

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 16T8/4F/850/GL/BYP**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19070032a

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

Review by:



Engineer: April Zou

Jul. 25, 2019

Approved by:



Manager: Jim Zhang

Jul. 25, 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: 16T8/4F/850/GL/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
139.8	2225.1	15.92	0.9791
CCT (K)	CRI	Stabilization Time (Light & Power)	
5097	83.6	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. 22, 2019
<b>Date of Test</b>	: Jul. 23, 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

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## SAMPLE PHOTO

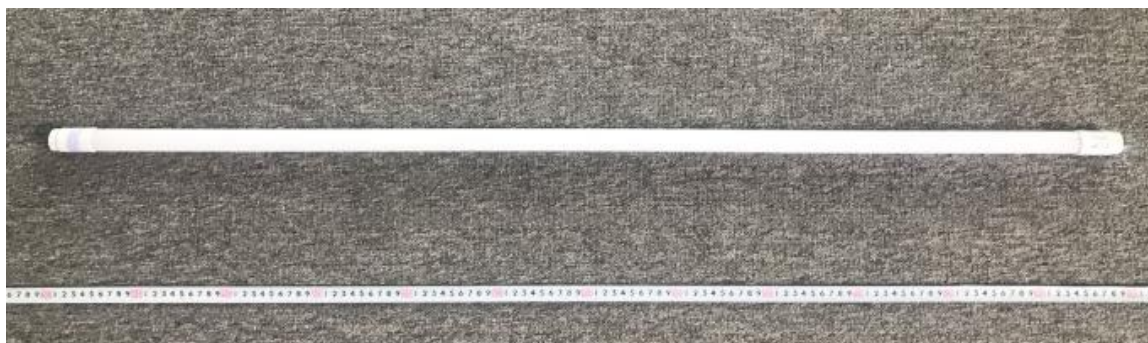


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 16T8/4F/850/GL/BYP
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 16W
<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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.135	0.061
Power Factor	0.9791	0.9301
Test Power (W)	15.92	15.82
THD A%	18.05	12.01
Luminous Efficacy (lm/W)	139.8	141.6
Total Luminous Flux (lm)	2225.1	2239.8
Color Rendering Index (CRI)	83.6	
R9	10.2	
Correlated Color Temperature (CCT)(K)	5097	
Chromaticity Chroma x	0.3425	
Chromaticity Chroma y	0.3519	
Chromaticity Chroma u	0.2096	
Chromaticity Chroma v	0.3230	
Duv	0.0012	
Chromaticity Chroma u'	0.2096	
Chromaticity Chroma v'	0.4845	

Special Color Rendering Indices	
R1	82.2
R2	89.7
R3	93.4
R4	82.4
R5	82.5
R6	84.4
R7	86.8
R8	67.6
R9	10.2
R10	74.4
R11	81.3
R12	61.4
R13	84.4
R14	96.7

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 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)	0.136
Power Factor	0.9787
Power (W)	16.00
Luminous Efficacy (lm/W)	137.2
Total Luminous Flux (lm)	2195.7
Beam Angle ( ° )	116.9 (0°-180°) / 258.9 (90°-270°)
Center Beam Candle Power (cd)	315
Maximum Beam Candle Power (cd)	315.8 (At: C=240.0, Gamma=1.5)
Spacing Criteria	1.30 (0°-180°) / 1.49 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	38.77%
Zonal Lumens in the 60 °-90 °Zone	26.52%
Zonal Lumens in the 90 °-120 °Zone	19.14%
Zonal Lumens in the 120 °-180 °Zone	15.56%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

