

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 13T8/4F/DIM/850/BYP**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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

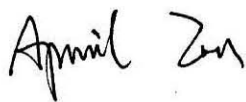
Tel: +86571 86376106

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

Report No.: HZ19050008e

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

Review by:



Engineer: April Zou  
May 17, 2019

Approved by:



Manager: Jim Zhang  
May 17, 2019

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: 13T8/4F/DIM/850/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
154.5	1920.0	12.43	0.9809
CCT (K)	CRI	Stabilization Time (Light & Power)	
4981	82.0	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>	: May 08, 2019
<b>Date of Test</b>	: May 14, 2019
<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 ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

## TABLE OF CONTENT

LM-79-08 TEST REPORT.....	1
TEST SUMMARY .....	2
SAMPLE PHOTO .....	4
TEST RESULTS .....	5
Sphere-Spectroradiometer Method.....	5
Goniophotometer Method .....	6
Spectral Power Distribution - Sphere Spectroradiometer Method .....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method .....	9
Color Rendition Report – Sphere Spectroradiometer Method .....	10
Zonal Lumen Tabulation- Goniophotometer Method .....	11
Illuminance Plots- Goniophotometer Method .....	12
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method .....	14
EQUIPMENT LIST .....	16
TEST METHODS .....	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method .....	17
Photometric and Electrical Measurements .....	17
Color Characteristics Measurements.....	17
Color Spatial Uniformity.....	17

## SAMPLE PHOTO

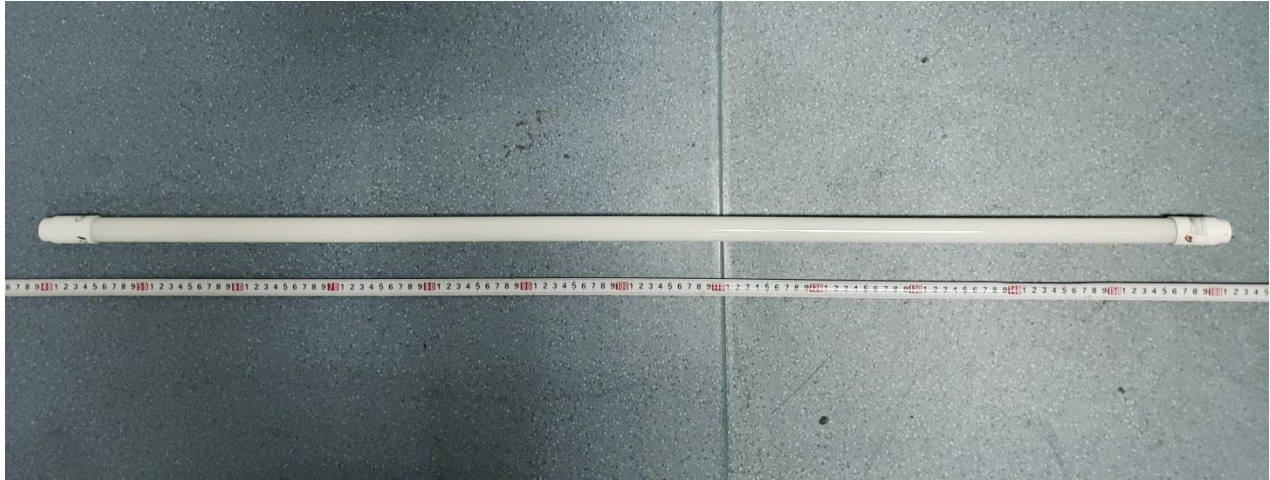


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 13T8/4F/DIM/850/BYP
<b>Electrical Ratings</b>	: 120V, 60Hz, 13W
<b>Product Description</b>	: 5000K
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

## TEST RESULTS

Test ambient temperature was 26.0°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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.106
Power Factor	0.9809
Test Power (W)	12.43
THD A%	14.76
Luminous Efficacy (lm/W)	154.5
Total Luminous Flux (lm)	1920.0
Color Rendering Index (CRI)	82.0
R9	3
Correlated Color Temperature (CCT)(K)	4981
Chromaticity Chroma x	0.3463
Chromaticity Chroma y	0.3601
Chromaticity Chroma u	0.2090
Chromaticity Chroma v	0.3259
Duv	0.0037
Chromaticity Chroma u'	0.2090
Chromaticity Chroma v'	0.4889

Special Color Rendering Indices	
R1	79.6
R2	87.6
R3	93.1
R4	80.5
R5	79.6
R6	82.2
R7	87.4
R8	65.8
R9	3
R10	70.3
R11	79.1
R12	54
R13	81.8
R14	96.4

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 30 m.

