

## **LM-79-08 Test Report**

for

### **GREEN CREATIVE LTD**

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

### **Horizontally-Mounted Lamps**

**Model: 14.5PLH/840/DIR**

### **Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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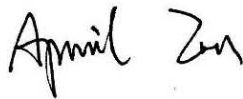
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[www.ledtestlab.com](http://www.ledtestlab.com)

Report No.: HZ18050045d

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

Review by:



Engineer: April Zou  
Jun. 05, 2018

Approved by:



Manager: Jim Zhang  
Jun. 05, 2018

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: 14.5PLH/840/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
115.9	1986.0	17.14	0.9956
CCT (K)	CRI	Stabilization Time (Light & Power)	
3973	83.7	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** : May 25, 2018

**Date of Test** : May 30, 2018

**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

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## Sample Photos

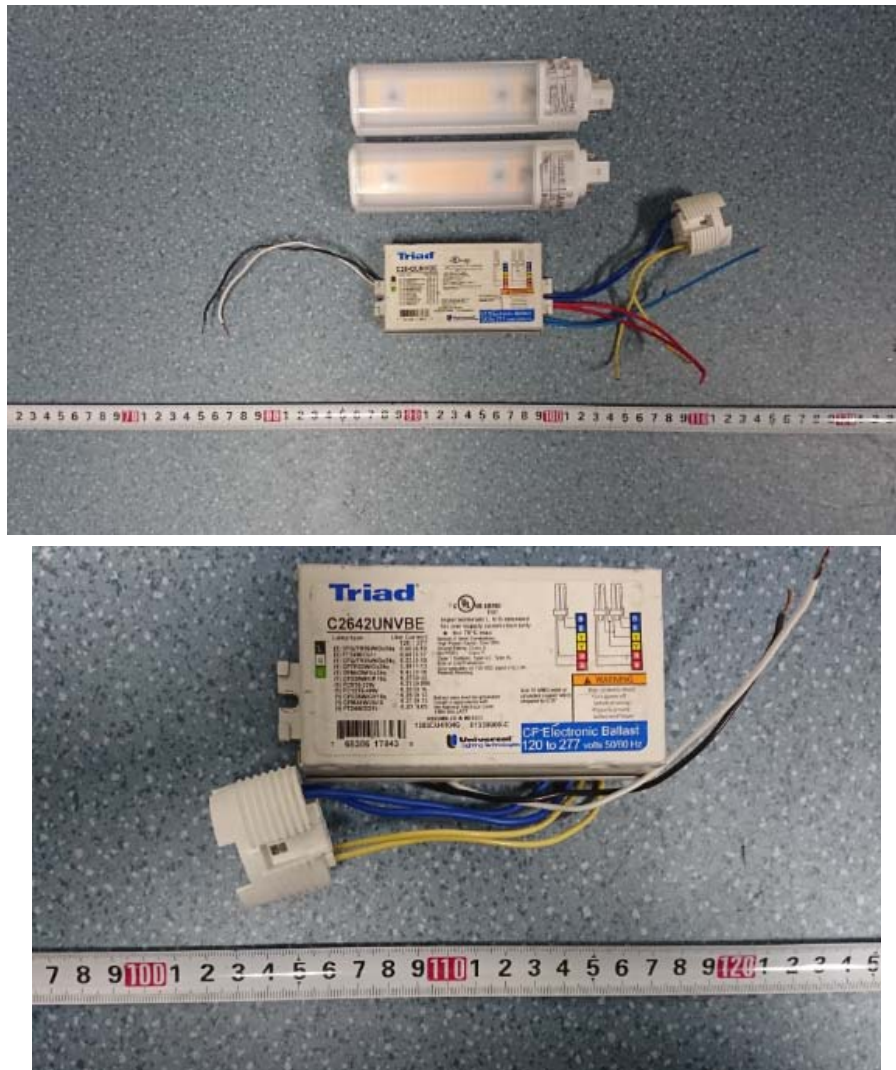


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: Horizontally-Mounted Lamps
<b>Model</b>	: 14.5PLH/840/DIR
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 14.5W
<b>Product Description</b>	: 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast:
	C2642UNVBE
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

## TEST RESULTS

Test ambient temperature was 25.0°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 70 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.287	0.124
Power Factor	0.9956	0.9873
Test Power (W)/2	17.14	16.99
THD A%	6.59	7.57
Luminous Efficacy (lm/W)	115.9	116.9
Total Luminous Flux (lm)	1986.0	1986.0
Color Rendering Index (CRI)	83.7	
R9	9.9	
Correlated Color Temperature (CCT)(K)	3973	
Chromaticity Chroma x	0.3825	
Chromaticity Chroma y	0.3811	
Chromaticity Chroma u	0.2248	
Chromaticity Chroma v	0.3359	
Duv	0.0014	
Chromaticity Chroma u'	0.2248	
Chromaticity Chroma v'	0.5038	

