LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

T5 TUBE

Model: 24T5HO/4F/850/DIR/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17050025b

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 16, 2017

Approved by: Zhang

Manager: Jim Zhang

May 16, 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: **24T5HO/4F/850/DIR/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
123.0	3553.0	28.88	0.9965

CCT (K)	CRI	Stabilization Time (Light & Power)
5022	81.2	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 09, 2017
Date of Test	: May 13, 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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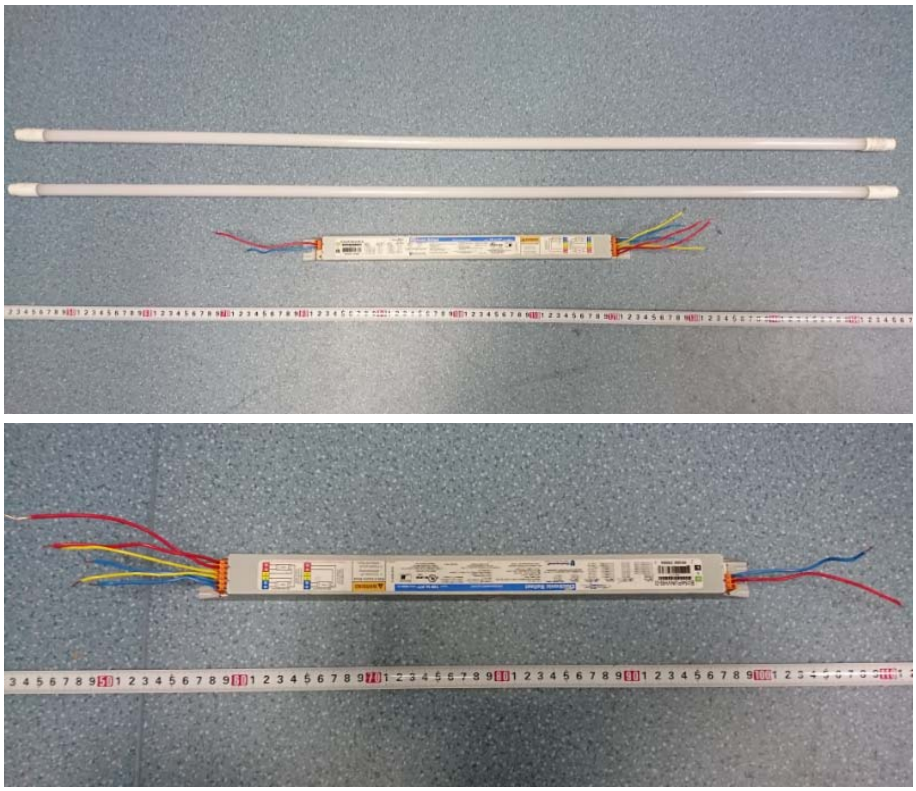


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: T5 TUBE
Model	: 24T5HO/4F/850/DIR/R
Electrical Ratings	: 120Vac, 60Hz, 29W
Product Description	: Mini Bi-Pin G5 base, 5000K, CRI80 LED Tubes supplied by a high frequency fluorescent lamp ballast: B254PUNVHB-D
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
Voltage frequency (Hz)	60
Test Current (A)	0.483
Power Factor	0.9965
Test Power (W)/2	28.88
THD A%	6.08
Luminous Efficacy (lm/W)	123.0
Total Luminous Flux (lm)	3553.0
Color Rendering Index (CRI)	81.2
R9	-1.8
Correlated Color Temperature (CCT)(K)	5022
Chromaticity Chroma x	0.3450
Chromaticity Chroma y	0.3585
Chromaticity Chroma u	0.2087
Chromaticity Chroma v	0.3253
Duv	0.0027
Chromaticity Chroma u ’	0.2087
Chromaticity Chroma v’	0.4880

