LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5HO

Model: 14.5T5HO/3F/840/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18030001a

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. 02, 2018

Approved by: Jim Zhang

Manager: Jim Zhang
Mar. 02, 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/840/DIR**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
120.4	2134.0	17.73	0.9880

CCT (K)	CRI	Stabilization Time (Light & Power)
3955	81.9	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. 01, 2018
Date of Test	: Mar. 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

Sample Photos

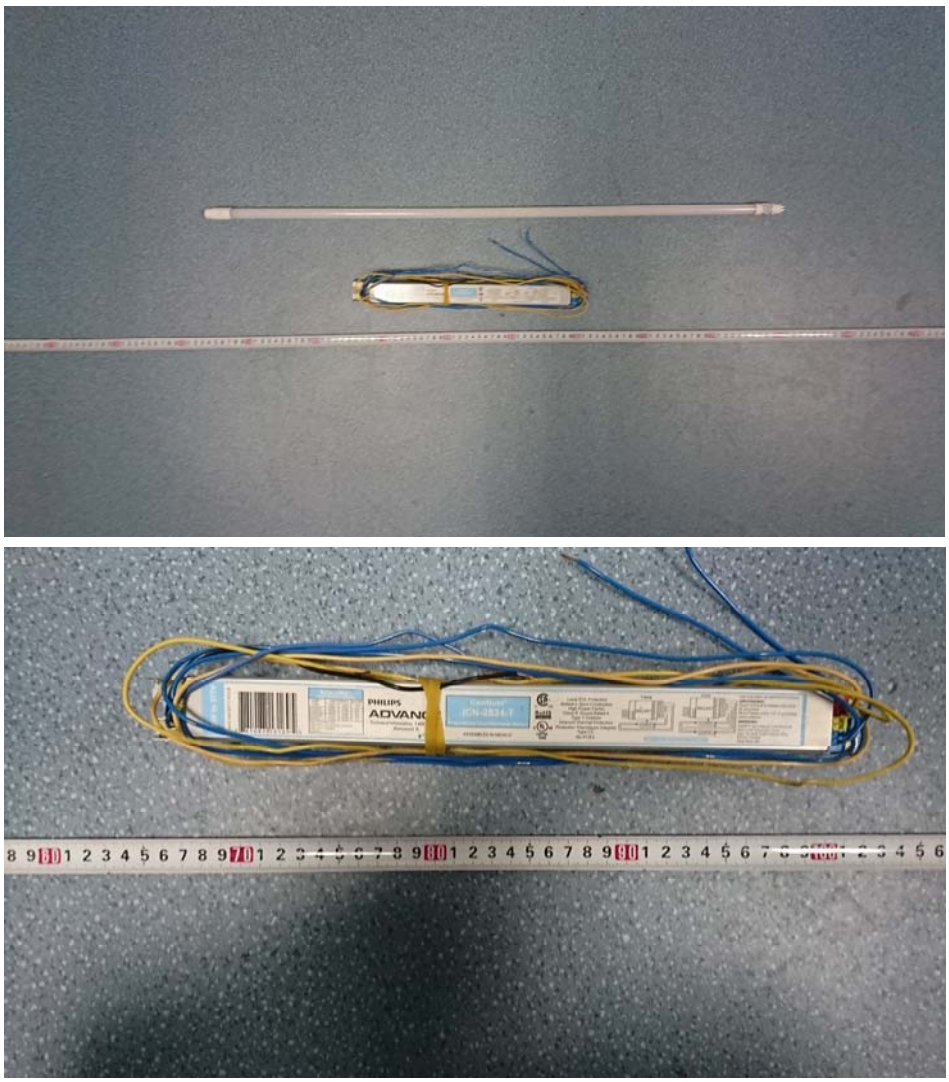


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5HO
Model	: 14.5T5HO/3F/840/DIR
Electrical Ratings	: 120-277V, 60Hz, 14.5W
Product Description	: 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast: ICN-2S24-T
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 24.9℃.

