LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5 Tube

Model: 15T5HE/4F/835/DIR/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17050004a

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

Review by: April Zou

Engineer: April Zou

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/835/DIR/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
123.9	2222.0	17.94	0.9960

CCT (K)	CRI	Stabilization Time (Light & Power)
3422	83.5	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

TABLE OF CONTENT

Sample Photos

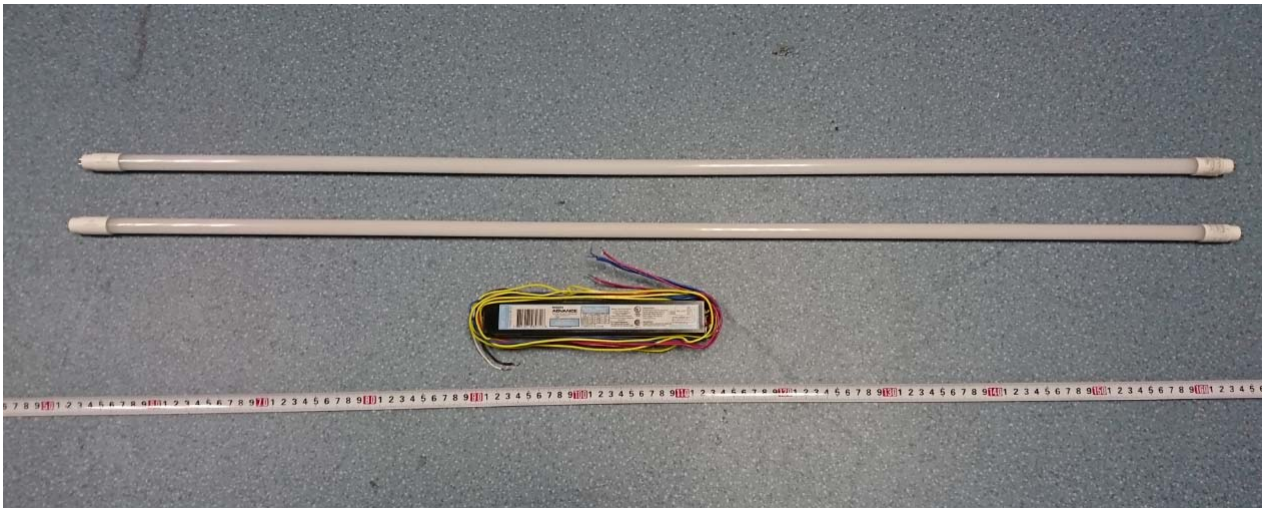


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5 Tube
Model	: 15T5HE/4F/835/DIR/R
Electrical Ratings	: 120Vac, 60Hz, 15W
Product Description	: Mini Bi-Pin G5 base, 3500K 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	0.996
Test Power (W)/2	17.94
THD A%	6.04
Luminous Efficacy (lm/W)	123.9
Total Luminous Flux (lm)	2222.0
Color Rendering Index (CRI)	83.5
R9	10.2
Correlated Color Temperature (CCT)(K)	3422
Chromaticity Chroma x	0.4091
Chromaticity Chroma y	0.3916
Chromaticity Chroma u	0.2378
Chromaticity Chroma v	0.3415
Duv	0.0008
Chromaticity Chroma u ’	0.2378
Chromaticity Chroma v’	0.5122

Special Color Rendering Indices	
R1	82.1
R2	91.8
R3	96.1
R4	80.9
R5	82.2
R6	89
R7	83.8
R8	61.8
R9	10.2
R10	80.5
R11	79.9
R12	67.9
R13	84.7
R14	98.5
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 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)	0.269
Power Factor	0.9951
Test Power (W)	32.16
Luminous Efficacy (lm/W)	142.9
Total Luminous Flux (lm)	2297.2
Beam Angle (°)	124.7
Center Beam Candle Power (cd)	585
Spacing Criteria	1.24 (0°-180°)/ 1.28 (90°-270°)
Zonal Lumens in the 0°-60°Zone	59.75%
Zonal Lumens in the 60°-90°Zone	27.15%
Zonal Lumens in the 90°-120°Zone	9.81%
Zonal Lumens in the 120°-180°Zone	3.29%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