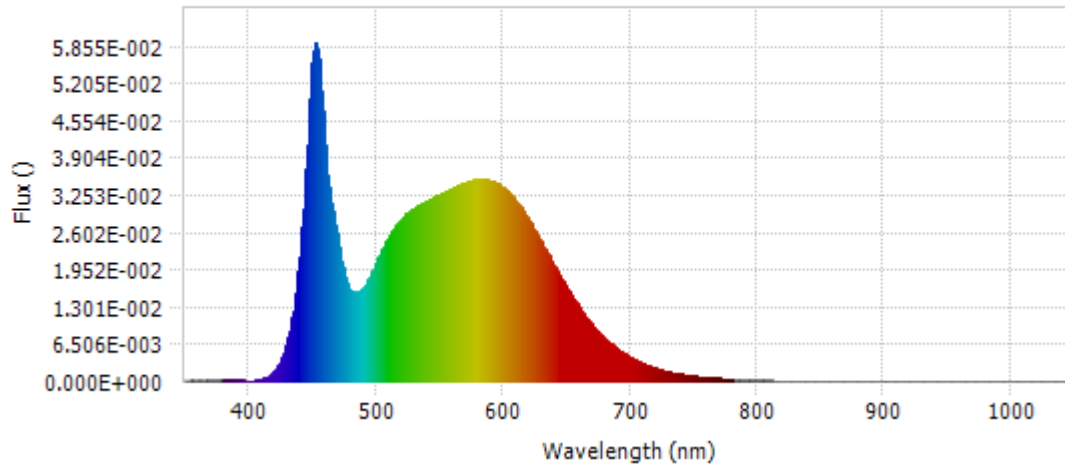
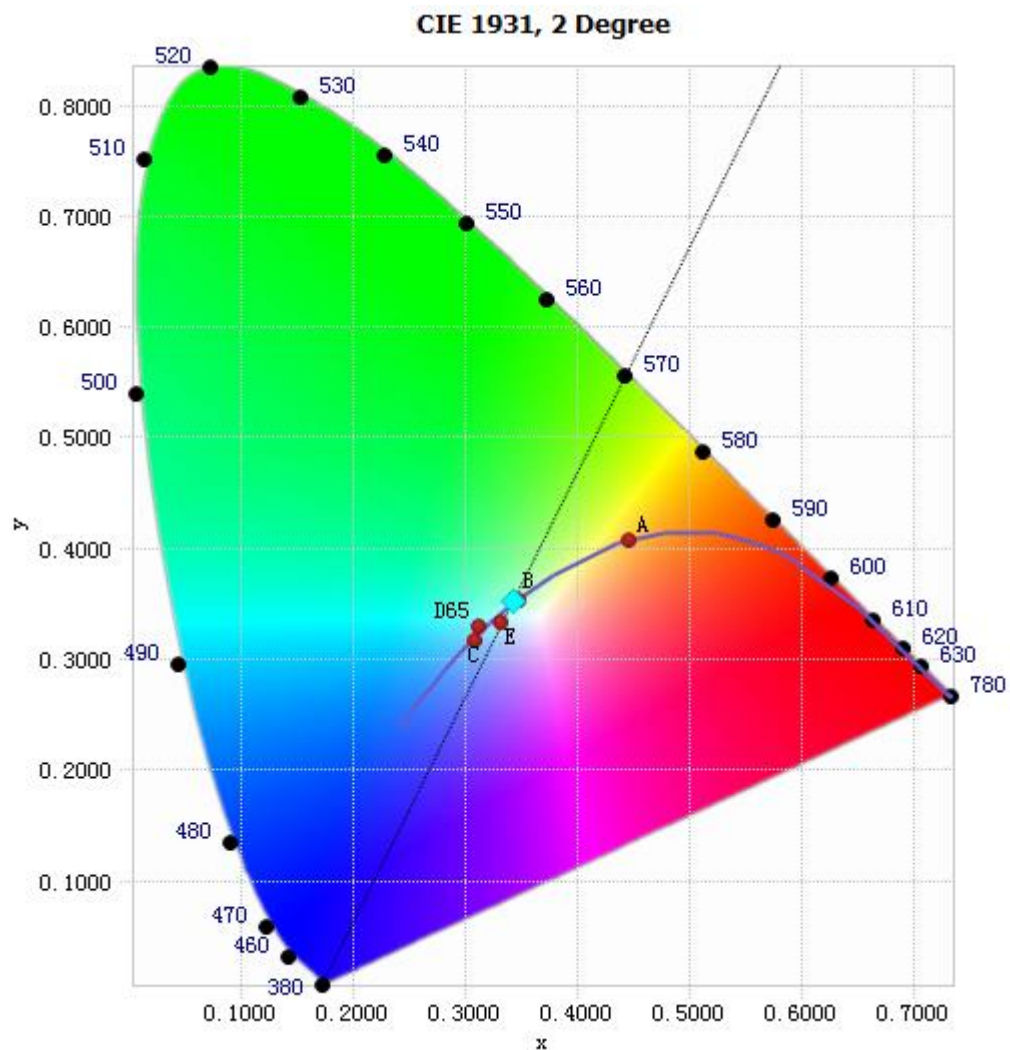


