

## LM-79-08 Test Report

for

### GREEN CREATIVE LTD

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

### LED Tube System

#### Model: 13.5T5HE/4F/850/EXT/A2

(LED tube model: 13.5T5HE/4F/850/EXT 2pcs and LED driver model: 15T8T5HEDRIVER/2CH 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

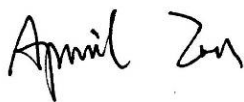
www.ledtestlab.com

Report No.: HZ18070047f/R1

This report is replaced the old report No. HZ18070047f dated Aug. 09, 2018

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: 13.5T5HE/4F/850/EXT/A2

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/2	Power Factor
141.9	2223.0	15.67	0.9960
CCT (K)	CRI	Stabilization Time (Light & Power)	
4925	81.7	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

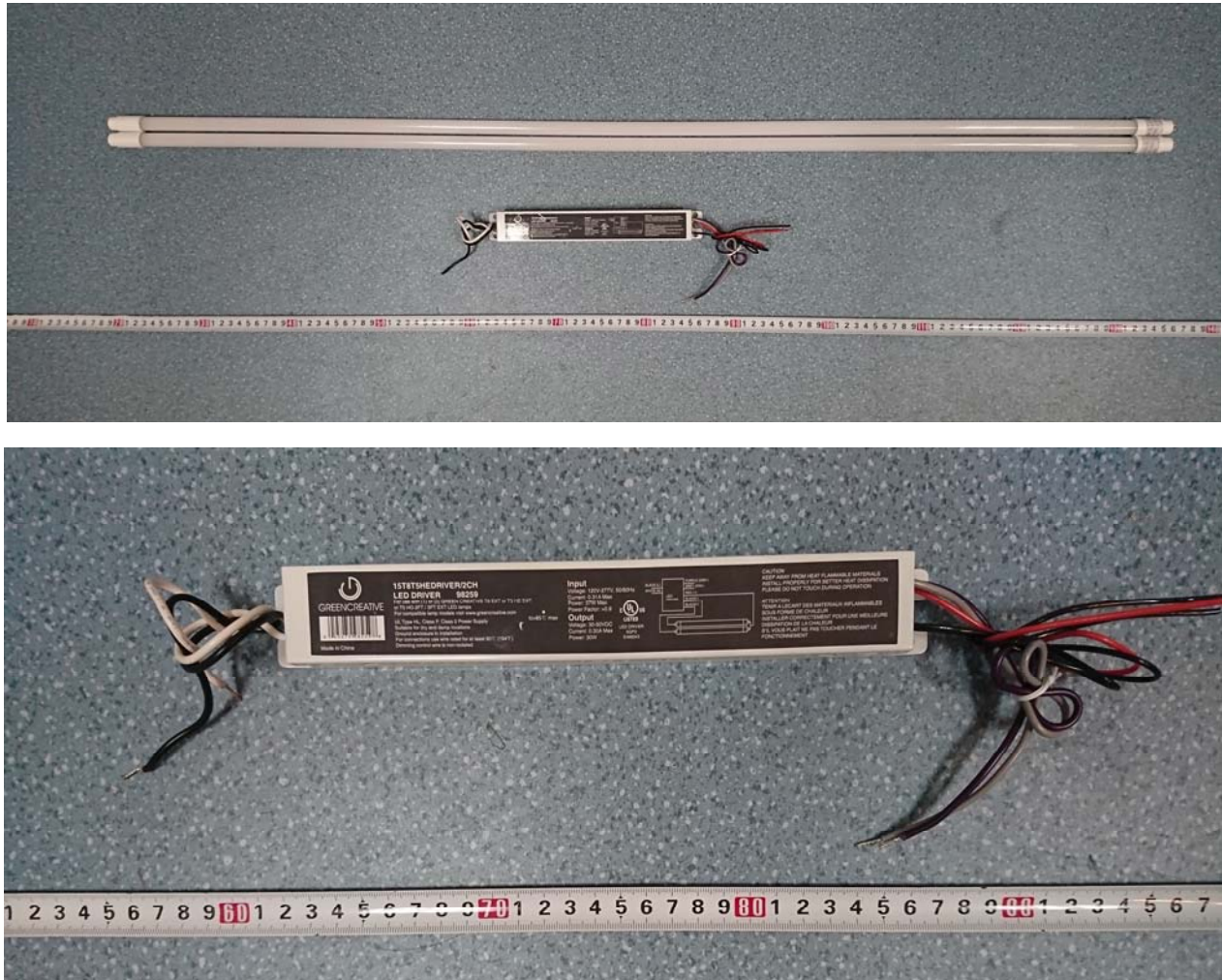


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube System
<b>Model</b>	: 13.5T5HE/4F/850/EXT/A2
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz
<b>Product Description</b>	: 5000K LED tube model: 13.5T5HE/4F/850/EXT 2 LED tubes supplied by a LED driver: 15T8T5HEDRIVER/2CH
<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)	0.262	0.120
Power Factor	0.9960	0.9559
Test Power (W)/2	15.67	15.82
THD A%	4.66	5.94
Luminous Efficacy (lm/W)	141.9	140.6
Luminous Flux per lamp (lm)	2223.0	2223.0
Color Rendering Index (CRI)	81.7	
R9	1.2	
Correlated Color Temperature (CCT)(K)	4925	
Chromaticity Chroma x	0.3481	
Chromaticity Chroma y	0.3618	
Chromaticity Chroma u	0.2095	
Chromaticity Chroma v	0.3267	
Duv	0.0038	
Chromaticity Chroma u'	0.2095	
Chromaticity Chroma v'	0.4901	

Special Color Rendering Indices	
R1	78.7
R2	87
R3	93.3
R4	80.9
R5	80.4
R6	83.6
R7	85.9
R8	64.1
R9	1.2
R10	69.6
R11	82.2
R12	50.9
R13	80.4
R14	96.4
Rf	81
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 25.0°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)	0.263
Power Factor	0.9952
Test Power (W)/2	15.71
Luminous Efficacy (lm/W)	139.5
Luminous Flux per lamp (lm)	2190.2
Beam Angle (°)	128.2
Center Beam Candle Power (cd)	544
Spacing Criteria	1.27 (0°-180°)/ 1.33 (90°-270°)
Zonal Lumens in the 0°-60°Zone	59.69%
Zonal Lumens in the 60°-90°Zone	27.65%
Zonal Lumens in the 90°-120°Zone	9.75%
Zonal Lumens in the 120°-180°Zone	2.91%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