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)	0.106
Power Factor	0.9809
Power (W)/2	12.48
Luminous Efficacy (lm/W)	151.6
Total Luminous Flux (lm)	1892.1
Beam Angle (°)	116.9 (0°-180°) / 252.9 (90°-270°)
Center Beam Candle Power (cd)	278
Maximum Beam Candle Power (cd)	278.0 (At: C=270.0, Gamma=3.0)
Spacing Criteria	1.28 (0°-180°) /1.49 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	39.40%
Zonal Lumens in the 60 °-90 °Zone	26.51%
Zonal Lumens in the 90 °-120 °Zone	18.83%
Zonal Lumens in the 120 °-180 °Zone	15.26%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

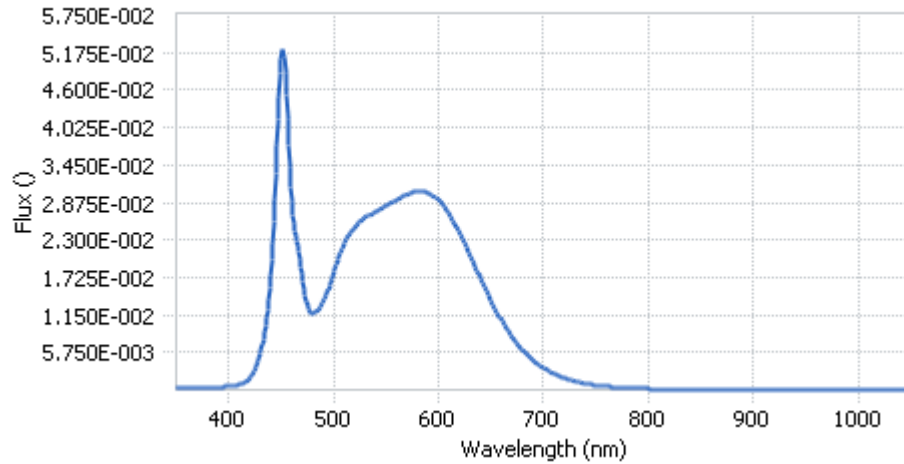


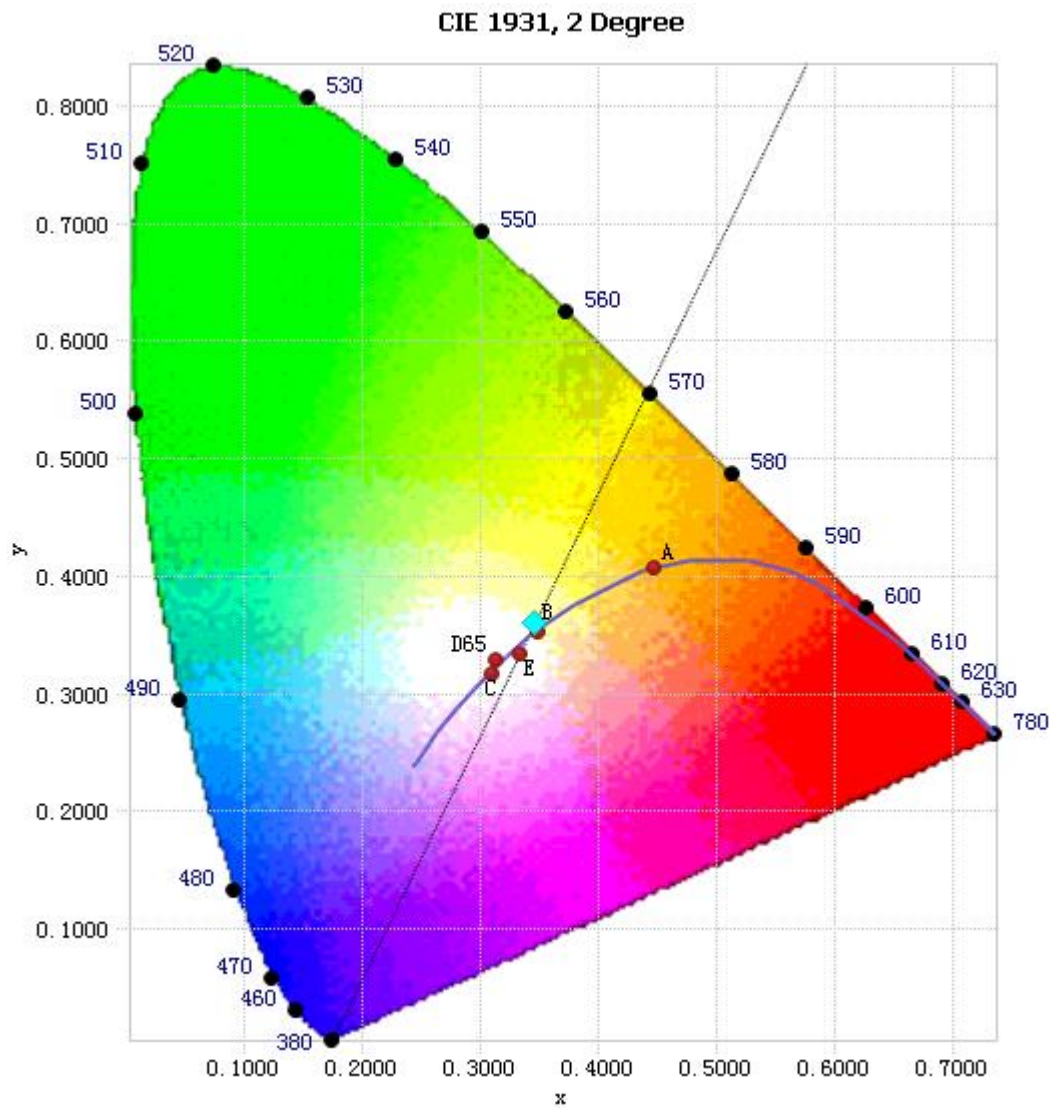
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.87E-04	485	1.22E-02	590	3.02E-02	695	3.92E-03
385	3.89E-04	490	1.34E-02	595	2.98E-02	700	3.36E-03
390	4.19E-04	495	1.55E-02	600	2.91E-02	705	2.88E-03
395	4.77E-04	500	1.81E-02	605	2.82E-02	710	2.46E-03
