

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

for

### **GREEN CREATIVE LTD**

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

### **LED Tube System**

### **Model: 14.5T8U6/840/EXT/A2**

(LED tube model: 14.5T8U6/840/EXT 2pcs and LED driver model: 15T8T5HEDRIVER/2CH 1pcs)

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

**NVLAP CODE: 200960-0**

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, Yuhang Dist,  
Hangzhou, Zhejiang Province, China 311100


Tel: +86 571 86376106

[www.ledtestlab.com](http://www.ledtestlab.com)

Report No.: HZ18080024ae

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: 14.5T8U6/840/EXT/A2

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/2	Power Factor
144.2	2370.0	16.44	0.9965
CCT (K)	CRI	Stabilization Time (Light & Power)	
3966	82.1	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

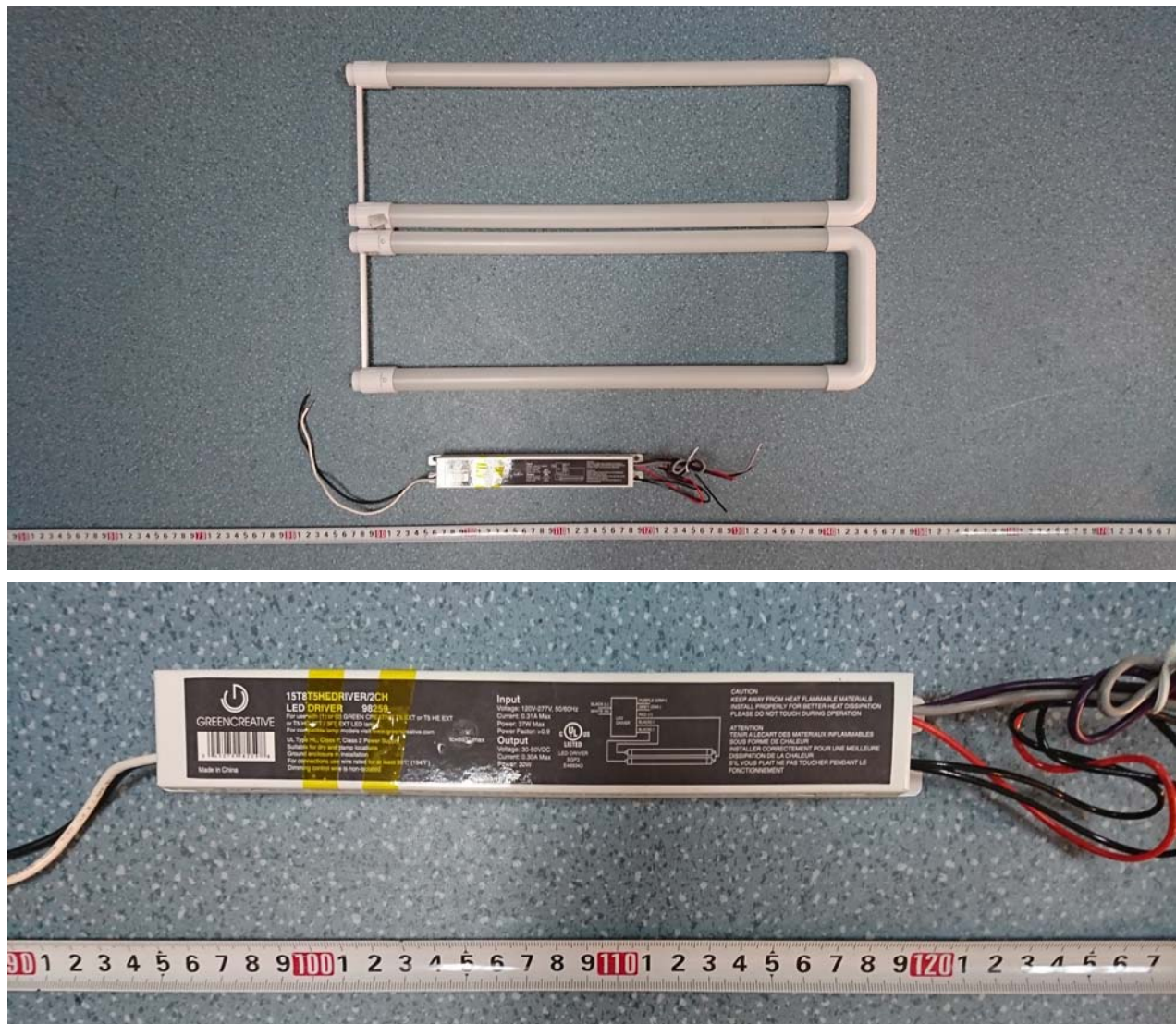


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube System
<b>Model</b>	: 14.5T8U6/840/EXT/A2
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 4000K LED tube model: 14.5T8U6/840/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 25.1 °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)	0.275	0.125
Power Factor	0.9965	0.9627
Test Power (W)/2	16.44	16.70
THD A%	3.97	7.71
Luminous Efficacy (lm/W)	144.2	141.9
Luminous Flux per lamp (lm)	2370.0	2368.0
Color Rendering Index (CRI)	82.1	
R9	1.7	
Correlated Color Temperature (CCT)(K)	3966	
Chromaticity Chroma x	0.3830	
Chromaticity Chroma y	0.3818	
Chromaticity Chroma u	0.2248	
Chromaticity Chroma v	0.3361	
Duv	0.0016	
Chromaticity Chroma u'	0.2248	
Chromaticity Chroma v'	0.5041	

Special Color Rendering Indices	
R1	80.1
R2	87.9
R3	94.4
R4	81.9
R5	80.5
R6	83.8
R7	85.6
R8	62.5
R9	1.7
R10	71.7
R11	81.3
R12	62.7
R13	81.9
R14	97
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 24.9°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)	0.276
Power Factor	0.9959
Test Power (W)/2	16.48
Luminous Efficacy (lm/W)	141.7
Luminous Flux per lamp (lm)	2334.5
Beam Angle (°)	137.6
Center Beam Candle Power (cd)	458
Spacing Criteria	1.22 (0°-180°)/ 1.42 (90°-270°)
Zonal Lumens in the 0°-60°Zone	48.27%
Zonal Lumens in the 60°-90°Zone	25.96%
Zonal Lumens in the 90°-120°Zone	14.00%
Zonal Lumens in the 120°-180°Zone	11.77%

