

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 13T8/4F/850/IS/DIR**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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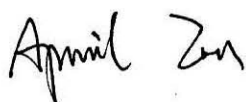
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Report No.: HZ19040014b

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

Review by:



Engineer: April Zou  
Apr. 18, 2019

Approved by:



Manager: Jim Zhang  
Apr. 18, 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/850/IS/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
135.9	2235.0	16.45	0.9923
CCT (K)	CRI	Stabilization Time (Light & Power)	
4915	81.4	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>	: Apr. 09, 2019
<b>Date of Test</b>	: Apr. 10, 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

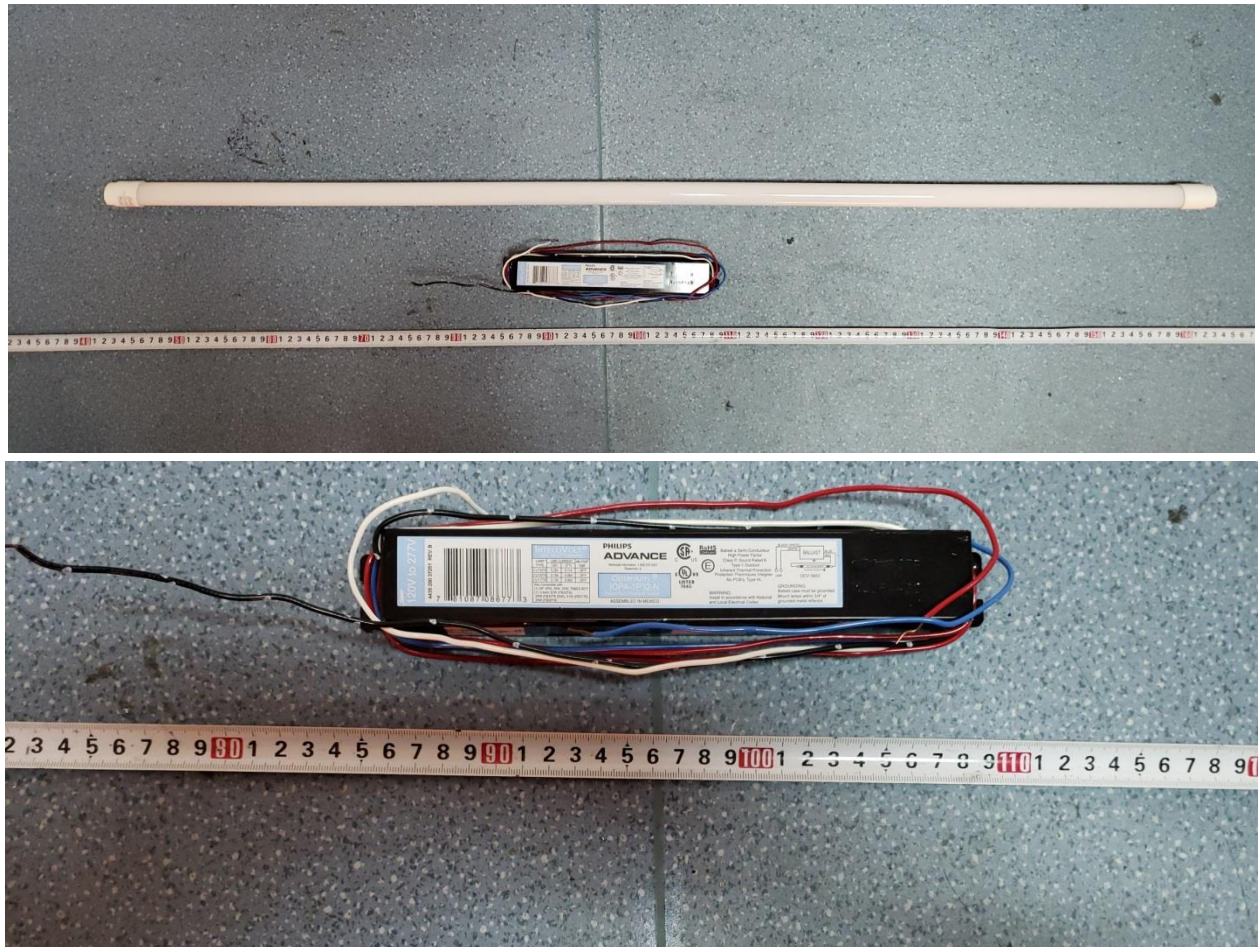


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 13T8/4F/850/IS/DIR
<b>Electrical Ratings</b>	: 120-277V, 60Hz
<b>Product Description</b>	: 5000K LED Tubes supplied by a high frequency fluorescent lamp ballast: IOPA-1P32-N
<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)	0.138	0.063
Power Factor	0.9923	0.9472
Test Power (W)	16.45	16.52
THD A%	9.52	12.18
Luminous Efficacy (lm/W)	135.9	135.4
Total Luminous Flux (lm)	2235.0	2236.0
Color Rendering Index (CRI)	81.4	
R9	0.5	
Correlated Color Temperature (CCT)(K)	4915	
Chromaticity Chroma x	0.3485	
Chromaticity Chroma y	0.3635	
Chromaticity Chroma u	0.2092	
Chromaticity Chroma v	0.3272	
Duv	0.0045	
Chromaticity Chroma u'	0.2092	
Chromaticity Chroma v'	0.4908	