400	5.13E-04	505	2.05E-02	610	2.70E-02	715	2.12E-03
405	6.11E-04	510	2.23E-02	615	2.57E-02	720	1.81E-03
410	8.10E-04	515	2.40E-02	620	2.41E-02	725	1.55E-03
415	1.17E-03	520	2.49E-02	625	2.24E-02	730	1.32E-03
420	1.85E-03	525	2.58E-02	630	2.07E-02	735	1.13E-03
425	3.14E-03	530	2.65E-02	635	1.88E-02	740	9.75E-04
430	5.59E-03	535	2.69E-02	640	1.71E-02	745	8.41E-04
435	9.89E-03	540	2.74E-02	645	1.54E-02	750	7.21E-04
440	1.76E-02	545	2.78E-02	650	1.37E-02	755	6.19E-04
445	3.31E-02	550	2.82E-02	655	1.21E-02	760	5.34E-04
450	5.08E-02	555	2.88E-02	660	1.07E-02	765	4.62E-04
455	4.51E-02	560	2.91E-02	665	9.36E-03	770	3.96E-04
460	2.88E-02	565	2.95E-02	670	8.15E-03	775	3.45E-04
465	2.28E-02	570	2.99E-02	675	7.07E-03	780	3.07E-04
470	1.77E-02	575	3.03E-02	680	6.13E-03		
475	1.28E-02	580	3.04E-02	685	5.30E-03		
480	1.17E-02	585	3.05E-02	690	4.57E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3463, 0.3601)

