LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5HO

Model: 10.5T5HO/2F/830/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18030001b

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

Review by:

Engineer: April Zou
Mar. 02, 2018

Approved by:

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: **10.5T5HO/2F/830/DIR**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
107.2	1503.0	14.02	0.9825

CCT (K)	CRI	Stabilization Time (Light & Power)
2919	82.7	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	: 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

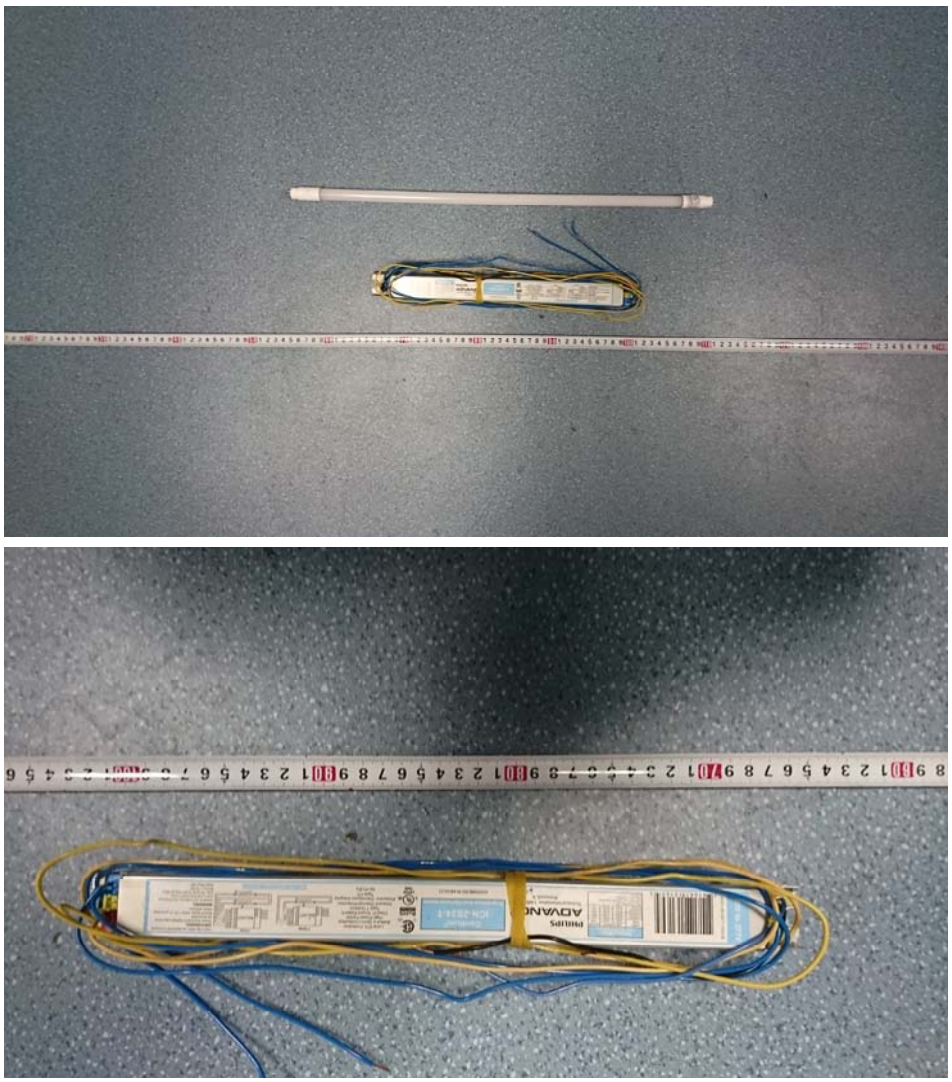


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5HO
Model	: 10.5T5HO/2F/830/DIR
Electrical Ratings	: 120-277V, 60Hz, 10.5W
Product Description	: 3000K 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)	0.119	0.061
Power Factor	0.9825	0.8487
Test Power (W)	14.02	14.39
THD A%	15.92	21.85
Luminous Efficacy (lm/W)	107.2	105.1
Total Luminous Flux (lm)	1503.0	1512.0
Color Rendering Index (CRI)	82.7	
R9	8.2	
Correlated Color Temperature (CCT)(K)	2919	
Chromaticity Chroma x	0.4409	
Chromaticity Chroma y	0.4023	
Chromaticity Chroma u	0.2539	
Chromaticity Chroma v	0.3475	
Duv	0.0015	
Chromaticity Chroma u ’	0.2539	
Chromaticity Chroma v’	0.5213	

Special Color Rendering Indices	
R1	82.1
R2	93.3
R3	93.8
R4	80.1
R5	82.6
R6	92.3
R7	80.9
R8	57.9
R9	8.2
R10	84.8
R11	79.8
R12	75.7
R13	85
R14	97.3
Rf	83
Rg	95

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 25.1℃.

