



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube System

### Model: 14.5T8/U6/850/EXT/A2

(LED tube model: 14.5T8/U6/850/EXT 2pcs and LED driver model: 15T8T5HEDRIVER/2CH 1pcs)

### Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18070047af/R1

This report is replaced the old report No. HZ18070047af dated Aug. 09, 2018

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:



Manager: Jim Zhang  
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: 14.5T8/U6/850/EXT/A2

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/2	Power Factor
143.9	2355.0	16.36	0.9982
CCT (K)	CRI	Stabilization Time (Light & Power)	
5075	83.2	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

### Test specifications:

<b>Date of Receipt</b>	: Jul. 30, 2018
<b>Date of Test</b>	: Aug. 06, 2018
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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## Sample Photos

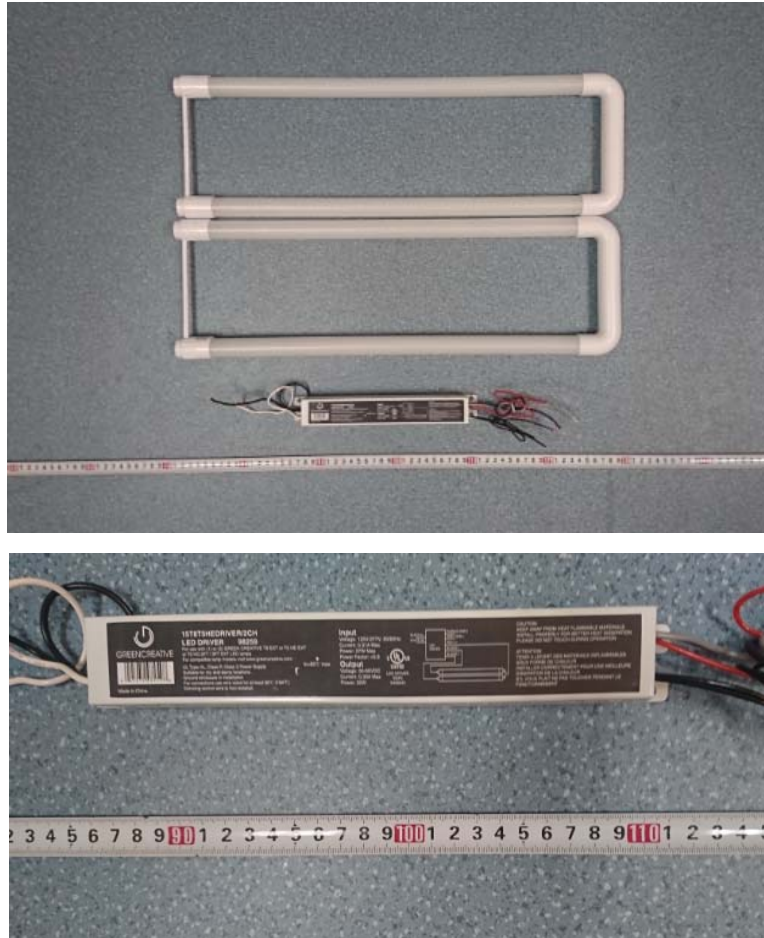


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube System
<b>Model</b>	: 14.5T8/U6/850/EXT/A2
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 5000K LED tube model: 14.5T8/U6/850/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 25.0°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)	0.273	0.124
Power Factor	0.9982	0.9693
Test Power (W)/2	16.36	16.63
THD A%	2.53	4.56
Luminous Efficacy (lm/W)	143.9	141.7
Luminous Flux per lamp (lm)	2355.0	2355.0
Color Rendering Index (CRI)	83.2	
R9	6.5	
Correlated Color Temperature (CCT)(K)	5075	
Chromaticity Chroma x	0.3437	
Chromaticity Chroma y	0.3583	
Chromaticity Chroma u	0.2079	
Chromaticity Chroma v	0.3251	
Duv	0.0039	
Chromaticity Chroma u'	0.2079	
Chromaticity Chroma v'	0.4877	

