



## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 24T5HO/4F/835/GL/DIR**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ19020012h

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

Review by:

Engineer: April Zou  
Mar. 08, 2019

Approved by:



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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/835/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
116.5	3634.0	31.20	0.9982
CCT (K)	CRI	Stabilization Time (Light & Power)	
3371	81.2	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

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## Sample Photo

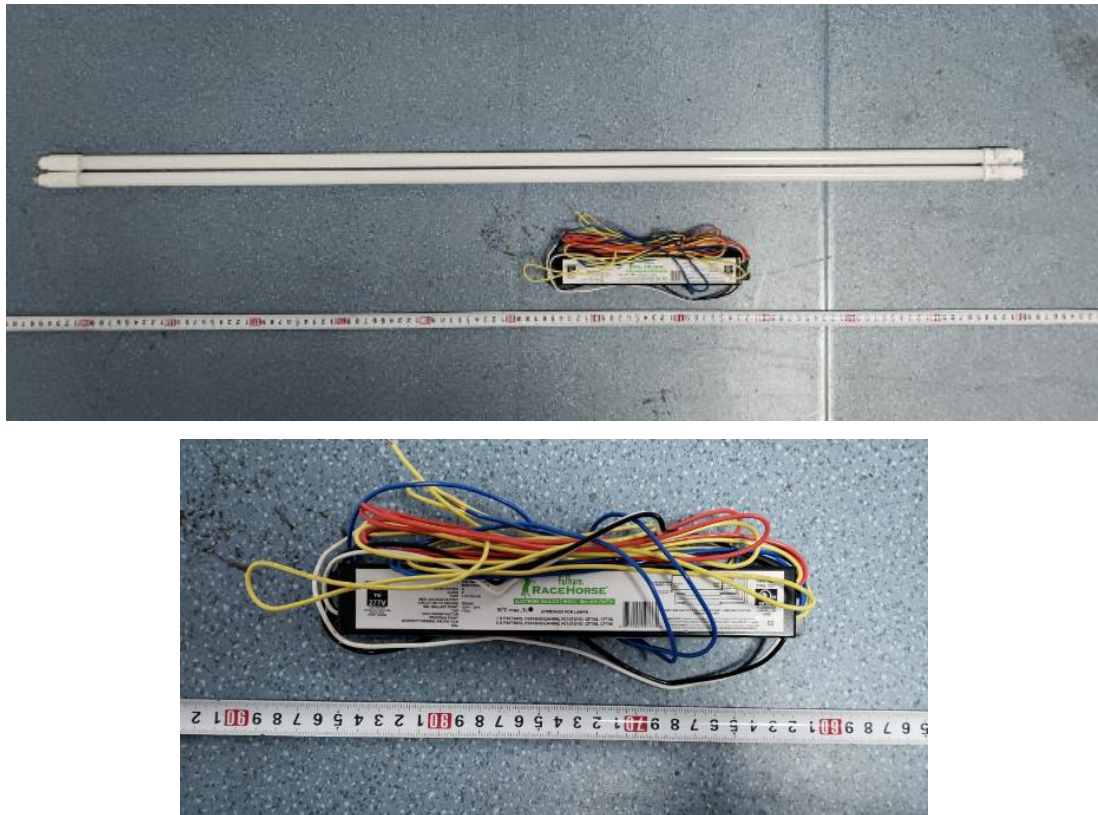


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 24T5HO/4F/835/GL/DIR
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 24W
<b>Product Description</b>	: 3500K 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	0.9982	0.9736
Test Power (W)/2	31.20	30.89
THD A%	4.56	6.96
Luminous Efficacy (lm/W)	116.5	117.7
Total Luminous Flux (lm)	3634.0	3634.0
Color Rendering Index (CRI)	81.2	
R9	0	
Correlated Color Temperature (CCT)(K)	3371	
Chromaticity Chroma x	0.4128	
Chromaticity Chroma y	0.3948	
Chromaticity Chroma u	0.2389	
Chromaticity Chroma v	0.3427	
Duv	0.0003	
Chromaticity Chroma u'	0.2389	
Chromaticity Chroma v'	0.5141	