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)	0.120
Power Factor	0.9829
Test Power (W)	14.11
Luminous Efficacy (lm/W)	107.8
Total Luminous Flux (lm)	1520.6
Beam Angle (°)	122.2
Center Beam Candle Power (cd)	403
Spacing Criteria	1.22 (0°-180°)/ 1.32 (90°-270°)
Zonal Lumens in the 0°-60°Zone	61.57%
Zonal Lumens in the 60°-90°Zone	26.93%
Zonal Lumens in the 90°-120°Zone	8.94%
Zonal Lumens in the 120°-180°Zone	2.55%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

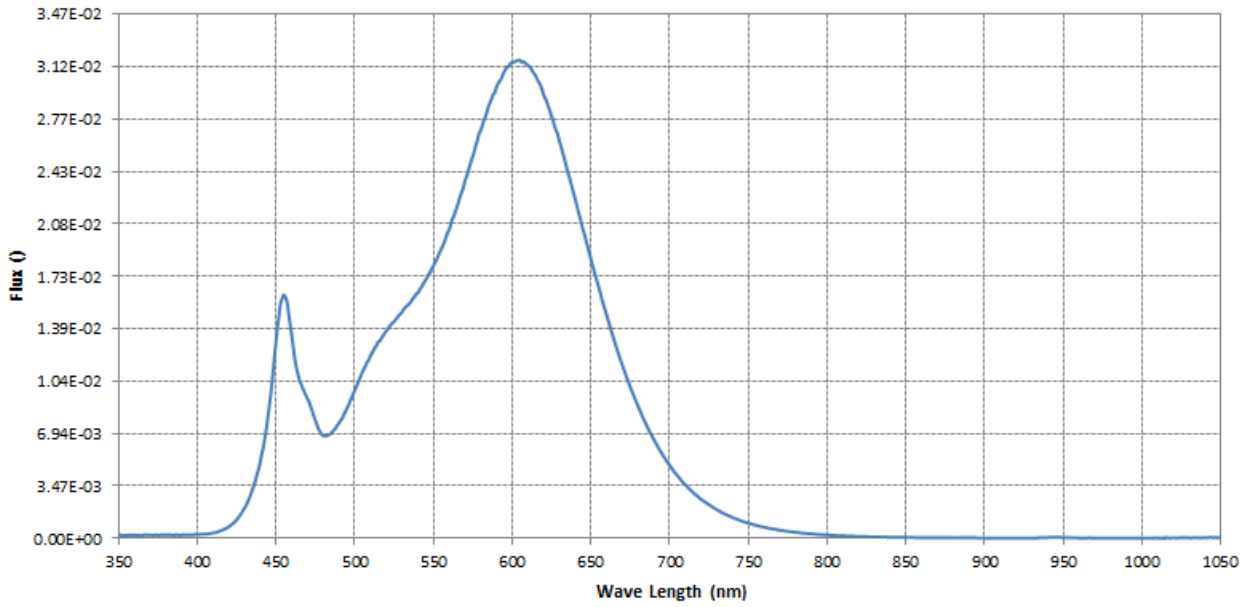
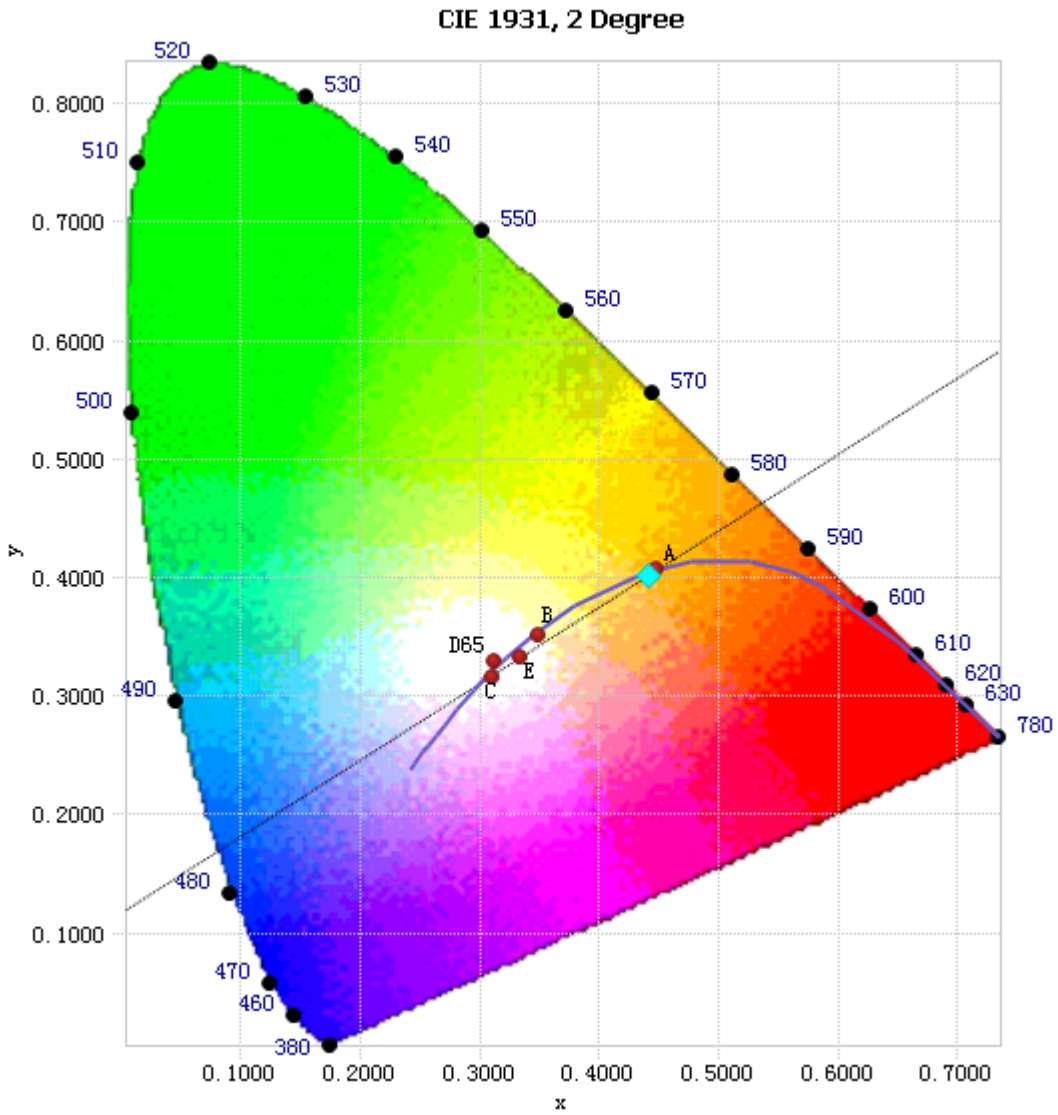