Table 3: Test data per Goniophotometer Method



## Spectral Power Distribution - Sphere Spectroradiometer Method

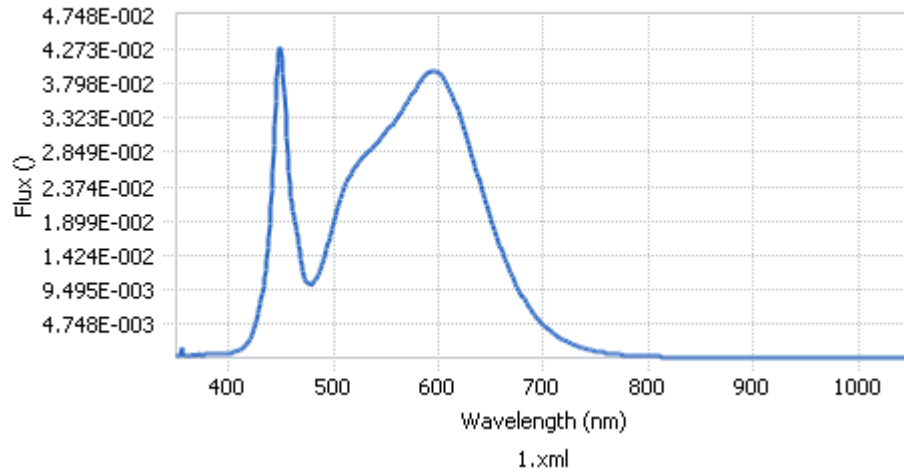
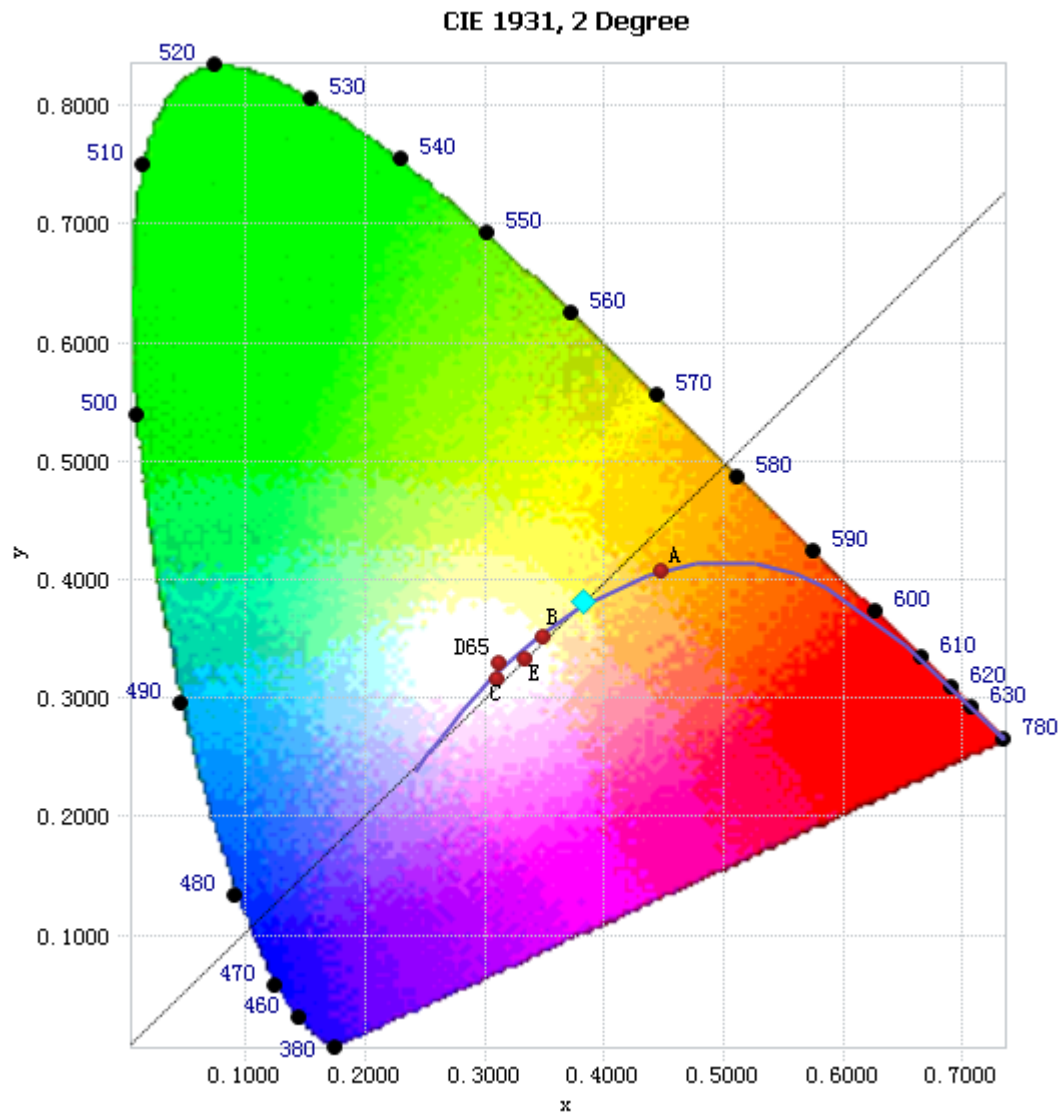


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.55E-04	485	1.14E-02	590	3.94E-02	695	5.35E-03
385	4.49E-04	490	1.33E-02	595	3.96E-02	700	4.57E-03
390	4.56E-04	495	1.60E-02	600	3.94E-02	705	3.89E-03
395	5.14E-04	500	1.89E-02	605	3.86E-02	710	3.30E-03
400	5.95E-04	505	2.14E-02	610	3.72E-02	715	2.83E-03
405	7.41E-04	510	2.35E-02	615	3.56E-02	720	2.41E-03
410	1.01E-03	515	2.52E-02	620	3.35E-02	725	2.05E-03
415	1.59E-03	520	2.63E-02	625	3.13E-02	730	1.74E-03
420	2.59E-03	525	2.72E-02	630	2.89E-02	735	1.49E-03
425	4.39E-03	530	2.82E-02	635	2.64E-02	740	1.26E-03
430	7.40E-03	535	2.88E-02	640	2.40E-02	745	1.08E-03
435	1.23E-02	540	2.96E-02	645	2.14E-02	750	9.26E-04
440	2.10E-02	545	3.05E-02	650	1.92E-02	755	7.84E-04
445	3.56E-02	550	3.13E-02	655	1.70E-02	760	6.75E-04
450	4.27E-02	555	3.23E-02	660	1.50E-02	765	5.70E-04
455	3.05E-02	560	3.32E-02	665	1.30E-02	770	4.92E-04
460	2.14E-02	565	3.42E-02	670	1.13E-02	775	4.22E-04
465	1.75E-02	570	3.53E-02	675	9.82E-03	780	3.62E-04
470	1.28E-02	575	3.66E-02	680	8.46E-03		
475	1.03E-02	580	3.78E-02	685	7.32E-03		
480	1.04E-02	585	3.88E-02	690	6.26E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3830, 0.3818)