Special Color Rendering Indices	
R1	82.1
R2	91.8
R3	96
R4	80.4
R5	82
R6	88.3
R7	85
R8	63.7
R9	9.9
R10	80.1
R11	79.3
R12	64.1
R13	84.9
R14	98.3
Rf	82
Rg	93

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 24.8°C.

The photometric distance is 2.47m.

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)	0.284
Power Factor	0.9956
Test Power (W)/2	16.96
Luminous Efficacy (lm/W)	118.2
Total Luminous Flux (lm)	2004.7
Beam Angle (°)	106.8
Center Beam Candle Power (cd)	696
Spacing Criteria	1.24 (0°-180°)/ 1.26 (90°-270°)
Zonal Lumens in the 0°-60°Zone	75.83%
Zonal Lumens in the 60°-90°Zone	21.09%
Zonal Lumens in the 90°-120°Zone	2.66%
Zonal Lumens in the 120°-180°Zone	0.43%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

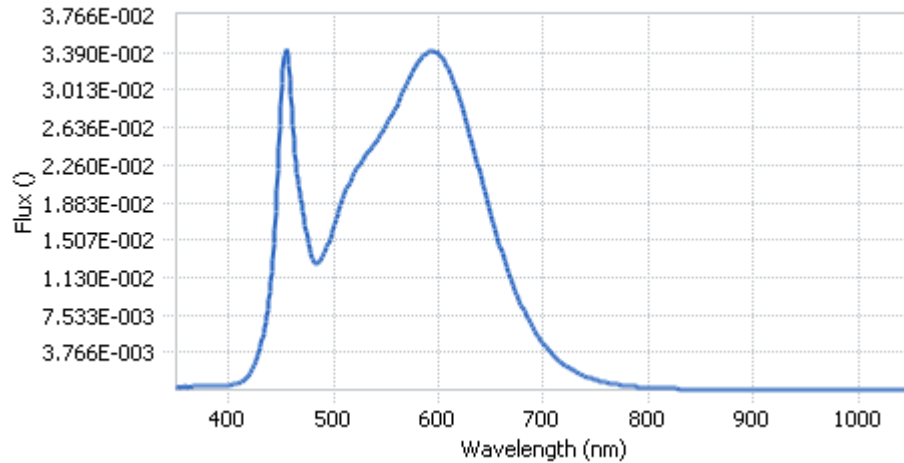


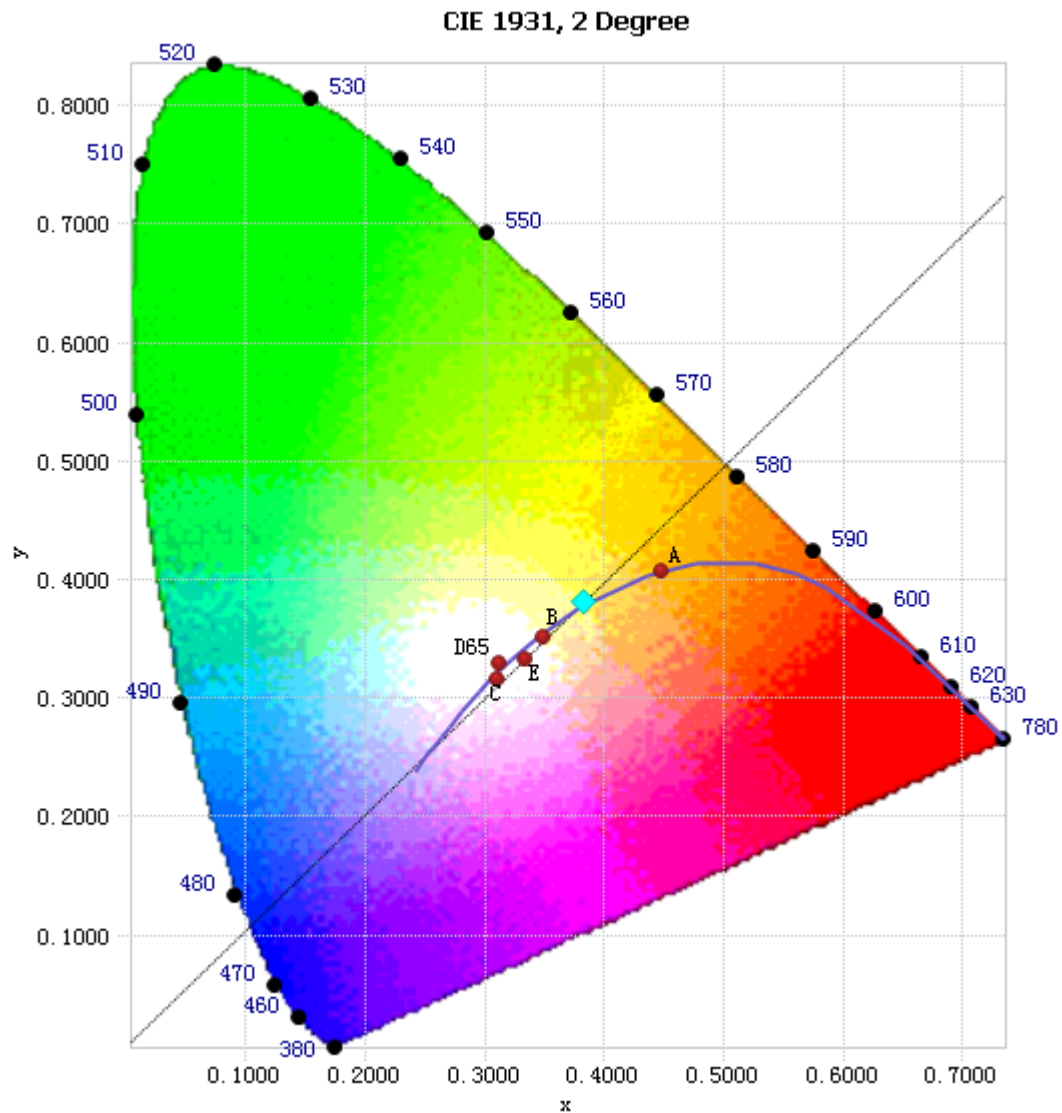
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.49E-04	485	1.28E-02	590	3.39E-02	695	5.38E-03
385	3.53E-04	490	1.35E-02	595	3.41E-02	700	4.63E-03
