LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5 Tube

Model: 15T5HE/4F/840/DIR/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17050004b

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

Review by: April Zou

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May 04, 2017

Approved by: Jim Zhang

Manager: Jim Zhang

May 04, 2017

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: **15T5HE/4F/840/DIR/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
126.1	2259.0	17.91	0.9959

CCT (K)	CRI	Stabilization Time (Light & Power)
4054	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	: May 02, 2017
Date of Test	: May 03, 2017
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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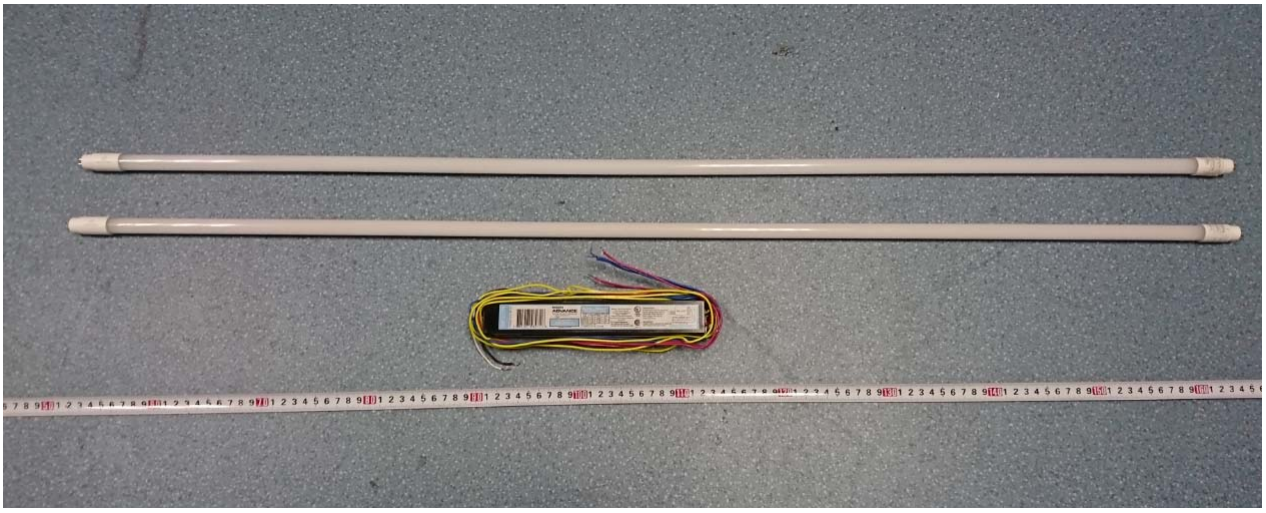


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5 Tube
Model	: 15T5HE/4F/840/DIR/R
Electrical Ratings	: 120Vac, 60Hz, 15W
Product Description	: Mini Bi-Pin G5 base, 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast: ICN-2S28-N
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 24.6℃.

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
Voltage frequency (Hz)	60
Test Current (A)	0.150
Power Factor	0.9959
Test Power (W)/2	17.91
THD A%	6.08
Luminous Efficacy (lm/W)	126.1
Total Luminous Flux (lm)	2259.0
Color Rendering Index (CRI)	81.7
R9	1.7
Correlated Color Temperature (CCT)(K)	4054
Chromaticity Chroma x	0.3789
Chromaticity Chroma y	0.3788
Chromaticity Chroma u	0.2233
Chromaticity Chroma v	0.3348
Duv	0.0008
Chromaticity Chroma u ’	0.2233
Chromaticity Chroma v’	0.5023

Special Color Rendering Indices	
R1	79.4
R2	87.5
R3	94
R4	81.1
R5	79.9
R6	83
R7	85.6
R8	62.7
R9	1.7
R10	70.8
R11	80.1
R12	61.6
R13	81.2
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 24.6℃.

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)	0.270
Power Factor	0.9952
Test Power (W)	32.22
Luminous Efficacy (lm/W)	142.3
Total Luminous Flux (lm)	2292.9
Beam Angle (°)	129.6
Center Beam Candle Power (cd)	560
Spacing Criteria	1.26 (0°-180°)/ 1.34 (90°-270°)
Zonal Lumens in the 0°-60°Zone	59.20%
Zonal Lumens in the 60°-90°Zone	27.93%
Zonal Lumens in the 90°-120°Zone	9.83%
Zonal Lumens in the 120°-180°Zone	3.04%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