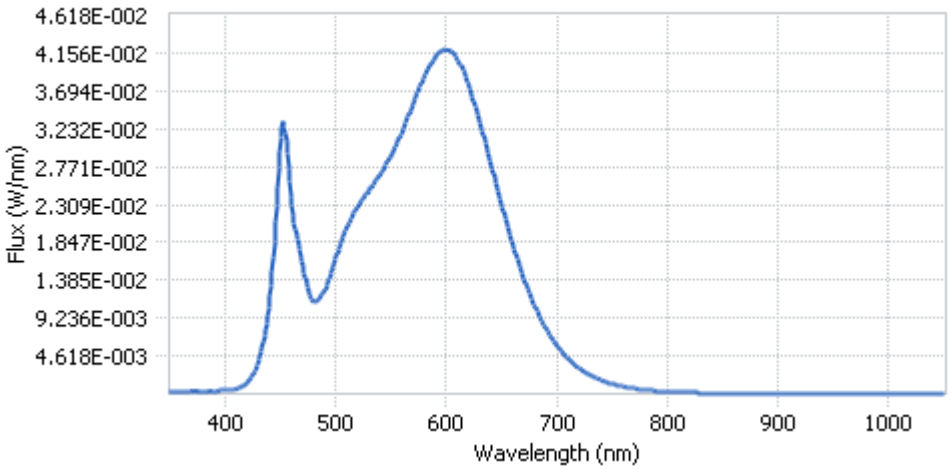
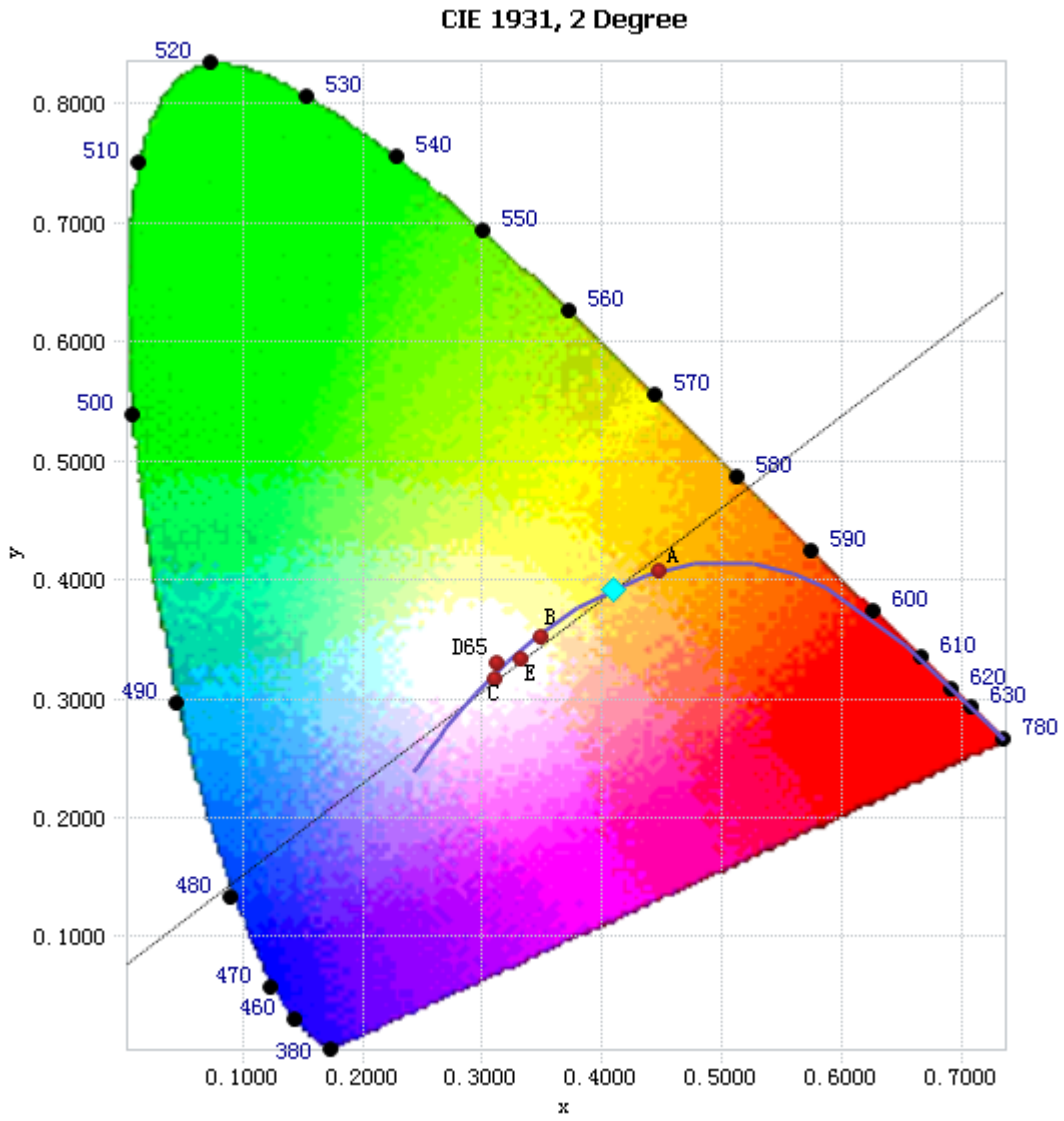


