

## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube System

**Model: 22T5HO/4F/835/EXT/A4**

(LED tube model: 22T5HO/4F/835/EXT 4pcs and LED driver model: 24T5HODRIVER/4CH 1pcs)

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, Yuhang Dist,  
Hangzhou, Zhejiang Province, China 311100

Tel: +86 571 86376106

[www.ledtestlab.com](http://www.ledtestlab.com)

Report No.: HZ1808024a

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

Review by:



Engineer: April Zou

Aug. 28, 2018

Approved by:



Manager: Jim Zhang

Aug. 28, 2018

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: 22T5HO/4F/835/EXT/A4

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/4	Power Factor
133.9	3524.0	26.33	0.9967
CCT (K)	CRI	Stabilization Time (Light & Power)	
3398	82.0	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** : Jul. 30, 2018

**Date of Test** : Aug. 02, 2018

**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 Photos.....	4
TEST RESULTS .....	5
Goniophotometer Method .....	6
Spectral Power Distribution - Sphere Spectroradiometer Method .....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method .....	9
Zonal Lumen Tabulation- Goniophotometer Method .....	10
Luminous Intensity Distribution Plots- Goniophotometer Method.....	12
Luminous Intensity Data- Goniophotometer Method.....	13
EQUIPMENT LIST .....	15
TEST METHODS .....	15
Seasoning of SSL Product.....	15
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	15
Goniophotometer Method .....	16
Photometric and Electrical Measurements.....	16
Color Characteristics Measurements.....	16
Color Spatial Uniformity .....	16