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)	0.150	0.071
Power Factor	0.9880	0.9360
Test Power (W)	17.73	18.41
THD A%	13.34	10.90
Luminous Efficacy (lm/W)	120.4	116.7
Total Luminous Flux (lm)	2134.0	2148.0
Color Rendering Index (CRI)	81.9	
R9	2.7	
Correlated Color Temperature (CCT)(K)	3955	
Chromaticity Chroma x	0.3832	
Chromaticity Chroma y	0.3811	
Chromaticity Chroma u	0.2252	
Chromaticity Chroma v	0.3359	
Duv	0.0012	
Chromaticity Chroma u ’	0.2252	
Chromaticity Chroma v’	0.5039	

Special Color Rendering Indices	
R1	79.9
R2	87.7
R3	94.1
R4	81.6
R5	80.3
R6	83.5
R7	85.6
R8	62.8
R9	2.7
R10	71.2
R11	80.8
R12	62.9
R13	81.6
R14	96.8
Rf	82
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 24.7℃.

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)	0.151
Power Factor	0.9884
Test Power (W)	17.94
Luminous Efficacy (lm/W)	120.9
Total Luminous Flux (lm)	2168.0
Beam Angle (°)	123.7
Center Beam Candle Power (cd)	563
Spacing Criteria	1.24 (0°-180°)/ 1.32 (90°-270°)
Zonal Lumens in the 0°-60°Zone	60.93%
Zonal Lumens in the 60°-90°Zone	27.03%
Zonal Lumens in the 90°-120°Zone	9.21%
Zonal Lumens in the 120°-180°Zone	2.83%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

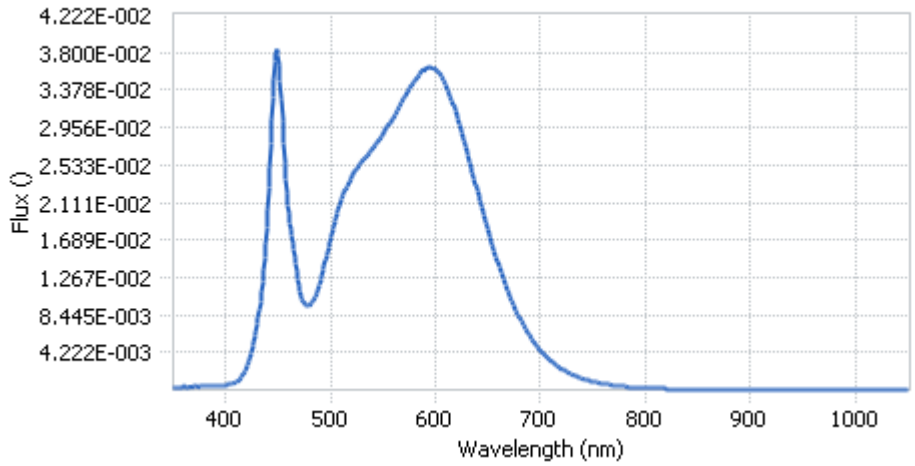
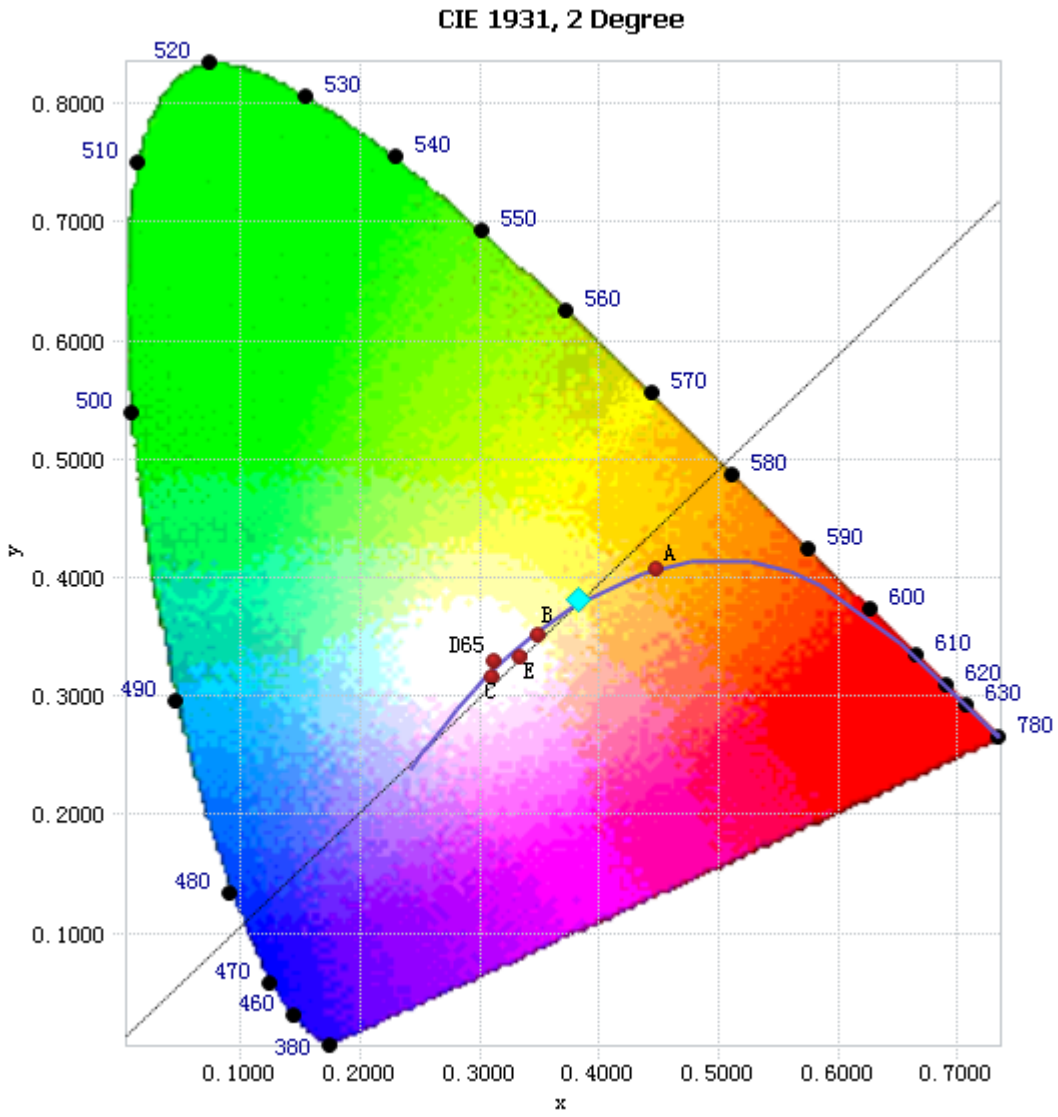