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.60E-04	485	1.15E-02	590	4.09E-02	695	6.94E-03
385	3.50E-04	490	1.26E-02	595	4.17E-02	700	5.96E-03
390	3.47E-04	495	1.42E-02	600	4.20E-02	705	5.08E-03
395	3.77E-04	500	1.63E-02	605	4.17E-02	710	4.34E-03
400	4.17E-04	505	1.84E-02	610	4.09E-02	715	3.73E-03
405	4.61E-04	510	2.01E-02	615	3.96E-02	720	3.19E-03
410	6.00E-04	515	2.16E-02	620	3.78E-02	725	2.72E-03
415	8.33E-04	520	2.28E-02	625	3.58E-02	730	2.32E-03
420	1.31E-03	525	2.38E-02	630	3.35E-02	735	1.97E-03
425	2.18E-03	530	2.48E-02	635	3.09E-02	740	1.69E-03
430	3.71E-03	535	2.57E-02	640	2.84E-02	745	1.44E-03
435	6.27E-03	540	2.67E-02	645	2.57E-02	750	1.23E-03
440	1.06E-02	545	2.78E-02	650	2.32E-02	755	1.05E-03
445	1.86E-02	550	2.90E-02	655	2.08E-02	760	9.03E-04
450	2.95E-02	555	3.04E-02	660	1.85E-02	765	7.73E-04
455	3.19E-02	560	3.19E-02	665	1.63E-02	770	6.69E-04
460	2.41E-02	565	3.36E-02	670	1.43E-02	775	5.70E-04
465	1.93E-02	570	3.53E-02	675	1.25E-02	780	4.94E-04
470	1.62E-02	575	3.69E-02	680	1.08E-02		
475	1.29E-02	580	3.85E-02	685	9.34E-03		
480	1.13E-02	585	4.00E-02	690	8.08E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4091, 0.3916)