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.05E-04	485	1.55E-02	590	3.51E-02	695	4.85E-03
385	1.96E-04	490	1.63E-02	595	3.46E-02	700	4.19E-03
390	1.97E-04	495	1.81E-02	600	3.39E-02	705	3.60E-03
395	1.55E-04	500	2.06E-02	605	3.28E-02	710	3.08E-03
400	1.24E-04	505	2.31E-02	610	3.15E-02	715	2.65E-03
405	1.59E-04	510	2.51E-02	615	3.00E-02	720	2.29E-03
410	3.56E-04	515	2.70E-02	620	2.82E-02	725	1.96E-03
415	8.54E-04	520	2.84E-02	625	2.63E-02	730	1.69E-03
420	1.85E-03	525	2.93E-02	630	2.43E-02	735	1.45E-03
425	3.67E-03	530	3.02E-02	635	2.23E-02	740	1.24E-03
430	6.90E-03	535	3.08E-02	640	2.03E-02	745	1.06E-03
435	1.23E-02	540	3.15E-02	645	1.82E-02	750	9.22E-04
440	2.15E-02	545	3.21E-02	650	1.63E-02	755	7.88E-04
445	3.72E-02	550	3.26E-02	655	1.45E-02	760	6.74E-04
450	5.55E-02	555	3.31E-02	660	1.28E-02	765	5.88E-04
455	5.63E-02	560	3.37E-02	665	1.13E-02	770	5.08E-04
460	4.11E-02	565	3.42E-02	670	9.83E-03	775	4.38E-04
465	3.11E-02	570	3.48E-02	675	8.61E-03	780	3.81E-04
470	2.47E-02	575	3.50E-02	680	7.48E-03		
475	1.89E-02	580	3.52E-02	685	6.49E-03		
480	1.59E-02	585	3.53E-02	690	5.61E-03		

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

# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3425, 0.3519)