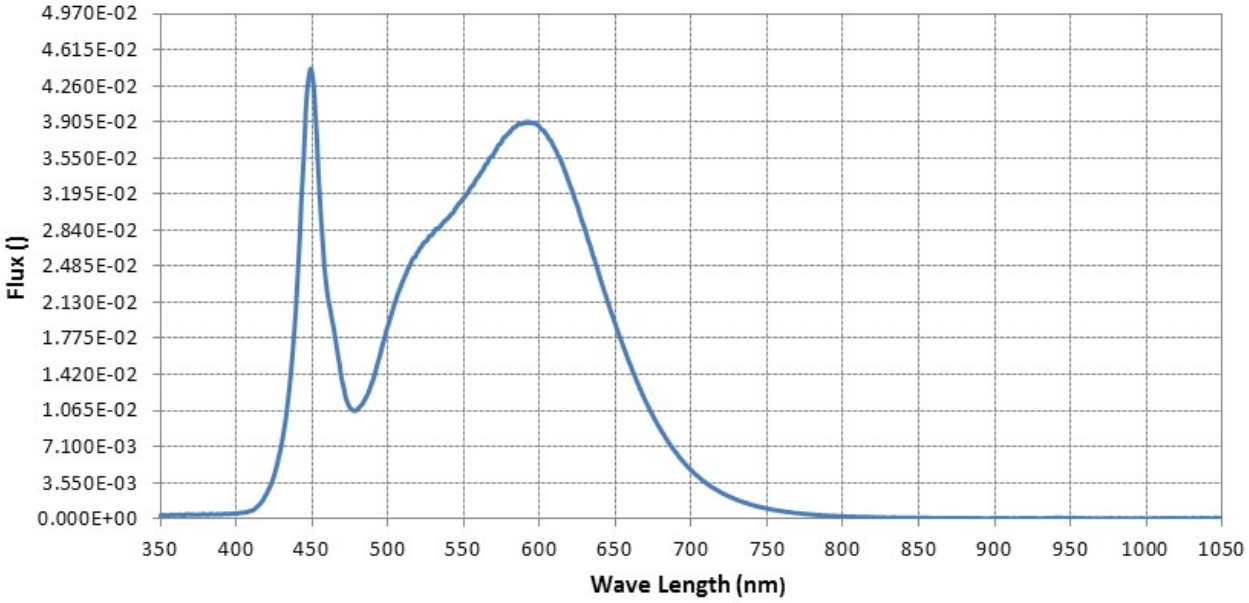
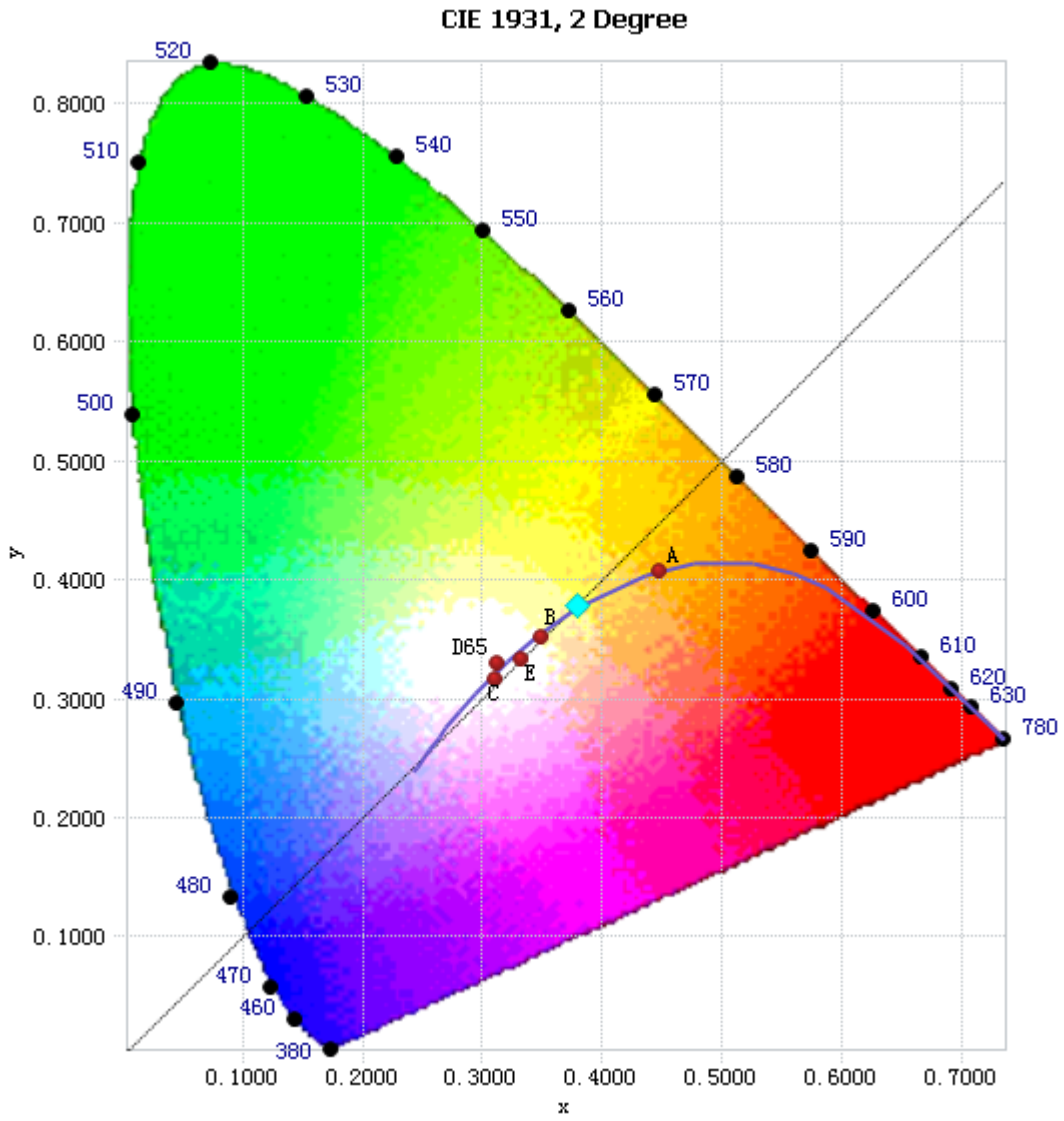


