LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5HO

Model: 14.5T5HO/3F/835/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18030016b

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

Review by: April Zou

Engineer: April Zou
Mar. 12, 2018

Approved by: Jim Zhang

Manager: Jim Zhang
Mar. 12, 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: **14.5T5HO/3F/835/DIR**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
118.4	2086.0	17.62	0.9878

CCT (K)	CRI	Stabilization Time (Light & Power)
3378	82.3	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	: Mar. 08, 2018
Date of Test	: Mar. 09, 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

Sample Photos

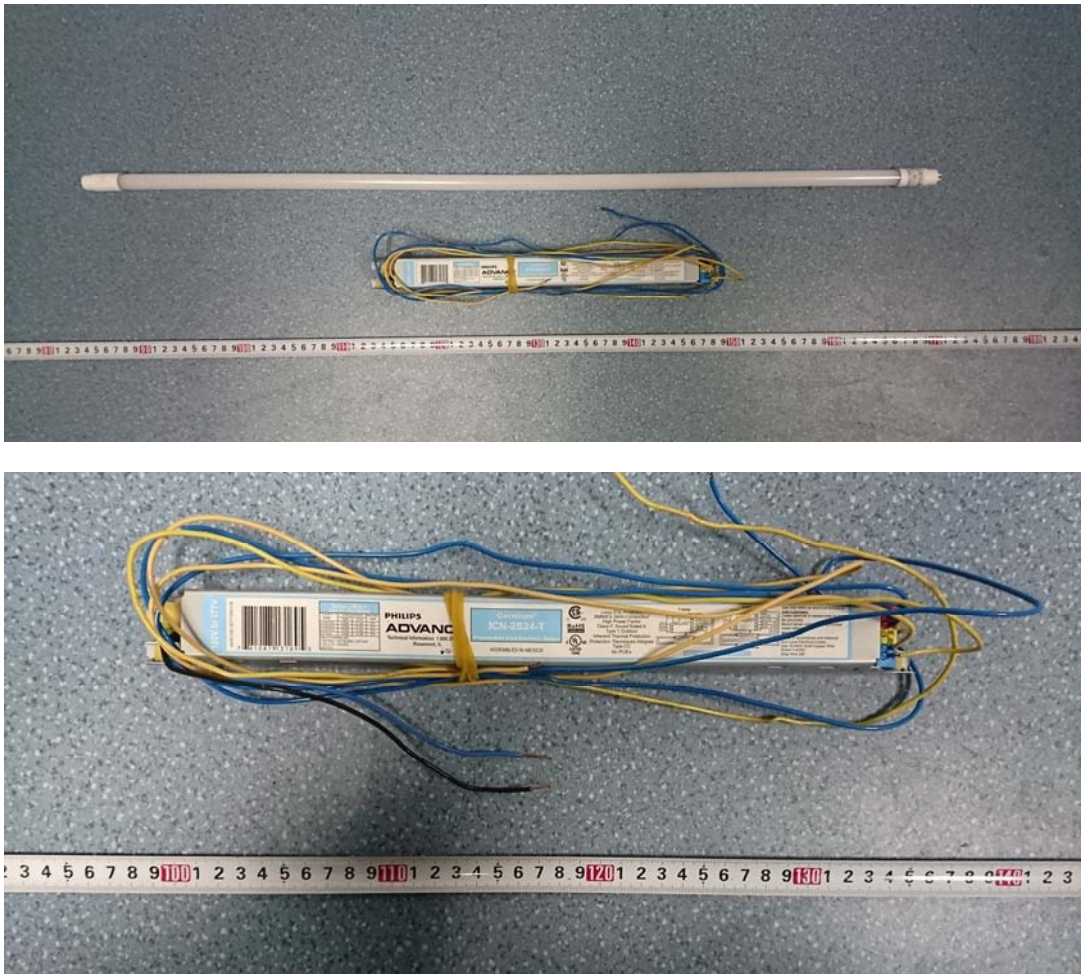


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5HO
Model	: 14.5T5HO/3F/835/DIR
Electrical Ratings	: 120-277V, 60Hz, 14.5W
Product Description	: 3500K LED Tubes supplied by a ballast: ICN-2S24-T
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.0℃.