Special Color Rendering Indices	
R1	78.8
R2	85.8
R3	92
R4	81.5
R5	79.5
R6	81
R7	87.3
R8	65.6
R9	0.5
R10	67.1
R11	80.5
R12	58.3
R13	80.3
R14	95.7
Rf	83
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 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)	0.139
Power Factor	0.9926
Power (W)	16.53
Luminous Efficacy (lm/W)	133.1
Total Luminous Flux (lm)	2199.4
Beam Angle (°)	116.9 (0°-180°) / 240.3 (90°-270°)
Center Beam Candle Power (cd)	336
Maximum Beam Candle Power (cd)	335.8 (At: C=260.0, Gamma=2.0)
Spacing Criteria	1.30 (0°-180°) / 1.47 (90°-270°)
Zonal Lumens in the 0°-60° Zone	40.77%
Zonal Lumens in the 60°-90° Zone	26.99%
Zonal Lumens in the 90°-120° Zone	18.43%
Zonal Lumens in the 120°-180° Zone	13.81%

Table 3: Test data per Goniophotometer Method



### Spectral Power Distribution - Sphere Spectroradiometer Method

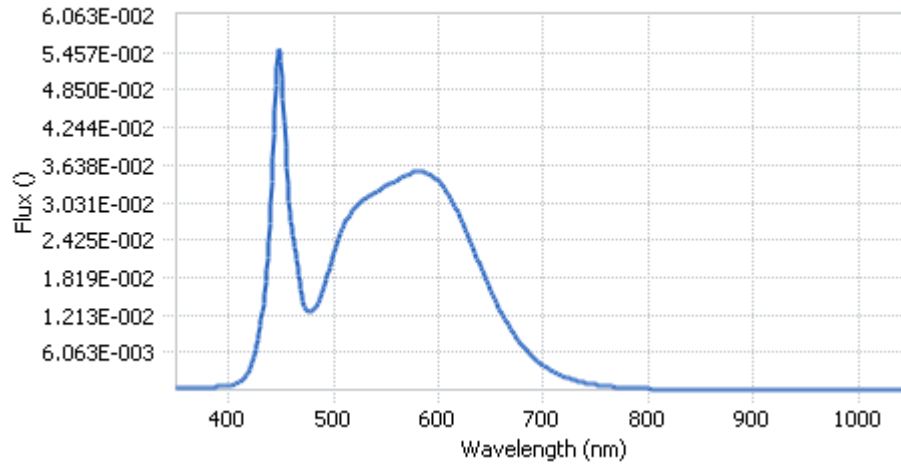
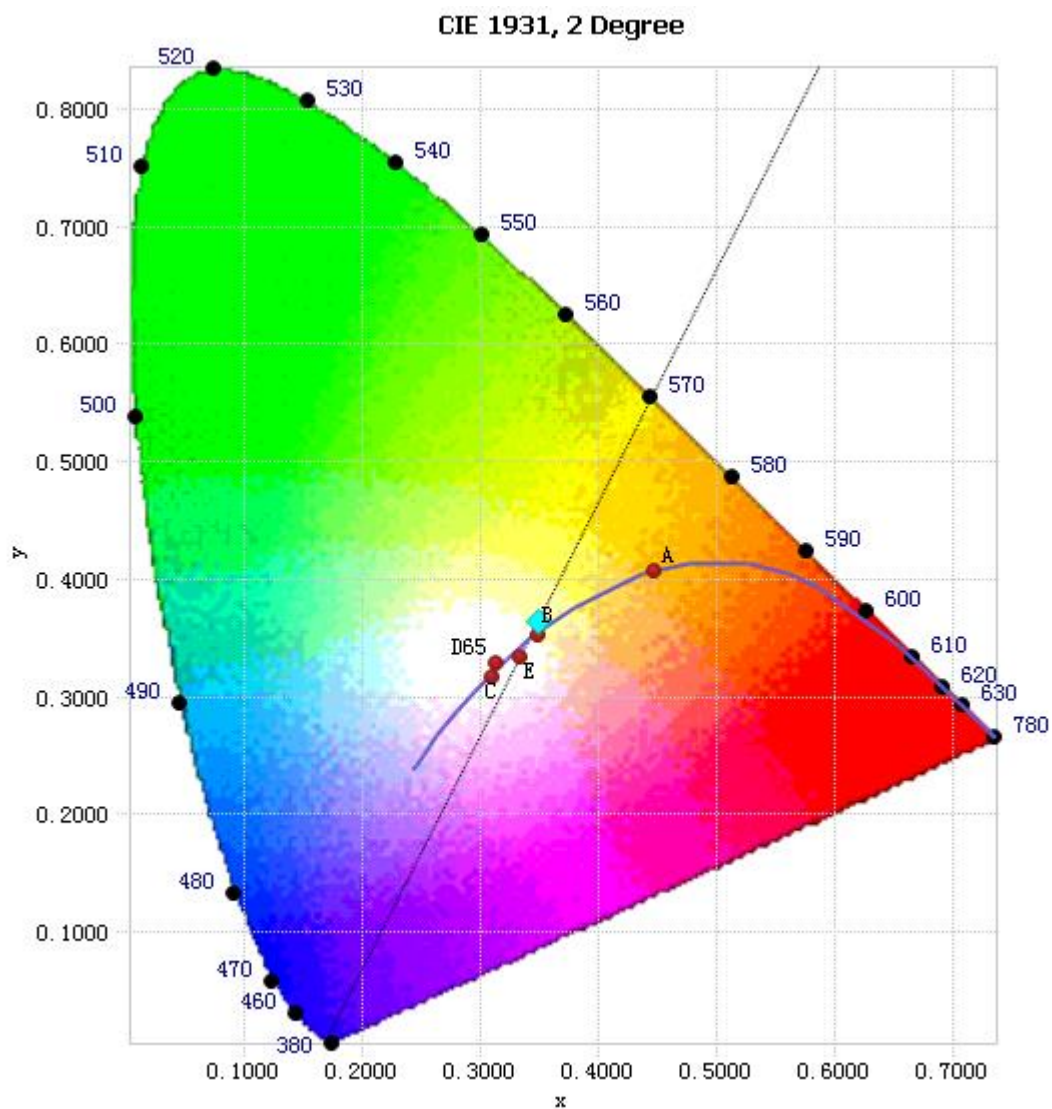


