LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Lamp

Model: 19.5PAR38HO/930FL40/277V

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19060039g

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

Review by: April Zou

Engineer: April Zou
Sep. 18, 2019

Approved by: Jim Zhang

Manager: Jim Zhang
Sep. 18, 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: **19.5PAR38HO/930FL40/277V**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
108.0	2041.5	18.90	0.9955

CCT (K)	CRI	Stabilization Time (Light & Power)
3031	92.9	60

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

Test specifications:

Date of Receipt : Jun. 20, 2019

Date of Test : Jul. 16, 2019

Test item : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

Reference Standard : 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)	
Name	: LED Lamp
Model	: 19.5PAR38HO/930FL40/277V
Electrical Ratings	: 120-277V, 60Hz, 19.5W
Product Description	: 3000K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 26.0 ℃.

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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.158	0.080
Power Factor	0.9955	0.9329
Test Power (W)	18.90	20.62
THD A%	8.72	21.68
Luminous Efficacy (lm/W)	108.0	105.8
Total Luminous Flux (lm)	2041.5	2181.0
Color Rendering Index (CRI)	92.9	
R9	62.1	
Correlated Color Temperature (CCT)(K)	3031	
Chromaticity Chroma x	0.4351	
Chromaticity Chroma y	0.4044	
Chromaticity Chroma u	0.2493	
Chromaticity Chroma v	0.3475	
Duv	0.0004	
Chromaticity Chroma u ’	0.2493	
Chromaticity Chroma v’	0.5212	

Special Color Rendering Indices	
R1	93
R2	95.4
R3	96.6
R4	93.6
R5	92.6
R6	94.3
R7	93.4
R8	83.8
R9	62.1
R10	88.5
R11	94.5
R12	82.6
R13	93.5
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 25.0 ℃.

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)	0.159
Power Factor	0.9953
Power (W)	18.94
Luminous Efficacy (lm/W)	113.0
Total Luminous Flux (lm)	2141.0
Beam Angle (°)	35.9 (0^o-180^o) / 35.9 (90^o-270^o)
Center Beam Candle Power (cd)	4137
Maximum Beam Candle Power (cd)	4137 (At: C=0.0, Gamma=0.0)
Spacing Criteria	0.58 (0^o-180^o) / 0.59 (90^o-270^o)
Zonal Lumens in the 0 °-60 °Zone	96.61%
Zonal Lumens in the 60 °-90 °Zone	3.25%
Zonal Lumens in the 90 °-120 °Zone	0.01%
Zonal Lumens in the 120 °-180 °Zone	0.13%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