## Sample Photos

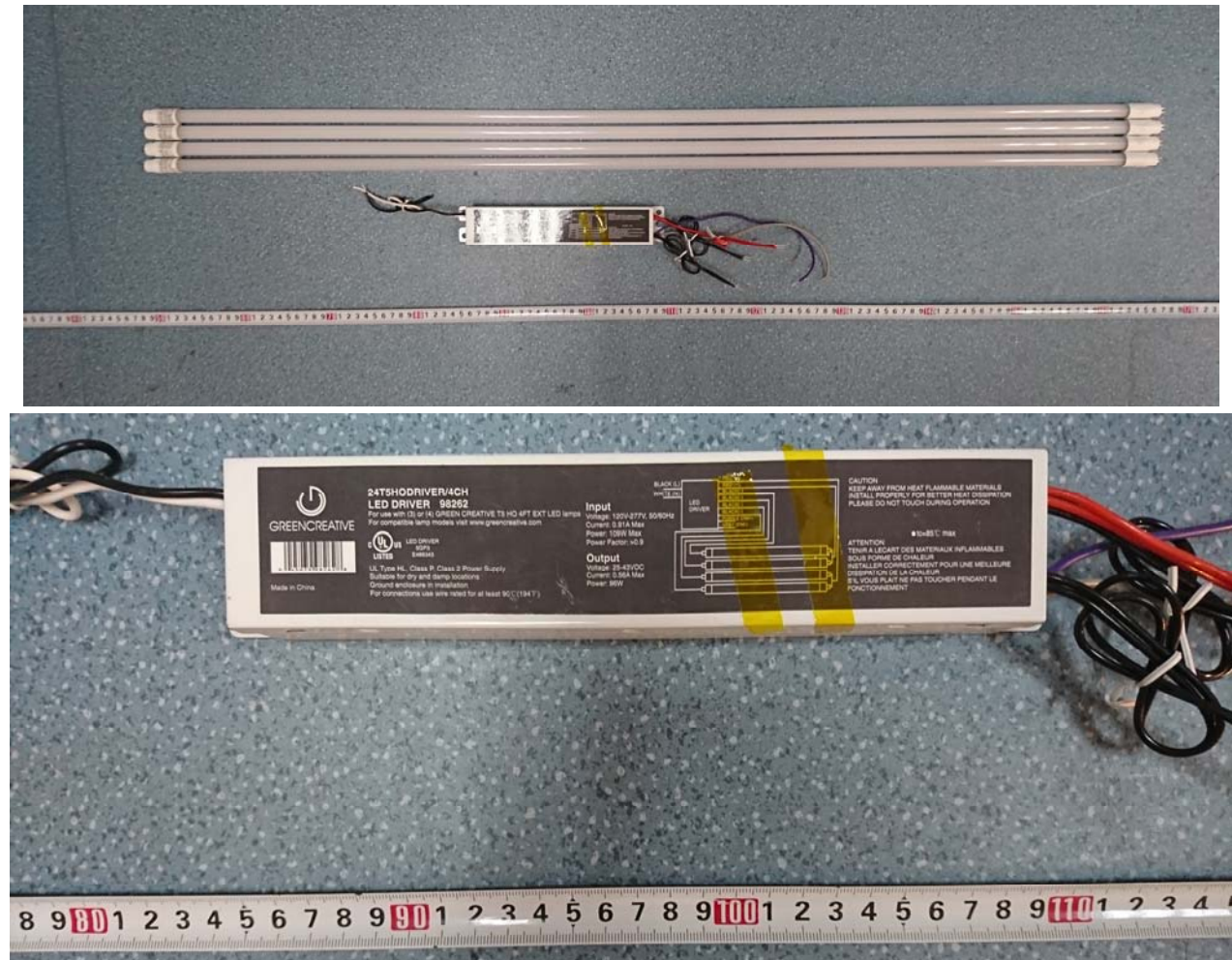


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube System
<b>Model</b>	: 22T5HO/4F/835/EXT/A4
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 3500K LED tube model: 22T5HO/4F/835/EXT 4 LED tubes supplied by a LED driver: 24T5HODRIVER/4CH
<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)	0.880	0.393
Power Factor	0.9967	0.9576
Test Power (W)/4	26.33	26.07
THD A%	3.61	7.16
Luminous Efficacy (lm/W)	133.9	135.2
Luminous Flux per lamp (lm)	3524.0	3524.0
Color Rendering Index (CRI)	82.0	
R9	1.7	
Correlated Color Temperature (CCT)(K)	3398	
Chromaticity Chroma x	0.4120	
Chromaticity Chroma y	0.3960	
Chromaticity Chroma u	0.2379	
Chromaticity Chroma v	0.3429	
Duv	0.0004	
Chromaticity Chroma u'	0.2379	
Chromaticity Chroma v'	0.5144	

Special Color Rendering Indices	
R1	80.4
R2	91.2
R3	95.7
R4	79
R5	80.5
R6	88.5
R7	82.6
R8	58.3
R9	1.7
R10	79.4
R11	78
R12	66.4
R13	83.2
R14	98.2
Rf	82
Rg	94

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 30m.

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)	0.882
Power Factor	0.9961
Test Power (W)/4	26.35
Luminous Efficacy (lm/W)	131.8
Luminous Flux per lamp (lm)	3472.4
Beam Angle (°)	119.5
Center Beam Candle Power (cd)	948
Spacing Criteria	1.23 (0°-180°)/ 1.31 (90°-270°)
Zonal Lumens in the 0°-60°Zone	63.22%
Zonal Lumens in the 60°-90°Zone	25.92%
Zonal Lumens in the 90°-120°Zone	8.01%
Zonal Lumens in the 120°-180°Zone	2.85%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