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.89E-04	485	1.40E-02	590	3.51E-02	695	4.59E-03
385	4.86E-04	490	1.62E-02	595	3.45E-02	700	3.93E-03
390	5.43E-04	495	1.92E-02	600	3.38E-02	705	3.37E-03
395	5.83E-04	500	2.21E-02	605	3.28E-02	710	2.88E-03
400	6.74E-04	505	2.47E-02	610	3.14E-02	715	2.46E-03
405	8.87E-04	510	2.67E-02	615	2.98E-02	720	2.12E-03
410	1.28E-03	515	2.83E-02	620	2.80E-02	725	1.81E-03
415	2.00E-03	520	2.95E-02	625	2.60E-02	730	1.55E-03
420	3.40E-03	525	3.03E-02	630	2.41E-02	735	1.32E-03
425	5.91E-03	530	3.10E-02	635	2.20E-02	740	1.13E-03
430	1.03E-02	535	3.14E-02	640	1.99E-02	745	9.76E-04
435	1.74E-02	540	3.20E-02	645	1.79E-02	750	8.42E-04
440	3.02E-02	545	3.25E-02	650	1.59E-02	755	7.20E-04
445	4.92E-02	550	3.29E-02	655	1.42E-02	760	6.21E-04
450	5.32E-02	555	3.34E-02	660	1.25E-02	765	5.33E-04
455	3.60E-02	560	3.39E-02	665	1.09E-02	770	4.67E-04
460	2.63E-02	565	3.44E-02	670	9.52E-03	775	4.03E-04
465	2.10E-02	570	3.48E-02	675	8.28E-03	780	3.46E-04
470	1.51E-02	575	3.51E-02	680	7.18E-03		
475	1.27E-02	580	3.53E-02	685	6.20E-03		
480	1.29E-02	585	3.54E-02	690	5.35E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3485, 0.3635)

