LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

PLS LAMP

Model: 6PLS/835/HYB/GX23/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17030069c

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

Review by: April Zou

Engineer: April Zou

Mar. 24, 2017

Approved by:

Manager: Jim Zhang

Mar. 24, 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: **6PLS/835/HYB/GX23/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
121.7	727.9	5.98	0.9752

CCT (K)	CRI	Stabilization Time (Light & Power)
3479	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	: Mar. 21, 2017
Date of Test	: Mar. 23, 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

TABLE OF CONTENT

Sample Photos

Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: PLS LAMP
Model	: 6PLS/835/HYB/GX23/R
Electrical Ratings	: 120-277Vac, 60Hz, 6W
Product Description	: GX23 base, 3500K, CRI80
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.0℃.

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 70 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.051	0.024
Power Factor	0.9752	0.8938
Test Power (W)	5.98	5.99
THD A%	20.28	26.02
Luminous Efficacy (lm/W)	121.7	121.6
Total Luminous Flux (lm)	727.9	728.1
Color Rendering Index (CRI)	83.0	
R9	7.8	
Correlated Color Temperature (CCT)(K)	3479	
Chromaticity Chroma x	0.4061	
Chromaticity Chroma y	0.3905	
Chromaticity Chroma u	0.2363	
Chromaticity Chroma v	0.3408	
Duv	0.0005	
Chromaticity Chroma u ’	0.2363	
Chromaticity Chroma v’	0.5113	

Special Color Rendering Indices	
R1	81.8
R2	92.5
R3	95
R4	79.5
R5	81.8
R6	89.8
R7	82.8
R8	60.5
R9	7.8
R10	82
R11	78.3
R12	67.6
R13	84.8
R14	98
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 24.6℃.

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)	0.051
Power Factor	0.9745
Test Power (W)	5.99
Luminous Efficacy (lm/W)	125.0
Total Luminous Flux (lm)	749.0
Beam Angle (°)	112.7
Center Beam Candle Power (cd)	226
Spacing Criteria	1.16 (0°-180°)/ 1.26 (90°-270°)
Zonal Lumens in the 0°-60°Zone	66.62%
Zonal Lumens in the 60°-90°Zone	24.95%
Zonal Lumens in the 90°-120°Zone	7.19%
Zonal Lumens in the 120°-180°Zone	1.23%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