Special Color Rendering Indices	
R1	80.9
R2	88.1
R3	93.4
R4	83.6
R5	82.9
R6	85
R7	85.9
R8	66.1
R9	6.5
R10	72.3
R11	85.2
R12	57.6
R13	82.5
R14	96.5
Rf	82
Rg	95

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 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)	0.274
Power Factor	0.9971
Test Power (W)/2	16.41
Luminous Efficacy (lm/W)	141.1
Luminous Flux per lamp (lm)	2319.6
Beam Angle (°)	140.7
Center Beam Candle Power (cd)	436
Spacing Criteria	1.23 (0°-180°)/ 1.42 (90°-270°)
Zonal Lumens in the 0°-60°Zone	46.78%
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

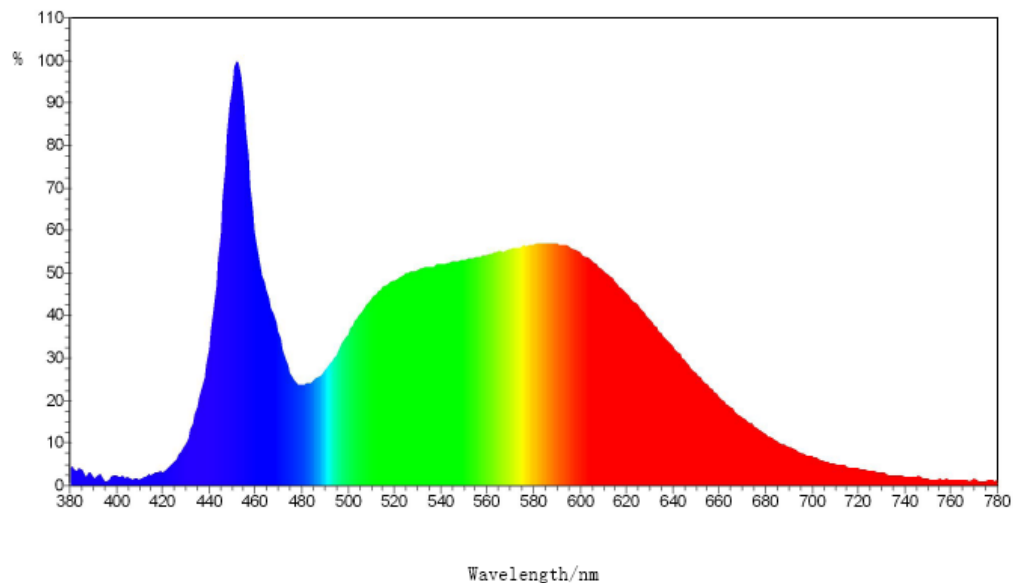
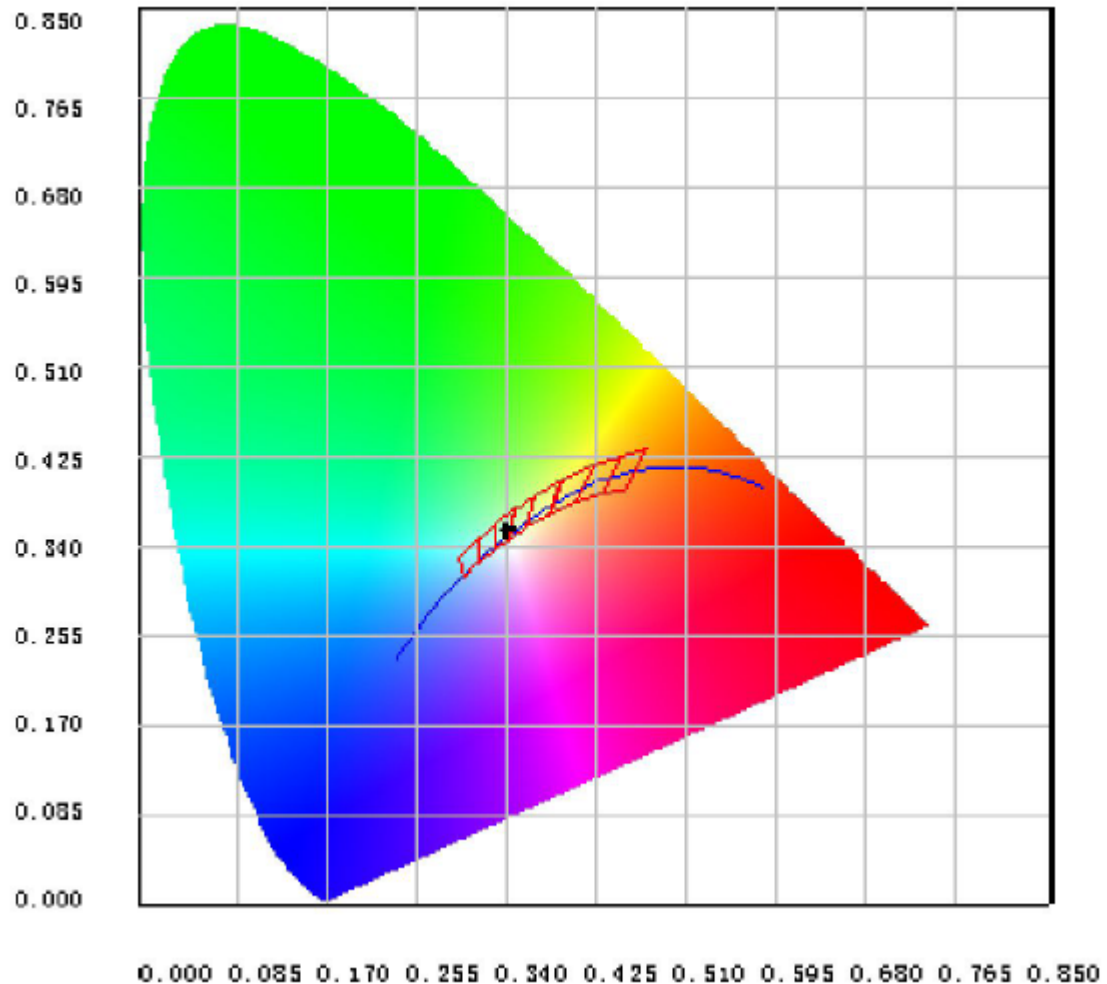