Special Color Rendering Indices	
R1	79.1
R2	88.2
R3	95.6
R4	80.1
R5	79.4
R6	84.8
R7	83.5
R8	58.8
R9	0
R10	72.7
R11	79.2
R12	66.4
R13	81.1
R14	97.6
Rf	83
Rg	97

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	0.9978
Test Power (W)/2	31.25
Luminous Efficacy (lm/W)	114.7
Total Luminous Flux (lm)	3582.6
Beam Angle ( °)	168.7
Center Beam Candle Power (cd)	592
Spacing Criteria	1.29 (0 °-180 °)/ 1.47 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	43.76%
Zonal Lumens in the 60 °-90 °Zone	27.93%
Zonal Lumens in the 90 °-120 °Zone	17.21%
Zonal Lumens in the 120 °-180 °Zone	11.09%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

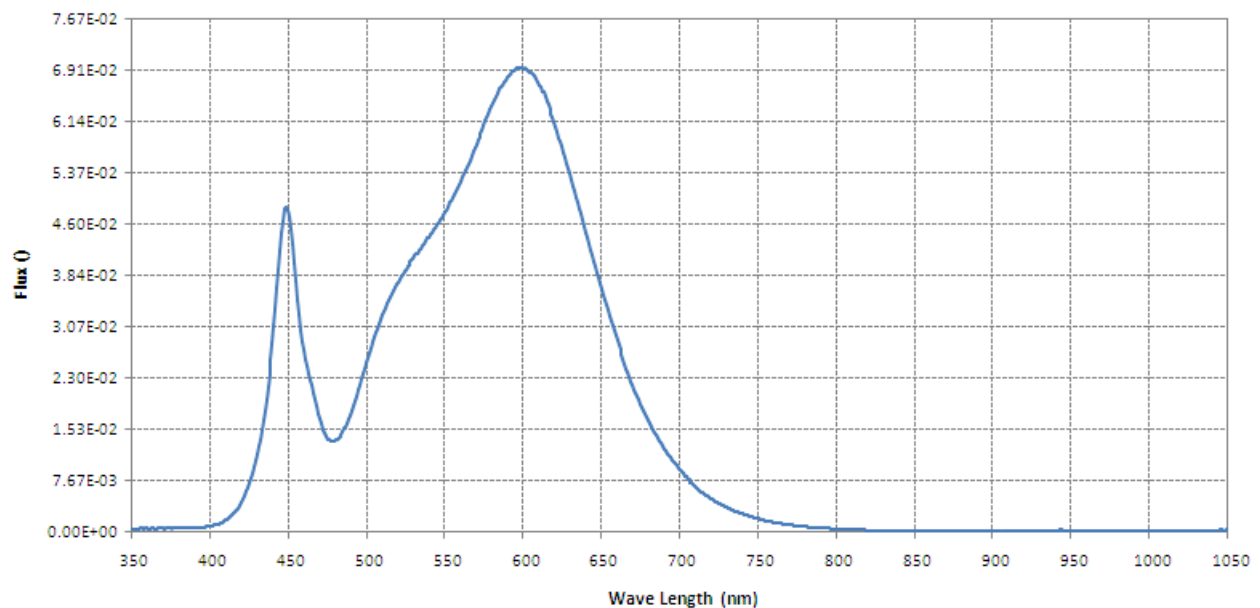


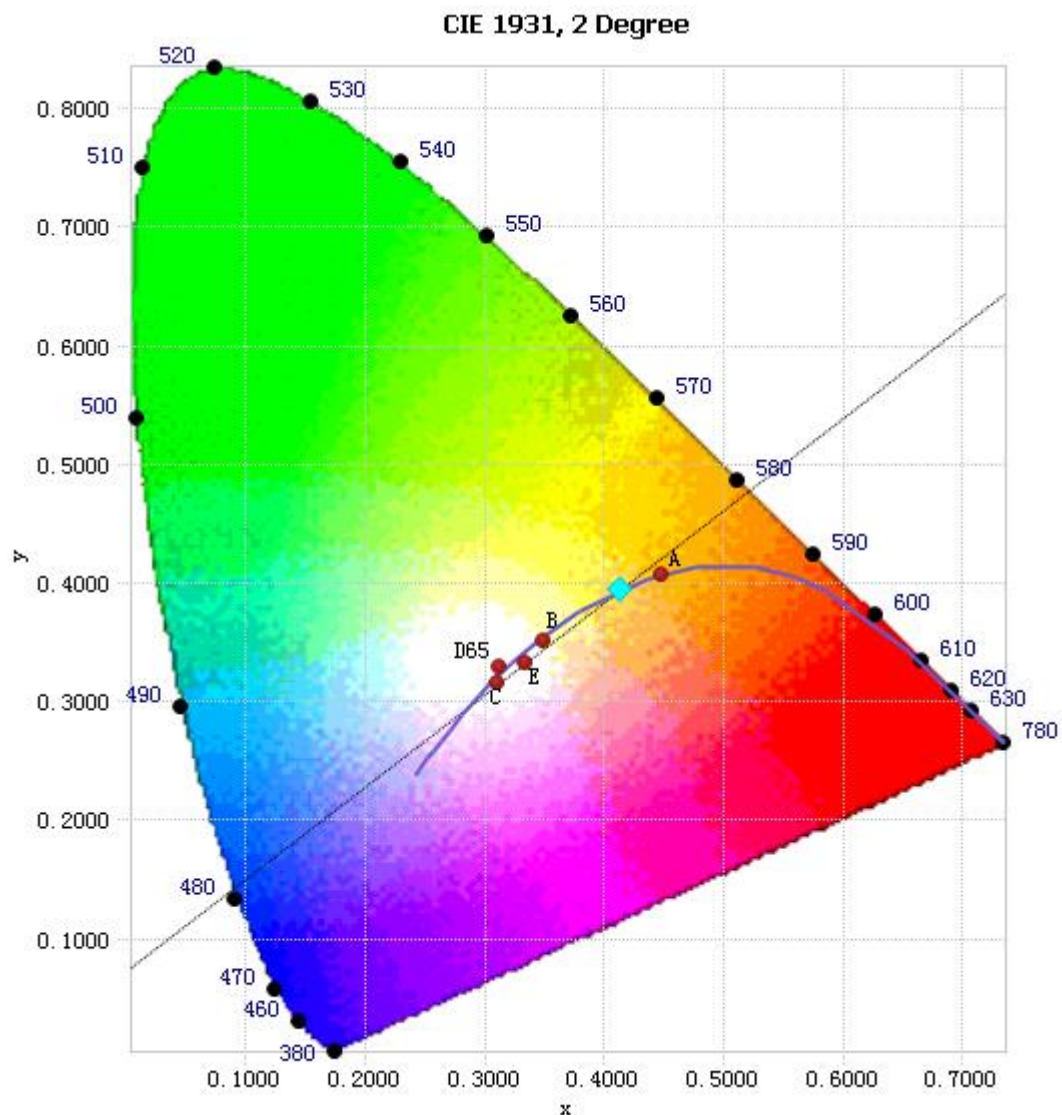
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.21E-04	485	1.50E-02	590	6.82E-02	695	1.08E-02
385	6.16E-04	490	1.75E-02	595	6.93E-02	700	9.30E-03
390	6.65E-04	495	2.12E-02	600	6.94E-02	705	7.95E-03
