

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

for

### **GREEN CREATIVE LTD**

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

### **Vertically-Mounted Lamps**

**Model: 16.5PLV/830/BYP**

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

**NVLAP CODE: 200960-0**

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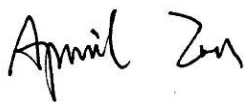
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Report No.: HZ18050048d

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

Review by:



Engineer: April Zou  
Jun. 04, 2018

Approved by:



Manager: Jim Zhang  
Jun. 04, 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: 16.5PLV/830/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
118.9	1878.0	15.80	0.9655
CCT (K)	CRI	Stabilization Time (Light & Power)	
3049	83.3	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>	: Vertically-Mounted Lamps
<b>Model</b>	: 16.5PLV/830/BYP
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 16.5W
<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 24.9°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)	0.136	0.060
Power Factor	0.9655	0.9606
Test Power (W)	15.80	16.02
THD A%	26.01	18.65
Luminous Efficacy (lm/W)	118.9	117.9
Total Luminous Flux (lm)	1878.0	1888.0
Color Rendering Index (CRI)	83.3	
R9	9.7	
Correlated Color Temperature (CCT)(K)	3049	
Chromaticity Chroma x	0.4299	
Chromaticity Chroma y	0.3956	
Chromaticity Chroma u	0.2497	
Chromaticity Chroma v	0.3446	
Duv	0.0025	
Chromaticity Chroma u'	0.2497	
Chromaticity Chroma v'	0.5169	

Special Color Rendering Indices	
R1	82.6
R2	93.3
R3	94.2
R4	80.6
R5	83.1
R6	91.8
R7	81.4
R8	59.1
R9	9.7
R10	84.6
R11	80.2
R12	75.1
R13	85.5
R14	97.6
Rf	83
Rg	96

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 24.7°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)	0.137
Power Factor	0.9645
Test Power (W)	15.90
Luminous Efficacy (lm/W)	120.1
Total Luminous Flux (lm)	1910.2
Beam Angle (°)	97.4
Center Beam Candle Power (cd)	791
Spacing Criteria	1.17 (0°-180°)/ 1.20 (90°-270°)
Zonal Lumens in the 0°-60°Zone	83.18%
Zonal Lumens in the 60°-90°Zone	16.55%
Zonal Lumens in the 90°-120°Zone	0.18%
Zonal Lumens in the 120°-180°Zone	0.09%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

