



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube System

#### Model: 14.5T8U6/850/EXT/A4

(LED tube model: 14.5T8U6/850/EXT 4pcs and LED driver model: 15T8T5HEDRIVER/4CH 1pcs)

### Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18080024e

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

Review by:

Engineer: April Zou  
Aug. 28, 2018

Approved by:



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Aug. 28, 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: 14.5T8U6/850/EXT/A4

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/4	Power Factor
138.4	2239.0	16.18	0.9969
CCT (K)	CRI	Stabilization Time (Light & Power)	
4878	82.7	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** : Jul. 30, 2018

**Date of Test** : Aug. 02, 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>	: LED Tube System
<b>Model</b>	: 14.5T8U6/850/EXT/A4
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 5000K LED tube model: 14.5T8U6/850/EXT 4 LED tubes supplied by a LED driver: 15T8T5HEDRIVER/4CH
<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 horizontal. 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)	0.541	0.237
Power Factor	0.9969	0.9696
Test Power (W)/4	16.18	15.89
THD A%	3.97	5.56
Luminous Efficacy (lm/W)	138.4	140.9
Luminous Flux per lamp (lm)	2239.0	2240.0
Color Rendering Index (CRI)	82.7	
R9	3.3	
Correlated Color Temperature (CCT)(K)	4878	
Chromaticity Chroma x	0.3493	
Chromaticity Chroma y	0.3613	
Chromaticity Chroma u	0.2105	
Chromaticity Chroma v	0.3266	
Duv	0.0031	
Chromaticity Chroma u'	0.2105	
Chromaticity Chroma v'	0.4899	

Special Color Rendering Indices	
R1	80.5
R2	88.5
R3	94
R4	81.3
R5	80.6
R6	83.5
R7	87.1
R8	65.5
R9	3.3
R10	72.3
R11	80.3
R12	57.1
R13	82.7
R14	96.9
Rf	82
Rg	94

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 30m.

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)	0.542
Power Factor	0.9963
Test Power (W)/4	16.21
Luminous Efficacy (lm/W)	136.1
Luminous Flux per lamp (lm)	2205.4
Beam Angle (°)	141.2
Center Beam Candle Power (cd)	414
Spacing Criteria	1.23 (0°-180°)/ 1.42 (90°-270°)
Zonal Lumens in the 0°-60°Zone	46.77%
Zonal Lumens in the 60°-90°Zone	25.79%
Zonal Lumens in the 90°-120°Zone	14.84%
Zonal Lumens in the 120°-180°Zone	12.60%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

