

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 15T8/4F/840/HYB**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19090007e

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

Review by:



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Sep. 10, 2019

Approved by:



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Sep. 10, 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: 15T8/4F/840/HYB

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
133.1	2306.8	17.33	0.9977
CCT (K)	CRI	Stabilization Time (Light & Power)	
4088	82.8	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>	: Sep. 05, 2019
<b>Date of Test</b>	: Sep. 09, 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

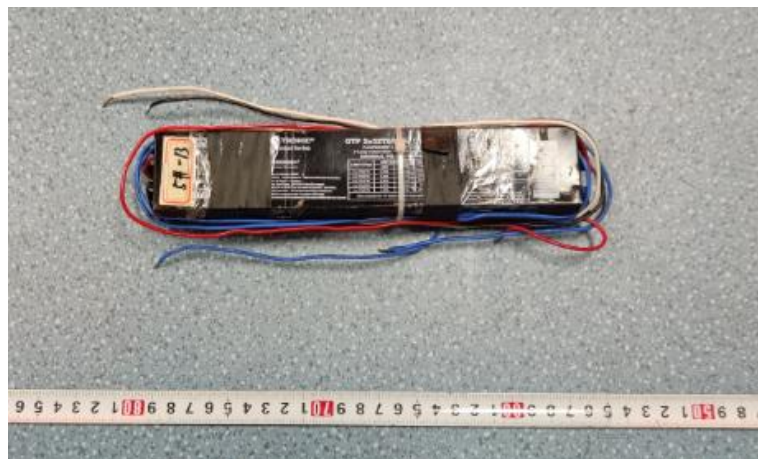


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 15T8/4F/840/HYB
<b>Electrical Ratings</b>	: 120-277V, 60Hz, 15W
<b>Product Description</b>	: 4000K LED tubes supplied by a high frequency fluorescent lamp ballast: QTP 2x32T8/UNV ISN-SC
<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)	0.290	0.129
Power Factor	0.9977	0.9686
Test Power (W)/2	17.33	17.37
THD A%	4.75	10.55
Luminous Efficacy (lm/W)	133.1	133.0
Total Luminous Flux (lm)	2306.8	2309.5
Color Rendering Index (CRI)	82.8	
R9	6.3	
Correlated Color Temperature (CCT)(K)	4088	
Chromaticity Chroma x	0.3771	
Chromaticity Chroma y	0.3766	
Chromaticity Chroma u	0.2230	
Chromaticity Chroma v	0.3340	
Duv	0.0009	
Chromaticity Chroma u'	0.2230	
Chromaticity Chroma v'	0.5010	

Special Color Rendering Indices	
R1	81
R2	89.5
R3	95.2
R4	81.3
R5	81
R6	85.1
R7	85.8
R8	63.8
R9	6.3
R10	74.9
R11	80.3
R12	60.1
R13	83.2
R14	97.7

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 25.2 °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)	0.294
Power Factor	0.9862
Power (W)/2	17.41
Luminous Efficacy (lm/W)	130.8
Total Luminous Flux (lm)	2276.9
Beam Angle ( ° )	110.5 (0°-180°) / 202.7 (90°-270°)
Center Beam Candle Power (cd)	407
Maximum Beam Candle Power (cd)	407.2 (At: C=240.0, Gamma=1.0)
Spacing Criteria	1.26 (0°-180°) / 1.40 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	44.89%
Zonal Lumens in the 60 °-90 °Zone	26.62%
Zonal Lumens in the 90 °-120 °Zone	16.74%
Zonal Lumens in the 120 °-180 °Zone	11.74%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

