



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 24T5HO/4F/830/GL/DIR**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19020012f

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

Review by:

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Mar. 08, 2019

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*Jim Zhang*

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Mar. 08, 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: 24T5HO/4F/830/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
110.9	3458.0	31.19	0.9983
CCT (K)	CRI	Stabilization Time (Light & Power)	
2935	81.6	60	

Table 1: Executive Data Summary

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

### Test specifications:

**Date of Receipt** : Feb. 21, 2019

**Date of Test** : Feb. 28, 2019

**Test item** : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

**Reference Standard** : IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

## TABLE OF CONTENT

LM-79-08 Test Report.....	1
Test Summary.....	2
Sample Photo.....	4
TEST RESULTS .....	5
Spectral Power Distribution - Sphere Spectroradiometer Method .....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method .....	9
Color Vector – Sphere Spectroradiometer Method .....	10
Zonal Lumen Tabulation- Goniophotometer Method .....	11
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

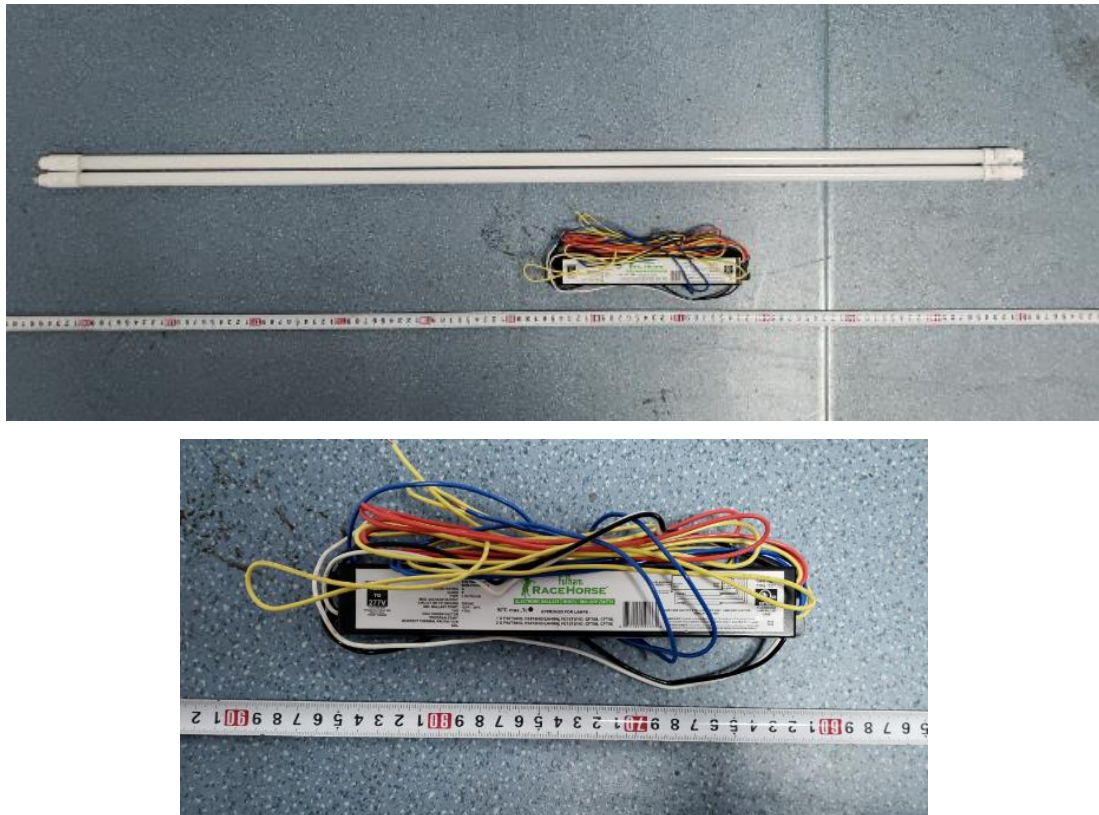


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 24T5HO/4F/830/GL/DIR
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 24W
<b>Product Description</b>	: 3000K LED Tubes supplied by a high frequency fluorescent lamp ballast: RHA-UNV-254-LT5
<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)	0.521	0.229
Power Factor	0.9983	0.9736
Test Power (W)/2	31.19	30.87
THD A%	4.40	6.94
Luminous Efficacy (lm/W)	110.9	112.0
Total Luminous Flux (lm)	3458.0	3458.0
Color Rendering Index (CRI)	81.6	
R9	1	
Correlated Color Temperature (CCT)(K)	2935	
Chromaticity Chroma x	0.4393	
Chromaticity Chroma y	0.4011	
Chromaticity Chroma u	0.2534	
Chromaticity Chroma v	0.3470	
Duv	0.0018	
Chromaticity Chroma u'	0.2534	
Chromaticity Chroma v'	0.5206	

