LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube System

Model: 14.5T8U6/830/EXT/A4

(LED tube model: 14.5T8U6/830/EXT 4pcs and LED driver model: 15T8T5HEDRIVER/4CH 1pcs)

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18080024c

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

Review by: April Zou

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: **14.5T8U6/830/EXT/A4**

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/4	Power Factor
128.9	2083.0	16.16	0.9969

CCT (K)	CRI	Stabilization Time (Light & Power)
2957	82.1	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

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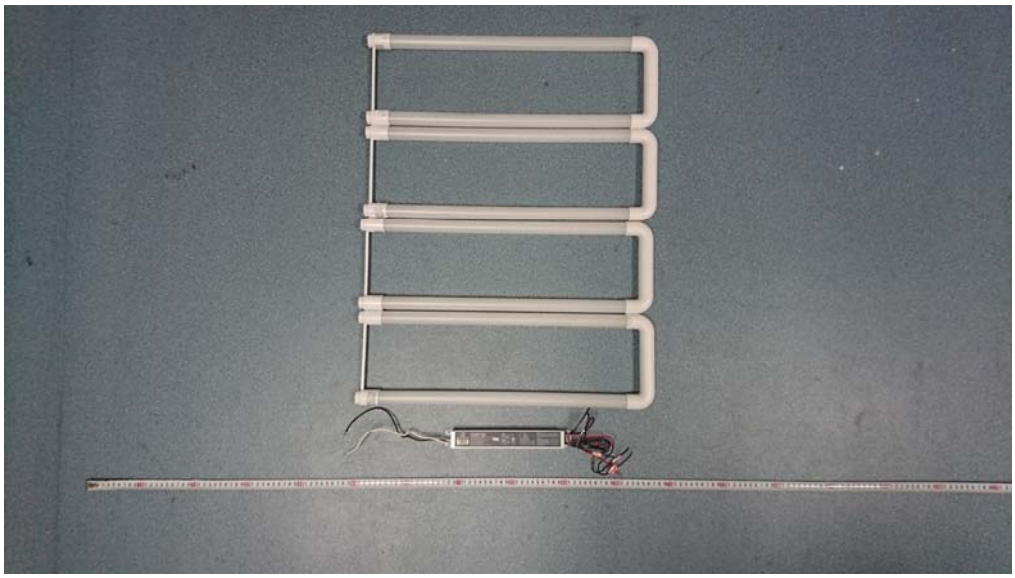


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED Tube System
Model	: 14.5T8U6/830/EXT/A4
Electrical Ratings	: 120-277V, 50/60Hz
Product Description	: 3000K LED tube model: 14.5T8U6/830/EXT 4 LED tubes supplied by a LED driver: 15T8T5HEDRIVER/4CH
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)	0.540	0.236
Power Factor	0.9969	0.9696
Test Power (W)/4	16.16	15.87
THD A%	4.00	5.40
Luminous Efficacy (lm/W)	128.9	131.2
Luminous Flux per lamp (lm)	2083.0	2083.0
Color Rendering Index (CRI)	82.1	
R9	3.8	
Correlated Color Temperature (CCT)(K)	2957	
Chromaticity Chroma x	0.4404	
Chromaticity Chroma y	0.4061	
Chromaticity Chroma u	0.2519	
Chromaticity Chroma v	0.3485	
Duv	0.0001	
Chromaticity Chroma u ’	0.2519	
Chromaticity Chroma v’	0.5227	

Special Color Rendering Indices	
R1	80.8
R2	92.2
R3	94.3
R4	79.2
R5	81.2
R6	91.1
R7	81
R8	56.6
R9	3.8
R10	82.6
R11	78.7
R12	72.1
R13	83.7
R14	97.5
Rf	83
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 24.8℃.