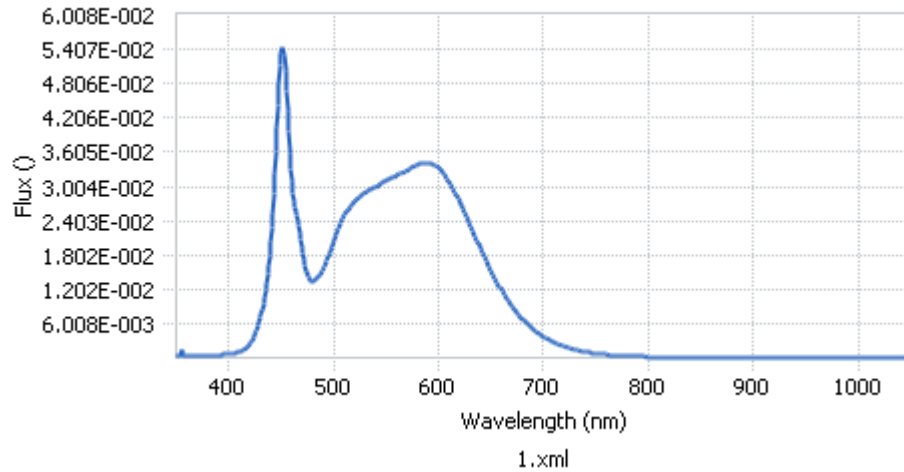


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.89E-04	485	1.42E-02	590	3.42E-02	695	4.30E-03
385	4.88E-04	490	1.55E-02	595	3.39E-02	700	3.70E-03
390	5.05E-04	495	1.78E-02	600	3.33E-02	705	3.16E-03
395	5.65E-04	500	2.05E-02	605	3.22E-02	710	2.69E-03
400	6.40E-04	505	2.30E-02	610	3.08E-02	715	2.31E-03
405	7.57E-04	510	2.48E-02	615	2.92E-02	720	1.97E-03
410	1.03E-03	515	2.64E-02	620	2.73E-02	725	1.69E-03
415	1.50E-03	520	2.75E-02	625	2.53E-02	730	1.45E-03
420	2.40E-03	525	2.82E-02	630	2.33E-02	735	1.23E-03
425	4.08E-03	530	2.90E-02	635	2.11E-02	740	1.05E-03
430	6.94E-03	535	2.94E-02	640	1.91E-02	745	8.90E-04
435	1.19E-02	540	3.01E-02	645	1.71E-02	750	7.68E-04
440	2.04E-02	545	3.06E-02	650	1.53E-02	755	6.60E-04
445	3.62E-02	550	3.11E-02	655	1.35E-02	760	5.67E-04
450	5.36E-02	555	3.15E-02	660	1.19E-02	765	4.89E-04
455	4.69E-02	560	3.19E-02	665	1.04E-02	770	4.20E-04
460	3.08E-02	565	3.24E-02	670	9.02E-03	775	3.59E-04
465	2.49E-02	570	3.29E-02	675	7.84E-03	780	3.12E-04
470	1.95E-02	575	3.34E-02	680	6.79E-03		
475	1.45E-02	580	3.39E-02	685	5.85E-03		
480	1.34E-02	585	3.42E-02	690	5.03E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method

