

## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube System

#### Model: 10.5T8/3F/840/EXT/A2

(LED tube model: 10.5T8/3F/840/EXT 2pcs and LED driver model: 15T8T5HEDRIVER/2CH 1pcs)

#### Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ1808024ah

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

Review by:



Engineer: April Zou

Aug. 29, 2018

Approved by:



Manager: Jim Zhang

Aug. 29, 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: 10.5T8/3F/840/EXT/A2

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/2	Power Factor
138.5	1704.0	12.30	0.9948
CCT (K)	CRI	Stabilization Time (Light & Power)	
4128	82.8	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. 03, 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>	: 10.5T8/3F/840/EXT/A2
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 4000K LED tube model: 10.5T8/3F/840/EXT 2 LED tubes supplied by a LED driver: 15T8T5HEDRIVER/2CH
<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)	0.206	0.098
Power Factor	0.9948	0.9400
Test Power (W)/2	12.30	12.69
THD A%	4.23	10.66
Luminous Efficacy (lm/W)	138.5	134.3
Luminous Flux per lamp (lm)	1704.0	1704.0
Color Rendering Index (CRI)	82.8	
R9	7.2	
Correlated Color Temperature (CCT)(K)	4128	
Chromaticity Chroma x	0.3762	
Chromaticity Chroma y	0.3773	
Chromaticity Chroma u	0.2221	
Chromaticity Chroma v	0.3341	
Duv	0.0015	
Chromaticity Chroma u'	0.2221	
Chromaticity Chroma v'	0.5012	

Special Color Rendering Indices	
R1	80.4
R2	86.9
R3	92.8
R4	84.1
R5	82.6
R6	85
R7	85.6
R8	64.7
R9	7.2
R10	70.2
R11	83.2
R12	59.5
R13	81.3
R14	95.9
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 24.7°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)	0.207
Power Factor	0.9948
Test Power (W)/2	12.33
Luminous Efficacy (lm/W)	136.1
Luminous Flux per lamp (lm)	1677.8
Beam Angle ( °)	171.5
Center Beam Candle Power (cd)	270
Spacing Criteria	1.26 (0 °-180 °)/ 1.45 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	41.92%
Zonal Lumens in the 60 °-90 °Zone	26.85%
Zonal Lumens in the 90 °-120 °Zone	17.98%
Zonal Lumens in the 120 °-180 °Zone	13.25%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