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

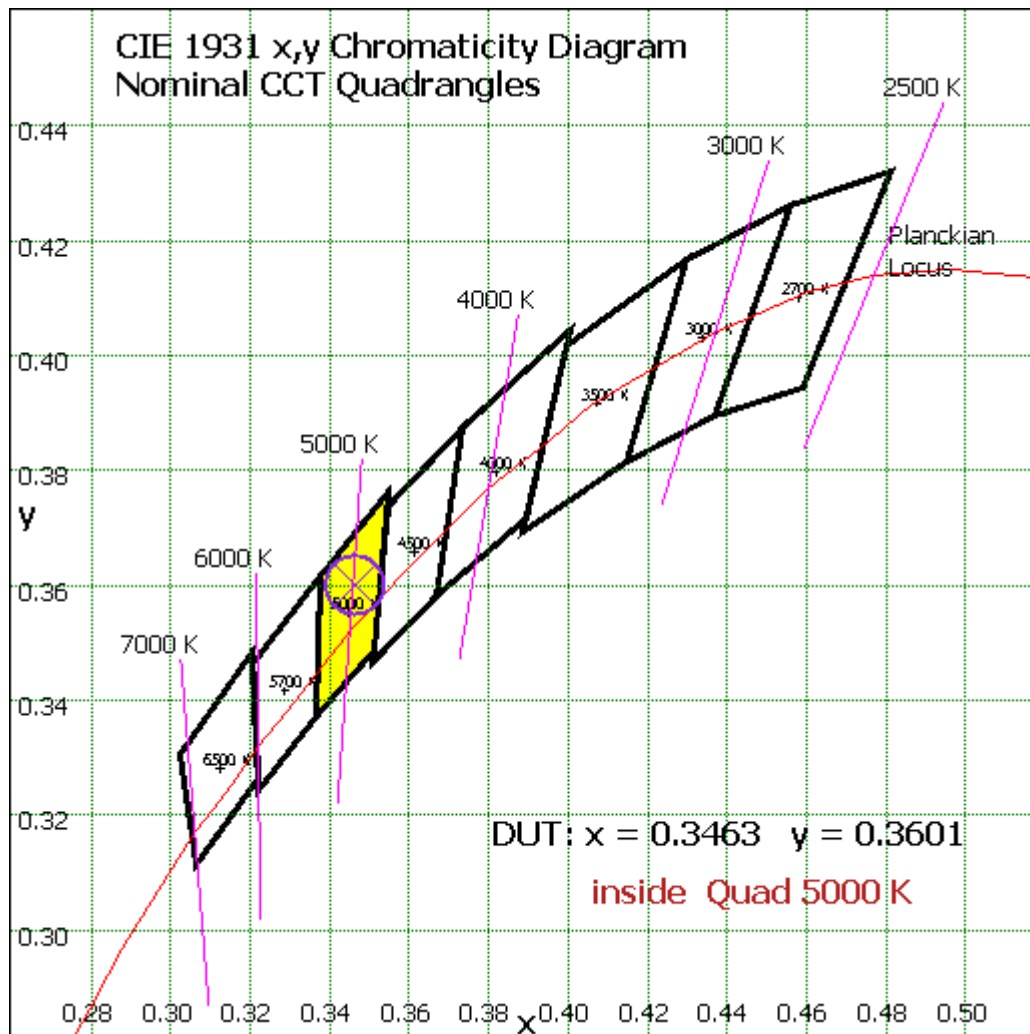
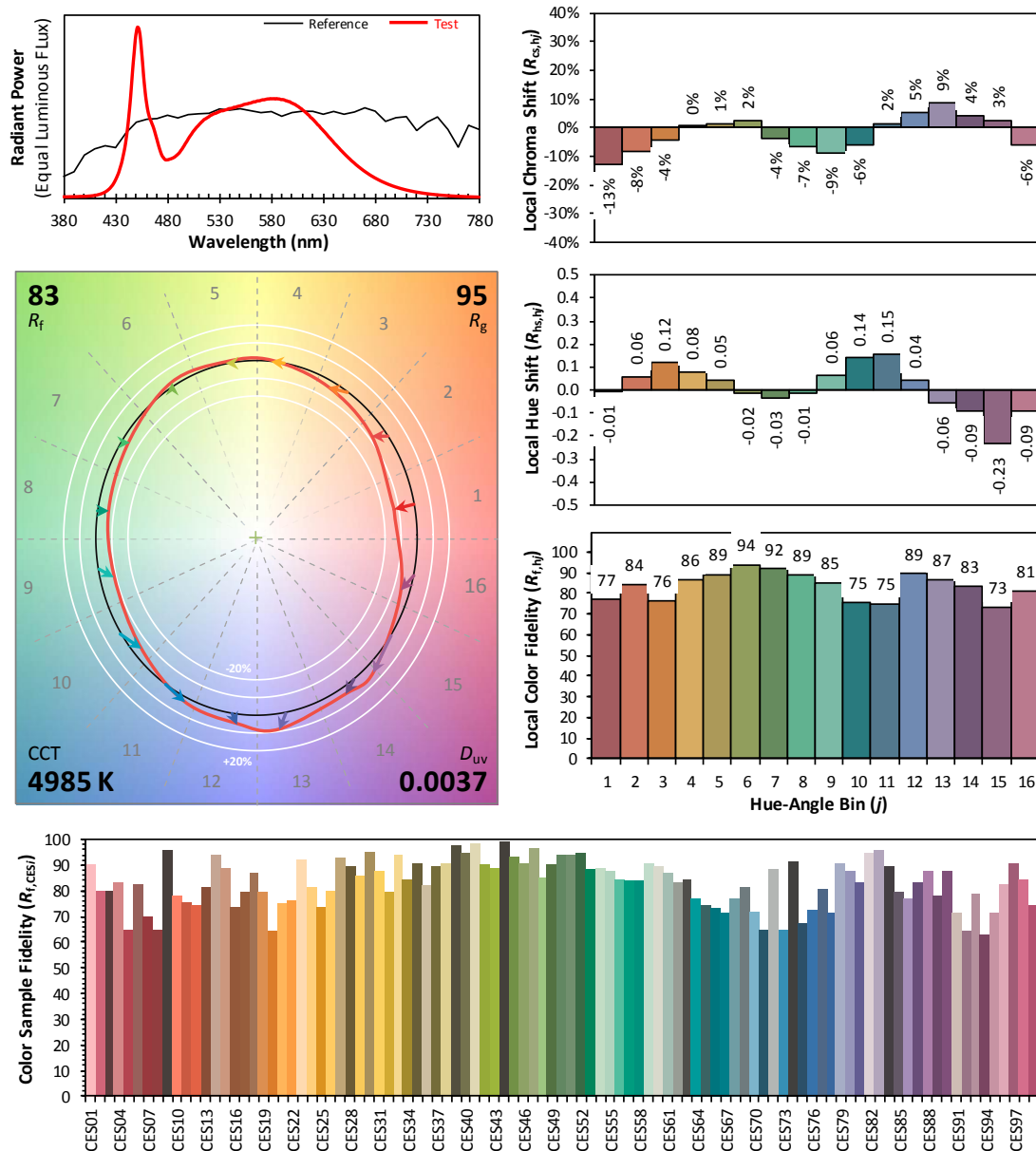