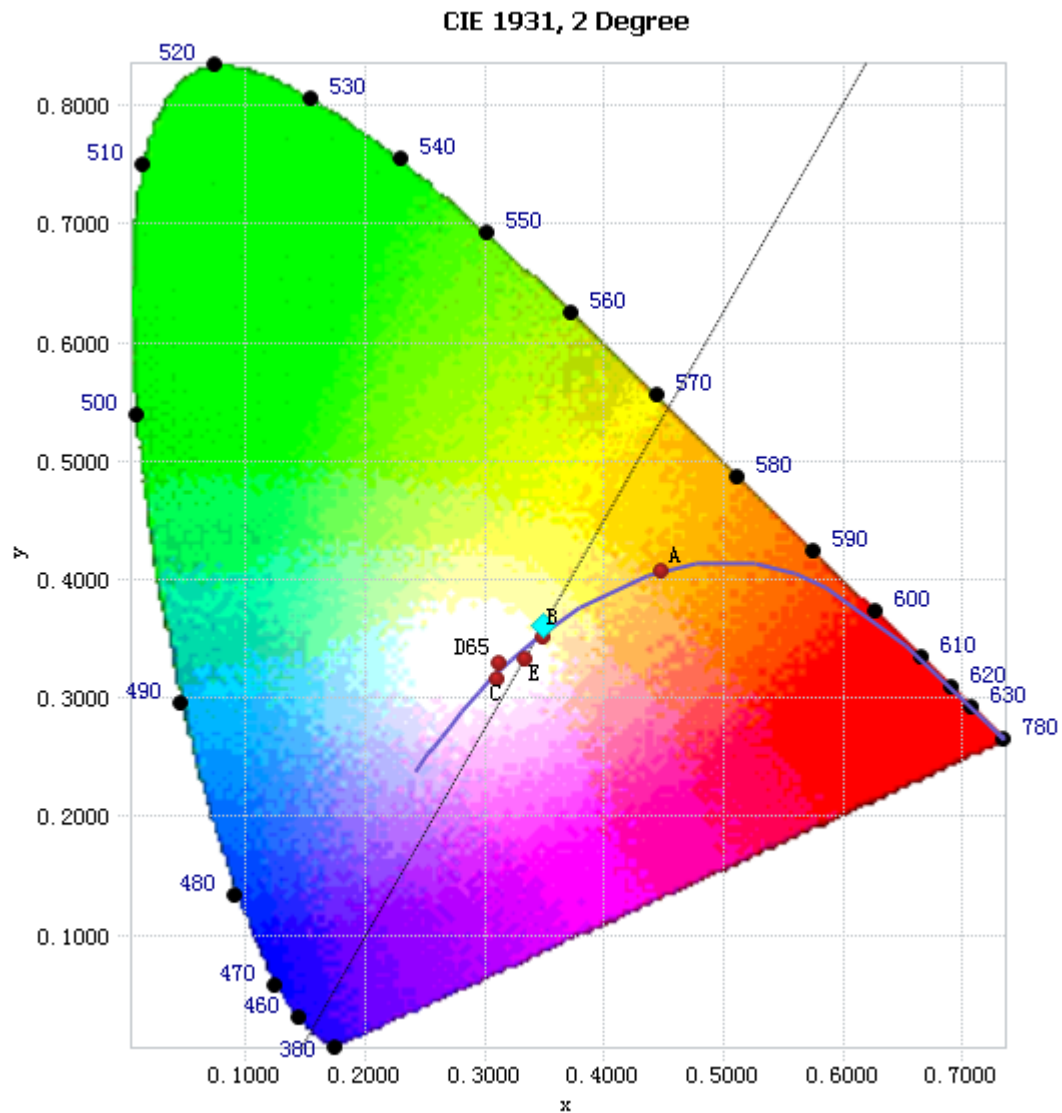


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

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



### Nominal CCT Quadrangles – Sphere Spectroradiometer Method

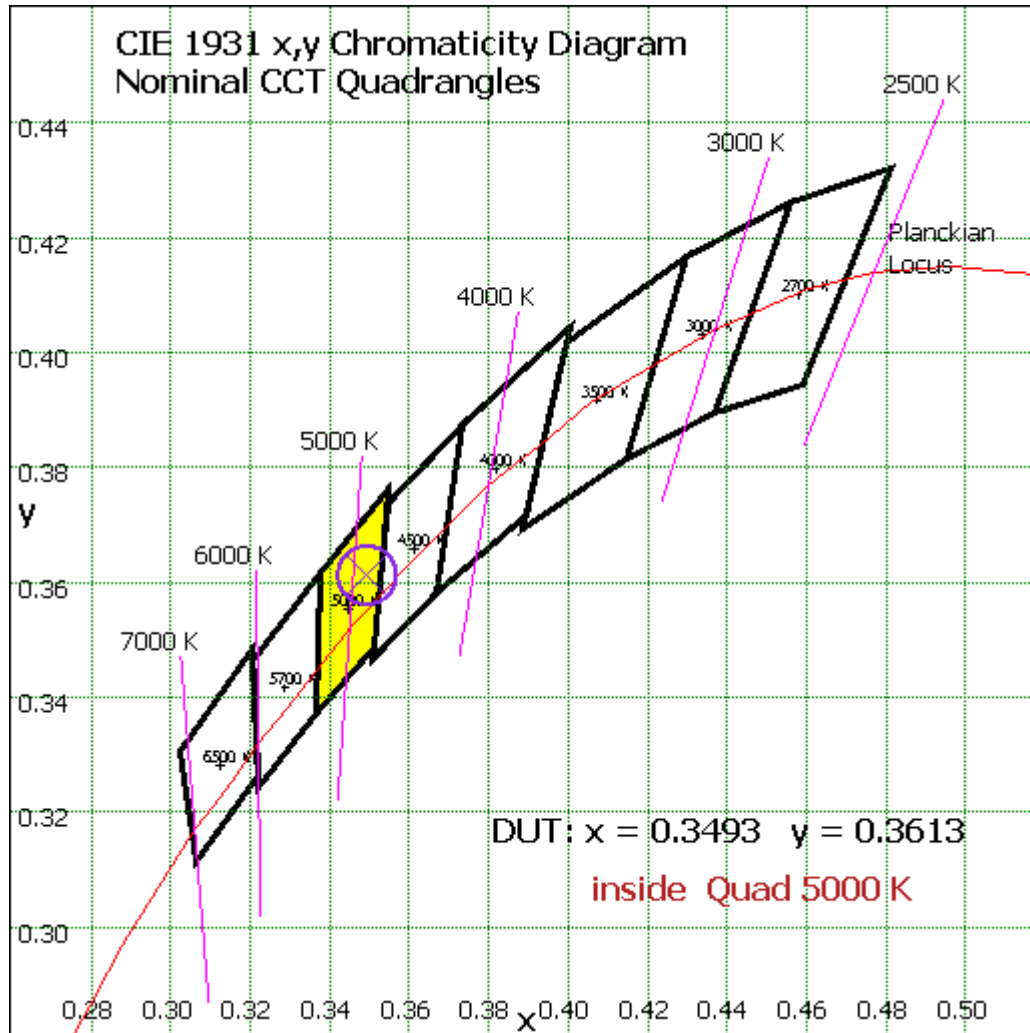


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	39.287	1.78%
10- 20	113.465	5.14%
20- 30	175.246	7.95%
30- 40	218.791	9.92%
40- 50	241.344	10.94%
50- 60	243.407	11.04%
60- 70	228.36	10.35%
70- 80	200.018	9.07%
80- 90	140.321	6.36%
90-100	104.212	4.73%
100-110	118.763	5.39%
110-120	104.353	4.73%
120-130	87.598	3.97%
130-140	70.803	3.21%
140-150	54.161	2.46%
150-160	38.219	1.73%
160-170	21.563	0.98%
170-180	5.481	0.25%
Total	2205.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1031.54	46.77%
60- 90	568.699	25.79%
0-90	1600.239	72.56%
90- 180	605.153	27.44%
0- 180	2205.4	100%