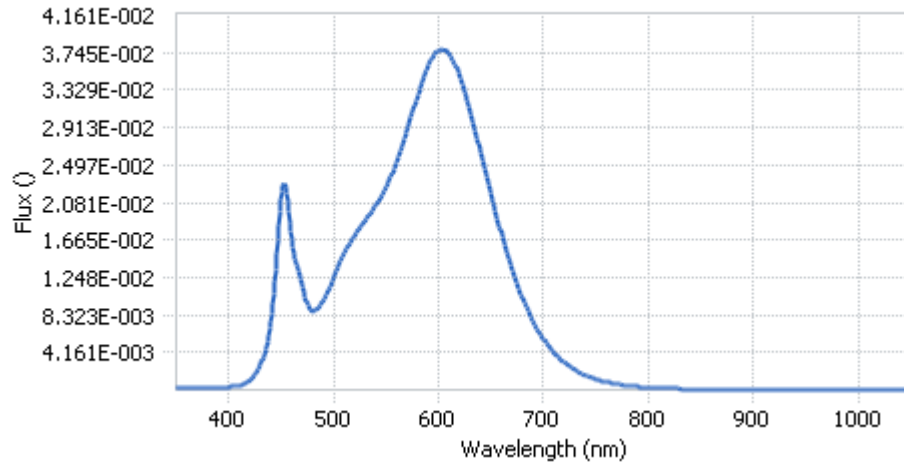
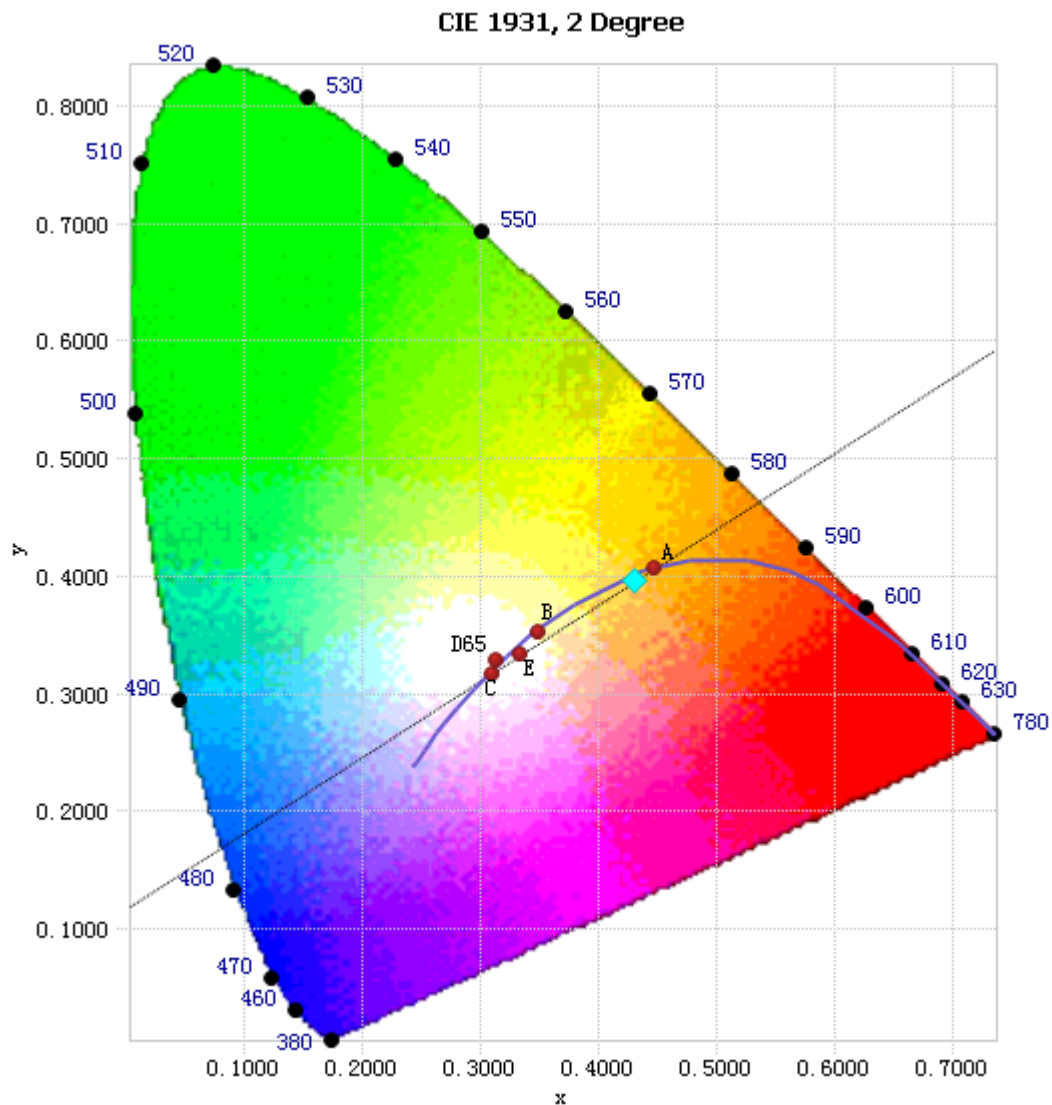


