



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### PLV Lamp

**Model: 6.5PLSV/827/HYB/GX23**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ17030047a

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

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Mar. 21, 2017

Approved by:



*Jim Zhang*

Manager: Jim Zhang  
Mar. 21, 2017

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: 6.5PLSV/827/HYB/GX23

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
87.9	570.7	6.49	0.9817
CCT (K)	CRI	Stabilization Time (Light & Power)	
2739	80.9	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** : Mar. 15, 2017

**Date of Test** : Mar. 17, 2017

**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>	: PLV Lamp
<b>Model</b>	: 6.5PLSV/827/HYB/GX23
<b>Electrical Ratings</b>	: 120-277Vac, 60Hz, 6.5W
<b>Product Description</b>	: GX23 base, 2700K
<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)	0.055	0.027
Power Factor	0.9817	0.8896
Test Power (W)	6.49	6.62
THD A%	17.01	25.94
Luminous Efficacy (lm/W)	87.9	86.1
Total Luminous Flux (lm)	570.7	569.9
Color Rendering Index (CRI)	80.9	
R9	3.7	
Correlated Color Temperature (CCT)(K)	2739	
Chromaticity Chroma x	0.4557	
Chromaticity Chroma y	0.4083	
Chromaticity Chroma u	0.2608	
Chromaticity Chroma v	0.3506	
Duv	0.0007	
Chromaticity Chroma u'	0.2608	
Chromaticity Chroma v'	0.5258	

Special Color Rendering Indices	
R1	79.1
R2	90.6
R3	95.6
R4	77.7
R5	79.1
R6	88.8
R7	80.9
R8	55.7
R9	3.7
R10	78.7
R11	76.2
R12	72.3
R13	81.7
R14	98.3
Rf	82
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 24.6°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)	0.055
Power Factor	0.9822
Test Power (W)	6.48
Luminous Efficacy (lm/W)	89.1
Total Luminous Flux (lm)	577.0
Beam Angle (°)	107.8
Center Beam Candle Power (cd)	202
Spacing Criteria	1.18(0°-180°)/ 1.23 (90°-270°)
Zonal Lumens in the 0°-60°Zone	75.52%
Zonal Lumens in the 60°-90°Zone	23.09%
Zonal Lumens in the 90°-120°Zone	1.34%
Zonal Lumens in the 120°-180°Zone	0.05%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

