

LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Lamp

Model: 5.5PAR20DIM/830FL40/N

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19070039i

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:



Manager: Jim Zhang

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: 5.5PAR20DIM/830FL40/N

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
99.8	538.0	5.39	0.7159
CCT (K)	CRI	Stabilization Time (Light & Power)	
3014	83.0	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	: Jul. 25, 2019
Date of Test	: Jul. 31, 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	: 5.5PAR20DIM/830FL40/N
Electrical Ratings	: 120V, 60Hz, 5.5W
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 °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)	0.063
Power Factor	0.7159
Test Power (W)	5.39
THD A%	68.98
Luminous Efficacy (lm/W)	99.8
Total Luminous Flux (lm)	538.0
Color Rendering Index (CRI)	83.0
R9	6.9
Correlated Color Temperature (CCT)(K)	3014
Chromaticity Chroma x	0.4351
Chromaticity Chroma y	0.4021
Chromaticity Chroma u	0.2502
Chromaticity Chroma v	0.3469
Duv	-0.0006
Chromaticity Chroma u'	0.2502
Chromaticity Chroma v'	0.5203

Special Color Rendering Indices	
R1	82.1
R2	93.5
R3	93.3
R4	80.3
R5	82.9
R6	92.7
R7	81
R8	57.8
R9	6.9
R10	85.6
R11	80.3
R12	77.4
R13	85.1
R14	96.8

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)	0.062
Power Factor	0.7221
Power (W)	5.35
Luminous Efficacy (lm/W)	101.9
Total Luminous Flux (lm)	545.4
Beam Angle (°)	37.0 (0°-180°) / 37.5 (90°-270°)
Center Beam Candle Power (cd)	1007
Maximum Beam Candle Power (cd)	1008 (At: C=40.0, Gamma=0.5)
Spacing Criteria	0.56 (0°-180°) / 0.61 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	96.07%
Zonal Lumens in the 60 °-90 °Zone	3.80%
Zonal Lumens in the 90 °-120 °Zone	0.01%
Zonal Lumens in the 120 °-180 °Zone	0.12%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