Special Color Rendering Indices	
R1	80.1
R2	91.3
R3	94.8
R4	79.5
R5	80.9
R6	90.1
R7	80.6
R8	55.4
R9	1
R10	80.8
R11	79.3
R12	76.2
R13	82.9
R14	97.8
Rf	84
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 25.3°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)	0.522
Power Factor	0.9979
Test Power (W)/2	31.24
Luminous Efficacy (lm/W)	109.0
Total Luminous Flux (lm)	3406.0
Beam Angle ( °)	169.2
Center Beam Candle Power (cd)	559
Spacing Criteria	1.29 (0 °-180 °)/ 1.46 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	43.52%
Zonal Lumens in the 60 °-90 °Zone	27.90%
Zonal Lumens in the 90 °-120 °Zone	17.36%
Zonal Lumens in the 120 °-180 °Zone	11.22%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

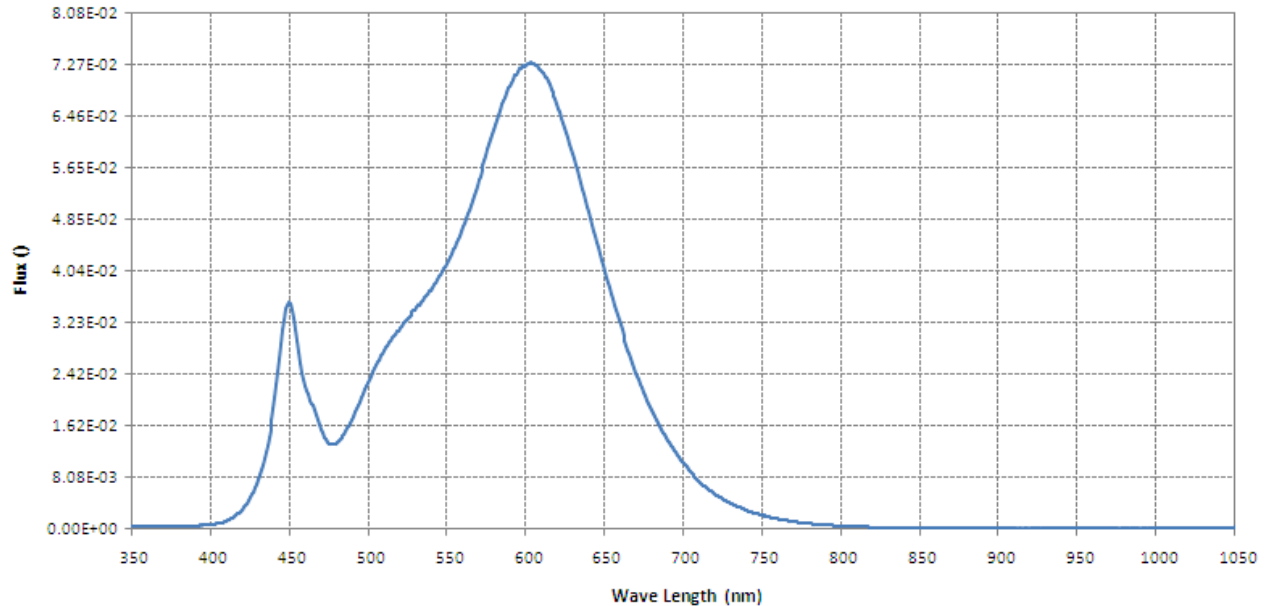
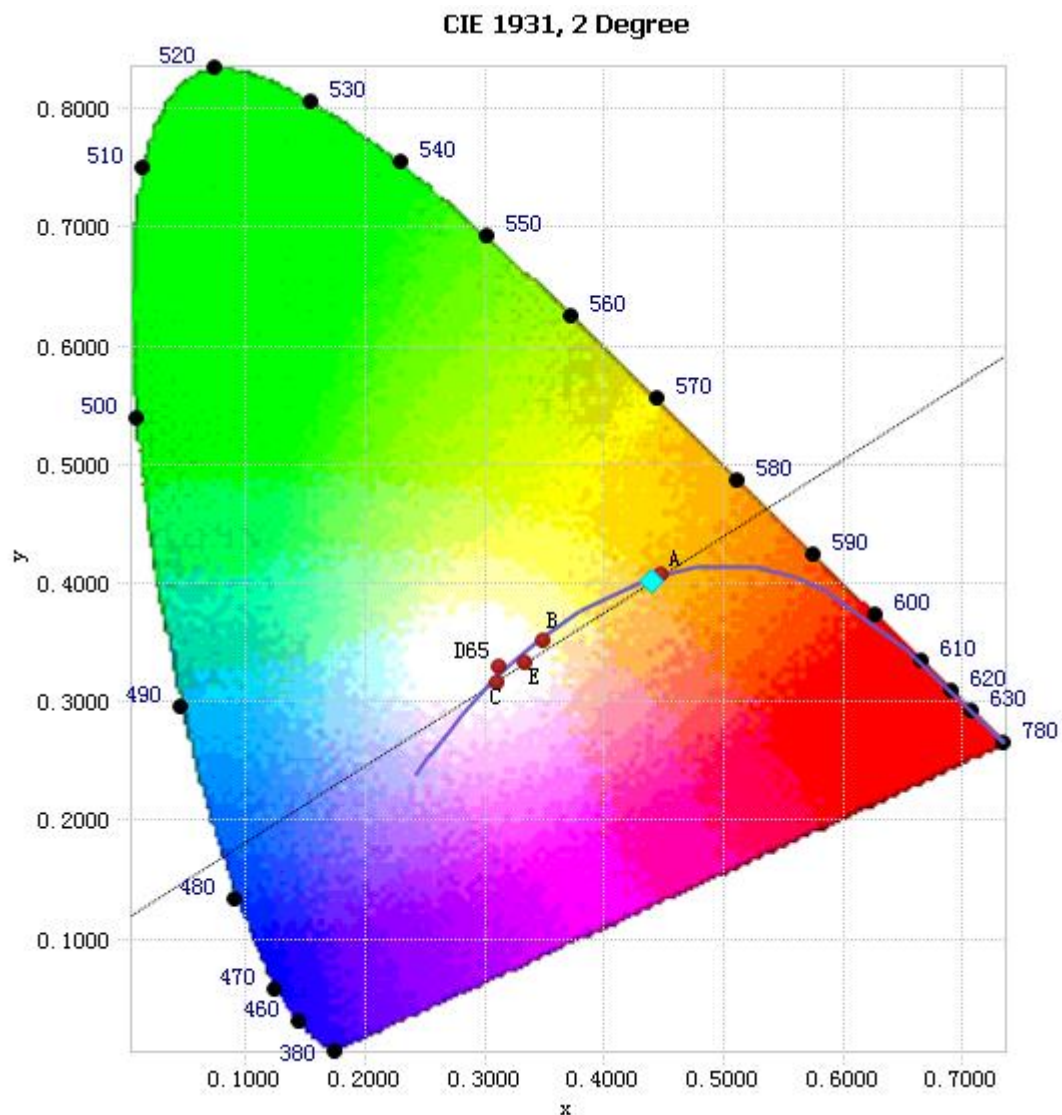


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	5.13E-04	485	1.49E-02	590	6.95E-02	695	1.20E-02
385	5.23E-04	490	1.71E-02	595	7.18E-02	700	1.03E-02
390	5.38E-04	495	2.00E-02	600	7.28E-02	705	8.79E-03