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

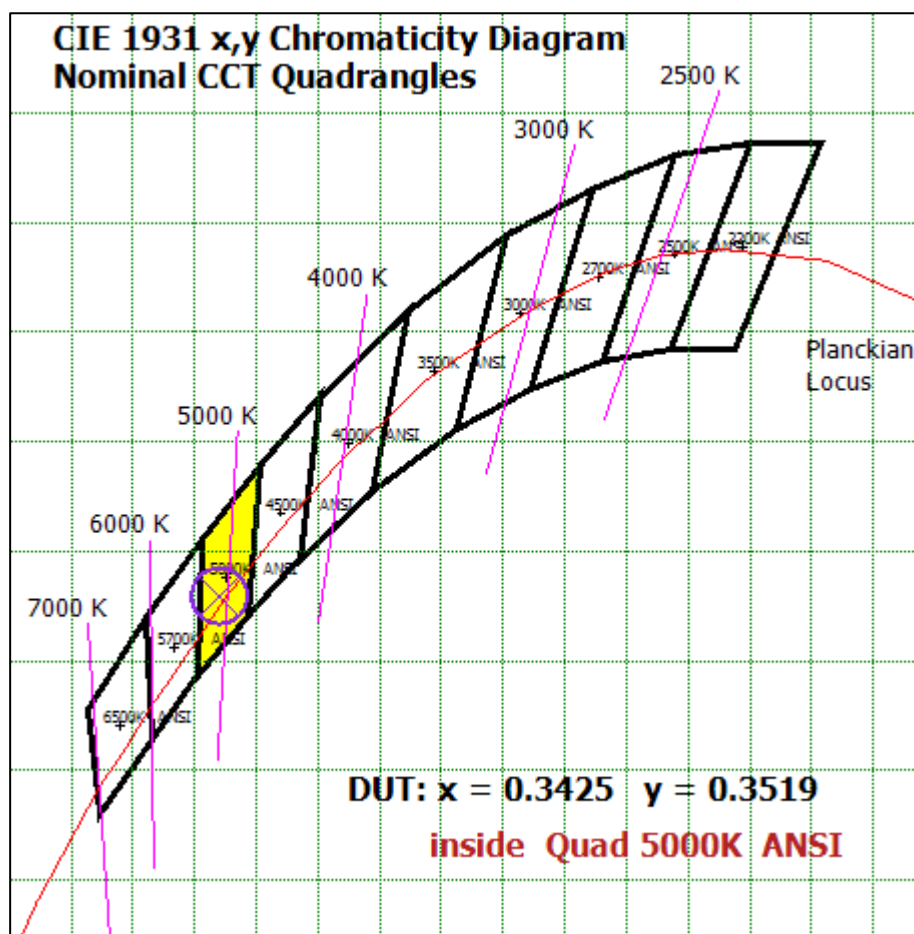
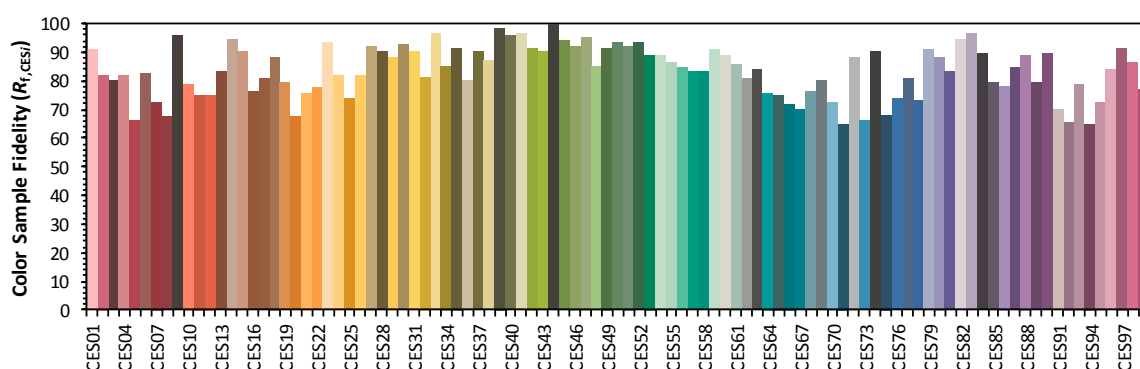
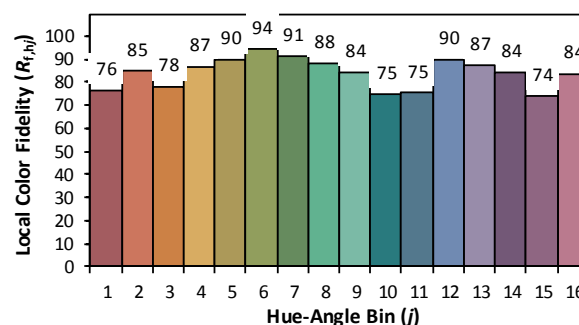
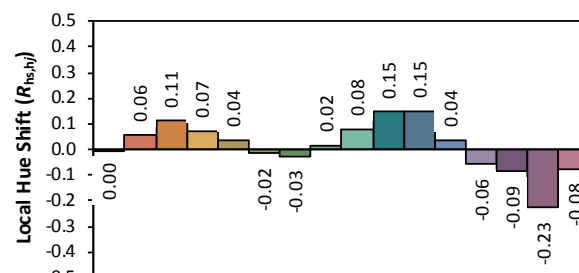
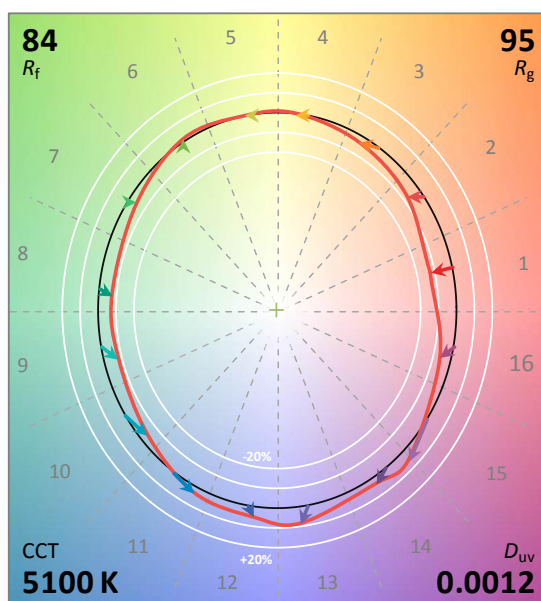
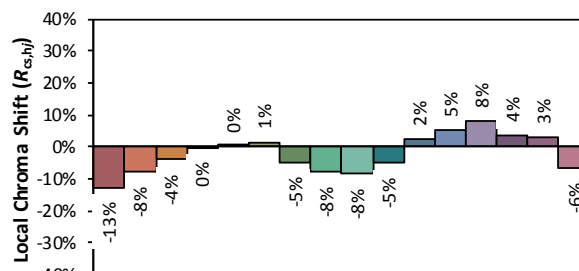