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.77E-03	485	1.60E-02	590	3.68E-02	695	5.08E-03
385	2.44E-03	490	1.76E-02	595	3.64E-02	700	4.48E-03
390	1.25E-03	495	1.99E-02	600	3.55E-02	705	3.78E-03
395	7.75E-04	500	2.31E-02	605	3.44E-02	710	3.31E-03
400	1.58E-03	505	2.60E-02	610	3.28E-02	715	3.02E-03
405	1.37E-03	510	2.84E-02	615	3.12E-02	720	2.67E-03
410	9.55E-04	515	3.03E-02	620	2.94E-02	725	2.30E-03
415	1.48E-03	520	3.13E-02	625	2.75E-02	730	1.99E-03
420	2.09E-03	525	3.24E-02	630	2.54E-02	735	1.66E-03
425	3.61E-03	530	3.28E-02	635	2.32E-02	740	1.39E-03
430	6.37E-03	535	3.33E-02	640	2.13E-02	745	1.43E-03
435	1.19E-02	540	3.37E-02	645	1.92E-02	750	1.16E-03
440	2.09E-02	545	3.41E-02	650	1.72E-02	755	1.08E-03
445	3.84E-02	550	3.45E-02	655	1.54E-02	760	9.32E-04
450	6.12E-02	555	3.48E-02	660	1.36E-02	765	8.94E-04
455	5.81E-02	560	3.52E-02	665	1.19E-02	770	1.07E-03
460	3.87E-02	565	3.57E-02	670	1.05E-02	775	7.71E-04
465	3.00E-02	570	3.61E-02	675	9.15E-03	780	8.08E-04
470	2.36E-02	575	3.65E-02	680	7.93E-03		
475	1.72E-02	580	3.67E-02	685	6.75E-03		
480	1.53E-02	585	3.70E-02	690	5.94E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3437, 0.3583)