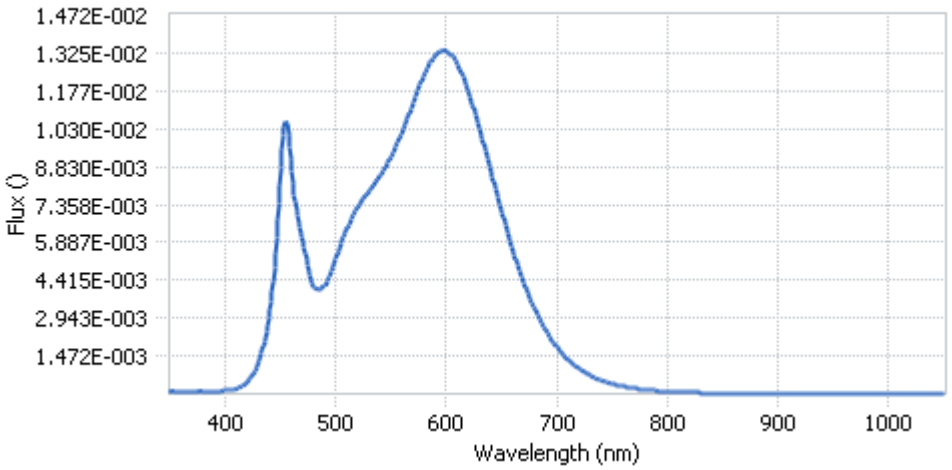
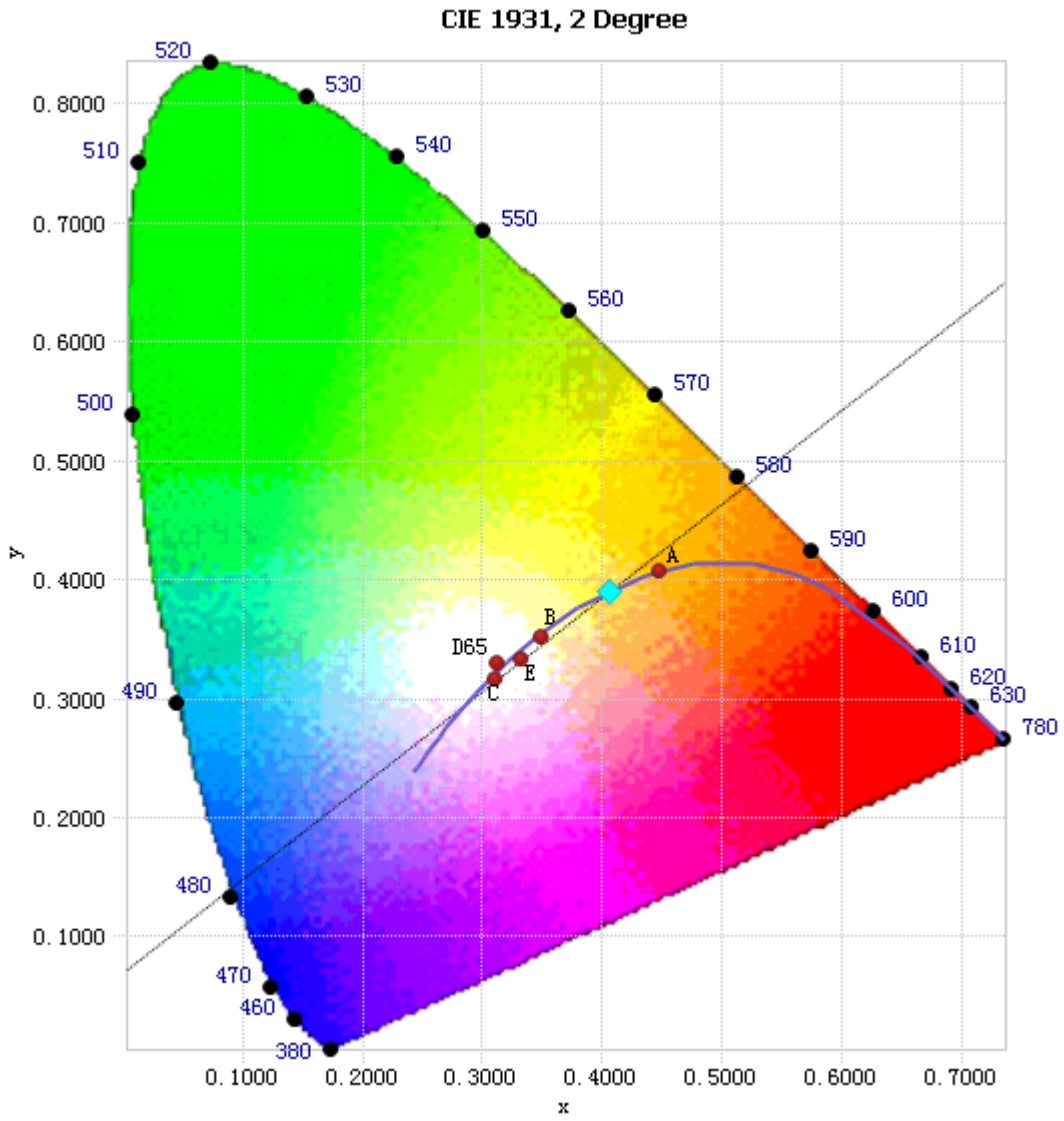