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

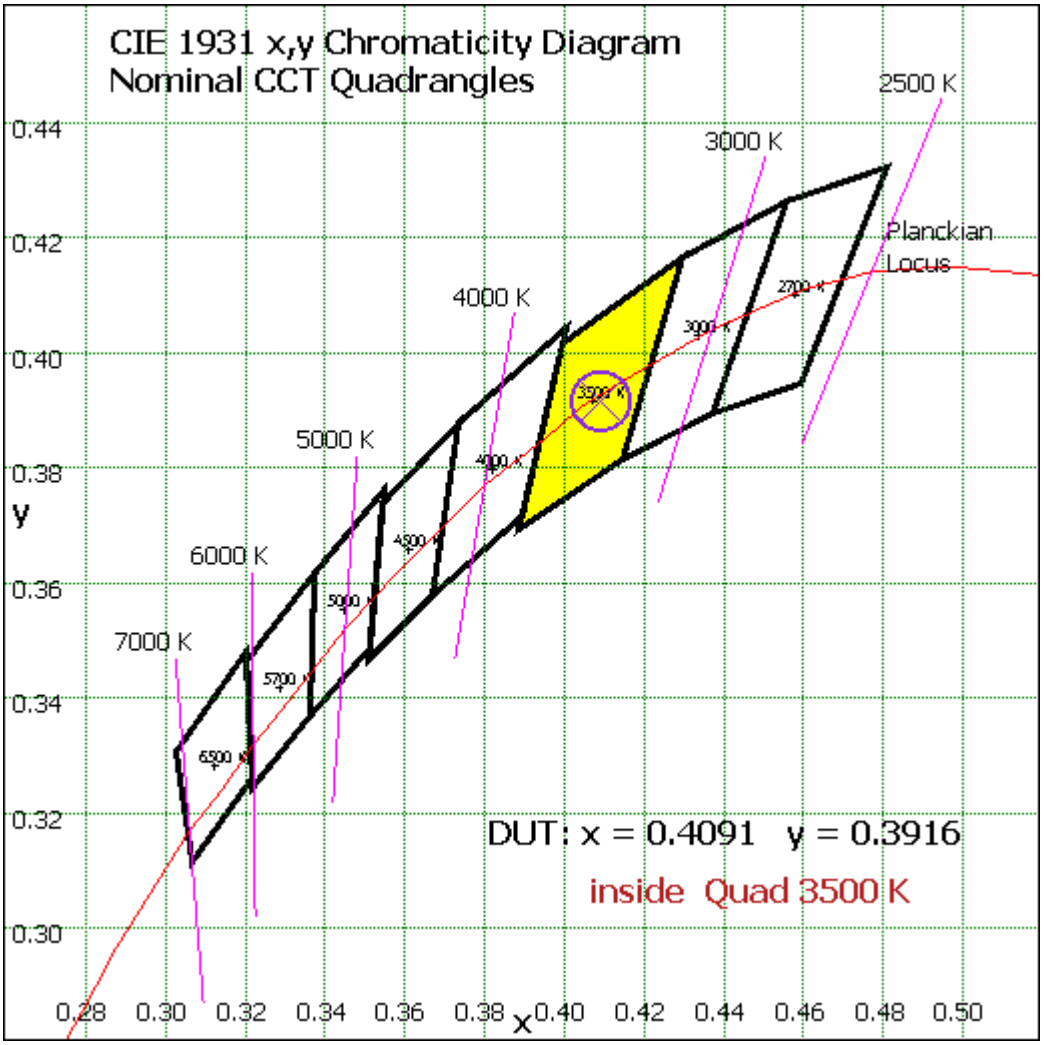


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	55.389	2.41%
10- 20	158.911	6.92%
20- 30	242.167	10.54%
30- 40	295.942	12.88%
40- 50	316.152	13.76%
50- 60	303.925	13.23%
60- 70	264.583	11.52%
70- 80	208.546	9.08%
80- 90	150.651	6.56%
90-100	105.549	4.59%
100-110	72.108	3.14%
110-120	47.67	2.08%
120-130	31.511	1.37%
130-140	20.168	0.88%
140-150	12.434	0.54%
150-160	7.164	0.31%
160-170	3.42	0.15%
170-180	0.936	0.04%
Total	2297.2	100%

γ(°)	Lumens	% Total
0- 60	1372.486	59.75%
60- 90	623.78	27.15%
0-90	1996.266	86.90%
90- 180	300.96	13.10%
0- 180	2297.2	100%