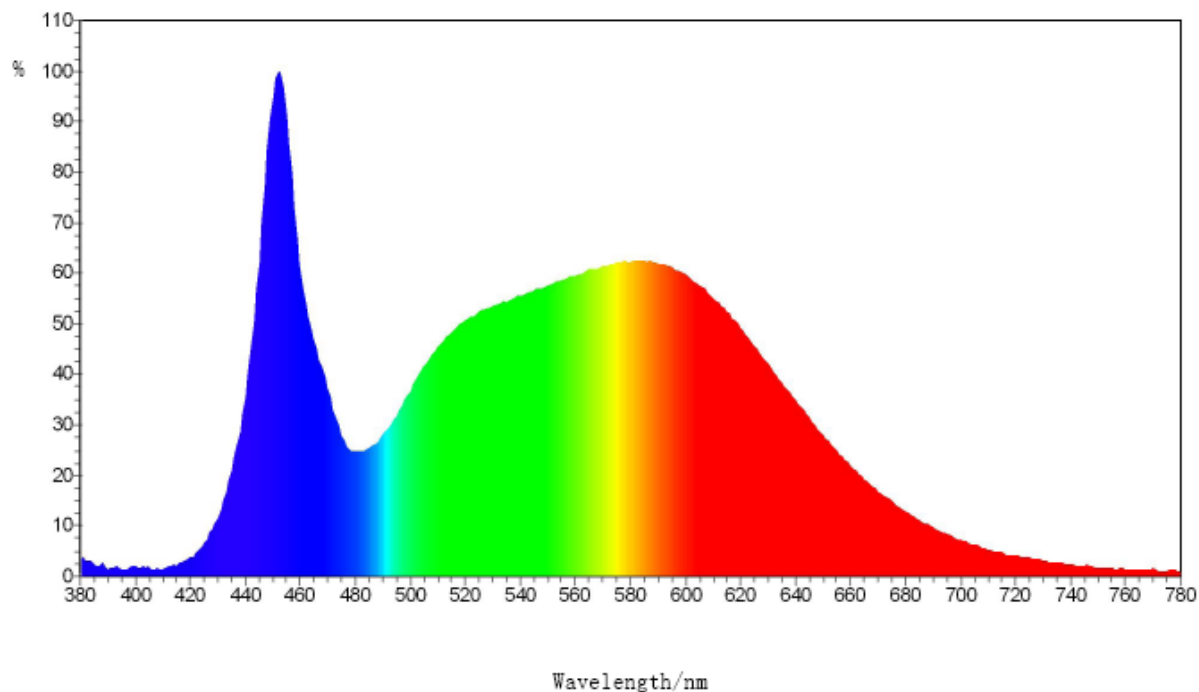
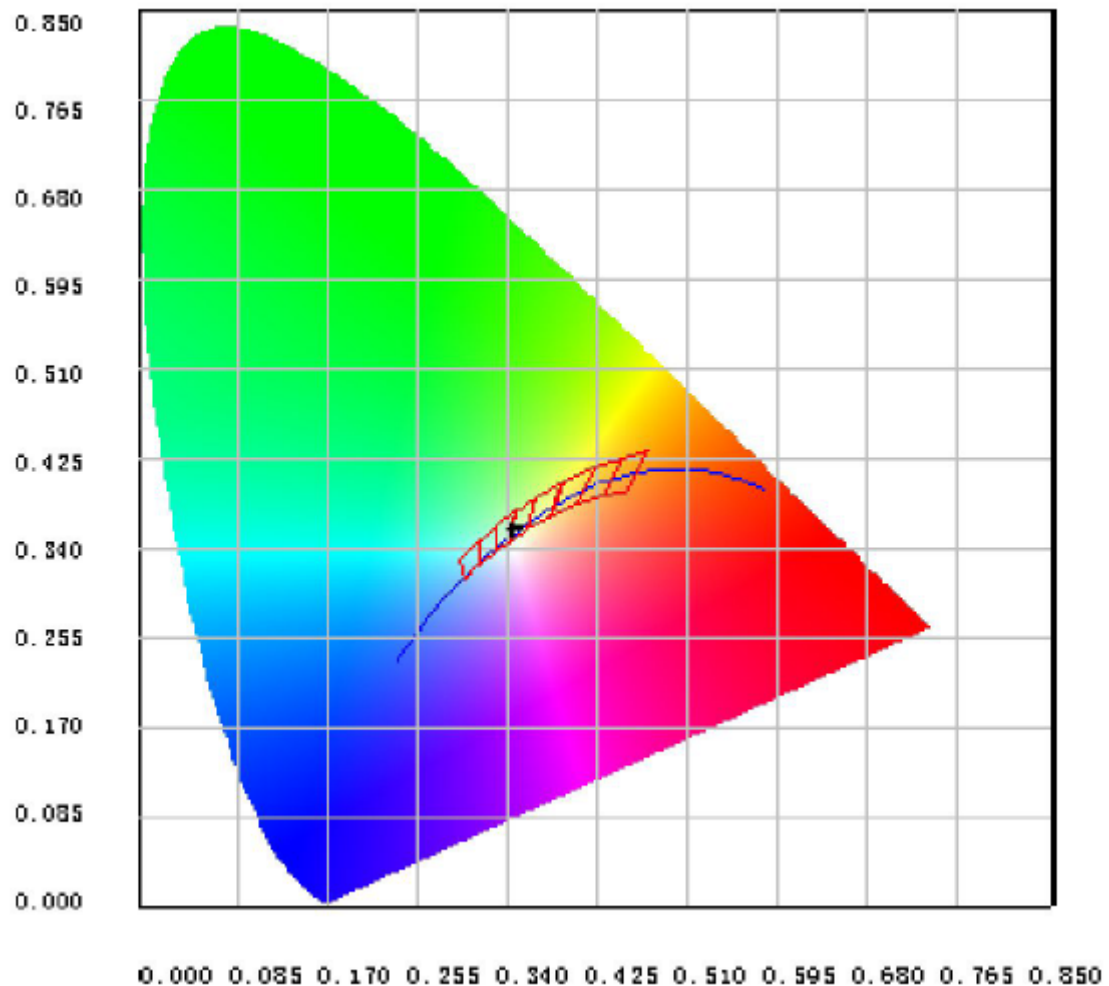


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.04E-03	485	1.44E-02	590	3.51E-02	695	4.77E-03
385	1.38E-03	490	1.60E-02	595	3.47E-02	700	4.16E-03
390	8.46E-04	495	1.81E-02	600	3.39E-02	705	3.54E-03
395	8.40E-04	500	2.09E-02	605	3.28E-02	710	3.04E-03
400	1.15E-03	505	2.36E-02	610	3.13E-02	715	2.70E-03
405	1.09E-03	510	2.57E-02	615	2.97E-02	720	2.46E-03
410	7.73E-04	515	2.74E-02	620	2.80E-02	725	2.10E-03
415	1.28E-03	520	2.86E-02	625	2.59E-02	730	1.81E-03
420	2.09E-03	525	2.97E-02	630	2.40E-02	735	1.59E-03
425	3.74E-03	530	3.04E-02	635	2.18E-02	740	1.30E-03
430	6.58E-03	535	3.08E-02	640	1.98E-02	745	1.25E-03
435	1.18E-02	540	3.15E-02	645	1.78E-02	750	1.05E-03
440	2.02E-02	545	3.21E-02	650	1.58E-02	755	9.69E-04
445	3.52E-02	550	3.26E-02	655	1.42E-02	760	8.62E-04
450	5.38E-02	555	3.32E-02	660	1.25E-02	765	8.20E-04
455	5.16E-02	560	3.38E-02	665	1.10E-02	770	9.22E-04
460	3.51E-02	565	3.44E-02	670	9.60E-03	775	6.67E-04
465	2.68E-02	570	3.48E-02	675	8.47E-03	780	6.36E-04
470	2.12E-02	575	3.53E-02	680	7.35E-03		
475	1.58E-02	580	3.54E-02	685	6.34E-03		
480	1.40E-02	585	3.55E-02	690	5.55E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3481, 0.3618)