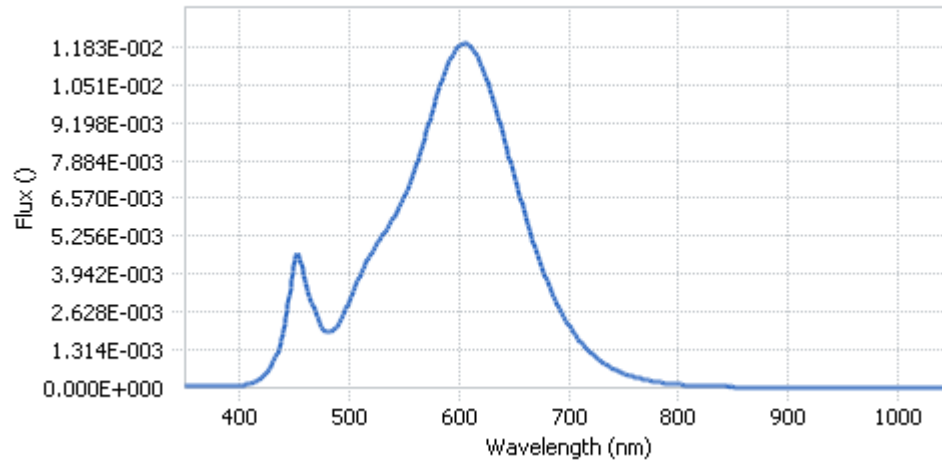


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.80E-05	485	2.00E-03	590	1.12E-02	695	2.51E-03
385	6.71E-05	490	2.21E-03	595	1.16E-02	700	2.18E-03
390	7.54E-05	495	2.58E-03	600	1.19E-02	705	1.89E-03
395	7.86E-05	500	3.04E-03	605	1.19E-02	710	1.63E-03
400	7.95E-05	505	3.49E-03	610	1.18E-02	715	1.42E-03
405	1.02E-04	510	3.92E-03	615	1.16E-02	720	1.24E-03
410	1.41E-04	515	4.35E-03	620	1.12E-02	725	1.06E-03
415	2.27E-04	520	4.67E-03	625	1.07E-02	730	9.13E-04
420	3.46E-04	525	4.98E-03	630	1.01E-02	735	7.81E-04
425	5.68E-04	530	5.26E-03	635	9.49E-03	740	6.71E-04
430	8.77E-04	535	5.54E-03	640	8.83E-03	745	5.75E-04
435	1.31E-03	540	5.89E-03	645	8.09E-03	750	4.98E-04
440	2.00E-03	545	6.23E-03	650	7.41E-03	755	4.27E-04
445	3.19E-03	550	6.62E-03	655	6.70E-03	760	3.70E-04
450	4.42E-03	555	7.08E-03	660	6.04E-03	765	3.17E-04
455	4.44E-03	560	7.61E-03	665	5.40E-03	770	2.73E-04
460	3.58E-03	565	8.21E-03	670	4.77E-03	775	2.34E-04
465	3.01E-03	570	8.87E-03	675	4.25E-03	780	1.99E-04
470	2.50E-03	575	9.51E-03	680	3.75E-03		
475	2.06E-03	580	1.02E-02	685	3.29E-03		
480	1.94E-03	585	1.08E-02	690	2.88E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method