Table 5: Zonal Lumen Data

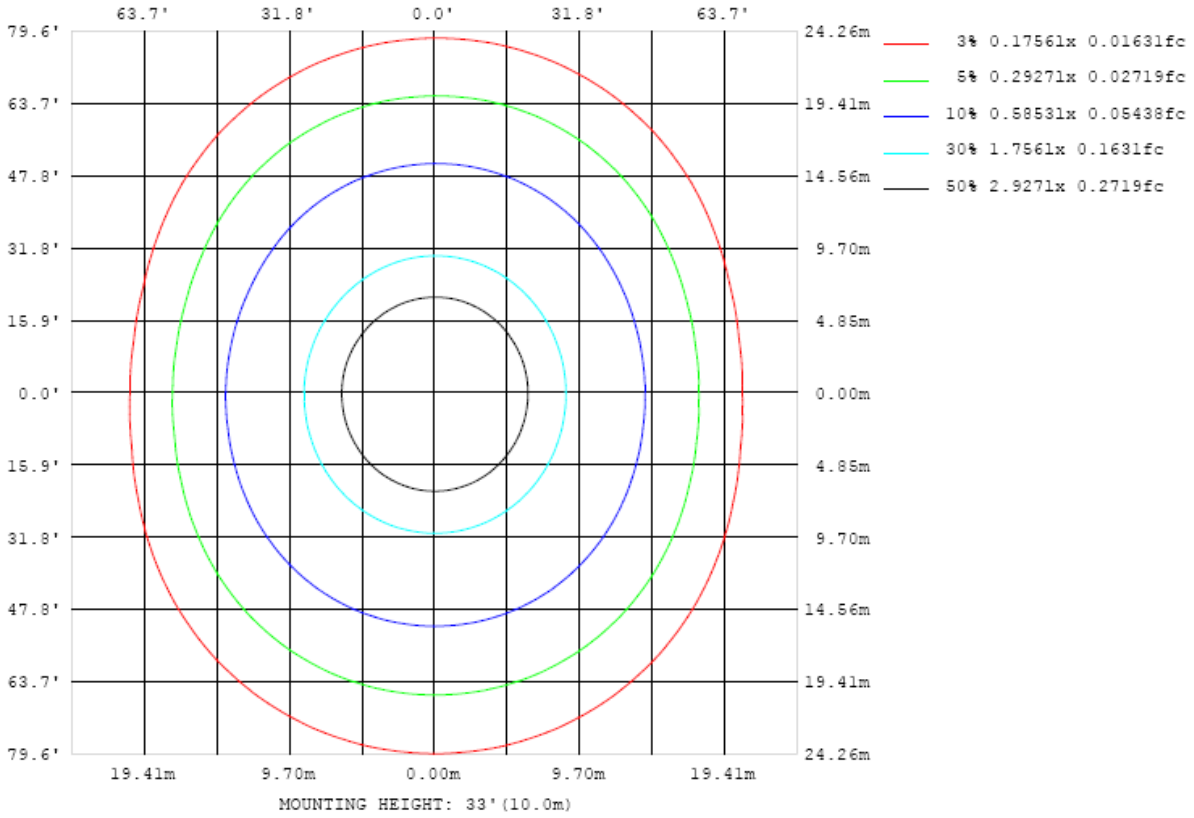


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

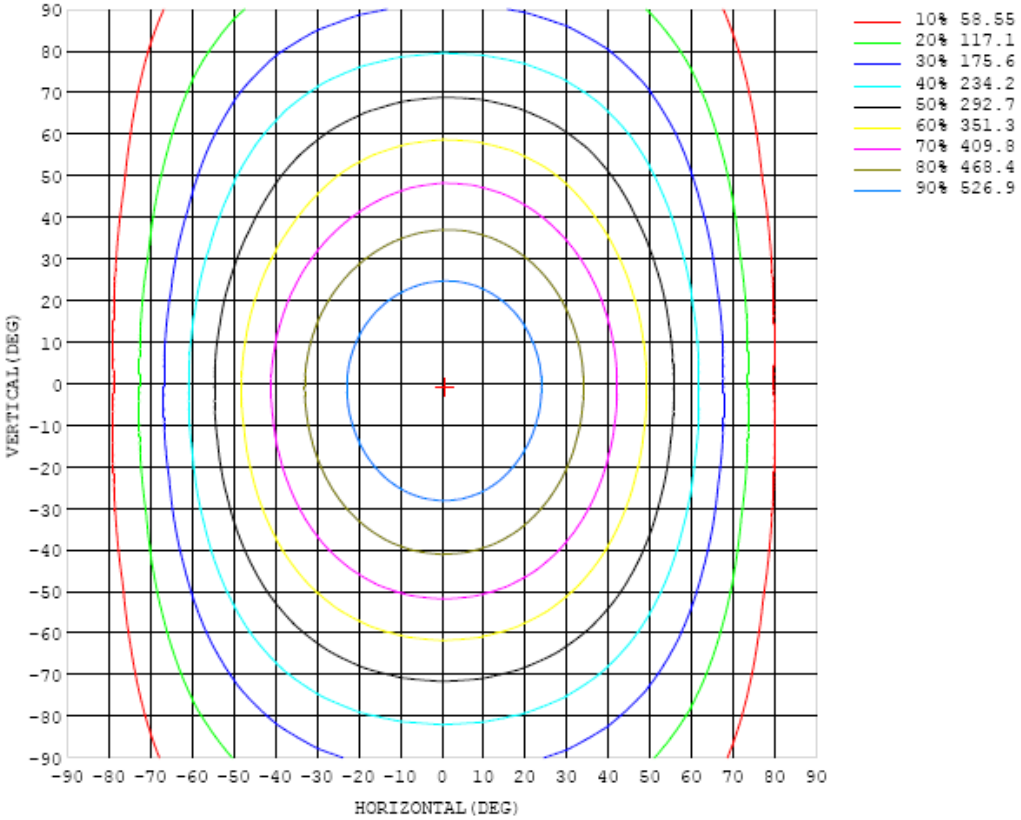


Chart 5: Isocandela Plot

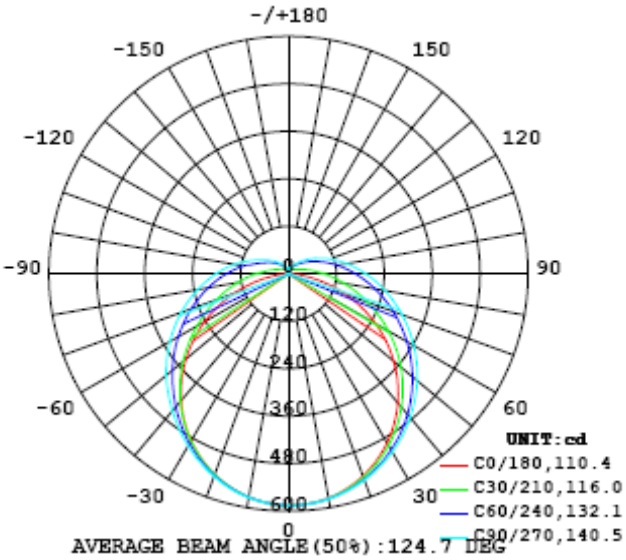


Chart 6: Polar Candela Distribution

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	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585
5	583	583	583	584	584	584	584	584	584	584	584	583	583	583	583	583	582	582	582
10	576	576	576	577	577	577	578	578	578	578	577	577	576	576	575	575	574	574	573
15	563	563	564	565	565	566	567	568	568	568	568	567	566	564	563	562	561	560	559
20	544	545	546	548	549	551	553	554	555	555	554	553	551	549	546	544	542	541	540
25	521	522	524	526	529	532	535	537	539	539	538	536	533	529	526	522	519	517	516
30	494	495	497	501	505	510	514	518	519	520	519	516	511	506	501	496	492	489	488
35	462	463	467	472	478	484	490	495	497	498	496	493	487	481	473	466	461	457	455
40	426	428	433	440	448	456	464	470	473	474	472	467	460	452	443	434	426	420	418
45	386	389	395	405	415	426	435	443	447	448	446	440	432	421	410	398	388	381	378
50	344	347	355	367	380	394	405	414	419	420	418	412	402	389	375	361	348	339	335