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.03E-04	485	1.18E-02	590	3.89E-02	695	5.56E-03
385	4.17E-04	490	1.36E-02	595	3.90E-02	700	4.77E-03
390	4.18E-04	495	1.63E-02	600	3.86E-02	705	4.08E-03
395	4.74E-04	500	1.90E-02	605	3.77E-02	710	3.48E-03
400	4.91E-04	505	2.14E-02	610	3.64E-02	715	2.98E-03
405	6.03E-04	510	2.35E-02	615	3.48E-02	720	2.56E-03
410	7.95E-04	515	2.51E-02	620	3.28E-02	725	2.19E-03
415	1.36E-03	520	2.63E-02	625	3.07E-02	730	1.86E-03
420	2.46E-03	525	2.73E-02	630	2.84E-02	735	1.59E-03
425	4.30E-03	530	2.81E-02	635	2.60E-02	740	1.36E-03
430	7.50E-03	535	2.89E-02	640	2.36E-02	745	1.16E-03
435	1.29E-02	540	2.96E-02	645	2.13E-02	750	9.89E-04
440	2.26E-02	545	3.06E-02	650	1.91E-02	755	8.53E-04
445	3.74E-02	550	3.16E-02	655	1.70E-02	760	7.38E-04
450	4.37E-02	555	3.27E-02	660	1.51E-02	765	6.35E-04
455	3.17E-02	560	3.37E-02	665	1.32E-02	770	5.46E-04
460	2.22E-02	565	3.49E-02	670	1.15E-02	775	4.69E-04
465	1.80E-02	570	3.60E-02	675	1.00E-02	780	4.08E-04
470	1.34E-02	575	3.71E-02	680	8.70E-03		
475	1.09E-02	580	3.80E-02	685	7.51E-03		
480	1.08E-02	585	3.87E-02	690	6.49E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3789, 0.3788)