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)	0.149	0.071
Power Factor	0.9878	0.9343
Test Power (W)	17.62	18.31
THD A%	13.30	11.69
Luminous Efficacy (lm/W)	118.4	114.6
Total Luminous Flux (lm)	2086.0	2099.0
Color Rendering Index (CRI)	82.3	
R9	2.1	
Correlated Color Temperature (CCT)(K)	3378	
Chromaticity Chroma x	0.4129	
Chromaticity Chroma y	0.3959	
Chromaticity Chroma u	0.2385	
Chromaticity Chroma v	0.3430	
Duv	0.0001	
Chromaticity Chroma u ’	0.2385	
Chromaticity Chroma v’	0.5145	

Special Color Rendering Indices	
R1	80.9
R2	91.8
R3	95.2
R4	79.3
R5	81.1
R6	89.5
R7	82.2
R8	58.1
R9	2.1
R10	80.9
R11	78.5
R12	67.8
R13	83.8
R14	98.0
Rf	82
Rg	93

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℃.

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)	0.150
Power Factor	0.9882
Test Power (W)	17.82
Luminous Efficacy (lm/W)	118.2
Total Luminous Flux (lm)	2105.9
Beam Angle (°)	124.6
Center Beam Candle Power (cd)	541
Spacing Criteria	1.23 (0°-180°)/ 1.33 (90°-270°)
Zonal Lumens in the 0°-60°Zone	60.47%
Zonal Lumens in the 60°-90°Zone	27.16%
Zonal Lumens in the 90°-120°Zone	9.47%
Zonal Lumens in the 120°-180°Zone	2.90%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

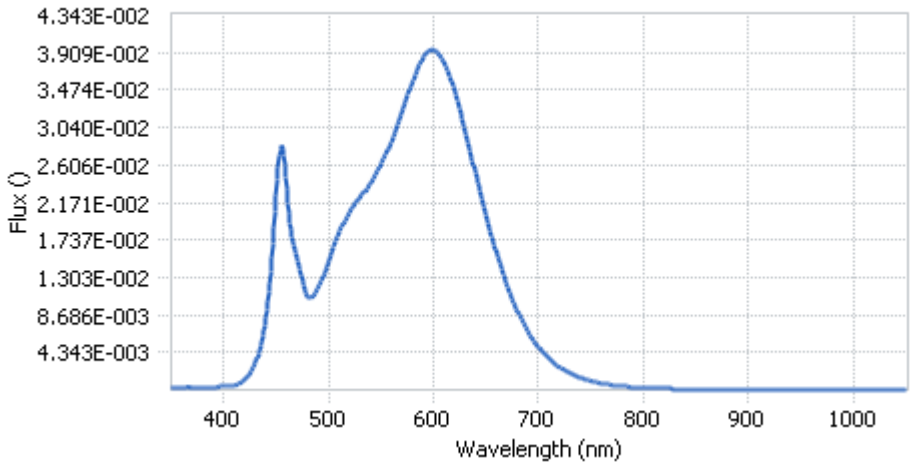
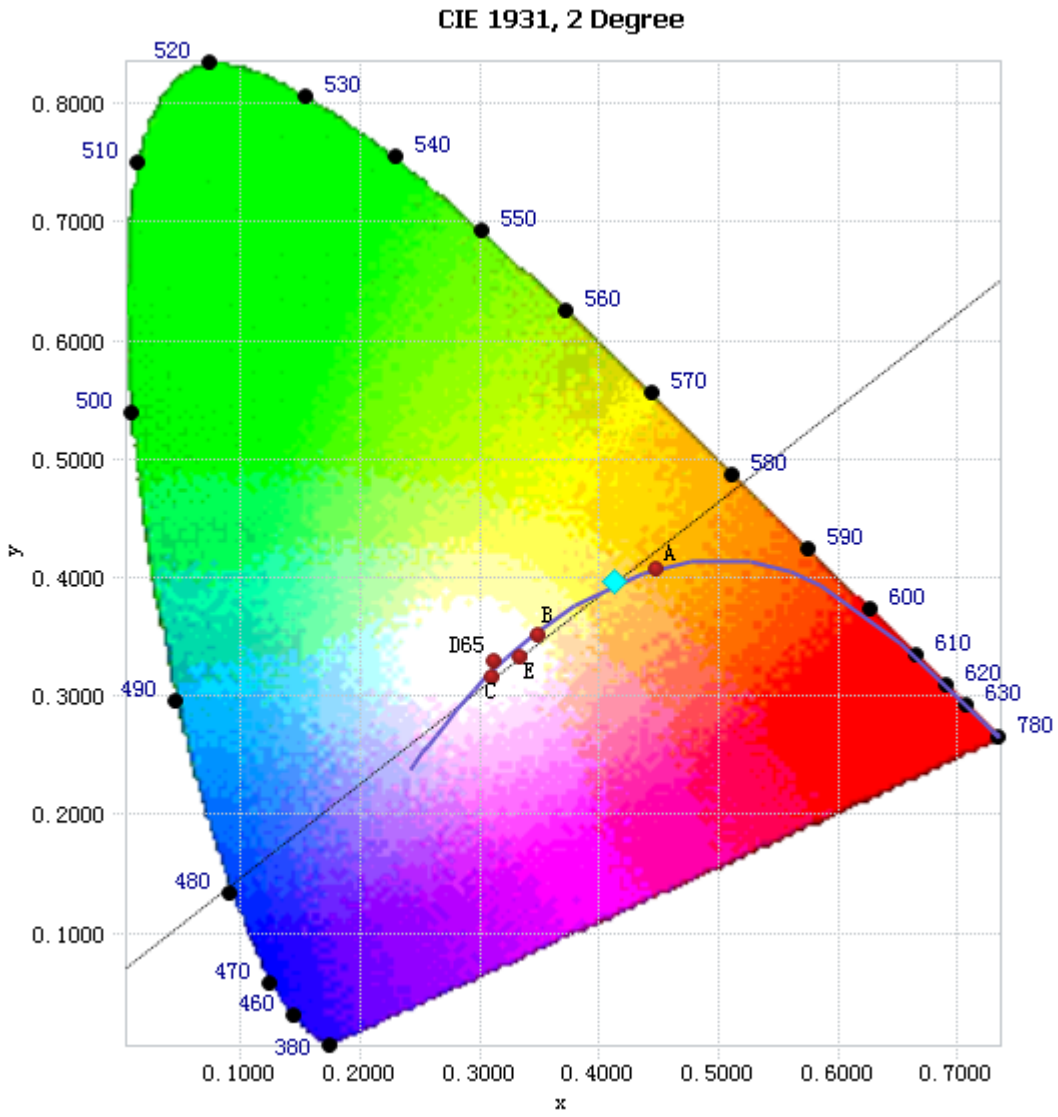