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.84E-04	485	1.04E-02	590	3.62E-02	695	5.19E-03
385	3.92E-04	490	1.21E-02	595	3.64E-02	700	4.46E-03
390	4.31E-04	495	1.46E-02	600	3.61E-02	705	3.82E-03
395	4.86E-04	500	1.72E-02	605	3.55E-02	710	3.25E-03
400	5.29E-04	505	1.94E-02	610	3.43E-02	715	2.78E-03
405	6.57E-04	510	2.14E-02	615	3.28E-02	720	2.38E-03
410	9.45E-04	515	2.29E-02	620	3.09E-02	725	2.05E-03
415	1.55E-03	520	2.41E-02	625	2.89E-02	730	1.76E-03
420	2.64E-03	525	2.49E-02	630	2.68E-02	735	1.50E-03
425	4.40E-03	530	2.57E-02	635	2.45E-02	740	1.28E-03
430	7.43E-03	535	2.64E-02	640	2.23E-02	745	1.09E-03
435	1.22E-02	540	2.72E-02	645	2.00E-02	750	9.35E-04
440	2.04E-02	545	2.80E-02	650	1.80E-02	755	8.06E-04
445	3.30E-02	550	2.88E-02	655	1.60E-02	760	6.92E-04
450	3.77E-02	555	2.98E-02	660	1.41E-02	765	5.96E-04
455	2.77E-02	560	3.07E-02	665	1.23E-02	770	5.13E-04
460	1.99E-02	565	3.18E-02	670	1.07E-02	775	4.44E-04
465	1.58E-02	570	3.29E-02	675	9.40E-03	780	3.75E-04
470	1.18E-02	575	3.38E-02	680	8.15E-03		
475	9.66E-03	580	3.49E-02	685	7.04E-03		
480	9.52E-03	585	3.57E-02	690	6.05E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3832, 0.3811)