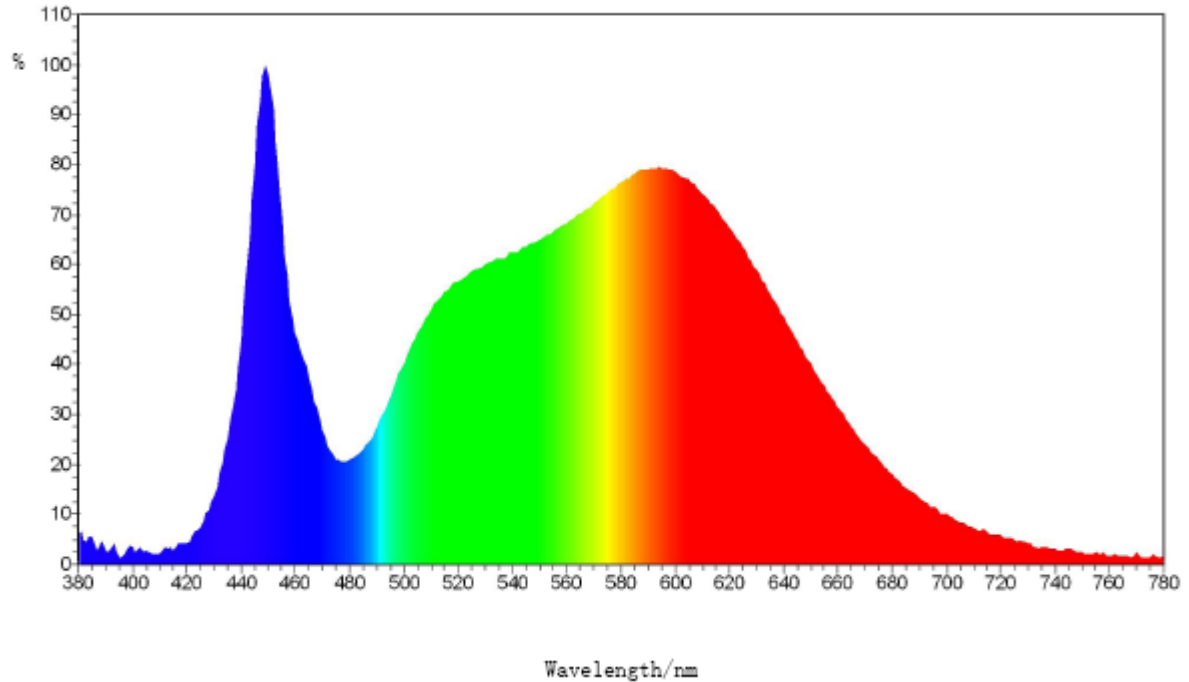


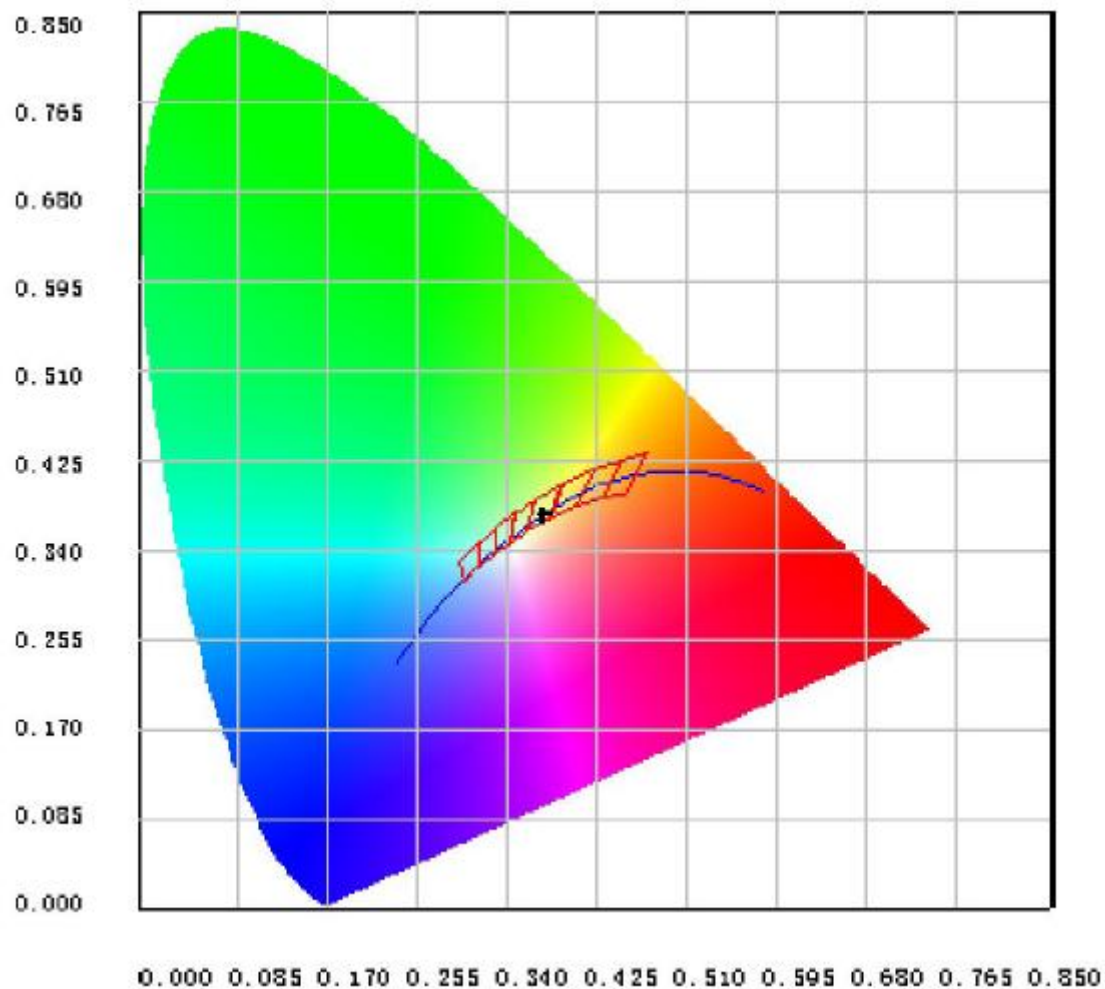
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.23E-03	485	1.23E-02	590	4.19E-02	695	6.11E-03
385	2.93E-03	490	1.46E-02	595	4.22E-02	700	5.34E-03
390	1.49E-03	495	1.78E-02	600	4.18E-02	705	4.53E-03
395	7.94E-04	500	2.13E-02	605	4.09E-02	710	3.87E-03
400	1.82E-03	505	2.44E-02	610	3.95E-02	715	3.44E-03
405	1.52E-03	510	2.69E-02	615	3.78E-02	720	3.07E-03
410	1.11E-03	515	2.89E-02	620	3.58E-02	725	2.65E-03
415	1.52E-03	520	3.00E-02	625	3.37E-02	730	2.31E-03
420	2.28E-03	525	3.12E-02	630	3.13E-02	735	1.82E-03
425	3.99E-03	530	3.19E-02	635	2.87E-02	740	1.58E-03
430	7.25E-03	535	3.24E-02	640	2.63E-02	745	1.60E-03
435	1.33E-02	540	3.31E-02	645	2.38E-02	750	1.22E-03
440	2.39E-02	545	3.38E-02	650	2.12E-02	755	1.23E-03
445	4.27E-02	550	3.46E-02	655	1.89E-02	760	9.98E-04
450	5.20E-02	555	3.54E-02	660	1.68E-02	765	9.77E-04
455	3.63E-02	560	3.62E-02	665	1.46E-02	770	1.23E-03
460	2.47E-02	565	3.73E-02	670	1.27E-02	775	7.83E-04
465	2.02E-02	570	3.84E-02	675	1.12E-02	780	9.85E-04
470	1.43E-02	575	3.96E-02	680	9.57E-03		
475	1.12E-02	580	4.06E-02	685	8.17E-03		
480	1.11E-02	585	4.15E-02	690	7.09E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3762, 0.3773)