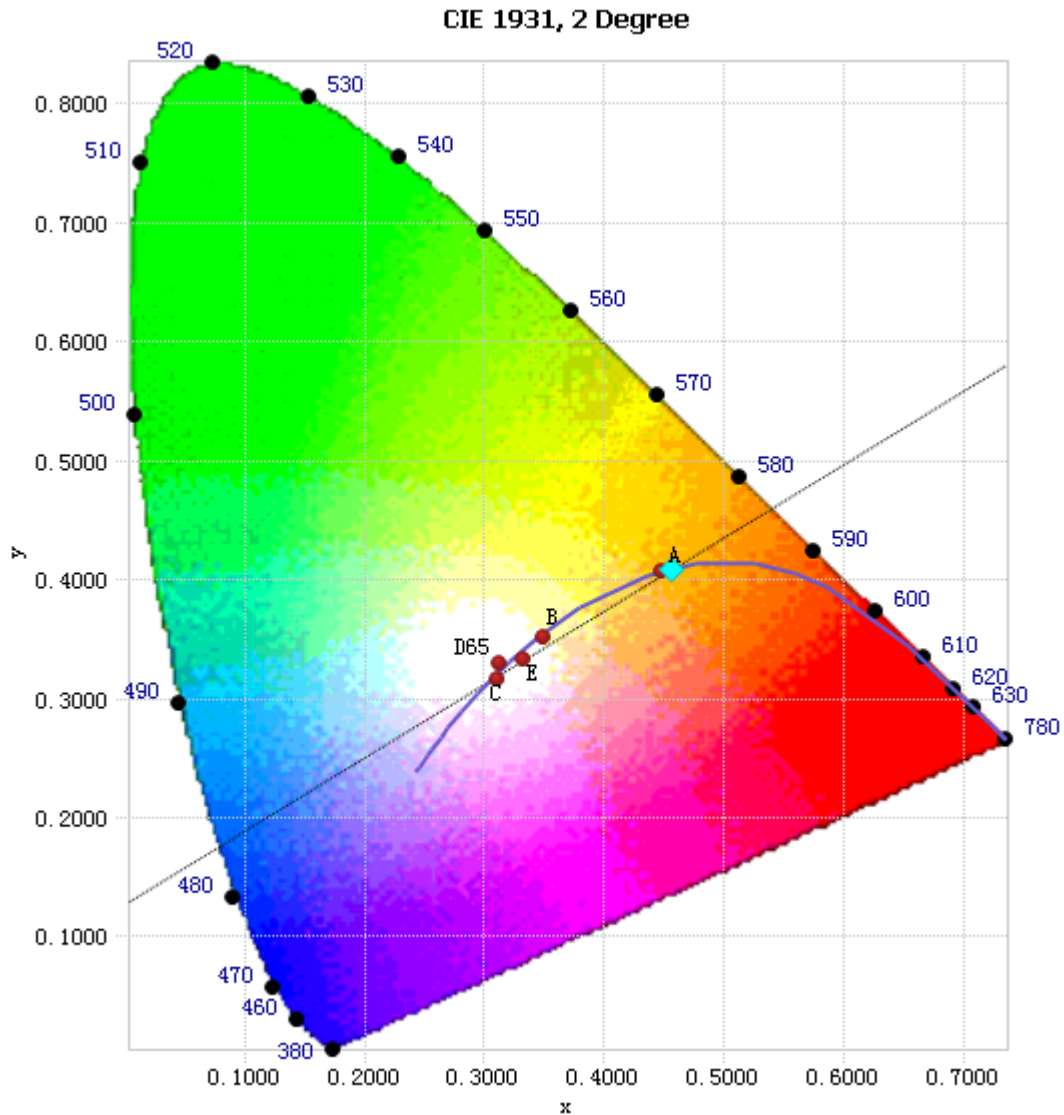


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.