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

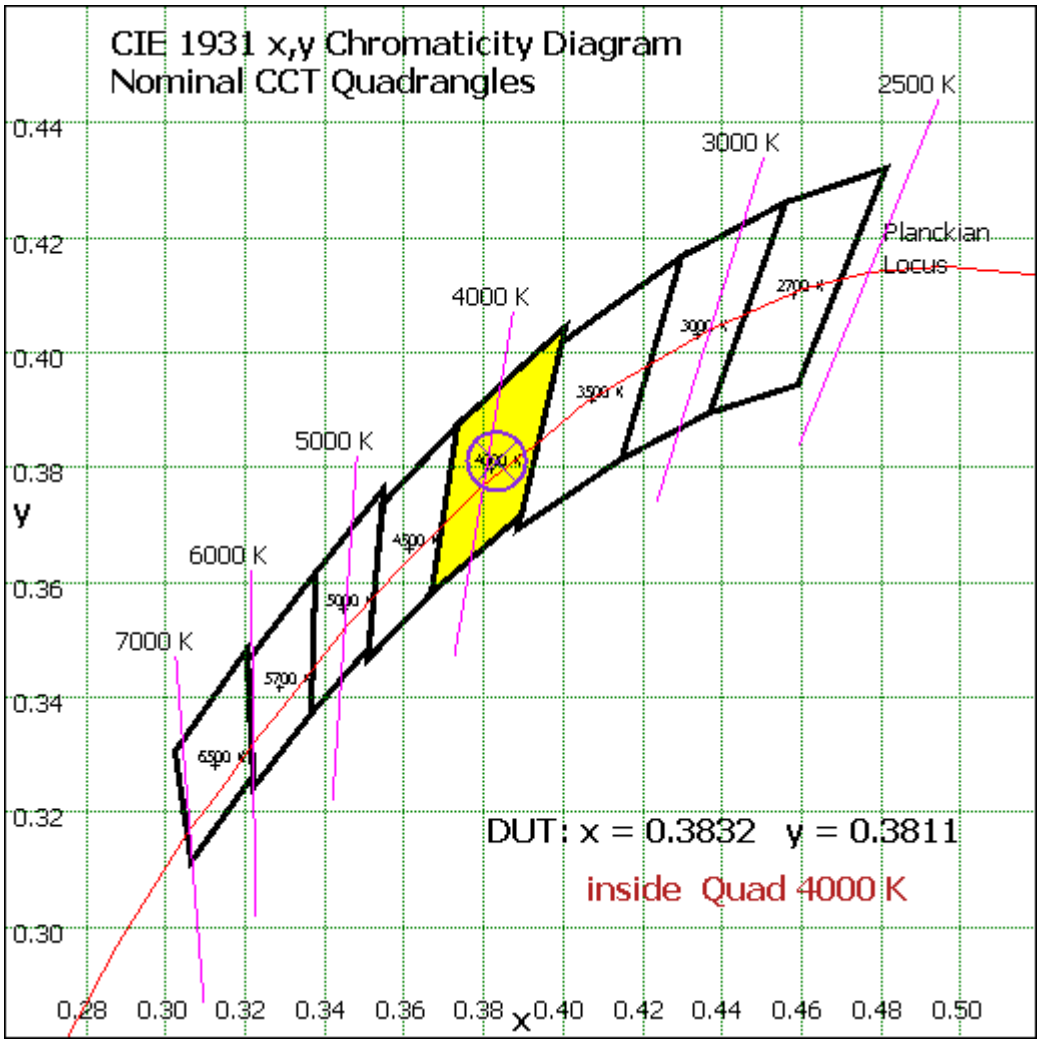


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	53.309	2.46%
10- 20	153.093	7.06%
20- 30	233.554	10.77%
30- 40	285.502	13.17%
40- 50	304.42	14.04%
50- 60	291.057	13.43%
60- 70	251.303	11.59%
70- 80	195.713	9.03%
80- 90	138.999	6.41%
90-100	95.403	4.40%
100-110	63.538	2.93%
110-120	40.671	1.88%
120-130	26.095	1.20%
130-140	16.362	0.75%
140-150	9.929	0.46%
150-160	5.661	0.26%
160-170	2.709	0.12%
170-180	0.68	0.03%
Total	2168.0	100%

γ(°)	Lumens	% Total
0- 60	1320.935	60.93%
60- 90	586.015	27.03%
0-90	1906.95	87.96%
90- 180	261.048	12.04%
0- 180	2168.0	100%