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

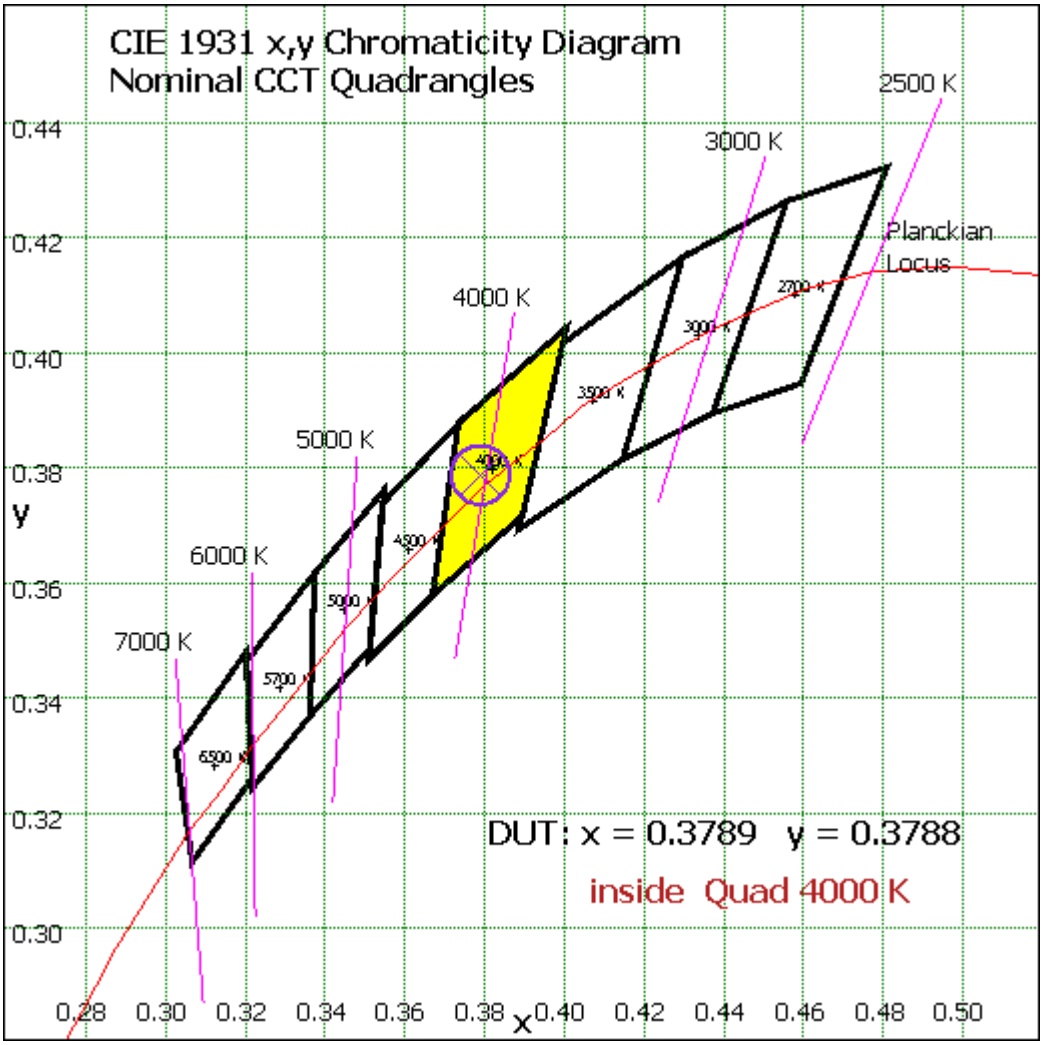


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	53.078	2.31%
10- 20	153.116	6.68%
20- 30	235.658	10.28%
30- 40	291.746	12.72%
40- 50	316.076	13.79%
50- 60	307.808	13.42%
60- 70	271.04	11.82%
70- 80	214.888	9.37%
80- 90	154.407	6.73%
90-100	106.644	4.65%
100-110	71.684	3.13%
110-120	47.008	2.05%
120-130	29.819	1.30%
130-140	18.586	0.81%
140-150	11.154	0.49%
150-160	6.296	0.27%
160-170	2.973	0.13%
170-180	0.87	0.04%
Total	2292.9	100%

γ(°)	Lumens	% Total
0- 60	1357.482	59.20%
60- 90	640.335	27.93%
0-90	1997.817	87.13%
90- 180	295.034	12.87%
0- 180	2292.9	100%