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



**Notes:** This is a recommended method for displaying ANSI/IES TM-30-18 information.

$x$  0.3463  
 $y$  0.3601  
 $u'$  0.2090  
 $v'$  0.4889

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	26.407	1.40%
10- 20	77.063	4.07%
20- 30	121.433	6.42%
30- 40	155.941	8.24%
40- 50	178.037	9.41%
50- 60	186.674	9.87%
60- 70	182.496	9.64%
70- 80	168.551	8.91%
80- 90	150.516	7.95%
90-100	134.164	7.09%
100-110	118.675	6.27%
110-120	103.522	5.47%
120-130	88.544	4.68%
130-140	73.342	3.88%
140-150	57.438	3.04%
150-160	40.506	2.14%
160-170	22.174	1.17%
170-180	6.648	0.35%
Total	1892.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	745.555	39.40%
60- 90	501.563	26.51%
0-90	1247.118	65.91%
90- 180	645.013	34.09%
0- 180	1892.1	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

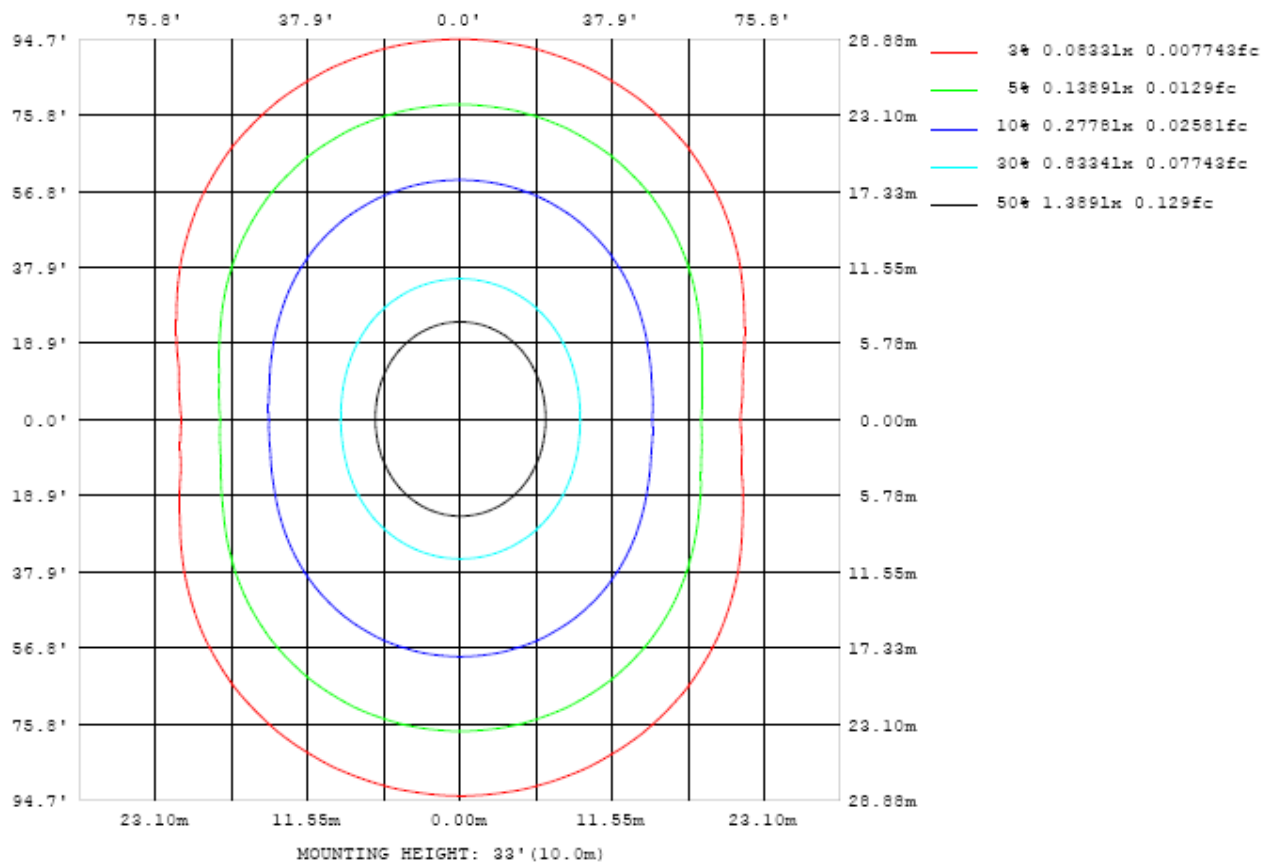


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

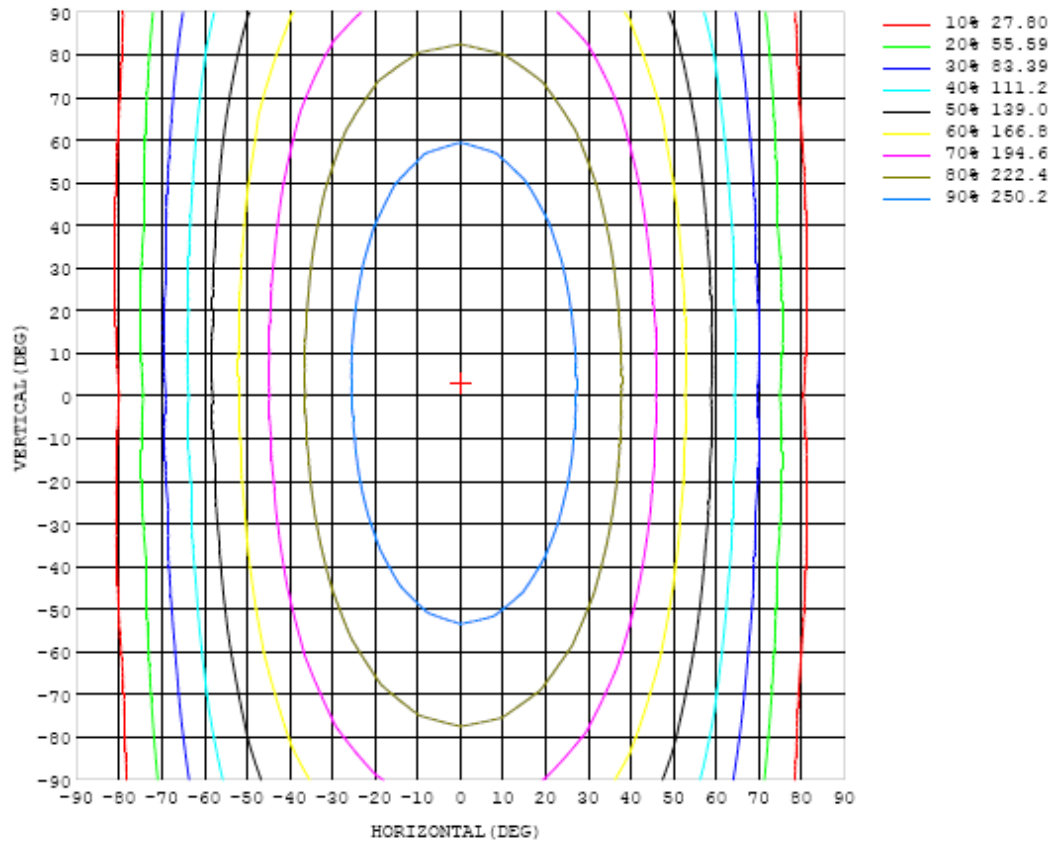


Chart 6: Isocandela Plot

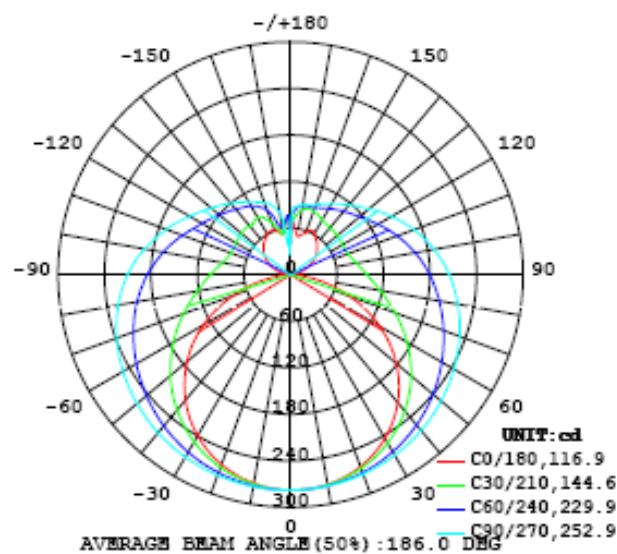


Chart 7: Polar Candela Distribution

## 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	0	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278
5	5	277	277	277	277	277	277	277	277	277	277	277	277	277	277	277	277	276	276	276
10	10	275	275	275	275	276	276	276	276	277	276	276	276	275	275	274	274	273	273	273
15	15	270	270	270	271	272	273	274	275	275	275	275	274	273	272	270	269	268	268	268