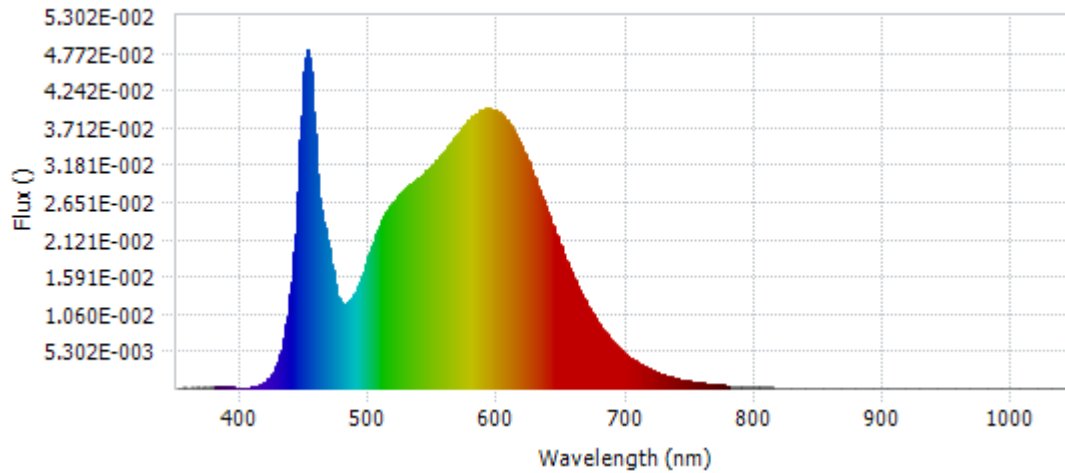


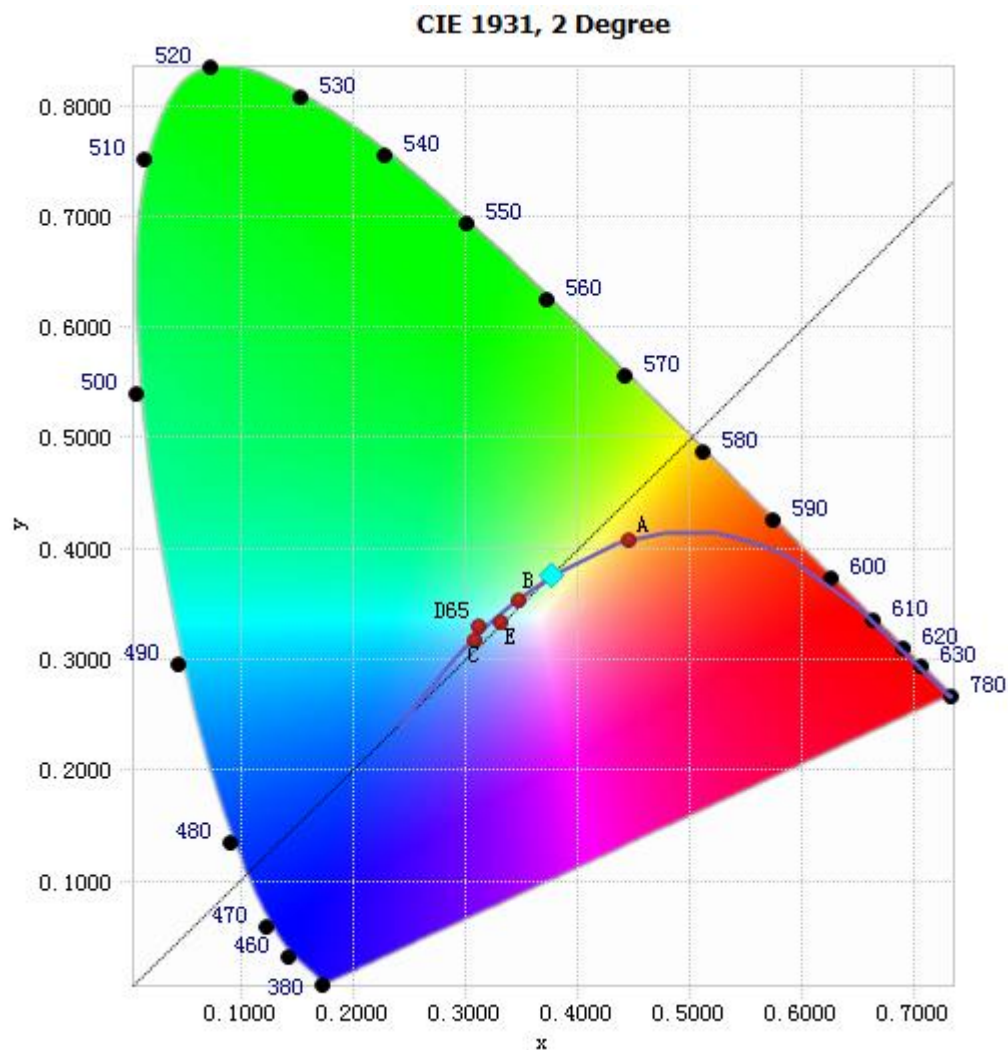
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.59E-04	485	1.27E-02	590	3.98E-02	695	5.64E-03
385	1.82E-04	490	1.41E-02	595	3.98E-02	700	4.85E-03
390	1.70E-04	495	1.65E-02	600	3.94E-02	705	4.13E-03
395	1.38E-04	500	1.93E-02	605	3.86E-02	710	3.52E-03
400	1.14E-04	505	2.19E-02	610	3.73E-02	715	3.00E-03
405	1.18E-04	510	2.40E-02	615	3.58E-02	720	2.57E-03
410	2.42E-04	515	2.57E-02	620	3.38E-02	725	2.20E-03
415	5.44E-04	520	2.69E-02	625	3.17E-02	730	1.87E-03
420	1.15E-03	525	2.78E-02	630	2.94E-02	735	1.60E-03
425	2.37E-03	530	2.87E-02	635	2.69E-02	740	1.36E-03
430	4.78E-03	535	2.94E-02	640	2.45E-02	745	1.16E-03
435	9.16E-03	540	3.02E-02	645	2.20E-02	750	9.95E-04
440	1.71E-02	545	3.11E-02	650	1.97E-02	755	8.52E-04
445	3.15E-02	550	3.20E-02	655	1.74E-02	760	7.32E-04
450	4.69E-02	555	3.30E-02	660	1.54E-02	765	6.18E-04
455	4.24E-02	560	3.42E-02	665	1.35E-02	770	5.32E-04
460	2.86E-02	565	3.54E-02	670	1.18E-02	775	4.62E-04
465	2.27E-02	570	3.66E-02	675	1.02E-02	780	3.89E-04
470	1.78E-02	575	3.76E-02	680	8.89E-03		
475	1.32E-02	580	3.86E-02	685	7.65E-03		
480	1.21E-02	585	3.95E-02	690	6.57E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3771, 0.3766)