395	7.45E-04	500	2.53E-02	605	6.88E-02	710	6.85E-03
400	8.95E-04	505	2.92E-02	610	6.70E-02	715	5.89E-03
405	1.17E-03	510	3.25E-02	615	6.46E-02	720	5.03E-03
410	1.76E-03	515	3.53E-02	620	6.13E-02	725	4.34E-03
415	2.73E-03	520	3.74E-02	625	5.77E-02	730	3.72E-03
420	4.46E-03	525	3.92E-02	630	5.36E-02	735	3.16E-03
425	7.35E-03	530	4.11E-02	635	4.94E-02	740	2.72E-03
430	1.18E-02	535	4.25E-02	640	4.49E-02	745	2.33E-03
435	1.83E-02	540	4.41E-02	645	4.05E-02	750	2.00E-03
440	2.82E-02	545	4.61E-02	650	3.64E-02	755	1.72E-03
445	4.21E-02	550	4.79E-02	655	3.24E-02	760	1.49E-03
450	4.83E-02	555	5.00E-02	660	2.87E-02	765	1.27E-03
455	3.76E-02	560	5.26E-02	665	2.52E-02	770	1.11E-03
460	2.72E-02	565	5.51E-02	670	2.19E-02	775	9.63E-04
465	2.20E-02	570	5.81E-02	675	1.92E-02	780	8.41E-04
470	1.69E-02	575	6.08E-02	680	1.67E-02		
475	1.39E-02	580	6.37E-02	685	1.45E-02		
480	1.38E-02	585	6.63E-02	690	1.25E-02		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4128, 0.3948)