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

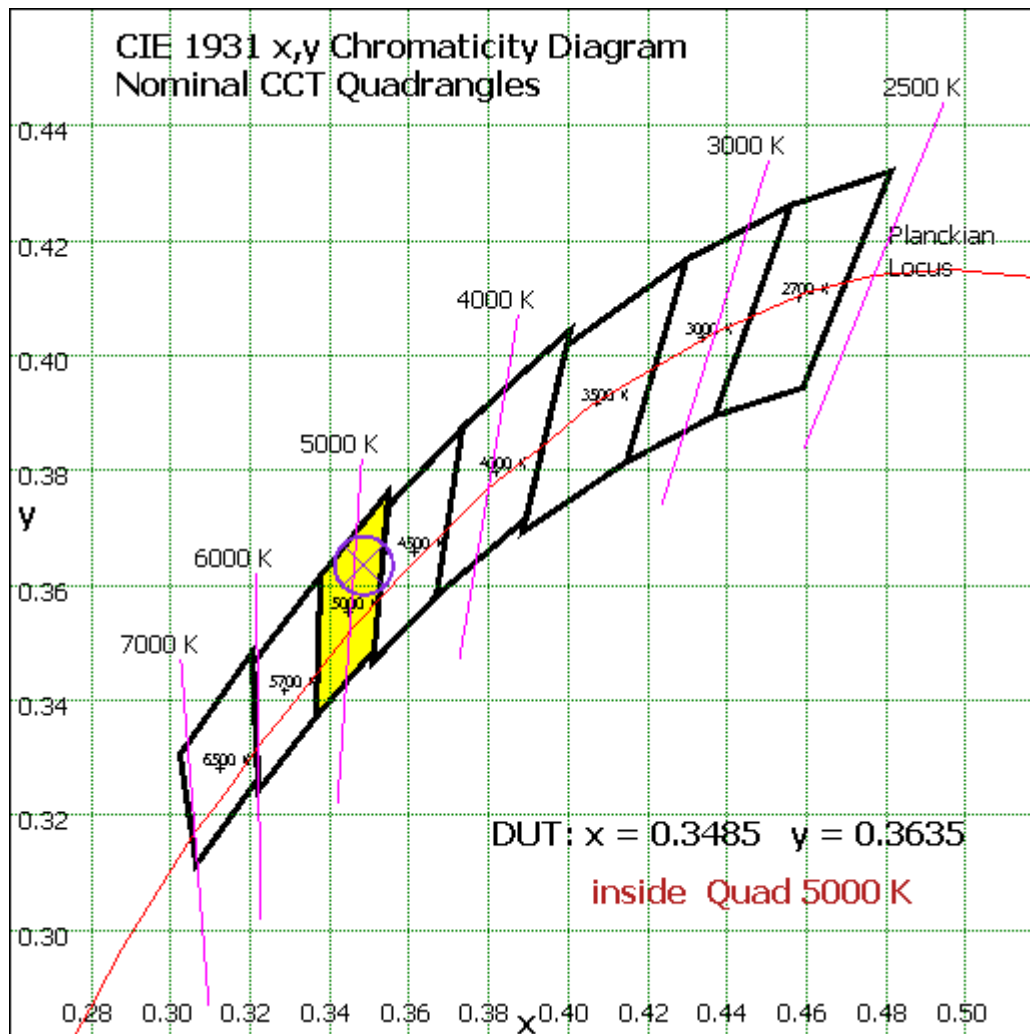
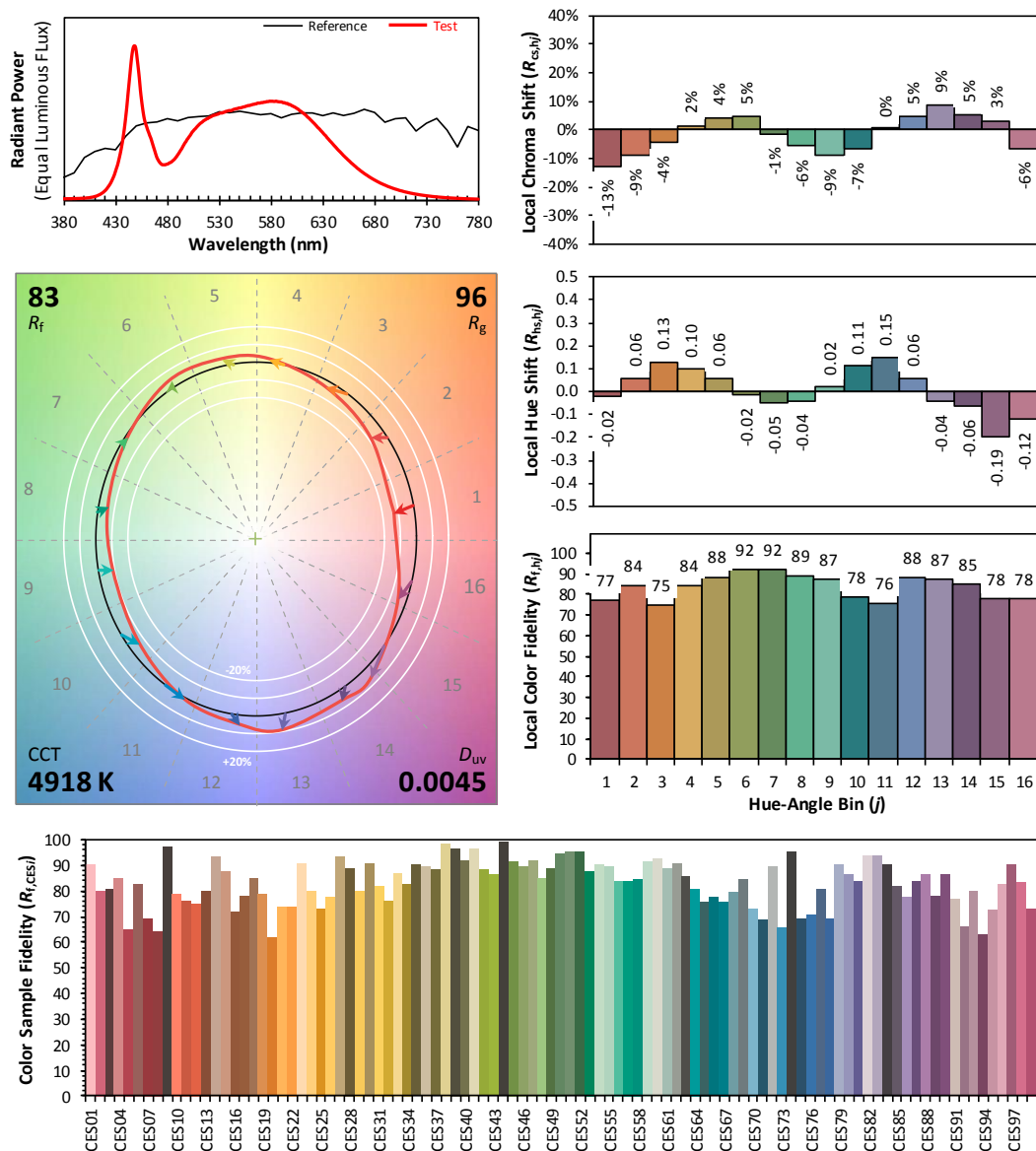