390	3.91E-04	495	1.47E-02	600	3.37E-02	705	3.99E-03
395	4.13E-04	500	1.65E-02	605	3.32E-02	710	3.42E-03
400	4.55E-04	505	1.81E-02	610	3.22E-02	715	2.93E-03
405	5.30E-04	510	1.96E-02	615	3.08E-02	720	2.52E-03
410	7.11E-04	515	2.08E-02	620	2.92E-02	725	2.18E-03
415	1.05E-03	520	2.19E-02	625	2.75E-02	730	1.87E-03
420	1.64E-03	525	2.27E-02	630	2.55E-02	735	1.60E-03
425	2.62E-03	530	2.35E-02	635	2.35E-02	740	1.36E-03
430	4.29E-03	535	2.41E-02	640	2.15E-02	745	1.17E-03
435	6.83E-03	540	2.49E-02	645	1.95E-02	750	1.00E-03
440	1.09E-02	545	2.57E-02	650	1.76E-02	755	8.66E-04
445	1.80E-02	550	2.66E-02	655	1.57E-02	760	7.48E-04
450	2.87E-02	555	2.75E-02	660	1.39E-02	765	6.46E-04
455	3.43E-02	560	2.85E-02	665	1.23E-02	770	5.52E-04
460	2.81E-02	565	2.98E-02	670	1.08E-02	775	4.80E-04
465	2.18E-02	570	3.09E-02	675	9.47E-03	780	4.09E-04
470	1.87E-02	575	3.19E-02	680	8.25E-03		
475	1.52E-02	580	3.28E-02	685	7.17E-03		
480	1.30E-02	585	3.36E-02	690	6.22E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3825, 0.3811)