Table 5: Zonal Lumen Data

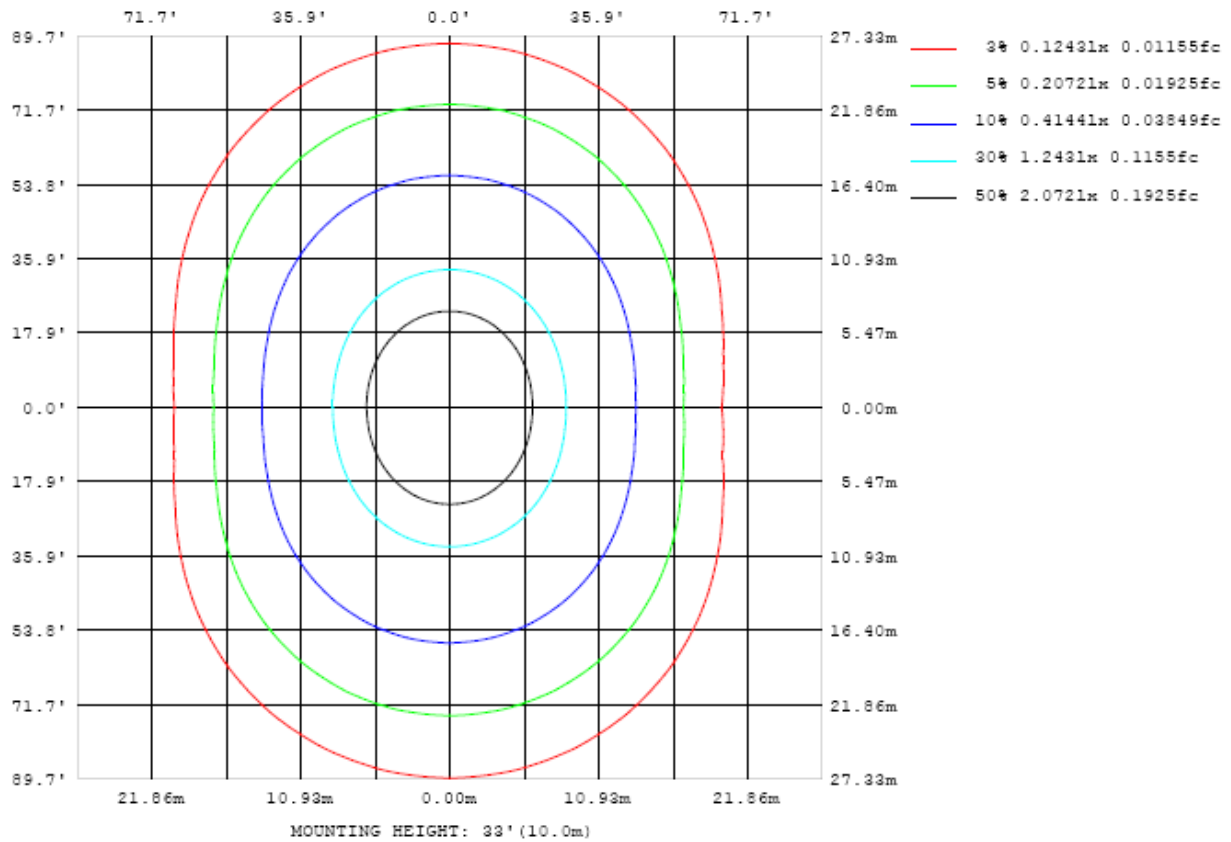


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

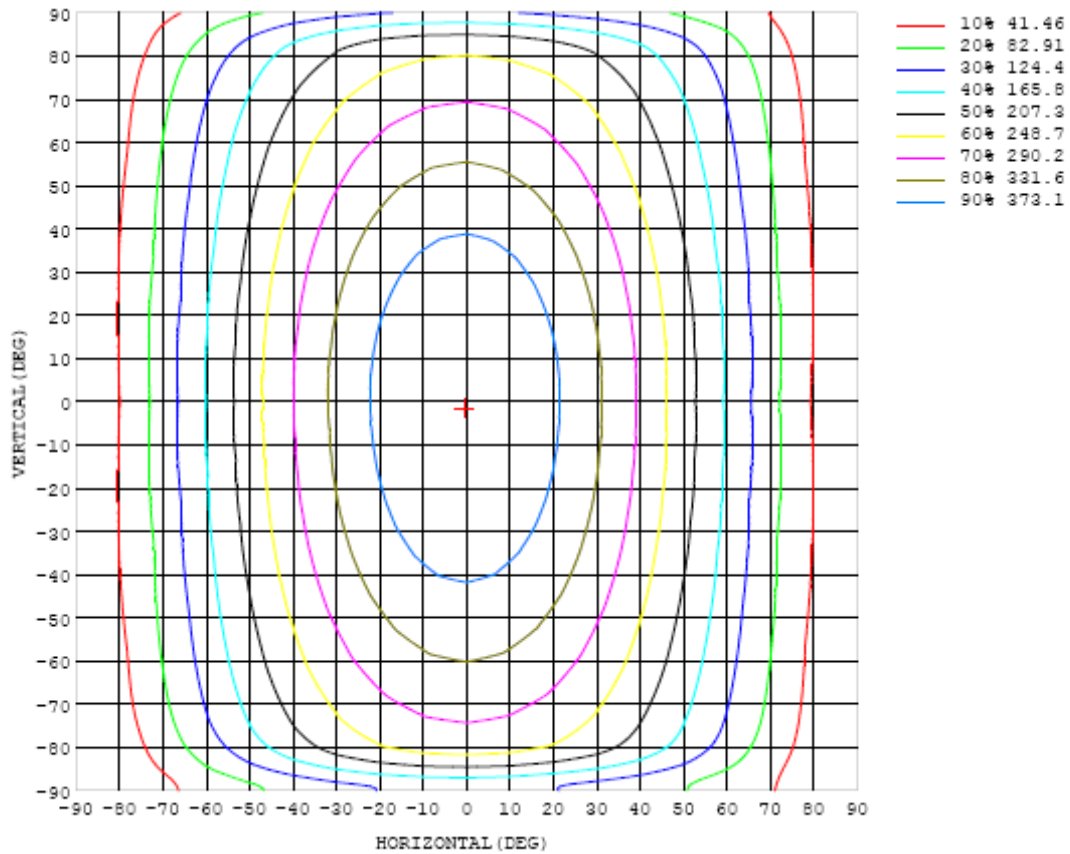


Chart 5: Isocandela Plot

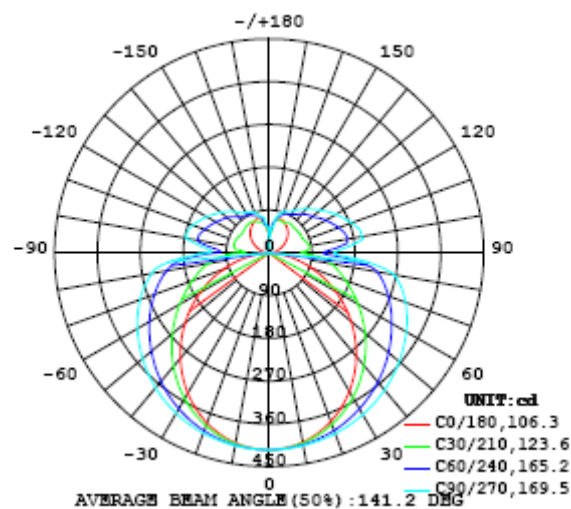


Chart 6: Polar Candela Distribution

## 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	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414
5	412	412	412	412	412	413	413	414	414	414	414	414	414	413	413	413	413	413	413
10	405	405	406	406	408	409	410	411	412	412	412	411	411	410	409	408	407	406	406
15	393	394	395	397	399	402	405	407	408	409	409	408	406	403	401	399	397	396	396
20	378	379	381	385	389	393	398	401	404	405	404	402	399	395	391	387	383	381	381
25	359	360	364	369	376	383	389	394	398	399	399	395	391	385	378	372	367	363	363
30	337	338	344	351	360	370	379	386	391	393	392	387	381	372	363	354	347	342	341
35	312	314	321	331	343	356	367	377	383	385	384	378	369	358	346	334	324	318	317
40	284	287	296	309	325	340	355	366	374	377	375	368	357	343	328	313	300	292	290
45	255	259	270	286	305	324	341	355	363	367	364	356	343	327	308	290	274	264	261
50	224	229	243	263	285	307	327	342	352	356	353	344	329	310	288	266	247	234	230