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

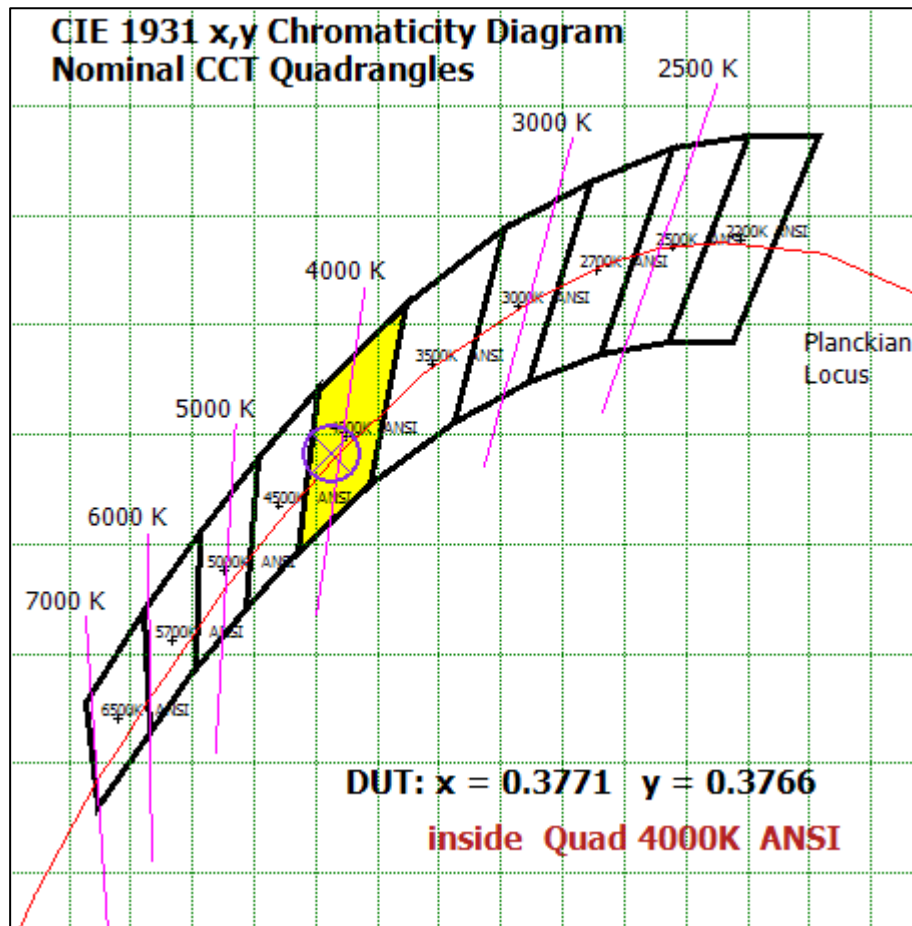
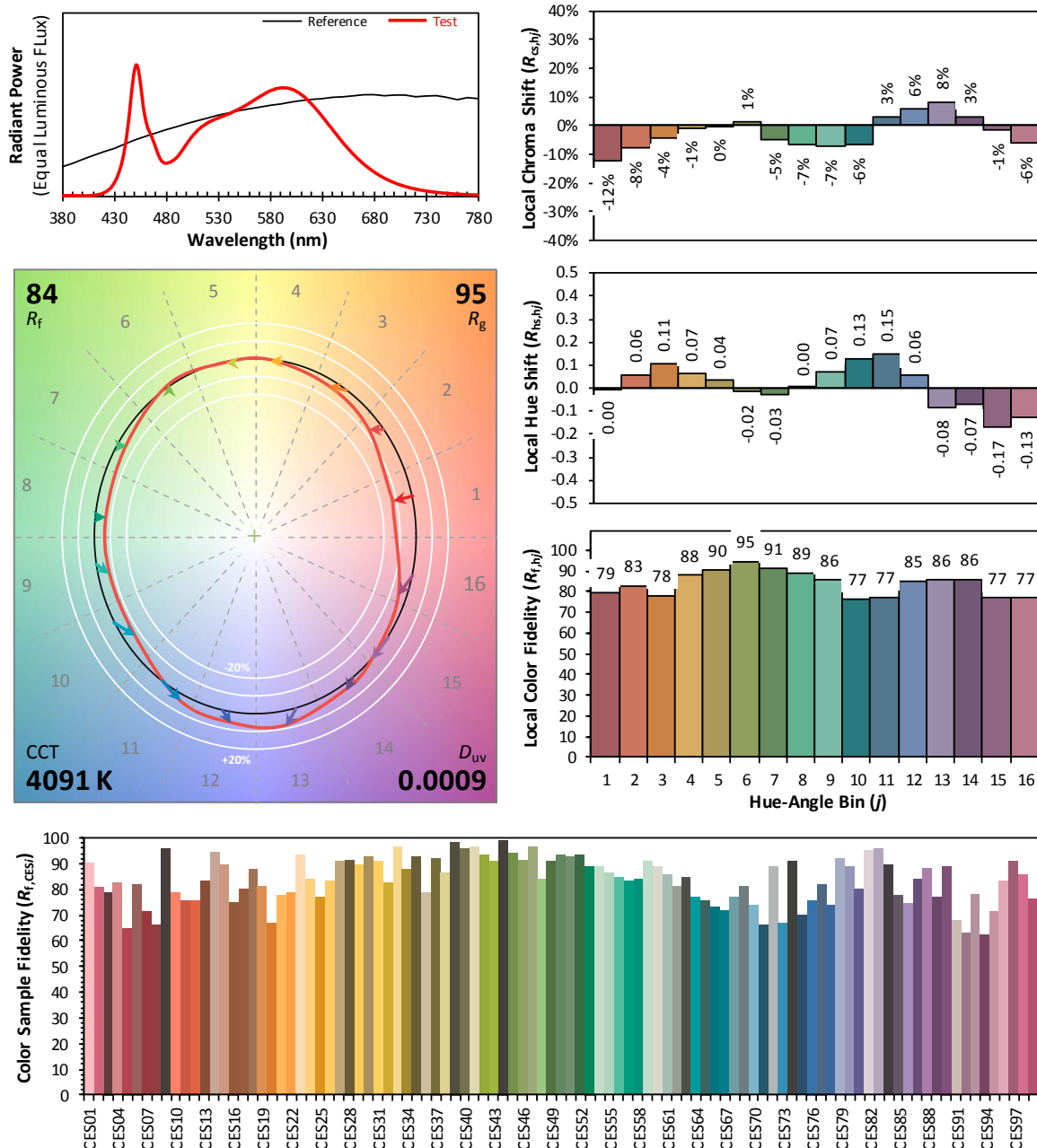


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.3771

$y$  0.3766

$u'$  0.2230

$v'$  0.5010

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	38.604	1.70%
10- 20	111.636	4.90%
20- 30	172.839	7.59%
30- 40	216.499	9.51%
40- 50	239.753	10.53%
50- 60	242.837	10.67%
60- 70	228.839	10.05%
70- 80	203.204	8.92%
80- 90	174.058	7.64%
90-100	149.106	6.55%
100-110	126.53	5.56%
110-120	105.6	4.64%
120-130	86.358	3.79%
130-140	68.901	3.03%
140-150	52.328	2.30%
150-160	35.849	1.57%
160-170	18.888	0.83%
170-180	5.094	0.22%
Total	2276.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1022.168	44.89%
60- 90	606.101	26.62%
0-90	1628.269	71.51%
90- 180	648.654	28.49%
0- 180	2276.9	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