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.25E-04	485	6.93E-03	590	2.98E-02	695	5.63E-03
385	1.98E-04	490	7.61E-03	595	3.09E-02	700	4.85E-03
390	2.13E-04	495	8.58E-03	600	3.15E-02	705	4.15E-03
395	2.32E-04	500	9.77E-03	605	3.16E-02	710	3.55E-03
400	2.49E-04	505	1.10E-02	610	3.13E-02	715	3.04E-03
405	2.79E-04	510	1.21E-02	615	3.06E-02	720	2.59E-03
410	3.57E-04	515	1.30E-02	620	2.94E-02	725	2.23E-03
415	5.08E-04	520	1.37E-02	625	2.79E-02	730	1.90E-03
420	7.61E-04	525	1.43E-02	630	2.63E-02	735	1.62E-03
425	1.20E-03	530	1.49E-02	635	2.44E-02	740	1.38E-03
430	1.98E-03	535	1.56E-02	640	2.25E-02	745	1.18E-03
435	3.19E-03	540	1.62E-02	645	2.04E-02	750	1.01E-03
440	5.02E-03	545	1.71E-02	650	1.85E-02	755	8.66E-04
445	8.07E-03	550	1.80E-02	655	1.66E-02	760	7.42E-04
450	1.29E-02	555	1.91E-02	660	1.48E-02	765	6.35E-04
455	1.61E-02	560	2.04E-02	665	1.31E-02	770	5.43E-04
460	1.35E-02	565	2.19E-02	670	1.15E-02	775	4.65E-04
465	1.05E-02	570	2.36E-02	675	1.00E-02	780	4.00E-04
470	9.26E-03	575	2.52E-02	680	8.75E-03		
475	7.84E-03	580	2.70E-02	685	7.57E-03		
480	6.80E-03	585	2.86E-02	690	6.54E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4409, 0.4023)