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Figure 1 is a line graph titled "Radiant Power (Equal Luminous Flux) vs. Wavelength (nm)". The x-axis represents Wavelength (nm) from 380 to 780. The y-axis represents Radiant Power (Equal Luminous Flux). Two curves are plotted: a black line for the Reference LED and a red line for the Test LED. The Reference LED curve is relatively flat, showing minor fluctuations between 0.000 and 0.001. The Test LED curve shows a prominent peak around 450 nm (reaching approximately 0.0015) and a smaller peak around 580 nm (reaching approximately 0.0008).



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

 $x = 0.3425$  $y = 0.3519$ 
$$U' \quad 0.2096$$

$V'$  0.4845

#### 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	29.991	1.37%
10- 20	87.582	3.99%
20- 30	138.193	6.29%
30- 40	177.809	8.10%
40- 50	203.574	9.27%
50- 60	214.212	9.76%
60- 70	210.521	9.59%
70- 80	195.712	8.91%
80- 90	176.005	8.02%
90-100	157.889	7.19%
100-110	140.141	6.38%
110-120	122.292	5.57%
120-130	104.507	4.76%
130-140	86.654	3.95%
140-150	68.144	3.10%
150-160	48.148	2.19%
160-170	26.426	1.20%
170-180	7.853	0.36%
Total	2195.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	851.361	38.77%
60- 90	582.238	26.52%
0-90	1433.599	65.29%
90- 180	762.054	34.71%
0- 180	2195.7	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