Special Color Rendering Indices	
R1	78.8
R2	86
R3	91.6
R4	81.5
R5	80.1
R6	81.1
R7	85.8
R8	64.5
R9	-1.8
R10	67.2
R11	80.9
R12	61.8
R13	80.4
R14	95.5
Rf	81
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)	0.483
Power Factor	0.9975
Test Power (W)/2	28.93
Luminous Efficacy (lm/W)	124.4
Total Luminous Flux (lm)	3600.0
Beam Angle (°)	128.0
Center Beam Candle Power (cd)	895
Spacing Criteria	1.26 (0°-180°)/ 1.32 (90°-270°)
Zonal Lumens in the 0°-60°Zone	59.67%
Zonal Lumens in the 60°-90°Zone	27.48%
Zonal Lumens in the 90°-120°Zone	9.69%
Zonal Lumens in the 120°-180°Zone	3.16%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

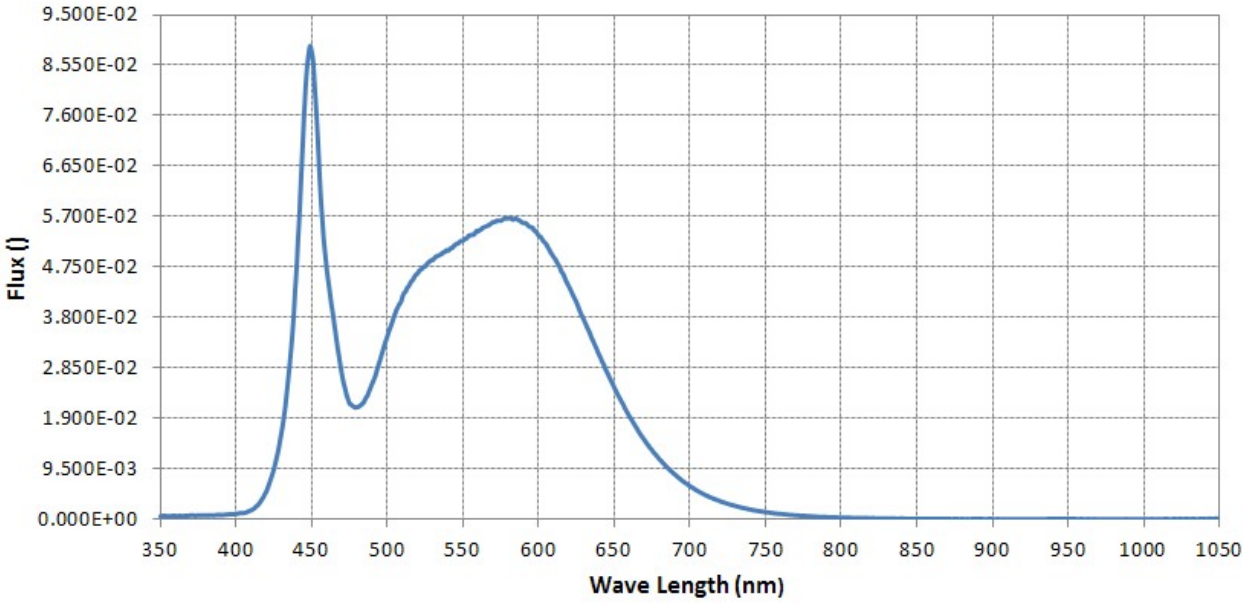
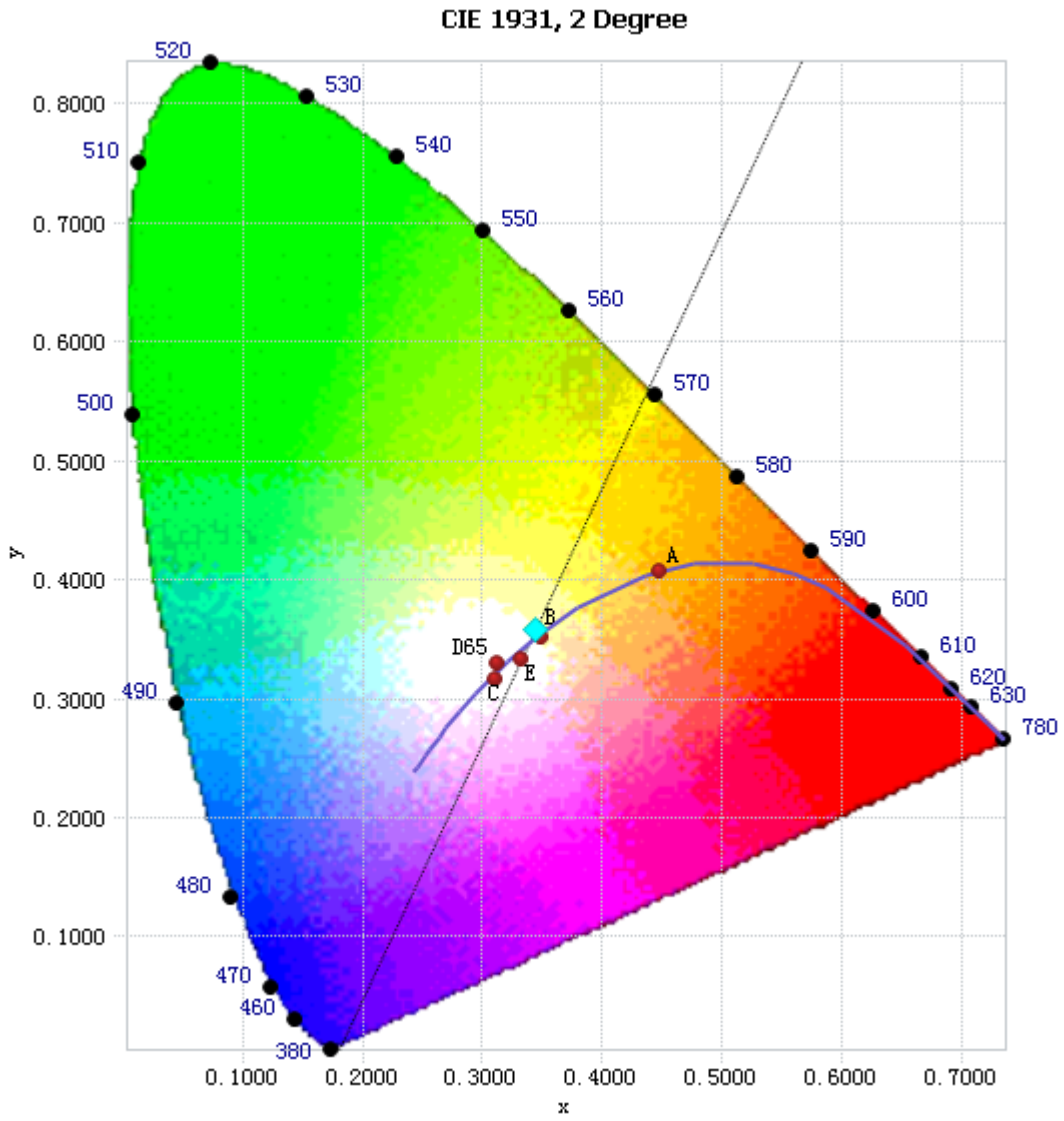