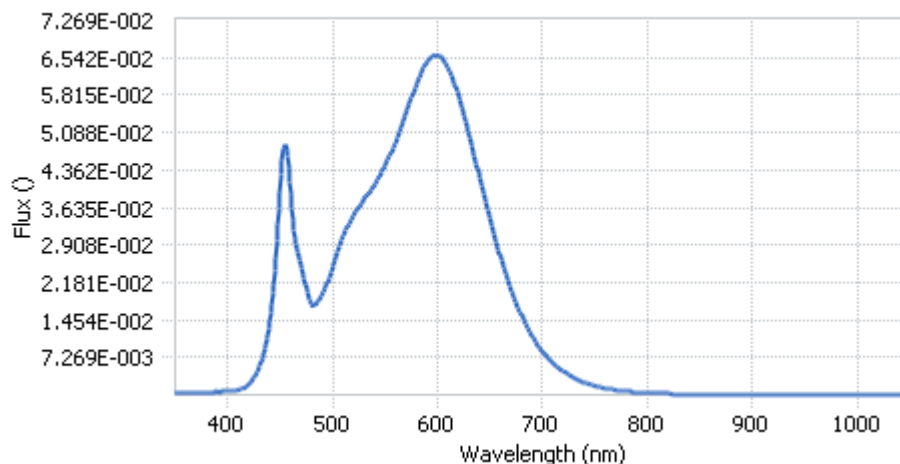


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	5.97E-04	485	1.78E-02	590	6.47E-02	695	9.84E-03
385	5.62E-04	490	1.95E-02	595	6.56E-02	700	8.47E-03
390	6.19E-04	495	2.18E-02	600	6.59E-02	705	7.21E-03
395	6.41E-04	500	2.49E-02	605	6.52E-02	710	6.16E-03
400	6.98E-04	505	2.82E-02	610	6.32E-02	715	5.28E-03
405	7.76E-04	510	3.08E-02	615	6.10E-02	720	4.51E-03
410	9.79E-04	515	3.31E-02	620	5.78E-02	725	3.88E-03
415	1.36E-03	520	3.48E-02	625	5.42E-02	730	3.29E-03
420	2.07E-03	525	3.65E-02	630	5.05E-02	735	2.80E-03
425	3.34E-03	530	3.80E-02	635	4.63E-02	740	2.40E-03
430	5.46E-03	535	3.93E-02	640	4.22E-02	745	2.05E-03
435	8.84E-03	540	4.09E-02	645	3.80E-02	750	1.76E-03
440	1.43E-02	545	4.26E-02	650	3.41E-02	755	1.50E-03
445	2.39E-02	550	4.45E-02	655	3.02E-02	760	1.29E-03
450	3.95E-02	555	4.67E-02	660	2.67E-02	765	1.10E-03
455	4.86E-02	560	4.91E-02	665	2.34E-02	770	9.49E-04
460	3.87E-02	565	5.18E-02	670	2.04E-02	775	8.18E-04
465	2.92E-02	570	5.48E-02	675	1.78E-02	780	7.02E-04
470	2.53E-02	575	5.75E-02	680	1.54E-02		
475	2.05E-02	580	6.05E-02	685	1.33E-02		
480	1.75E-02	585	6.29E-02	690	1.15E-02		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method