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

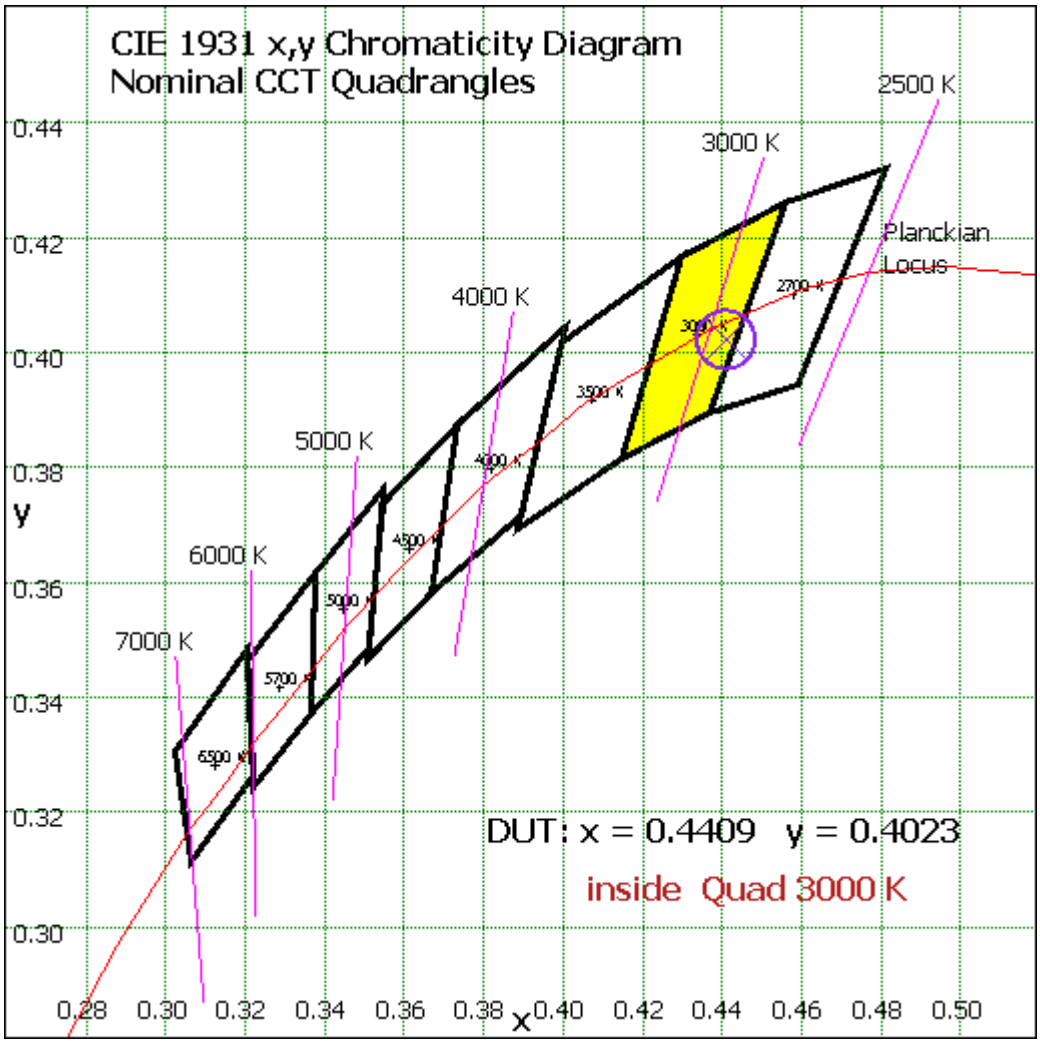


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	38.152	2.51%
10- 20	109.406	7.19%
20- 30	166.442	10.95%
30- 40	202.64	13.33%
40- 50	215.033	14.14%
50- 60	204.582	13.45%
60- 70	175.952	11.57%
70- 80	136.675	8.99%
80- 90	96.929	6.37%
90-100	66.121	4.35%
100-110	43.187	2.84%
110-120	26.703	1.76%
120-130	16.739	1.10%
130-140	10.327	0.68%
140-150	6.143	0.40%
150-160	3.507	0.23%
160-170	1.676	0.11%
170-180	0.424	0.03%
Total	1520.6	100%

γ(°)	Lumens	% Total
0- 60	936.255	61.57%
60- 90	409.556	26.93%
0-90	1345.811	88.50%
90- 180	174.827	11.50%
0- 180	1520.6	100%