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.32E-04	485	1.09E-02	590	3.85E-02	695	5.78E-03
385	2.97E-04	490	1.18E-02	595	3.92E-02	700	4.96E-03
390	3.35E-04	495	1.32E-02	600	3.93E-02	705	4.24E-03
395	3.60E-04	500	1.50E-02	605	3.88E-02	710	3.62E-03
400	3.87E-04	505	1.68E-02	610	3.80E-02	715	3.09E-03
405	4.24E-04	510	1.83E-02	615	3.66E-02	720	2.63E-03
410	5.38E-04	515	1.96E-02	620	3.46E-02	725	2.26E-03
415	7.55E-04	520	2.07E-02	625	3.25E-02	730	1.93E-03
420	1.18E-03	525	2.15E-02	630	3.00E-02	735	1.63E-03
425	1.91E-03	530	2.23E-02	635	2.76E-02	740	1.40E-03
430	3.13E-03	535	2.31E-02	640	2.51E-02	745	1.20E-03
435	5.13E-03	540	2.40E-02	645	2.25E-02	750	1.03E-03
440	8.35E-03	545	2.50E-02	650	2.02E-02	755	8.83E-04
445	1.38E-02	550	2.61E-02	655	1.80E-02	760	7.53E-04
450	2.24E-02	555	2.74E-02	660	1.58E-02	765	6.50E-04
455	2.82E-02	560	2.89E-02	665	1.39E-02	770	5.57E-04
460	2.32E-02	565	3.06E-02	670	1.21E-02	775	4.75E-04
465	1.77E-02	570	3.23E-02	675	1.05E-02	780	4.12E-04
470	1.54E-02	575	3.41E-02	680	9.11E-03		
475	1.26E-02	580	3.58E-02	685	7.87E-03		
480	1.08E-02	585	3.73E-02	690	6.76E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4129, 0.3959)