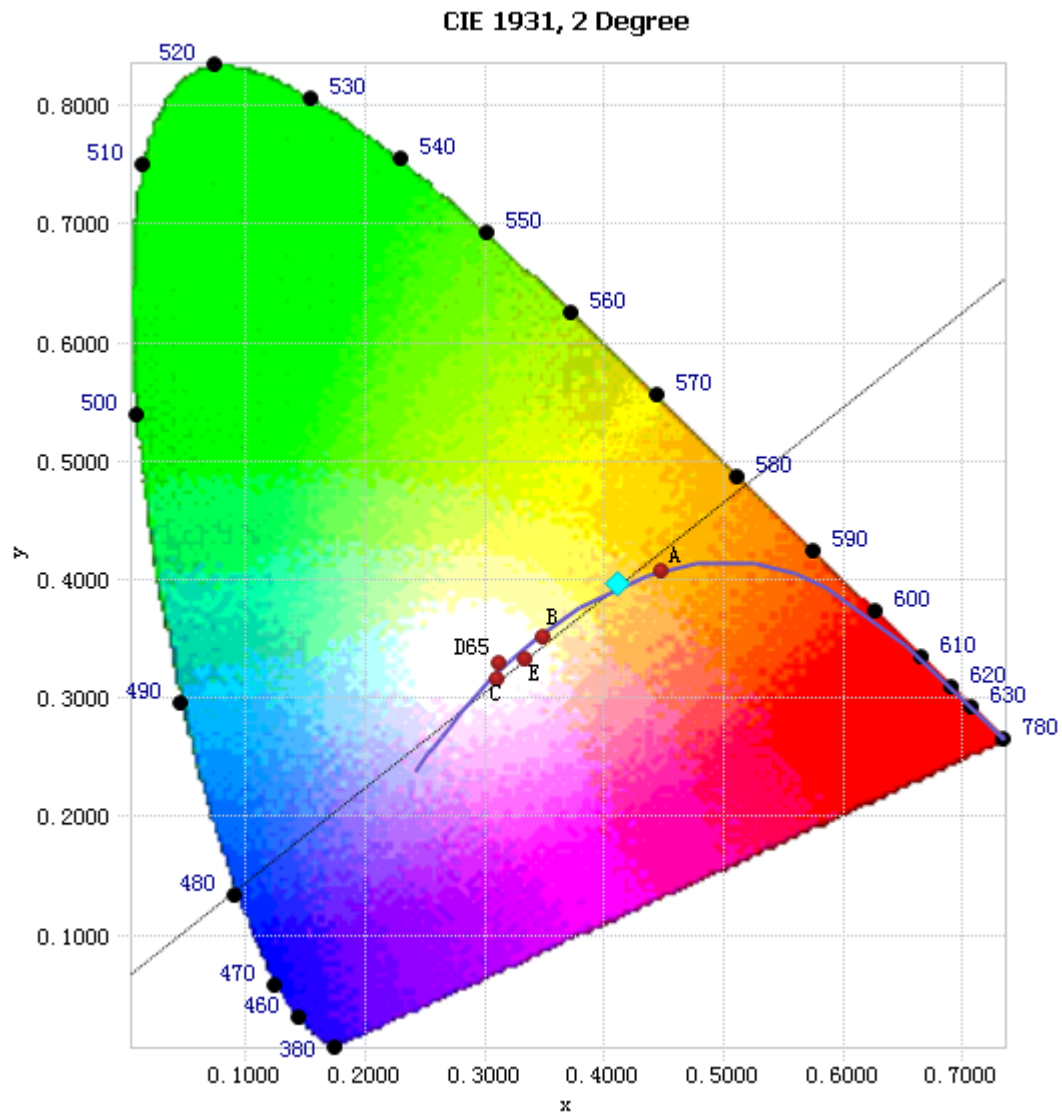


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

### Nominal CCT Quadrangles – Sphere Spectroradiometer Method

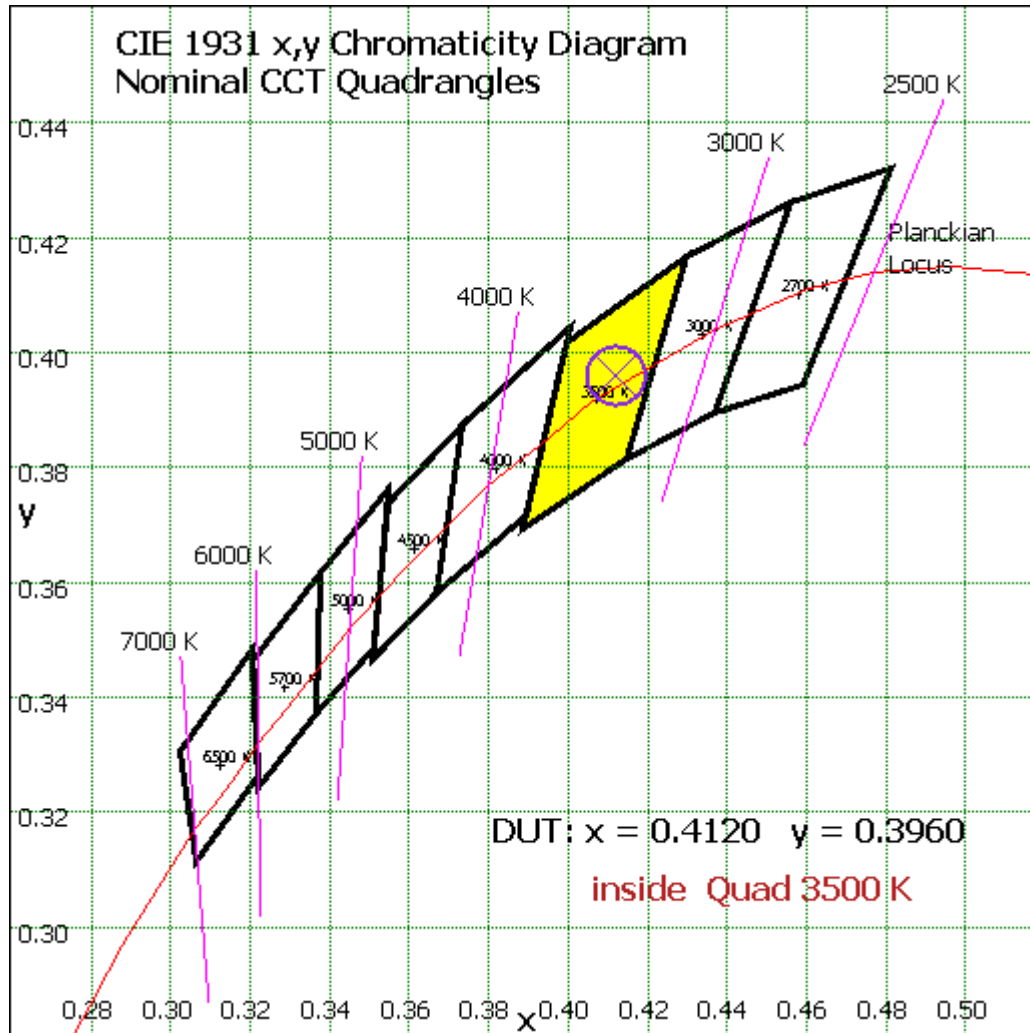


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	89.769	2.59%
10- 20	257.67	7.42%
20- 30	392.342	11.30%
30- 40	477.29	13.75%
40- 50	504.036	14.52%
50- 60	474.003	13.65%
60- 70	398.817	11.49%
70- 80	299.086	8.61%
80- 90	202.293	5.83%
90-100	133.207	3.84%
100-110	87.7	2.53%
110-120	57.289	1.65%
120-130	38.398	1.11%
130-140	26.053	0.75%
140-150	17.165	0.49%
150-160	10.506	0.30%
160-170	5.23	0.15%
170-180	1.501	0.04%
Total	3472.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	2195.11	63.22%
60- 90	900.196	25.92%
0-90	3095.306	89.14%
90- 180	377.049	10.86%
0- 180	3472.4	100%