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.07E-04	485	4.04E-03	590	1.31E-02	695	2.11E-03
385	9.44E-05	490	4.24E-03	595	1.33E-02	700	1.84E-03
390	1.09E-04	495	4.63E-03	600	1.33E-02	705	1.57E-03
395	1.16E-04	500	5.20E-03	605	1.31E-02	710	1.34E-03
400	1.28E-04	505	5.82E-03	610	1.28E-02	715	1.16E-03
405	1.41E-04	510	6.35E-03	615	1.24E-02	720	9.90E-04
410	1.95E-04	515	6.85E-03	620	1.18E-02	725	8.52E-04
415	2.85E-04	520	7.26E-03	625	1.11E-02	730	7.24E-04
420	4.51E-04	525	7.59E-03	630	1.04E-02	735	6.20E-04
425	7.30E-04	530	7.85E-03	635	9.57E-03	740	5.36E-04
430	1.16E-03	535	8.14E-03	640	8.79E-03	745	4.57E-04
435	1.85E-03	540	8.49E-03	645	7.93E-03	750	3.95E-04
440	2.96E-03	545	8.82E-03	650	7.16E-03	755	3.41E-04
445	4.89E-03	550	9.20E-03	655	6.38E-03	760	2.95E-04
450	8.11E-03	555	9.63E-03	660	5.66E-03	765	2.51E-04
455	1.06E-02	560	1.01E-02	665	4.99E-03	770	2.19E-04
460	9.13E-03	565	1.07E-02	670	4.38E-03	775	1.88E-04
465	7.10E-03	570	1.13E-02	675	3.82E-03	780	1.63E-04
470	6.10E-03	575	1.18E-02	680	3.33E-03		
475	4.97E-03	580	1.24E-02	685	2.86E-03		
480	4.18E-03	585	1.28E-02	690	2.47E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4061, 0.3905)