20	20	263	263	264	266	268	270	271	273	274	274	273	272	270	268	265	263	262	261	260
25	25	255	255	256	259	262	265	268	270	271	271	271	269	266	263	259	256	253	252	251
30	30	243	244	247	251	255	260	264	267	268	269	268	265	261	257	252	247	243	240	240
35	35	230	231	235	241	247	253	258	263	265	266	264	261	256	250	243	237	231	227	226
40	40	215	217	222	229	237	246	253	258	261	262	260	256	250	243	234	225	217	212	211
45	45	198	200	207	217	227	238	247	253	257	258	256	251	244	234	224	212	202	195	194
50	50	178	181	190	203	216	229	240	248	252	253	251	246	237	226	213	199	186	177	174
55	55	157	161	172	188	205	220	233	242	247	249	246	240	230	217	201	184	168	156	153
60	60	133	138	154	173	193	211	225	236	242	243	241	234	223	208	190	169	149	134	130
65	65	108	115	134	158	182	202	218	229	236	238	235	228	215	199	178	155	130	111	105
70	70	81.2	91.0	115	144	170	193	210	223	230	232	229	221	208	190	167	140	112	87.7	78.8
75	75	55.2	67.9	97.0	130	159	184	203	216	223	226	223	214	200	181	156	127	94.1	65.2	52.6
80	80	30.1	46.8	81.1	117	149	175	195	209	217	219	216	207	193	173	147	115	78.8	44.8	28.2
85	85	9.88	30.5	69.0	107	140	167	187	201	210	212	209	200	186	165	138	105	67.4	29.4	8.78
90	90	0.29	21.6	60.5	98.5	132	159	180	194	202	205	202	193	178	157	130	97.2	59.5	21.4	0.71
95	95	2.41	19.2	55.2	91.8	124	151	172	186	194	197	194	185	170	150	123	91.0	54.8	19.7	3.10
100	100	6.93	21.1	52.2	86.2	117	143	163	177	186	188	185	177	162	142	117	86.0	52.5	22.2	8.23
105	105	13.0	25.6	51.3	81.9	111	136	155	168	176	179	176	168	154	135	111	82.3	52.2	27.0	15.0