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

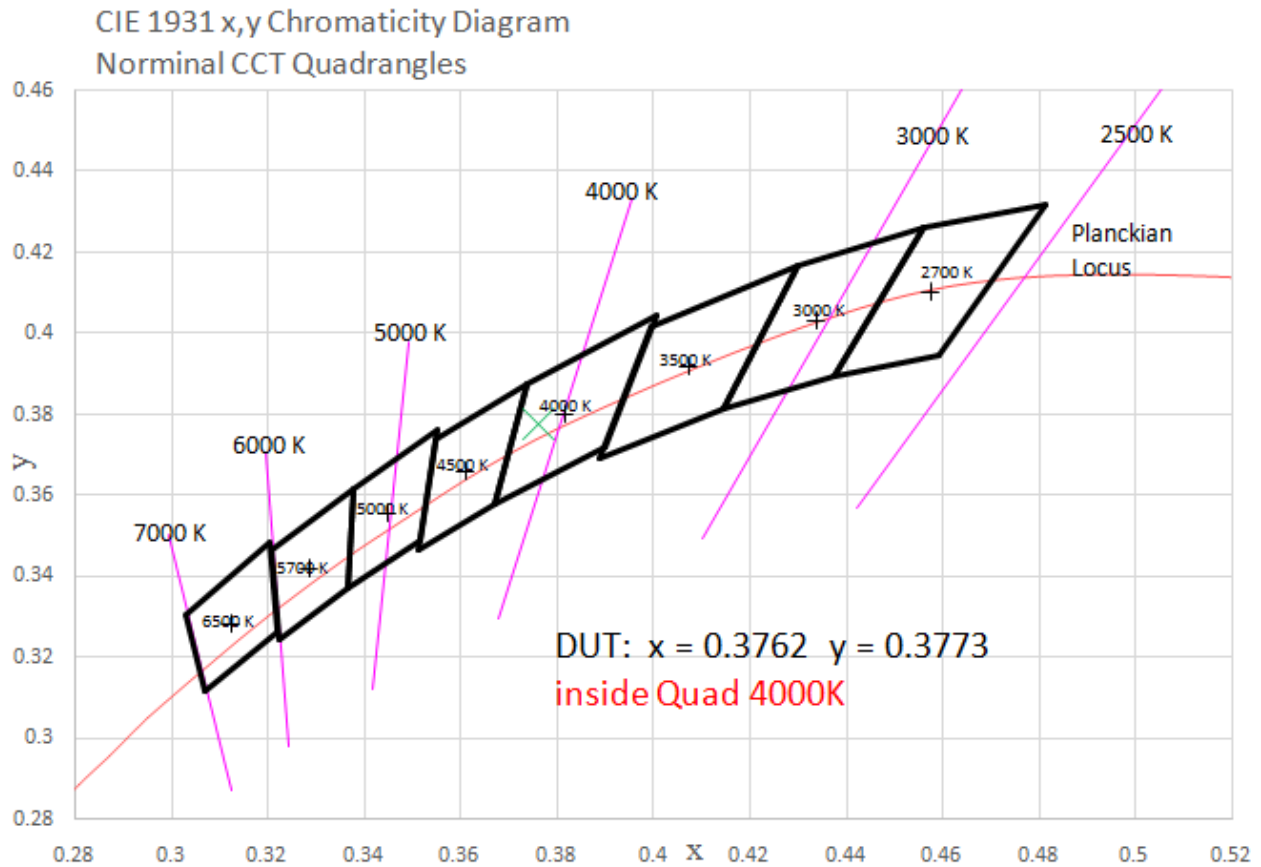


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	25.634	1.53%
10- 20	74.481	4.44%
20- 30	116.419	6.94%
30- 40	147.863	8.81%
40- 50	166.641	9.93%
50- 60	172.322	10.27%
60- 70	166.104	9.90%
70- 80	151.315	9.02%
80- 90	133.109	7.93%
90-100	116.514	6.94%
100-110	100.37	5.98%
110-120	84.776	5.05%
120-130	70.474	4.20%
130-140	56.948	3.39%
140-150	43.624	2.60%
150-160	30.296	1.81%
160-170	16.458	0.98%
170-180	4.488	0.27%
Total	1677.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	703.36	41.92%
60- 90	450.528	26.85%
0-90	1153.888	68.77%
90- 180	523.948	31.23%
0- 180	1677.8	100%