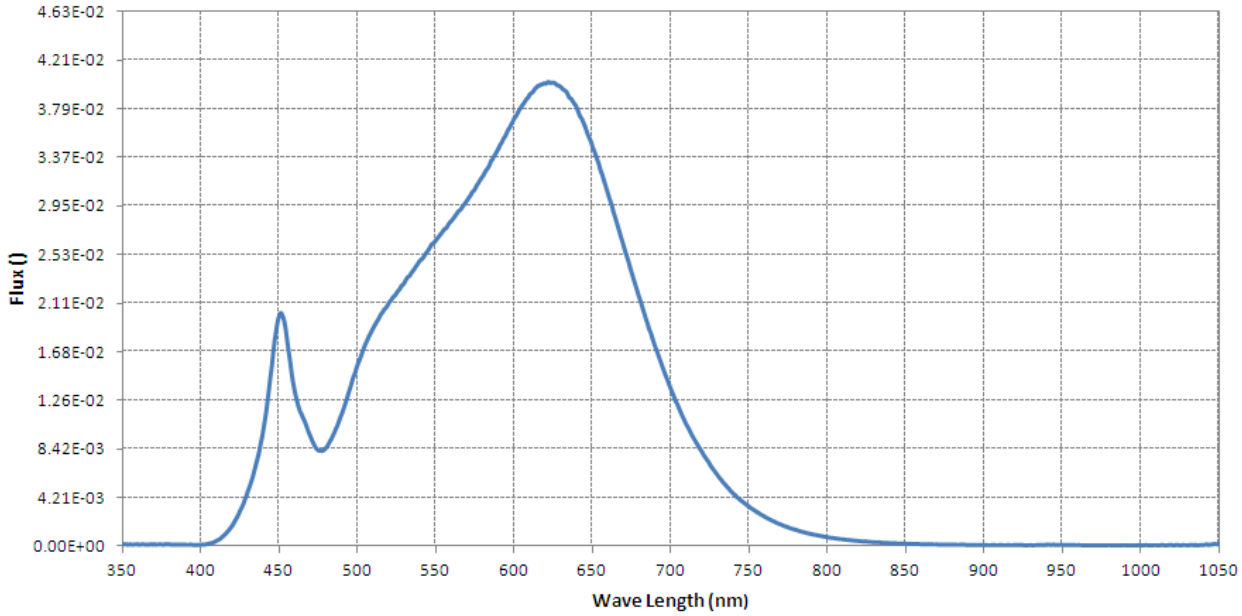
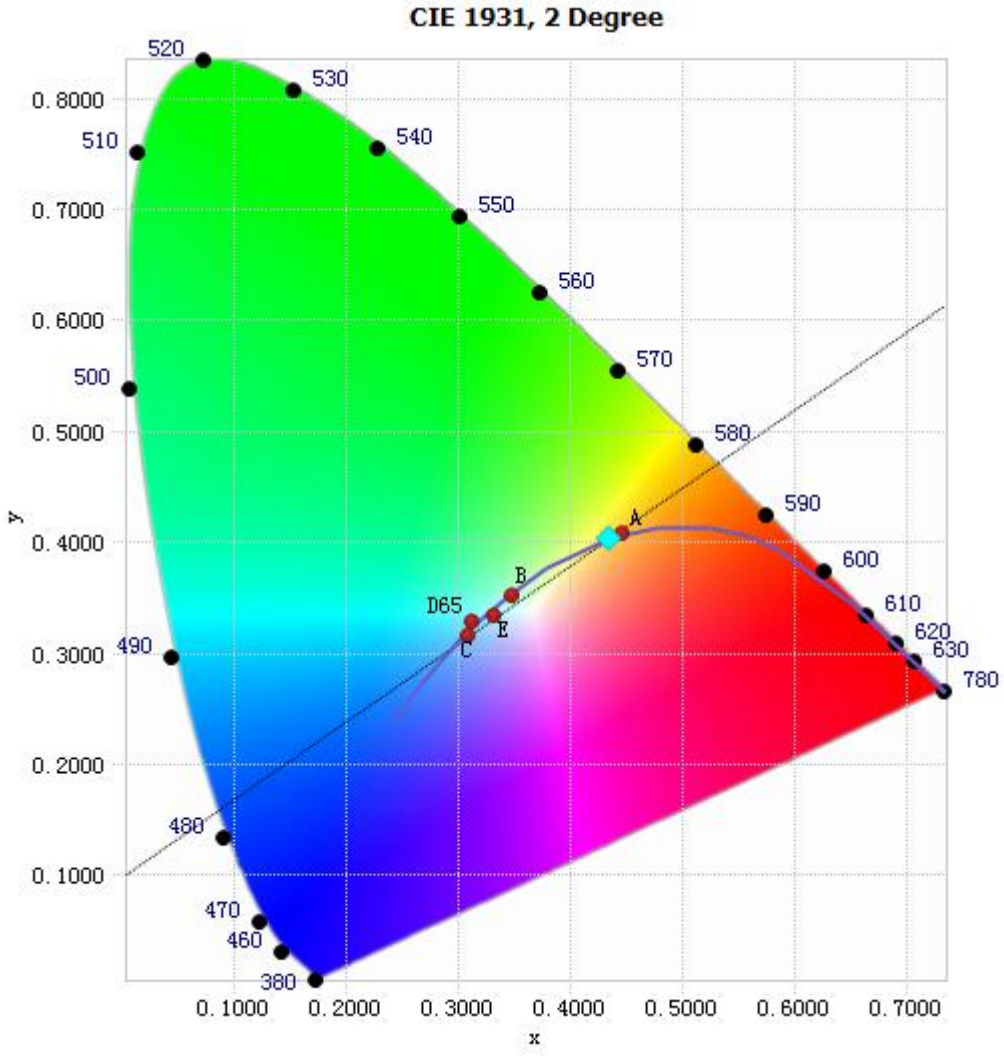