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	7.67E-04	485	2.24E-02	590	5.58E-02	695	7.26E-03
385	7.32E-04	490	2.56E-02	595	5.50E-02	700	6.27E-03
390	8.05E-04	495	2.98E-02	600	5.34E-02	705	5.37E-03
395	9.39E-04	500	3.44E-02	605	5.18E-02	710	4.57E-03
400	9.91E-04	505	3.86E-02	610	4.93E-02	715	3.97E-03
405	1.18E-03	510	4.19E-02	615	4.67E-02	720	3.40E-03
410	1.69E-03	515	4.44E-02	620	4.39E-02	725	2.92E-03
415	2.83E-03	520	4.63E-02	625	4.08E-02	730	2.52E-03
420	5.22E-03	525	4.76E-02	630	3.75E-02	735	2.14E-03
425	9.42E-03	530	4.88E-02	635	3.42E-02	740	1.85E-03
430	1.63E-02	535	4.99E-02	640	3.10E-02	745	1.57E-03
435	2.79E-02	540	5.06E-02	645	2.78E-02	750	1.36E-03
440	4.71E-02	545	5.17E-02	650	2.48E-02	755	1.17E-03
445	7.64E-02	550	5.25E-02	655	2.21E-02	760	1.00E-03
450	8.79E-02	555	5.35E-02	660	1.94E-02	765	8.67E-04
455	6.61E-02	560	5.42E-02	665	1.71E-02	770	7.58E-04
460	4.69E-02	565	5.51E-02	670	1.49E-02	775	6.50E-04
465	3.65E-02	570	5.60E-02	675	1.30E-02	780	5.72E-04
470	2.72E-02	575	5.62E-02	680	1.13E-02		
475	2.18E-02	580	5.67E-02	685	9.77E-03		
480	2.11E-02	585	5.66E-02	690	8.44E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3450, 0.3585)

