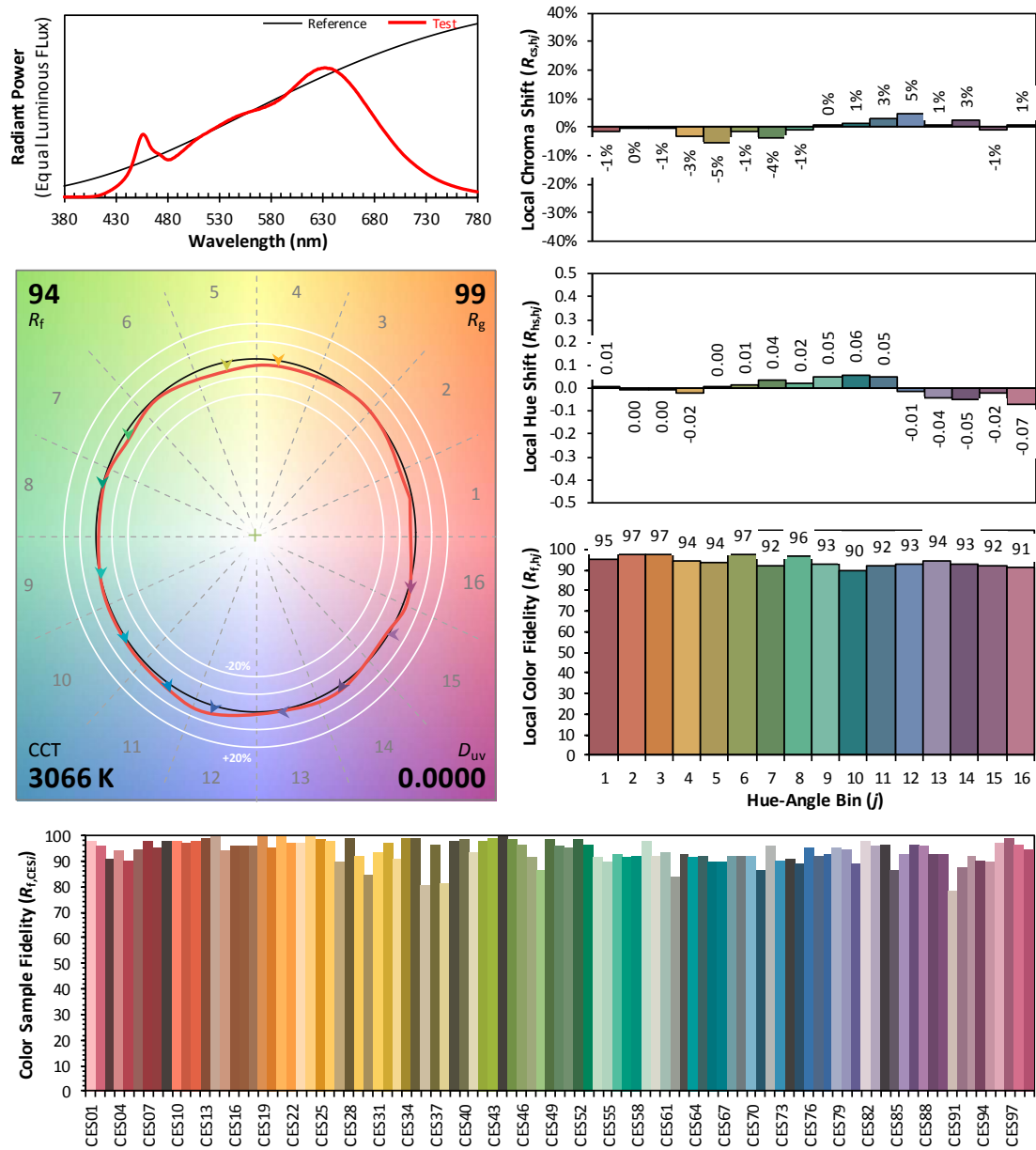


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4323  
 $y$  0.4024  
 $u'$  0.2483  
 $v'$  0.5200