55	192	199	216	239	265	290	312	329	340	344	341	331	314	292	268	243	220	204	199
60	160	168	188	215	245	273	297	316	328	332	329	317	299	275	248	219	192	173	167
65	128	137	161	192	225	256	282	302	314	319	315	303	283	258	228	196	165	142	135
70	95.7	107	136	171	206	239	266	287	300	304	300	288	268	241	209	174	140	112	102
75	65.2	79.2	113	151	189	222	249	270	283	288	284	271	251	224	191	154	116	83.5	70.5
80	37.3	55.1	92.5	133	170	203	230	249	261	266	262	250	230	203	171	134	94.4	58.5	41.3
85	14.7	35.6	72.8	109	138	160	176	188	196	200	198	190	178	160	136	106	71.1	36.4	16.8
90	3.18	17.8	44.1	68.7	84.1	101	114	126	134	136	134	125	113	96.0	76.6	58.7	31.9	11.0	0.73
95	6.51	22.0	52.1	83.3	111	132	148	160	168	171	168	159	145	125	102	74.7	44.3	19.5	4.61
100	11.6	25.2	52.4	85.9	117	145	166	182	193	198	195	184	167	143	115	83.8	51.5	24.3	10.2
105	17.4	29.0	52.3	82.2	112	140	163	180	191	195	192	182	165	142	114	83.3	52.3	28.9	16.4
110	23.2	32.9	52.6	79.2	107	133	155	172	181	184	181	171	156	134	108	80.5	53.2	33.6	23.2
115	29.9	38.0	54.0	75.7	102	126	146	161	170	173	170	161	146	127	103	77.7	55.1	38.6	30.2