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)	0.541
Power Factor	0.9963
Test Power (W)/4	16.18
Luminous Efficacy (lm/W)	126.9
Luminous Flux per lamp (lm)	2053.2
Beam Angle (°)	140.8
Center Beam Candle Power (cd)	385
Spacing Criteria	1.23 (0°-180°)/ 1.43 (90°-270°)
Zonal Lumens in the 0°-60°Zone	46.45%
Zonal Lumens in the 60°-90°Zone	25.97%
Zonal Lumens in the 90°-120°Zone	14.88%
Zonal Lumens in the 120°-180°Zone	12.70%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

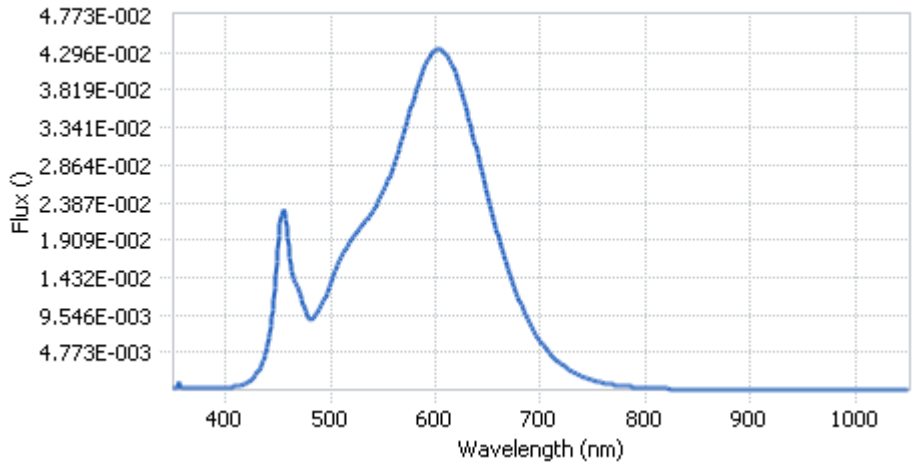
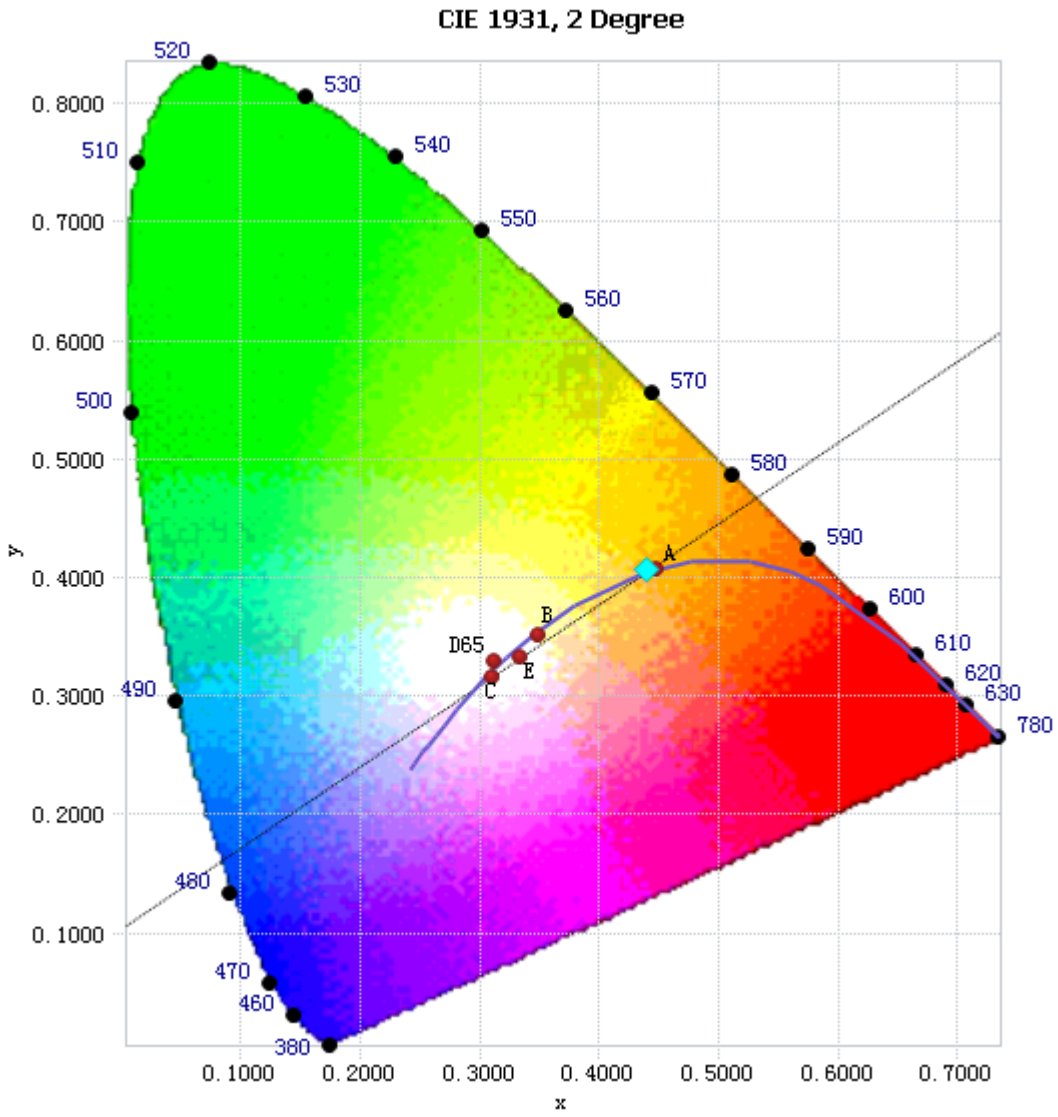