Table 5: Zonal Lumen Data

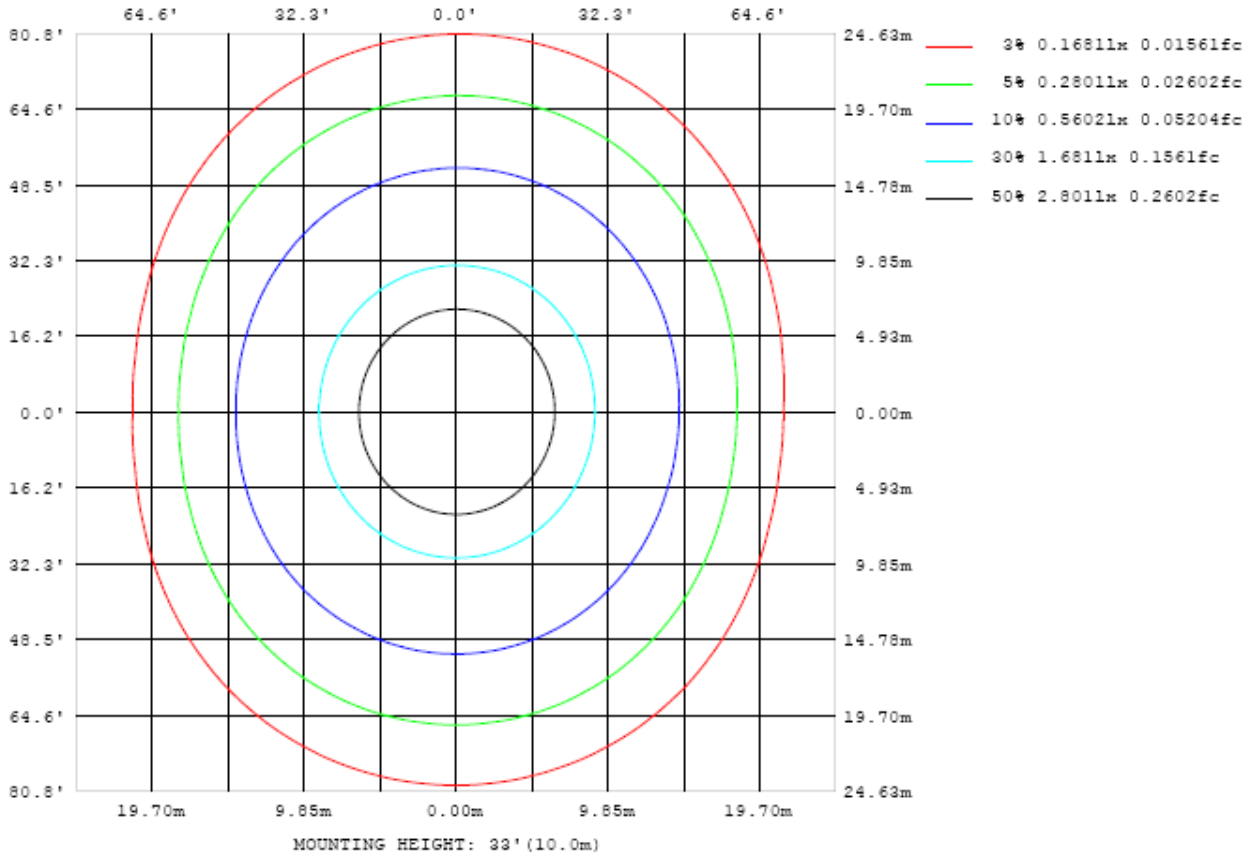


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

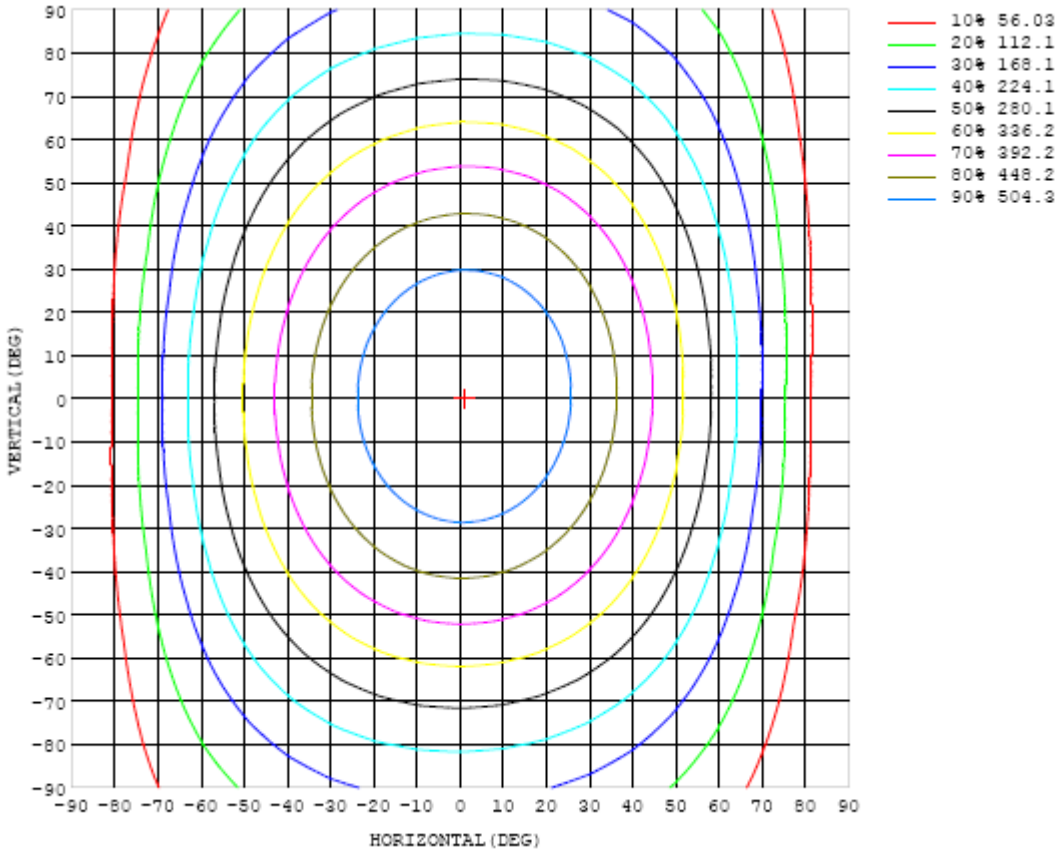


Chart 5: Isocandela Plot

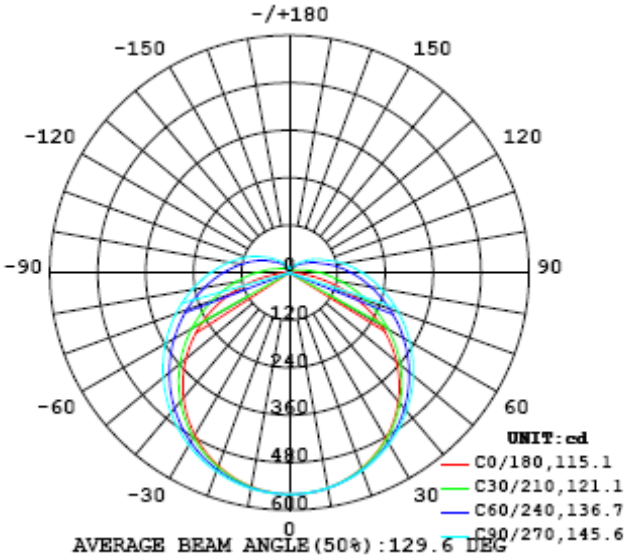


Chart 6: Polar Candela Distribution

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	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560
5	559	559	558	559	558	558	558	558	558	558	558	558	557	557	557	557	557	557	557
10	553	552	552	552	553	553	553	553	553	553	552	552	551	551	550	549	549	549	549
15	542	542	542	542	543	543	544	544	544	544	543	542	541	540	539	538	537	537	537
20	527	527	527	528	529	530	531	532	532	532	531	530	528	526	524	522	521	520	520
25	507	507	508	509	511	513	515	516	517	517	516	514	512	509	506	503	501	499	499
30	484	483	484	486	489	492	495	498	499	499	498	495	492	488	484	480	477	474	474
35	456	456	457	460	464	469	473	476	478	479	477	474	470	464	459	453	449	446	445
40	424	424	426	431	436	442	448	452	455	456	454	450	445	438	431	424	418	414	413
45	389	389	392	398	405	413	421	427	430	431	429	425	418	410	400	391	384	379	377
50	350	350	355	362	372	382	391	399	403	404	402	397	390	379	368	357	347	341	339