Table 5: Zonal Lumen Data

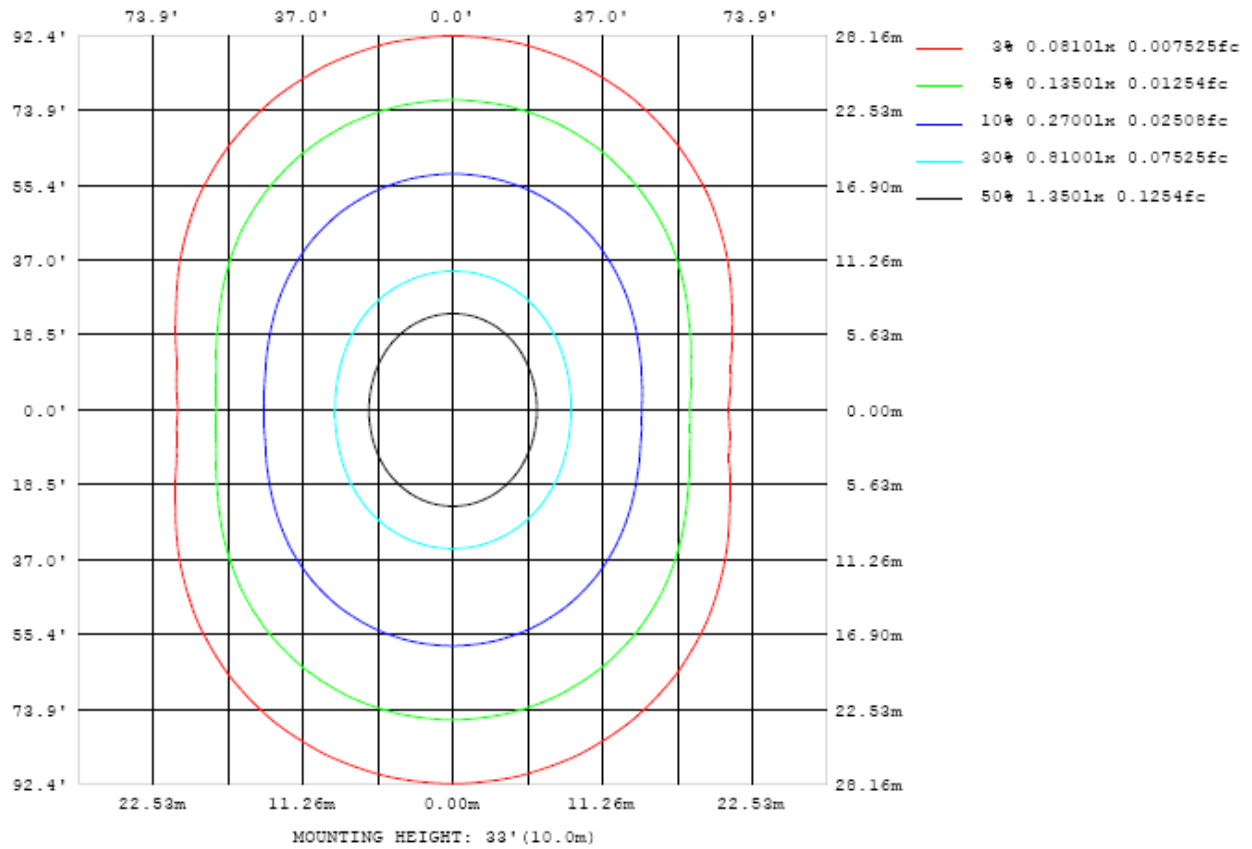


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

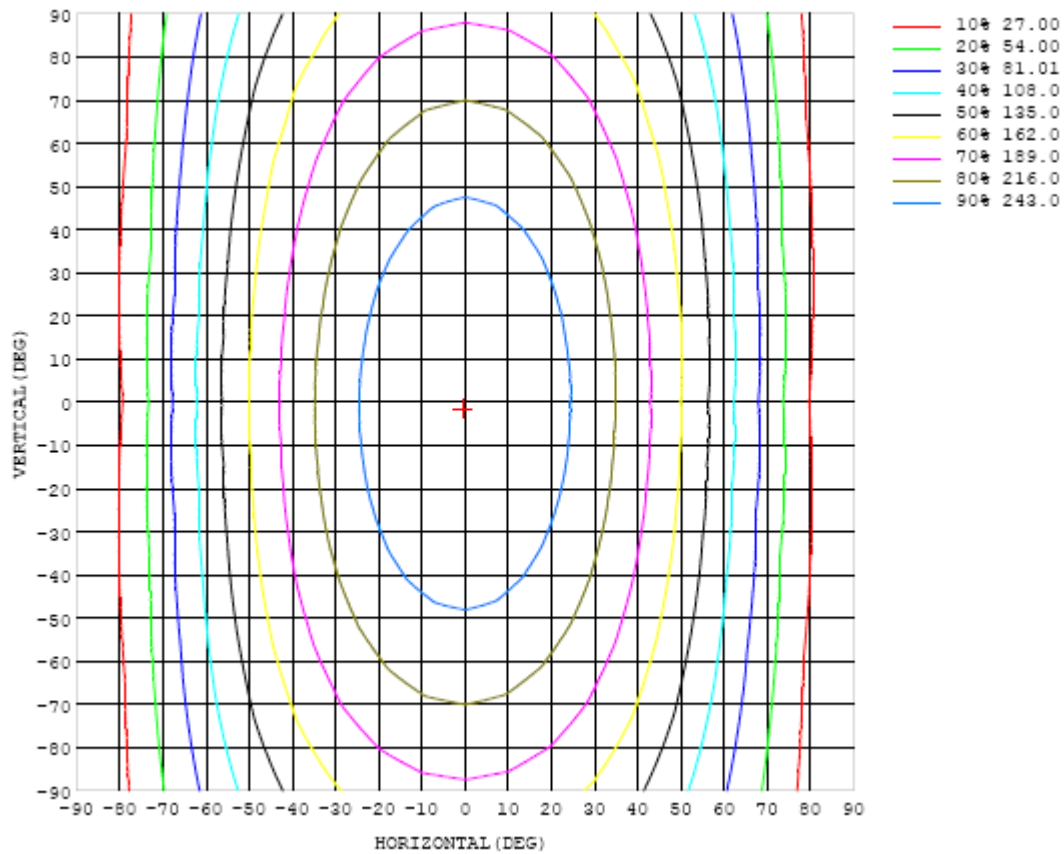


Chart 5: Isocandela Plot

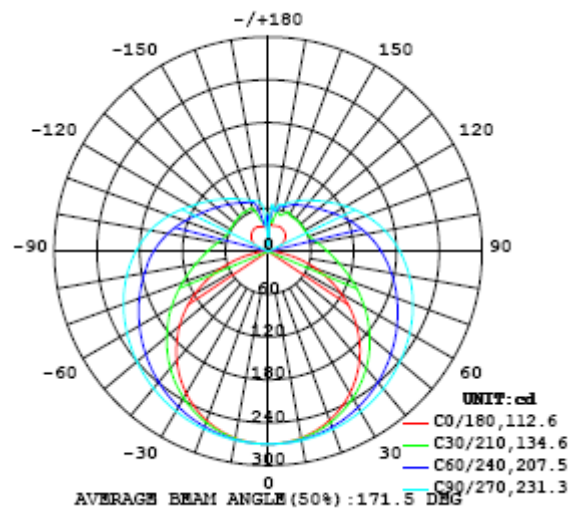


Chart 6: Polar Candela Distribution

## 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	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270
5	269	269	269	269	269	269	270	270	270	270	270	270	270	269	269	269	269	269	269
10	265	265	266	266	267	267	268	268	269	269	269	269	268	268	267	266	266	266	266
15	260	260	261	262	263	264	265	266	267	267	267	267	266	264	263	262	261	260	260
20	252	252	253	255	257	260	262	264	265	265	265	264	262	260	258	256	254	253	252
25	242	242	244	247	250	254	257	260	262	263	262	260	258	255	251	248	245	243	242
30	229	230	233	237	242	247	252	256	258	259	258	256	253	248	243	238	234	231	230
35	215	216	220	226	233	240	246	251	254	255	255	252	247	241	234	227	221	217	216
40	199	201	206	214	223	232	239	246	250	251	250	246	240	232	224	215	207	201	199
45	181	184	190	200	212	223	232	240	245	246	245	241	233	224	213	201	191	184	181
50	162	165	174	186	200	213	225	233	239	241	239	234	226	214	201	187	174	165	162