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

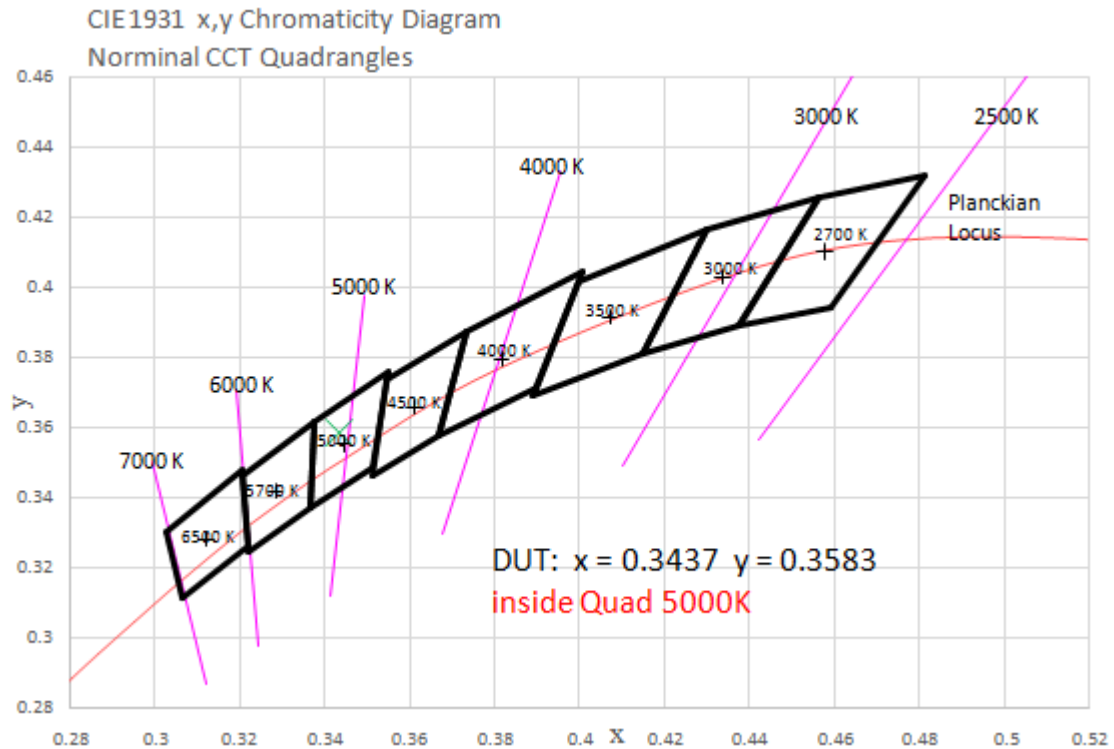


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	41.324	1.78%
10- 20	119.346	5.15%
20- 30	184.328	7.95%
30- 40	230.129	9.92%
40- 50	253.851	10.94%
50- 60	256.019	11.04%
60- 70	240.188	10.35%
70- 80	210.369	9.07%
80- 90	147.56	6.36%
90-100	109.591	4.72%
100-110	124.904	5.38%
110-120	109.754	4.73%
120-130	92.138	3.97%
130-140	74.477	3.21%
140-150	56.965	2.46%
150-160	40.198	1.73%
160-170	22.68	0.98%
170-180	5.765	0.25%
Total	2319.6	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1084.997	46.78%
60- 90	598.117	25.79%
0-90	1683.114	72.56%
90- 180	636.472	27.44%
0- 180	2319.6	100%