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.04E-04	485	9.60E-03	590	3.38E-02	695	1.50E-02
385	6.55E-05	490	1.13E-02	595	3.51E-02	700	1.33E-02
390	7.48E-05	495	1.34E-02	600	3.64E-02	705	1.17E-02
395	5.06E-05	500	1.54E-02	605	3.75E-02	710	1.02E-02
400	6.59E-05	505	1.72E-02	610	3.84E-02	715	9.00E-03
405	1.55E-04	510	1.85E-02	615	3.91E-02	720	7.92E-03
410	4.18E-04	515	1.97E-02	620	3.93E-02	725	6.85E-03
415	9.14E-04	520	2.07E-02	625	3.94E-02	730	5.93E-03
420	1.72E-03	525	2.15E-02	630	3.90E-02	735	5.11E-03
425	2.99E-03	530	2.24E-02	635	3.81E-02	740	4.39E-03
430	4.69E-03	535	2.34E-02	640	3.72E-02	745	3.80E-03
435	6.91E-03	540	2.43E-02	645	3.57E-02	750	3.30E-03
440	1.01E-02	545	2.51E-02	650	3.39E-02	755	2.83E-03
445	1.52E-02	550	2.60E-02	655	3.19E-02	760	2.43E-03
450	1.96E-02	555	2.69E-02	660	2.98E-02	765	2.09E-03
455	1.74E-02	560	2.77E-02	665	2.76E-02	770	1.80E-03
460	1.30E-02	565	2.85E-02	670	2.54E-02	775	1.53E-03
465	1.09E-02	570	2.94E-02	675	2.32E-02	780	1.32E-03
470	9.20E-03	575	3.04E-02	680	2.10E-02		
475	8.07E-03	580	3.15E-02	685	1.89E-02		
480	8.36E-03	585	3.27E-02	690	1.69E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4351, 0.4044)