## Nominal CCT Quadrangles – Sphere Spectroradiometer Method

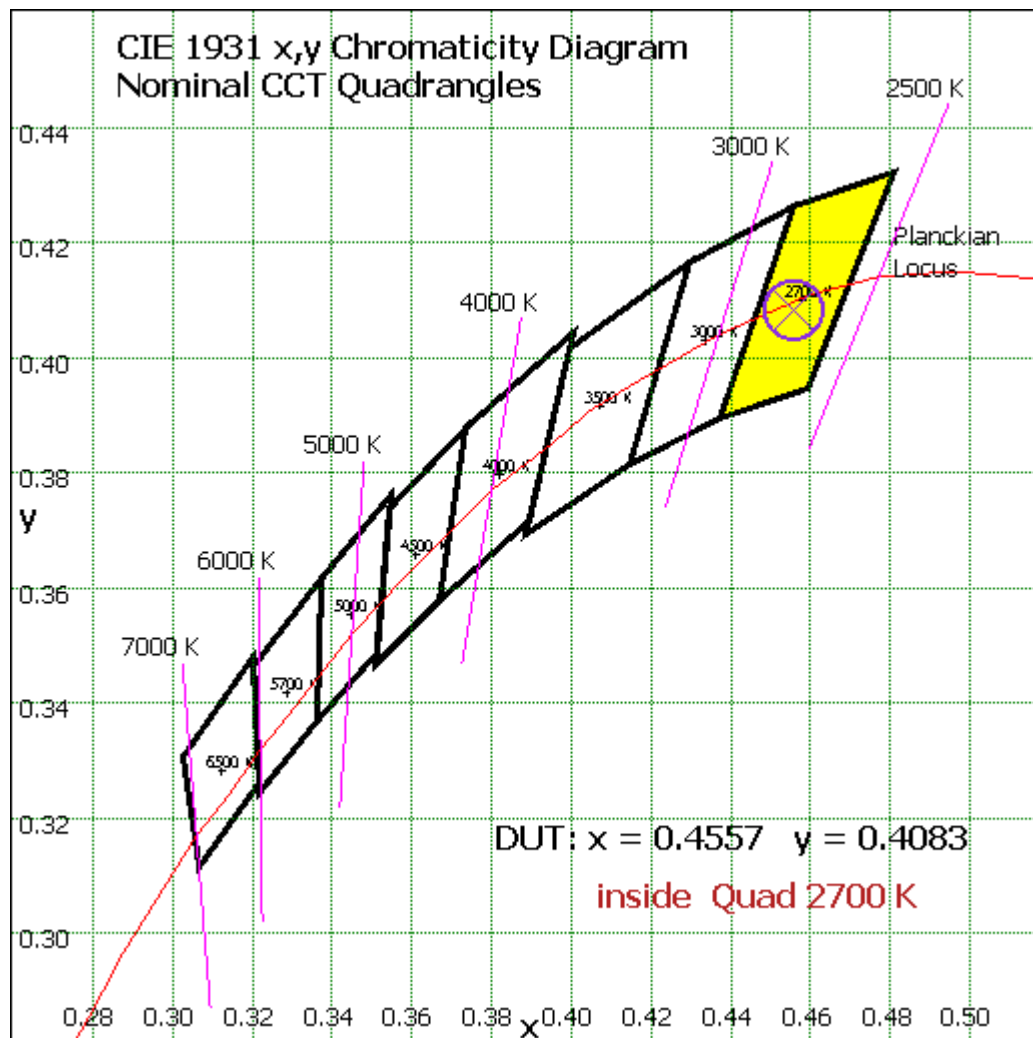


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	19.058	3.30%
10- 20	54.221	9.40%
20- 30	81.103	14.05%
30- 40	96.055	16.65%
40- 50	97.907	16.97%
50- 60	87.465	15.16%
60- 70	68.013	11.79%
70- 80	43.959	7.62%
80- 90	21.238	3.68%
90-100	6.507	1.13%
100-110	1.081	0.19%
110-120	0.121	0.02%
120-130	0.052	0.01%
130-140	0.068	0.01%
140-150	0.074	0.01%
150-160	0.063	0.01%
160-170	0.041	0.01%
170-180	0.015	0.00%
Total	577.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	435.809	75.52%
60- 90	133.21	23.09%
0-90	569.019	98.61%
90- 180	8.022	1.39%
0- 180	577.0	100%