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

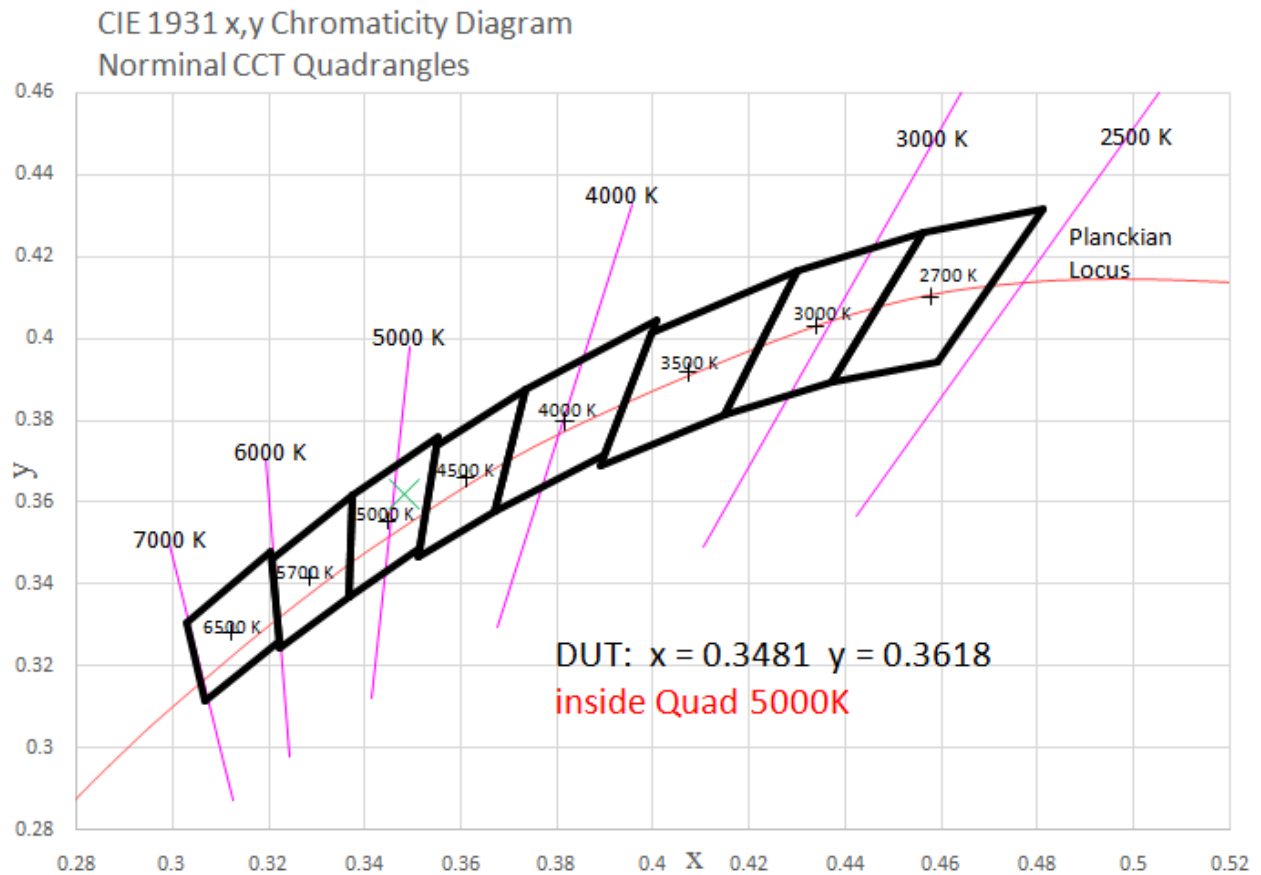


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	51.549	2.35%
10- 20	148.547	6.78%
20- 30	228.139	10.42%
30- 40	281.5	12.85%
40- 50	303.614	13.86%
50- 60	294.023	13.42%
60- 70	257.213	11.74%
70- 80	202.786	9.26%
80- 90	145.527	6.64%
90-100	101.078	4.62%
100-110	68.295	3.12%
110-120	44.075	2.01%
120-130	27.995	1.28%
130-140	17.16	0.78%
140-150	10.067	0.46%
150-160	5.486	0.25%
160-170	2.481	0.11%
170-180	0.633	0.03%
Total	2190.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1307.372	59.69%
60- 90	605.526	27.65%
0-90	1912.898	87.34%
90- 180	277.27	12.66%
0- 180	2190.2	100%