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.06E-04	485	9.48E-03	590	4.13E-02	695	7.19E-03
385	3.11E-04	490	1.05E-02	595	4.25E-02	700	6.16E-03
390	2.88E-04	495	1.18E-02	600	4.33E-02	705	5.26E-03
395	3.22E-04	500	1.36E-02	605	4.34E-02	710	4.47E-03
400	3.59E-04	505	1.55E-02	610	4.27E-02	715	3.82E-03
405	3.76E-04	510	1.69E-02	615	4.16E-02	720	3.26E-03
410	4.72E-04	515	1.82E-02	620	3.99E-02	725	2.77E-03
415	6.19E-04	520	1.92E-02	625	3.78E-02	730	2.36E-03
420	8.87E-04	525	2.01E-02	630	3.54E-02	735	2.00E-03
425	1.40E-03	530	2.10E-02	635	3.28E-02	740	1.69E-03
430	2.20E-03	535	2.18E-02	640	3.01E-02	745	1.45E-03
435	3.58E-03	540	2.28E-02	645	2.72E-02	750	1.22E-03
440	5.92E-03	545	2.39E-02	650	2.46E-02	755	1.05E-03
445	1.02E-02	550	2.52E-02	655	2.19E-02	760	8.94E-04
450	1.79E-02	555	2.68E-02	660	1.95E-02	765	7.61E-04
455	2.29E-02	560	2.86E-02	665	1.71E-02	770	6.52E-04
460	1.81E-02	565	3.06E-02	670	1.50E-02	775	5.54E-04
465	1.40E-02	570	3.28E-02	675	1.30E-02	780	4.81E-04
470	1.27E-02	575	3.52E-02	680	1.13E-02		
475	1.04E-02	580	3.75E-02	685	9.80E-03		
480	9.01E-03	585	3.96E-02	690	8.39E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4404, 0.4061)