Table 5: Zonal Lumen Data

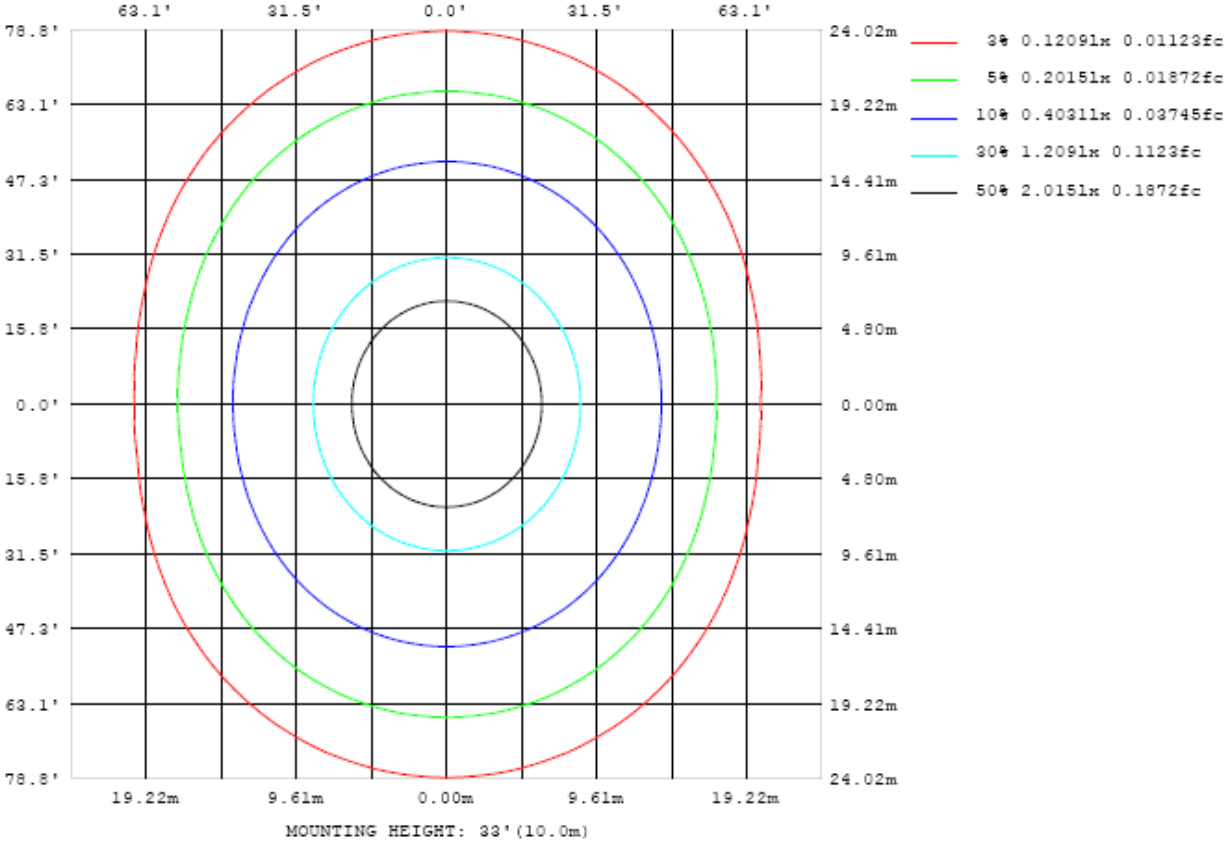


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

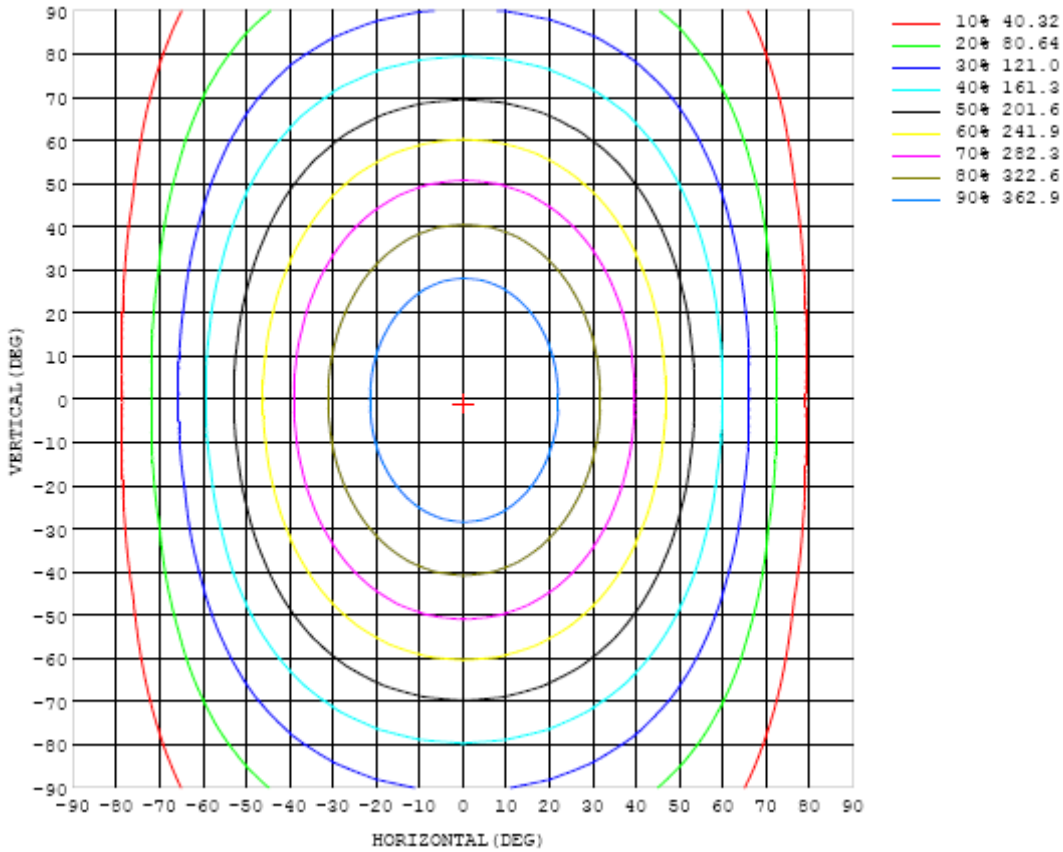


Chart 5: Isocandela Plot

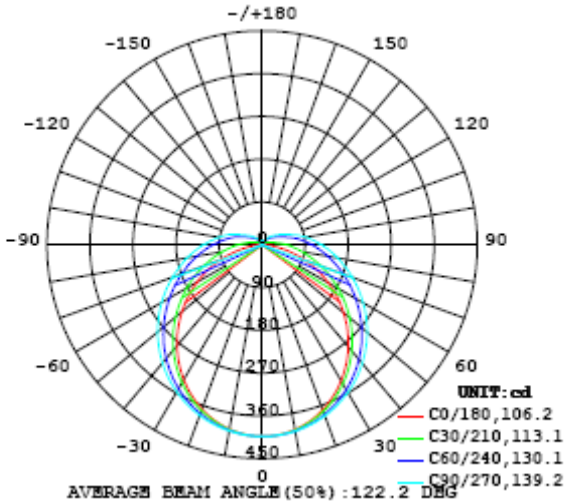


Chart 6: Polar Candela Distribution

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	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403
5	401	401	401	401	402	402	402	402	402	402	402	402	402	401	401	401	401	401	401
10	395	395	395	396	397	397	398	398	398	398	398	398	397	396	396	395	395	394	394
15	384	385	385	386	388	389	390	391	392	392	392	391	390	388	387	385	384	383	383
20	370	370	372	373	376	378	380	382	383	383	383	381	379	377	374	372	370	368	368
25	352	352	354	357	360	364	367	370	372	372	371	369	366	363	359	355	352	350	349
30	330	331	334	338	342	347	352	356	358	358	357	355	351	346	341	336	332	329	328
35	306	308	311	316	322	328	334	339	342	343	342	338	333	327	320	313	308	305	303
40	280	281	285	292	299	307	315	321	324	326	324	320	314	306	297	289	283	278	277
45	252	254	258	266	275	285	294	301	305	307	305	300	293	283	273	263	255	250	249
50	222	224	230	239	250	261	271	280	285	286	284	279	270	260	248	236	227	221	219