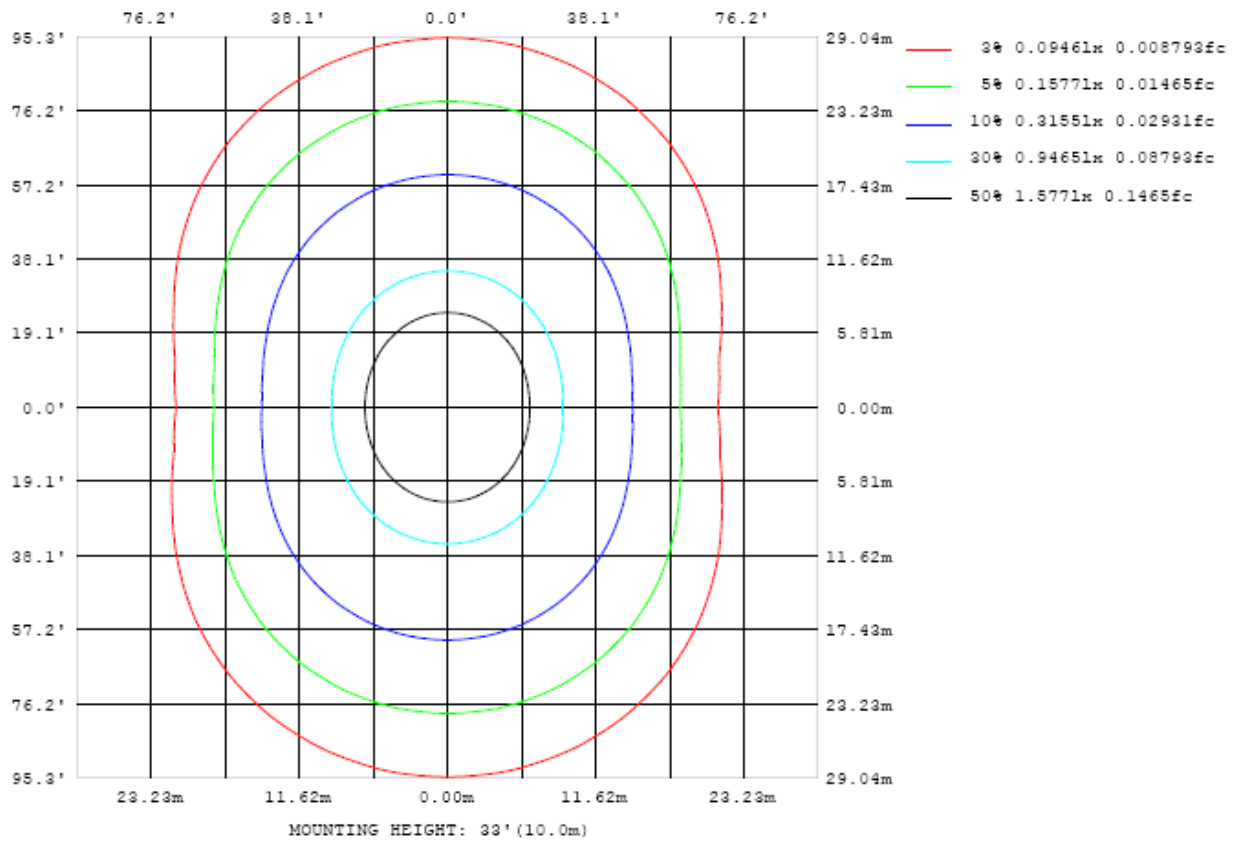


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

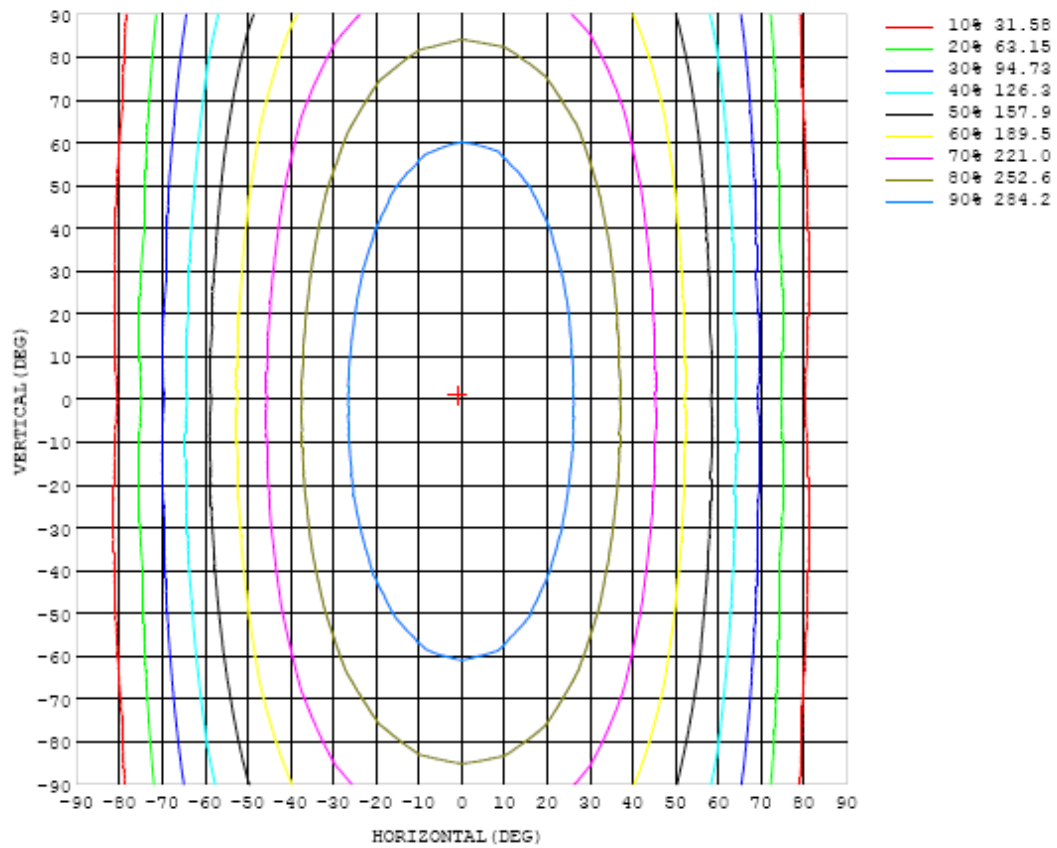


Chart 6: Isocandela Plot

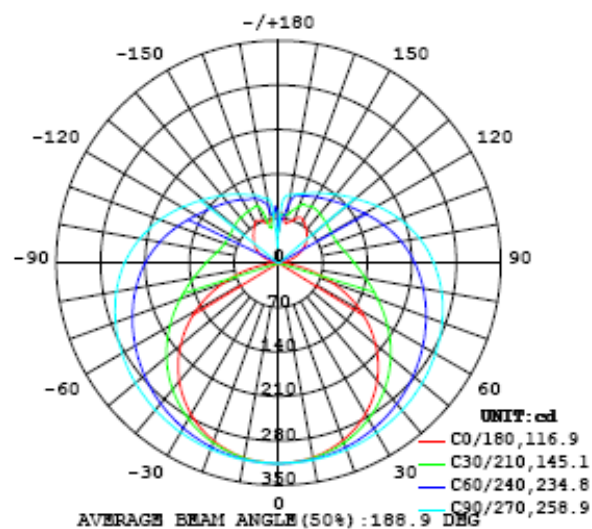


Chart 7: Polar Candela Distribution

## 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	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
5	314	314	314	314	315	315	315	315	315	316	316	315	315	315	315	315	315	314	314
10	311	311	311	312	312	313	314	314	315	315	315	315	314	313	313	312	312	311	311
15	305	305	306	307	308	310	311	313	314	314	314	313	312	311	309	308	307	306	306
20	297	298	299	301	303	306	309	311	312	313	313	311	310	307	304	302	300	299	298
25	287	288	290	293	297	301	305	308	310	311	310	309	306	302	298	294	291	289	288
30	274	276	279	284	289	295	300	305	308	309	308	306	301	296	291	285	280	277	275
35	259	261	266	272	280	289	295	301	305	306	305	301	296	289	282	274	267	262	260
40	242	244	251	260	270	281	290	297	301	303	301	297	290	282	271	261	252	246	243
45	222	225	234	246	259	272	283	292	297	299	297	292	284	273	260	247	236	227	223
50	200	204	215	231	247	263	276	287	293	295	293	287	278	264	249	232	217	206	201
55	175	181	195	215	235	254	270	281	288	290	288	281	270	255	236	216	197	183	177
60	149	156	175	198	223	245	262	275	283	285	283	275	263	245	224	199	176	159	150
65	120	130	154	182	210	235	255	269	277	280	277	269	255	235	211	183	156	133	122
70	90.0	103	133	166	199	226	247	263	272	274	271	262	247	225	198	167	134	106	92.4
75	59.9	76.6	113	152	187	217	239	256	265	268	265	255	239	216	187	152	114	79.3	62.8
80	33.1	53.2	95.5	139	177	208	231	248	258	261	258	247	231	207	176	138	96.1	55.4	34.6
85	10.1	35.9	82.4	128	167	199	223	240	250	253	250	239	222	198	166	127	82.0	36.7	11.5