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

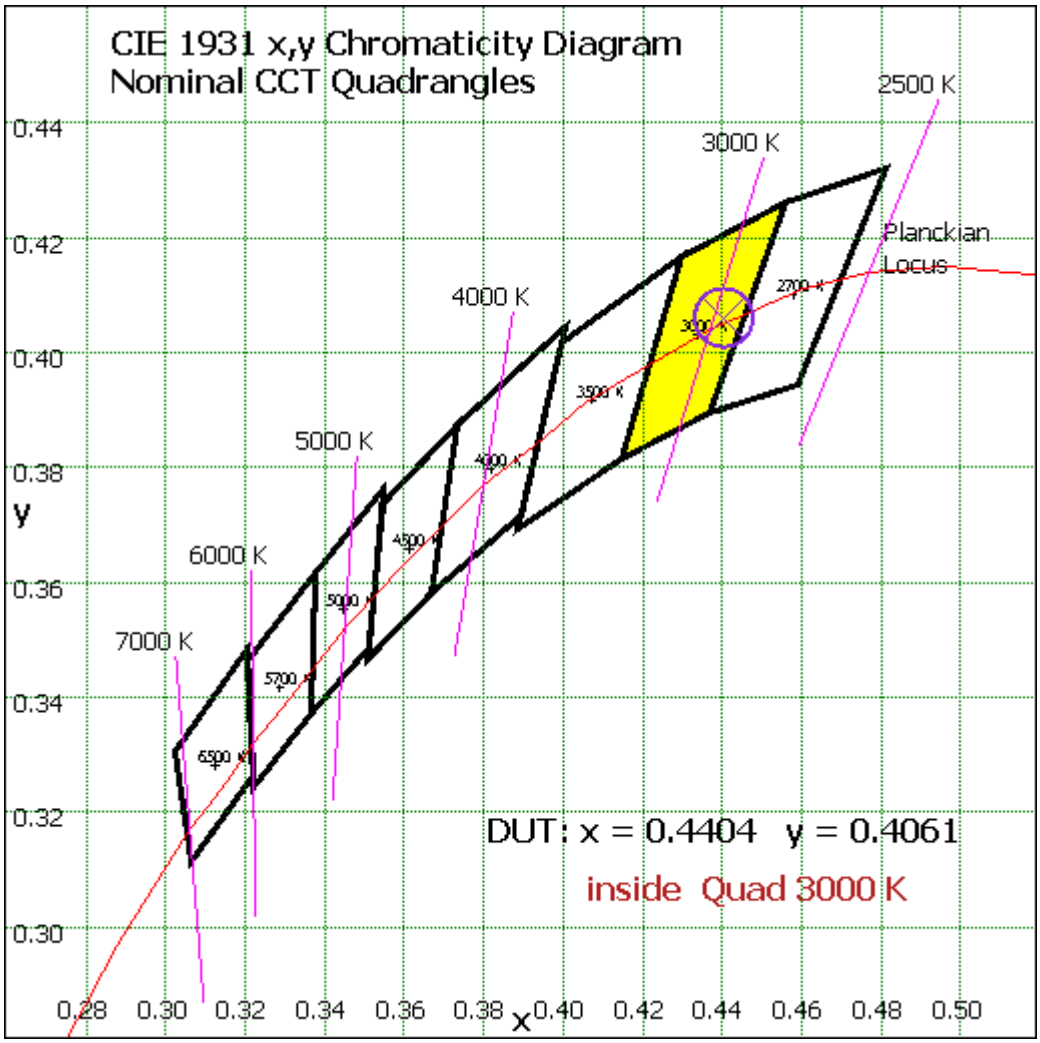


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	36.449	1.78%
10- 20	105.091	5.12%
20- 30	161.928	7.89%
30- 40	201.884	9.83%
40- 50	222.827	10.85%
50- 60	225.447	10.98%
60- 70	212.812	10.37%
70- 80	188.214	9.17%
80- 90	132.256	6.44%
90-100	96.059	4.68%
100-110	111.201	5.42%
110-120	98.267	4.79%
120-130	82.298	4.01%
130-140	66.389	3.23%
140-150	50.848	2.48%
150-160	35.731	1.74%
160-170	20.305	0.99%
170-180	5.157	0.25%
Total	2053.2	100%

γ(°)	Lumens	% Total
0- 60	953.626	46.45%
60- 90	533.282	25.97%
0-90	1486.908	72.42%
90- 180	566.255	27.58%
0- 180	2053.2	100%