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.95E-04	485	9.11E-03	590	3.60E-02	695	6.54E-03
385	2.71E-04	490	9.88E-03	595	3.70E-02	700	5.64E-03
390	2.96E-04	495	1.11E-02	600	3.76E-02	705	4.82E-03
395	3.07E-04	500	1.25E-02	605	3.77E-02	710	4.12E-03
400	3.40E-04	505	1.40E-02	610	3.74E-02	715	3.55E-03
405	3.84E-04	510	1.51E-02	615	3.63E-02	720	3.03E-03
410	4.90E-04	515	1.63E-02	620	3.48E-02	725	2.59E-03
415	7.02E-04	520	1.72E-02	625	3.30E-02	730	2.22E-03
420	1.06E-03	525	1.80E-02	630	3.09E-02	735	1.89E-03
425	1.68E-03	530	1.87E-02	635	2.87E-02	740	1.61E-03
430	2.76E-03	535	1.96E-02	640	2.64E-02	745	1.38E-03
435	4.49E-03	540	2.05E-02	645	2.40E-02	750	1.18E-03
440	7.58E-03	545	2.15E-02	650	2.17E-02	755	1.01E-03
445	1.34E-02	550	2.25E-02	655	1.95E-02	760	8.65E-04
450	2.11E-02	555	2.38E-02	660	1.73E-02	765	7.47E-04
455	2.18E-02	560	2.53E-02	665	1.53E-02	770	6.43E-04
460	1.66E-02	565	2.70E-02	670	1.34E-02	775	5.49E-04
465	1.39E-02	570	2.88E-02	675	1.17E-02	780	4.74E-04
470	1.18E-02	575	3.08E-02	680	1.02E-02		
475	9.51E-03	580	3.27E-02	685	8.83E-03		
480	8.77E-03	585	3.45E-02	690	7.60E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4299, 0.3956)