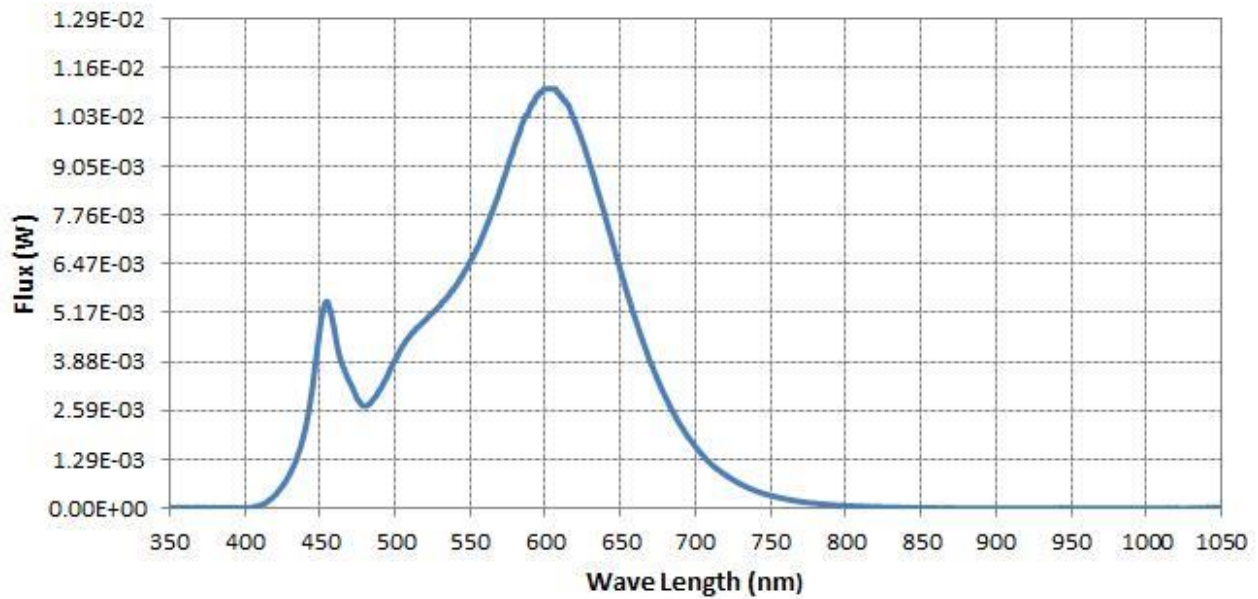
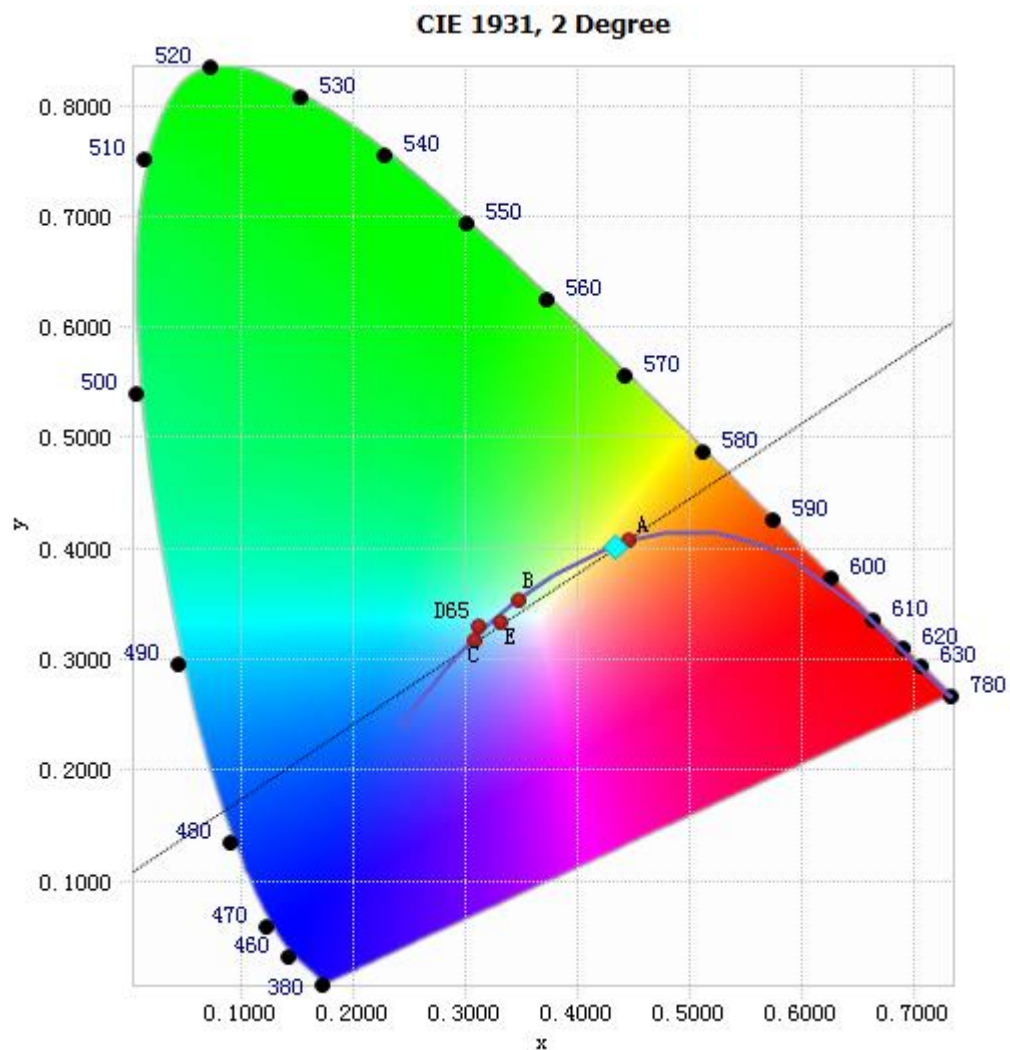