55	308	309	315	325	337	350	361	369	375	376	374	369	360	348	335	321	308	300	297
60	263	264	273	286	301	317	330	340	346	348	346	339	329	316	300	283	268	257	253
65	215	217	229	246	265	283	298	309	316	319	316	310	299	284	265	246	226	212	206
70	166	169	185	206	229	250	267	279	287	290	287	280	268	252	231	209	185	166	158
75	115	120	141	168	195	218	236	250	258	261	259	251	239	221	199	173	146	121	109
80	66.7	74.0	102	133	163	188	207	222	230	233	231	224	211	192	169	141	110	80.3	61.8
85	25.4	36.1	68.9	103	134	160	180	195	204	207	205	197	184	165	141	112	79.0	46.0	22.7
90	2.83	13.3	44.0	77.3	108	135	155	170	179	183	180	173	160	141	117	87.5	55.5	23.7	1.86
95	0.90	4.35	26.8	57.2	86.4	112	132	147	156	159	157	150	137	119	95.2	67.8	37.8	11.3	0.35
100	1.16	2.40	16.0	40.3	66.5	90.3	110	124	134	137	135	128	116	98.0	75.9	50.5	25.3	6.99	0.65
105	1.60	2.22	11.9	29.5	51.6	71.6	88.3	102	111	115	113	106	94.8	79.3	60.3	38.3	18.9	5.50	1.27
110	2.36	2.58	9.50	23.0	40.9	58.8	74.2	85.0	92.1	95.2	93.8	88.3	78.8	65.1	48.4	30.7	14.9	5.10	1.92
115	3.22	3.09	8.14	18.3	32.5	47.7	61.3	71.9	77.7	79.8	78.6	73.9	65.4	53.6	39.6	25.0	12.8	5.04	2.61
120	4.09	3.54	7.50	15.5	26.4	38.5	49.7	58.7	64.8	66.9	65.8	61.3	53.9	44.1	32.3	20.6	11.4	5.08	3.26