Table 5: Zonal Lumen Data

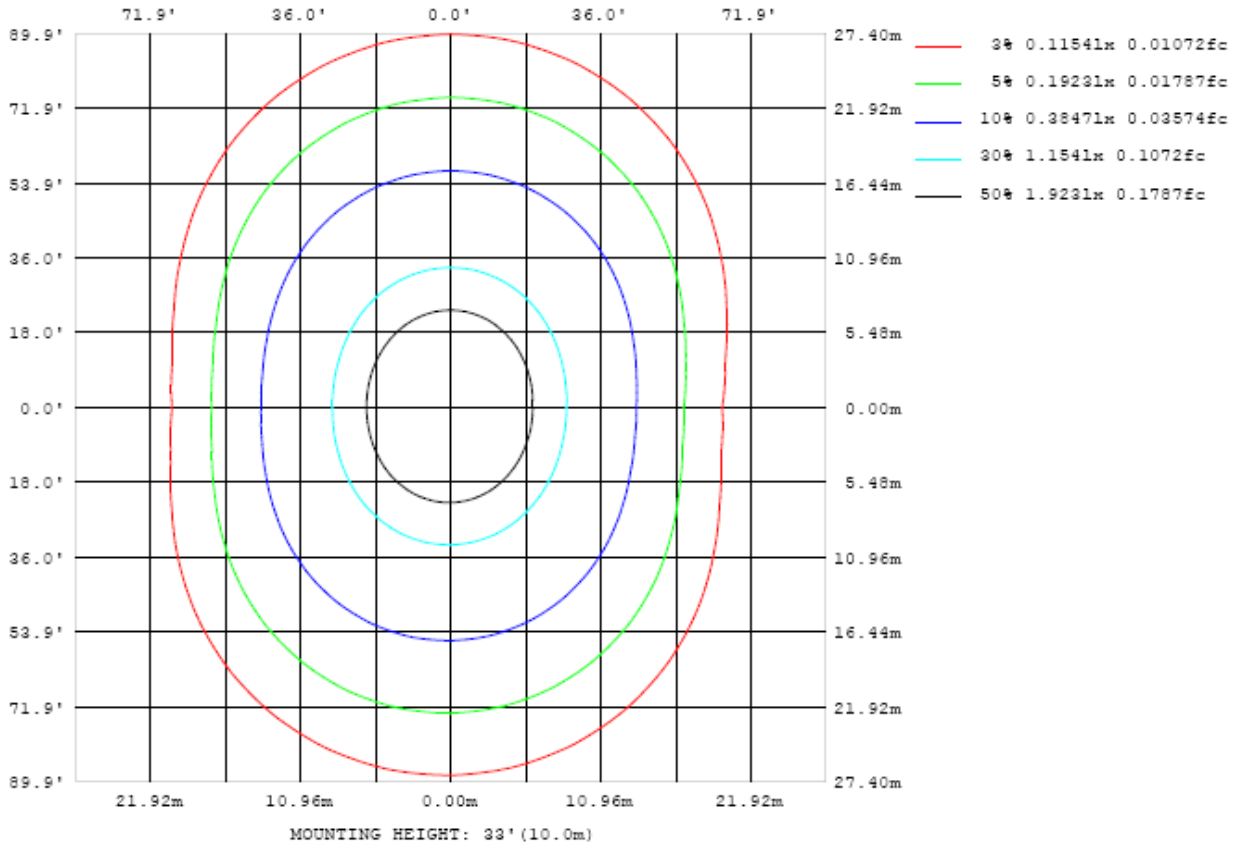


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

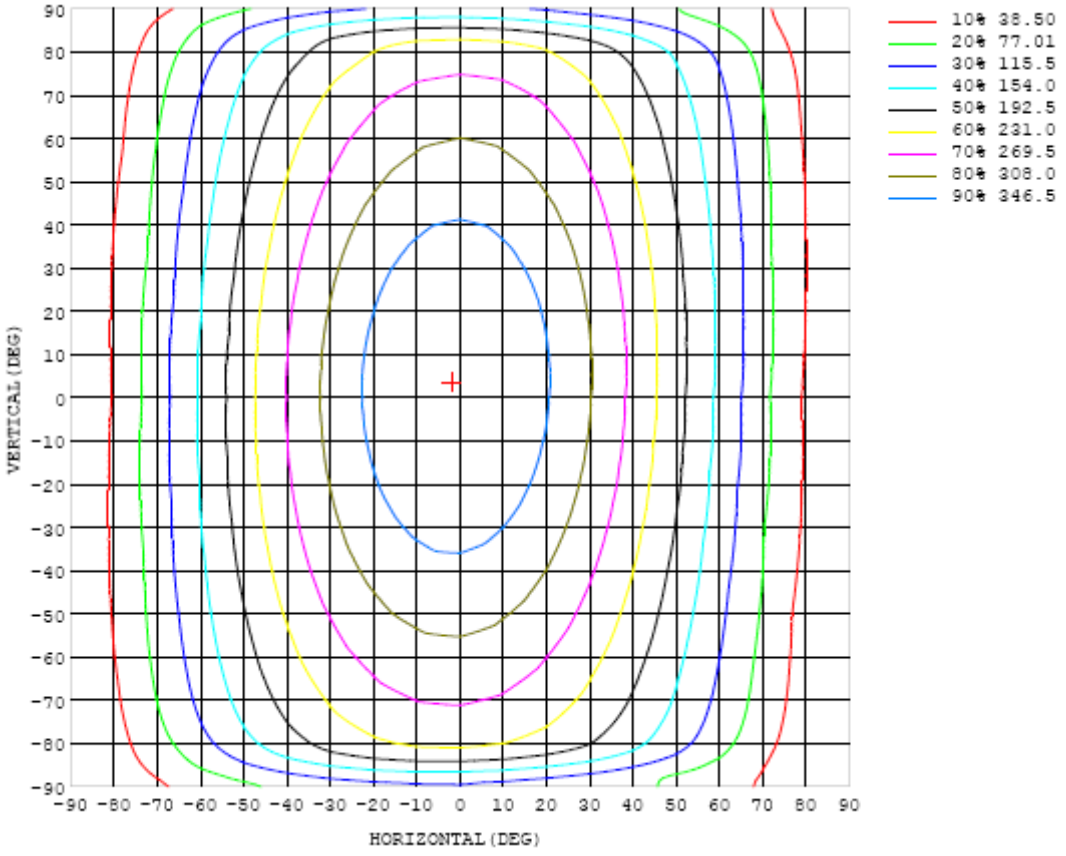


Chart 5: Isocandela Plot

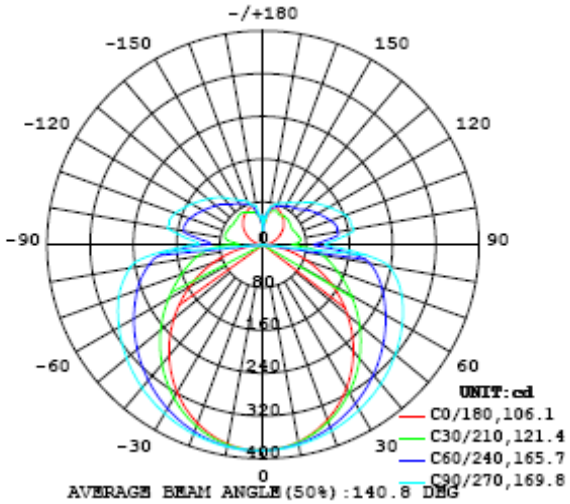


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385
5	382	382	382	382	382	382	382	383	383	383	383	383	383	384	383	383	383	383	383
10	374	374	375	375	376	377	378	379	380	380	380	380	380	380	379	378	378	378	378
15	363	363	364	365	367	369	371	373	375	376	376	376	374	373	372	370	369	368	368
20	348	348	350	352	356	359	363	366	369	370	371	370	367	365	362	359	357	355	355
25	330	331	333	337	342	348	354	358	362	364	364	362	359	355	350	345	341	339	338
30	309	310	313	319	326	335	342	349	354	356	356	354	349	343	336	329	323	319	318
35	286	286	291	299	309	320	330	339	345	348	348	344	338	330	320	310	303	297	296
40	260	261	268	278	291	305	317	328	336	339	339	334	326	315	303	291	280	273	271
45	233	235	243	256	272	289	304	317	325	330	329	324	314	300	285	270	257	247	244
50	205	207	217	233	253	272	290	305	315	320	319	312	301	285	267	249	232	220	216
55	175	178	191	211	233	256	276	292	304	309	308	300	287	270	249	227	207	193	187