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

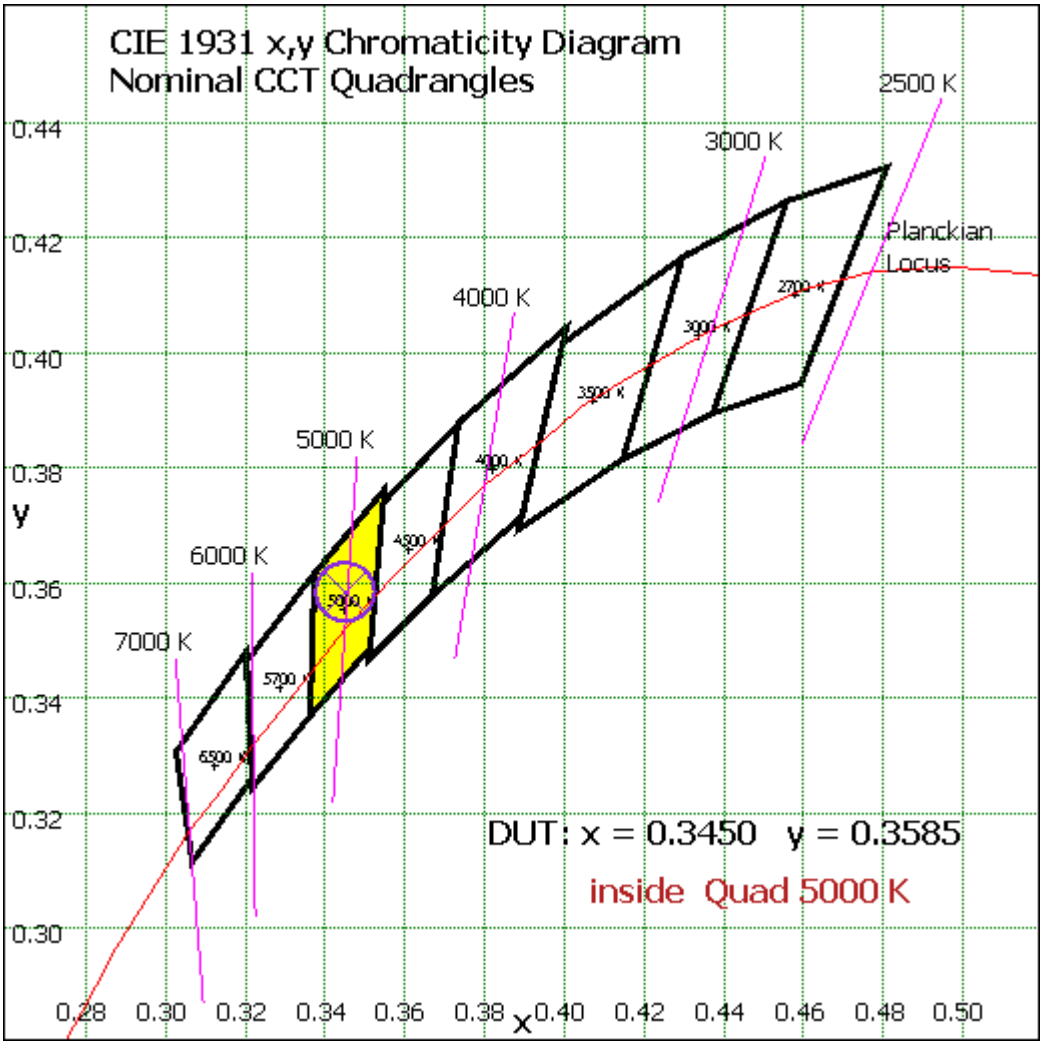


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	84.786	2.36%
10- 20	244.317	6.79%
20- 30	375.156	10.42%
30- 40	462.735	12.85%
40- 50	498.717	13.85%
50- 60	482.455	13.40%
60- 70	421.349	11.70%
70- 80	331.192	9.20%
80- 90	236.861	6.58%
90-100	164.218	4.56%
100-110	111.54	3.10%
110-120	72.949	2.03%
120-130	47.431	1.32%
130-140	30.316	0.84%
140-150	18.695	0.52%
150-160	10.763	0.30%
160-170	5.093	0.14%
170-180	1.365	0.04%
Total	3599.9	100%

γ(°)	Lumens	% Total
0- 60	2148.166	59.67%
60- 90	989.402	27.48%
0-90	3137.568	87.16%
90- 180	462.37	12.84%
0- 180	3599.9	100%

Table 5: Zonal Lumen Data

Note: The Flux in this table might be a little different from the total flux in Table 2 due to rounding.