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

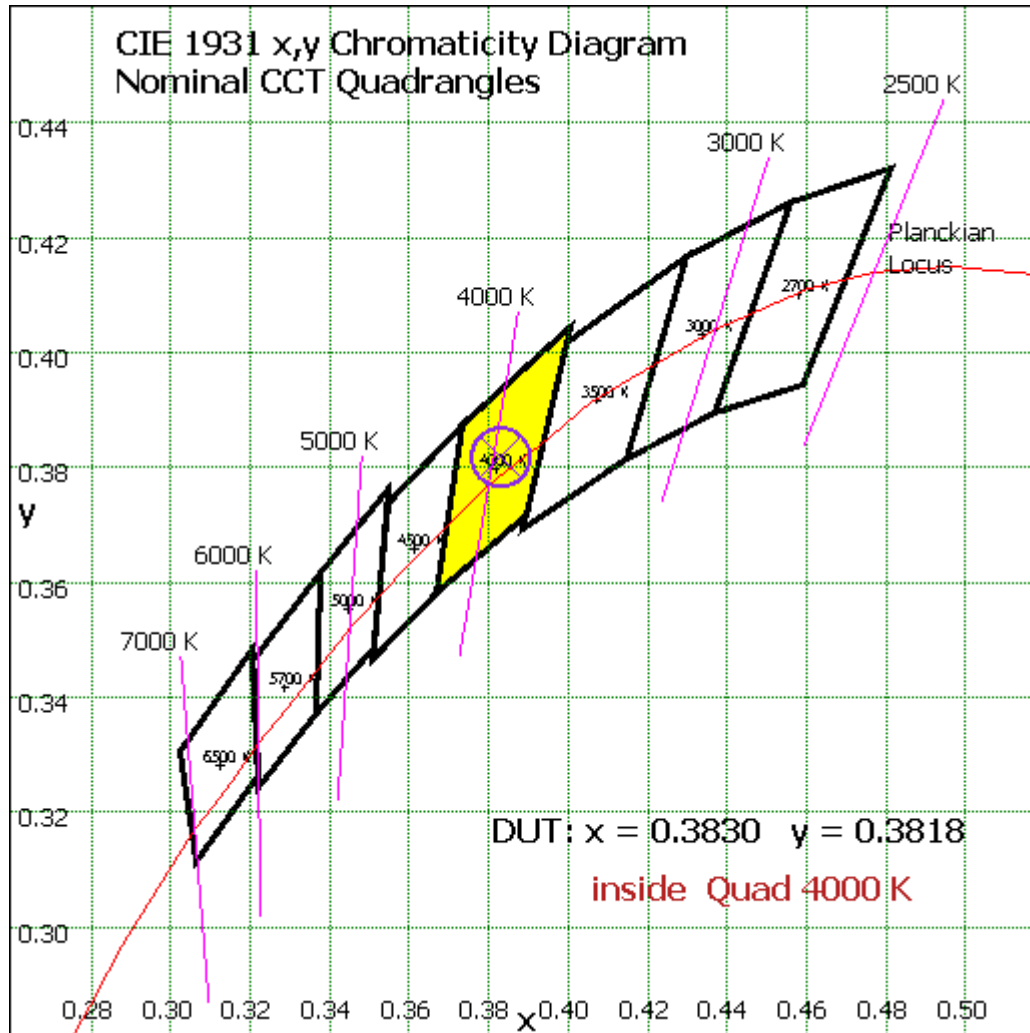


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	43.433	1.86%
10- 20	125.271	5.37%
20- 30	192.913	8.26%
30- 40	239.683	10.27%
40- 50	262.663	11.25%
50- 60	262.804	11.26%
60- 70	244.373	10.47%
70- 80	213.033	9.13%
80- 90	148.539	6.36%
90-100	105.325	4.51%
100-110	117.488	5.03%
110-120	104.093	4.46%
120-130	86.747	3.72%
130-140	69.666	2.98%
140-150	53.112	2.28%
150-160	37.808	1.62%
160-170	21.978	0.94%
170-180	5.535	0.24%
Total	2334.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1126.767	48.27%
60- 90	605.945	25.96%
0-90	1732.712	74.22%
90- 180	601.752	25.78%
0- 180	2334.5	100%