Table 5: Zonal Lumen Data

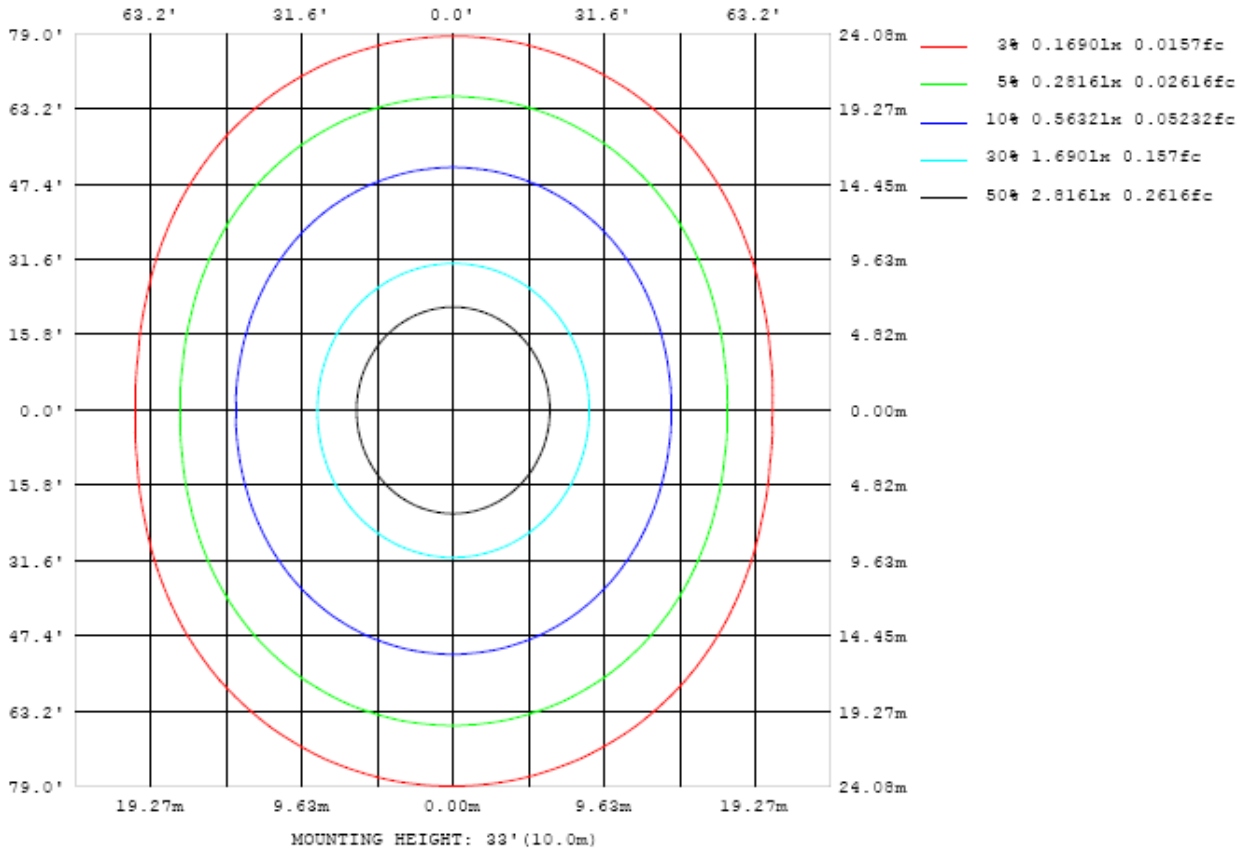


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

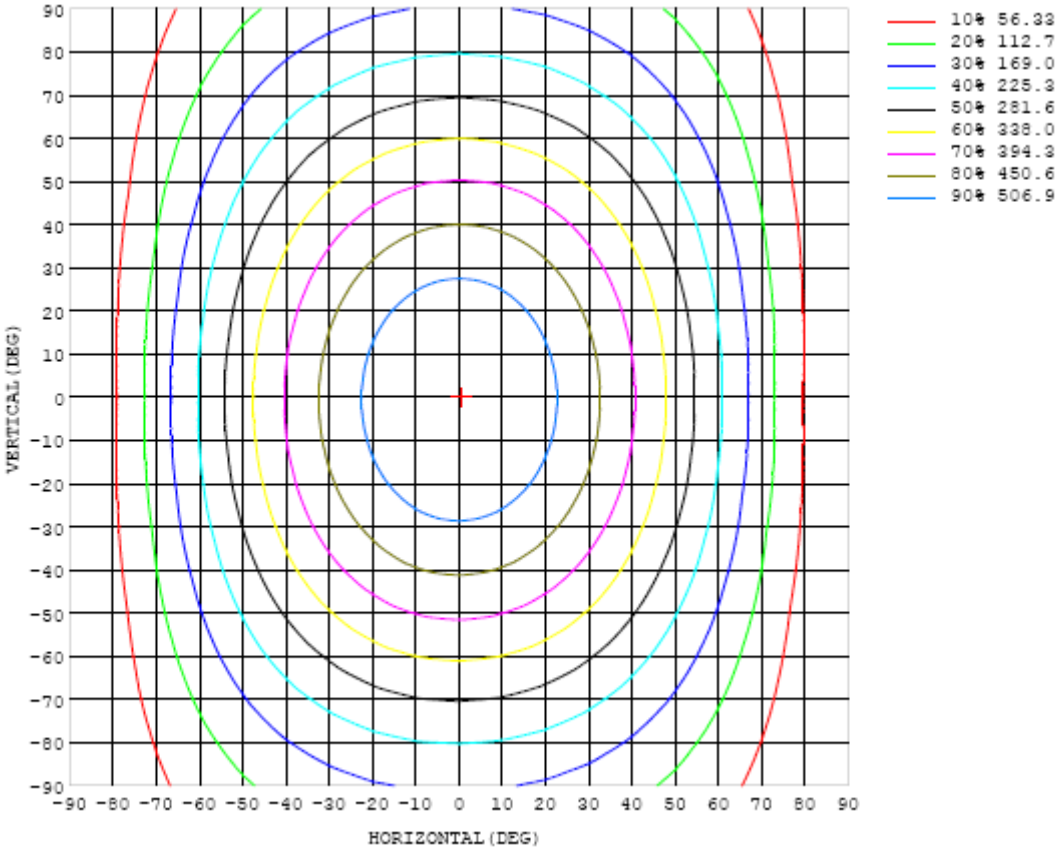


Chart 5: Isocandela Plot

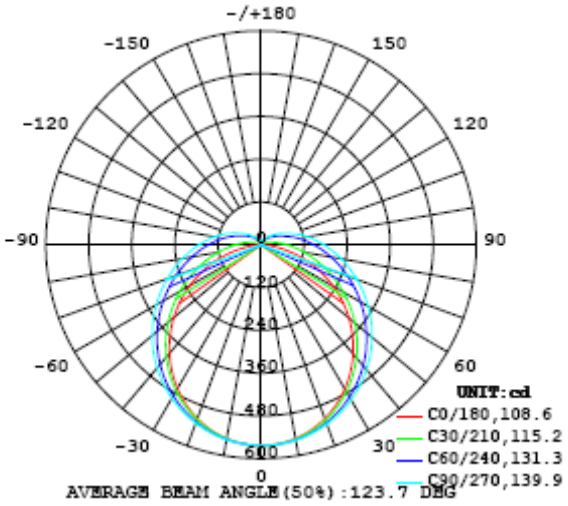


Chart 6: Polar Candela Distribution

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	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563
5	560	561	561	561	561	561	561	562	562	561	562	562	561	561	561	561	561	560	560
10	552	552	552	553	554	555	555	556	556	556	556	556	555	555	554	553	552	552	552
15	538	538	539	541	542	544	545	547	547	548	548	547	545	544	542	541	539	538	538
20	519	520	521	523	526	529	531	534	535	536	535	534	532	529	526	523	521	519	519
25	495	496	498	502	506	510	514	517	519	520	520	518	514	510	506	502	498	496	495
30	467	468	471	476	481	487	493	498	501	502	501	498	493	488	482	476	471	467	466
35	435	436	440	446	454	462	469	475	479	481	479	476	470	462	454	446	440	435	433
40	399	401	406	414	423	433	443	450	455	457	456	451	443	434	424	414	405	400	398
45	361	363	369	379	390	403	414	423	429	431	429	424	415	403	391	379	368	362	359
50	320	322	330	342	356	370	384	394	401	403	401	395	385	371	356	342	329	321	317