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

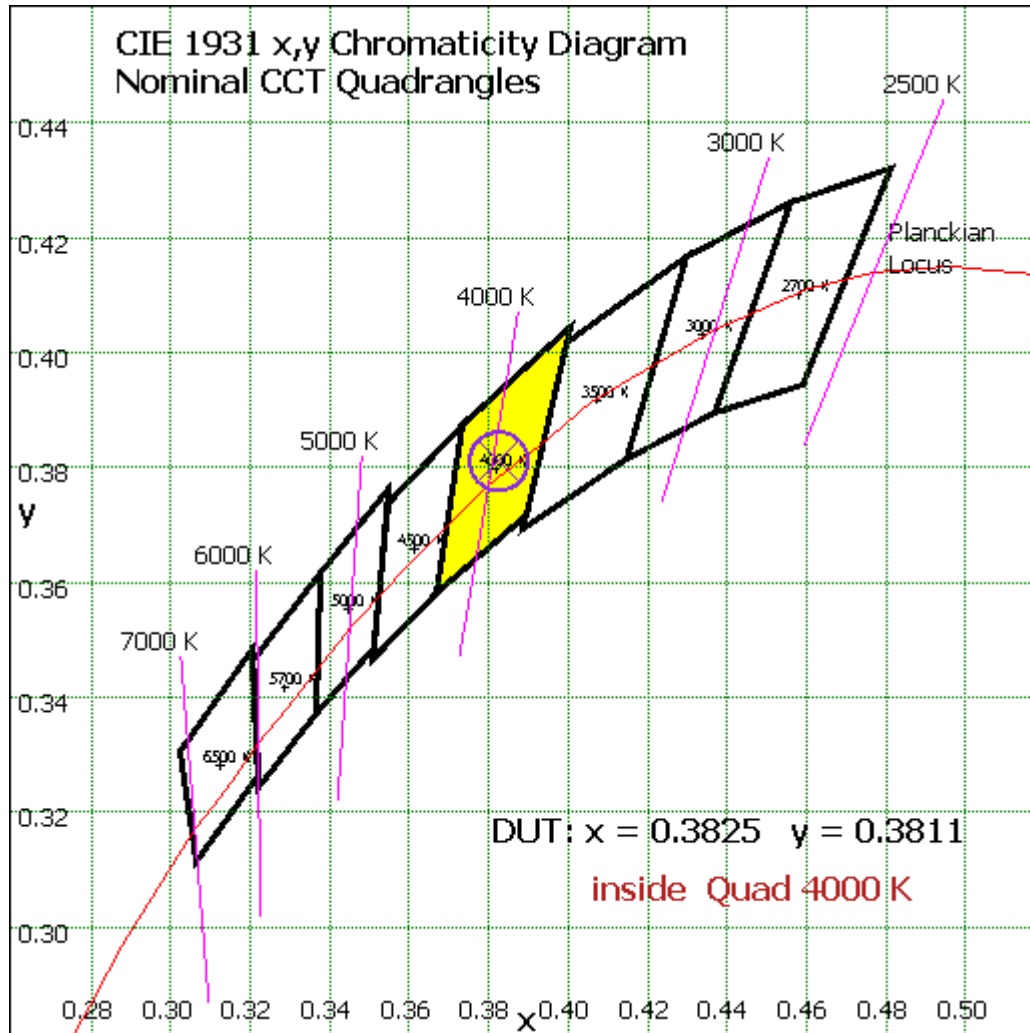


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	66.084	3.30%
10- 20	190.101	9.48%
20- 30	286.684	14.30%
30- 40	339.779	16.95%
40- 50	341.137	17.02%
50- 60	296.388	14.78%
60- 70	222.836	11.12%
70- 80	137.216	6.84%
80- 90	62.651	3.13%
90-100	28.278	1.41%
100-110	15.914	0.79%
110-120	9.132	0.46%
120-130	4.785	0.24%
130-140	2.205	0.11%
140-150	0.863	0.04%
150-160	0.369	0.02%
160-170	0.228	0.01%
170-180	0.079	0.00%
Total	2004.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1520.173	75.83%
60- 90	422.703	21.09%
0-90	1942.876	96.91%
90- 180	61.853	3.09%
0- 180	2004.7	100%