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

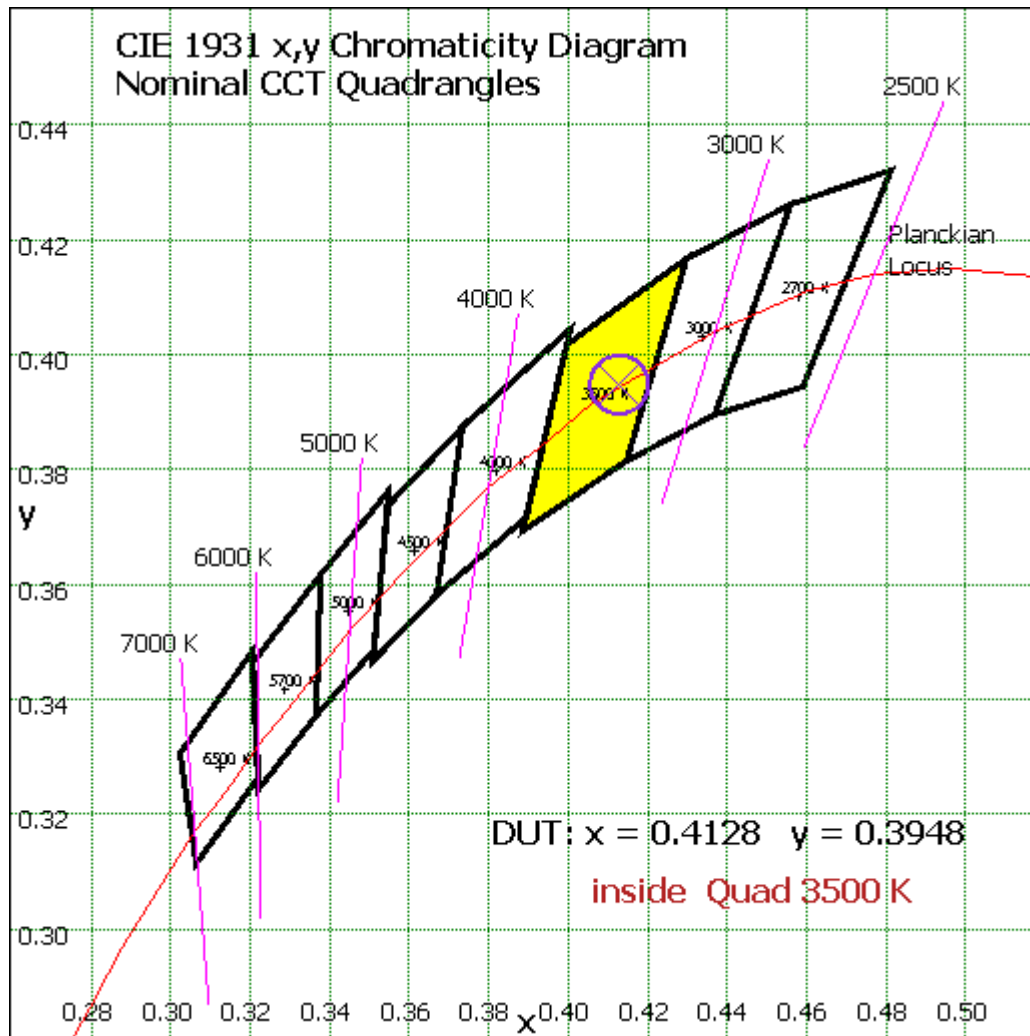


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Vector – Sphere Spectroradiometer Method