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.60E-05	485	2.86E-03	590	1.06E-02	695	1.89E-03
385	2.49E-05	490	3.14E-03	595	1.09E-02	700	1.63E-03
390	2.67E-05	495	3.50E-03	600	1.11E-02	705	1.40E-03
395	2.54E-05	500	3.92E-03	605	1.11E-02	710	1.19E-03
400	1.96E-05	505	4.29E-03	610	1.09E-02	715	1.03E-03
405	3.10E-05	510	4.57E-03	615	1.07E-02	720	8.81E-04
410	8.01E-05	515	4.79E-03	620	1.02E-02	725	7.59E-04
415	1.76E-04	520	4.98E-03	625	9.67E-03	730	6.44E-04
420	3.41E-04	525	5.17E-03	630	9.06E-03	735	5.48E-04
425	5.87E-04	530	5.36E-03	635	8.38E-03	740	4.64E-04
430	9.08E-04	535	5.59E-03	640	7.70E-03	745	4.01E-04
435	1.37E-03	540	5.86E-03	645	6.99E-03	750	3.43E-04
440	2.04E-03	545	6.17E-03	650	6.29E-03	755	2.93E-04
445	3.17E-03	550	6.52E-03	655	5.62E-03	760	2.50E-04
450	4.72E-03	555	6.91E-03	660	5.00E-03	765	2.15E-04
455	5.47E-03	560	7.37E-03	665	4.41E-03	770	1.83E-04
460	4.66E-03	565	7.88E-03	670	3.87E-03	775	1.57E-04
465	3.79E-03	570	8.44E-03	675	3.38E-03	780	1.36E-04
470	3.33E-03	575	9.03E-03	680	2.95E-03		
475	2.89E-03	580	9.64E-03	685	2.55E-03		
480	2.71E-03	585	1.02E-02	690	2.20E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4351, 0.4021)