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

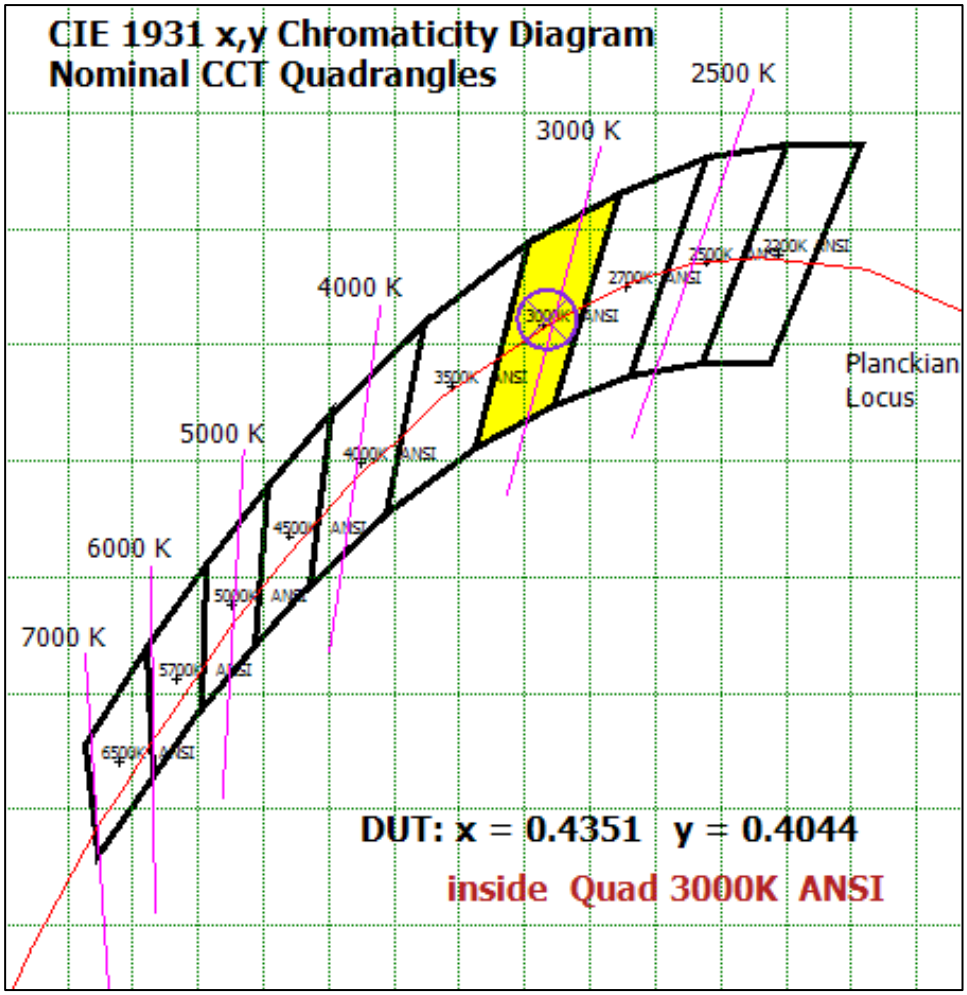
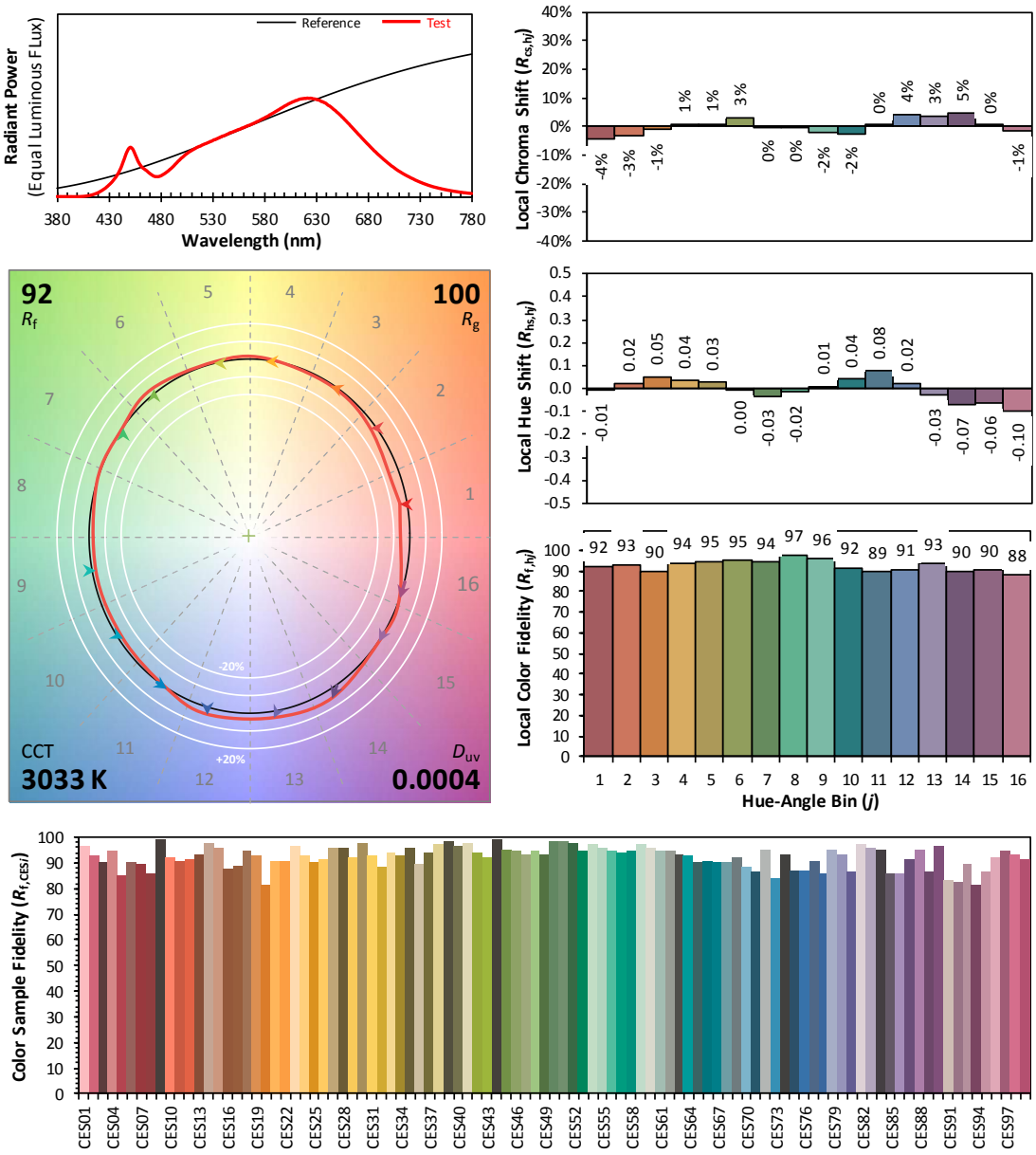