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

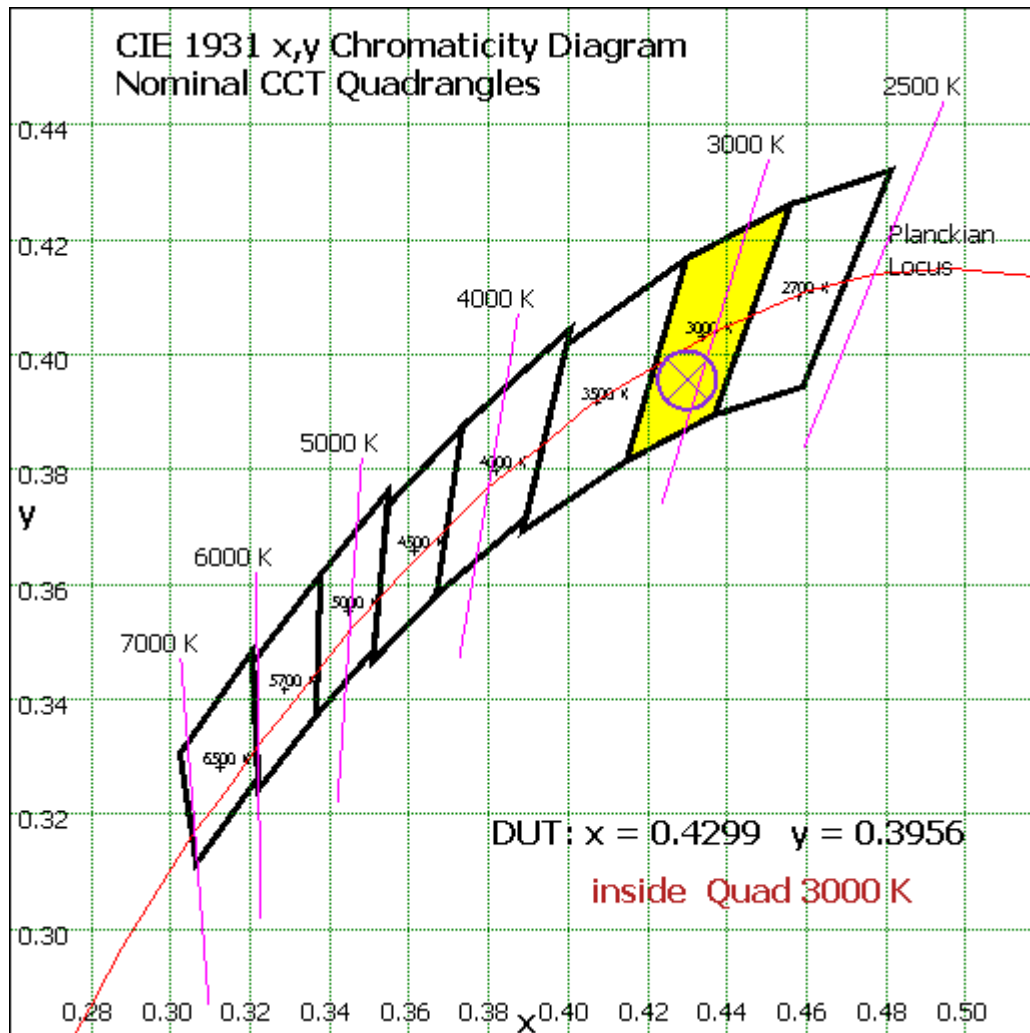


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	74.737	3.91%
10- 20	213.159	11.16%
20- 30	317.136	16.60%
30- 40	363.947	19.05%
40- 50	344.857	18.05%
50- 60	275.071	14.40%
60- 70	185.031	9.69%
70- 80	98.588	5.16%
80- 90	32.511	1.70%
90-100	3.124	0.16%
100-110	0.146	0.01%
110-120	0.194	0.01%
120-130	0.268	0.01%
130-140	0.355	0.02%
140-150	0.393	0.02%
150-160	0.346	0.02%
160-170	0.232	0.01%
170-180	0.08	0.00%
Total	1910.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1588.907	83.18%
60- 90	316.13	16.55%
0-90	1905.037	99.73%
90- 180	5.138	0.27%
0- 180	1910.2	100%