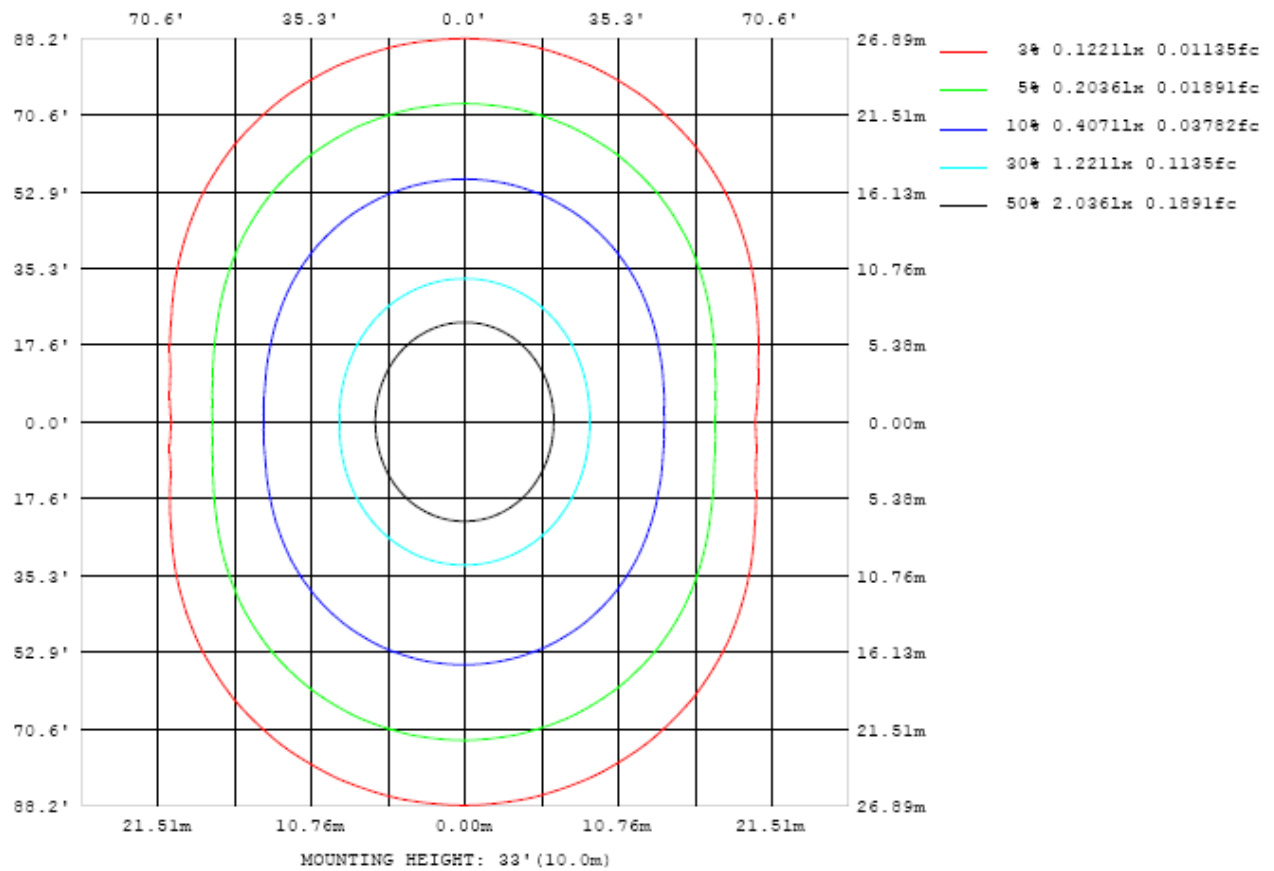


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

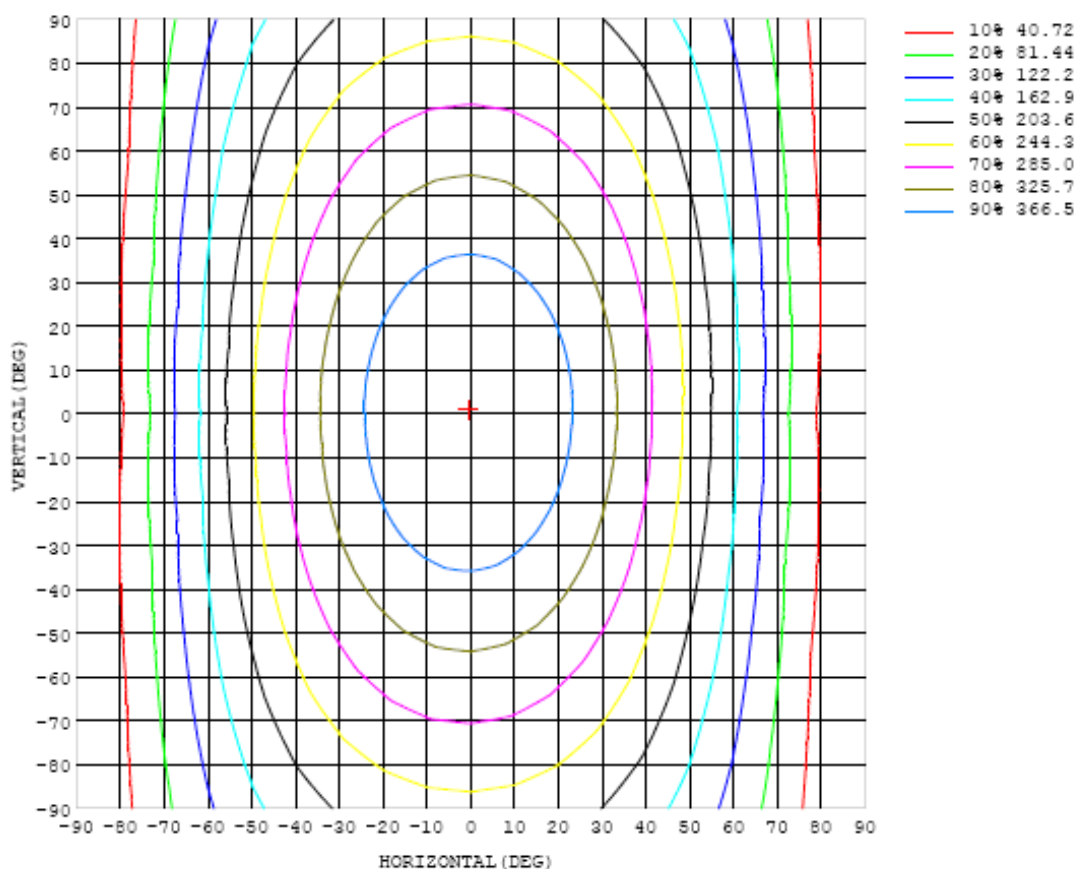


Chart 6: Isocandela Plot

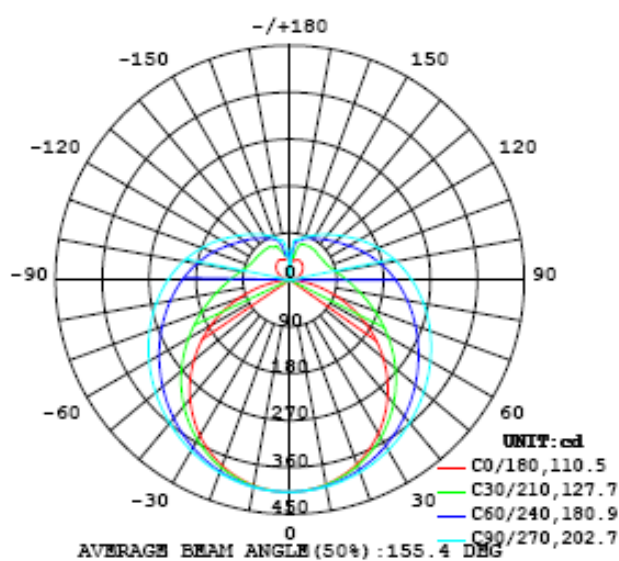


Chart 7: Polar Candela Distribution

## 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	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407
5	405	405	405	405	405	405	406	406	406	406	406	406	406	406	406	406	406	406	406
10	399	399	399	400	400	401	402	402	403	403	403	403	403	402	402	401	401	400	401
15	389	389	390	391	393	394	396	397	398	399	399	398	398	396	395	394	393	392	392
20	376	376	378	380	383	385	388	391	392	393	393	392	390	388	386	383	381	380	380
25	360	360	363	366	370	375	379	382	385	386	386	384	381	378	374	370	367	364	364
30	340	341	344	349	356	362	368	373	376	378	377	375	371	366	360	354	349	346	345
35	317	319	323	331	339	348	356	362	366	368	368	365	359	352	344	336	329	324	323
40	292	294	300	310	321	332	342	351	356	358	357	353	346	337	327	316	307	300	298
45	264	267	275	288	302	316	329	338	345	347	346	341	333	322	308	295	282	273	271
50	234	238	249	265	283	300	314	326	333	336	334	329	319	305	289	272	256	244	241