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

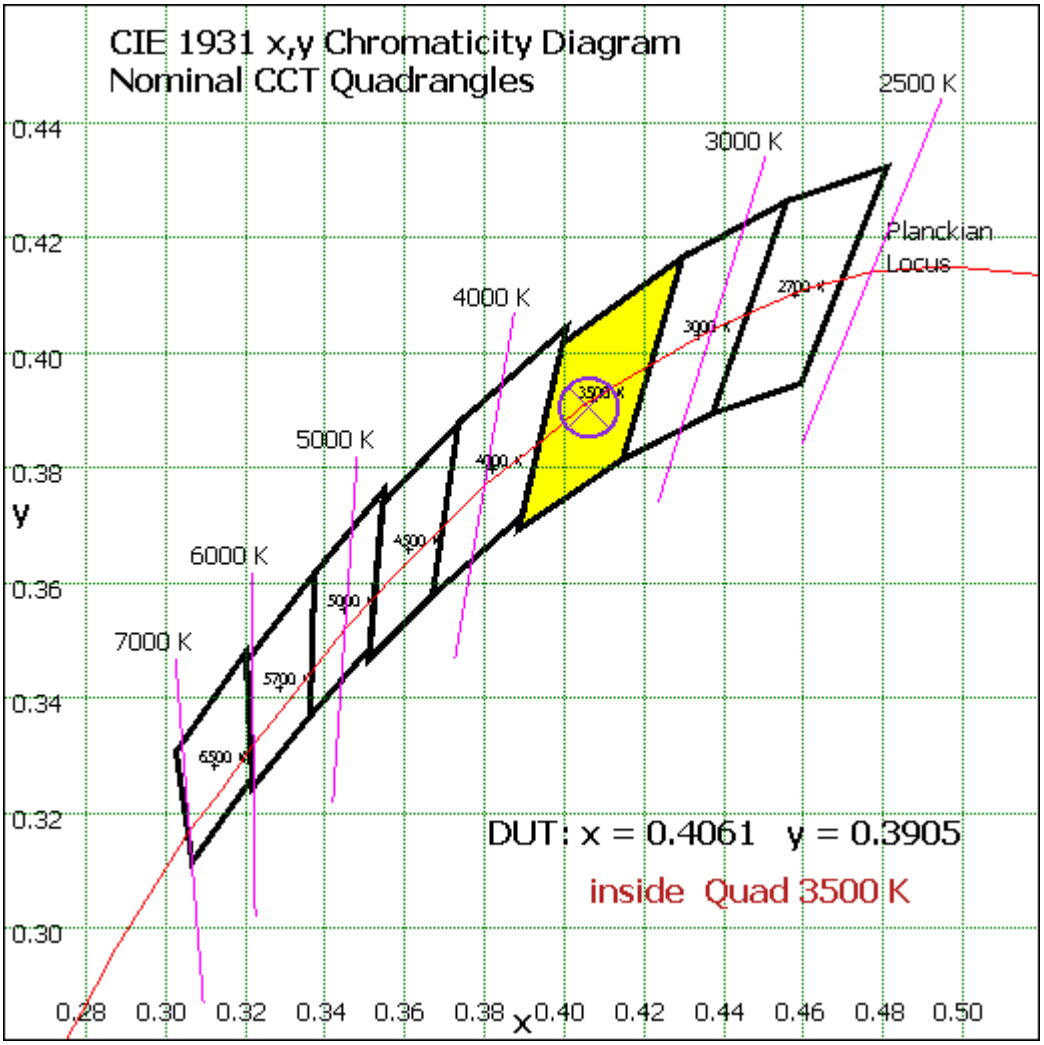


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	21.378	2.85%
10- 20	60.837	8.12%
20- 30	91.155	12.17%
30- 40	108.712	14.51%
40- 50	112.697	15.05%
50- 60	104.208	13.91%
60- 70	85.872	11.46%
70- 80	61.87	8.26%
80- 90	39.171	5.23%
90-100	25.349	3.38%
100-110	17.479	2.33%
110-120	11.054	1.48%
120-130	5.518	0.74%
130-140	2.303	0.31%
140-150	0.892	0.12%
150-160	0.362	0.05%
160-170	0.127	0.02%
170-180	0.027	0.00%
Total	749.0	100%

γ(°)	Lumens	% Total
0- 60	498.987	66.62%
60- 90	186.913	24.95%
0-90	685.9	91.57%
90- 180	63.111	8.43%
0- 180	749.0	100%