Table 5: Zonal Lumen Data

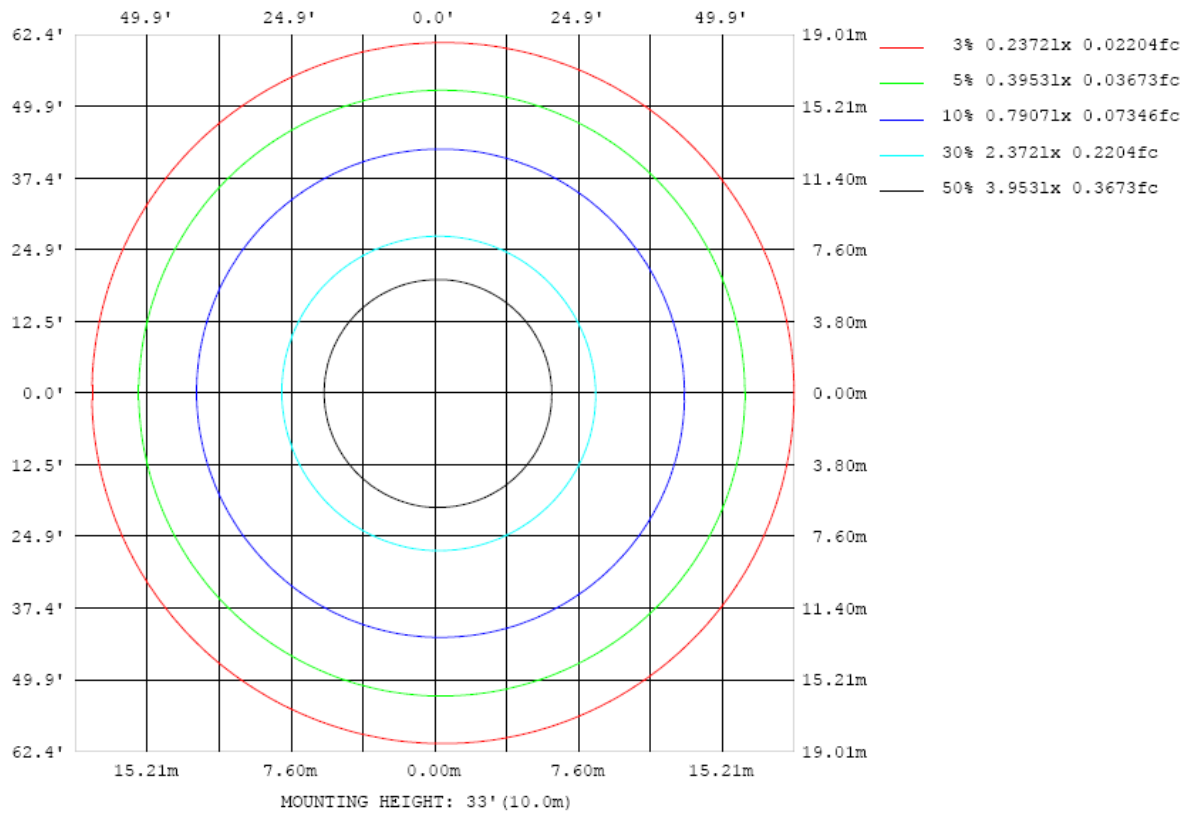


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

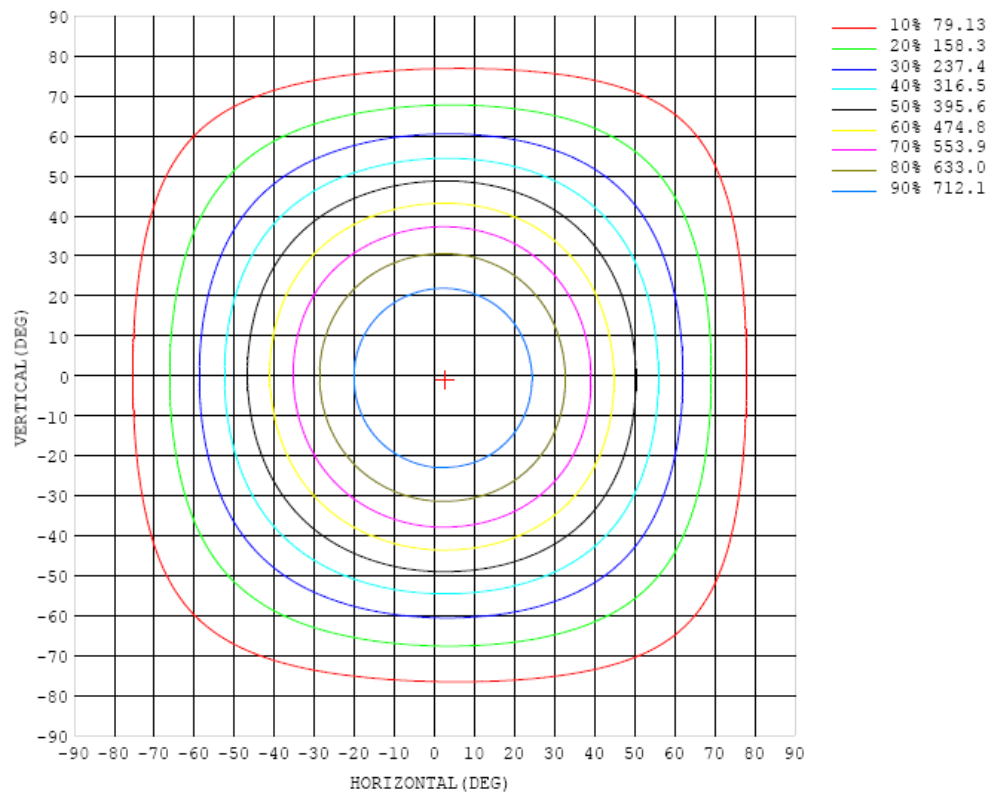


Chart 5: Isocandela Plot

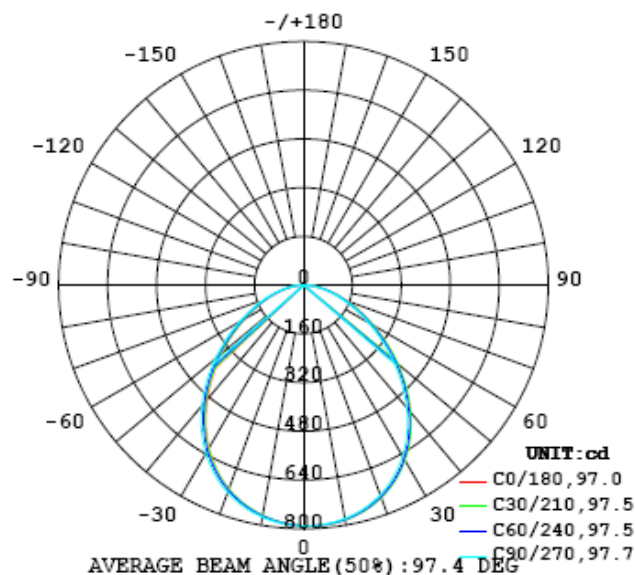


Chart 6: Polar Candela Distribution

## 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	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791
5	790	790	790	790	790	790	789	789	788	788	787	787	786	785	785	784	784	784	783
10	783	783	783	782	782	782	781	780	779	778	776	775	774	773	772	770	770	769	768
15	766	767	767	767	766	765	764	763	761	760	758	755	753	752	750	748	747	746	745
20	742	742	742	742	741	740	739	737	734	732	730	727	724	721	719	717	715	714	713
25	706	707	708	707	707	706	703	701	698	695	692	688	684	681	678	675	673	672	671
30	661	663	663	663	662	660	658	655	651	648	643	638	634	629	625	623	620	619	619
35	606	607	608	608	606	604	601	598	594	590	585	579	573	568	564	560	558	557	558
40	542	544	545	544	542	539	536	533	529	525	519	513	506	500	495	492	490	490	490
45	472	474	476	474	472	469	466	462	458	454	449	442	435	429	425	422	420	419	420
50	400	402	402	401	399	396	392	389	385	381	376	370	364	359	355	352	350	350	350
55	329	330	330	329	327	324	320	317	313	309	306	301	296	292	289	287	285	284	284
60	263	263	263	261	259	257	254	251	247	244	241	237	234	231	228	226	225	224	223
65	203	203	202	201	199	196	194	191	188	186	183	180	178	176	174	172	171	170	170
70	150	149	148	147	146	144	141	139	137	135	132	130	129	127	126	124	123	123	123
75	103	103	102	101	99.7	98.1	96.4	94.7	92.8	90.9	89.1	87.5	86.0	84.8	83.8	83.0	82.3	81.7	82.0
80	64.2	63.7	64.0	62.5	61.7	60.6	59.4	58.1	56.5	55.1	53.8	52.5	51.2	50.3	49.6	48.9	48.4	48.1	48.2