55	191	194	201	211	224	237	249	258	264	265	263	257	248	235	222	209	198	190	188
60	160	163	171	184	198	213	226	236	242	244	241	235	225	211	197	182	168	159	157
65	128	131	142	157	173	189	203	213	220	222	220	213	202	188	172	155	139	128	125
70	95.3	99.9	113	131	149	166	180	192	199	201	198	191	180	165	148	129	111	96.8	92.6
75	64.3	70.6	86.7	106	126	144	159	171	178	180	177	170	159	144	125	105	84.9	68.1	61.2
80	35.2	43.8	63.7	84.8	106	124	139	151	158	160	158	151	139	124	105	84.0	62.6	42.1	32.8
85	12.0	23.0	44.1	66.6	87.2	106	121	132	139	141	139	132	121	105	86.7	66.2	43.8	22.4	10.5
90	0.37	10.3	29.7	51.2	71.7	89.3	104	115	122	124	122	115	104	89.1	71.6	51.2	29.9	10.5	0.24
95	0.33	4.31	19.0	38.6	58.0	75.6	89.0	99.3	106	108	106	99.4	88.9	76.0	58.1	38.8	19.3	4.79	0.39
100	0.45	2.75	12.5	27.4	45.0	61.4	75.7	84.4	90.7	92.9	90.9	84.9	75.2	61.7	45.4	27.8	13.2	3.27	0.47
105	0.70	2.11	9.18	20.7	34.2	48.0	60.4	70.0	75.6	77.7	76.0	70.4	60.9	48.2	34.8	21.8	10.0	2.75	0.82
110	1.09	1.96	7.36	16.5	27.5	38.7	48.6	56.3	61.2	63.2	61.6	56.7	49.0	39.5	28.5	17.4	8.38	2.87	1.17
115	1.48	2.36	6.20	13.5	22.5	31.8	40.3	46.7	50.9	52.4	51.1	47.3	40.8	32.6	23.3	14.5	7.42	3.09	1.54
120	1.89	2.88	5.43	11.2	18.7	26.3	33.3	38.8	42.3	43.6	42.5	39.2	33.9	27.0	19.5	12.3	6.81	3.31	1.97