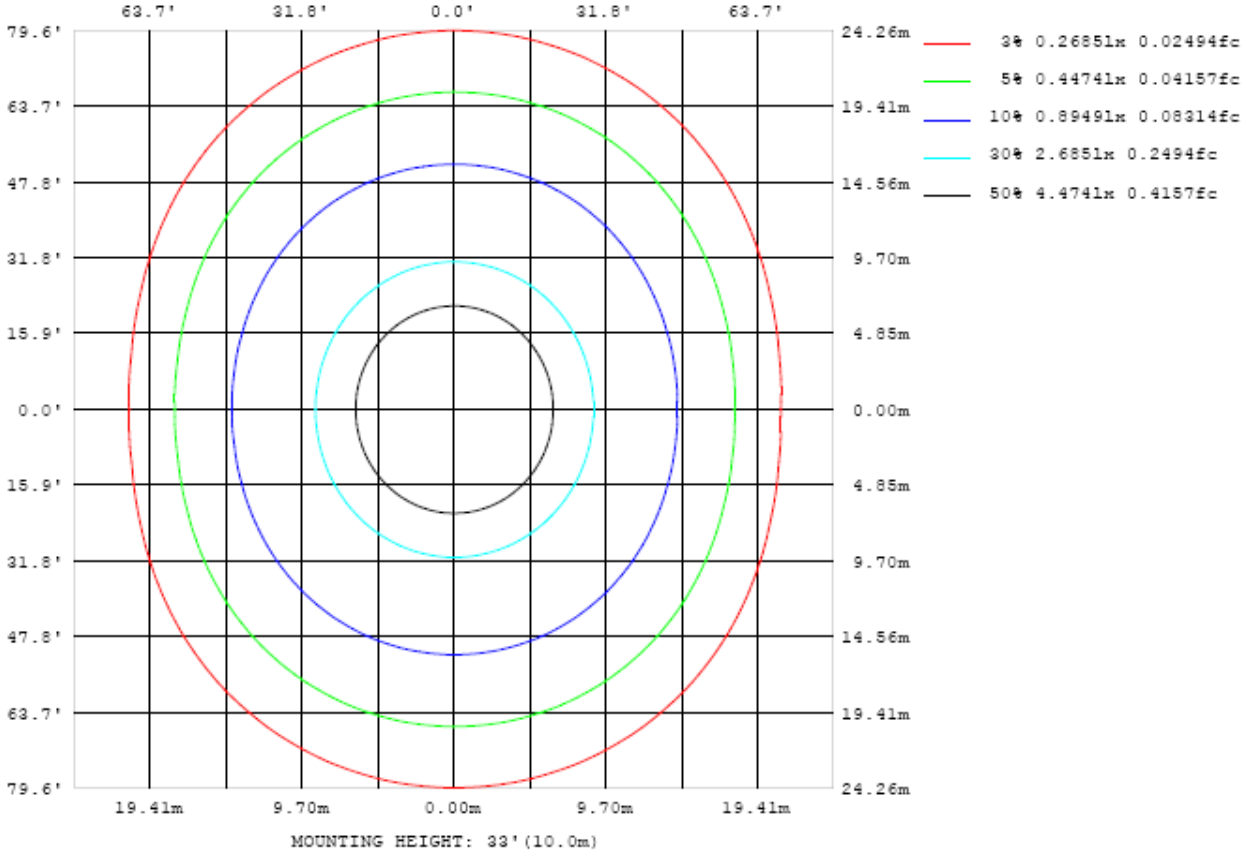


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

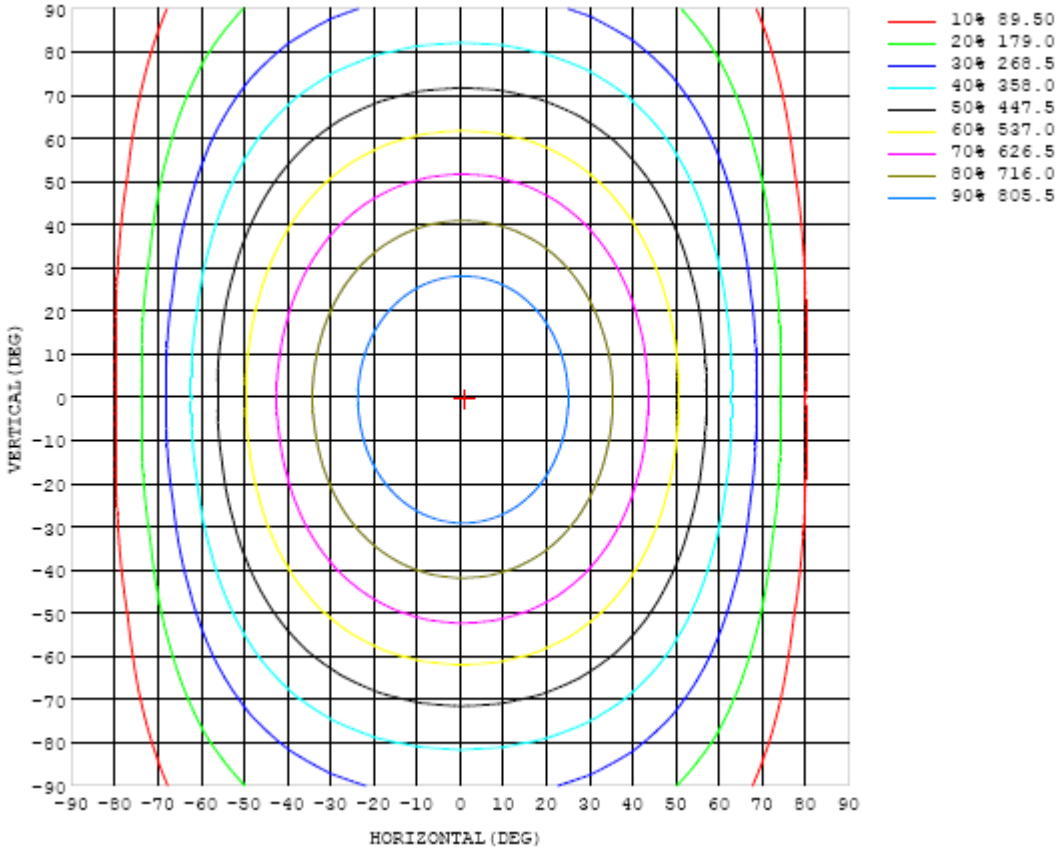


Chart 5: Isocandela Plot

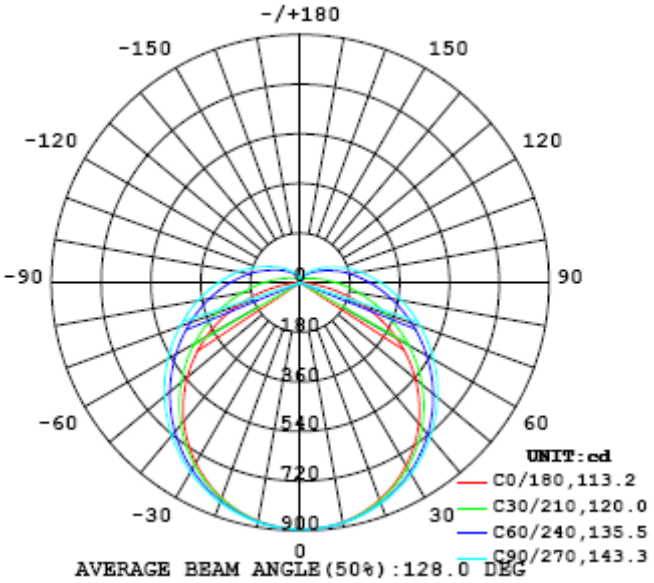


Chart 6: Polar Candela Distribution

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	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895
5	892	892	892	893	893	893	893	893	893	893	892	892	892	891	891	891	890	890	890
10	882	882	882	883	884	884	885	885	885	885	884	884	883	881	880	879	878	878	878
15	864	864	865	866	868	869	870	871	872	871	871	869	867	865	863	861	859	858	858
20	838	839	841	843	845	848	850	852	853	853	851	849	846	843	839	836	833	831	830
25	805	806	809	812	817	821	825	827	829	829	827	824	820	815	809	804	800	797	796
30	765	767	771	775	782	788	794	798	800	801	799	794	788	781	774	767	760	756	756
35	719	721	726	733	741	750	758	764	767	768	765	760	752	743	733	723	715	710	709
40	666	669	676	685	696	708	718	725	730	731	728	721	712	700	687	675	664	657	656
45	608	611	620	632	646	661	674	684	689	691	687	679	668	653	637	621	608	599	597