Table 5: Zonal Lumen Data

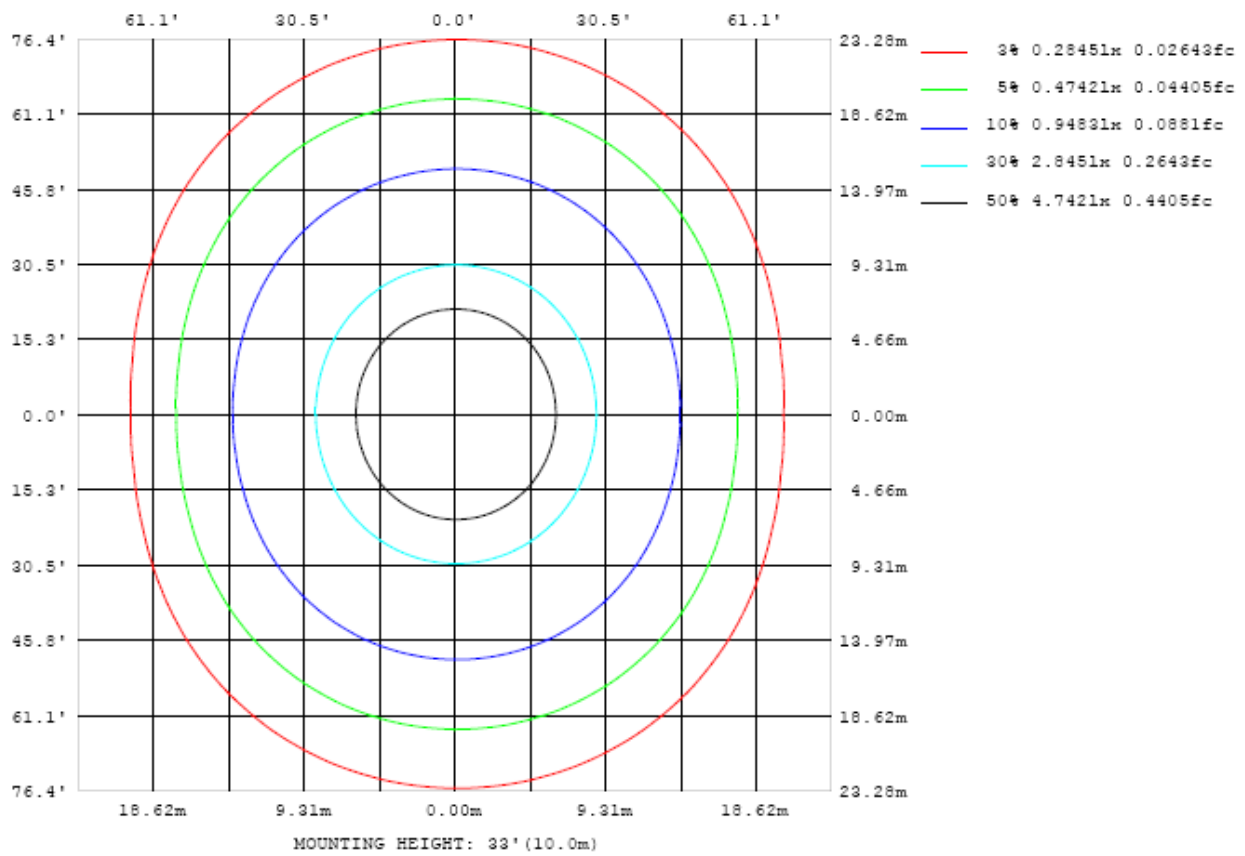


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

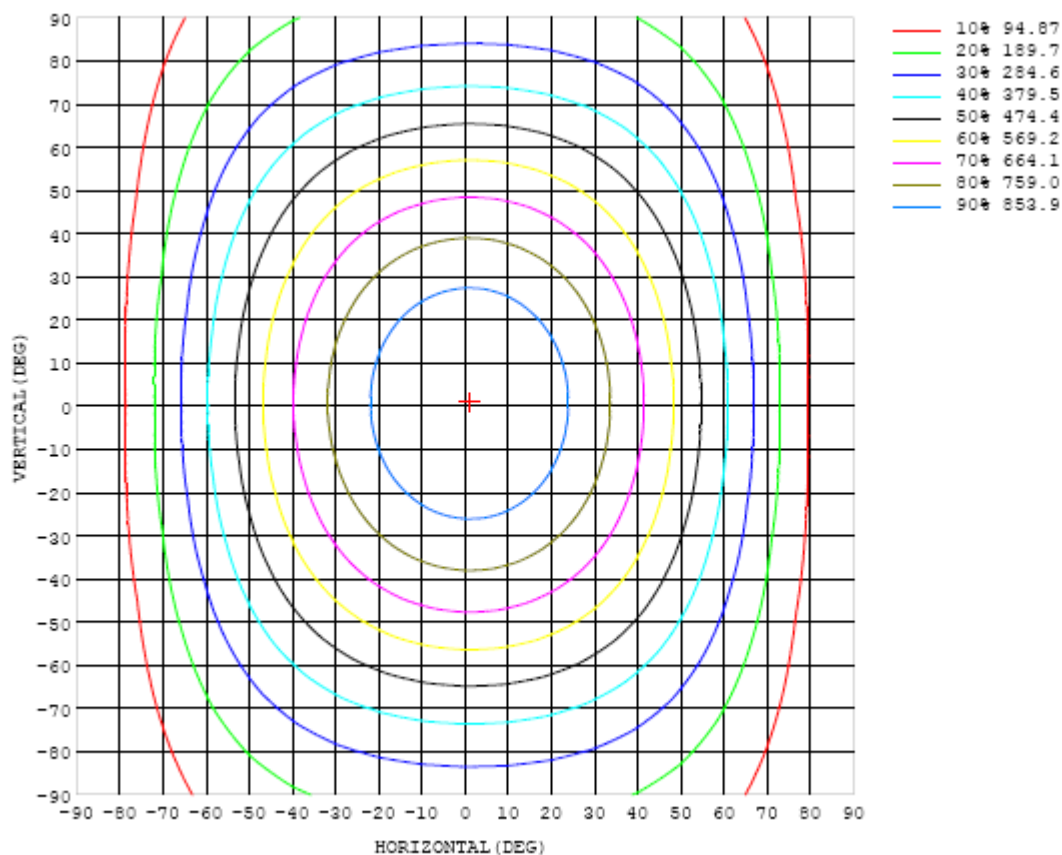


Chart 5: Isocandela Plot

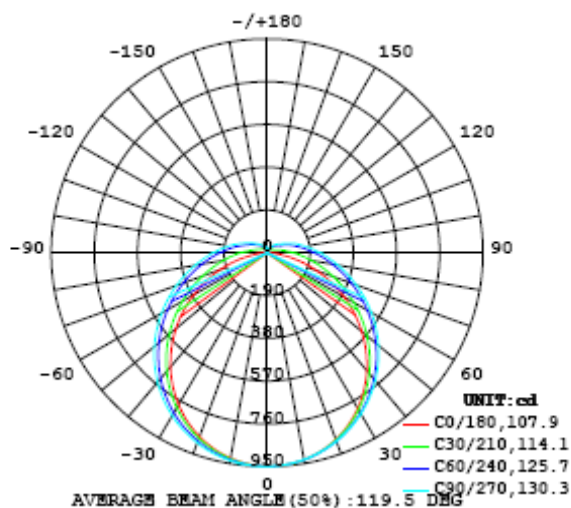


Chart 6: Polar Candela Distribution

## 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	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948
5	946	946	945	945	945	945	945	944	944	944	944	943	943	942	942	942	942	941	942
10	934	934	933	933	934	934	934	934	933	933	932	931	930	929	928	927	926	926	926
15	913	913	913	913	914	915	916	916	916	915	914	912	910	908	906	904	902	902	902
20	883	883	884	885	887	889	891	892	892	891	889	887	883	879	876	872	870	869	869
25	844	845	846	849	853	856	859	861	862	861	859	855	850	845	839	834	830	828	828
30	798	798	801	805	811	817	821	825	826	826	823	818	811	804	796	788	782	779	779
35	743	744	748	755	764	772	779	784	786	786	782	776	768	757	747	737	728	724	723
40	682	683	690	699	711	722	731	738	741	741	737	730	719	707	693	679	668	662	661
45	615	617	625	638	653	668	679	688	692	692	688	680	667	652	635	618	604	596	594
50	543	547	558	574	593	610	625	635	640	640	635	626	612	594	574	554	536	525	523
55	468	473	487	507	530	551	567	579	585	585	580	571	555	535	512	488	466	452	449
60	390	397	415	440	467	491	509	522	528	529	524	514	498	476	450	421	395	378	373
65	312	320	343	374	405	431	451	465	472	473	468	457	440	417	389	356	325	303	296
70	233	244	274	310	345	373	395	409	417	418	413	403	385	361	330	294	258	229	220
75	156	172	209	251	289	319	342	356	364	365	361	350	333	308	276	237	195	159	146
80	85.5	108	152	198	238	269	292	307	315	317	312	302	284	260	227	186	140	96.7	77.5
85	29.4	57.4	106	153	194	225	248	263	271	272	268	258	241	217	184	144	96.3	49.4	24.6