85	33.3	33.0	32.8	32.4	31.8	31.0	30.2	29.3	28.3	27.4	26.5	25.6	24.8	24.1	23.5	23.2	22.9	23.0	23.2
90	12.2	12.1	12.0	11.8	11.5	11.1	10.7	10.3	9.85	9.46	9.07	8.73	8.37	8.10	7.87	7.74	7.69	7.75	7.80
95	2.01	1.94	1.86	1.75	1.64	1.53	1.44	1.38	1.34	1.36	1.38	1.42	1.47	1.53	1.59	1.64	1.67	1.67	1.64
100	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.11	0.18	0.27	0.36	0.44	0.51	0.54	0.54	0.50
105	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.13	0.13	0.14
110	0.13	0.13	0.13	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	0.18
115	0.17	0.17	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	0.20	0.20	0.20	0.22
120	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.27
125	0.27	0.26	0.26	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.33
130	0.33	0.32	0.32	0.33	0.33	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.42
135	0.41	0.39	0.39	0.40	0.40	0.40	0.41	0.41	0.42	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.45	0.53
140	0.49	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.53	0.64
145	0.57	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56	0.56	0.55	0.60	0.74
150	0.65	0.57	0.57	0.57	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60	0.60	0.60	0.61	0.60	0.66	0.82
155	0.72	0.62	0.62	0.63	0.63	0.63	0.64	0.64	0.64	0.65	0.65	0.65	0.65	0.66	0.66	0.66	0.64	0.73	0.87
160	0.80	0.67	0.67	0.68	0.68	0.68	0.68	0.68	0.69	0.69	0.69	0.69	0.69	0.70	0.70	0.70	0.69	0.79	0.90
165	0.86	0.70	0.71	0.72	0.72	0.72	0.73	0.73	0.73	0.73	0.74	0.74	0.74	0.74	0.74	0.74	0.73	0.84	0.91
170	0.89	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.87	0.88
175	0.86	0.86	0.81	0.81	0.82	0.82	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.84	0.85	0.85
180	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82