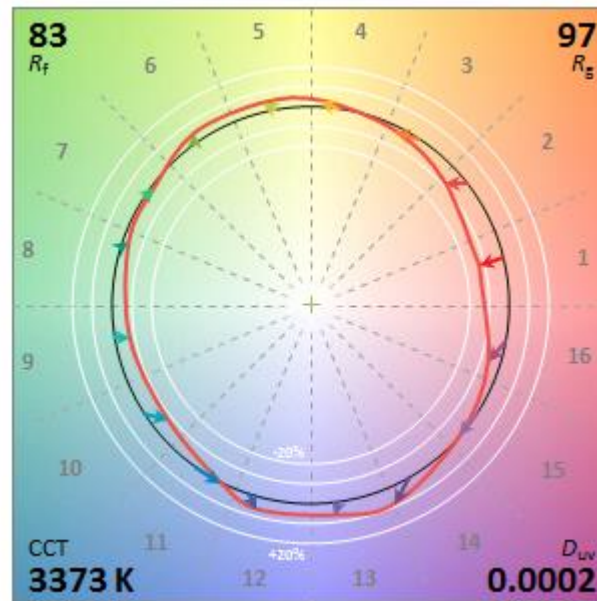


Chart 4: Color Vector Diagram of TM-30-18

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	56.221	1.57%
10- 20	163.865	4.57%
20- 30	257.511	7.19%
30- 40	329.245	9.19%
40- 50	373.416	10.42%
50- 60	387.561	10.82%
60- 70	373.246	10.42%
70- 80	336.843	9.40%
80- 90	290.62	8.11%
90-100	246.882	6.89%
100-110	204.223	5.70%
110-120	165.624	4.62%
120-130	132.573	3.70%
130-140	103.391	2.89%
140-150	76.276	2.13%
150-160	51.139	1.43%
160-170	26.718	0.75%
170-180	7.262	0.20%
Total	3582.6	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1567.819	43.76%
60- 90	1000.709	27.93%
0-90	2568.528	71.69%
90- 180	1014.088	28.31%
0- 180	3582.6	100%