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

x	0.4351
y	0.4044
u'	0.2493
v'	0.5212

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

γ(°)	Lumens	% Total
0- 10	350.907	16.39%
10- 20	698.437	32.62%
20- 30	530.997	24.80%
30- 40	281.866	13.16%
40- 50	136.231	6.36%
50- 60	69.997	3.27%
60- 70	42.3	1.98%
70- 80	21.793	1.02%
80- 90	5.577	0.26%
90-100	0.069	0.00%
100-110	0.032	0.00%
110-120	0.061	0.00%
120-130	0.147	0.01%
130-140	0.38	0.02%
140-150	0.67	0.03%
150-160	0.777	0.04%
160-170	0.595	0.03%
170-180	0.2	0.01%
Total	2141.0	100%

γ(°)	Lumens	% Total
0- 60	2068.435	96.61%
60- 90	69.67	3.25%
0-90	2138.105	99.86%
90- 180	2.931	0.14%
0- 180	2141.0	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

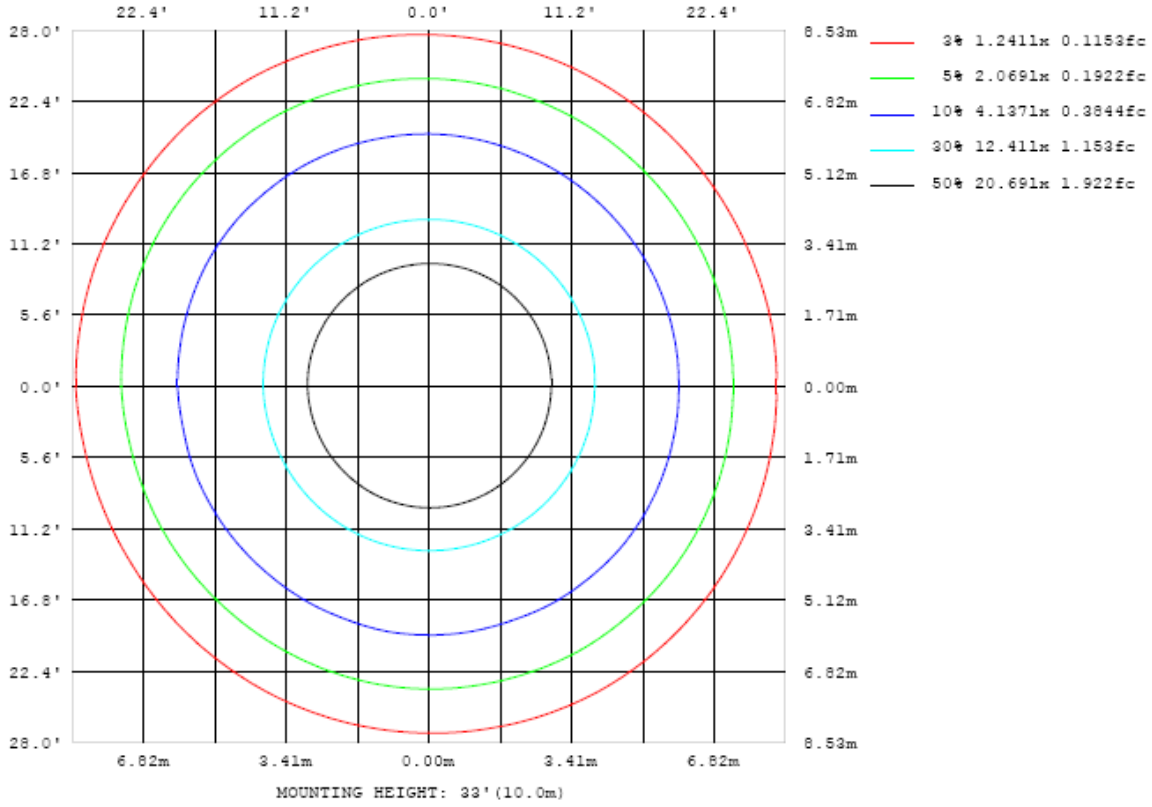


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

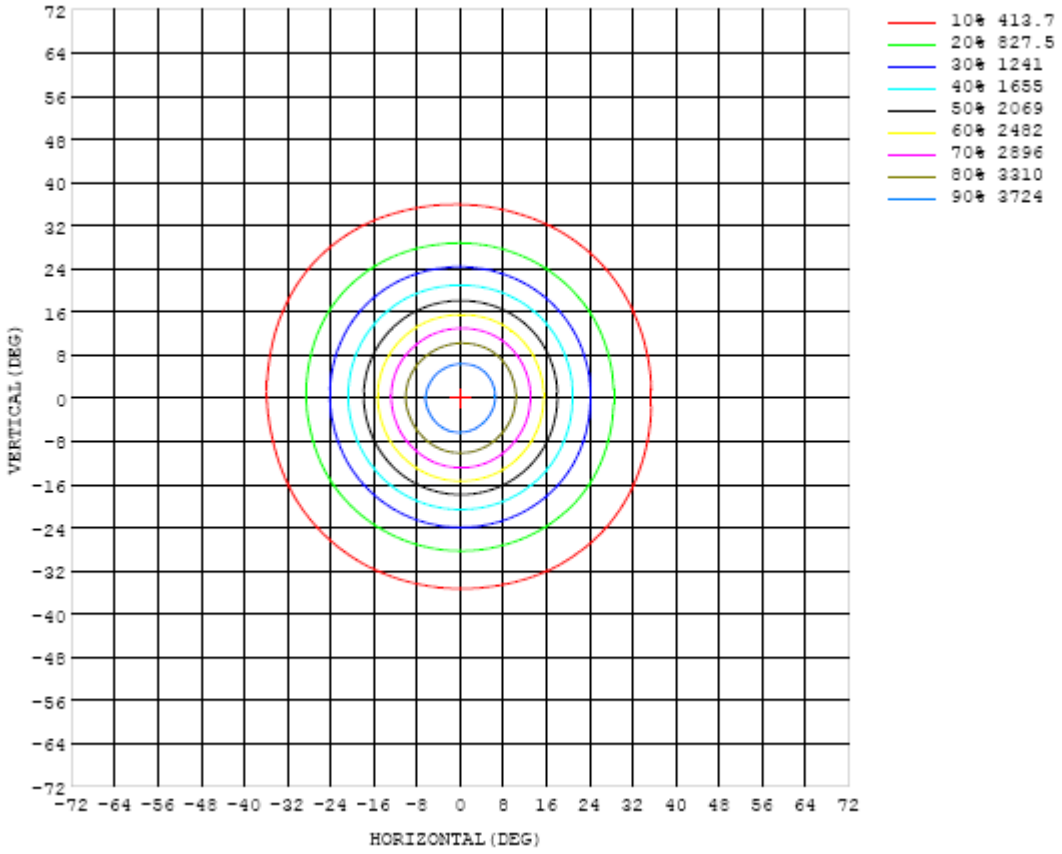


Chart 6: Isocandela Plot

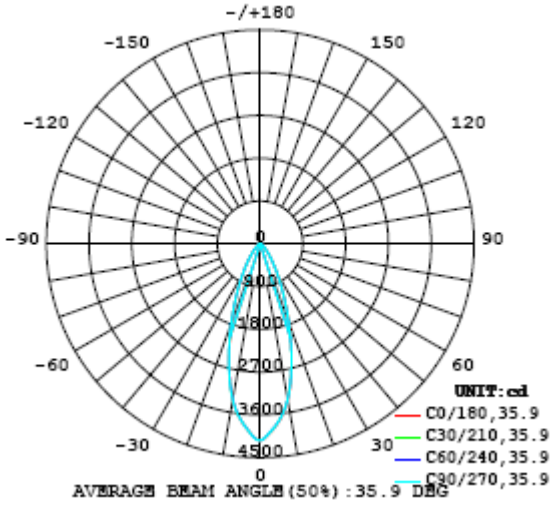


Chart 7: Polar Candela Distribution

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	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137
5	3842	3837	3836	3831	3829	3829	3828	3830	3828	3831	3833	3837	3837	3837	3837	3834	3835	3840	3840
10	3350	3339	3334	3324	3320	3318	3326	3328	3330	3328	3328	3326	3316	3307	3304	3305	3308	3317	3329
15	2559	2551	2549	2544	2541	2543	2546	2545	2542	2540	2536	2531	2522	2515	2513	2514	2512	2519	2534
20	1768	1762	1762	1757	1754	1749	1749	1747	1745	1742	1741	1738	1734	1731	1727	1731	1734	1743	1762
25	1143	1144	1145	1145	1139	1132	1131	1128	1127	1128	1125	1120	1115	1113	1115	1123	1128	1135	1152
30	712	712	715	719	725	714	715	697	703	705	707	689	691	689	698	701	713	707	726
35	433	433	434	435	434	431	432	429	426	426	423	420	419	417	419	424	429	434	450
40	267	268	270	270	271	271	271	270	266	264	263	263	262	262	262	263	268	274	284
45	166	167	167	168	170	170	171	170	167	166	165	165	166	166	166	167	169	171	177
50	106	107	108	108	110	110	109	109	108	107	107	107	107	107	108	109	109	110	112