395	5.79E-04	500	2.30E-02	605	7.29E-02	710	7.51E-03
400	6.98E-04	505	2.57E-02	610	7.16E-02	715	6.45E-03
405	8.83E-04	510	2.80E-02	615	6.96E-02	720	5.52E-03
410	1.29E-03	515	2.99E-02	620	6.65E-02	725	4.74E-03
415	1.95E-03	520	3.16E-02	625	6.30E-02	730	4.07E-03
420	3.05E-03	525	3.30E-02	630	5.88E-02	735	3.46E-03
425	4.89E-03	530	3.44E-02	635	5.44E-02	740	2.94E-03
430	7.78E-03	535	3.58E-02	640	4.96E-02	745	2.53E-03
435	1.20E-02	540	3.75E-02	645	4.49E-02	750	2.17E-03
440	1.88E-02	545	3.95E-02	650	4.04E-02	755	1.84E-03
445	2.91E-02	550	4.17E-02	655	3.61E-02	760	1.60E-03
450	3.56E-02	555	4.42E-02	660	3.20E-02	765	1.37E-03
455	2.96E-02	560	4.74E-02	665	2.80E-02	770	1.18E-03
460	2.25E-02	565	5.06E-02	670	2.45E-02	775	1.02E-03
465	1.93E-02	570	5.46E-02	675	2.15E-02	780	8.76E-04
470	1.56E-02	575	5.85E-02	680	1.86E-02		
475	1.35E-02	580	6.26E-02	685	1.61E-02		
480	1.36E-02	585	6.65E-02	690	1.39E-02		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4393, 0.4011)