55	299	303	314	329	345	360	374	384	390	392	389	382	370	356	339	322	306	294	290
60	251	257	271	289	308	327	342	354	360	362	359	351	339	322	303	282	263	248	243
65	202	210	227	250	272	293	310	323	330	332	329	321	307	289	267	243	220	201	194
70	152	162	184	211	237	260	279	292	300	303	299	291	276	257	233	205	177	153	144
75	102	116	144	175	204	229	249	263	271	273	270	261	246	226	200	170	137	108	95.1
80	55.9	73.9	107	142	173	199	220	234	243	245	242	233	218	197	170	138	102	67.7	49.6
85	18.1	40.2	77.0	113	145	172	193	207	216	219	215	206	191	170	143	110	73.3	36.0	14.5
90	0.38	19.3	53.8	88.8	120	147	168	182	191	193	190	181	166	145	119	86.6	51.4	17.5	0.87
95	0.50	9.60	37.4	69.8	99.5	125	145	159	167	170	167	159	144	124	98.2	68.5	36.3	9.22	1.04
100	0.95	6.30	26.4	54.3	81.8	105	124	138	146	149	146	137	124	105	80.8	53.6	26.0	6.23	1.86
105	1.28	5.32	19.7	42.0	66.3	88.0	106	119	126	129	126	118	105	87.5	65.8	42.0	19.9	5.63	2.62
110	1.66	5.28	16.0	33.4	53.4	72.4	88.4	100	108	110	107	100	88.1	72.2	53.8	33.6	16.2	5.89	3.42
115	2.21	5.49	13.7	27.6	43.8	59.8	73.4	83.5	89.8	91.9	89.6	83.4	73.7	60.3	44.1	27.7	14.4	6.34	4.22
120	2.74	6.00	12.5	23.2	36.5	49.8	61.4	70.2	75.7	77.6	75.8	70.5	61.8	49.4	36.6	23.6	13.3	6.94	4.96