Table 5: Zonal Lumen

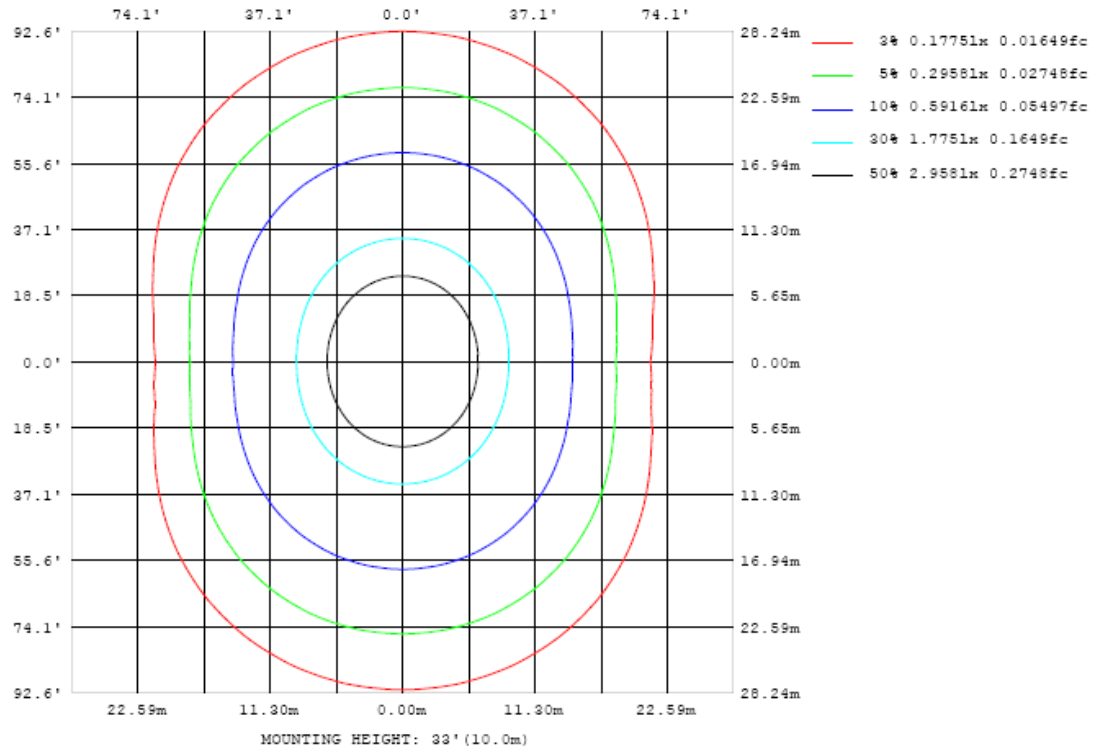


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

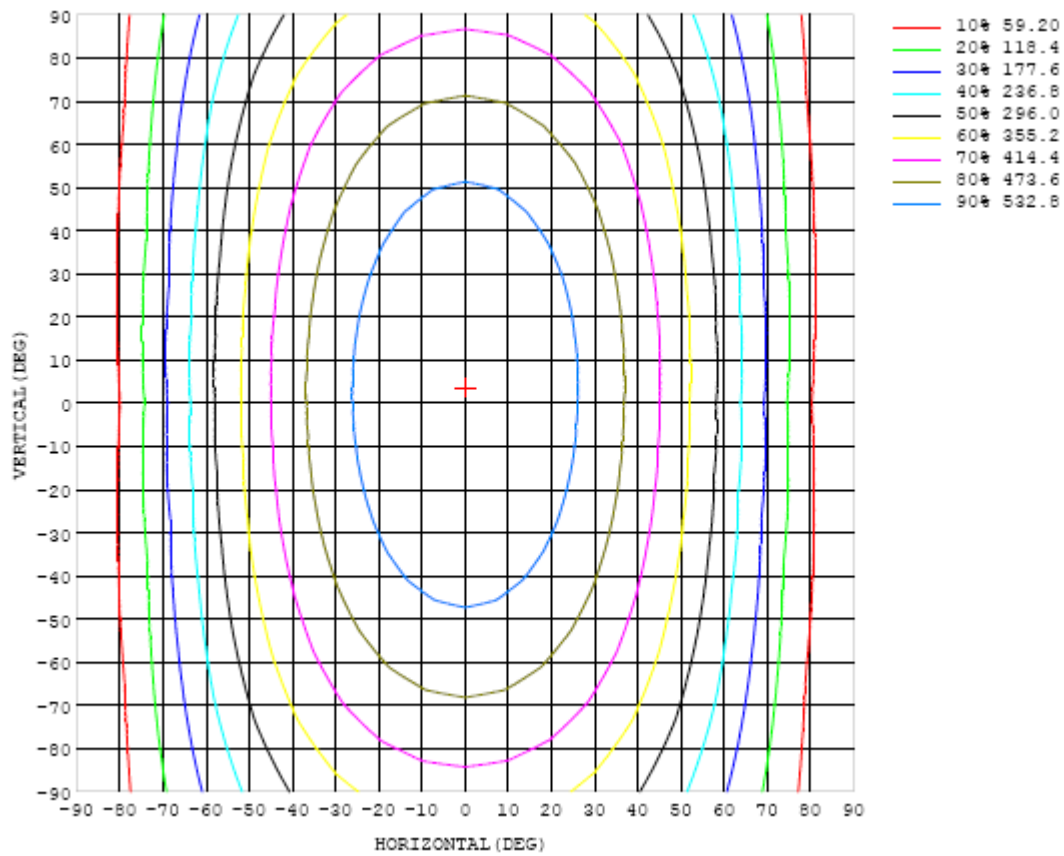


Chart 6: Isocandela Plot

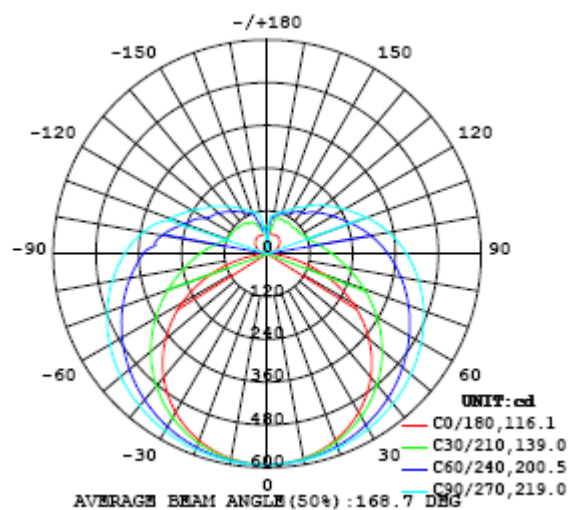


Chart 7: Polar Candela Distribution

## 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	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592
5	589	589	590	590	590	590	590	590	590	590	591	590	590	590	590	590	590	589	590
10	583	583	583	584	585	586	587	587	588	588	588	588	587	586	585	584	583	583	583
15	572	572	573	575	577	579	581	583	584	585	584	583	581	579	577	575	573	573	573
20	557	557	559	562	566	570	574	577	579	580	579	577	574	570	566	563	560	557	557
25	537	538	541	546	552	559	565	570	573	574	573	570	565	559	553	547	541	538	538
30	513	514	520	527	536	546	554	561	565	567	566	561	554	546	536	527	520	514	514
35	485	487	494	505	517	530	542	551	557	558	557	551	542	531	518	505	494	486	485
40	452	455	465	479	496	513	528	539	547	549	546	540	528	513	496	479	465	454	452
45	414	419	432	451	473	494	513	526	535	538	535	527	513	495	473	451	432	418	414
50	373	378	396	421	448	474	496	513	523	526	523	513	496	475	448	421	396	377	372
55	327	334	358	389	422	453	479	498	509	513	509	498	479	453	422	389	357	333	326
60	277	287	317	356	395	431	460	482	495	499	495	482	461	431	396	356	316	285	275
65	224	238	276	322	368	409	441	465	479	484	479	466	442	409	369	322	275	236	222
70	169	187	234	289	342	387	422	447	463	467	463	448	423	387	342	290	234	185	167
75	114	138	195	258	316	364	402	429	445	450	445	429	402	365	317	259	195	136	111
80	62.2	93.5	161	230	291	342	381	409	426	431	426	410	382	343	292	231	161	92.8	59.0
85	20.3	59.6	132	204	267	320	360	389	406	412	406	390	361	321	269	206	134	60.7	18.7