Table 5: Zonal Lumen Data

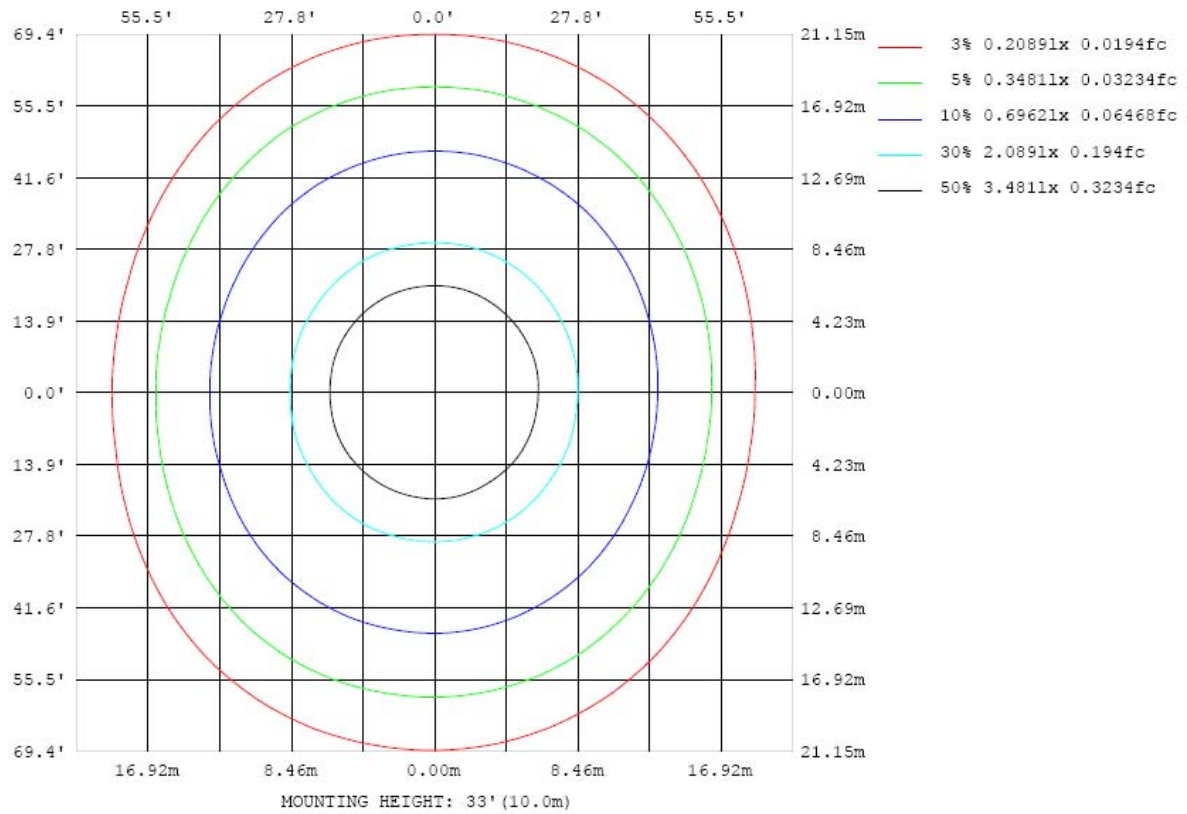


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

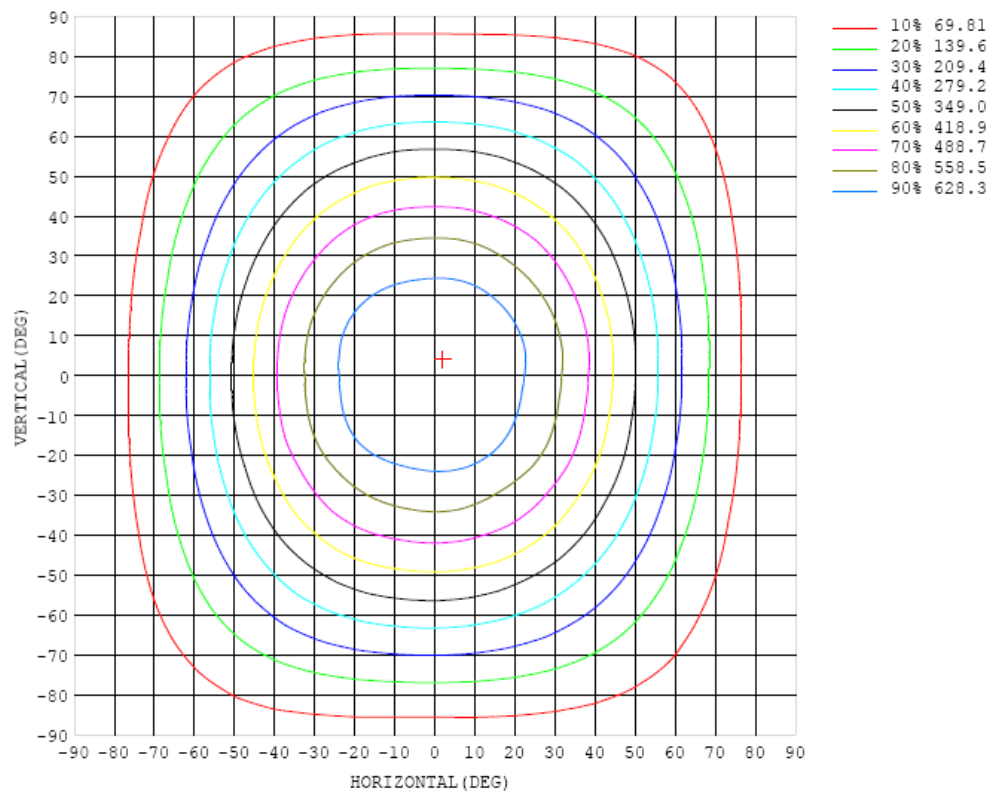


Chart 5: Isocandela Plot

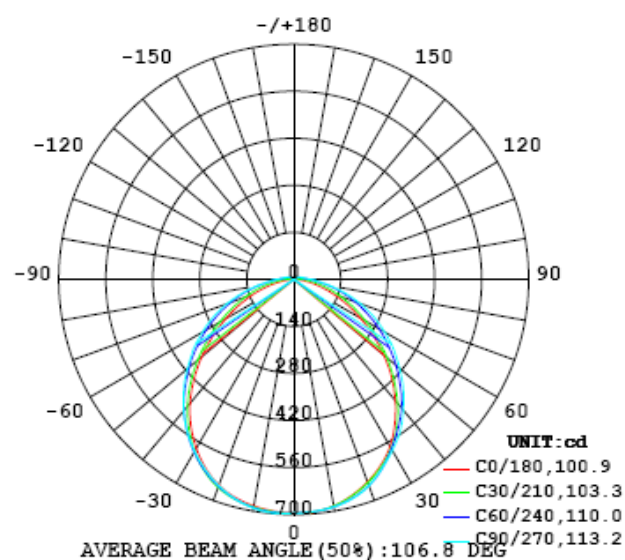


Chart 6: Polar Candela Distribution

## 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	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696
5	695	694	694	694	694	694	694	694	694	693	693	693	692	692	692	692	692	692	692
10	685	684	684	685	686	687	688	688	688	688	687	686	686	685	685	684	684	684	685
15	666	665	666	668	670	673	674	676	676	675	675	674	674	673	673	673	672	672	672
20	641	640	642	644	647	651	653	655	655	654	653	653	654	655	656	655	653	651	652
25	612	610	612	616	618	621	622	623	622	621	620	621	624	628	629	628	625	621	621
30	574	572	576	580	583	582	582	585	588	588	587	587	588	590	592	591	587	582	581
35	525	524	529	535	538	539	542	547	551	552	551	551	551	549	545	544	542	536	534
40	470	469	475	481	485	493	499	504	507	508	507	508	509	505	497	491	489	483	481
45	413	412	418	422	430	442	449	454	460	462	461	461	458	454	447	436	430	424	421
50	350	349	356	363	375	386	398	405	409	411	411	411	408	401	391	379	367	362	358