55	141	145	156	171	188	204	217	227	233	235	233	228	218	205	189	172	156	144	141
60	118	123	137	156	176	194	209	220	227	229	227	221	210	195	177	158	138	123	118
65	94.8	101	119	141	164	184	201	213	220	223	221	214	202	186	166	143	120	101	94.5
70	71.3	79.2	101	127	152	174	192	205	213	216	214	206	194	176	154	129	102	79.5	70.4
75	48.0	58.5	83.9	113	141	165	184	198	206	209	206	199	185	167	143	116	86.0	59.2	46.5
80	25.7	39.4	69.7	102	131	156	175	190	198	201	199	191	177	158	134	104	72.4	41.0	24.6
85	8.58	24.8	58.0	91.5	122	147	167	181	190	193	191	182	169	149	124	94.5	61.3	27.4	7.87
90	0.47	16.9	49.7	83.1	113	138	158	173	182	185	182	174	160	141	116	86.2	53.2	20.1	0.43
95	2.01	14.1	44.0	76.4	105	130	150	164	173	176	173	165	151	132	108	79.3	47.6	17.3	2.25
100	5.14	15.2	40.2	70.1	97.6	122	141	155	163	166	164	156	143	124	101	73.5	43.9	18.0	5.38
105	9.42	18.1	38.7	65.2	90.7	113	132	145	153	156	154	146	133	116	93.6	68.6	42.2	20.5	9.70
110	14.2	21.8	39.3	61.6	84.6	106	123	136	143	146	144	137	125	108	87.5	64.9	42.4	23.9	14.5
115	19.3	25.1	40.9	59.8	79.4	98.4	114	126	133	136	134	127	116	101	82.0	62.9	43.9	27.5	19.5
120	24.4	31.2	42.9	59.1	76.2	91.9	106	117	124	126	124	118	108	93.9	78.3	61.7	45.4	31.9	24.4