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

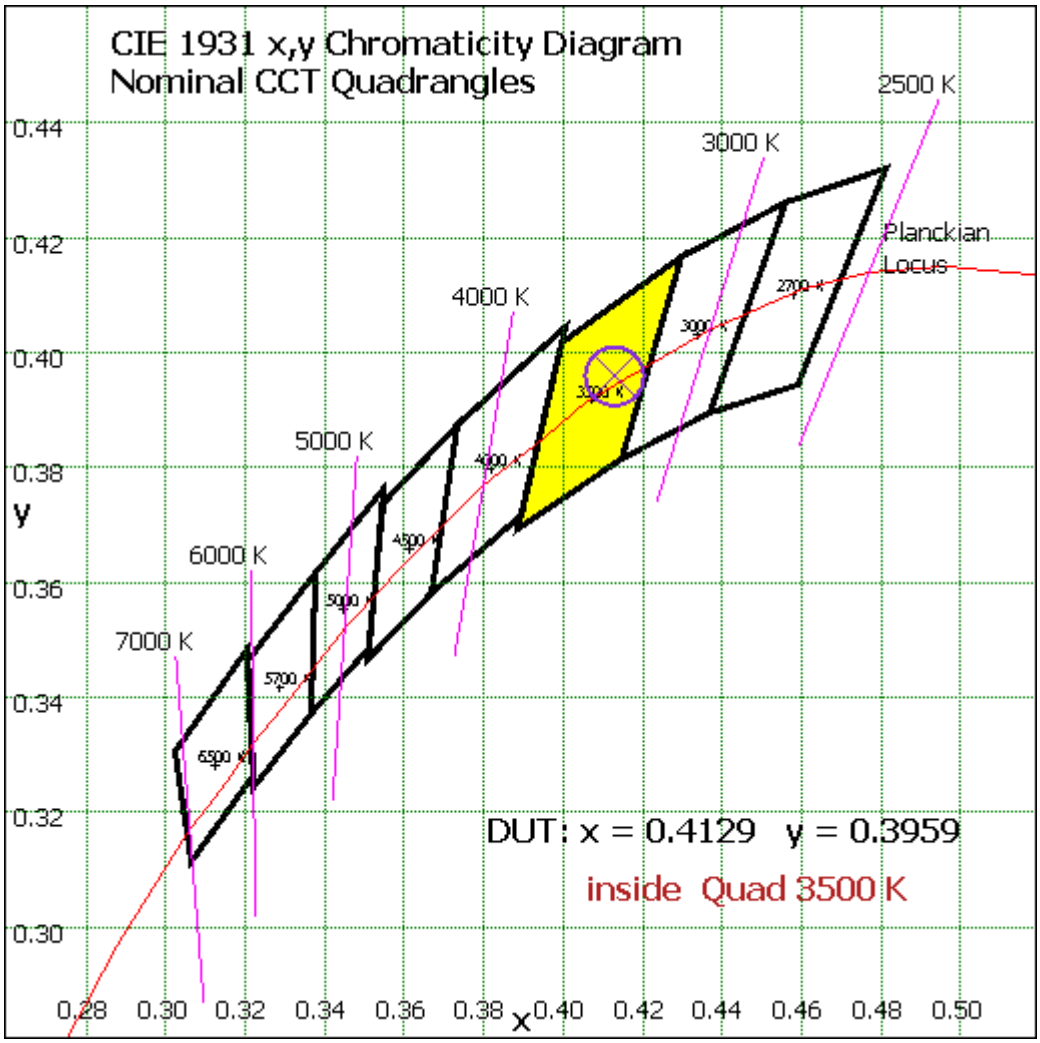


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	51.193	2.43%
10- 20	147.103	6.99%
20- 30	224.676	10.67%
30- 40	275.043	13.06%
40- 50	293.798	13.95%
50- 60	281.567	13.37%
60- 70	243.988	11.59%
70- 80	191.118	9.08%
80- 90	136.905	6.50%
90-100	94.853	4.50%
100-110	63.517	3.02%
110-120	41.053	1.95%
120-130	26.307	1.25%
130-140	16.405	0.78%
140-150	9.759	0.46%
150-160	5.449	0.26%
160-170	2.561	0.12%
170-180	0.65	0.03%
Total	2105.9	100%

γ(°)	Lumens	% Total
0- 60	1273.38	60.47%
60- 90	572.011	27.16%
0-90	1845.391	87.63%
90- 180	260.554	12.37%
0- 180	2105.9	100%