Table 5: Zonal Lumen Data

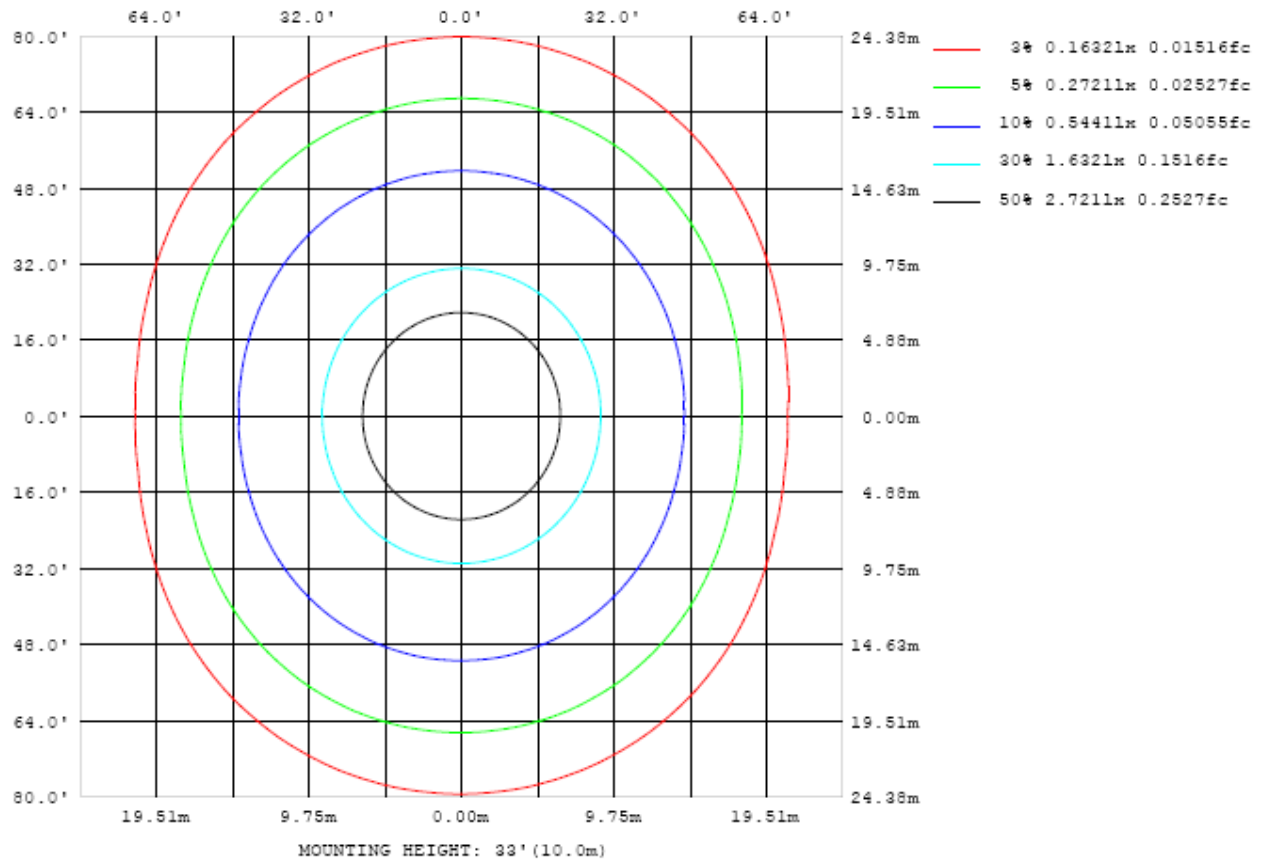


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

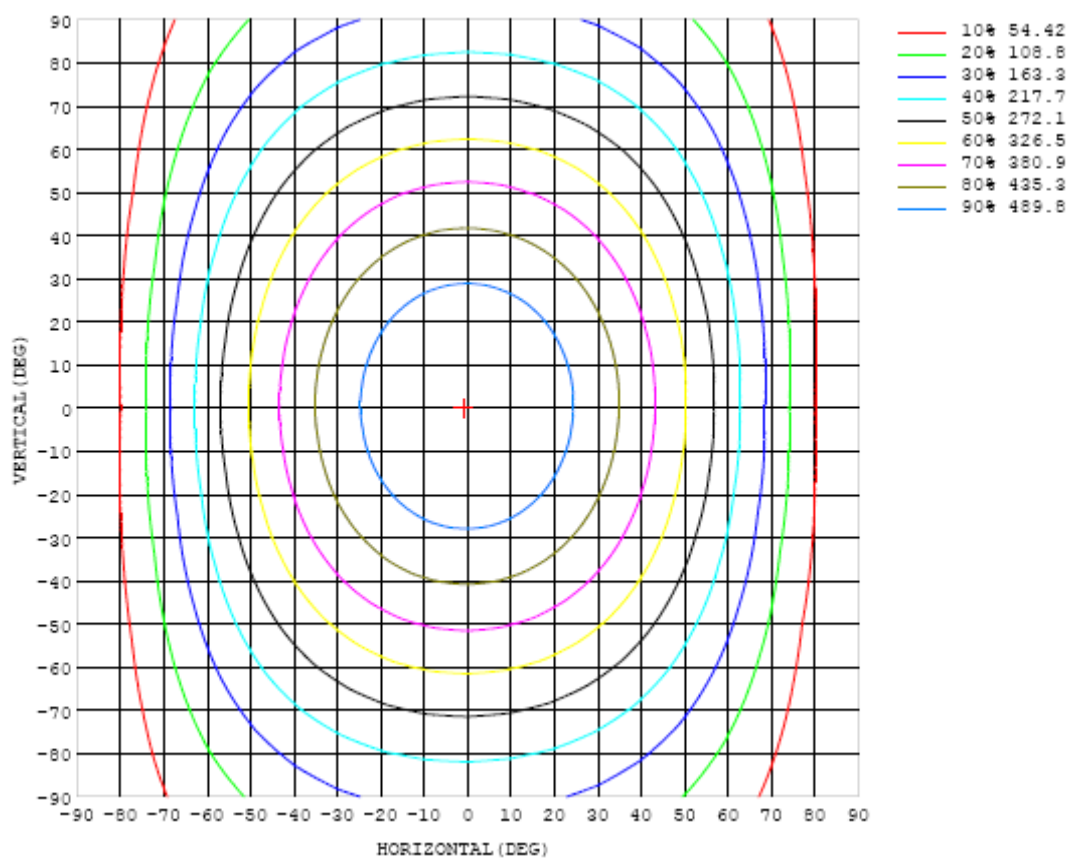


Chart 5: Isocandela Plot

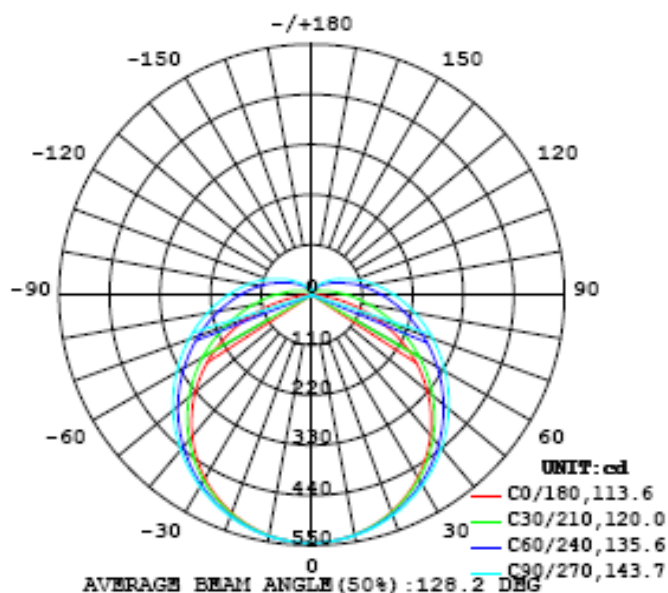


Chart 6: Polar Candela Distribution

## 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	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544
5	542	542	541	541	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542
10	534	534	534	535	535	535	536	536	536	536	536	536	536	536	536	536	535	535	536
15	523	523	523	523	524	525	526	527	527	527	527	527	527	526	525	525	524	524	524
20	507	507	507	508	510	511	513	514	515	515	515	515	514	512	511	510	509	508	509
25	487	487	488	489	491	494	496	498	500	500	500	499	497	495	493	491	489	488	489
30	462	462	464	466	470	473	476	479	481	482	482	480	478	475	472	469	466	464	465
35	434	434	436	440	445	449	454	458	461	462	461	459	456	451	447	442	439	436	437
40	402	403	405	410	417	423	429	434	438	439	438	436	431	425	419	413	408	405	405
45	367	368	371	378	386	395	403	409	413	415	414	411	405	397	389	381	374	369	370
50	328	330	335	343	354	365	374	382	387	389	388	384	377	368	357	347	337	331	331