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

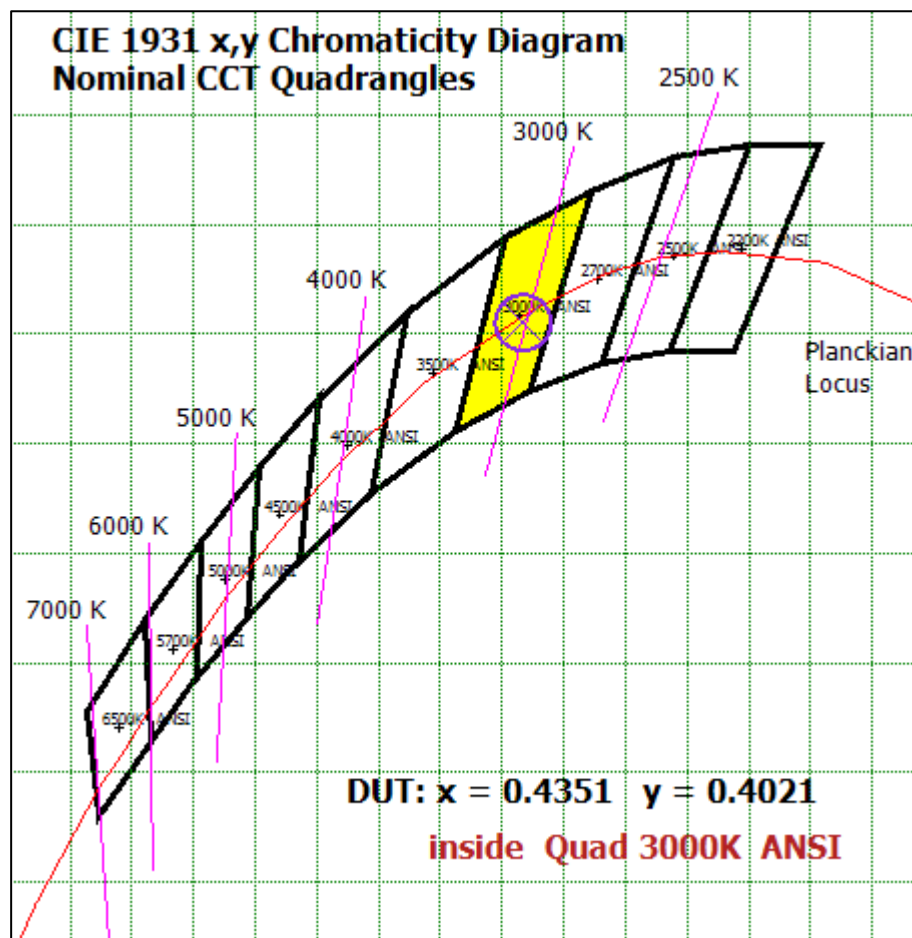
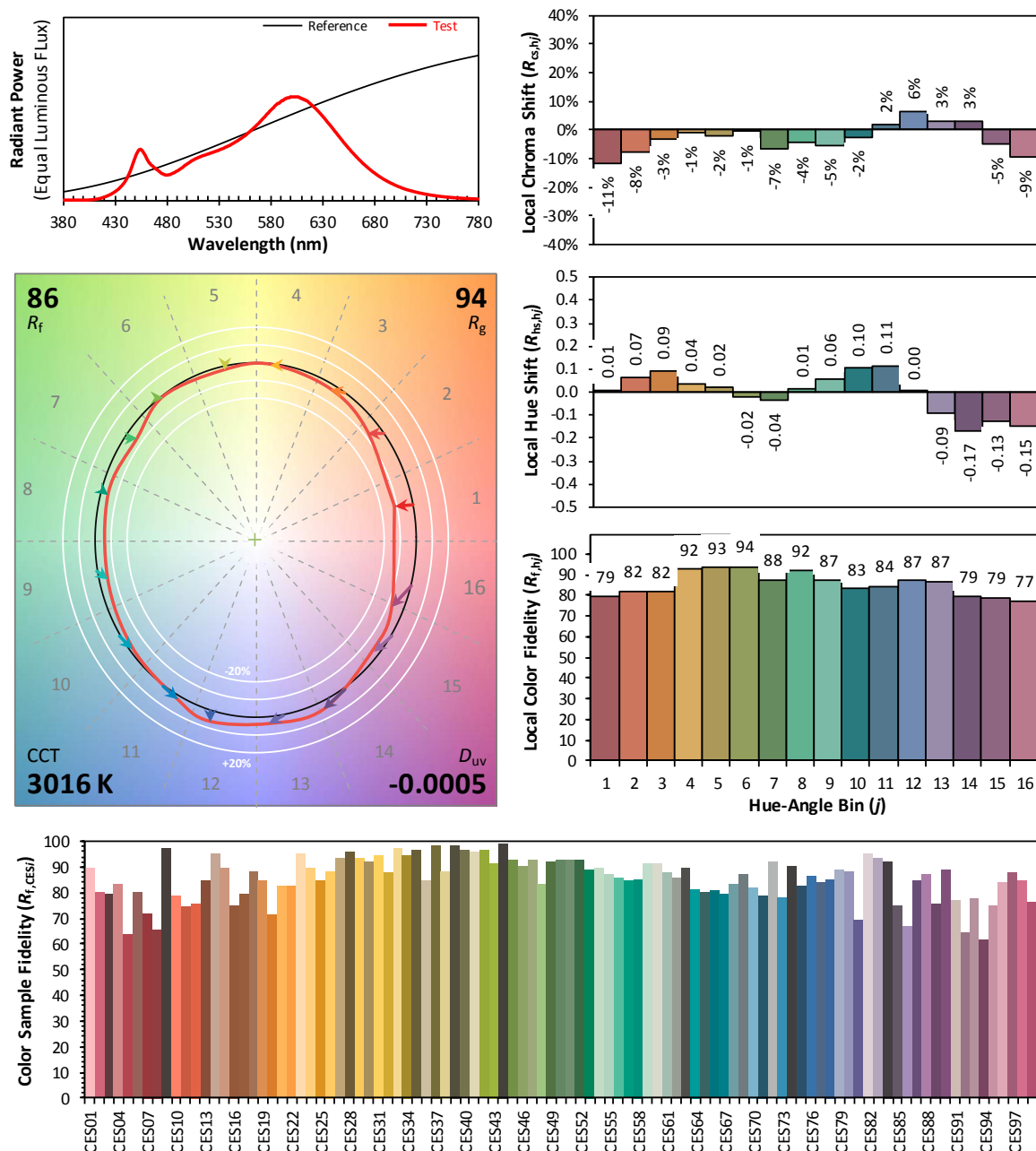