Table 5: Zonal Lumen Data

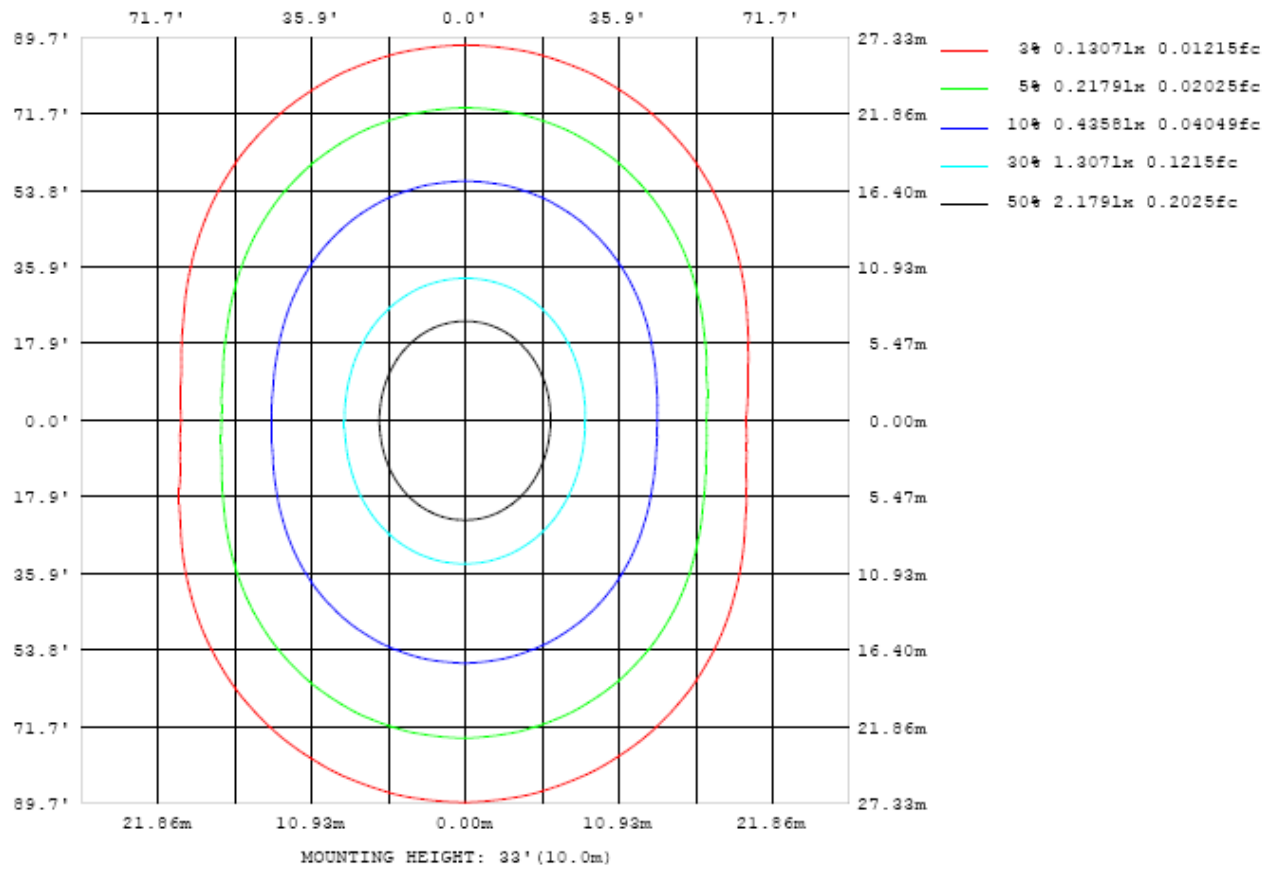


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

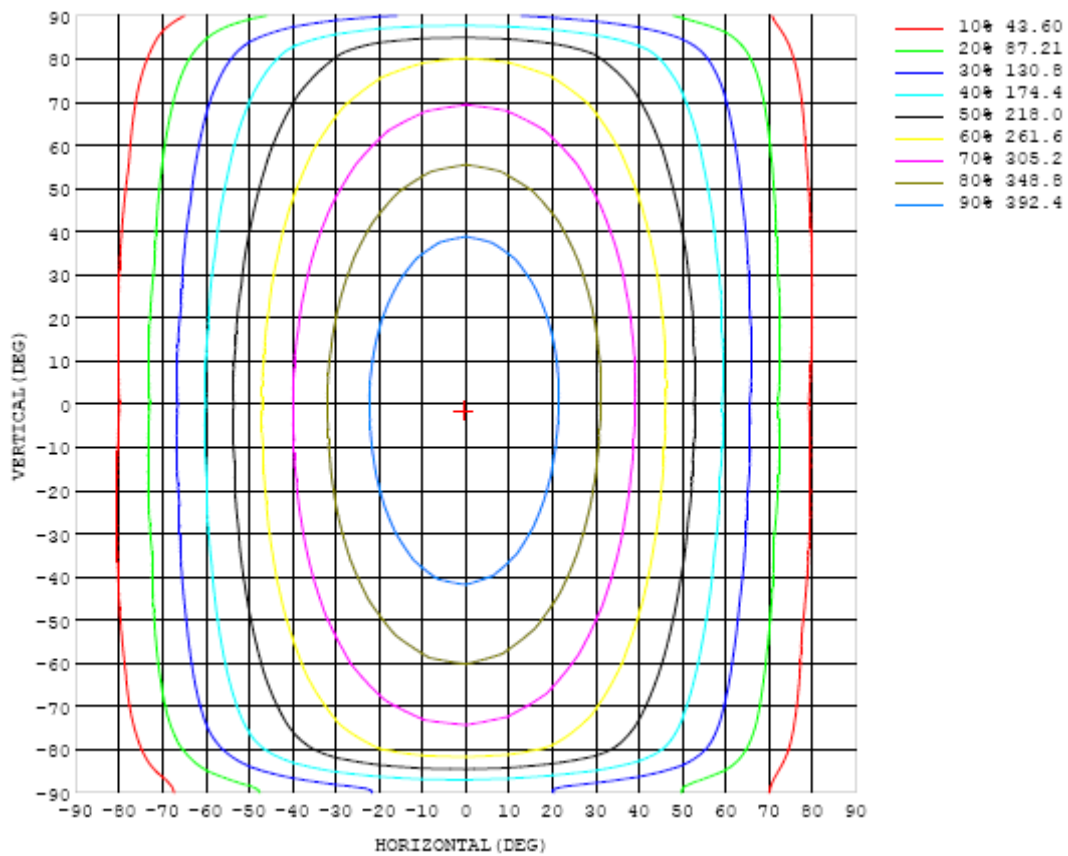


Chart 5: Isocandela Plot

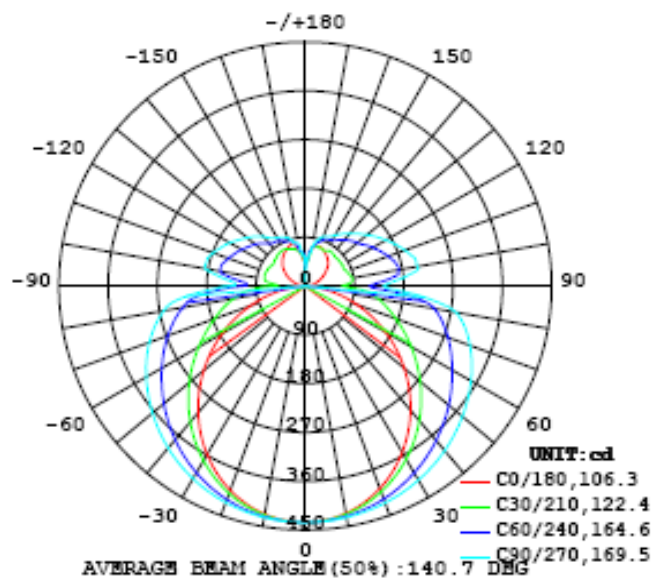


Chart 6: Polar Candela Distribution

## 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	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436
5	433	433	433	434	434	434	435	435	435	435	435	435	435	435	434	434	434	434	434
10	426	426	426	427	429	430	431	432	433	433	433	433	432	431	430	429	428	427	427
15	414	414	415	417	420	423	425	428	429	430	430	429	427	425	422	420	418	416	416
20	397	398	400	404	409	413	418	422	424	425	425	423	420	416	412	407	404	401	401
25	377	379	382	387	395	402	409	414	418	420	419	416	412	405	398	392	386	382	381
30	354	356	361	368	378	388	398	406	411	413	412	408	401	392	383	373	365	360	359
35	328	330	337	347	360	373	385	396	402	405	404	398	389	378	365	353	342	335	333
40	299	302	311	324	340	356	372	384	393	396	394	388	376	362	346	331	317	307	305
45	268	272	283	299	319	339	357	372	382	386	384	376	362	345	326	307	290	278	274
50	236	240	254	274	297	321	342	359	370	374	372	363	348	328	305	282	262	247	242