Table 5: Zonal Lumen Data

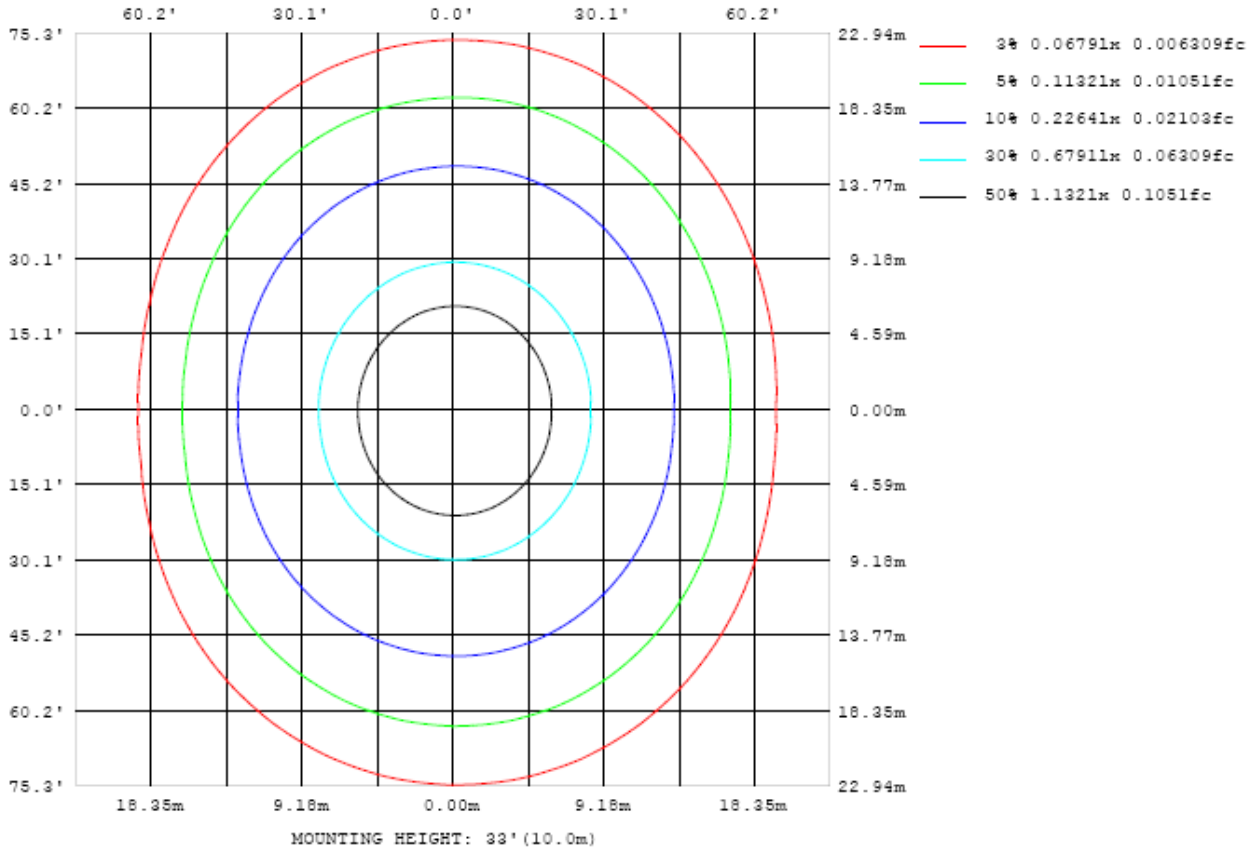


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

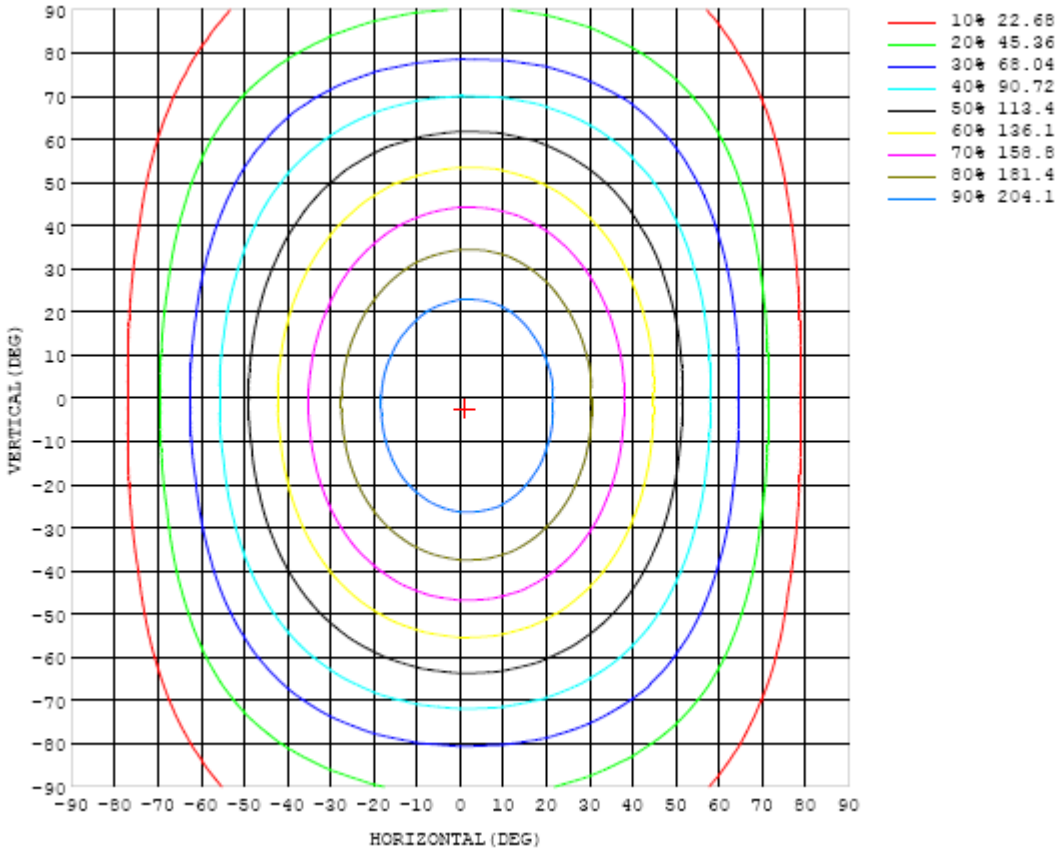


Chart 5: Isocandela Plot

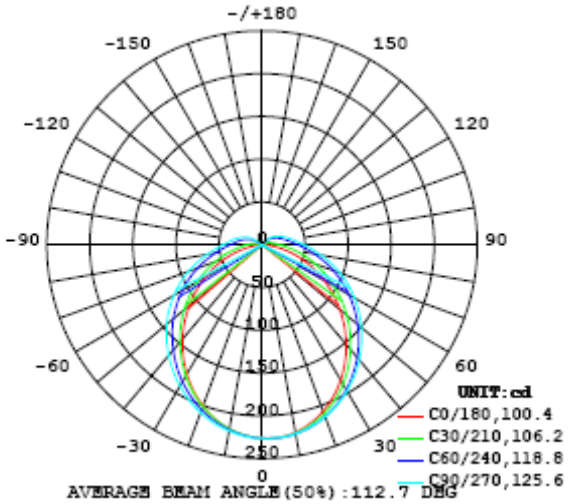


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C (DEG) / γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226
5	226	226	226	226	226	226	227	227	226	226	226	226	225	225	225	224	224	224	224
10	223	223	223	224	224	224	224	225	224	224	224	223	222	222	221	220	219	219	218
15	216	217	217	218	219	219	220	221	220	220	219	218	217	216	214	213	212	211	211
20	207	208	209	210	212	213	214	215	214	214	213	212	210	208	206	204	202	201	201
25	196	197	198	200	202	204	206	207	207	207	205	204	201	198	196	193	191	189	188
30	183	184	186	188	191	193	196	197	198	197	196	194	191	187	184	180	177	175	175
35	168	169	171	174	178	181	184	187	187	187	185	183	179	175	170	166	163	160	159
40	152	153	156	160	164	168	172	175	176	175	174	171	167	162	156	151	147	144	144
45	135	137	140	144	149	154	159	162	164	163	161	158	153	148	142	136	131	128	127
50	118	120	124	128	134	140	145	149	151	151	148	145	140	133	127	120	115	111	110
55	101	103	107	112	119	125	131	135	137	137	135	131	126	119	112	105	98.8	94.4	93.2