55	73.6	73.7	74.0	73.7	74.8	74.9	75.4	74.7	74.4	74.6	74.4	74.9	74.6	75.7	75.8	76.2	76.8	76.5	77.9
60	54.8	54.9	54.9	55.1	55.3	55.5	55.9	55.7	55.3	55.1	55.1	55.1	55.5	55.9	56.2	56.4	56.7	56.7	56.9
65	42.3	42.3	42.2	42.1	42.2	42.3	42.7	42.4	42.2	41.9	41.7	41.7	41.9	41.9	42.0	42.2	42.3	42.5	42.8
70	31.0	31.0	30.9	30.8	30.7	30.8	31.0	30.8	30.6	30.5	30.3	30.2	30.2	30.3	30.1	30.3	30.2	30.3	30.6
75	21.0	20.9	20.8	20.7	20.6	20.6	20.7	20.6	20.4	20.2	20.1	19.9	19.9	19.9	19.8	19.9	19.9	19.9	20.2
80	12.2	12.2	12.2	12.1	12.0	12.0	11.9	11.8	11.7	11.5	11.4	11.3	11.3	11.2	11.1	11.1	11.1	11.1	11.2
85	5.07	5.05	5.04	4.97	4.92	4.85	4.79	4.70	4.61	4.54	4.47	4.39	4.35	4.29	4.25	4.23	4.21	4.19	4.36
90	0.66	0.66	0.64	0.62	0.60	0.58	0.57	0.54	0.52	0.49	0.46	0.45	0.43	0.41	0.40	0.40	0.39	0.38	0.42
95	0.01	0.01	0.01	0.02	0.02	0.01	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
100	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
105	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
110	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	0.04
115	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06
120	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.10
125	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	0.13	0.13	0.13	0.13	0.18
130	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.35
135	0.36	0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.36	0.62
140	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.57	0.56	0.57	0.56	0.57	0.57	0.57	0.56	0.97
145	0.76	0.77	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.76	1.37
150	0.99	1.01	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	0.99	1.76
155	1.24	1.27	1.27	1.27	1.27	1.27	1.28	1.28	1.28	1.28	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.26	2.07
160	1.50	1.52	1.53	1.53	1.53	1.53	1.54	1.54	1.54	1.54	1.55	1.55	1.55	1.55	1.54	1.55	1.55	1.50	2.32
165	1.68	1.71	1.71	1.72	1.72	1.72	1.73	1.73	1.73	1.73	1.74	1.74	1.74	1.74	1.74	1.75	1.75	1.69	2.45