55	202	208	225	248	276	302	326	345	357	362	360	349	332	310	284	258	233	215	209
60	168	175	195	223	254	284	310	331	344	349	346	335	316	292	263	233	205	183	175
65	134	142	166	199	233	266	294	316	330	335	332	320	301	274	243	210	177	151	142
70	101	111	139	176	213	248	277	300	314	320	317	304	284	257	224	187	150	120	107
75	68.3	80.7	115	155	195	230	260	282	297	303	299	287	267	238	205	166	126	90.5	74.1
80	38.6	54.8	93.2	135	175	210	239	260	274	279	276	265	245	217	184	145	104	64.8	43.3
85	14.4	34.2	72.6	111	143	166	184	197	206	210	208	201	188	170	146	115	78.7	41.8	17.4
90	2.55	16.4	43.5	70.3	86.7	104	119	131	140	143	141	133	120	103	82.3	64.4	36.2	13.5	0.71
95	6.15	20.6	51.5	84.4	114	137	154	168	176	180	177	168	154	134	110	81.7	49.6	23.0	4.88
100	11.6	24.3	51.8	86.9	120	149	173	190	202	208	206	195	178	153	124	91.7	57.4	28.1	10.7
105	17.7	28.7	52.1	83.2	115	144	170	188	200	205	203	193	176	152	123	91.0	58.0	32.6	17.3
110	24.0	33.0	52.9	80.4	110	137	161	179	190	194	191	181	166	144	117	87.7	58.4	37.1	24.5
115	31.1	38.7	54.9	77.0	104	130	152	168	178	182	180	171	156	135	111	84.4	60.1	42.1	31.9