55	288	288	294	304	317	333	344	354	361	363	363	362	356	347	335	320	306	299	295
60	228	229	235	248	263	279	293	304	309	312	312	311	306	296	280	264	249	238	234
65	174	174	182	196	212	229	242	253	260	263	262	261	255	244	229	212	195	182	178
70	124	125	134	149	166	181	194	203	209	211	211	210	205	195	181	165	147	133	127
75	80.7	81.9	92.2	107	123	137	148	155	158	159	159	159	156	148	137	122	105	89.1	81.6
80	44.9	46.3	57.7	73.1	86.0	97.1	104	109	111	111	111	111	110	105	96.1	83.4	67.9	53.6	43.8
85	19.0	20.4	31.4	44.5	56.1	64.6	69.7	72.7	73.6	72.7	73.0	74.1	72.8	70.6	63.9	51.4	35.5	24.0	17.7
90	4.63	6.14	15.2	26.5	36.2	43.4	47.9	50.2	50.7	50.3	50.7	51.3	50.8	48.2	42.9	33.0	21.8	10.6	1.85
95	0.71	1.56	7.60	16.3	24.7	31.2	35.4	37.5	38.1	38.0	38.2	38.7	38.1	35.6	30.7	22.3	13.4	5.33	0.33
100	0.30	0.68	4.16	10.7	17.6	23.4	27.3	29.4	30.2	30.1	30.4	30.6	29.8	27.4	22.9	16.0	8.67	2.69	0.21
105	0.21	0.46	2.44	6.94	12.9	18.0	21.6	23.8	24.7	24.8	25.0	25.0	24.0	21.5	17.5	11.9	4.21	1.39	0.17
110	0.22	0.34	1.64	4.86	9.14	13.6	17.2	19.3	20.4	20.6	20.7	20.5	19.4	16.9	13.1	6.96	3.26	0.71	0.21
115	0.25	0.31	1.17	3.36	6.67	10.1	13.2	15.4	16.6	17.0	17.1	16.7	15.4	12.9	7.89	5.64	1.96	0.63	0.23
120	0.29	0.31	0.89	2.29	4.77	7.50	9.95	11.8	13.0	13.5	13.5	13.0	11.6	8.53	6.50	3.60	1.62	0.42	0.28