Table 5: Zonal Lumen Data

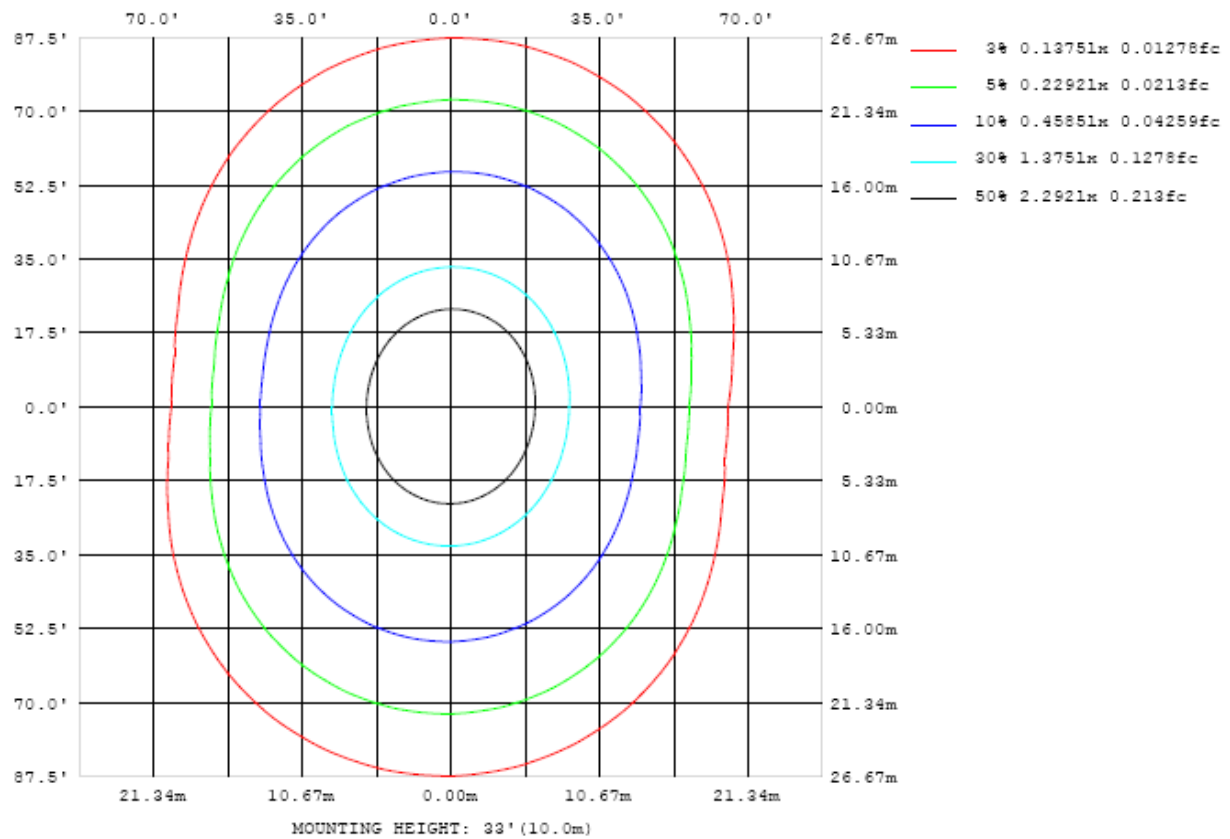


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

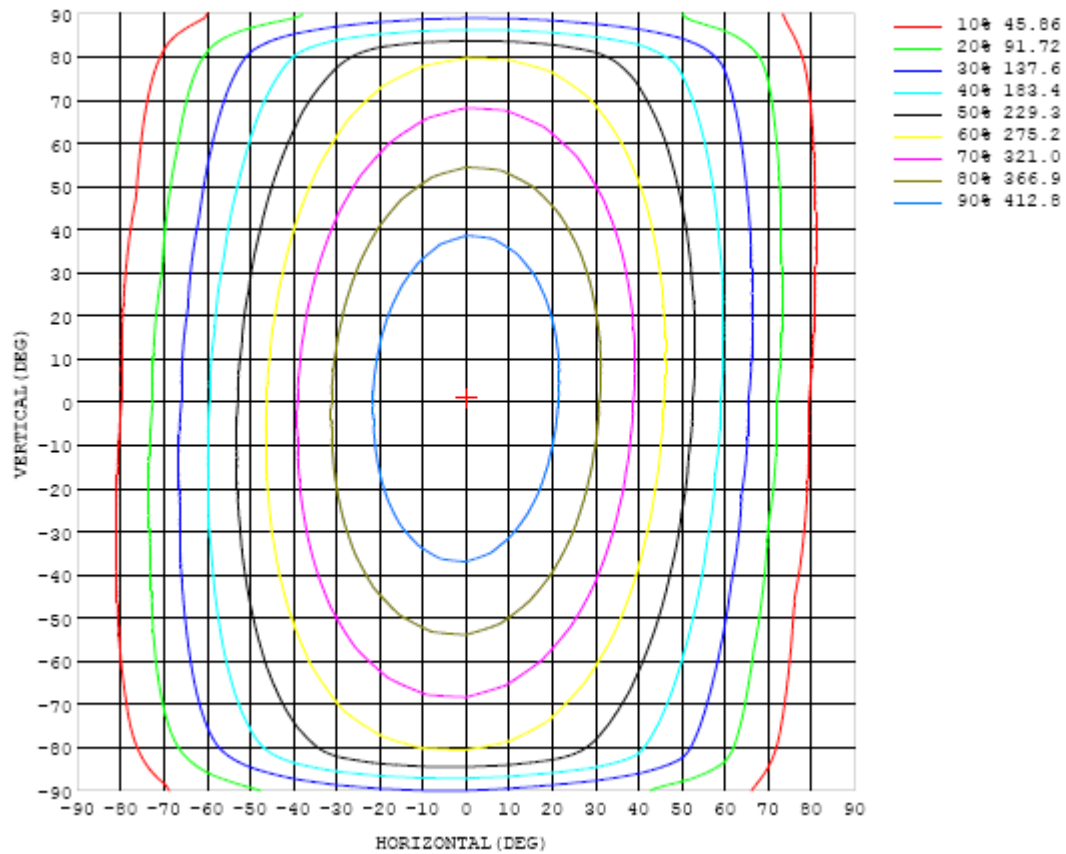


Chart 5: Isocandela Plot

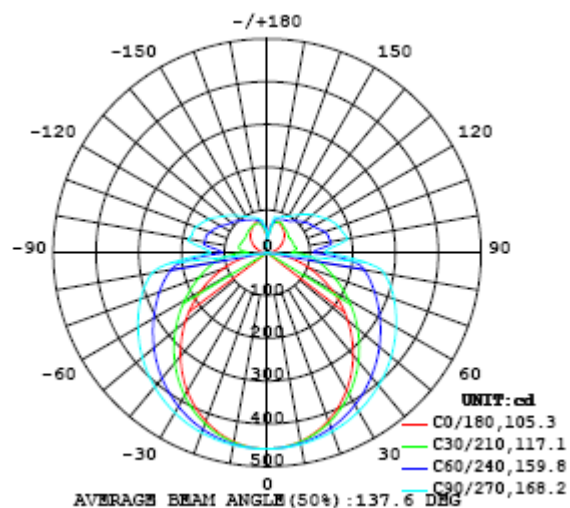


Chart 6: Polar Candela Distribution

## 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	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458
5	456	456	456	456	456	456	456	457	457	457	457	457	457	457	456	456	456	456	456
10	448	448	448	449	450	451	452	453	454	454	454	454	453	452	451	450	449	448	448
15	435	435	436	437	440	443	445	447	449	450	450	449	447	445	442	440	438	436	436
20	418	418	419	422	427	431	436	440	443	444	444	442	439	436	431	426	423	420	419
25	396	396	399	404	410	417	424	430	435	437	436	434	430	424	417	410	404	399	398
30	371	372	375	382	391	401	411	419	425	428	427	424	418	409	400	390	382	376	373
35	343	344	349	358	370	383	395	406	413	417	417	412	404	394	381	368	357	349	346
40	313	313	320	332	347	363	378	391	401	405	405	399	389	376	361	345	331	320	315
45	280	281	290	304	323	343	361	376	387	392	392	385	374	358	339	320	303	289	283
50	246	247	258	276	298	321	342	360	372	378	377	370	357	339	317	295	274	257	250