55	202	207	221	241	263	283	300	313	321	324	322	316	304	289	270	249	229	214	209
60	169	175	193	218	243	266	285	299	308	312	310	303	290	273	251	226	201	182	175
65	134	142	165	195	224	250	271	286	296	299	297	289	276	256	232	203	174	149	140
70	99.1	110	139	173	206	234	257	273	283	287	285	276	262	241	214	182	147	117	104
75	65.5	79.3	114	154	190	219	243	260	270	274	271	263	248	226	197	162	123	86.3	69.2
80	34.3	52.9	93.3	136	174	205	229	246	257	261	258	249	234	211	182	145	102	60.2	36.8
85	10.1	32.6	76.8	121	160	192	216	233	244	247	245	236	220	198	167	130	85.6	40.0	11.2
90	0.56	22.2	65.8	109	148	179	203	220	231	234	232	223	207	185	155	117	74.0	28.8	0.41
95	2.57	18.7	57.9	99.0	136	167	190	207	217	221	219	210	194	172	143	107	65.5	24.2	2.05
100	6.82	20.0	52.8	90.5	125	155	178	194	204	207	205	196	181	160	132	97.6	59.7	24.5	5.79
105	11.7	23.2	50.6	83.7	116	143	165	181	190	194	191	183	169	148	122	90.2	56.5	27.4	11.3
110	17.1	28.1	50.7	78.7	108	133	153	168	177	180	178	170	157	137	113	84.5	56.1	31.5	17.2
115	21.8	33.6	51.9	76.0	101	123	142	155	164	167	165	158	145	127	105	80.9	57.1	36.6	22.2
120	25.8	38.5	53.6	74.4	95.1	115	131	144	151	154	153	146	134	118	99.4	78.7	58.8	41.6	26.9