125	0.32	0.34	0.71	1.59	3.34	5.51	7.54	9.07	10.0	10.4	10.4	9.64	8.39	6.65	4.75	2.26	1.05	0.38	0.35
130	0.38	0.39	0.58	1.19	2.31	3.81	5.45	6.79	7.66	7.97	7.69	7.23	6.24	4.71	2.77	1.31	0.66	0.44	0.43
135	0.45	0.46	0.51	0.81	1.66	2.76	3.84	4.48	5.27	5.61	5.55	5.06	3.69	2.88	2.04	0.96	0.59	0.47	0.53
140	0.51	0.52	0.55	0.66	0.97	1.70	2.64	3.33	3.70	3.70	3.55	3.32	2.91	2.03	1.32	0.77	0.61	0.52	0.62
145	0.55	0.57	0.58	0.63	0.72	1.02	1.53	1.94	2.44	2.54	2.49	2.07	1.27	1.01	0.68	0.67	0.59	0.53	0.71
150	0.61	0.59	0.60	0.62	0.66	0.71	0.89	1.11	1.29	1.31	1.20	1.06	0.86	0.77	0.64	0.59	0.60	0.57	0.76
155	0.71	0.68	0.65	0.64	0.65	0.67	0.69	0.72	0.75	0.77	0.77	0.72	0.70	0.70	0.63	0.64	0.61	0.60	0.80
160	0.81	0.81	0.77	0.72	0.69	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.66	0.65	0.64	0.63	0.81
165	0.90	0.93	0.92	0.88	0.83	0.79	0.76	0.73	0.70	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68	0.67	0.82
170	0.95	0.98	1.00	1.00	0.97	0.93	0.88	0.83	0.79	0.76	0.73	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.81
175	0.77	0.78	0.98	1.00	0.99	0.97	0.95	0.92	0.89	0.87	0.84	0.83	0.81	0.80	0.79	0.79	0.78	0.78	0.79
180	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77