55	211	213	226	248	273	300	323	343	357	363	363	355	340	319	295	269	244	224	215
60	175	178	194	219	249	279	304	326	340	348	347	338	323	300	273	244	215	192	180
65	140	142	162	192	225	258	286	308	324	332	331	322	305	281	252	220	187	159	145
70	105	108	132	167	203	237	267	291	307	316	315	305	288	263	232	197	161	128	110
75	72.2	75.6	105	143	182	218	249	273	290	298	297	288	270	244	212	175	136	99.3	76.3
80	42.4	47.2	81.0	123	163	200	230	254	270	278	277	267	250	224	191	154	113	73.7	45.3
85	18.7	24.2	61.4	102	140	168	188	203	214	220	220	214	203	185	159	127	88.4	50.2	19.4
90	6.01	8.71	35.1	62.5	79.2	96.3	110	122	132	137	137	132	122	106	87.3	71.4	42.3	19.3	1.80
95	8.82	12.3	36.8	66.2	93.2	113	128	140	149	153	152	147	137	122	103	79.2	51.1	26.5	6.07
100	12.7	16.7	38.3	69.3	99.0	127	151	170	184	191	190	183	168	147	119	89.2	59.0	32.0	12.0
105	18.6	21.5	40.4	65.0	96.3	125	149	164	176	184	183	175	162	143	118	90.7	58.9	35.9	18.0
110	25.2	27.4	41.8	64.9	89.8	118	143	161	172	178	177	170	158	139	115	87.2	59.9	39.4	24.5
115	31.9	33.8	42.9	64.5	87.6	110	133	151	164	170	169	161	149	131	108	84.6	60.2	43.2	31.6