55	287	289	296	307	321	334	345	354	360	362	361	356	348	337	324	310	298	290	289
60	243	245	255	270	286	302	316	326	332	335	333	328	318	305	290	273	258	247	244
65	196	200	213	232	252	270	286	297	305	307	306	299	289	274	256	236	217	201	197
70	148	154	172	195	219	240	257	269	277	280	278	272	260	244	223	200	176	156	149
75	100.0	108	132	160	187	210	228	242	250	253	251	244	232	214	192	166	137	111	100
80	54.9	67.1	96.4	128	157	182	201	216	224	227	225	218	205	187	163	135	103	71.5	54.0
85	17.7	33.9	67.1	100	131	156	176	191	200	203	201	193	180	161	137	107	73.3	40.0	17.4
90	0.87	14.3	44.8	77.3	107	133	153	167	176	179	177	170	156	138	113	84.2	52.1	20.2	0.54
95	0.42	6.27	29.8	59.6	87.6	112	132	146	154	158	156	148	135	117	93.4	66.2	36.3	10.5	0.40
100	0.71	4.23	20.1	44.6	70.6	93.5	112	126	134	138	135	128	116	98.1	75.9	50.6	25.6	7.00	0.66
105	1.04	3.92	14.9	34.2	55.7	76.1	94.0	107	115	118	116	109	97.3	80.6	61.0	39.6	19.5	5.89	0.98
110	1.45	4.10	12.2	27.2	45.1	62.4	77.1	88.6	96.0	99.0	97.1	90.7	80.4	66.8	49.8	31.9	15.9	5.74	1.34
115	1.95	4.42	10.8	22.3	36.9	51.9	64.8	74.0	80.5	83.0	81.6	76.2	67.7	55.5	41.1	26.2	13.8	5.84	1.70
120	2.45	4.74	10.1	18.9	30.6	42.7	54.0	62.6	68.1	70.2	69.0	64.4	56.6	46.3	34.1	22.1	12.4	5.88	2.13