60	146	149	165	189	214	240	262	280	292	297	296	288	274	254	231	206	183	165	158
65	116	121	140	167	196	224	248	267	280	286	284	275	260	239	213	186	158	137	128
70	86.5	93.1	117	147	179	209	234	254	267	273	271	262	246	224	196	166	135	109	97.7
75	59.0	67.4	95.2	129	163	193	219	239	252	258	256	247	231	208	180	148	114	84.0	68.8
80	33.3	44.4	76.9	113	147	176	201	220	232	238	237	228	212	189	162	130	94.4	61.4	41.7
85	13.2	26.4	59.7	91.8	118	138	153	165	174	179	180	176	167	153	132	105	73.3	41.1	18.3
90	3.48	12.3	34.3	54.2	71.7	84.0	95.2	104	112	115	114	108	98.9	85.9	71.3	55.3	32.8	13.7	1.54
95	7.05	15.9	40.7	67.7	93.4	110	123	133	139	142	139	133	122	107	88.3	66.3	41.4	19.7	3.93
100	11.5	18.9	40.8	70.0	98.5	120	140	156	166	170	169	161	147	127	103	76.6	49.1	24.2	8.85
105	17.2	23.1	41.4	67.0	94.3	119	140	155	164	168	166	159	146	128	105	77.6	49.9	27.7	14.6
110	23.1	27.0	42.6	65.0	89.3	112	133	148	158	162	161	153	140	122	100	74.8	50.1	31.4	20.9
115	30.0	33.0	44.1	62.3	85.6	106	125	139	148	151	150	144	131	115	94.7	72.1	49.5	35.6	27.5
120	36.2	37.4	47.9	61.5	81.4	100	117	130	138	141	140	134	123	108	90.1	69.3	50.8	40.3	34.1