120	38.7	40.4	48.0	63.4	85.3	106	125	141	153	159	158	151	139	123	103	81.8	60.1	47.0	38.0
125	44.9	46.8	52.6	62.1	81.9	102	119	133	142	148	147	141	131	117	98.6	78.6	61.5	51.2	44.2
130	51.3	52.1	57.9	64.4	78.9	96.0	112	125	134	138	137	132	122	109	92.4	76.7	62.9	55.7	50.2
135	56.9	57.6	62.2	66.8	76.3	90.9	104	115	123	127	127	122	113	101	88.2	75.4	65.2	60.8	55.8
140	62.0	62.6	66.1	68.5	75.6	85.1	97.3	107	114	116	116	112	105	95.5	85.3	75.6	67.7	65.8	60.4
145	66.1	67.2	70.0	70.7	75.7	83.5	90.6	97.8	104	107	106	103	97.9	92.0	83.6	74.8	69.3	69.3	64.7
150	70.0	71.1	73.7	74.1	76.4	82.1	87.3	92.6	96.6	98.5	98.5	96.8	93.6	88.4	80.8	74.2	73.0	72.4	68.8
155	73.6	73.9	76.1	77.3	78.1	81.4	85.9	89.4	92.2	93.0	93.0	92.0	89.2	84.2	78.9	77.0	76.6	75.1	73.0
160	76.3	76.9	76.5	77.3	80.2	82.0	83.7	86.2	88.1	88.8	88.1	86.6	84.8	82.4	80.7	79.4	76.6	75.6	76.3
165	75.3	73.3	73.1	74.4	74.5	77.2	82.8	85.3	84.8	85.0	85.0	83.7	80.8	79.5	76.6	75.2	71.7	73.2	74.5
170	70.3	60.3	57.7	63.0	68.8	68.5	68.8	69.9	73.0	72.8	69.6	65.7	67.4	67.6	61.7	59.6	59.1	60.9	62.2
175	57.2	47.9	43.4	42.9	41.8	42.9	43.8	48.9	50.6	46.3	52.7	44.0	43.0	43.1	42.9	43.3	45.0	46.2	47.7
180	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9