55	277	280	289	303	320	337	352	364	372	374	372	365	353	338	321	304	288	278	274
60	232	236	248	265	284	303	320	333	341	344	342	335	321	305	285	265	247	234	229
65	187	191	206	226	249	270	288	302	311	314	312	304	290	272	250	227	206	190	183
70	140	147	165	189	214	237	257	271	281	284	282	273	259	240	216	191	165	145	137
75	94.7	103	126	154	182	206	227	242	251	255	252	244	229	209	184	157	128	103	91.6
80	52.6	64.2	91.8	123	152	177	198	214	223	227	224	216	201	180	155	126	94.4	65.4	48.8
85	17.7	33.1	63.8	95.4	125	151	172	188	197	200	197	189	174	154	129	99.0	67.9	35.7	15.7
90	1.05	14.1	42.5	72.8	102	127	148	163	172	176	173	165	150	130	106	77.3	46.7	17.5	0.37
95	0.51	5.93	27.7	55.8	82.5	106	126	141	149	153	150	142	129	110	86.5	60.0	31.8	8.67	0.49
100	0.76	3.72	18.3	40.4	65.7	87.9	106	120	129	132	130	122	109	91.3	69.4	44.5	22.0	5.74	0.70
105	1.12	3.10	13.4	30.9	50.8	70.3	87.4	101	109	112	110	103	90.1	73.3	54.6	34.8	16.7	4.71	1.13
110	1.65	3.09	10.7	24.4	40.9	57.2	70.8	81.9	89.1	91.9	90.3	83.8	73.8	60.5	44.4	27.8	13.6	4.67	1.64
115	2.24	3.38	9.09	19.9	33.3	47.0	59.2	68.7	74.2	76.6	75.2	70.3	61.6	50.0	36.5	23.0	11.8	4.92	2.21
120	2.88	3.45	8.33	16.5	27.5	38.8	49.1	57.3	62.5	64.5	63.3	58.8	51.3	41.5	30.4	19.5	10.6	5.26	2.76