125	29.2	42.2	56.4	73.5	91.0	108	122	133	139	142	141	134	124	111	94.9	77.5	60.5	45.6	31.0
130	32.2	44.8	59.0	72.8	87.8	102	114	123	129	131	130	125	116	105	91.3	76.5	63.0	48.2	34.7
135	35.1	45.2	62.2	73.3	85.1	97.1	107	115	120	122	121	116	109	99.6	88.5	76.3	65.1	51.5	37.5
140	37.9	48.1	64.6	74.2	82.8	92.8	101	108	112	113	112	109	103	95.1	85.4	76.6	66.8	52.2	39.9
145	39.6	50.3	65.5	73.1	82.0	89.2	95.8	101	105	106	105	102	97.5	90.9	83.5	76.7	67.1	52.5	41.9
150	41.1	52.9	66.0	74.6	80.7	86.8	91.4	95.4	98.2	99.2	98.6	96.4	92.5	87.1	82.0	75.9	63.0	54.8	43.1
155	41.8	50.7	64.5	73.2	79.0	84.1	87.9	90.4	92.6	93.3	92.9	90.9	87.6	84.1	79.7	72.9	65.3	54.0	43.2
160	41.2	45.4	63.6	73.1	77.0	80.6	84.0	86.2	87.3	87.8	87.4	86.3	83.8	79.3	70.2	62.3	56.1	48.1	41.0
165	38.5	41.8	49.0	67.9	75.9	78.1	78.4	79.7	81.3	82.4	81.9	79.4	74.3	63.4	56.7	51.3	47.7	43.1	40.4
170	37.6	40.5	41.5	44.6	59.4	71.8	75.1	77.8	78.2	79.0	77.4	66.7	55.6	48.4	48.2	47.5	44.5	41.6	40.9
175	50.3	53.1	53.1	52.5	50.6	48.7	52.5	58.0	65.2	68.4	40.4	38.5	44.9	50.7	53.9	53.6	53.4	53.1	52.8
180	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5