125	4.95	3.99	6.92	13.0	21.9	31.5	40.6	48.0	52.9	54.8	54.0	50.3	44.1	36.0	26.5	17.7	10.5	5.18	3.96
130	5.73	4.44	6.81	11.5	18.2	25.9	33.5	39.6	43.5	45.2	44.5	41.5	36.0	29.2	22.3	15.4	9.87	5.38	4.81
135	6.50	4.97	6.99	10.8	15.2	21.5	27.1	32.0	35.4	36.9	36.3	33.8	29.6	24.5	19.1	13.7	9.47	5.57	5.79
140	7.43	5.55	7.28	10.0	13.1	17.6	22.4	25.9	28.4	29.6	29.2	27.2	24.2	20.6	16.2	12.2	9.02	5.90	6.59
145	8.03	6.32	7.45	9.43	12.0	14.6	17.9	21.1	23.2	24.1	23.9	22.5	20.1	17.1	14.1	11.5	8.56	6.34	7.21
150	8.61	7.27	7.12	9.11	10.9	13.0	14.6	16.8	18.3	19.1	18.9	18.0	16.6	14.3	12.4	10.7	7.65	7.02	8.06
155	9.21	7.98	6.22	7.83	10.5	11.5	12.7	14.2	15.2	15.6	15.5	15.1	13.5	11.6	10.6	9.37	6.42	7.60	8.52
160	9.76	8.59	6.85	6.18	7.49	10.2	11.4	12.0	12.8	13.1	13.1	11.2	9.94	9.38	8.79	7.02	6.29	7.31	8.15
165	9.99	9.15	7.69	6.33	6.16	6.20	6.72	9.40	10.8	11.8	8.21	8.26	8.61	7.83	6.37	5.88	6.36	7.11	7.66
170	9.76	9.20	8.80	8.08	7.26	7.28	8.02	8.65	8.54	4.28	8.76	8.42	7.79	7.30	6.69	6.64	6.94	7.15	7.33
175	10.6	10.1	9.23	8.55	8.19	8.38	8.21	7.69	2.54	3.43	5.59	7.01	7.30	7.08	6.96	7.04	7.02	6.87	6.81
180	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15