60	83.2	85.4	90.2	96.4	103	110	116	121	124	124	122	118	112	105	97.1	89.6	82.8	77.8	76.5
65	66.0	68.4	74.0	81.0	88.5	95.7	102	107	110	110	108	104	97.9	90.7	82.7	74.7	67.3	61.7	59.8
70	49.5	52.3	58.7	65.9	74.0	81.5	88.2	93.2	95.8	96.2	94.2	90.2	84.3	77.1	68.9	60.6	52.8	46.2	43.6
75	33.6	36.6	43.8	52.1	60.8	67.9	74.6	79.6	82.1	82.5	80.8	77.0	71.2	64.2	56.2	47.5	38.8	31.5	28.2
80	19.4	23.0	30.7	39.3	47.8	55.6	62.1	66.7	69.1	69.6	68.1	64.0	59.2	52.5	44.3	35.6	26.6	18.4	14.6
85	8.31	12.0	19.9	28.6	36.8	44.7	50.8	55.5	58.0	58.2	56.8	53.6	48.5	42.0	34.3	25.8	17.0	8.81	4.51
90	0.83	5.45	12.7	20.8	28.8	36.0	41.9	46.2	48.5	48.8	47.6	44.7	39.9	34.0	26.8	19.0	11.0	3.94	0.12
95	0.28	2.67	8.68	15.9	23.3	29.8	35.1	39.1	41.2	41.6	40.5	37.9	33.4	28.2	21.7	14.7	7.79	2.06	0.10
100	0.31	1.76	6.34	12.7	19.3	25.3	30.2	33.8	35.7	36.1	35.1	32.7	28.8	23.9	18.0	11.7	5.71	1.21	0.19
105	0.27	1.39	4.79	10.2	16.1	21.4	26.0	29.3	31.1	31.4	30.6	28.4	24.9	20.4	15.1	9.49	4.29	1.15	0.15
110	0.14	0.81	3.40	8.17	13.3	18.2	22.3	25.3	26.9	27.3	26.6	24.6	21.4	17.3	12.6	7.59	2.89	0.75	0.17
115	0.08	0.43	2.18	6.01	10.9	15.4	19.0	21.7	23.2	23.6	22.9	21.1	18.3	14.6	10.4	5.54	1.98	0.61	0.22