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	351.082	33.57%
10- 20	365.835	34.98%
20- 30	124.855	11.94%
30- 40	64.795	6.20%
40- 50	50.39	4.82%
50- 60	39.279	3.76%
60- 70	27.395	2.62%
70- 80	15.298	1.46%
80- 90	5.303	0.51%
90-100	0.342	0.03%
100-110	0.017	0.00%
110-120	0.027	0.00%
120-130	0.046	0.00%
130-140	0.124	0.01%
140-150	0.305	0.03%
150-160	0.418	0.04%
160-170	0.314	0.03%
170-180	0.095	0.01%
Total	1045.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	996.236	95.25%
60- 90	47.996	4.59%
0-90	1044.232	99.84%
90- 180	1.688	0.16%
0- 180	1045.9	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

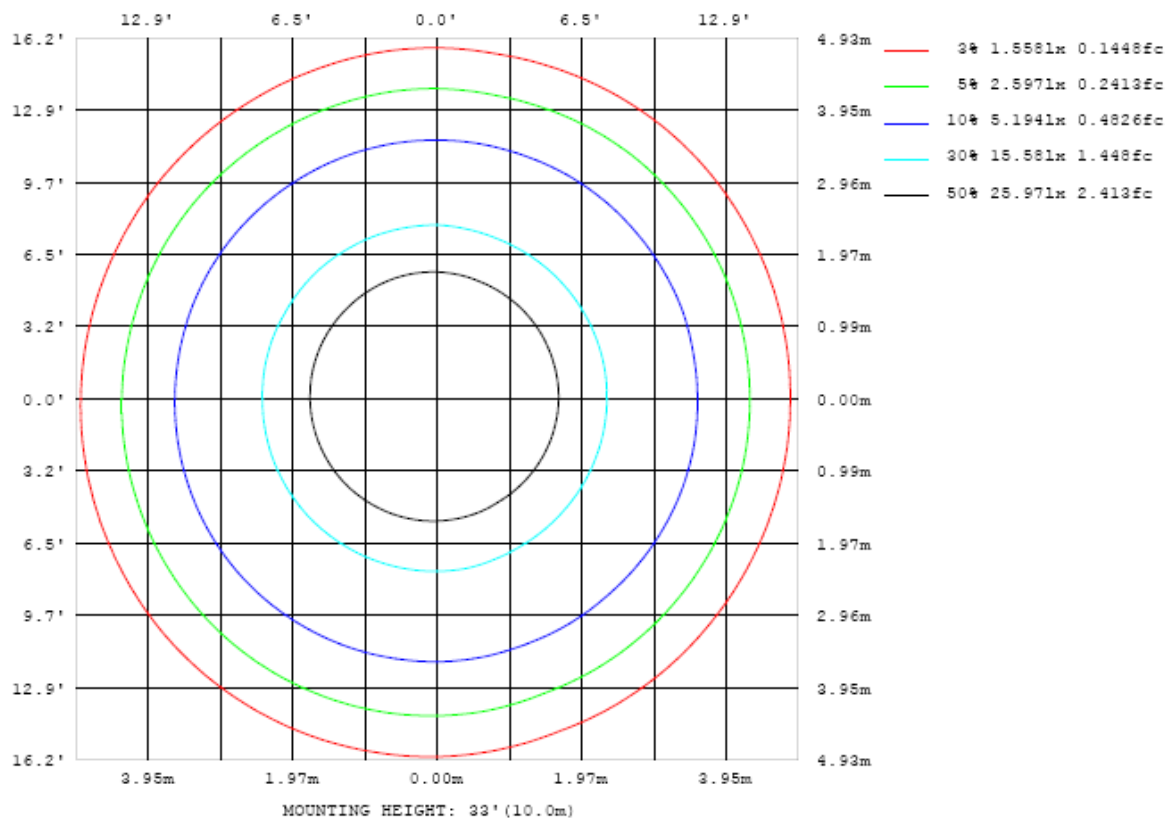


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

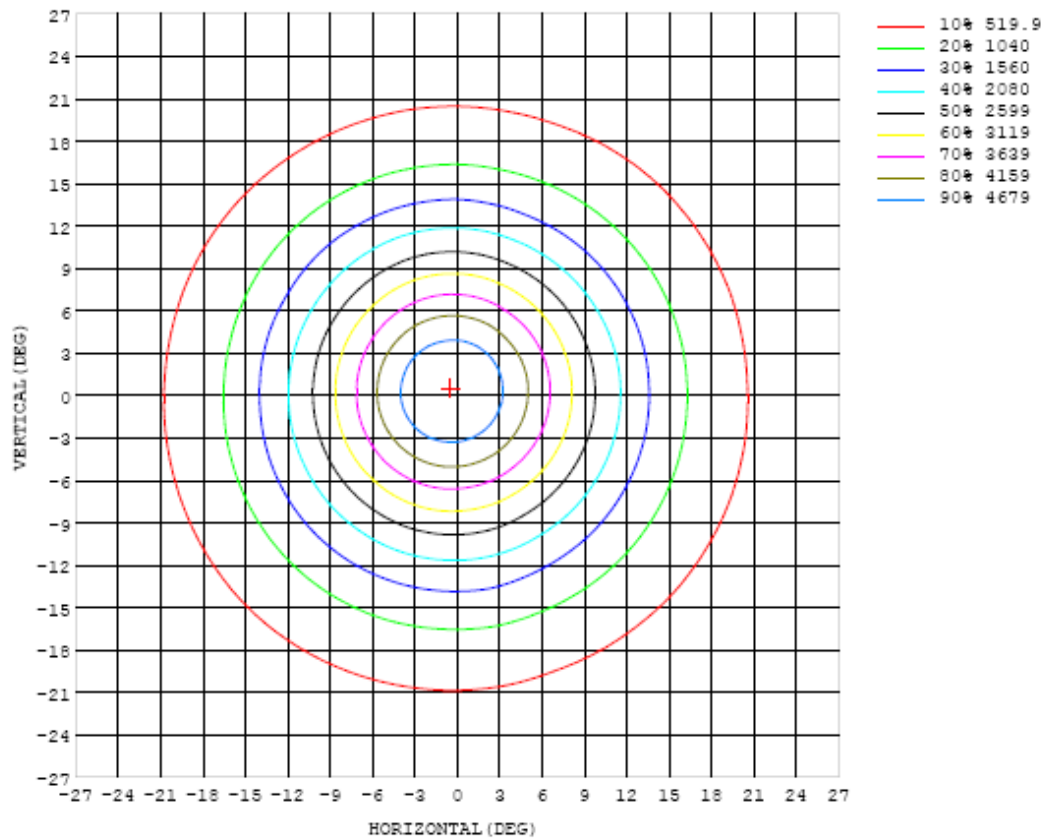


Chart 6: Isocandela Plot

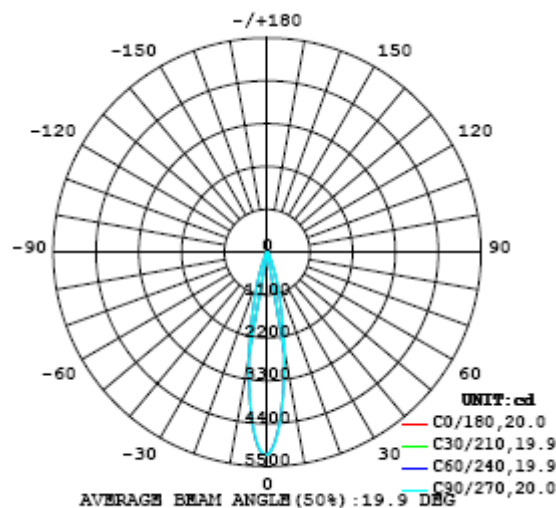


Chart 7: Polar Candela Distribution

## 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	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191
5	4155	4140	4131	4121	4116	4120	4122	4130	4145	4164	4189	4215	4243	4272	4300	4326	4351	4373	4388
10	2523	2514	2507	2498	2491	2494	2495	2517	2536	2550	2563	2583	2595	2612	2627	2640	2652	2663	2674
15	1264	1261	1261	1261	1262	1264	1267	1281	1304	1310	1316	1325	1329	1333	1336	1334	1336	1332	1331
20	576	581	582	579	578	576	580	582	592	598	600	605	607	609	610	607	603	599	594
25	241	241	242	242	243	244	245	244	250	256	259	262	264	264	263	260	257	254	251