Table 5: Zonal Lumen Data

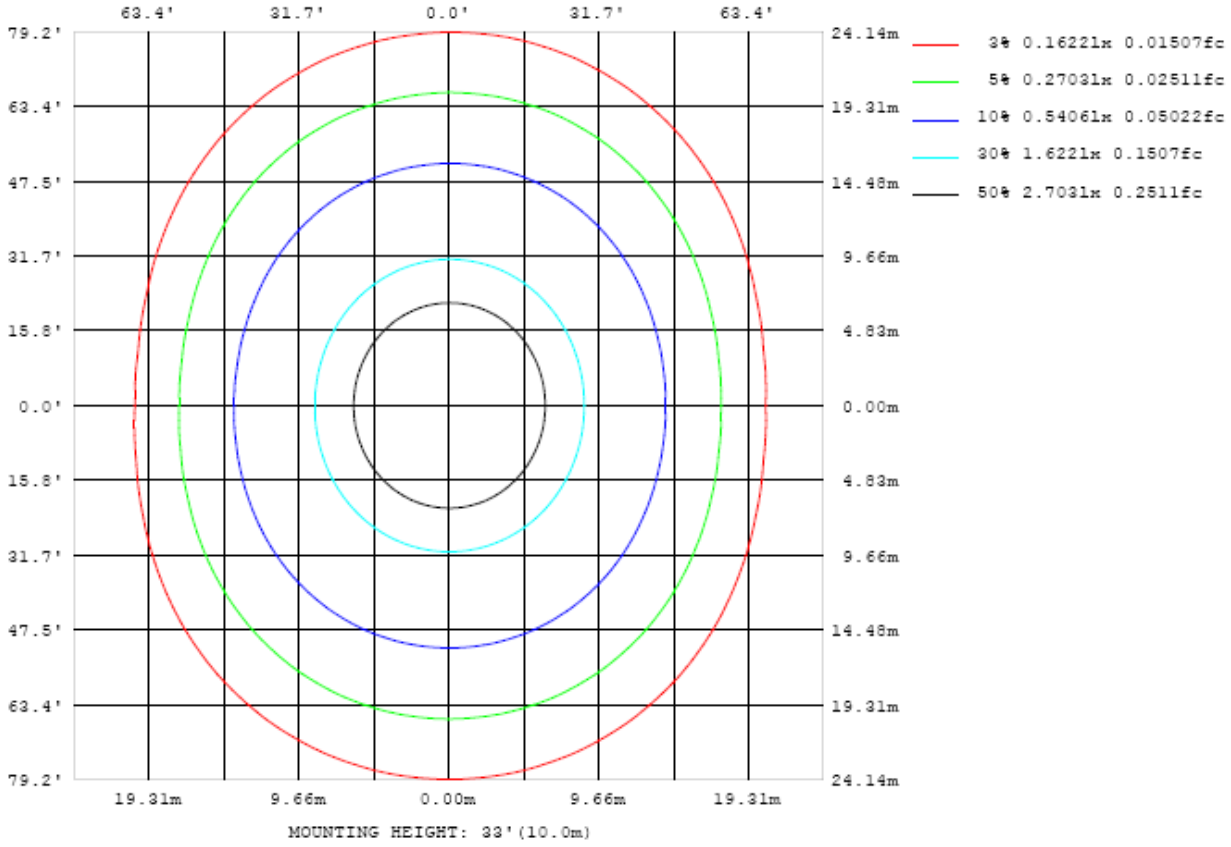


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

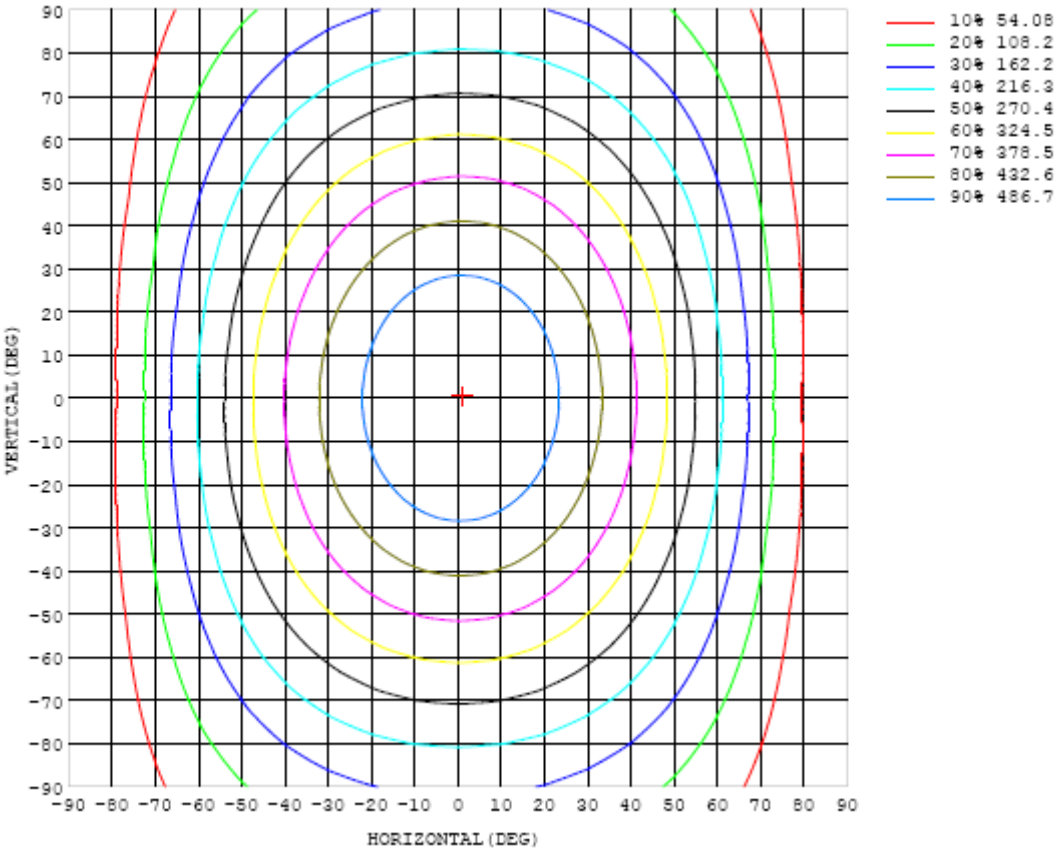


Chart 5: Isocandela Plot

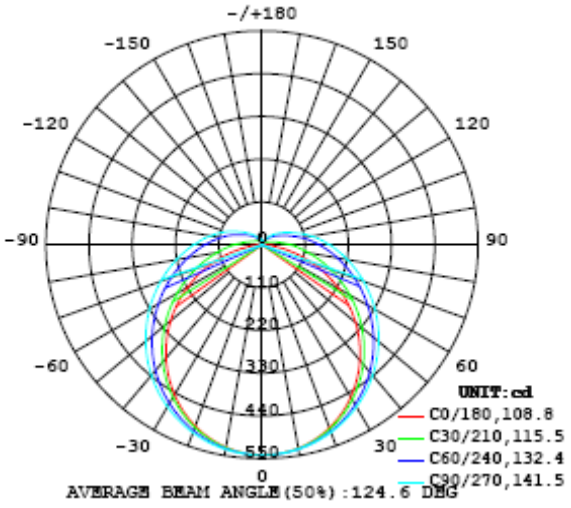


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541
5	539	539	539	539	539	539	539	539	539	539	539	538	538	538	538	538	538	538	537
10	531	531	532	532	532	533	533	534	534	534	533	533	532	531	530	530	529	529	529
15	519	519	519	520	522	523	524	525	525	525	524	523	522	520	519	517	516	515	515
20	501	501	502	504	507	509	511	512	513	513	513	511	509	506	503	501	498	497	496
25	479	479	481	484	487	491	494	497	498	498	497	495	492	487	483	479	476	474	473
30	452	453	456	459	465	470	474	478	480	481	480	476	472	466	460	455	450	447	445
35	421	423	426	431	439	445	452	457	460	461	459	455	449	442	434	427	420	416	414
40	387	389	394	401	410	419	427	433	437	438	436	431	424	415	405	396	388	382	380
45	350	353	358	367	378	390	399	407	412	413	411	405	397	386	374	363	353	346	343
50	311	314	321	332	346	359	371	380	386	387	385	378	368	356	342	328	316	307	303
55	269	273	282	296	311	327	341	352	358	360	357	350	339	325	309	292	277	267	262
60	226	230	242	258	277	295	311	323	330	332	329	321	309	293	275	256	238	225	219
65	181	187	202	222	243	263	280	293	301	304	301	293	280	262	242	220	199	183	175
70	136	143	162	186	210	232	251	264	273	275	272	264	250	232	210	186	161	140	131
75	91.0	101	124	152	179	203	222	236	245	248	245	236	222	203	180	154	125	100.0	86.7
80	50.2	62.7	90.9	122	150	175	195	209	218	221	218	210	196	176	152	124	93.8	64.3	46.1
85	16.8	32.2	63.5	95.1	124	149	169	184	193	195	193	185	171	152	127	98.8	67.8	36.1	14.7
90	1.13	13.6	42.3	72.9	102	126	146	161	169	172	170	161	148	129	105	77.5	47.3	18.1	0.69