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

x 0.4351
 y 0.4021
 u' 0.2502
 v' 0.5203

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	88.277	16.19%
10- 20	179.363	32.89%
20- 30	123.411	22.63%
30- 40	71.84	13.17%
40- 50	39.997	7.33%
50- 60	21.069	3.86%
60- 70	12.647	2.32%
70- 80	6.314	1.16%
80- 90	1.745	0.32%
90-100	0.043	0.01%
100-110	0.006	0.00%
110-120	0.014	0.00%
120-130	0.036	0.01%
130-140	0.092	0.02%
140-150	0.163	0.03%
150-160	0.19	0.03%
160-170	0.145	0.03%
170-180	0.049	0.01%
Total	545.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	523.957	96.07%
60- 90	20.706	3.80%
0-90	544.663	99.86%
90- 180	0.738	0.14%
0- 180	545.4	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

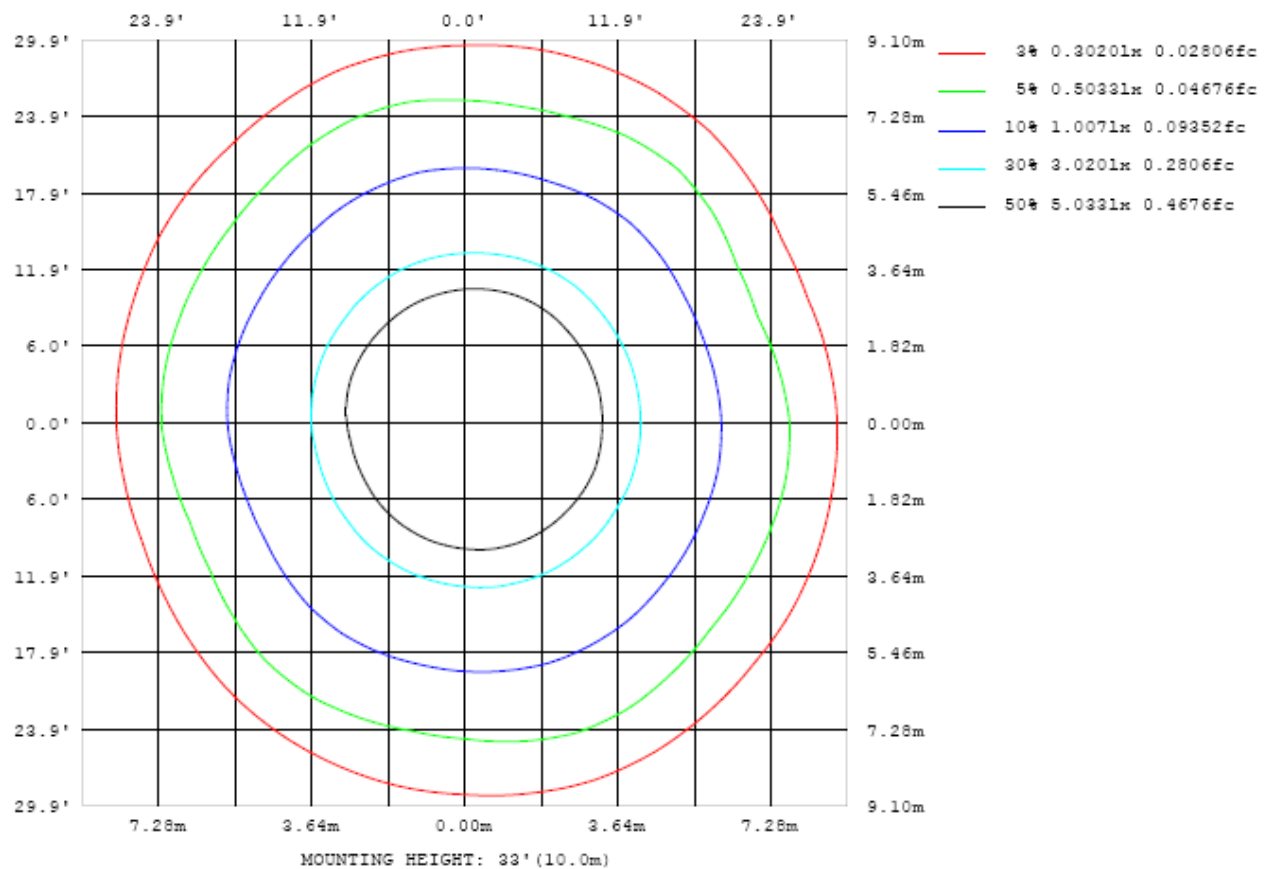


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

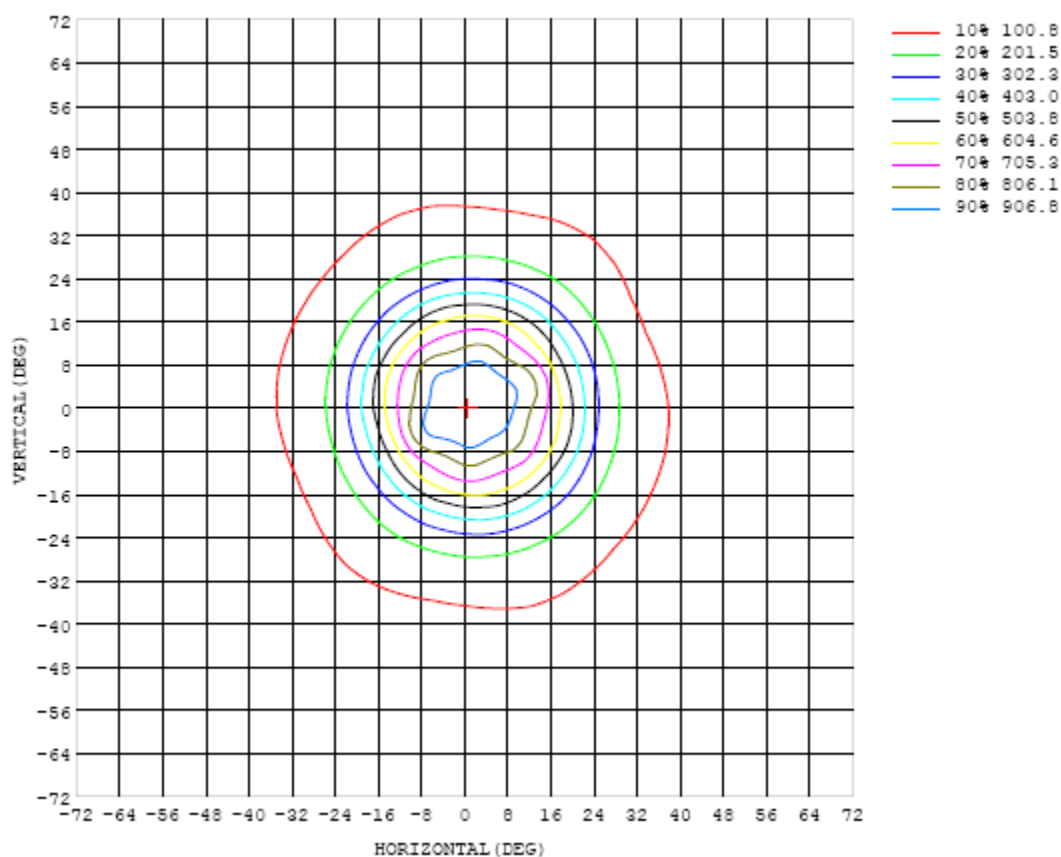


Chart 6: Isocandela Plot

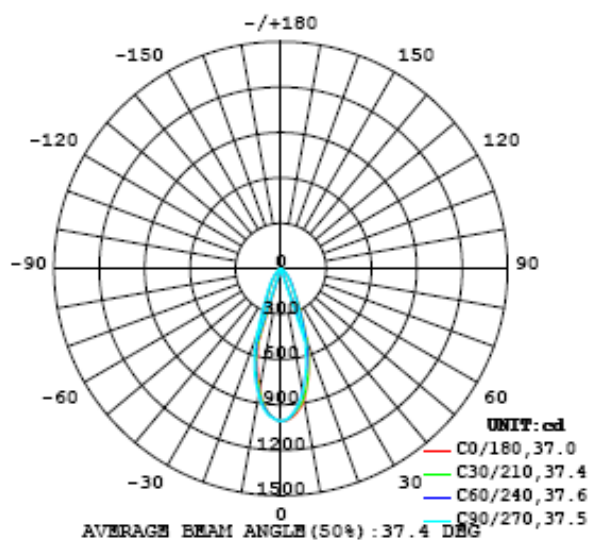


Chart 7: Polar Candela Distribution

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	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007
5	978	975	970	964	960	957	957	958	956	954	946	946	949	955	961	963	961	957	955
10	882	870	868	866	855	833	823	823	831	825	803	790	792	813	840	852	847	822	805
15	713	698	698	703	698	678	665	658	656	645	634	621	613	599	590	581	578	582	597