30	129	129	129	129	128	128	128	128	130	133	134	135	137	140	141	141	140	139	139
35	98.4	97.5	97.2	96.7	96.6	96.5	96.5	96.9	98.2	100	101	103	104	105	106	107	107	107	107
40	77.7	77.3	76.9	76.7	76.8	76.6	76.5	76.8	78.1	79.7	80.3	80.7	81.1	81.7	82.6	83.3	83.6	83.7	83.8
45	63.6	63.6	63.9	64.2	64.0	63.8	63.9	64.1	64.4	65.1	65.4	65.3	65.3	65.3	66.0	66.4	66.7	66.8	67.0
50	51.8	51.8	51.6	51.8	52.1	52.2	52.0	51.6	51.5	52.1	52.2	52.4	52.9	53.2	53.3	53.5	53.1	52.8	52.5
55	44.3	44.5	44.4	44.5	44.4	43.9	43.6	43.5	43.4	43.7	44.2	44.6	44.6	44.5	44.7	44.9	44.8	44.3	44.0
60	35.1	35.2	35.2	35.1	34.9	34.8	34.7	34.8	35.0	35.5	35.7	35.9	35.9	35.9	35.9	35.9	35.7	35.6	35.6
65	27.1	27.1	27.0	26.9	26.9	26.9	26.9	26.9	27.1	27.5	27.7	27.9	27.9	27.9	27.9	28.0	28.0	28.0	28.1
70	20.2	20.1	20.0	19.9	19.8	19.8	19.9	19.9	20.0	20.4	20.6	20.7	20.8	20.8	20.8	21.0	21.0	21.1	21.2
75	14.0	13.9	13.8	13.7	13.6	13.6	13.6	13.6	13.7	14.0	14.2	14.3	14.3	14.3	14.4	14.5	14.6	14.7	14.8
80	9.01	8.86	8.81	8.69	8.65	8.63	8.59	8.67	8.79	8.90	9.14	9.11	9.10	9.05	9.11	9.16	9.30	9.36	9.46
85	4.20	4.21	4.13	4.04	4.06	3.99	3.96	4.03	4.02	4.16	4.32	4.36	4.39	4.56	4.63	4.68	4.87	4.95	5.02
90	1.21	1.17	1.16	1.14	1.12	1.11	1.11	1.11	1.12	1.21	1.25	1.29	1.34	1.40	1.47	1.54	1.61	1.67	1.73
95	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.06	0.07	0.09	0.10	0.10
100	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
105	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