125	3.27	6.44	11.8	20.1	30.5	41.4	51.3	58.8	63.5	65.1	63.6	59.1	51.7	41.4	30.7	20.8	12.4	7.59	5.66
130	3.78	6.72	11.4	17.9	26.0	34.6	42.5	48.9	52.8	54.2	52.9	49.0	41.1	34.7	26.5	18.7	12.3	8.16	6.23
135	4.25	7.24	11.2	16.3	22.5	29.2	35.4	40.4	43.6	44.7	43.7	40.5	35.4	29.4	23.0	16.6	11.9	8.75	6.81
140	4.69	7.75	10.9	15.0	19.8	25.0	29.8	33.6	36.0	36.9	36.2	33.7	29.8	25.2	19.9	15.6	11.8	9.37	7.33
145	5.10	8.19	10.1	14.0	17.6	21.5	25.1	28.0	29.9	30.5	30.0	28.0	25.1	21.5	17.7	14.5	11.8	10.00	7.74
150	5.59	8.72	9.97	13.0	15.8	18.6	21.2	23.4	24.8	25.3	24.9	22.9	20.7	18.6	15.9	13.5	11.5	10.5	8.02
155	5.80	8.36	10.4	11.3	14.3	16.3	18.1	19.6	20.6	21.0	20.8	19.6	17.4	16.3	14.3	12.7	11.2	10.5	8.19
160	5.63	6.86	10.3	11.5	12.1	14.4	15.7	16.7	17.4	17.6	17.6	16.8	15.3	14.5	12.3	11.6	10.8	9.92	8.27
165	5.61	5.92	8.21	11.3	12.1	12.6	13.2	14.1	14.7	14.9	14.9	14.0	13.1	11.4	11.1	10.2	9.66	9.11	8.22
170	5.85	5.82	6.35	8.47	11.1	11.7	12.3	12.8	12.9	13.0	12.9	11.8	10.2	9.53	9.49	9.55	9.44	8.61	8.48
175	8.41	8.45	8.18	8.10	9.44	9.22	9.67	10.5	12.1	12.2	9.43	7.78	8.02	8.84	9.29	9.71	9.75	9.79	9.73
180	3.72	3.71	3.70	3.68	3.65	3.61	3.57	3.53	3.48	3.44	3.45	3.46	3.47	3.48	3.48	3.49	3.50	3.50	3.50