125	2.34	3.29	5.32	9.54	15.6	21.9	27.7	32.3	35.2	36.3	35.3	32.5	28.2	22.6	16.5	10.7	6.19	3.56	2.35
130	2.83	3.62	5.04	7.58	12.7	18.2	22.9	26.8	29.2	30.1	29.4	27.1	23.4	18.9	13.6	9.10	6.07	3.61	2.48
135	3.29	3.77	4.93	7.43	11.0	15.0	18.8	21.9	24.1	24.9	24.3	22.4	19.4	15.6	11.8	8.27	5.71	3.66	2.91
140	3.70	3.67	5.21	7.37	9.29	11.7	15.1	18.1	19.8	20.3	19.9	18.6	16.1	13.2	10.4	8.04	5.38	3.65	3.55
145	4.07	3.67	4.95	6.72	8.37	10.5	11.9	13.3	15.1	16.1	15.5	14.1	13.1	11.3	9.37	7.41	4.86	3.62	4.03
150	4.40	3.66	4.47	6.11	7.87	8.77	10.6	11.8	12.4	12.6	12.6	12.2	11.0	9.86	8.55	6.68	4.44	3.68	4.38
155	4.53	3.77	3.97	5.39	7.25	8.36	9.40	10.2	10.6	10.6	10.6	10.3	9.77	8.88	7.55	5.35	3.94	3.55	4.34
160	4.89	4.17	3.62	4.50	5.28	6.94	8.26	8.80	9.29	9.58	9.50	9.22	8.63	7.30	5.61	4.61	3.55	3.57	4.48
165	5.35	4.47	3.70	3.82	4.33	5.23	5.75	6.67	7.41	7.88	7.79	7.40	5.82	5.09	4.08	3.51	3.53	3.62	4.77
170	5.01	4.11	3.74	3.74	3.79	3.85	3.86	4.34	5.57	6.51	3.54	3.56	3.55	3.52	3.41	3.26	3.28	3.23	3.83
175	5.02	4.29	3.63	3.56	3.58	3.59	3.61	3.79	3.65	1.36	3.57	3.41	2.96	2.54	2.57	2.79	2.96	2.97	3.01
180	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96