95	0.55	5.56	26.8	55.0	82.0	106	125	139	147	150	147	140	127	109	86.0	59.9	31.7	8.86	0.43
100	0.72	3.41	17.9	40.3	64.5	86.2	104	118	126	129	127	120	107	89.6	68.2	44.0	22.1	5.66	0.62
105	1.00	2.91	12.9	30.4	50.4	69.3	85.0	97.5	106	108	106	99.5	87.3	71.4	53.9	34.6	16.6	4.44	1.02
110	1.52	3.00	10.1	23.9	40.4	56.6	70.2	80.3	86.9	89.3	87.4	81.7	71.9	59.5	43.8	27.5	13.2	4.04	1.49
115	2.13	3.35	8.67	19.1	32.7	46.4	58.4	67.6	72.7	75.0	73.6	68.9	60.4	49.1	35.8	22.4	11.1	3.95	2.01
120	2.72	3.75	7.88	15.7	26.6	38.0	48.2	56.2	61.2	63.2	61.8	57.5	50.1	40.5	29.5	18.6	9.75	4.29	2.56
125	3.31	4.11	7.30	13.5	21.9	31.2	39.7	46.5	50.8	52.4	51.3	47.6	41.4	33.4	24.5	15.7	8.61	4.76	3.12
130	3.90	4.20	6.98	11.8	18.3	25.7	32.6	38.2	41.8	43.2	42.3	39.1	34.0	27.5	20.4	13.5	7.93	5.00	3.65
135	4.47	4.34	7.06	10.6	15.5	21.2	26.6	31.1	34.1	35.2	34.5	32.0	27.9	22.7	16.9	11.2	7.66	5.04	4.12
140	5.10	4.34	6.95	9.73	13.1	17.6	21.8	25.3	27.6	28.5	28.0	26.0	22.8	18.6	13.6	10.0	7.09	4.92	4.62
145	5.58	4.42	6.60	9.40	11.5	14.4	17.6	20.3	22.1	22.8	22.4	21.0	18.4	15.0	11.8	9.65	7.00	4.94	5.18
150	5.97	4.62	5.96	8.69	10.6	12.2	14.0	15.9	17.3	17.8	17.5	16.4	14.7	12.6	10.7	8.84	6.99	5.00	5.49
155	6.41	5.03	5.65	7.95	9.78	11.1	12.2	13.2	13.8	14.1	13.9	13.2	12.0	11.0	9.80	8.49	6.66	5.11	5.98
160	6.72	5.01	5.03	6.62	8.55	9.82	10.6	11.3	11.7	11.9	11.7	11.0	10.4	9.67	8.63	7.34	5.68	4.99	5.89
165	6.52	4.97	4.71	4.97	7.37	8.57	9.30	9.91	10.2	10.3	9.99	9.49	8.81	7.43	6.39	5.45	4.71	4.98	5.50
170	6.07	5.02	4.58	4.65	4.89	5.66	7.25	8.51	8.94	9.01	7.76	5.99	5.26	5.06	4.91	4.76	4.85	4.91	5.17
175	5.68	5.45	5.31	5.65	6.09	6.15	6.04	5.97	5.88	3.56	4.70	5.98	6.07	5.98	6.02	5.91	5.69	5.42	5.09
180	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541	541		
5	537	538	538	538	538	538	539	539	539	539	539	539	539	539	539	539	539		