120	0.10	0.32	1.34	3.55	8.44	12.6	16.0	18.4	19.8	20.2	19.6	18.0	15.4	12.1	8.04	2.98	1.67	0.57	0.24
125	0.11	0.27	1.00	2.30	5.09	9.65	13.0	15.3	16.6	16.9	16.4	15.0	12.7	9.39	4.76	2.42	1.30	0.56	0.32
130	0.13	0.25	0.77	1.68	3.09	5.84	9.34	11.9	13.3	13.7	13.2	11.8	9.23	5.63	3.24	1.97	1.05	0.57	0.45
135	0.15	0.24	0.62	1.16	1.96	3.58	5.46	7.36	9.00	9.52	9.00	7.37	5.44	3.85	2.75	1.55	0.86	0.55	0.50
140	0.17	0.24	0.46	0.87	1.65	2.42	3.41	4.56	5.35	5.63	5.38	4.73	3.93	3.11	2.08	1.27	0.74	0.47	0.46
145	0.19	0.24	0.39	0.65	1.34	2.14	2.54	2.47	3.28	3.70	3.79	3.49	2.94	2.30	1.61	1.07	0.66	0.45	0.35
150	0.21	0.24	0.34	0.51	0.88	1.57	1.99	2.35	2.59	2.65	2.59	2.41	2.10	1.71	1.25	0.87	0.56	0.35	0.25
155	0.25	0.28	0.35	0.47	0.70	1.13	1.41	1.63	1.77	1.82	1.76	1.61	1.40	1.13	0.86	0.58	0.38	0.26	0.25
160	0.35	0.39	0.44	0.46	0.59	0.81	0.97	1.10	1.18	1.21	1.17	1.02	0.96	0.76	0.64	0.47	0.34	0.27	0.27
165	0.31	0.34	0.36	0.39	0.48	0.57	0.66	0.72	0.76	0.77	0.75	0.71	0.64	0.52	0.47	0.40	0.32	0.24	0.27
170	0.28	0.28	0.30	0.34	0.37	0.41	0.45	0.47	0.48	0.47	0.46	0.44	0.41	0.38	0.34	0.33	0.30	0.24	0.25
175	0.22	0.23	0.23	0.23	0.24	0.29	0.29	0.31	0.32	0.33	0.32	0.31	0.31	0.30	0.26	0.24	0.22	0.21	0.22
180	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	0.17	0.17