110	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
115	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
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
125	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	0.05	0.05	0.06	0.06	0.06	0.06
130	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.08	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10
135	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.16	0.19	0.18	0.19	0.19	0.19	0.19	0.20	0.20	0.20
140	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.21	0.31	0.37	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37
145	0.35	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.36	0.52	0.65	0.63	0.63	0.63	0.63	0.63	0.64	0.64	0.64
150	0.49	0.50	0.51	0.51	0.51	0.52	0.53	0.53	0.51	0.73	0.99	0.96	0.95	0.95	0.95	0.95	0.95	0.96	0.96
155	0.63	0.63	0.64	0.65	0.66	0.66	0.67	0.68	0.66	0.87	1.26	1.23	1.23	1.23	1.23	1.24	1.24	1.25	1.26
160	0.74	0.75	0.75	0.76	0.77	0.78	0.79	0.81	0.79	0.91	1.41	1.41	1.41	1.41	1.41	1.42	1.43	1.43	1.44
165	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.89	0.90	0.89	1.34	1.45	1.43	1.44	1.44	1.45	1.46	1.48	1.49
170	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.96	0.97	0.95	1.06	1.32	1.31	1.30	1.30	1.30	1.31	1.33	1.35
175	0.90	0.91	0.91	0.92	0.92	0.93	0.93	0.94	0.94	0.94	0.94	0.93	0.97	1.00	0.97	0.95	0.94	0.95	0.97
180	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88