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	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403
5	401	401	401	401	401	401	402	402	402	402	402	402	402	401	401	401	401
10	394	394	395	395	396	396	397	398	398	398	397	397	397	396	395	395	395
15	383	384	385	386	387	389	390	391	391	391	390	390	389	387	386	385	384
20	368	370	371	374	376	378	380	382	382	382	381	379	378	375	373	371	370
25	350	352	355	358	362	365	368	370	371	370	369	366	363	360	357	354	352
30	329	331	335	340	345	350	353	356	357	357	355	351	347	342	338	334	331
35	305	308	313	319	326	332	337	340	342	341	338	334	328	322	316	311	307
40	279	283	289	296	305	312	319	323	324	323	320	314	307	299	292	286	282
45	251	256	263	272	282	291	299	304	306	304	300	293	285	276	266	259	254
50	221	227	236	247	259	269	278	283	285	284	279	271	261	251	240	231	225
55	191	198	209	222	235	246	256	262	264	263	258	248	237	225	213	202	195
60	161	169	182	196	211	223	233	240	243	241	235	225	213	200	185	173	164
65	130	141	156	171	187	201	212	218	221	219	213	203	190	175	159	145	133
70	98.4	112	130	148	165	179	190	197	199	197	191	181	167	151	134	116	103
75	69.0	86.0	106	126	144	158	169	176	178	176	170	160	146	128	109	89.5	72.6
80	43.2	62.9	84.4	105	123	138	150	157	159	157	150	140	125	108	87.4	65.7	46.2
85	22.9	43.8	65.9	86.6	105	120	131	138	140	138	132	121	107	88.8	68.3	46.1	25.0
90	10.4	29.7	50.7	70.8	88.5	103	114	120	122	121	114	104	90.0	72.6	52.6	31.2	11.4
95	4.43	19.8	38.7	57.3	74.0	87.6	97.8	104	106	104	98.6	88.7	75.2	58.7	40.0	20.8	4.82
100	2.84	12.5	28.6	45.9	61.3	74.1	83.7	89.7	91.7	90.0	84.4	75.1	62.5	47.1	29.8	12.9	2.77
105	2.56	9.07	20.5	34.6	49.8	61.9	71.1	76.5	78.4	76.7	71.7	62.8	50.8	36.0	21.0	8.95	2.33
110	2.63	7.28	15.9	26.8	37.8	48.8	58.0	63.6	65.5	63.9	58.7	49.8	38.6	27.0	15.8	6.81	2.36
115	2.74	6.39	13.0	21.5	30.6	38.7	45.2	49.4	51.0	49.6	45.4	38.9	30.6	21.6	12.7	5.85	2.53
120	3.03	5.94	10.9	17.7	25.0	31.6	36.9	40.3	41.4	40.2	36.9	31.7	24.9	17.6	10.3	5.44	2.85
125	3.28	5.64	9.53	14.8	20.6	26.0	30.2	33.0	34.0	33.0	30.3	25.9	20.4	14.4	8.92	5.28	3.19
130	3.27	5.40	8.45	12.5	17.0	21.3	24.8	27.1	27.9	27.1	24.8	21.3	16.9	12.1	8.08	5.24	3.54
135	3.55	5.34	7.70	10.7	14.2	17.6	20.4	22.2	22.8	22.2	20.4	17.6	14.1	10.5	7.54	5.30	3.93
140	4.16	5.33	7.20	9.53	12.1	14.6	16.8	18.1	18.6	18.1	16.7	14.5	11.9	9.40	7.11	5.39	4.33
145	4.53	5.41	6.83	8.57	10.5	12.2	13.7	14.7	15.1	14.7	13.7	12.2	10.3	8.45	6.78	5.53	4.72
150	4.30	5.36	6.52	7.79	9.13	10.4	11.5	12.2	12.4	12.1	11.4	10.3	9.04	7.72	6.55	5.67	5.04
155	5.01	5.32	6.19	7.14	8.06	8.92	9.64	10.1	10.3	10.1	9.62	8.91	8.06	7.19	6.41	5.80	5.34
160	5.13	4.85	5.60	6.53	7.21	7.77	8.23	8.53	8.63	8.54	8.25	7.83	7.32	6.78	6.29	5.89	5.51
165	5.46	5.16	4.98	5.56	6.52	6.82	7.10	7.32	7.41	7.38	7.24	7.00	6.71	6.47	6.20	5.93	5.76
170	4.67	5.43	5.52	4.52	5.04	6.27	6.47	6.52	6.55	6.55	6.52	6.45	6.32	6.11	5.82	5.92	5.77
175	3.45	4.10	4.64	5.15	5.18	5.07	5.38	5.62	5.70	5.73	5.75	5.82	5.92	5.98	5.95	5.75	5.53
180	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96

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

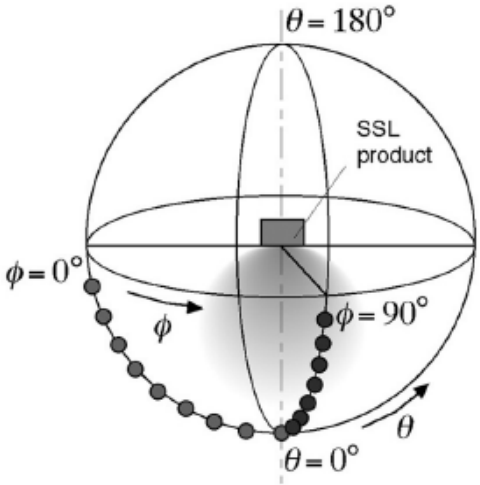
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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