10	529	529	530	531	531	532	533	534	534	534	534	534	534	533	532	532	532		
15	515	516	517	519	521	522	524	525	526	526	525	525	524	522	521	520	519		
20	496	498	500	503	506	509	511	513	514	514	513	512	509	507	505	503	501		
25	473	475	479	483	487	491	495	498	499	499	498	495	492	488	485	481	479		
30	446	449	453	459	465	471	476	479	481	481	479	475	470	465	460	456	453		
35	415	419	425	432	440	448	454	458	461	460	458	453	446	439	432	426	423		
40	381	386	393	402	412	422	430	435	438	437	434	427	419	410	401	394	389		
45	344	350	359	370	383	394	404	410	413	412	408	400	390	378	367	358	352		
50	305	312	323	337	352	365	376	383	387	385	380	371	359	346	332	321	313		
55	264	273	286	303	320	335	347	355	359	358	352	341	328	312	296	282	272		
60	222	233	249	269	288	305	318	327	331	329	323	311	296	277	259	242	230		
65	178	193	213	235	256	275	289	298	302	301	293	281	264	244	222	202	187		
70	136	154	178	203	226	246	260	270	274	272	265	252	233	211	187	163	144		
75	94.6	118	146	172	197	217	233	243	247	245	237	224	204	181	155	127	103		
80	57.5	85.6	117	146	170	191	207	217	221	219	211	197	177	154	125	94.6	65.6		
85	29.3	59.4	91.3	121	147	167	183	192	196	194	186	172	153	128	99.3	67.6	36.5		
90	12.7	40.2	70.7	99.5	125	145	160	170	173	171	163	150	131	106	77.7	47.1	18.0		
95	6.12	27.4	54.6	81.6	105	125	140	149	153	151	143	130	111	87.5	60.6	32.8	8.94		
100	4.38	18.9	41.9	66.5	88.8	107	121	130	133	131	124	111	93.4	71.6	47.1	22.8	5.86		
105	4.10	14.7	32.2	53.1	73.7	91.0	104	112	115	113	106	94.3	77.8	57.4	35.8	17.0	4.81		
110	4.42	12.4	26.1	42.8	59.4	75.2	87.5	95.1	98.2	96.3	89.5	78.2	62.6	45.4	28.4	13.8	4.83		
115	4.85	11.2	22.1	35.5	49.4	61.7	71.5	78.1	80.9	79.1	73.1	63.5	51.3	37.4	23.7	11.9	5.06		
120	5.27	10.5	19.2	30.0	41.4	51.6	59.9	65.2	67.2	65.7	60.9	53.0	42.8	31.4	20.2	10.8	5.37		