90	0.96	27.2	73.6	119	159	190	215	232	242	245	241	231	213	189	157	117	72.3	26.4	0.50
95	4.35	25.0	68.0	112	151	182	206	223	233	236	232	222	205	180	148	110	66.0	23.1	2.83
100	10.9	27.8	64.7	106	143	173	196	213	222	225	222	212	195	171	140	103	62.0	24.5	7.96
105	18.9	33.5	64.4	101	135	164	186	202	212	214	211	201	185	162	132	97.2	60.7	29.6	14.9
110	27.6	41.5	66.3	97.4	129	155	176	191	200	203	200	190	174	153	125	93.3	61.5	37.1	22.8
115	36.4	49.9	70.1	96.1	123	146	166	180	189	191	188	179	164	144	119	91.1	64.4	45.0	30.9
120	44.7	57.8	74.6	96.1	119	139	156	170	177	179	177	168	155	137	114	90.2	68.6	52.3	38.6
125	52.3	65.8	79.3	96.9	116	133	148	160	166	168	165	158	146	130	111	90.8	73.5	60.0	45.0
130	58.2	72.6	83.9	98.2	114	128	141	151	157	158	156	149	139	125	109	92.3	78.6	66.3	50.4
135	63.6	78.9	88.3	99.8	112	124	134	143	148	149	147	141	132	121	108	94.3	83.4	73.1	55.9
140	68.5	83.8	90.7	101	111	120	129	136	140	141	139	134	127	118	107	96.4	87.2	79.1	61.2
145	73.2	89.1	94.5	103	110	117	124	130	133	134	132	128	123	115	107	98.4	91.2	84.4	66.8
150	77.7	93.1	96.7	103	109	115	120	124	127	127	126	123	119	113	106	99.8	93.8	88.8	73.2
155	79.4	93.9	95.1	100	109	112	116	119	121	121	121	119	115	111	106	102	97.6	91.6	74.3
160	72.8	85.2	92.9	95.1	104	110	113	115	116	117	116	115	113	110	107	103	100	93.8	69.4
165	66.8	77.5	81.3	86.5	89.1	103	111	112	112	112	112	112	110	109	107	104	102	98.0	65.1
170	63.5	69.3	76.0	77.6	76.9	81.8	93.6	106	109	109	109	109	108	107	105	101	99.0	89.9	68.2
175	74.9	75.6	76.1	77.1	74.2	70.2	69.7	76.0	88.7	102	106	106	106	103	98.9	96.3	90.4	80.7	73.8
180	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0