120	36.5	42.4	56.2	76.4	95.7	119	137	151	159	162	159	151	137	119	97.8	76.6	57.3	43.9	37.4
125	43.1	46.2	58.2	75.6	93.7	111	128	141	148	151	148	141	129	112	94.4	76.2	58.7	50.1	44.0
130	49.8	52.3	62.3	75.2	90.7	107	119	130	137	140	138	131	121	107	91.4	74.4	62.5	55.3	50.5
135	55.4	56.4	64.8	74.1	86.8	101	113	122	128	130	128	122	113	102	87.8	75.3	65.8	60.1	56.1
140	60.8	64.1	66.8	75.4	84.0	95.7	107	114	119	120	119	114	107	96.0	85.3	76.7	69.7	65.2	61.4
145	65.4	68.0	67.5	75.8	83.5	90.4	99.0	105	110	112	111	106	99.8	91.9	84.9	77.6	70.6	68.4	65.8
150	68.9	70.9	70.1	72.5	82.2	88.8	93.5	98.0	101	103	102	99.1	94.9	90.5	84.8	78.1	72.1	70.7	70.0
155	72.4	75.0	72.9	71.4	77.3	86.0	91.1	93.7	95.5	96.2	96.3	94.8	91.7	87.3	82.2	77.0	73.7	73.5	73.0
160	74.9	80.5	75.7	71.5	74.5	79.6	85.7	90.0	91.9	92.4	91.9	89.9	87.3	83.8	79.6	74.5	72.6	77.5	76.3
165	72.5	76.2	75.2	72.2	70.9	74.2	79.8	82.2	83.4	84.0	81.3	82.1	80.6	77.4	71.7	69.6	74.6	77.5	75.9
170	66.7	59.4	62.3	68.2	68.5	67.5	68.9	70.5	69.7	67.7	66.5	63.5	63.4	63.0	62.2	63.1	63.9	63.3	63.4
175	49.5	44.4	43.5	42.8	42.6	45.9	52.4	52.8	47.8	52.3	53.6	47.4	44.3	43.6	44.3	45.8	47.1	47.9	48.9
180	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1