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	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191	5191		
5	4400	4411	4417	4419	4417	4408	4398	4387	4370	4346	4329	4299	4260	4235	4216	4197	4176		
10	2685	2690	2689	2687	2687	2687	2687	2675	2658	2633	2603	2584	2570	2559	2546	2537	2531		
15	1334	1331	1326	1323	1322	1316	1311	1303	1297	1279	1267	1264	1262	1263	1264	1266	1265		
20	591	589	585	581	574	570	568	567	565	561	557	564	568	570	574	579	574		
25	248	245	243	240	237	235	234	235	234	231	234	238	241	242	242	243	242		
30	138	138	137	136	136	135	135	135	134	133	133	133	134	134	133	131	130		
35	107	107	106	106	106	105	105	104	104	103	102	102	101	101	100	99.9	99.3		
40	83.7	83.7	83.6	83.4	83.7	83.6	83.0	82.4	81.5	81.0	81.0	80.9	80.6	80.0	79.2	78.4	77.9		
45	66.8	66.9	66.5	66.4	66.0	66.3	65.9	65.7	65.6	65.5	65.4	65.6	65.5	65.1	64.4	63.9	63.6		
50	52.4	52.4	52.3	52.4	52.4	52.3	52.3	52.2	52.1	52.2	52.4	52.2	52.2	52.1	51.7	51.8	51.7		
55	44.1	44.0	44.3	44.5	44.5	44.6	44.6	44.4	44.4	44.2	44.0	44.1	44.0	43.8	43.8	44.1	44.1		
60	35.6	35.6	35.7	35.7	35.9	35.9	35.8	35.8	35.6	35.3	35.1	35.0	34.9	34.9	34.9	34.9	34.9		
65	28.0	28.0	28.0	28.1	28.1	28.1	28.0	27.8	27.8	27.7	27.5	27.3	27.2	27.2	27.1	27.2	27.1		
70	21.2	21.2	21.2	21.2	21.3	21.2	21.1	21.0	20.9	20.8	20.6	20.5	20.4	20.3	20.3	20.3	20.2		
75	14.8	14.7	14.7	14.8	14.9	14.8	14.7	14.7	14.7	14.6	14.5	14.4	14.3	14.2	14.1	14.1	14.1		
80	9.46	9.37	9.41	9.63	9.74	9.70	9.73	9.70	9.82	9.81	9.61	9.57	9.55	9.46	9.37	9.33	9.21		
85	5.17	5.13	5.10	5.15	5.07	4.99	5.02	4.91	4.79	4.75	4.60	4.54	4.52	4.42	4.35	4.36	4.28		
90	1.76	1.78	1.79	1.80	1.80	1.78	1.76	1.77	1.71	1.68	1.63	1.59	1.52	1.44	1.38	1.31	1.25		
95	0.11	0.10	0.11	0.11	0.12	0.13	0.15	0.16	0.13	0.12	0.10	0.08	0.06	0.05	0.04	0.03	0.02		
100	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		
105	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02		
110	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		
115	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03		
120	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03		
125	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
130	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06		
135	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.18	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11		
140	0.37	0.37	0.38	0.38	0.38	0.38	0.39	0.33	0.21	0.21	0.21	0.21	0.21	0.21	0.20	0.21	0.20		
145	0.64	0.64	0.65	0.65	0.65	0.66	0.68	0.55	0.33	0.33	0.33	0.34	0.34	0.34	0.34	0.35	0.35		
150	0.96	0.97	0.97	0.98	0.98	0.99	1.03	0.77	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.49	0.49		
155	1.26	1.27	1.27	1.28	1.28	1.29	1.33	0.89	0.61	0.61	0.60	0.60	0.60	0.61	0.61	0.61	0.62		
160	1.45	1.46	1.47	1.47	1.48	1.48	1.52	0.83	0.71	0.71	0.71	0.71	0.71	0.72	0.72	0.73	0.73		
165	1.51	1.52	1.53	1.53	1.54	1.56	1.48	0.83	0.81	0.80	0.80	0.80	0.80	0.81	0.81	0.82	0.82		
170	1.36	1.39	1.40	1.42	1.43	1.47	0.99	0.86	0.86	0.87	0.87	0.88	0.88	0.89	0.89	0.90	0.90		
175	1.02	1.07	1.10	1.12	0.90	0.84	0.84	0.85	0.85	0.85	0.85	0.85	0.86	0.87	0.88	0.89	0.89		
180	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88		

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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