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

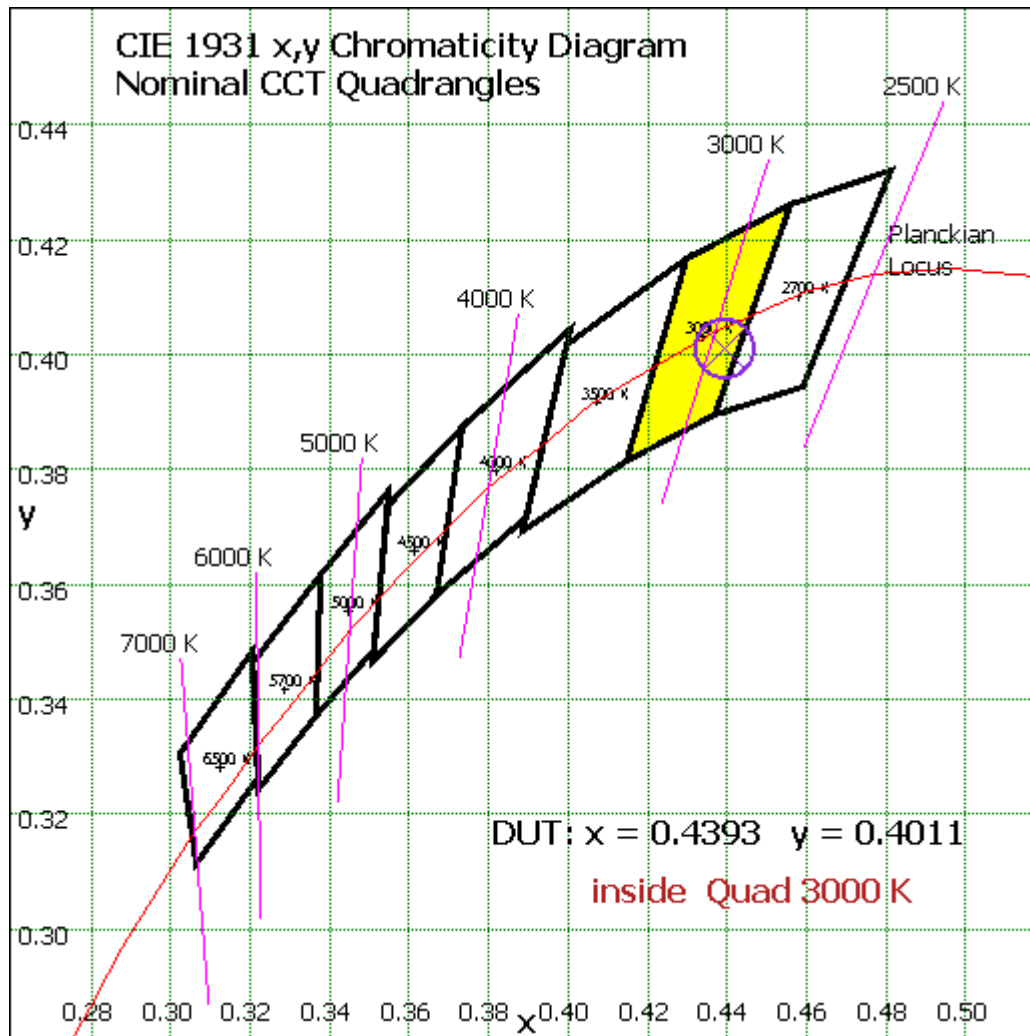


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Vector – Sphere Spectroradiometer Method