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	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458	458		
5	456	456	457	457	457	457	458	458	458	458	458	458	457	457	457	456	456		
10	449	449	450	451	453	454	455	456	456	456	455	455	453	452	451	450	448		
15	437	438	440	442	445	448	450	452	453	453	451	449	447	444	441	439	436		
20	420	422	425	430	435	439	443	446	448	447	445	442	438	433	428	423	420		
25	399	402	407	414	421	428	434	438	441	440	437	432	426	419	411	405	400		
30	374	379	386	395	405	415	423	429	432	431	427	421	412	402	392	383	376		
35	347	353	362	374	387	400	410	418	421	421	416	407	396	383	370	358	349		
40	317	324	336	351	367	383	396	405	409	408	402	392	378	362	346	331	320		
45	285	294	308	327	346	365	380	391	396	395	388	376	359	340	321	302	289		
50	251	262	280	302	325	346	363	375	381	380	372	358	340	318	295	273	256		
55	217	230	251	277	302	326	346	359	365	364	356	341	320	295	268	243	223		
60	182	198	223	252	281	306	328	342	349	348	339	322	300	272	243	214	190		
65	148	166	195	228	259	287	310	325	332	331	321	304	280	251	218	185	158		
70	113	137	170	205	239	268	292	307	315	313	304	286	261	230	195	159	127		
75	80.5	109	147	184	219	249	272	288	296	295	285	267	242	210	174	135	98.0		
80	50.8	83.8	124	163	198	228	251	266	274	273	263	246	222	191	154	113	72.9		
85	26.1	60.1	97.6	132	159	180	194	203	207	206	200	190	176	157	130	92.9	52.6		
90	4.84	23.7	46.0	67.9	88.2	106	119	129	133	133	127	118	106	92.0	74.5	54.1	29.3		
95	10.7	32.6	59.1	85.4	108	128	141	151	156	155	150	141	129	111	89.2	60.2	31.1		
100	15.9	38.2	67.5	96.8	124	149	168	180	187	186	178	164	143	121	92.7	61.1	32.9		
105	20.7	38.8	67.6	97.1	125	148	164	175	181	180	174	162	143	118	90.4	60.0	33.6		
110	26.7	40.2	65.1	93.7	120	142	160	172	177	175	167	155	138	115	86.1	57.6	35.1		
115	33.1	43.1	64.0	87.0	113	135	151	163	167	167	161	149	131	107	80.4	57.8	39.2		
120	38.9	46.5	62.4	83.3	104	125	142	153	158	157	151	139	122	100	79.3	57.9	43.6		
125	45.0	50.3	62.3	81.0	99.2	115	130	141	145	145	139	128	113	96.2	76.0	58.6	47.2		
130	51.2	54.2	64.0	78.7	95.3	110	121	129	133	133	128	120	106	90.2	74.7	60.6	51.7		
135	55.9	57.9	65.5	78.0	91.0	105	114	121	124	124	119	111	99.2	86.6	74.1	63.0	56.2		
140	60.6	62.0	67.8	77.3	88.0	98.0	107	112	114	113	110	103	94.1	84.3	74.0	64.6	60.2		
145	65.2	64.7	69.8	77.1	85.1	93.1	99.3	103	105	104	102	97.0	89.8	81.6	74.5	66.0	63.4		
150	69.3	66.3	70.9	77.9	82.9	88.5	93.7	96.5	98.2	97.4	95.4	91.4	86.4	81.2	74.5	67.6	66.8		
155	71.8	68.5	72.0	77.5	82.1	85.8	88.4	90.4	91.7	91.5	90.2	88.1	85.2	80.3	74.1	69.4	70.5		
160	73.6	70.8	72.9	75.9	78.7	83.1	85.5	87.3	88.0	88.2	87.4	85.6	83.2	79.3	75.2	71.2	72.1		
165	74.4	69.7	72.2	76.6	77.7	78.1	79.6	82.6	83.4	83.5	83.0	81.9	80.4	79.1	76.2	71.9	71.8		
170	63.9	63.6	63.4	66.4	68.8	71.4	74.8	76.4	76.7	78.3	79.3	79.2	78.2	74.6	68.9	67.9	69.1		
175	49.1	50.5	51.7	53.6	57.3	60.6	60.9	59.8	58.5	57.6	59.5	62.4	63.1	61.3	59.7	59.3	59.6		
180	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9	44.9		

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**

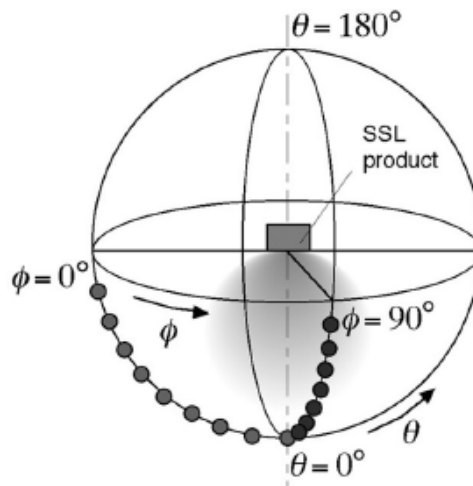
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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