20	505	510	509	494	482	478	472	459	442	427	410	401	387	376	362	357	354	355	367
25	296	296	297	295	294	286	277	270	263	253	245	239	232	224	216	211	210	211	216
30	181	181	180	180	180	180	177	175	170	165	160	158	157	151	143	135	134	139	146
35	124	126	122	120	118	123	126	126	120	112	109	110	111	107	99.0	91.4	89.5	94.1	101
40	83.9	84.7	83.9	83.6	82.9	85.2	88.8	89.1	84.5	79.4	77.0	75.4	73.9	70.9	66.4	63.1	61.2	61.7	63.8
45	49.3	51.3	54.8	58.1	58.5	57.0	55.8	55.4	55.6	56.5	54.8	50.8	46.2	42.6	41.3	40.7	39.7	38.7	38.5
50	30.4	31.6	34.5	37.8	39.2	37.5	34.9	34.0	35.9	38.1	37.5	34.0	30.3	28.1	27.4	27.4	27.0	26.2	26.0
55	21.5	22.0	23.6	25.5	26.7	25.7	24.0	23.3	24.3	26.0	25.8	23.7	21.5	20.1	19.8	19.7	19.5	19.1	19.0
60	16.7	16.9	17.8	19.1	19.9	19.2	18.0	17.5	18.0	18.9	18.8	17.3	15.7	14.9	14.7	14.7	14.6	14.3	14.0
65	12.8	12.9	13.5	14.4	14.9	14.3	13.5	12.9	13.2	13.8	13.7	12.7	11.5	11.0	10.9	10.9	10.8	10.7	10.5
70	9.49	9.49	9.82	10.3	10.6	10.2	9.57	9.21	9.26	9.52	9.45	8.79	8.11	7.80	7.77	7.80	7.74	7.61	7.55
75	6.44	6.39	6.49	6.62	6.65	6.45	6.17	5.95	5.86	5.82	5.67	5.38	5.13	4.99	4.94	4.92	4.89	4.87	4.95
80	3.82	3.78	3.76	3.73	3.65	3.55	3.47	3.37	3.26	3.14	3.03	2.91	2.83	2.75	2.71	2.70	2.69	2.69	2.77
85	1.88	1.85	1.82	1.79	1.75	1.68	1.61	1.53	1.45	1.36	1.28	1.21	1.16	1.11	1.08	1.06	1.07	1.06	1.11
90	0.45	0.42	0.38	0.35	0.30	0.26	0.22	0.19	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.09	0.10	0.10	0.11
95	0.01	0.01	0.01	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	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
110	0.00	0.00	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
115	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
120	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	0.03
125	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.05
130	0.04	0.04	0.05	0.05	0.05	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	0.09
135	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.16
140	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.26
145	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.36
150	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.46
155	0.29	0.29	0.29	0.30	0.30	0.30	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.54
160	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.60
165	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.44	0.44	0.62
170	0.44	0.44	0.44	0.44	0.44	0.43	0.44	0.44	0.44	0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45	0.60
175	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.52
180	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49