110	110	19.3	30.4	52.7	79.0	105	128	146	159	167	170	167	159	146	128	106	79.7	54.1	33.0	21.9
115	115	26.0	36.2	55.4	77.6	100	121	138	150	158	160	158	150	138	121	101	78.8	57.3	39.3	28.7
120	120	32.7	42.6	58.4	77.4	96.4	115	130	141	148	151	148	141	130	115	97.3	79.0	61.0	45.8	35.1
125	125	38.8	49.4	60.7	78.0	93.8	109	123	133	139	141	139	133	123	110	95.1	79.8	64.3	52.2	40.6
130	130	44.1	55.6	63.9	78.6	92.2	105	116	125	130	132	130	125	117	106	93.6	80.9	67.7	58.4	45.6
135	135	48.9	61.1	66.7	78.8	90.9	102	111	118	123	124	123	119	112	103	92.4	81.8	70.9	62.6	49.8
140	140	52.8	66.4	70.8	79.1	89.4	99.0	107	112	116	117	116	113	107	99.8	91.4	82.5	74.3	67.7	53.8
145	145	56.8	71.7	74.8	79.6	87.6	95.9	103	107	110	111	110	108	103	97.1	90.1	83.1	77.1	71.5	56.7
150	150	61.4	76.4	78.8	81.6	86.5	92.8	98.3	102	105	106	105	103	99.2	94.4	89.1	84.1	77.4	73.5	60.8
155	155	63.1	78.9	83.3	84.7	86.8	90.9	94.5	97.8	99.7	100	100.0	98.5	95.6	92.0	88.5	84.5	79.5	75.0	61.9
160	160	58.3	78.2	86.4	87.2	88.4	89.9	91.9	94.0	95.5	96.0	95.8	94.9	92.9	90.4	87.8	81.2	72.9	68.6	60.9
165	165	53.7	72.3	86.3	88.1	89.0	90.2	91.1	92.1	92.9	93.1	92.9	92.5	91.7	88.7	80.8	71.1	64.0	60.2	56.3
170	170	51.0	61.5	78.4	84.4	86.4	89.3	90.7	91.2	91.4	91.4	91.1	90.9	86.0	76.1	67.5	61.5	61.2	59.3	55.1
175	175	61.8	64.0	68.7	75.5	80.6	83.7	85.7	88.2	89.2	88.8	89.0	81.2	66.3	57.9	57.8	62.2	63.5	64.6	65.5
180	180	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6