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	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791	791		
5	783	783	783	783	784	784	784	785	786	786	787	787	788	789	789	790	790		
10	768	768	768	768	769	770	771	772	774	775	776	777	778	780	780	781	782		
15	745	745	745	746	747	748	750	751	754	755	757	758	760	762	763	764	765		
20	713	713	714	715	716	718	719	722	724	727	729	731	733	736	738	739	741		
25	671	671	672	674	675	678	680	683	686	689	692	694	697	699	702	704	705		
30	619	620	621	623	626	628	631	635	638	641	644	647	650	653	655	658	660		
35	559	560	562	565	567	569	573	577	581	585	588	590	593	595	598	601	603		
40	492	494	496	499	501	504	508	512	517	521	524	526	528	530	533	536	539		
45	422	424	426	428	431	434	439	443	448	452	455	457	459	461	463	466	469		
50	351	353	355	358	360	363	367	372	377	381	384	386	388	390	392	395	397		
55	285	286	287	290	292	295	299	303	307	311	314	317	319	321	324	326	328		
60	223	224	225	228	230	232	236	239	243	246	250	253	255	258	260	261	262		
65	170	170	171	172	174	176	179	182	185	188	191	194	197	200	201	202	203		
70	123	123	124	125	127	129	131	133	136	138	141	144	146	148	149	150	150		
75	82.1	82.4	83.2	84.3	85.5	87.1	88.8	90.5	92.6	94.6	96.6	98.6	100	102	103	104	104		
80	48.4	48.8	49.6	50.5	51.5	52.7	53.9	55.2	56.7	58.0	59.5	60.8	62.2	63.1	63.9	64.3	64.5		
85	23.5	23.9	24.4	25.1	25.8	26.5	27.3	28.2	29.0	29.8	30.6	31.3	32.0	32.5	32.9	33.1	33.2		
90	7.97	8.19	8.42	8.69	9.02	9.35	9.71	10.1	10.5	10.8	11.2	11.5	11.6	11.9	12.2	12.1	12.3		
95	1.62	1.59	1.55	1.52	1.52	1.52	1.55	1.61	1.70	1.81	1.91	1.98	2.02	2.06	2.08	2.08	2.05		
100	0.44	0.37	0.28	0.19	0.12	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08		
105	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12		
110	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16		
115	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20		
120	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.24	0.24	0.24	0.24	0.24		
125	0.33	0.33	0.32	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.30	0.30	0.30	0.30	0.30	0.30		
130	0.42	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.38	0.39		
135	0.53	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.50		
140	0.63	0.63	0.63	0.62	0.62	0.62	0.61	0.61	0.61	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.61		
145	0.73	0.73	0.73	0.72	0.72	0.72	0.72	0.71	0.71	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.71		
150	0.81	0.81	0.81	0.80	0.80	0.80	0.80	0.80	0.79	0.79	0.79	0.79	0.78	0.78	0.78	0.78	0.80		
155	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.84	0.86		
160	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.90		
165	0.90	0.90	0.91	0.91	0.91	0.91	0.91	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.92		
170	0.89	0.89	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90		
175	0.85	0.85	0.85	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86		
180	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82		

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.

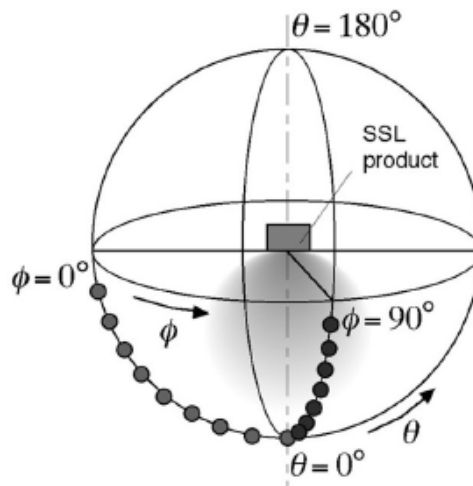
### **Color Spatial Uniformity**

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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