Table 5: Zonal Lumen Data

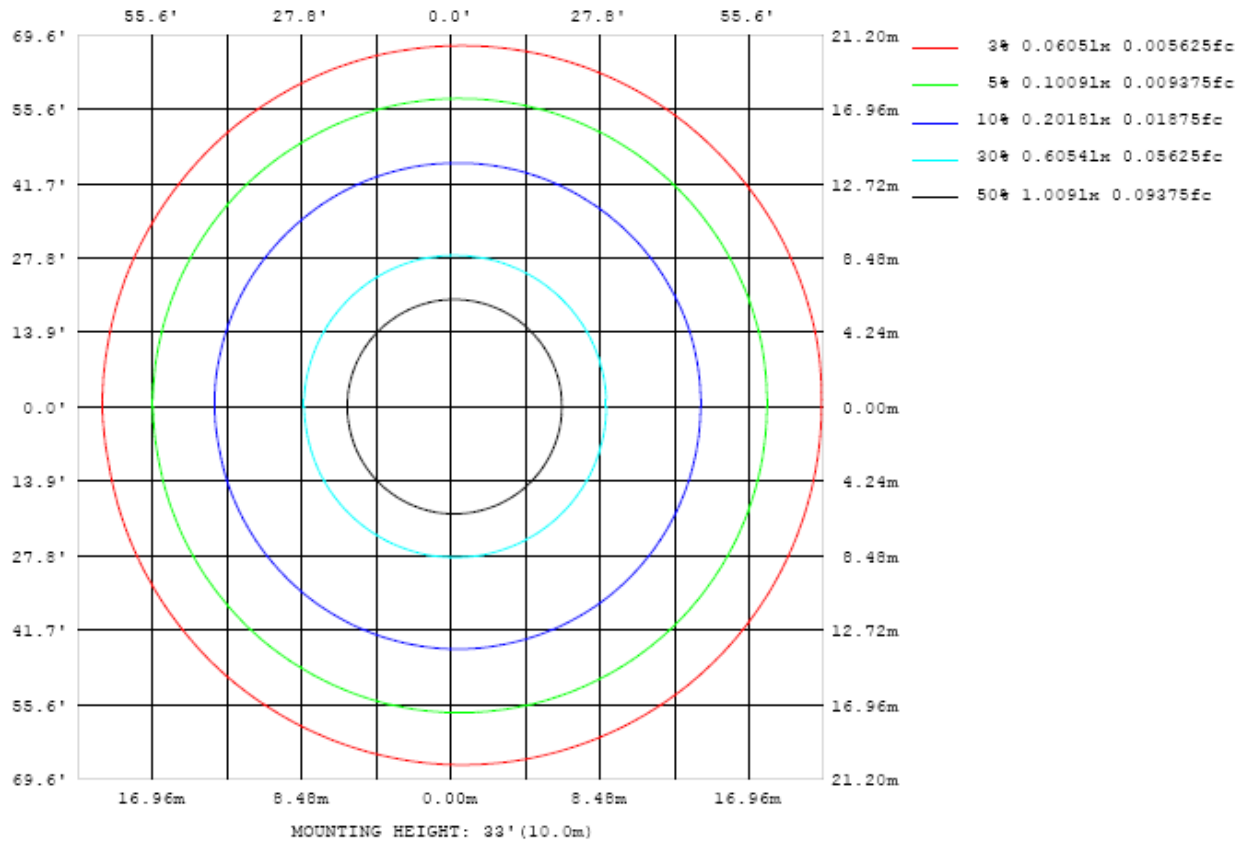


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

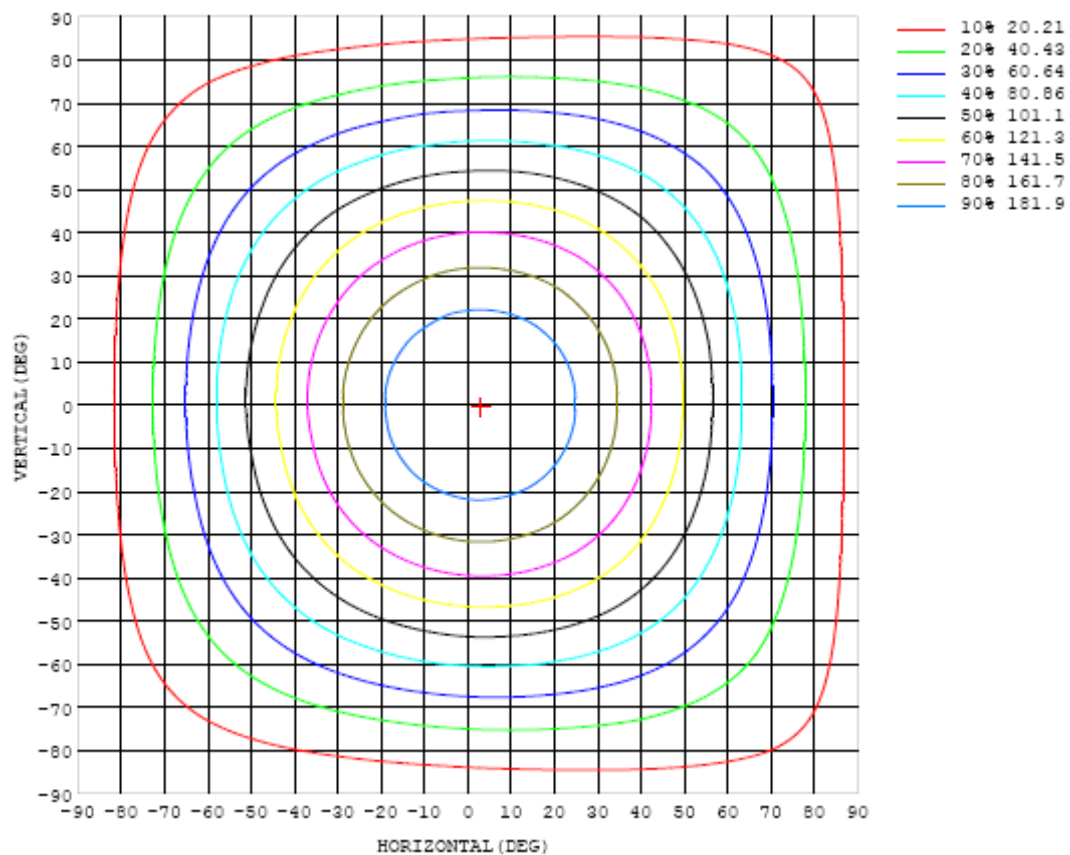


Chart 5: Isocandela Plot

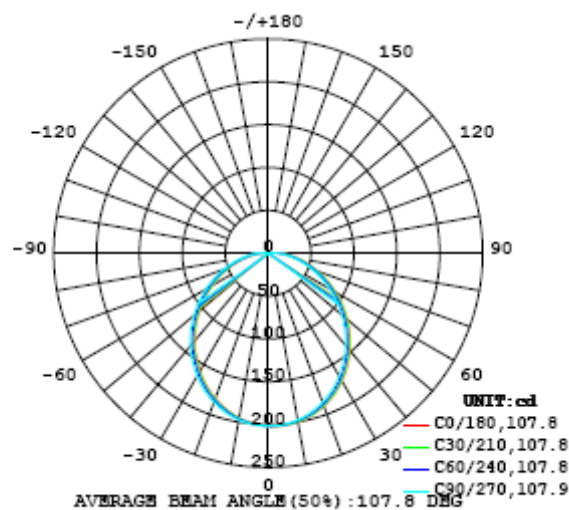


Chart 6: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202
5	202	202	202	202	202	201	201	201	201	201	200	200	200	200	200	200	200	200	200
10	200	200	200	199	199	199	198	198	198	197	197	197	196	196	196	195	195	195	195
15	196	196	196	195	195	194	194	193	193	192	192	191	190	190	189	189	189	189	189
20	190	190	189	189	188	188	187	186	186	185	184	183	183	182	181	181	181	180	180
25	182	182	181	181	180	179	178	178	177	176	175	174	173	172	172	171	171	170	171
30	172	172	171	171	170	169	168	167	166	165	164	163	162	161	160	160	159	159	159
35	160	160	160	159	159	158	157	155	154	153	152	151	150	149	148	147	147	146	147
40	148	148	147	147	146	145	144	142	141	140	139	137	136	135	134	134	133	133	134
45	134	134	134	133	132	131	130	129	127	126	125	123	122	121	120	119	119	118	119
50	120	120	119	119	118	117	115	114	113	112	110	109	107	106	105	105	104	104	105
55	105	105	105	104	103	102	101	99.4	98.1	97.0	95.5	94.0	92.7	91.6	90.6	89.9	89.4	89.1	90.1
60	90.6	90.3	89.7	89.0	88.3	87.2	86.0	84.7	83.4	82.1	80.7	79.3	78.0	77.1	75.9	75.3	74.8	74.6	75.4
65	75.8	75.6	75.1	74.4	73.5	72.6	71.3	70.1	68.7	67.5	66.1	64.8	63.6	62.7	61.8	61.2	60.8	60.5	61.2
70	61.6	61.4	61.0	60.1	59.5	58.6	57.4	56.2	55.1	53.8	52.4	51.1	50.1	49.1	48.2	47.6	47.2	47.1	47.6
75	48.1	47.9	47.4	46.5	45.7	45.1	43.9	42.7	41.6	40.4	39.2	38.0	36.9	36.1	35.3	34.8	34.5	34.4	34.7