90	2.02	26.5	71.9	117	156	187	209	224	231	233	229	220	204	180	148	109	65.0	21.8	0.86
95	0.56	12.9	48.5	88.8	125	155	176	190	197	199	196	187	171	149	119	83.0	43.7	9.89	0.94
100	1.15	8.55	33.2	68.1	100	127	148	161	168	170	167	158	144	123	95.7	63.3	28.8	7.20	1.66
105	2.25	7.52	24.5	51.1	80.2	105	124	136	143	145	142	134	121	101	75.7	46.1	22.5	6.79	2.75
110	3.53	7.74	20.3	40.0	62.3	84.5	102	115	121	123	120	113	99.5	80.5	57.3	36.9	18.7	7.27	3.94
115	4.85	8.55	18.0	33.3	50.8	66.8	82.4	93.7	100	102	99.3	91.7	78.9	62.4	47.8	31.9	17.4	8.32	5.11
120	6.12	9.59	16.7	29.0	43.1	56.8	66.5	75.0	80.3	81.8	79.0	72.9	63.5	54.9	41.8	27.3	16.6	9.55	6.29
125	7.32	10.7	16.2	25.8	37.1	48.3	58.5	64.9	67.9	68.5	67.2	63.9	57.5	47.4	35.8	25.4	16.3	10.7	7.41
130	8.50	11.8	16.1	23.4	32.6	41.6	49.4	55.7	59.6	60.8	59.3	55.2	48.7	40.5	32.1	23.5	16.2	11.5	8.40
135	9.32	12.3	16.2	21.8	28.9	36.2	42.6	47.4	50.4	51.3	50.2	46.9	41.7	35.7	28.8	22.0	16.4	12.5	9.47
140	10.0	12.8	16.2	20.8	26.2	31.7	36.8	40.8	43.2	43.9	43.0	40.5	36.6	31.6	26.0	20.8	16.6	13.0	10.3
145	10.6	13.5	16.9	19.8	23.9	28.2	32.0	35.1	37.0	37.7	37.0	35.1	32.0	28.1	24.1	20.2	16.8	13.7	11.0
150	11.4	14.4	17.1	19.1	22.2	25.2	28.2	30.4	31.8	32.3	31.9	30.5	28.3	25.5	22.5	19.6	16.9	14.5	11.7
155	11.7	14.5	17.2	19.0	21.0	23.0	24.9	26.4	27.6	28.0	27.7	26.7	25.2	23.3	21.2	18.7	16.9	14.5	11.8
160	11.1	14.3	17.6	18.9	19.9	21.0	22.3	23.5	24.1	24.3	24.2	23.6	22.8	21.8	19.9	17.3	14.9	13.3	11.8
165	11.3	13.4	16.8	18.8	19.7	20.2	20.5	21.1	21.5	21.6	21.7	21.7	21.4	19.9	17.4	14.9	13.0	12.1	11.4
170	11.6	12.0	15.0	17.6	18.6	19.5	20.0	20.2	20.3	20.6	20.7	20.5	18.3	15.6	14.0	13.5	13.6	12.6	11.4
175	14.6	14.5	14.5	15.1	16.5	17.4	17.9	18.7	19.2	19.2	18.8	15.9	12.8	12.3	13.5	14.3	14.5	14.8	14.6
180	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67