125	3.47	4.75	8.01	14.2	22.9	32.2	40.8	47.6	52.0	53.8	52.7	48.9	42.6	34.6	25.5	16.8	9.93	5.59	3.23
130	4.03	5.26	7.39	12.6	19.3	26.8	33.8	39.4	43.1	44.6	43.8	40.7	35.5	28.8	21.6	14.7	9.41	5.56	3.68
135	4.60	5.70	7.53	11.5	16.7	22.4	28.0	32.5	35.5	36.8	36.1	33.6	29.4	24.2	18.5	13.3	9.24	6.00	4.11
140	5.14	5.90	7.23	10.3	14.5	19.0	23.2	26.7	29.1	30.1	29.6	27.6	24.4	20.4	16.2	12.3	9.18	6.33	4.53
145	5.66	6.50	8.35	9.96	12.8	16.2	19.3	21.9	23.7	24.5	24.1	22.7	20.3	17.4	14.3	11.4	8.90	6.64	4.88
150	6.13	6.75	8.60	9.14	11.2	13.7	16.2	18.1	19.4	19.9	19.7	18.7	17.1	15.0	12.8	10.5	8.81	6.75	5.28
155	6.66	6.36	8.32	9.88	10.0	11.8	13.5	14.8	15.9	16.3	16.2	15.6	14.5	13.1	11.3	9.83	8.83	6.56	5.61
160	6.82	5.39	7.34	9.47	10.2	10.9	11.4	12.4	13.1	13.4	13.4	13.1	12.2	10.9	10.2	9.35	7.99	5.91	5.30
165	6.35	5.49	5.92	7.53	10.0	10.3	10.8	11.4	11.8	11.9	11.9	11.7	10.8	9.14	8.16	7.58	5.96	5.14	5.30
170	5.88	5.49	5.60	5.59	5.95	8.32	9.69	10.3	10.4	10.5	10.5	8.86	7.16	6.73	6.39	5.67	5.32	5.15	5.17
175	6.12	6.12	6.53	6.79	6.83	6.71	7.20	7.15	6.85	6.15	4.40	5.81	6.22	6.54	6.33	6.24	6.15	5.97	5.61
180	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40