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.3485

$y$  0.3635

$u'$  0.2092

$v'$  0.4908

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	31.901	1.45%
10- 20	93.047	4.23%
20- 30	146.473	6.66%
30- 40	187.822	8.54%
40- 50	213.973	9.73%
50- 60	223.57	10.17%
60- 70	217.598	9.89%
70- 80	199.582	9.07%
80- 90	176.326	8.02%
90-100	155.047	7.05%
100-110	134.988	6.14%
110-120	115.313	5.24%
120-130	96.433	4.38%
130-140	77.934	3.54%
140-150	59.742	2.72%
150-160	40.951	1.86%
160-170	21.859	0.99%
170-180	6.795	0.31%
Total	2199.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	896.786	40.77%
60- 90	593.506	26.99%
0-90	1490.292	67.76%
90- 180	709.062	32.24%
0- 180	2199.4	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

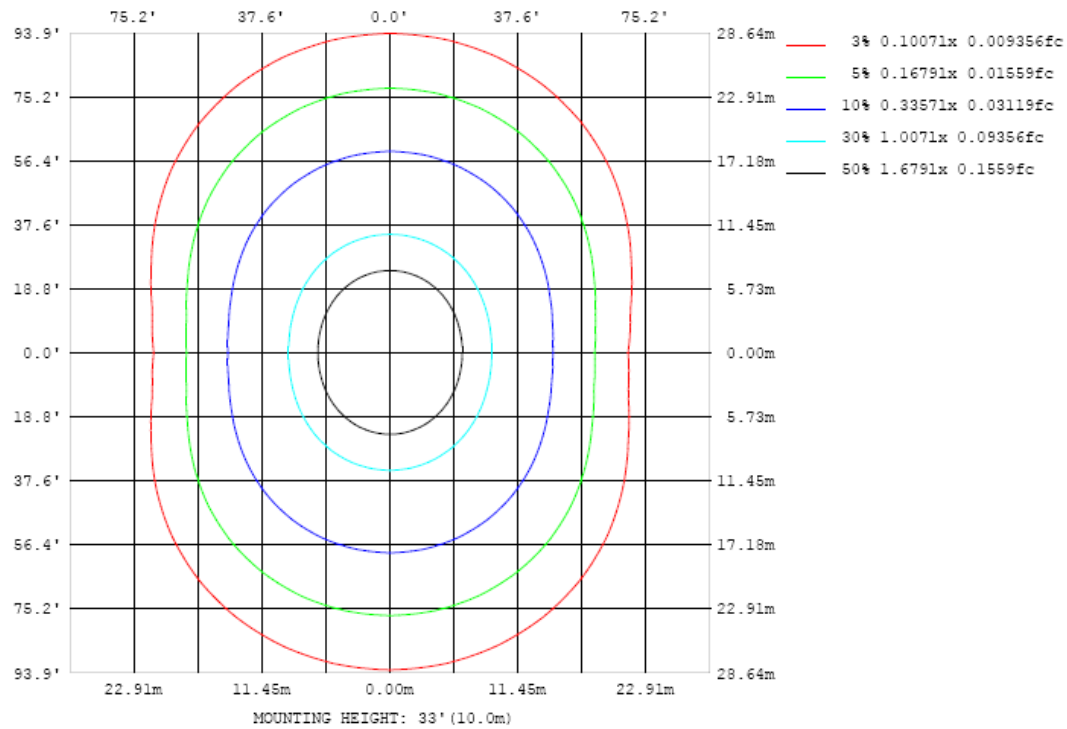


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

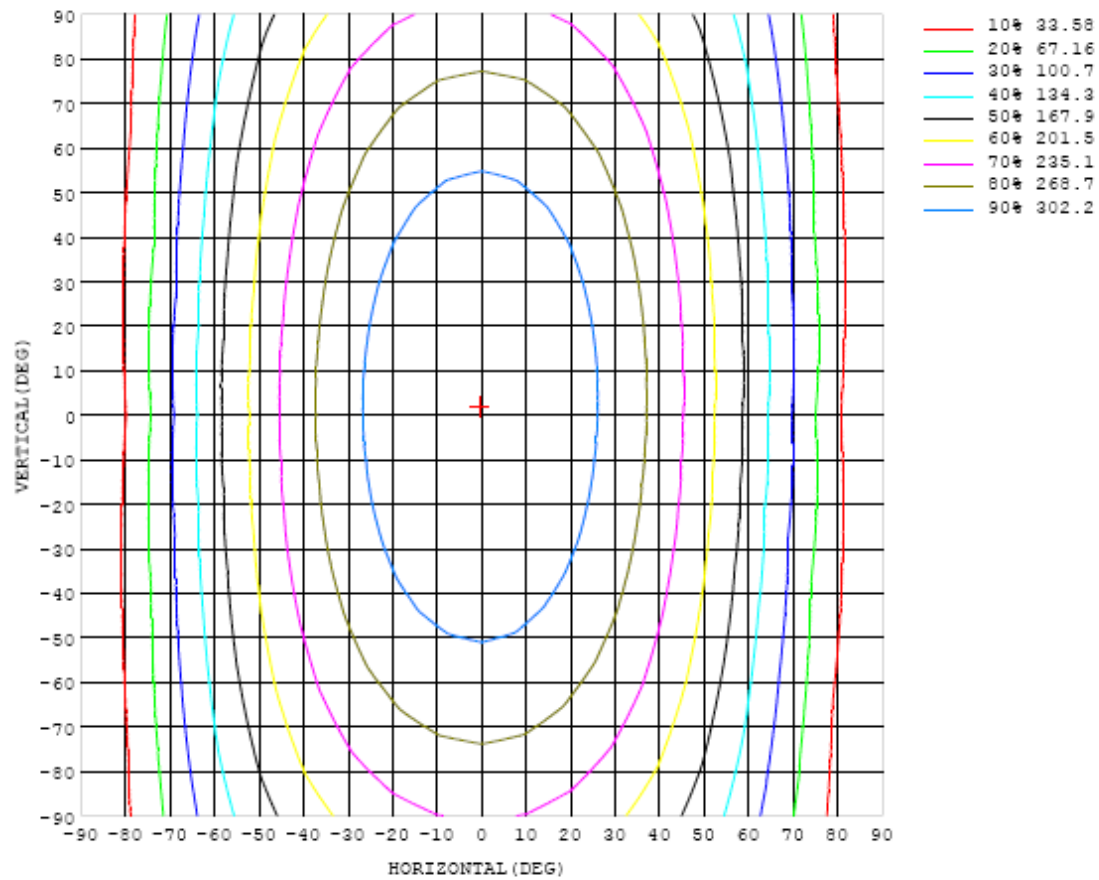


Chart 6: Isocandela Plot

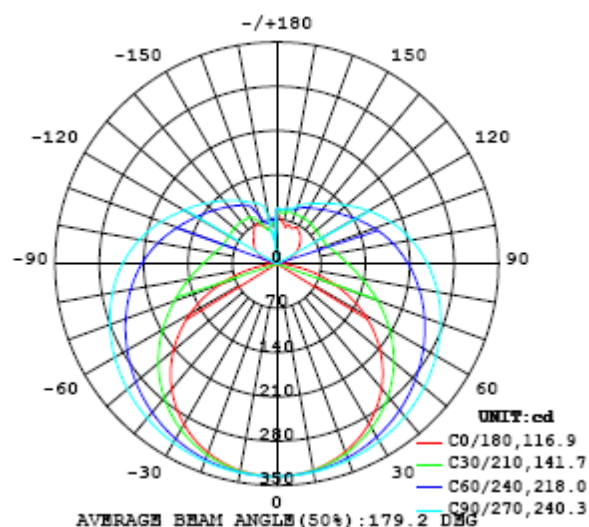


Chart 7: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336
5	334	334	334	334	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335
10	330	330	331	331	332	332	333	333	334	334	334	334	333	333	332	332	332	332	331
15	324	324	325	326	327	329	330	331	332	332	332	332	331	329	328	327	326	326	326
20	316	316	317	319	321	324	326	328	329	330	329	329	327	325	323	320	319	318	317