120	38.3	43.6	57.2	78.4	98.3	123	143	157	167	170	168	160	146	128	105	82.8	62.1	47.4	39.4
125	45.6	47.8	59.6	77.6	96.8	114	133	147	156	159	157	149	137	120	101	82.2	63.0	53.6	46.4
130	52.6	54.3	64.3	77.6	93.7	111	124	135	144	147	145	139	128	114	97.9	79.8	66.7	59.0	53.3
135	58.7	58.8	67.3	76.8	89.8	105	118	128	134	137	135	129	120	109	93.8	80.4	70.0	63.8	59.2
140	63.5	67.3	69.6	78.5	87.2	99.4	111	119	125	127	125	121	113	102	90.7	81.6	73.8	69.1	64.8
145	68.2	71.7	70.4	78.9	87.2	94.2	103	110	115	118	117	112	106	97.5	90.0	82.5	74.7	72.2	69.5
150	72.0	74.6	73.8	75.4	85.6	92.8	97.8	103	106	108	108	105	100	95.7	89.9	82.9	76.2	74.4	74.0
155	75.6	78.9	77.0	74.8	80.4	89.8	95.4	98.3	100	101	101	99.9	96.9	92.4	87.0	81.5	77.6	77.2	77.3
160	77.5	84.7	80.3	75.2	77.9	83.1	89.6	94.3	96.5	97.1	96.8	94.8	92.2	88.5	84.3	78.9	75.9	81.4	80.7
165	75.6	80.1	79.3	76.2	74.5	77.5	83.6	86.3	87.5	88.6	85.5	86.4	85.0	81.9	75.9	72.9	78.1	81.4	80.2
170	71.6	62.7	64.9	71.5	72.1	71.0	72.3	74.1	73.6	71.3	70.3	66.9	66.7	66.4	65.4	66.3	67.3	66.6	66.7
175	52.9	46.9	45.9	45.2	44.7	47.6	54.7	56.1	50.1	54.6	56.8	50.4	46.8	45.9	46.5	48.1	49.5	50.3	51.3
180	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3