170	1.78	1.81	1.82	1.82	1.82	1.82	1.82	1.82	1.83	1.82	1.82	1.82	1.82	1.82	1.81	1.81	1.81	1.76	2.35
175	1.82	1.84	1.85	1.85	1.85	1.85	1.86	1.87	1.87	1.88	1.88	1.89	1.89	1.90	1.90	1.90	1.91	1.89	2.06
180	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137	4137		
5	3835	3835	3831	3831	3832	3832	3834	3834	3838	3841	3841	3847	3848	3847	3848	3845	3842		
10	3327	3332	3326	3322	3318	3320	3325	3330	3340	3349	3360	3371	3374	3372	3368	3361	3359		
15	2538	2548	2546	2548	2548	2555	2557	2559	2566	2573	2584	2591	2594	2593	2587	2575	2571		
20	1768	1776	1776	1778	1781	1786	1784	1785	1786	1787	1791	1793	1794	1794	1791	1784	1780		
25	1161	1170	1176	1181	1177	1177	1175	1173	1173	1169	1163	1160	1158	1159	1163	1159	1155		
30	732	740	748	750	746	747	742	737	735	730	721	718	715	714	719	718	715		
35	455	462	466	468	466	466	460	456	452	447	440	438	436	434	434	434	433		
40	287	290	291	292	294	293	288	284	279	275	273	270	268	266	265	265	268		
45	179	182	182	184	185	185	182	180	177	174	173	172	170	169	167	167	168		
50	113	116	117	118	118	117	117	115	113	112	110	109	109	109	108	108	108		
55	77.7	78.7	79.6	80.6	80.4	80.5	80.1	79.3	78.2	77.5	76.0	75.7	75.2	74.8	74.2	74.5	74.1		
60	56.8	57.2	57.7	58.2	58.3	58.3	58.2	57.8	57.5	56.9	56.4	56.0	55.6	55.3	55.2	55.0	55.0		
65	42.6	42.7	43.1	43.3	43.5	43.7	43.5	43.2	43.2	43.0	42.8	42.7	42.3	42.0	42.0	42.0	42.2		
70	30.6	30.6	30.8	31.0	31.0	31.2	31.3	31.1	31.2	31.0	30.9	30.8	30.7	30.6	30.8	30.9	31.1		
75	20.1	20.2	20.2	20.3	20.3	20.5	20.6	20.7	20.7	20.7	20.6	20.7	20.6	20.7	20.8	20.9	21.1		
80	11.2	11.2	11.3	11.3	11.3	11.5	11.6	11.7	11.7	11.8	11.8	11.8	11.9	11.9	12.0	12.1	12.2		
85	4.35	4.36	4.37	4.41	4.44	4.53	4.60	4.69	4.76	4.80	4.86	4.90	4.96	5.00	5.09	5.14	5.19		
90	0.42	0.42	0.43	0.44	0.46	0.48	0.51	0.54	0.58	0.60	0.62	0.64	0.67	0.68	0.70	0.71	0.72		
95	0.01	0.01	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		
100	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		
105	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		