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	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407		
5	406	406	406	406	406	406	407	407	406	406	406	406	406	406	405	405	405		
10	401	401	402	402	403	404	404	404	404	404	403	403	402	401	400	400	399		
15	392	393	394	396	397	398	400	400	400	400	399	397	396	394	392	391	390		
20	380	382	384	387	389	391	393	394	394	394	392	390	387	384	381	379	377		
25	365	367	371	375	379	382	385	387	387	386	384	381	376	372	368	364	361		
30	347	350	355	361	367	372	376	378	379	378	374	370	364	358	351	346	342		
35	325	330	337	345	353	360	365	369	369	368	364	358	350	341	333	325	320		
40	301	307	317	327	338	347	354	358	359	357	352	345	335	324	312	302	295		
45	274	282	295	309	322	333	342	347	348	346	340	331	319	305	291	278	269		
50	245	256	272	289	305	319	329	335	336	334	327	316	302	286	268	252	240		
55	214	229	248	269	289	305	316	323	325	322	314	302	286	266	245	225	209		
60	182	201	225	250	272	290	303	310	312	309	301	287	269	247	222	197	178		
65	150	173	202	231	256	275	289	297	300	296	287	273	253	228	200	170	147		
70	117	146	180	213	240	261	276	284	287	283	274	259	237	210	178	145	115		
75	85.1	121	161	196	225	247	262	271	274	270	261	245	222	194	160	121	84.5		
80	57.2	99.5	143	180	210	233	249	258	261	257	247	231	208	178	142	100.0	58.0		
85	36.3	82.4	128	166	197	220	236	245	247	244	234	218	194	165	127	83.4	38.2		
90	25.0	70.3	115	154	184	207	222	231	234	231	221	204	181	152	115	71.4	27.0		
95	20.7	62.0	105	142	171	194	209	218	221	218	208	192	170	141	104	62.8	22.2		
100	21.7	56.4	95.5	131	160	181	196	205	207	204	195	179	158	129	94.8	56.5	22.1		
105	25.4	54.0	88.1	121	148	169	182	191	193	190	181	167	146	119	87.1	53.3	25.3		
110	30.2	54.1	83.0	112	137	156	170	177	180	177	169	155	135	110	81.3	52.5	29.6		
115	35.0	55.8	79.9	104	127	145	157	165	167	164	156	143	125	102	77.6	53.3	33.9		
120	40.2	57.5	78.2	99.0	118	134	145	152	154	152	144	132	116	96.6	75.5	55.5	38.8		
125	45.1	59.3	77.0	94.9	111	125	134	140	142	140	133	123	109	92.3	74.5	57.9	43.8		
130	50.1	61.3	76.2	91.2	105	117	125	130	132	130	124	115	103	89.1	74.4	60.1	48.7		
135	53.6	63.4	75.5	88.4	99.6	110	117	121	122	121	116	108	98.4	86.8	75.0	62.7	51.9		
140	56.2	64.2	75.2	85.2	95.2	103	110	113	114	113	109	102	94.4	85.2	75.3	64.9	57.1		
145	59.2	66.2	75.0	83.1	90.3	97.3	103	106	107	106	102	97.4	91.0	83.7	75.3	67.4	61.1		
150	60.4	68.8	73.8	80.8	86.9	91.4	94.3	98.9	99.8	99.1	96.5	92.7	88.0	81.8	74.8	69.0	62.1		
155	58.1	66.4	69.0	79.4	83.0	87.2	90.0	92.7	93.4	92.8	90.9	87.8	83.9	79.5	75.7	70.3	61.5		
160	47.5	61.6	65.5	72.3	80.4	82.2	84.5	84.9	87.1	86.8	85.5	83.0	80.1	77.8	73.9	72.7	56.7		
165	42.6	48.5	55.7	58.2	64.7	73.4	78.8	79.9	79.0	80.5	79.8	79.5	79.2	72.8	69.1	67.7	49.4		
170	40.7	42.6	47.5	51.0	49.7	49.8	57.0	66.7	75.6	75.3	75.4	76.0	67.9	64.1	64.1	57.7	43.3		
175	52.6	51.5	53.7	52.7	52.2	49.4	42.5	39.4	43.7	48.1	47.0	51.4	57.1	56.2	51.7	51.5	50.1		
180	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	PF2010A	HZTE028-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	DPS1060	HZTE001-06	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	WY12010	HZTE004-03	Aug. 02, 2019	Aug. 01, 2020
Temperature recorder	JM624U	HZTE018-08	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 02, 2019	Aug. 01, 2020
Standard source	D908	HZTE012-01	Aug. 02, 2019	Aug. 01, 2020
Integrate Sphere system	3M	HZTE015-04	Aug. 02, 2019	Aug. 01, 2020
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2019	Aug. 01, 2020
AC Power Supply	PCR 500L	HZTE001-07	Aug. 02, 2019	Aug. 01, 2020
DC Power Supply	IT6154	HZTE004-04	Aug. 02, 2019	Aug. 01, 2020
Standard source	SCL-1400	HZTE012-02	Aug. 02, 2019	Aug. 01, 2020
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 02, 2019	Aug. 01, 2020
Temperature Meter	TES1310	HZTE017-01	Aug. 02, 2019	Aug. 01, 2020

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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