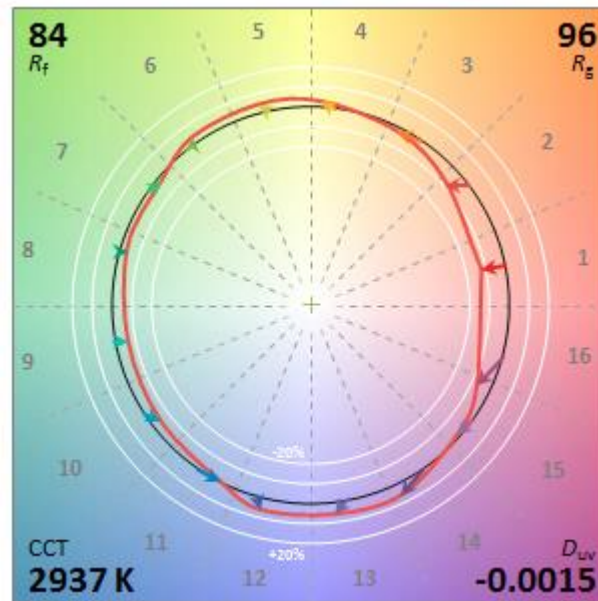


Chart 4: Color Vector Diagram of TM-30-18

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	53.09	1.56%
10- 20	154.763	4.54%
20- 30	243.28	7.14%
30- 40	311.148	9.14%
40- 50	353.111	10.37%
50- 60	366.878	10.77%
60- 70	353.81	10.39%
70- 80	319.856	9.39%
80- 90	276.619	8.12%
90-100	235.934	6.93%
100-110	195.845	5.75%
110-120	159.513	4.68%
120-130	127.83	3.75%
130-140	99.029	2.91%
140-150	72.869	2.14%
150-160	49.411	1.45%
160-170	25.969	0.76%
170-180	7.011	0.21%
Total	3406.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1482.27	43.52%
60- 90	950.285	27.90%
0-90	2432.555	71.42%
90- 180	973.411	28.58%
0- 180	3406.0	100%