125	28.7	36.1	45.0	59.0	73.4	86.9	98.8	108	114	116	115	109	100	88.7	75.6	61.4	47.2	35.9	28.4
130	31.8	36.7	46.6	59.1	71.5	82.5	92.8	101	106	108	106	102	94.2	84.0	73.6	61.0	48.6	40.1	31.3
135	34.0	37.3	48.7	59.3	69.8	79.2	87.6	94.1	98.3	99.9	98.7	94.8	88.7	80.6	71.5	61.0	50.1	41.7	33.6
140	35.8	42.3	53.6	58.9	68.3	76.5	83.1	88.6	92.0	93.3	92.3	89.2	84.1	77.4	69.5	60.6	52.9	41.6	35.2
145	36.9	41.6	54.1	58.7	66.7	73.6	78.6	83.2	86.0	87.2	86.4	83.7	79.3	74.2	67.7	59.9	54.3	42.7	36.4
150	37.6	41.7	51.7	60.9	64.0	70.5	75.3	78.2	80.2	81.1	80.5	78.4	75.6	71.1	65.2	59.3	52.6	43.9	37.3
155	38.1	43.9	48.6	60.0	63.3	66.6	70.6	73.9	75.7	76.2	75.8	74.1	71.1	67.3	63.7	58.8	50.6	46.2	37.5
160	37.5	42.7	52.3	53.8	63.0	65.9	66.4	68.5	69.5	70.0	69.7	68.8	67.3	65.2	59.7	54.8	49.6	43.5	36.7
165	37.0	39.2	44.8	56.6	55.6	59.9	64.6	66.7	67.9	68.0	67.9	68.0	66.2	55.7	50.0	44.2	41.3	37.3	35.8
170	36.6	36.0	37.1	47.4	58.3	59.4	57.7	57.7	57.9	58.6	59.0	59.2	48.3	41.6	39.8	37.7	35.0	33.4	34.9
175	45.5	44.4	42.8	43.8	46.7	46.8	51.3	60.5	65.1	66.3	57.4	38.4	33.5	38.4	39.7	42.2	39.9	40.1	42.3
180	8.24	8.24	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23