90	1.11	39.1	110	182	246	298	339	368	386	391	386	369	340	300	248	185	113	41.9	1.27
95	3.73	30.6	94.2	163	225	277	318	347	364	370	364	348	319	279	227	166	97.4	33.7	3.49
100	8.53	30.9	83.7	146	205	256	295	324	341	346	341	325	297	257	208	149	87.3	34.7	8.74
105	14.3	34.5	79.1	133	187	235	273	300	317	322	317	301	274	237	190	137	83.4	38.0	15.4
110	20.9	40.7	76.6	125	172	215	250	276	292	297	292	277	252	217	175	129	81.5	43.4	22.3
115	28.1	47.7	75.2	117	160	198	230	253	268	272	268	254	231	201	164	122	78.6	50.0	29.0
120	34.5	54.3	77.8	110	150	184	212	233	246	250	246	234	214	187	153	116	82.6	56.3	34.9
125	40.3	60.8	78.0	107	140	170	196	215	226	230	227	216	198	173	143	110	80.1	61.8	40.1
130	45.7	68.2	83.8	107	129	158	180	198	208	211	208	198	182	159	131	111	84.1	68.9	44.3
135	50.1	73.3	89.2	104	128	143	164	181	191	194	190	182	166	145	131	104	88.6	74.8	47.7
140	53.2	81.6	91.2	104	121	140	151	160	168	174	174	168	153	142	123	104	90.4	79.0	50.7
145	55.3	87.0	93.9	106	116	130	144	154	158	159	157	154	143	131	116	106	92.0	85.4	52.6
150	57.1	88.7	97.0	102	116	125	131	139	144	146	145	139	128	122	115	104	95.2	88.9	54.4
155	57.5	86.3	98.5	105	113	121	128	131	133	133	130	127	123	119	113	101	90.1	86.4	54.9
160	56.8	74.6	102	105	107	115	121	124	125	126	125	122	120	115	100	93.3	83.7	77.8	54.9
165	56.0	63.6	81.3	105	108	109	113	116	117	118	118	115	111	94.6	85.3	77.2	73.3	68.0	54.6
170	58.8	59.8	62.9	74.4	99.6	103	103	110	111	111	109	101	82.3	74.1	73.0	72.5	70.8	63.2	56.5
175	78.0	77.4	74.0	69.4	69.9	74.7	81.7	87.3	100	103	73.6	59.2	62.9	70.9	75.7	78.3	78.6	79.2	74.7
180	18.0	18.0	17.9	17.9	17.9	17.9	17.8	17.8	17.8	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7