25	305	305	307	310	314	318	321	324	326	327	326	325	322	319	315	312	309	307	306
30	291	292	295	299	305	310	316	320	322	323	323	320	317	312	307	301	297	294	293
35	275	276	281	287	295	302	309	314	318	319	318	315	311	304	297	289	282	278	277
40	257	259	264	273	283	293	302	308	313	315	313	310	303	295	285	275	266	260	258
45	236	238	246	258	271	283	294	302	307	309	308	303	296	285	273	260	248	240	237
50	213	216	226	241	257	273	285	295	301	303	302	296	287	275	260	243	228	217	213
55	187	191	205	223	243	262	277	288	295	297	295	289	278	264	246	226	206	192	186
60	160	165	182	205	229	250	267	280	288	290	288	281	269	252	231	208	184	165	158
65	130	137	159	187	215	239	258	272	280	283	281	273	260	241	217	190	161	137	128
70	98.6	108	136	169	201	227	248	263	272	275	272	264	250	230	204	172	138	108	95.4
75	67.3	80.0	113	152	187	216	238	254	263	267	264	255	240	219	190	156	117	80.6	63.2
80	37.5	54.6	94.0	137	174	205	228	245	254	258	255	246	230	208	178	141	98.8	56.8	33.2
85	13.0	34.2	78.3	124	163	194	218	235	245	248	245	236	220	197	166	129	84.3	38.6	9.67
90	0.90	22.7	67.8	113	152	183	207	224	234	238	235	225	209	186	156	118	74.2	29.0	0.40
95	2.78	19.1	60.7	104	142	173	197	214	224	227	224	215	199	176	146	109	67.5	25.5	2.87
100	7.44	20.7	56.0	96.0	133	163	186	203	213	216	213	204	188	166	137	102	62.7	26.7	8.20
105	12.8	25.0	54.0	89.7	124	153	175	191	201	204	201	192	177	156	128	95.2	60.3	30.2	15.1