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	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585		
5	582	582	582	582	582	582	582	582	582	582	582	582	583	583	583	583	583		
10	573	573	573	573	573	574	574	574	574	575	575	575	575	575	575	575	575		
15	559	559	559	559	560	560	561	561	562	562	562	562	562	562	562	562	563		
20	540	540	540	541	542	543	544	545	545	546	546	546	545	545	544	544	544		
25	516	516	516	518	519	521	523	524	525	526	526	525	524	523	522	521	521		
30	487	487	488	490	493	496	499	501	503	503	503	501	499	497	495	494	494		
35	454	455	456	460	464	468	473	476	478	479	478	475	472	468	465	463	462		
40	417	418	422	426	433	439	445	450	452	453	451	447	442	436	431	427	426		
45	378	379	384	391	400	409	417	423	426	426	423	417	410	402	395	389	386		
50	335	338	345	355	367	379	390	397	400	400	396	388	377	366	356	348	345		
55	290	295	305	319	335	349	361	368	372	372	367	358	346	331	317	306	300		
60	243	251	265	285	303	319	331	340	343	343	337	327	313	296	277	262	253		
65	196	207	228	250	271	288	302	310	315	314	307	296	280	261	239	218	206		
70	149	167	192	217	240	259	273	282	286	285	278	266	248	227	202	177	158		
75	104	129	159	187	211	231	246	254	259	257	250	237	218	195	168	138	112		
80	64.2	96.2	129	160	184	204	218	228	231	230	222	209	190	166	136	102	69.8		
85	35.0	69.3	103	134	159	179	193	202	206	204	196	183	164	139	108	72.8	37.7		
90	17.7	48.5	81.2	111	136	155	170	179	182	180	172	159	140	115	84.4	50.4	18.1		
95	9.60	33.6	62.8	90.1	115	134	148	156	159	157	150	137	118	94.0	65.3	34.5	8.50		
100	6.78	24.6	48.4	73.6	95.8	115	128	136	138	136	129	116	98.9	76.1	49.5	23.8	5.78		
105	6.75	19.8	39.2	59.6	78.7	92.7	108	115	118	116	110	97.1	80.5	60.4	38.5	18.3	5.21		
110	6.96	16.2	31.5	48.9	65.4	78.8	87.0	96.1	98.6	97.0	90.9	80.5	66.5	49.5	31.4	15.0	5.21		
115	7.17	15.2	27.0	40.6	54.0	65.1	75.6	76.7	84.1	82.3	76.9	67.8	55.7	41.3	26.1	13.4	5.36		
120	7.81	14.1	24.0	35.7	47.4	57.7	65.5	69.9	70.7	70.0	65.2	57.4	47.0	34.8	22.6	12.5	5.99		
125	8.46	13.5	21.5	30.9	40.5	49.0	55.7	58.9	60.9	59.4	55.3	48.6	39.8	29.8	19.7	11.6	6.52		
130	8.93	13.0	19.5	27.1	34.8	41.9	47.4	50.9	50.5	50.3	46.8	41.2	34.0	25.9	18.1	11.2	6.67		
135	9.54	12.7	17.9	23.9	30.2	35.7	39.8	42.5	43.0	42.5	39.6	35.0	29.3	22.8	16.2	11.1	6.88		
140	9.95	12.5	16.4	21.2	26.0	30.6	34.1	36.3	36.6	35.7	33.5	29.8	25.3	20.2	14.6	11.2	7.42		
145	10.4	12.5	15.3	19.0	22.8	26.1	28.6	29.8	29.9	28.9	28.0	24.9	21.7	17.5	13.9	11.1	8.09		
150	10.8	12.1	14.1	17.0	19.8	22.3	24.2	25.4	26.0	25.2	23.4	21.1	18.6	15.6	13.7	10.8	8.50		
155	10.7	11.7	13.4	15.1	17.3	19.2	20.6	21.5	21.7	21.2	19.5	18.7	16.4	15.2	13.4	10.7	9.15		
160	9.47	10.8	11.8	13.2	15.4	16.4	17.5	18.2	18.3	16.8	16.9	16.3	15.7	14.4	12.6	11.0	7.45		
165	8.71	9.69	10.2	10.8	11.8	13.8	15.3	15.7	15.9	15.7	15.2	14.7	14.0	13.1	12.2	10.9	6.33		
170	8.52	8.78	9.38	9.91	10.0	9.80	10.9	12.6	13.8	13.8	13.0	13.0	12.6	11.8	11.4	7.76	6.11		
175	9.74	9.71	9.57	9.79	9.41	9.75	9.03	7.73	8.14	11.6	11.3	10.6	10.3	9.36	9.53	8.51	8.31		
180	3.50	3.50	3.49	3.48	3.48	3.47	3.46	3.45	3.44	3.48	3.53	3.57	3.61	3.65	3.68	3.70	3.71		

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

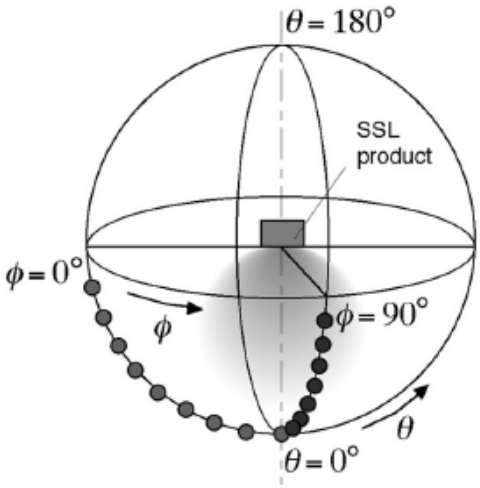
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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