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	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007	1007		
5	951	953	956	959	961	962	962	964	971	977	980	978	979	978	978	980	980		
10	796	802	821	847	855	843	830	831	848	871	883	875	873	883	901	910	904		
15	611	620	634	642	653	654	661	672	683	700	714	711	707	721	749	763	744		
20	372	382	390	398	412	429	446	457	464	478	489	499	503	502	494	496	499		
25	220	223	227	232	241	247	253	263	272	276	288	292	296	297	300	301	300		
30	150	149	149	152	156	164	169	174	175	177	178	182	183	181	177	177	178		
35	102	101	101	102	106	114	120	123	121	118	120	127	129	124	113	110	118		
40	65.6	67.4	70.1	72.0	73.8	78.5	83.8	85.3	83.6	84.6	86.1	89.4	90.3	84.3	76.2	75.0	79.2		
45	40.1	43.5	47.2	49.5	49.3	49.8	51.5	54.2	57.9	61.0	60.4	58.2	54.4	51.2	49.9	50.0	49.9		
50	26.8	29.0	31.6	33.2	32.8	32.0	32.2	34.7	38.9	41.4	39.9	36.2	32.8	31.9	32.0	32.1	31.3		
55	19.3	20.7	22.4	23.4	23.0	22.2	22.2	23.8	26.4	27.8	26.7	24.4	22.7	22.4	22.5	22.5	22.0		
60	14.3	15.2	16.6	17.3	17.1	16.5	16.5	17.5	19.1	20.1	19.2	17.8	17.1	17.1	17.3	17.3	17.1		
65	10.7	11.3	12.2	12.7	12.5	12.1	12.2	12.9	13.9	14.6	14.0	13.1	12.8	12.9	13.1	13.2	13.0		
70	7.68	8.03	8.54	8.91	8.85	8.70	8.75	9.23	9.90	10.3	9.99	9.54	9.39	9.55	9.75	9.78	9.65		
75	5.03	5.18	5.40	5.59	5.69	5.73	5.83	6.08	6.42	6.65	6.57	6.44	6.44	6.57	6.70	6.72	6.63		
80	2.82	2.89	2.99	3.07	3.17	3.26	3.36	3.47	3.57	3.66	3.73	3.79	3.86	3.91	3.95	3.95	3.92		
85	1.15	1.21	1.28	1.33	1.39	1.46	1.54	1.62	1.69	1.76	1.82	1.87	1.92	1.95	1.97	1.97	1.95		
90	0.12	0.13	0.14	0.16	0.17	0.19	0.21	0.24	0.28	0.32	0.37	0.42	0.47	0.51	0.53	0.53	0.52		
95	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
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	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01		
110	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		
115	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01		
120	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02		
125	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
130	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07		
135	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13		
140	0.26	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.21		
145	0.36	0.36	0.36	0.36	0.35	0.35	0.34	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.31	0.31	0.31		
150	0.46	0.46	0.46	0.46	0.45	0.45	0.44	0.44	0.43	0.43	0.42	0.42	0.41	0.41	0.41	0.41	0.41		
155	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50	0.50	0.50		
160	0.60	0.60	0.60	0.60	0.59	0.59	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.57	0.57	0.57	0.57		
165	0.63	0.63	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62		
170	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.62	0.62	0.62	0.62	0.62	0.63	0.63		
175	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.56	0.57		
180	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49		

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 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.

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° 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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