Table 5: Zonal Lumen

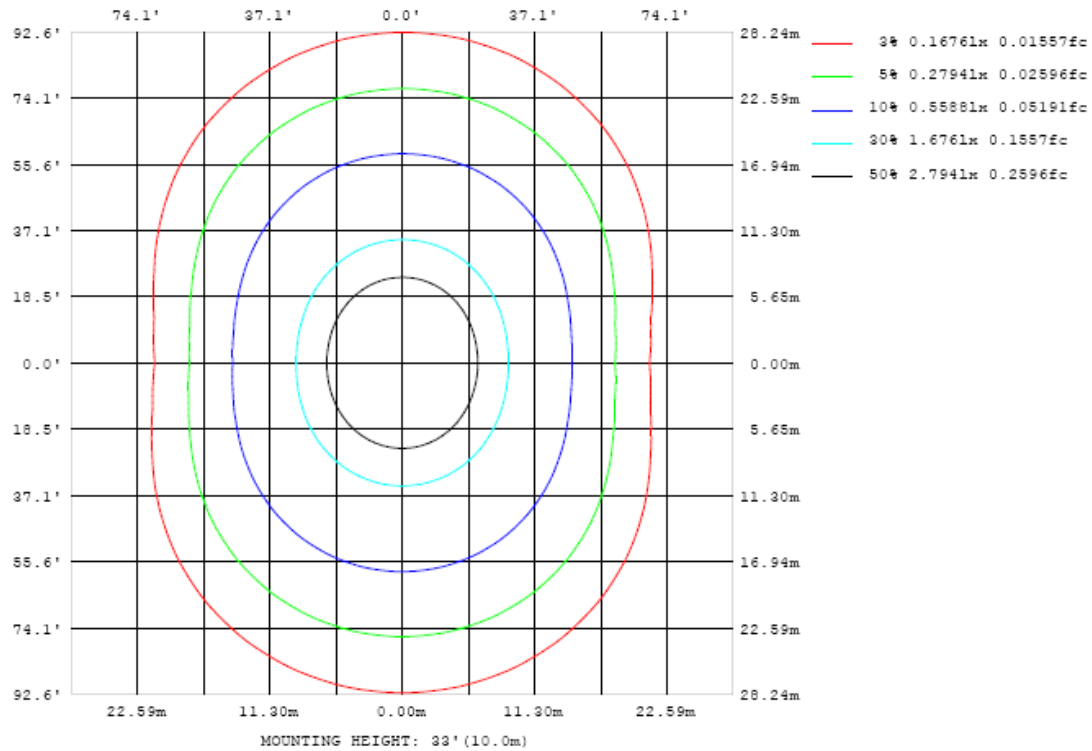


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

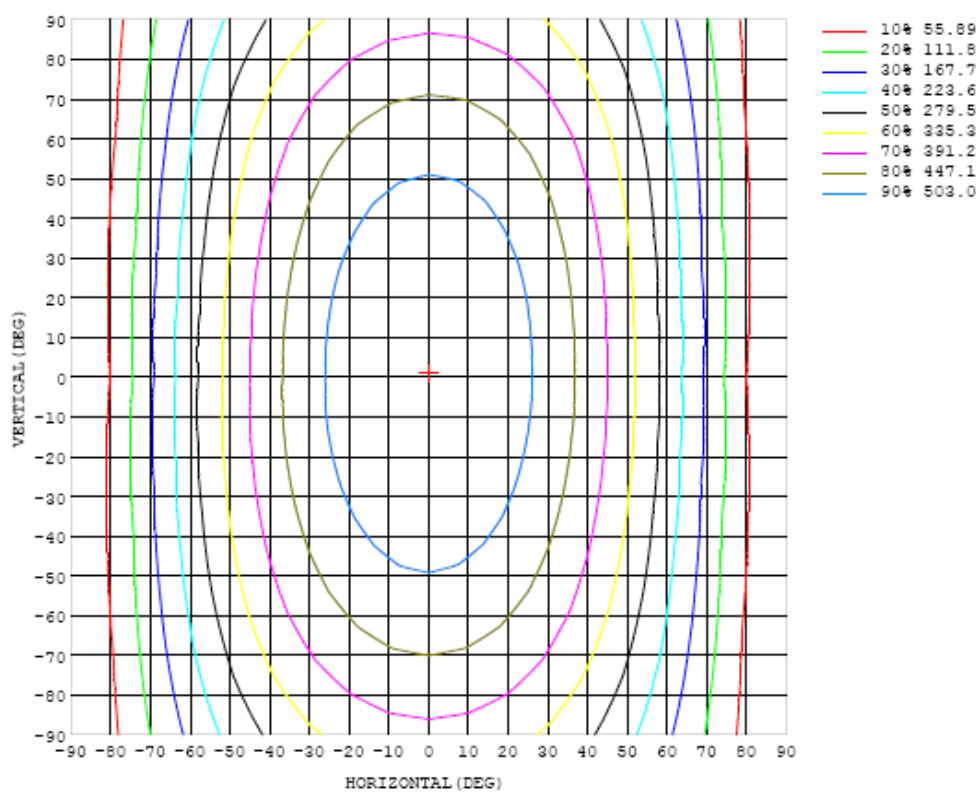


Chart 6: Isocandela Plot

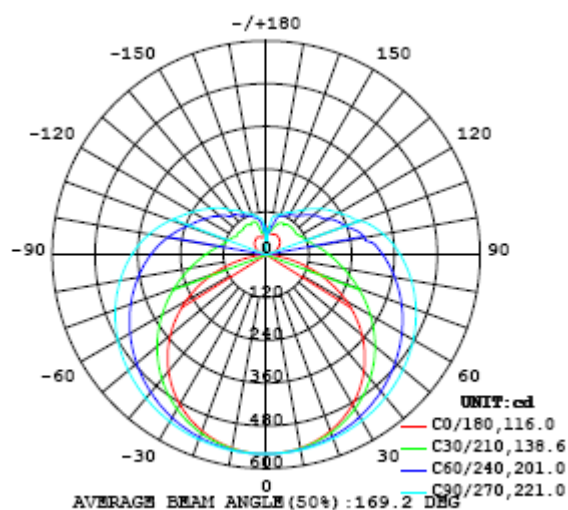


Chart 7: Polar Candela Distribution

## 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	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559
5	557	557	557	557	557	557	557	558	558	558	558	558	558	557	557	557	557	557	557
10	550	551	551	552	553	554	554	555	556	556	556	555	555	554	553	552	551	551	550
15	540	541	542	543	545	548	550	551	553	553	553	552	550	548	546	544	542	541	540
20	526	526	528	532	535	539	543	546	548	549	548	546	544	540	536	532	529	527	526
25	507	508	512	517	523	529	535	539	543	544	543	540	535	530	524	518	513	509	507
30	485	486	491	499	507	517	525	531	536	537	536	532	526	518	509	500	493	487	484
35	458	460	467	477	490	502	514	522	528	530	528	523	515	504	492	479	469	461	458
40	426	429	439	454	470	486	501	512	519	521	519	512	502	488	472	456	441	431	426
45	391	395	408	427	448	469	487	500	509	512	509	501	488	471	451	430	411	397	391
50	351	357	374	399	425	451	472	488	498	501	498	488	473	452	428	402	378	360	351
55	307	315	338	369	401	431	456	474	486	489	486	475	457	433	404	373	342	319	308
60	260	271	300	338	376	411	440	460	472	476	473	460	440	413	379	342	305	275	261
65	210	223	260	306	352	391	422	444	458	462	458	445	423	392	354	311	266	229	211
70	158	176	222	276	327	370	404	428	442	447	442	428	404	371	330	281	228	182	159
75	105	129	185	247	303	349	385	411	426	431	426	411	386	350	305	252	192	137	107
80	55.5	87.8	154	221	280	329	366	393	408	414	408	392	366	329	282	225	160	95.4	58.5