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	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436	436		
5	434	434	434	435	435	435	435	435	435	435	435	435	435	434	434	433	433		
10	428	428	429	430	431	432	433	433	433	433	432	431	430	429	428	427	426		
15	417	418	420	422	424	427	428	430	430	429	428	426	423	421	418	416	414		
20	402	404	407	411	415	419	422	424	425	424	422	418	414	409	405	401	399		
25	383	386	391	397	403	409	414	417	418	417	414	408	402	395	389	383	379		
30	360	365	372	381	389	398	405	409	410	409	404	397	388	379	370	362	356		
35	335	341	350	362	374	384	394	399	401	399	393	384	372	360	348	338	331		
40	307	315	327	341	356	370	381	388	390	387	380	370	355	340	325	312	303		
45	277	287	302	320	338	354	367	375	378	375	367	354	337	319	301	285	273		
50	246	258	277	298	319	337	352	361	364	361	352	337	318	297	275	256	242		
55	214	229	251	275	299	320	337	347	350	347	337	320	299	275	250	227	210		
60	181	199	225	253	280	303	321	332	336	332	321	303	280	253	225	198	178		
65	149	171	200	231	261	285	304	316	320	316	305	286	261	232	201	170	146		
70	116	143	177	211	241	267	287	299	303	299	288	269	243	212	178	144	115		
75	86.0	118	155	190	222	248	268	280	284	281	269	250	224	193	158	120	85.9		
80	58.6	94.3	133	169	201	227	247	258	263	259	247	229	204	173	138	98.5	60.4		
85	35.0	70.0	107	142	170	193	208	216	218	214	205	191	171	147	115	77.9	40.2		
90	9.52	31.2	56.0	79.2	99.5	116	128	135	137	133	125	114	99.7	83.8	66.0	45.2	19.8		
95	14.9	38.7	64.3	87.5	107	124	135	142	146	144	139	131	118	101	79.6	51.7	23.6		
100	21.4	45.5	75.5	107	134	158	174	183	186	184	175	161	139	114	86.2	53.3	26.0		
105	25.9	48.1	77.0	106	133	157	173	182	186	183	174	161	139	113	82.6	52.5	29.6		
110	31.0	50.1	76.4	103	128	150	166	175	179	176	168	154	133	107	79.5	53.2	32.9		
115	36.3	51.2	75.4	99.8	123	142	157	166	169	167	159	146	126	102	78.0	53.5	38.0		
120	42.8	53.9	73.5	96.5	117	135	148	157	160	157	149	137	119	98.3	76.6	55.5	44.1		
125	48.5	56.7	71.3	92.6	111	127	139	146	149	146	140	129	113	95.0	73.7	57.5	49.8		
130	54.3	61.1	73.7	87.1	105	120	130	137	139	137	131	121	107	90.1	74.4	62.1	55.2		
135	59.3	65.1	74.7	85.6	97.8	111	122	128	130	128	123	114	101	86.4	74.9	65.6	59.0		
140	64.3	68.0	77.2	85.9	93.9	102	111	117	119	117	112	104	94.6	85.6	77.4	69.2	63.9		
145	67.7	71.2	78.4	85.4	93.0	99.1	103	106	108	107	104	99.4	92.5	85.4	79.3	71.5	67.5		
150	70.1	71.1	77.9	84.6	90.7	96.1	101	103	104	103	101	96.2	90.9	85.8	79.0	72.2	69.5		
155	71.6	70.0	75.8	83.9	87.8	91.3	96.6	98.8	99.4	98.8	97.1	94.0	89.8	84.1	78.0	72.2	71.2		
160	74.5	70.1	72.6	80.2	85.8	88.1	87.8	92.6	95.0	94.9	93.7	91.5	86.6	81.8	76.9	73.6	72.7		
165	76.1	70.6	70.6	75.1	79.7	83.8	86.6	85.9	81.9	85.6	86.6	84.4	81.1	78.2	76.4	72.9	71.5		
170	66.0	64.9	65.4	65.5	66.5	69.9	73.9	78.9	80.6	79.3	78.5	78.1	77.1	73.9	70.5	69.7	70.9		
175	52.4	53.8	54.9	55.6	58.5	61.8	61.8	59.9	58.6	58.5	59.7	61.3	62.1	60.7	60.5	61.7	60.4		
180	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3	44.3		

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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