110	20.4	31.5	54.7	84.9	116	143	164	180	189	192	189	181	166	146	120	90.2	60.6	35.5	22.6
115	28.2	38.2	56.8	82.2	109	133	153	168	177	180	177	169	156	137	113	87.2	62.1	40.7	29.6
120	35.5	45.0	59.8	81.5	104	125	143	156	164	167	165	157	145	128	107	85.6	65.1	44.6	36.2
125	41.6	50.6	63.7	81.1	99.8	118	133	145	152	155	153	146	135	120	103	84.5	67.5	53.2	43.1
130	46.9	55.5	67.2	81.3	96.9	112	125	135	141	144	142	136	127	115	100	84.7	70.0	56.1	47.1
135	53.2	61.3	70.6	82.2	94.6	107	118	126	132	134	132	127	120	110	97.2	85.1	69.7	57.8	52.3
140	57.9	65.6	73.8	82.9	93.0	103	112	119	123	125	124	120	113	105	95.2	85.4	73.0	63.7	55.6
145	61.2	69.5	75.8	83.4	91.8	99.6	106	112	115	117	116	112	107	101	93.8	82.8	72.0	70.2	63.1
150	65.3	73.2	78.7	83.7	90.3	96.6	102	106	109	110	109	107	103	97.9	91.2	81.4	73.9	72.9	69.2
155	62.1	77.0	80.2	83.4	88.0	93.4	97.7	101	103	104	103	101	98.4	94.4	87.1	78.3	76.7	72.8	68.3
160	62.5	80.9	81.5	83.2	86.3	88.6	92.2	95.0	97.0	97.7	97.2	95.8	93.7	90.0	84.9	80.8	74.6	70.5	63.3
165	62.8	79.7	83.5	84.4	85.9	88.2	88.3	88.3	88.6	88.8	89.1	88.9	88.0	86.3	83.6	76.5	68.7	62.9	58.0
170	65.3	77.8	80.4	81.7	84.7	86.3	87.8	88.1	88.2	88.3	88.1	87.8	86.8	82.2	76.1	67.8	61.6	61.2	60.0
175	71.0	76.7	79.8	81.0	83.0	85.3	84.9	85.2	85.8	86.0	86.3	85.2	81.6	76.2	69.1	61.4	58.0	59.6	61.6
180	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9