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	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560	560		
5	557	557	557	558	558	558	558	559	559	559	559	559	559	559	559	559	559		
10	549	550	550	551	552	552	553	554	554	554	554	554	554	554	553	553	553		
15	537	538	539	540	542	543	544	545	546	546	546	546	545	545	544	543	542		
20	520	522	523	526	528	530	532	534	535	535	535	534	533	532	530	529	527		
25	500	501	504	507	511	514	517	519	520	521	520	519	517	515	513	510	508		
30	475	477	481	485	490	495	499	502	503	504	503	501	498	495	491	488	485		
35	447	450	454	460	466	473	478	481	484	484	483	480	476	471	466	461	457		
40	415	419	425	432	440	448	454	459	462	462	460	456	451	444	437	431	426		
45	379	385	392	402	412	421	429	435	438	438	435	430	423	415	406	398	392		
50	341	348	358	369	382	393	402	409	412	412	409	403	394	383	372	362	354		
55	300	309	321	335	350	363	374	382	386	386	382	374	363	350	336	324	313		
60	257	267	283	300	318	333	346	354	358	358	353	345	331	316	299	283	270		
65	211	225	244	266	286	303	317	326	331	330	325	315	300	282	261	241	225		
70	165	183	206	231	254	273	288	298	302	302	296	285	269	248	224	199	178		
75	118	141	171	198	223	244	260	270	275	274	268	256	238	215	188	159	132		
80	73.6	104	137	168	194	216	232	243	248	247	240	228	209	185	155	122	88.6		
85	37.8	71.6	108	140	168	190	206	217	222	221	214	201	182	157	126	89.6	52.8		
90	16.0	48.0	83.2	116	143	166	182	192	197	196	189	176	157	131	99.9	64.1	28.1		
95	6.72	32.2	63.8	94.6	122	143	159	170	175	173	166	153	134	109	79.0	45.9	15.3		
100	4.59	21.6	49.3	77.3	102	123	139	149	153	152	145	132	114	90.3	62.6	33.4	9.68		
105	4.32	16.4	36.8	62.7	85.9	105	120	129	133	132	126	114	96.4	74.5	49.4	24.8	7.92		
110	4.63	13.7	29.9	49.6	71.2	88.8	102	111	115	114	108	96.6	80.7	60.4	39.1	20.0	7.47		
115	5.07	12.2	25.2	41.0	57.0	73.6	86.2	94.4	98.1	96.9	91.1	80.5	65.8	49.2	32.2	17.1	7.44		
120	5.59	11.6	21.7	34.6	47.6	60.8	70.9	77.8	80.9	79.9	74.9	66.3	54.6	41.1	27.4	15.3	7.77		
125	6.14	10.9	19.1	29.4	40.3	49.2	59.4	64.9	67.4	66.6	62.5	55.4	45.8	34.8	23.6	14.2	8.27		
130	6.67	10.7	17.0	25.3	34.3	42.7	49.6	54.3	56.4	55.7	52.3	46.5	38.7	29.8	20.6	13.4	8.70		
135	7.40	10.7	15.6	21.7	29.0	34.4	37.7	45.5	47.0	46.5	43.7	39.1	32.8	25.6	18.2	12.9	9.15		
140	7.98	10.6	14.3	19.0	24.6	30.0	34.7	37.8	39.1	38.7	36.5	32.8	27.7	22.0	17.1	12.6	9.61		
145	8.32	10.7	13.9	17.5	21.0	25.1	28.3	30.6	32.0	31.7	30.1	27.3	23.5	19.7	15.6	12.1	9.88		
150	9.00	10.8	13.2	16.0	18.8	21.8	22.3	23.0	25.8	25.8	24.7	22.9	20.4	17.5	14.4	12.0	10.1		
155	9.00	10.7	12.8	14.6	16.9	18.9	20.2	21.0	21.8	21.7	20.8	19.3	17.8	15.6	13.5	11.9	10.4		
160	9.18	10.5	12.1	13.3	14.5	15.9	17.2	18.0	18.1	17.8	17.4	16.7	15.4	14.1	12.9	11.6	10.5		
165	8.35	9.49	11.3	12.2	13.1	13.8	14.4	14.6	14.5	14.7	14.7	14.3	13.8	13.0	12.2	11.4	10.7		
170	7.73	8.38	9.38	10.9	11.8	12.3	12.6	12.9	13.0	13.0	12.8	12.6	12.3	12.0	11.6	11.1	10.7		
175	7.20	7.72	8.41	9.20	10.1	10.9	11.3	11.4	11.4	11.2	11.1	11.1	11.1	11.0	10.9	10.9	10.8		
180	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15	9.15		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 27, 2016	Jul. 26, 2017
Digital Power Meter	PF2010A	HZTE028-01	Jul. 27, 2016	Jul. 26, 2017
AC Power Supply	PCR 500L	HZTE001-08	Jul. 27, 2016	Jul. 26, 2017
DC Power Supply	WY12010	HZTE004-03	Jul. 27, 2016	Jul. 26, 2017
Temperature Meter	TES1310	HZTE017-01	Jul. 27, 2016	Jul. 26, 2017
Standard source	D908	HZTE012-01	Jul. 27, 2016	Jul. 26, 2017
Integrate Sphere system	2M	HZTE015-01	Jul. 27, 2016	Jul. 26, 2017
Digital Power Meter	WT210	HZTE008-01	Jul. 27, 2016	Jul. 26, 2017
AC Power Supply	PCR 500L	HZTE001-07	Jul. 27, 2016	Jul. 26, 2017
DC Power Supply	6154	HZTE004-04	Jul. 27, 2016	Jul. 26, 2017
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 27, 2016	Jul. 26, 2017
Standard source	SCL-1400	HZTE012-02	Jul. 27, 2016	Jul. 26, 2017

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 1.06% 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 1.94% with a coverage factor k=2.

Color Characteristics Measurements

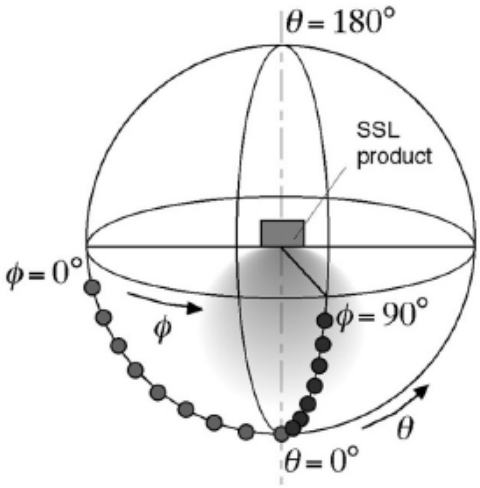
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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