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		414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414	414		
5		413	413	413	413	413	414	414	414	414	414	414	413	413	413	412	412	412		
10		407	407	408	409	410	411	411	412	412	412	411	410	409	408	407	406	405		
15		396	397	399	402	404	406	407	409	409	408	407	405	402	400	397	395	394		
20		382	384	387	391	395	399	402	403	404	403	401	397	393	389	385	381	379		
25		364	367	372	378	384	390	394	397	397	396	393	388	381	375	369	364	360		
30		343	347	354	363	371	379	385	389	390	388	384	377	368	359	351	343	339		
35		319	325	334	345	356	366	375	380	381	379	373	364	353	341	330	321	314		
40		292	300	312	326	340	353	363	369	371	368	361	350	336	322	308	296	288		
45		264	274	289	306	323	338	350	357	359	356	348	335	319	301	284	269	259		
50		235	247	265	285	305	322	336	344	346	343	334	319	301	280	260	242	229		
55		204	219	241	264	287	306	321	330	333	329	319	303	282	259	235	214	199		
60		173	191	217	243	268	290	306	316	319	315	304	286	264	238	211	186	168		
65		143	165	193	223	250	273	291	301	304	300	288	270	246	218	188	159	137		
70		113	139	171	203	232	256	274	285	288	284	272	253	228	198	166	134	107		
75		84.2	115	151	184	214	238	256	267	270	266	254	236	211	180	147	110	79.3		
80		58.5	93.3	130	164	194	218	236	246	250	245	234	215	191	162	128	89.7	54.6		
85		36.1	70.0	105	138	164	185	198	206	207	203	194	180	160	137	106	70.3	35.2		
90		10.7	32.0	55.5	77.4	96.3	112	123	129	130	126	118	107	93.3	78.1	60.9	40.5	16.8		
95		16.0	39.2	63.5	85.2	104	119	129	136	139	137	131	123	110	94.1	73.2	46.3	20.3		
100		22.1	45.9	74.8	104	130	152	167	174	177	174	165	151	130	106	78.9	47.8	22.8		
105		26.2	48.3	76.0	104	129	151	166	174	177	174	164	151	130	105	75.6	47.4	26.5		
110		30.8	50.0	75.2	101	124	144	159	167	171	167	158	145	124	99.4	73.0	48.3	29.9		
115		35.5	50.7	74.0	97.2	119	137	150	159	161	158	150	137	118	94.9	71.7	49.0	35.1		
120		41.4	52.9	72.0	93.8	113	129	142	149	152	149	141	129	111	91.4	70.7	51.3	41.1		
125		46.6	55.0	69.7	89.9	108	122	133	139	141	139	132	121	106	88.3	68.2	53.7	46.8		
130		52.0	59.1	71.3	84.5	102	115	125	130	132	130	124	114	100	84.1	69.4	58.2	52.0		
135		56.7	62.7	72.0	82.5	94.3	107	116	122	123	121	116	107	94.3	80.9	70.2	61.5	55.8		
140		61.3	65.3	74.2	82.4	90.0	97.9	106	111	113	111	106	97.9	89.1	80.6	72.7	65.1	60.5		
145		64.5	68.3	75.2	82.0	89.1	94.7	98.5	101	102	101	98.3	93.9	87.3	80.6	74.6	67.4	64.1		
150		66.6	68.1	74.7	81.0	86.7	91.8	95.9	98.1	98.7	97.8	95.3	91.0	85.9	81.0	74.4	68.2	66.1		
155		67.7	66.9	72.9	80.2	83.8	87.3	92.2	94.1	94.5	93.8	92.1	89.0	84.9	79.4	73.5	68.4	67.9		
160		70.2	66.6	69.6	76.9	81.9	83.8	83.8	88.3	90.4	90.1	88.9	86.6	81.9	77.3	72.7	69.8	69.3		
165		71.7	66.9	67.4	71.8	76.2	80.0	82.4	81.2	78.1	81.6	82.2	80.0	76.8	74.1	72.3	69.0	68.1		
170		62.6	61.7	62.2	62.3	63.5	66.8	70.8	75.3	76.6	75.3	74.6	74.2	73.1	69.9	66.9	66.3	67.5		
175		49.9	51.3	52.2	53.1	56.0	58.8	58.6	56.8	55.6	55.7	56.9	58.4	58.9	57.6	57.6	58.7	57.0		
180		42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1		

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**

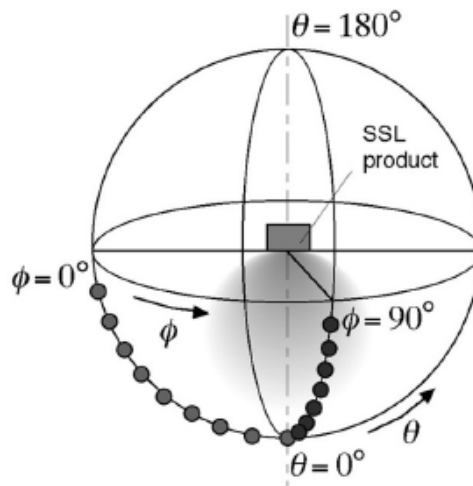
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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