Table 6: Luminous Intensity Data



Table--2 UNIT: cd

C (D&G) y (D&G)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336	336		
5	335	335	335	335	335	336	336	336	336	336	336	335	335	335	335	335	334		
10	332	332	333	333	334	334	335	335	335	335	334	334	333	332	332	331	331		
15	326	327	328	329	331	332	333	334	334	333	333	331	330	328	327	326	325		
20	318	319	321	324	326	329	331	332	332	331	330	328	326	323	320	318	316		
25	308	310	313	317	321	324	327	329	329	329	327	324	320	316	312	308	306		
30	294	298	303	308	314	319	323	326	326	325	323	319	313	307	302	296	293		
35	279	284	290	298	306	313	318	322	323	322	318	312	305	298	290	283	278		
40	261	267	276	287	297	306	313	317	318	317	313	306	297	287	276	267	260		
45	240	249	261	275	288	299	307	312	314	312	307	298	287	275	261	249	240		
50	217	229	244	261	277	291	300	306	308	306	300	290	277	262	245	230	218		
55	192	207	227	247	266	282	293	300	302	300	293	282	267	248	228	209	194		
60	165	184	208	233	255	273	285	293	295	293	285	273	256	235	211	187	168		
65	137	161	190	219	244	263	277	286	288	286	277	264	245	221	193	165	141		
70	107	137	172	205	232	254	269	278	281	278	269	254	234	207	176	143	113		
75	78.6	115	156	191	221	244	260	270	273	270	260	245	223	194	160	121	85.0		
80	53.0	96.2	141	179	210	234	251	260	264	261	251	235	212	182	145	102	60.1		
85	33.9	81.2	128	168	199	224	241	251	254	251	241	225	201	170	132	87.0	40.4		
90	24.1	70.6	117	157	189	213	230	240	244	241	231	214	190	160	121	75.7	29.2		
95	21.2	63.1	108	147	178	202	219	229	232	229	219	203	179	149	111	67.1	24.4		
100	23.4	59.0	99.7	137	167	190	207	217	220	217	207	191	168	139	102	61.7	24.9		
105	28.3	58.3	93.6	128	157	179	195	204	207	205	195	180	158	130	95.4	59.5	28.7		
110	34.5	59.8	90.1	120	147	167	182	191	194	192	183	168	148	121	90.6	59.7	34.5		
115	40.8	62.5	88.2	114	138	157	170	179	182	179	171	157	138	114	87.6	61.4	40.1		
120	46.6	65.7	87.3	110	130	147	160	167	169	167	160	147	130	109	86.1	64.5	45.8		
125	51.0	68.8	87.2	106	124	139	150	156	159	156	150	138	123	105	85.7	68.0	50.9		
130	54.5	72.1	87.6	103	118	131	141	147	148	146	140	131	118	102	86.0	70.6	54.4		
135	56.5	73.8	87.6	101	113	124	132	137	139	137	132	124	113	99.8	86.5	73.4	57.5		
140	57.4	75.7	87.4	98.7	109	118	125	129	130	129	124	117	108	97.6	87.0	74.6	58.0		
145	57.2	78.6	85.7	95.1	105	112	118	121	122	121	117	112	104	95.9	87.3	77.6	58.9		
150	55.6	79.9	85.5	90.9	100.0	107	111	114	115	114	111	106	101	94.9	87.1	79.7	57.4		
155	55.5	69.5	76.3	83.1	90.3	100	105	107	108	107	106	103	98.6	93.2	85.5	71.3	53.4		
160	55.2	57.8	66.0	69.9	74.2	79.5	92.9	102	102	102	101	98.9	95.4	92.3	78.9	58.1	47.8		
165	51.5	53.2	55.7	58.5	65.6	68.0	65.9	80.3	96.7	95.7	94.3	89.6	88.4	80.5	55.6	48.6	48.9		
170	57.2	54.9	59.0	61.6	63.6	66.2	66.7	63.2	57.6	87.0	74.2	68.0	62.5	54.2	54.9	51.7	50.9		
175	63.0	63.6	66.5	69.1	70.1	72.5	74.7	74.5	8.21	75.4	74.5	71.7	68.2	65.1	64.6	64.9	65.9		
180	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9	85.9		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 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**

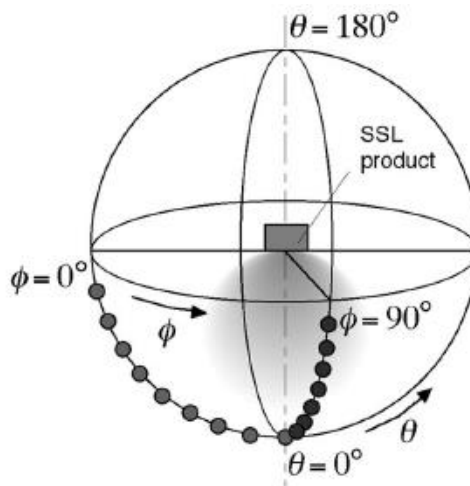
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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