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	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592		
5	590	590	590	591	591	591	591	592	592	592	591	591	591	591	590	590	590		
10	584	584	585	587	588	589	590	590	591	590	590	589	588	587	585	584	583		
15	573	575	577	580	582	584	586	587	588	588	586	585	582	580	577	575	573		
20	559	561	565	569	574	578	581	584	584	584	582	578	574	570	565	561	558		
25	539	544	549	556	563	570	575	578	579	578	575	570	564	557	550	544	540		
30	516	522	531	541	551	560	567	572	573	572	567	560	552	542	531	523	517		
35	488	497	509	523	536	548	558	564	566	564	558	549	537	524	510	498	489		
40	456	468	484	502	520	535	547	555	557	555	547	536	521	503	485	469	457		
45	420	435	456	479	502	521	535	544	547	544	535	522	503	481	458	437	422		
50	380	399	426	455	482	505	522	533	536	533	522	506	484	457	428	402	382		
55	336	361	394	430	461	488	508	519	524	520	508	489	464	432	397	364	339		
60	289	321	362	403	440	470	492	505	510	506	492	471	442	406	364	324	292		
65	239	279	328	377	418	451	475	489	494	490	476	452	420	379	332	283	243		
70	189	238	296	350	396	432	458	473	478	473	458	433	398	353	299	242	193		
75	140	200	265	324	373	411	439	455	460	455	439	413	375	327	268	204	145		
80	96.2	167	237	299	351	390	419	436	441	436	419	392	353	301	239	169	100		
85	62.6	138	211	276	329	369	399	416	421	416	399	370	330	277	213	140	64.9		
90	43.0	117	189	254	307	348	377	395	400	395	377	349	308	255	190	118	43.7		
95	32.0	98.1	168	230	282	316	353	372	378	373	355	327	286	233	170	99.3	32.6		
100	31.9	85.2	146	208	259	299	325	342	353	347	330	302	262	210	150	86.1	31.7		
105	37.1	75.0	134	186	234	273	300	312	324	320	303	276	237	189	136	77.4	36.3		
110	43.4	78.9	117	170	213	246	274	288	286	291	276	251	216	173	122	77.0	42.7		
115	49.8	80.8	117	150	193	227	249	263	266	266	253	230	197	157	118	78.6	49.7		
120	56.5	82.9	116	148	173	201	228	238	244	238	230	205	178	149	113	81.7	56.6		
125	62.5	85.0	113	142	167	187	207	217	221	220	209	191	170	142	112	85.0	63.2		
130	66.9	87.5	111	136	159	177	193	203	206	200	193	180	161	136	111	88.5	68.7		
135	68.6	85.1	109	130	149	166	179	187	188	186	175	168	152	131	110	92.2	69.7		
140	71.9	90.3	108	125	141	155	166	172	174	171	165	151	143	126	109	94.7	71.3		
145	73.4	92.7	106	120	133	145	153	159	159	158	152	145	133	122	109	96.2	72.5		
150	76.2	93.6	100	116	126	134	141	147	145	145	141	135	128	118	107	96.7	75.1		
155	76.2	89.4	98.5	104	119	126	132	134	136	134	132	127	122	115	107	95.5	73.8		
160	65.5	76.7	86.8	93.0	101	119	123	125	126	125	124	120	116	112	104	88.3	65.6		
165	57.5	65.1	72.1	79.7	84.0	89.8	104	117	118	117	116	115	109	94.8	91.1	83.1	60.1		
170	56.5	59.6	66.8	70.4	70.8	68.2	74.5	84.6	103	109	109	87.5	90.3	86.4	83.6	68.2	56.4		
175	74.8	75.7	75.3	79.4	74.9	76.5	67.0	49.8	44.0	0.82	78.7	81.3	79.8	78.0	79.2	73.5	74.0		
180	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.8	17.8	17.8	17.9	17.9	17.9	17.9	18.0		

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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