125	5.76	10.2	17.1	25.8	35.0	43.5	50.3	54.7	56.3	55.0	51.0	44.4	36.0	26.7	17.5	10.3	5.77		
130	6.25	9.93	15.4	22.5	29.9	36.8	42.3	45.8	47.2	46.1	42.8	37.4	30.5	23.0	15.6	9.97	6.19		
135	6.73	9.80	14.2	19.7	25.6	31.0	35.5	38.4	39.5	38.6	35.8	31.5	26.0	20.0	14.3	9.83	6.66		
140	7.11	9.50	13.0	17.5	22.0	26.2	29.8	32.1	32.9	32.2	30.0	26.6	22.3	17.6	13.3	9.73	7.02		
145	7.48	9.50	12.2	15.5	19.0	22.3	25.0	26.7	27.3	26.8	25.1	22.4	19.2	15.7	12.4	9.66	7.36		
150	7.56	9.48	11.1	13.5	16.7	19.0	20.9	22.2	22.6	22.2	21.0	19.1	16.7	14.1	11.6	9.53	7.64		
155	7.97	9.40	10.7	12.4	14.4	16.2	17.5	18.4	18.7	18.5	17.6	16.3	14.6	12.8	11.1	9.49	7.95		
160	7.68	9.16	10.1	11.0	12.4	13.7	14.6	15.3	15.6	15.4	14.8	14.0	12.9	11.7	10.5	9.35	8.26		
165	6.59	7.65	9.08	9.94	10.5	11.4	12.4	12.8	13.0	12.9	12.6	12.2	11.6	10.9	10.1	9.34	8.31		
170	5.76	6.38	7.01	7.75	8.94	9.59	10.3	10.9	11.0	11.0	10.9	10.7	10.5	10.1	9.66	9.09	7.94		
175	5.10	5.28	5.62	5.70	6.10	6.68	7.73	8.78	9.45	9.52	9.41	9.29	9.09	8.87	8.44	7.43	6.35		
180	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91	3.91		

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 4π. 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 FA19 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 expended 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 FA19 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 expended uncertainty is 2.3% with a coverage factor k=2.

Color Characteristics Measurements

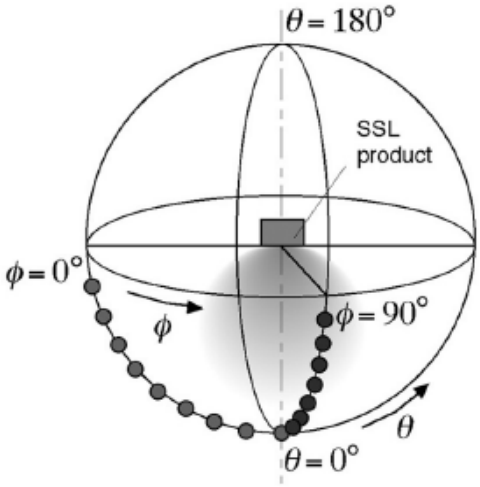
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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°/180° and C=90°/270°) and at 10° 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, Δu'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 ***