80	35.2	34.9	34.6	33.8	33.0	32.5	31.4	30.3	29.5	28.3	27.3	26.3	25.3	24.5	24.0	23.5	23.3	23.2	23.6
85	23.9	23.8	23.3	22.6	22.1	21.6	20.6	19.8	19.0	18.2	17.2	16.4	15.7	15.1	14.7	14.4	14.2	14.2	14.7
90	14.6	14.4	14.1	13.7	13.2	12.8	12.2	11.5	10.9	10.4	9.67	9.08	8.59	8.20	7.90	7.71	7.63	7.64	7.80
95	7.88	7.75	7.54	7.31	6.96	6.60	6.23	5.82	5.40	4.94	4.57	4.23	3.95	3.75	3.58	3.50	3.44	3.45	3.58
100	3.52	3.44	3.33	3.16	2.99	2.78	2.54	2.31	2.11	1.93	1.76	1.63	1.52	1.45	1.39	1.35	1.33	1.34	1.39
105	1.30	1.27	1.21	1.14	1.05	0.96	0.86	0.78	0.70	0.64	0.60	0.56	0.54	0.53	0.53	0.52	0.53	0.54	0.57
110	0.48	0.46	0.43	0.39	0.35	0.31	0.27	0.24	0.22	0.20	0.19	0.19	0.19	0.19	0.19	0.20	0.21	0.22	0.23
115	0.15	0.14	0.12	0.09	0.07	0.06	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06
120	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.06
125	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07
130	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08
135	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.11
140	0.09	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.13
145	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.15
150	0.11	0.09	0.09	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	0.10	0.12	0.16
155	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.13	0.17
160	0.14	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.14	0.17
165	0.15	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.15	0.17
170	0.16	0.12	0.12	0.12	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	0.16	0.17
175	0.17	0.16	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16
180	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