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	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563		
5	560	560	560	561	561	561	561	561	561	561	561	561	560	560	560	560	560		
10	552	552	553	553	554	554	555	555	555	555	555	554	554	553	552	552	552		
15	538	539	540	541	542	543	545	545	546	545	545	544	542	541	540	539	538		
20	519	520	522	524	527	529	531	532	533	532	531	529	527	524	522	520	519		
25	495	497	500	503	507	511	514	515	516	516	514	511	507	504	500	497	496		
30	467	469	473	478	484	489	493	496	497	496	494	490	485	479	474	470	468		
35	434	438	443	450	458	465	470	474	475	474	471	465	459	451	445	439	436		
40	399	403	411	419	429	438	445	449	451	450	445	439	430	421	412	405	401		
45	360	366	375	387	398	409	417	422	424	423	418	410	400	388	377	368	363		
50	320	327	338	352	366	378	388	394	396	394	389	379	367	354	341	330	322		
55	277	286	300	316	332	347	358	365	367	365	359	348	334	319	303	289	280		
60	233	245	262	280	299	314	327	335	338	335	328	317	301	284	265	248	237		
65	188	203	223	245	266	283	296	304	308	305	298	285	269	248	227	208	193		
70	144	163	187	211	234	252	267	275	278	276	268	255	237	215	191	168	149		
75	101	125	153	180	203	223	237	247	250	247	239	225	207	183	158	131	107		
80	62.3	91.0	122	151	176	195	210	219	223	220	212	198	179	155	127	96.4	68.0		
85	31.8	63.1	95.3	125	151	170	185	194	197	195	187	172	154	129	100	68.3	37.2		
90	14.2	42.3	73.3	102	127	147	162	170	173	171	163	150	130	106	77.6	46.9	17.9		
95	6.31	28.1	55.8	83.0	107	126	140	149	152	150	142	128	110	86.5	59.8	31.9	8.39		
100	4.13	19.1	41.7	66.6	88.9	107	121	129	132	130	122	109	91.7	69.9	45.4	21.6	5.33		
105	3.86	14.2	31.8	51.8	72.6	89.8	102	110	113	111	104	91.9	75.2	55.0	34.2	16.0	4.48		
110	4.13	11.7	25.4	41.8	58.2	72.6	84.7	92.3	95.1	93.0	86.1	74.5	60.0	43.6	27.0	12.7	4.56		
115	4.51	10.4	21.0	34.2	47.9	60.0	69.5	75.4	77.7	76.0	70.3	61.3	49.4	35.7	22.2	11.0	4.85		
120	5.02	9.68	18.0	28.6	39.7	49.8	57.8	62.9	64.8	63.3	58.5	50.9	40.9	29.7	18.7	10.1	5.29		
125	5.38	9.30	15.8	24.2	33.2	41.5	48.1	52.4	54.0	52.8	48.7	42.4	34.1	25.0	16.3	9.72	5.81		
130	5.89	9.03	14.1	20.7	27.9	34.6	40.1	43.6	44.9	43.9	40.6	35.3	28.7	21.4	14.6	9.52	6.26		
135	6.38	8.91	13.0	18.1	23.7	28.9	33.3	36.2	37.3	36.4	33.8	29.6	24.3	18.6	13.4	9.38	6.80		
140	6.82	9.01	12.1	16.1	20.3	24.4	27.8	30.0	30.8	30.1	28.0	24.8	20.8	16.6	12.5	9.40	7.28		
145	6.99	8.89	11.3	14.4	17.6	20.6	23.1	24.8	25.4	24.9	23.4	21.0	18.0	14.7	11.6	9.37	7.76		
150	7.20	8.60	10.7	12.9	15.4	17.6	19.4	20.6	21.0	20.7	19.5	17.8	15.7	13.1	11.1	9.49	8.19		
155	7.69	8.81	10.1	11.5	13.4	15.0	16.3	17.1	17.5	17.3	16.5	15.3	13.5	12.1	10.8	9.35	8.43		
160	6.88	8.45	9.51	10.4	11.7	13.0	13.8	14.3	14.5	14.3	13.7	13.1	12.3	11.4	10.3	9.38	8.47		
165	6.24	7.14	8.36	9.52	10.2	11.1	11.9	12.2	12.4	12.4	12.1	11.8	11.3	10.6	9.92	9.44	8.37		
170	5.26	5.81	6.47	7.05	8.16	9.33	10.0	10.4	10.8	10.8	10.6	10.3	10.1	9.80	9.48	9.02	7.16		
175	5.14	5.44	5.64	5.74	5.53	5.52	6.30	7.33	8.09	9.03	9.35	9.27	9.23	8.74	7.84	6.87	6.44		
180	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40		

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

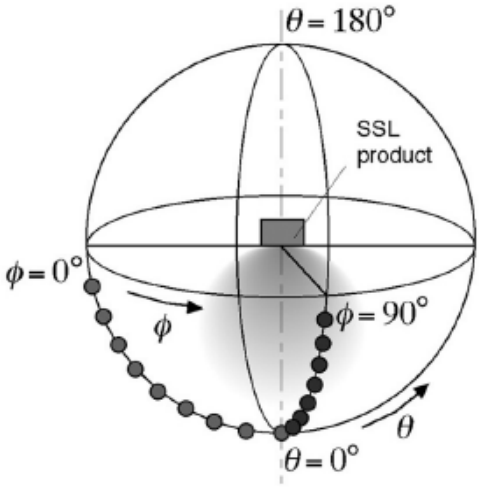
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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