125	42.8	43.8	51.3	62.6	77.4	94.4	110	122	129	131	130	125	115	101	85.3	67.6	53.8	45.4	40.6
130	49.0	49.1	53.0	64.3	75.8	88.1	102	113	120	122	121	116	107	94.7	81.1	67.1	56.3	49.9	46.9
135	54.5	54.4	57.1	65.8	75.5	84.7	94.2	104	110	112	111	106	98.7	89.1	78.8	67.8	59.6	54.5	52.7
140	59.1	59.3	57.8	65.6	74.7	83.1	90.1	95.9	100	102	102	98.3	92.7	85.8	77.4	68.3	62.4	58.8	57.8
145	63.7	63.2	62.9	66.8	74.3	80.7	87.2	92.1	95.3	96.3	95.7	93.4	88.9	83.1	75.9	70.1	63.8	62.6	62.4
150	67.3	67.4	66.3	63.9	72.5	79.0	83.9	87.7	90.2	91.1	90.7	88.3	84.8	80.4	76.8	71.0	65.0	64.0	66.5
155	71.0	70.6	67.3	65.5	70.0	75.7	80.1	84.1	85.8	86.3	86.1	84.8	82.2	78.4	74.7	70.1	66.5	64.9	70.0
160	74.6	74.2	67.0	67.6	68.5	71.4	77.3	79.6	80.7	81.2	81.7	81.2	78.4	75.9	73.0	70.0	65.2	68.5	73.4
165	71.7	72.5	68.8	65.7	67.1	71.8	73.1	73.9	75.3	76.5	75.7	73.9	73.4	72.5	70.7	64.1	62.7	71.0	72.7
170	57.8	59.0	64.2	64.2	62.3	63.5	65.9	69.8	71.1	69.6	70.2	65.6	61.6	60.2	57.3	58.0	59.0	60.8	59.5
175	42.6	42.4	42.3	44.4	52.6	55.8	53.7	50.5	49.3	49.4	50.9	51.5	51.1	46.0	45.1	44.6	45.1	45.4	44.6
180	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9