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	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202	202		
5	200	200	200	200	200	200	200	201	201	201	201	201	202	202	202	202	202		
10	195	195	196	196	196	196	197	197	198	198	198	199	199	199	200	200	200		
15	189	189	189	190	190	191	191	192	192	193	193	194	195	195	196	196	196		
20	181	181	181	182	182	183	184	185	185	186	187	188	188	189	189	190	190		
25	171	171	172	172	173	174	175	176	176	177	178	179	180	180	181	182	182		
30	159	160	160	161	162	163	164	165	166	167	168	169	170	170	171	172	172		
35	147	147	148	149	150	150	152	153	154	155	156	157	158	159	160	161	161		
40	134	134	135	136	137	138	139	140	142	142	144	145	146	147	148	148	148		
45	120	120	121	122	123	124	125	127	128	129	130	132	133	134	135	135	135		
50	105	106	106	107	108	110	111	112	113	115	116	117	119	119	120	121	121		
55	90.3	90.9	91.9	92.5	93.4	94.7	96.0	97.7	98.6	100	102	103	104	105	105	106	106		
60	75.7	76.4	76.9	78.1	79.0	80.0	81.6	83.1	84.2	85.3	87.0	88.0	89.2	90.3	90.7	91.4	91.8		
65	61.5	62.1	62.9	63.8	64.9	66.0	67.4	68.6	69.7	70.7	72.1	73.5	74.6	75.4	76.0	76.7	76.9		
70	48.0	48.4	49.0	49.9	51.0	52.1	53.5	54.7	55.8	56.7	58.3	59.4	60.4	61.1	62.0	62.3	62.4		
75	35.3	35.6	36.4	37.1	38.2	39.1	40.4	41.6	42.3	43.6	44.9	45.7	46.7	47.4	48.0	48.5	48.6		
80	23.8	24.3	24.9	25.7	26.6	27.4	28.4	29.6	30.3	31.2	32.3	33.3	34.0	34.7	35.0	35.6	35.6		
85	14.9	15.3	15.6	16.3	16.8	17.6	18.4	19.2	20.0	20.7	21.4	22.2	22.9	23.4	23.9	24.1	24.2		
90	8.02	8.29	8.60	8.96	9.38	9.93	10.4	11.1	11.6	12.2	12.8	13.4	13.9	14.4	14.8	14.8	15.0		
95	3.68	3.85	4.03	4.27	4.52	4.84	5.18	5.55	5.86	6.20	6.59	6.93	7.29	7.57	7.81	7.96	8.01		
100	1.44	1.51	1.59	1.69	1.79	1.97	2.14	2.32	2.47	2.65	2.84	3.02	3.21	3.36	3.49	3.58	3.63		
105	0.59	0.60	0.62	0.65	0.68	0.73	0.79	0.85	0.90	0.98	1.05	1.14	1.20	1.27	1.32	1.36	1.37		
110	0.24	0.24	0.25	0.25	0.26	0.27	0.30	0.32	0.34	0.38	0.41	0.44	0.47	0.49	0.51	0.52	0.52		
115	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.08	0.09	0.11	0.13	0.15	0.16	0.18	0.19	0.19	0.18		
120	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		
125	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06		
130	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		
135	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	0.10	0.10		
140	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12		
145	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14		
150	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16		
155	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17		
160	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		
165	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		
170	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		
175	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17		
180	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 27, 2016	Jul. 26, 2017
Digital Power Meter	PF2010A	HZTE028-01	Jul. 27, 2016	Jul. 26, 2017
AC Power Supply	PCR 500L	HZTE001-08	Jul. 27, 2016	Jul. 26, 2017
DC Power Supply	WY12010	HZTE004-03	Jul. 27, 2016	Jul. 26, 2017
Temperature Meter	TES1310	HZTE017-01	Jul. 27, 2016	Jul. 26, 2017
Standard source	D908	HZTE012-01	Jul. 27, 2016	Jul. 26, 2017
Integrate Sphere system	2M	HZTE015-01	Jul. 27, 2016	Jul. 26, 2017
Digital Power Meter	WT210	HZTE008-01	Jul. 27, 2016	Jul. 26, 2017
AC Power Supply	PCR 500L	HZTE001-07	Jul. 27, 2016	Jul. 26, 2017
DC Power Supply	6154	HZTE004-04	Jul. 27, 2016	Jul. 26, 2017
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 27, 2016	Jul. 26, 2017
Standard source	SCL-1400	HZTE012-02	Jul. 27, 2016	Jul. 26, 2017

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 FA19 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 expended uncertainty is 1.06% 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 FA19 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 1.94% 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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