85	17.9	56.3	128	197	258	308	347	374	390	395	390	373	347	309	260	201	133	63.0	19.2
90	1.00	38.6	108	177	238	289	328	355	371	376	371	354	327	289	239	180	112	43.1	1.43
95	3.65	30.6	92.7	160	216	266	308	335	351	356	351	334	307	269	220	162	95.8	32.6	3.32
100	9.29	29.6	82.9	142	199	247	282	307	329	334	328	312	285	248	200	144	83.5	31.3	7.51
105	16.8	34.3	74.6	131	179	224	262	286	296	310	304	288	262	226	181	131	74.7	34.5	13.1
110	24.5	41.7	74.2	117	167	207	238	260	275	279	279	263	239	206	167	118	73.9	40.8	19.2
115	32.1	48.1	72.7	115	150	191	222	241	251	256	255	242	220	190	151	113	74.2	47.2	25.2
120	38.9	55.8	77.9	108	145	171	200	224	234	236	231	223	199	172	142	108	77.1	53.9	31.0
125	45.2	63.0	81.3	103	136	165	184	203	213	218	212	202	182	163	135	105	80.4	60.2	36.5
130	50.0	68.0	84.5	104	125	152	172	189	198	200	196	184	171	152	127	104	83.6	66.3	42.0
135	54.1	70.3	86.1	105	120	139	158	172	180	183	178	167	157	142	122	104	87.5	68.7	46.3
140	57.6	73.6	89.6	104	119	131	144	155	163	165	162	155	139	131	118	104	90.7	71.0	49.0
145	59.8	76.2	93.3	104	116	127	136	142	147	149	147	142	134	124	114	104	93.6	73.2	51.8
150	62.0	79.1	93.3	97.5	113	121	129	135	138	137	137	134	128	120	110	103	95.3	75.9	54.5
155	62.6	78.8	91.7	98.9	108	116	122	126	129	130	128	126	121	115	108	102	94.3	74.8	55.0
160	61.2	70.6	82.2	91.1	98.3	111	116	119	120	121	120	119	116	112	107	101	89.6	68.6	53.5
165	60.0	63.3	70.6	78.7	84.5	88.8	100	113	114	115	114	113	111	109	99.3	89.0	83.9	67.5	50.3
170	59.8	59.2	62.2	69.2	70.9	72.8	78.2	84.1	92.2	107	108	108	100	89.9	85.5	83.0	77.9	62.6	52.2
175	75.7	73.8	73.5	72.6	69.9	70.3	62.5	57.1	56.9	60.8	83.4	70.3	62.6	74.8	80.3	77.2	74.5	72.6	69.6
180	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3