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	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696		
5	693	693	694	695	695	696	697	697	697	698	698	698	698	697	697	696	696		
10	686	687	688	689	690	690	690	691	691	692	692	693	692	692	690	689	687		
15	674	676	678	678	677	676	676	676	676	677	678	678	678	677	675	672	669		
20	654	657	659	659	658	656	654	653	653	654	655	655	654	652	651	649	646		
25	624	628	630	630	630	628	626	624	624	625	626	624	622	621	620	619	617		
30	584	589	591	593	594	594	592	591	591	592	591	589	586	584	583	582	580		
35	538	542	545	547	551	554	555	554	554	555	553	549	545	542	539	536	532		
40	484	489	492	497	503	509	512	511	510	510	509	505	501	494	487	481	477		
45	424	429	434	443	453	458	463	464	463	464	460	456	450	442	431	423	419		
50	361	366	373	386	397	407	414	415	414	414	411	407	397	386	375	364	357		
55	297	303	313	327	343	354	361	366	366	366	361	354	344	331	317	303	294		
60	236	242	255	271	287	303	310	314	315	314	310	304	292	277	261	247	235		
65	180	187	202	218	236	250	259	264	264	263	260	253	241	227	209	194	181		
70	128	138	154	171	187	200	208	212	212	211	209	203	193	179	163	147	133		
75	83.1	94.6	111	127	141	152	158	160	160	159	158	154	146	135	121	105	90.6		
80	45.8	58.0	73.8	88.3	99.3	107	111	112	111	111	111	108	103	95.0	83.5	69.2	55.0		
85	19.5	31.0	44.7	56.7	65.6	71.2	73.7	74.0	73.1	73.1	73.2	72.0	68.5	62.4	53.3	41.3	28.5		
90	4.37	14.9	26.7	36.9	44.4	49.1	51.1	51.3	50.5	50.4	50.6	49.6	46.8	41.7	33.8	23.6	12.3		
95	1.35	7.47	16.7	25.3	32.1	36.4	38.4	38.7	38.2	38.0	38.1	37.1	34.4	29.6	22.5	13.7	5.47		
100	0.61	4.26	10.9	18.2	24.2	28.2	30.2	30.7	30.4	30.2	30.1	29.0	26.4	22.0	15.9	8.76	2.93		
105	0.49	2.57	7.36	13.2	18.5	22.3	24.3	25.0	24.9	24.8	24.5	23.3	20.7	16.7	11.3	5.75	1.72		
110	0.32	1.60	5.05	9.64	14.1	17.6	19.7	20.6	20.6	20.5	20.1	18.8	16.3	12.6	8.11	3.87	1.15		
115	0.28	0.82	3.46	7.01	10.7	13.7	15.8	16.8	17.0	16.9	16.4	15.0	12.6	9.41	5.83	2.61	0.82		
120	0.30	0.76	2.33	5.03	7.95	10.5	12.3	13.3	13.6	13.5	12.9	11.6	9.60	6.97	4.14	1.74	0.64		
125	0.36	0.52	1.37	3.53	5.81	7.87	9.42	10.3	10.6	10.6	10.0	8.90	7.19	5.07	2.90	1.24	0.55		
130	0.43	0.54	0.91	2.40	4.14	5.78	7.06	7.85	8.13	8.07	7.61	6.65	5.26	3.60	1.94	0.90	0.47		
135	0.53	0.58	0.72	1.22	2.85	4.11	5.13	5.78	6.03	5.98	5.61	4.83	3.74	2.47	1.22	0.65	0.55		
140	0.63	0.62	0.75	0.97	1.59	2.78	3.55	4.06	4.27	4.25	3.95	3.35	2.49	1.34	0.81	0.69	0.64		
145	0.71	0.73	0.78	0.82	1.11	1.48	2.03	2.66	2.83	2.82	2.57	1.86	1.34	0.94	0.81	0.73	0.72		
150	0.77	0.78	0.81	0.81	0.89	1.07	1.22	1.33	1.39	1.37	1.28	1.10	0.93	0.82	0.80	0.84	0.84		
155	0.80	0.80	0.80	0.82	0.84	0.88	0.86	0.88	0.87	0.87	0.85	0.86	0.83	0.83	0.91	0.92	0.92		
160	0.81	0.81	0.81	0.82	0.82	0.84	0.84	0.84	0.81	0.80	0.81	0.86	0.82	0.91	0.94	0.96	0.98		
165	0.82	0.82	0.82	0.83	0.83	0.83	0.83	0.84	0.81	0.80	0.81	0.81	0.92	0.93	0.96	0.98	1.01		
170	0.82	0.82	0.82	0.82	0.82	0.82	0.80	0.80	0.82	0.79	0.80	0.80	0.81	0.94	0.96	0.98	1.01		
175	0.80	0.79	0.79	0.79	0.79	0.79	0.78	0.78	0.78	0.77	0.77	0.78	0.78	0.78	0.79	0.79	0.79		
180	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	PF2010A	HZTE028-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	DPS1060	HZTE001-06	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	WY12010	HZTE004-03	Aug. 10, 2017	Aug. 09, 2018
Temperature recorder	JM624U	HZTE018-08	Aug. 17, 2017	Aug. 16, 2018
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 16, 2017	Aug. 15, 2018
Standard source	D908	HZTE012-01	Aug. 20, 2017	Aug. 19, 2018
Integrate Sphere system	2M	HZTE015-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	WT210	HZTE008-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	PCR 500L	HZTE001-07	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	IT6154	HZTE004-04	Aug. 10, 2017	Aug. 09, 2018
Standard source	SCL-1400	HZTE012-02	Aug. 20, 2017	Aug. 19, 2018
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 16, 2017	Aug. 15, 2018
Temperature Meter	TES1310	HZTE017-01	Aug. 17, 2017	Aug. 16, 2018

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**

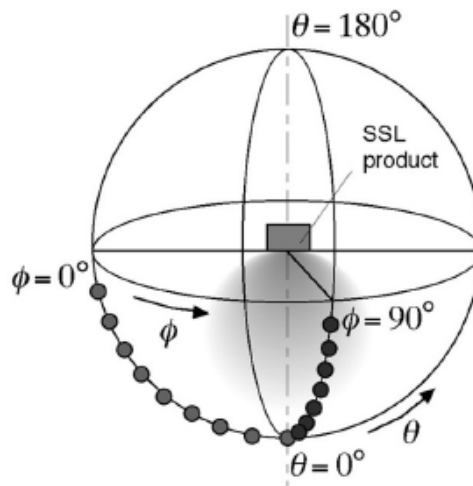
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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