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	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270		
5	269	269	269	269	269	269	269	270	270	270	269	269	269	269	269	269	269		
10	266	266	266	267	267	268	268	268	268	268	268	268	267	267	266	266	266		
15	260	261	262	263	264	265	266	267	267	267	266	265	264	263	261	260	260		
20	252	253	255	257	259	261	263	264	265	264	263	262	259	257	255	253	252		
25	243	244	247	250	254	257	259	261	262	261	260	257	254	250	247	244	243		
30	231	233	237	242	247	252	255	258	259	258	255	252	247	243	237	233	231		
35	217	220	226	233	240	246	250	254	255	254	251	246	240	233	226	221	217		
40	201	206	214	223	231	239	245	249	250	249	245	240	232	223	214	207	201		
45	183	190	200	211	222	232	239	244	246	244	240	233	223	212	201	191	184		
50	165	173	186	200	213	224	233	238	240	239	233	225	214	201	187	175	167		
55	145	156	171	188	203	216	226	233	235	233	227	217	205	189	173	158	147		
60	123	138	157	176	194	208	220	226	229	227	220	209	195	177	159	140	125		
65	101	119	142	165	184	200	212	220	223	220	213	202	185	167	144	122	104		
70	79.2	101	128	153	175	192	205	213	216	214	206	194	176	155	130	104	82.0		
75	58.1	84.8	115	143	167	184	198	206	209	206	199	186	168	145	117	87.7	61.0		
80	39.5	70.5	103	133	158	176	190	199	202	199	191	177	159	135	106	73.3	42.4		
85	25.7	59.3	93.4	124	149	169	182	191	194	191	183	170	151	126	95.7	61.9	28.1		
90	18.4	51.5	85.3	116	141	161	174	183	186	183	175	162	142	117	87.3	53.6	20.1		
95	15.2	45.6	78.1	108	133	152	166	174	177	174	167	153	134	109	79.9	47.4	16.3		
100	16.3	41.7	71.7	99.8	124	143	157	165	168	165	157	144	125	101	73.2	42.9	16.7		
105	19.7	40.7	66.5	92.6	115	134	147	155	158	155	147	135	116	93.8	67.6	41.0	19.9		
110	24.3	41.5	63.6	86.1	107	124	137	145	147	145	137	125	108	87.0	63.8	41.1	24.4		
115	29.0	43.5	62.1	81.7	99.8	115	127	134	137	134	127	116	100	81.8	61.7	42.5	29.1		
120	33.8	45.9	61.6	78.4	94.3	108	117	124	126	124	118	108	94.3	78.2	60.7	45.3	33.9		
125	38.4	48.5	61.6	75.8	89.5	101	110	115	117	115	110	101	89.4	75.5	60.8	48.4	38.5		
130	42.8	51.3	62.1	74.0	85.5	95.4	103	108	109	108	103	95.3	85.3	73.6	61.6	51.5	42.9		
135	46.1	54.1	62.7	72.5	82.0	90.2	96.6	101	102	101	96.6	90.3	81.9	72.4	62.7	54.4	47.0		
140	47.8	56.8	63.6	71.3	79.1	85.8	91.0	94.3	95.5	94.3	91.0	85.8	79.0	71.5	63.8	57.1	50.4		
145	48.3	58.3	64.5	70.5	76.5	81.8	86.0	88.7	89.6	88.7	86.0	81.9	76.6	70.9	64.9	59.6	52.2		
150	49.6	60.4	63.2	69.7	74.3	78.3	81.5	83.6	84.4	83.7	81.7	78.6	74.7	70.6	66.0	61.9	53.3		
155	53.1	61.7	64.8	68.4	72.4	75.3	77.6	79.2	79.8	79.4	78.0	76.0	73.2	70.5	67.2	63.1	55.2		
160	45.8	56.4	62.6	64.3	70.5	72.7	74.3	75.4	76.0	75.8	75.0	73.8	72.2	70.5	68.2	63.0	52.2		
165	40.0	45.3	49.2	53.0	60.1	67.7	71.7	72.5	73.0	72.9	72.6	72.0	71.2	69.9	66.7	59.4	45.4		
170	35.4	37.4	39.5	38.9	40.3	43.5	53.8	68.4	69.7	69.7	69.3	68.4	67.4	65.1	57.0	44.2	39.6		
175	42.8	43.1	42.3	44.6	42.4	42.0	34.9	30.9	38.7	61.4	61.0	54.2	48.2	47.6	46.5	42.8	43.9		
180	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.24		

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**

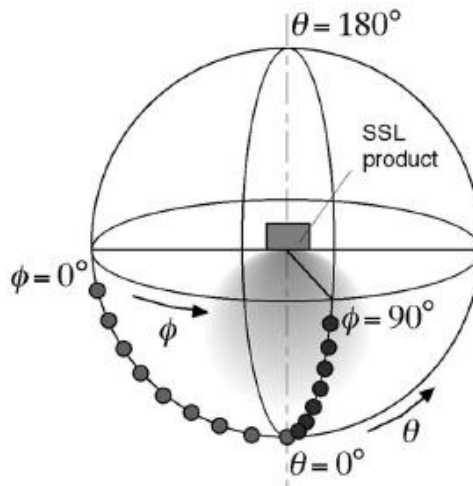
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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