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	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315		
5	314	314	315	315	315	315	315	315	315	315	315	315	315	315	315	315	314		
10	311	311	312	313	313	314	314	315	314	315	314	314	314	312	312	311	311		
15	306	306	307	309	310	311	313	314	314	313	313	312	311	309	307	306	305		
20	298	299	301	304	306	309	311	312	312	312	310	309	306	304	301	299	298		
25	289	290	293	297	301	305	308	309	310	310	307	305	301	297	293	290	287		
30	276	279	284	289	295	300	304	307	308	307	304	301	295	289	283	278	275		
35	262	266	272	280	288	295	300	304	305	304	300	295	288	280	272	265	261		
40	245	251	260	270	280	289	296	300	302	301	296	290	281	270	259	250	244		
45	226	234	245	259	272	282	291	296	298	297	291	283	272	259	245	233	225		
50	205	216	230	247	262	275	286	292	294	292	286	277	263	247	230	215	203		
55	182	196	214	234	253	268	280	287	289	288	281	270	254	235	214	195	180		
60	157	174	197	222	243	261	274	282	284	282	275	262	245	223	198	174	155		
65	130	153	181	209	233	253	267	276	279	277	268	255	235	211	182	153	129		
70	103	131	165	196	224	245	260	270	273	271	262	247	226	199	166	131	101		
75	77.0	111	149	185	214	237	253	263	266	264	255	239	217	187	151	112	75.5		
80	53.3	93.4	136	173	204	228	245	256	259	257	247	231	208	177	139	95.2	52.9		
85	34.9	79.5	124	163	195	219	237	248	251	249	239	223	199	167	127	82.2	36.0		
90	24.9	69.8	115	154	186	210	228	239	243	240	230	214	190	158	119	73.2	27.5		
95	21.6	63.1	106	144	176	200	218	229	232	230	220	204	180	149	111	67.4	25.3		
100	23.7	59.1	98.6	135	166	190	207	218	222	219	210	194	171	141	104	64.3	28.2		
105	28.8	58.4	93.3	127	157	180	196	207	210	208	199	183	161	133	99.1	64.3	33.7		
110	35.5	60.0	90.1	121	148	169	185	195	199	196	188	173	152	126	96.2	66.5	40.8		
115	41.9	63.1	88.6	115	140	159	174	184	187	185	177	163	144	121	95.1	70.1	47.6		
120	49.5	67.3	88.5	111	133	150	164	172	175	174	166	154	137	117	95.2	74.4	55.2		
125	54.5	71.4	89.4	109	127	142	154	162	165	163	157	146	132	115	95.9	78.4	61.8		
130	59.2	74.6	90.6	107	123	136	146	153	155	154	148	139	127	113	96.8	81.8	67.5		
135	63.6	79.0	92.1	106	119	130	138	144	146	145	141	133	123	111	97.8	86.0	72.3		
140	67.3	82.9	92.8	104	116	125	132	137	139	138	134	128	120	110	99.2	89.8	74.8		
145	70.2	85.1	93.7	103	112	120	126	130	132	131	128	123	117	109	101	93.2	77.2		
150	71.2	87.8	94.5	102	109	115	120	124	125	125	123	119	114	108	99.7	94.5	77.6		
155	62.7	82.2	95.4	100	107	111	114	117	119	119	118	116	112	106	96.4	91.5	74.0		
160	55.8	69.6	95.3	98.9	103	108	111	113	114	115	114	111	103	90.9	87.2	82.0	68.2		
165	54.7	56.4	65.0	93.2	97.6	102	105	107	108	108	103	91.9	81.3	78.5	75.2	69.2	63.5		
170	54.6	60.5	59.5	64.3	76.7	87.7	94.0	99.8	103	91.8	71.7	73.5	75.4	73.6	69.9	65.7	64.2		
175	71.3	71.9	78.0	82.3	82.9	81.5	81.3	78.2	51.9	72.1	82.5	83.4	83.5	83.0	81.3	79.3	76.6		
180	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0		

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 \*\*\*

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