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	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948	948		
5	942	943	943	944	944	945	945	946	946	946	947	947	946	947	946	946	946		
10	927	928	929	930	932	934	935	936	937	937	938	938	937	936	936	935	934		
15	903	905	907	910	913	916	918	920	921	922	922	921	920	918	916	915	914		
20	870	873	877	881	886	891	894	897	899	899	899	897	895	892	889	886	884		
25	830	834	840	846	853	859	864	867	870	870	869	866	863	858	853	849	846		
30	782	787	795	804	813	821	828	832	835	836	833	829	824	817	810	804	800		
35	727	734	744	755	767	777	785	791	795	795	792	787	779	770	760	752	746		
40	665	675	687	702	716	729	739	746	750	750	746	739	729	717	704	693	686		
45	599	611	627	644	662	677	688	696	700	700	695	687	674	659	643	629	620		
50	529	543	562	583	604	622	634	643	648	647	642	631	616	598	578	561	549		
55	456	473	496	521	544	564	578	588	592	592	585	573	556	535	512	490	475		
60	382	403	430	458	484	506	521	531	536	535	528	515	496	471	443	418	398		
65	307	333	365	397	425	448	465	475	480	478	471	456	435	408	376	345	322		
70	234	266	303	338	369	392	409	420	424	423	415	400	378	348	312	275	245		
75	165	203	245	284	315	340	356	367	371	370	361	346	323	291	252	210	173		
80	103	149	195	234	267	291	308	318	322	320	312	296	273	240	199	153	107		
85	55.4	105	152	192	223	247	263	273	277	275	267	251	228	195	154	105	55.7		
90	27.0	72.0	117	156	186	209	224	234	237	235	227	212	189	158	117	70.3	24.8		
95	14.1	48.6	89.4	126	155	176	191	200	203	201	193	178	157	127	88.7	46.5	11.3		
100	9.97	34.9	67.6	99.8	128	149	163	171	173	171	164	150	129	99.9	65.9	32.1	7.84		
105	9.36	27.4	53.3	80.1	103	122	135	143	146	144	136	122	103	78.8	51.0	24.7	7.47		
110	9.62	23.3	43.8	65.9	85.9	102	113	120	122	120	113	102	85.2	64.4	41.5	20.8	8.19		
115	9.85	21.2	37.3	55.4	72.4	86.2	96.1	102	104	102	95.8	85.7	71.3	53.7	34.8	19.0	8.84		
120	10.7	20.0	32.8	47.5	61.6	73.4	82.0	87.1	88.9	87.1	81.7	72.7	60.4	45.6	30.5	18.2	9.55		
125	11.6	19.3	29.5	41.3	52.9	62.9	70.3	74.8	76.4	74.7	69.9	62.2	51.8	39.6	27.7	18.0	10.6		
130	12.8	19.0	27.1	36.5	46.0	54.3	60.5	64.3	65.6	64.2	60.1	53.5	44.9	35.2	25.8	17.9	12.0		
135	13.7	19.0	25.4	32.9	40.4	47.1	52.3	55.4	56.5	55.2	51.7	46.3	39.5	31.8	24.2	17.5	13.2		
140	14.7	19.1	24.1	30.0	35.8	41.1	45.2	47.8	48.6	47.6	44.7	40.4	35.0	29.0	23.1	18.1	14.0		
145	15.4	19.0	23.1	27.6	32.0	36.1	39.2	41.2	41.9	41.0	38.8	35.5	31.4	26.5	21.7	18.5	14.7		
150	15.7	19.5	22.2	25.5	28.8	31.8	34.2	35.7	36.2	35.6	34.0	31.5	28.1	24.5	21.5	19.0	15.2		
155	14.4	18.0	19.2	23.0	26.0	28.0	29.8	30.9	31.3	30.9	29.8	27.8	25.4	23.4	21.3	18.7	14.3		
160	12.1	14.9	17.2	18.5	21.9	24.8	26.0	26.6	26.8	26.7	26.1	25.1	23.9	22.5	21.1	17.5	12.6		
165	11.6	12.6	14.1	15.1	15.5	17.8	21.8	23.7	24.0	23.8	23.6	23.2	22.3	21.4	19.7	15.0	11.2		
170	12.1	12.3	12.7	14.4	14.6	14.7	13.8	17.0	22.0	21.8	21.4	20.5	19.8	17.9	14.6	12.6	11.7		
175	15.0	15.5	15.7	15.8	15.9	16.1	15.5	13.9	9.98	14.3	16.1	16.6	16.3	15.4	15.1	15.0	14.8		
180	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67	9.67		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	PF2010A	HZTE028-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	DPS1060	HZTE001-06	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	WY12010	HZTE004-03	Aug. 10, 2017	Aug. 09, 2018
Temperature recorder	JM624U	HZTE018-08	Aug. 17, 2017	Aug. 16, 2018
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 16, 2017	Aug. 15, 2018
Standard source	D908	HZTE012-01	Aug. 20, 2017	Aug. 19, 2018
Integrate Sphere system	2M	HZTE015-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	WT210	HZTE008-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	PCR 500L	HZTE001-07	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	IT6154	HZTE004-04	Aug. 10, 2017	Aug. 09, 2018
Standard source	SCL-1400	HZTE012-02	Aug. 20, 2017	Aug. 19, 2018
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 16, 2017	Aug. 15, 2018
Temperature Meter	TES1310	HZTE017-01	Aug. 17, 2017	Aug. 16, 2018

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**

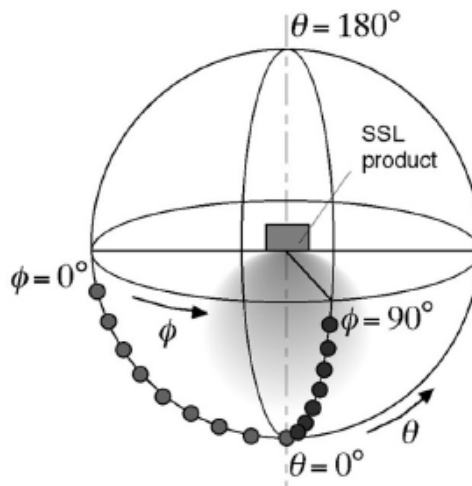
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.