125	2.95	4.96	9.62	16.5	25.8	35.8	44.7	52.3	57.0	58.9	57.8	53.9	47.3	38.6	28.5	19.2	11.4	6.24	2.49
130	3.44	5.15	9.14	14.8	22.0	30.0	37.4	43.4	47.5	49.1	48.2	44.9	39.5	32.1	24.4	16.9	10.7	6.22	2.86
135	3.89	5.28	8.98	13.6	19.1	25.4	31.3	36.0	39.3	40.6	39.9	37.2	32.8	27.1	21.0	15.1	9.99	6.14	3.27
140	4.27	5.45	8.86	12.3	16.8	21.6	26.1	29.8	32.4	33.4	32.9	30.8	27.3	22.9	18.2	13.7	9.64	6.38	3.64
145	4.53	5.58	8.20	11.5	14.8	18.4	21.8	24.6	26.5	27.3	26.9	25.3	22.8	19.5	16.0	12.3	9.39	6.50	3.95
150	4.68	5.65	8.28	10.7	13.1	15.8	18.3	20.3	21.8	22.4	22.1	20.9	19.1	16.7	13.8	11.3	8.75	6.57	4.20
155	4.80	5.35	7.96	9.63	11.9	13.6	15.3	16.9	17.9	18.3	18.1	17.3	15.8	14.0	12.3	9.92	8.32	6.08	4.37
160	4.84	5.02	7.51	9.22	10.3	12.0	13.1	14.2	14.8	15.0	14.9	14.4	13.4	12.4	10.0	8.66	6.86	5.31	4.49
165	4.83	4.58	5.75	8.40	9.43	10.1	10.9	11.9	12.3	12.5	12.4	12.1	11.3	8.81	8.01	6.63	5.73	4.64	4.57
170	4.91	4.56	4.84	6.10	7.84	8.69	9.34	10.0	10.2	10.3	10.3	9.55	7.39	6.38	6.51	5.80	5.29	5.10	4.82
175	5.97	5.73	5.53	5.55	6.12	6.11	6.42	6.79	7.53	7.98	6.04	4.46	5.44	5.83	5.75	6.24	6.03	5.95	6.07
180	0.16	0.16	0.16	0.15	0.13	0.12	0.10	0.08	0.06	0.04	0.05	0.06	0.07	0.08	0.09	0.09	0.10	0.10	0.10