110	0.04	0.04	0.05	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.05		
115	0.06	0.07	0.07	0.07	0.06	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07		
120	0.10	0.10	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10		
125	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.18	0.18		
130	0.35	0.35	0.35	0.35	0.35	0.35	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.32	0.33	0.33	0.33		
135	0.63	0.63	0.62	0.62	0.62	0.62	0.62	0.61	0.61	0.60	0.60	0.60	0.59	0.59	0.59	0.59	0.59		
140	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.96	0.95	0.95	0.95	0.96	0.94		
145	1.39	1.39	1.39	1.39	1.39	1.39	1.38	1.38	1.38	1.37	1.37	1.37	1.37	1.37	1.37	1.38	1.35		
150	1.80	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.78	1.78	1.78	1.78	1.78	1.79	1.80	1.76		
155	2.13	2.13	2.13	2.12	2.12	2.12	2.12	2.13	2.13	2.13	2.13	2.13	2.13	2.14	2.14	2.16	2.10		
160	2.41	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.42	2.35		
165	2.55	2.55	2.55	2.55	2.54	2.55	2.54	2.55	2.54	2.54	2.54	2.54	2.55	2.55	2.55	2.58	2.47		
170	2.50	2.50	2.50	2.50	2.51	2.51	2.52	2.53	2.53	2.53	2.54	2.54	2.55	2.55	2.55	2.59	2.44		
175	2.22	2.21	2.21	2.22	2.22	2.23	2.23	2.24	2.25	2.25	2.26	2.27	2.27	2.27	2.28	2.31	2.13		
180	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08		

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 4π. 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.

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The uncertainty of integrating sphere system reported in this document is expended 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 expended uncertainty is 2.3% with a coverage factor k=2.

Color Characteristics Measurements

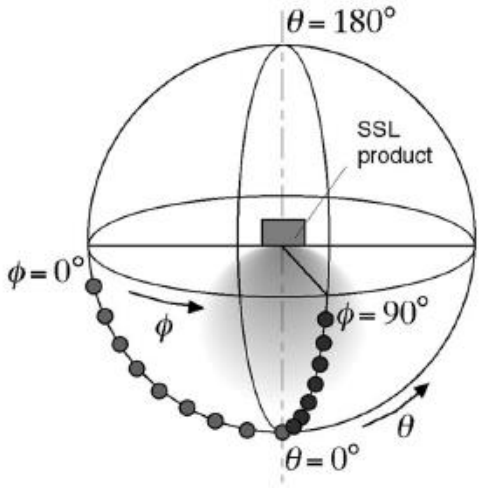
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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°/180° and C=90°/270°) and at 10° 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, Δu'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 ***