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	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226	226		
5	224	224	224	224	224	224	224	225	225	225	225	225	226	226	226	226	226		
10	218	218	219	219	219	220	220	221	221	222	222	222	222	222	222	222	223		
15	211	211	211	212	213	214	214	215	216	216	217	217	217	216	216	216	216		
20	200	201	201	203	204	206	207	208	209	209	210	209	209	208	208	208	208		
25	188	189	190	192	194	196	198	199	200	201	201	200	200	198	197	196	196		
30	174	176	177	180	182	185	188	189	191	191	191	190	188	187	185	184	183		
35	159	161	163	166	170	173	176	178	180	181	180	179	176	174	171	170	169		
40	144	146	148	152	156	161	164	167	169	169	168	166	163	160	157	154	153		
45	128	130	134	138	143	148	152	155	157	157	156	153	150	146	142	139	137		
50	111	114	118	123	129	135	139	143	145	145	144	140	136	131	126	123	120		
55	94.2	97.5	102	108	115	121	126	130	132	132	130	127	122	116	110	106	103		
60	77.5	81.6	87.2	93.9	101	107	113	116	119	119	116	112	107	101	94.7	89.5	85.5		
65	61.3	65.9	72.3	79.6	86.5	93.2	98.9	102	105	105	102	98.0	92.5	86.1	79.5	73.5	69.0		
70	45.6	51.1	58.3	65.7	73.1	79.9	85.0	89.1	90.7	90.6	88.2	84.0	78.7	71.6	64.3	57.6	52.7		
75	30.8	37.1	44.9	52.8	60.2	66.8	71.9	75.5	77.1	77.1	74.8	70.6	64.7	57.8	50.4	43.2	37.0		
80	17.8	25.0	33.3	41.3	48.4	54.8	59.8	63.1	64.5	64.4	62.4	58.3	52.5	45.5	37.9	30.0	23.2		
85	8.26	15.9	24.0	31.9	38.9	45.1	49.7	52.8	53.8	53.8	51.9	47.9	42.2	35.4	27.6	19.7	12.2		
90	3.16	9.99	17.7	25.2	31.8	37.4	41.9	44.5	45.7	45.7	43.6	39.9	34.6	28.0	20.5	12.7	5.69		
95	1.15	6.16	13.6	20.4	26.6	32.0	35.9	38.4	39.6	39.4	37.4	34.0	29.0	22.8	15.9	8.73	2.89		
100	1.22	4.49	10.4	16.7	22.3	27.3	31.0	33.4	34.4	34.2	32.3	29.0	24.4	18.8	12.3	6.40	2.11		
105	0.88	3.91	7.73	13.3	18.7	23.2	26.6	28.8	29.8	29.5	27.8	24.8	20.5	15.3	9.68	4.81	1.44		
110	0.55	2.53	5.06	9.96	15.2	19.5	22.7	24.7	25.6	25.2	23.6	20.8	16.8	11.7	6.74	2.95	0.78		
115	0.46	1.66	3.76	5.45	10.6	15.5	18.8	20.7	21.5	21.2	19.7	16.9	12.1	7.25	3.98	1.60	0.35		
120	0.45	1.22	2.53	4.24	5.50	9.28	13.4	16.0	16.9	16.4	14.2	10.3	6.25	4.20	2.43	1.05	0.26		
125	0.48	0.98	1.80	2.88	3.98	5.52	6.84	8.46	9.29	8.74	7.25	5.53	3.91	2.78	1.66	0.75	0.23		
130	0.55	0.84	1.36	2.05	2.73	3.70	4.58	5.26	5.43	5.23	4.54	3.51	2.62	1.92	1.19	0.56	0.22		
135	0.58	0.75	1.08	1.53	1.96	2.59	3.06	3.33	3.47	3.37	2.99	2.32	1.83	1.37	0.88	0.45	0.23		
140	0.52	0.61	0.85	1.13	1.36	1.73	1.97	2.24	2.35	2.30	2.07	1.63	1.32	0.99	0.67	0.39	0.24		
145	0.27	0.33	0.47	0.66	0.86	1.20	1.40	1.58	1.69	1.66	1.54	1.24	0.94	0.74	0.53	0.35	0.26		
150	0.25	0.29	0.38	0.50	0.65	0.87	1.00	1.11	1.16	1.15	1.05	0.86	0.73	0.59	0.45	0.33	0.28		
155	0.25	0.27	0.32	0.40	0.51	0.64	0.72	0.78	0.82	0.82	0.76	0.65	0.53	0.45	0.38	0.33	0.32		
160	0.27	0.25	0.29	0.34	0.42	0.47	0.52	0.55	0.55	0.50	0.51	0.42	0.42	0.38	0.33	0.31	0.35		
165	0.29	0.27	0.29	0.30	0.32	0.33	0.34	0.37	0.41	0.42	0.42	0.31	0.31	0.33	0.31	0.28	0.32		
170	0.25	0.29	0.28	0.29	0.30	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.31	0.28	0.31	0.28	0.28		
175	0.23	0.23	0.23	0.24	0.23	0.24	0.23	0.25	0.26	0.24	0.25	0.25	0.24	0.24	0.23	0.23	0.24		
180	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		

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 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 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 expended uncertainty is 1.94% with a coverage factor k=2.

Color Characteristics Measurements

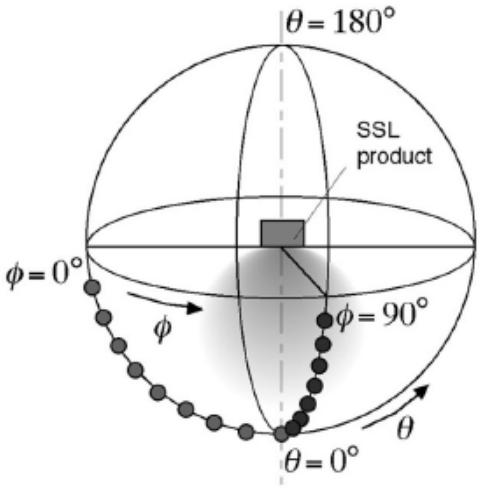
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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