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	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544	544		
5	542	542	542	542	542	543	543	543	543	542	542	542	542	542	542	542	542		
10	536	536	536	537	537	537	538	538	537	537	537	537	536	536	535	535	535		
15	524	525	526	527	528	528	529	529	529	529	529	528	527	526	525	524	523		
20	509	510	511	513	515	516	517	518	518	517	517	515	514	512	510	509	508		
25	489	491	493	495	498	500	502	503	503	502	501	499	497	494	491	489	488		
30	465	467	471	474	478	481	484	485	486	485	483	480	477	473	469	466	464		
35	438	440	445	450	455	459	463	465	466	465	462	459	454	448	443	439	436		
40	406	410	415	422	429	435	440	443	444	442	439	434	428	421	414	409	405		
45	371	376	383	392	401	408	415	418	420	418	414	408	400	391	383	375	370		
50	333	339	349	360	371	380	388	393	394	392	387	380	371	360	348	339	332		
55	292	300	312	326	340	351	360	366	367	365	360	351	340	326	313	301	292		
60	248	259	275	292	308	321	331	338	340	338	332	322	308	293	276	261	249		
65	202	217	236	257	276	291	303	310	312	310	303	292	277	259	239	220	205		
70	156	175	199	223	244	262	274	282	285	282	275	263	246	226	203	179	160		
75	110	135	164	191	214	233	246	255	257	255	247	234	217	194	168	141	115		
80	68.1	98.9	132	161	186	205	219	228	231	228	220	207	188	165	137	105	74.3		
85	34.6	68.7	103	134	160	180	194	203	206	203	195	181	163	138	109	75.3	41.3		
90	15.2	46.2	79.8	110	136	156	170	179	182	179	171	158	139	114	85.0	52.3	20.3		
95	6.61	30.8	61.1	89.9	115	134	148	157	160	157	150	136	118	93.9	65.9	36.0	9.75		
100	4.17	20.9	46.0	72.6	95.8	114	128	136	139	137	129	116	98.7	76.3	50.4	24.6	5.98		
105	3.59	15.4	35.0	56.9	78.5	96.1	109	117	120	117	110	98.2	81.3	60.5	38.2	17.9	4.59		
110	3.59	12.2	27.5	45.8	63.4	78.4	90.5	98.1	101	98.7	91.8	80.4	65.5	48.1	29.9	13.8	4.31		
115	3.91	10.3	22.2	37.0	51.9	64.7	74.7	80.9	83.2	81.3	75.6	66.1	53.6	38.9	24.0	11.3	4.36		
120	4.29	9.19	18.4	30.2	42.5	53.3	61.8	67.2	69.1	67.5	62.5	54.5	43.8	31.6	19.5	9.91	4.62		
125	4.69	8.51	15.6	24.8	34.8	43.7	50.8	55.5	57.1	55.7	51.5	44.7	35.8	25.9	16.4	9.08	5.00		
130	5.13	8.06	13.4	20.6	28.5	35.7	41.6	45.4	46.7	45.6	42.1	36.5	29.3	21.4	14.0	8.61	5.45		
135	5.60	7.91	11.9	17.4	23.4	29.1	33.8	36.8	37.9	37.0	34.2	29.7	24.1	18.0	12.4	8.34	5.92		
140	6.08	7.82	10.8	14.9	19.5	23.7	27.3	29.7	30.5	29.8	27.6	24.1	19.9	15.3	11.3	8.19	6.36		
145	6.50	7.85	9.70	12.8	16.3	19.4	22.1	23.8	24.4	23.9	22.2	19.7	16.6	13.3	10.4	8.15	6.79		
150	6.79	7.87	9.22	11.4	13.6	16.0	17.8	19.1	19.5	19.1	18.0	16.2	13.9	11.7	9.68	8.17	7.17		
155	6.53	7.55	8.56	9.71	11.7	13.1	14.3	15.3	15.6	15.4	14.5	13.4	12.0	10.6	9.25	8.23	7.01		
160	5.61	6.73	7.52	8.36	9.93	11.1	11.8	12.4	12.6	12.5	12.1	11.5	10.7	9.79	8.98	8.32	6.36		
165	4.99	5.76	6.29	6.76	7.60	8.64	10.1	10.4	10.5	10.5	10.4	10.1	9.64	9.20	8.68	8.20	5.65		
170	4.88	5.20	5.77	6.16	6.31	6.13	6.66	8.66	9.23	9.23	9.18	9.08	8.70	8.35	7.97	6.45	5.03		
175	6.07	6.21	6.21	6.47	6.21	6.36	5.75	4.88	6.08	8.47	8.40	7.35	6.93	6.52	6.43	6.06	5.91		
180	0.10	0.10	0.09	0.09	0.08	0.07	0.06	0.05	0.04	0.06	0.08	0.10	0.12	0.13	0.15	0.16	0.16		

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**

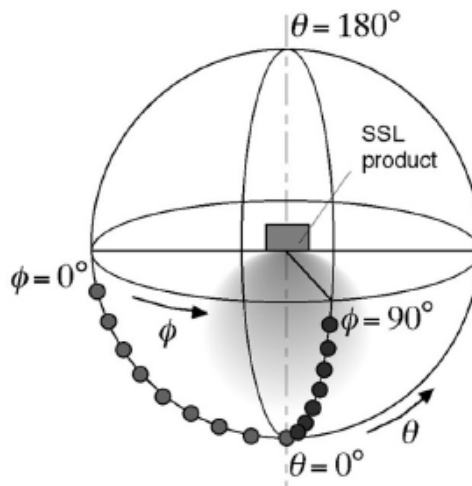
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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