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	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559	559		
5	557	557	557	558	558	558	558	559	559	559	558	558	558	557	557	557	557		
10	551	552	552	554	555	556	557	557	557	557	557	556	555	553	552	551	551		
15	541	542	544	547	549	551	553	555	555	554	553	552	549	547	544	542	541		
20	527	529	533	537	541	545	549	551	552	551	549	546	542	537	533	529	527		
25	509	513	518	525	531	537	543	546	547	546	543	538	532	525	518	513	509		
30	487	492	500	510	519	528	535	539	541	539	535	529	520	511	501	492	487		
35	460	468	479	492	505	516	526	531	533	532	527	518	507	494	480	469	460		
40	430	440	455	472	489	504	515	522	525	523	517	506	491	474	457	441	430		
45	396	409	428	450	471	490	504	513	516	513	506	492	475	453	431	411	396		
50	357	375	400	427	452	474	491	501	505	503	493	478	457	431	403	377	358		
55	316	338	369	402	433	458	478	489	493	490	480	462	438	407	373	341	316		
60	271	300	337	377	412	441	463	476	481	477	466	446	418	383	343	304	272		
65	224	260	306	351	391	423	447	461	466	463	451	429	398	359	312	265	225		
70	176	221	274	326	370	404	430	445	451	447	434	411	377	334	283	227	178		
75	129	183	245	301	348	385	412	428	434	430	417	392	356	310	254	192	132		
80	86.3	150	217	277	326	365	393	410	416	412	398	372	336	287	228	160	91.8		
85	54.2	123	192	254	305	345	374	391	397	394	379	352	315	265	204	134	61.9		
90	35.1	102	171	233	284	324	353	371	377	374	359	332	295	245	184	114	44.2		
95	26.7	86.2	152	213	263	303	332	350	356	353	338	311	274	225	166	98.8	35.8		
100	27.1	75.9	135	193	242	281	309	327	334	330	315	289	253	206	149	88.8	36.4		
105	29.9	72.5	123	175	221	258	286	303	309	306	292	267	232	187	137	84.6	39.4		
110	37.2	70.2	115	161	202	236	262	278	284	281	268	244	213	174	129	82.6	44.7		
115	43.7	69.0	108	150	187	217	241	255	261	258	246	226	198	162	122	79.8	50.6		
120	48.9	70.5	101	139	174	201	222	235	240	238	227	209	183	151	116	82.7	56.6		
125	54.9	72.5	100.0	131	160	186	205	216	221	219	209	193	170	142	109	80.6	62.1		
130	60.5	78.6	99.5	121	148	171	188	199	203	201	192	177	155	130	109	85.1	67.3		
135	65.7	83.4	96.4	120	136	154	172	182	186	184	176	161	144	128	103	89.0	72.1		
140	72.6	85.3	98.7	112	132	146	153	159	165	167	162	151	138	118	104	90.0	74.7		
145	75.4	87.1	100	111	121	137	146	152	154	153	148	136	124	115	104	92.1	79.2		
150	76.8	90.1	98.3	110	120	128	132	137	139	139	132	125	121	114	103	94.9	80.9		
155	71.8	90.6	96.3	106	115	122	127	129	129	127	124	122	117	109	99.5	89.2	77.4		
160	59.2	84.2	99.2	101	108	115	119	121	122	121	118	116	109	97.0	89.5	82.4	71.4		
165	53.4	62.0	83.5	102	104	107	110	112	113	113	111	103	85.5	78.7	74.8	70.6	63.5		
170	56.5	57.8	60.0	70.1	90.3	94.9	101	106	106	104	85.5	73.1	71.2	71.3	71.2	63.5	60.3		
175	71.8	75.8	75.0	71.9	68.8	65.5	71.0	76.8	83.6	54.7	64.3	73.3	76.7	76.4	75.5	77.1	76.6		
180	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

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

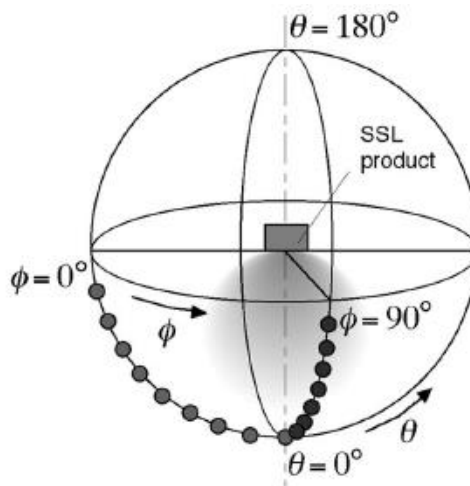
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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