Table 6: Luminous Intensity Data

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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	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385	385		
5	384	384	384	384	385	385	385	385	385	385	384	384	384	383	382	382	382		
10	378	379	380	381	382	383	383	384	383	383	382	381	380	379	377	376	375		
15	369	371	372	374	376	378	380	381	381	380	378	376	374	371	368	366	364		
20	356	358	361	365	368	372	374	376	376	376	373	369	365	361	356	353	350		
25	340	343	347	353	358	364	368	370	371	370	366	361	355	348	342	337	333		
30	320	324	331	338	346	354	360	363	365	363	358	352	343	334	325	318	312		
35	298	303	312	322	333	343	351	356	357	355	350	341	330	318	307	297	289		
40	273	281	291	304	318	331	340	347	349	347	340	329	316	301	286	274	265		
45	247	256	270	286	303	318	329	337	340	337	329	317	301	283	266	250	239		
50	220	231	247	267	287	304	318	327	330	327	318	304	286	265	244	225	211		
55	191	205	225	248	270	290	306	316	319	316	306	290	270	247	223	200	184		
60	163	179	203	228	254	276	293	304	308	305	294	277	255	229	202	176	156		
65	134	154	181	210	238	262	280	292	297	293	282	264	240	212	181	153	128		
70	105	130	161	192	222	248	267	280	284	281	269	250	225	195	162	130	102		
75	78.4	107	142	176	207	233	252	264	269	266	254	236	210	180	146	109	77.1		
80	53.8	86.2	123	158	188	214	234	246	251	247	236	218	193	163	129	91.5	55.6		
85	32.4	65.7	101	134	159	181	195	201	203	198	189	175	157	137	109	74.1	38.4		
90	9.29	30.4	53.3	74.1	92.6	107	117	124	124	120	112	103	91.8	78.1	61.7	43.1	20.6		
95	12.7	33.8	57.1	79.3	99.1	117	129	138	143	142	136	128	116	100	79.0	52.8	24.8		
100	18.7	42.4	70.4	99.0	125	149	165	176	180	178	168	154	135	112	83.5	53.1	27.4		
105	23.0	44.4	73.0	101	127	149	165	175	180	177	168	154	134	109	80.8	52.7	30.9		
110	28.0	46.4	71.6	98.5	123	144	160	169	173	170	162	148	128	104	78.1	53.8	33.4		
115	33.1	48.2	70.7	94.3	117	137	151	160	163	160	153	140	122	99.6	76.6	54.7	37.1		
120	38.6	49.5	69.7	91.0	111	129	142	150	153	151	144	132	115	95.9	75.6	55.3	40.2		
125	43.8	51.6	67.2	88.1	106	121	132	140	143	141	135	124	110	92.7	74.1	56.1	46.5		
130	49.4	55.9	68.3	82.7	101	114	124	131	133	132	126	117	104	89.3	72.5	58.5	51.4		
135	54.5	59.5	68.7	80.7	93.6	107	117	122	125	123	118	110	98.7	85.9	71.6	59.2	57.7		
140	58.9	62.6	70.8	79.7	89.3	98.3	107	113	115	114	109	102	93.3	82.0	72.0	63.1	61.4		
145	62.9	64.2	71.7	78.9	86.4	93.5	99.1	103	104	104	101	95.2	88.7	80.8	70.6	63.6	64.8		
150	64.8	63.8	70.1	78.2	83.3	89.2	93.4	96.1	97.2	96.6	94.1	90.7	85.6	77.7	71.5	66.6	66.8		
155	66.5	62.7	66.5	75.8	81.3	84.1	88.5	91.4	92.2	91.9	89.9	86.1	81.5	76.4	70.5	68.1	68.5		
160	70.4	64.7	64.0	70.4	77.3	81.5	83.2	83.1	86.0	86.5	84.7	82.2	78.1	73.6	71.6	69.1	69.0		
165	71.1	66.6	63.2	64.1	70.2	75.1	77.6	78.6	76.5	74.7	75.7	76.0	74.6	72.9	70.5	67.5	68.7		
170	59.4	58.7	57.0	57.0	58.9	59.0	60.3	65.2	73.2	73.1	72.8	71.5	69.0	65.8	65.8	66.1	65.9		
175	44.8	45.0	45.4	45.9	46.5	47.2	51.6	53.5	52.0	50.2	49.3	50.1	52.1	54.6	55.7	49.8	43.1		
180	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0		

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

Color Characteristics Measurements

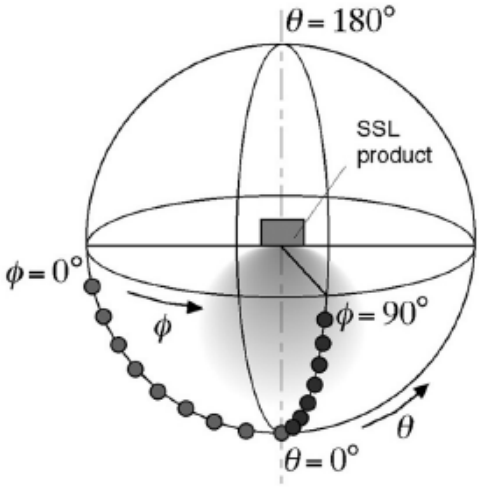
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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