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	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278		
5	277	277	277	277	277	277	278	278	278	278	278	278	278	278	278	277	277		
10	273	274	274	275	276	276	277	277	277	277	277	277	277	276	275	275	275		
15	268	269	270	272	273	274	275	276	277	277	276	275	274	273	272	271	270		
20	261	263	265	267	269	272	274	275	275	275	274	273	271	269	267	265	264		
25	252	254	257	261	265	268	271	273	274	273	272	270	267	263	260	257	255		
30	241	244	249	254	259	264	268	271	272	271	269	266	261	256	252	248	245		
35	228	233	239	246	253	260	265	268	269	268	265	261	255	249	242	236	232		
40	214	220	228	237	247	254	261	264	266	265	261	256	248	240	231	223	217		
45	197	205	216	228	239	249	256	261	263	261	257	250	241	230	218	208	201		
50	178	189	202	217	231	243	251	257	259	257	252	244	233	219	205	192	182		
55	159	172	188	206	223	236	246	252	254	252	247	237	224	208	191	174	162		
60	137	154	174	195	214	230	241	247	250	247	241	230	215	197	176	156	140		
65	114	135	161	185	206	223	235	242	244	242	235	223	206	185	162	137	117		
70	90.6	117	147	174	197	216	229	236	239	236	228	216	197	174	147	118	92.5		
75	67.8	99.5	134	165	189	208	222	230	233	230	222	208	189	164	133	99.4	68.9		
80	47.5	84.5	122	155	181	201	215	223	226	223	214	200	180	154	121	83.5	47.5		
85	32.3	72.6	112	146	173	193	207	216	218	215	207	192	171	145	110	70.8	31.1		
90	24.2	64.2	104	138	165	185	199	208	210	207	199	184	164	136	101	61.7	21.9		
95	21.2	57.9	95.8	129	156	176	190	199	201	198	189	175	155	127	93.2	55.0	18.5		
100	23.2	54.3	89.3	121	147	167	181	189	191	188	180	166	145	118	86.2	51.0	20.4		
105	28.0	54.2	84.4	114	139	158	171	178	181	178	170	156	136	111	81.1	50.4	25.4		
110	34.4	56.0	82.2	108	130	148	161	168	171	168	160	147	128	104	78.2	51.9	31.8		
115	40.7	59.3	81.3	104	123	140	151	159	161	158	150	137	121	100.0	77.0	55.0	37.9		
120	46.6	63.1	81.5	101	118	132	142	149	150	148	141	130	115	96.7	77.0	59.2	43.9		
125	52.2	66.0	82.0	98.4	113	126	135	140	142	139	133	123	110	94.6	78.1	63.5	49.5		
130	57.2	66.6	82.5	96.9	109	120	128	133	134	132	126	118	107	93.3	79.8	67.3	54.2		
135	60.4	72.8	84.0	95.5	106	115	121	125	127	125	120	113	104	92.6	81.6	70.2	56.5		
140	62.6	76.4	81.3	93.0	103	110	116	119	120	118	114	108	101	92.1	83.1	72.4	56.7		
145	64.1	79.0	83.2	91.2	100	106	110	113	114	113	109	105	98.7	91.4	84.4	74.8	58.3		
150	65.0	80.5	84.5	86.4	95.7	102	106	108	108	108	105	101	96.5	91.0	85.3	75.9	59.3		
155	61.1	75.5	81.1	86.5	89.3	96.7	101	103	103	103	101	98.3	94.8	90.9	85.0	71.7	55.4		
160	54.7	64.9	71.1	75.8	82.5	87.4	93.9	98.0	98.7	98.4	97.4	95.7	93.3	89.8	83.6	64.0	49.6		
165	51.6	54.5	60.4	63.5	66.7	71.0	79.3	89.3	92.0	94.0	93.6	92.1	88.7	83.8	75.6	52.4	46.6		
170	53.7	55.4	55.8	60.7	61.7	64.8	59.7	63.2	82.4	84.3	83.4	80.5	76.0	66.1	53.8	49.0	49.5		
175	64.8	67.0	69.4	70.6	71.1	71.0	71.1	66.5	39.2	53.6	66.2	68.1	64.7	65.1	66.2	64.5	62.1		
180	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6	58.6		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 14, 2018	Aug. 13, 2019
Digital Power Meter	PF2010A	HZTE028-01	Sep. 12, 2018	Sep. 11, 2019
AC Power Supply	DPS1060	HZTE001-06	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	WY12010	HZTE004-03	Aug. 09, 2018	Aug. 08, 2019
Temperature recorder	JM624U	HZTE018-08	Aug. 09, 2018	Aug. 08, 2019
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 09, 2018	Aug. 08, 2019
Standard source	D908	HZTE012-01	Aug. 14, 2018	Aug. 13, 2019
Integrate Sphere system	3M	HZTE015-04	Aug. 16, 2018	Aug. 15, 2019
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2018	Aug. 01, 2019
AC Power Supply	PCR 500L	HZTE001-07	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	IT6154	HZTE004-04	Aug. 09, 2018	Aug. 08, 2019
Standard source	SCL-1400	HZTE012-02	Aug. 16, 2018	Aug. 15, 2019
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 09, 2018	Aug. 08, 2019
Temperature Meter	TES1310	HZTE017-01	Aug. 09, 2018	Aug. 08, 2019

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 \*\*\*

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.