50	544	548	559	575	593	612	627	639	646	648	644	635	621	604	584	565	548	536	534
55	475	481	495	515	538	560	578	592	600	602	598	588	572	552	529	505	484	469	466
60	402	409	427	453	481	507	528	544	553	556	552	540	522	499	472	444	417	398	393
65	325	334	358	390	423	454	478	496	506	509	504	492	473	447	416	382	349	324	317
70	245	258	289	329	367	401	428	448	459	462	457	444	424	396	361	322	282	249	239
75	165	183	224	270	314	351	380	401	413	416	412	398	376	346	309	265	218	176	161
80	89.6	114	164	217	264	304	334	356	368	372	367	354	331	300	260	213	161	110	86.4
85	28.9	60.2	114	170	219	260	292	314	326	330	326	312	289	257	217	168	113	59.5	26.7
90	0.41	26.6	77.2	131	180	221	252	274	287	291	287	273	250	219	179	131	77.8	27.9	0.50
95	0.79	12.3	52.2	100	147	186	216	238	251	255	250	237	215	185	146	101	53.7	13.8	0.76
100	1.53	8.07	35.5	76.3	118	155	184	205	217	221	217	205	184	155	119	77.5	37.3	9.59	1.26
105	2.40	6.90	26.1	58.0	93.8	128	155	175	187	191	187	175	155	128	94.7	60.0	28.4	8.40	2.11
110	3.49	7.32	21.3	45.6	74.7	103	128	146	158	162	158	147	128	104	76.4	48.0	23.6	8.68	3.06
115	4.62	8.15	18.5	37.5	60.8	84.1	105	120	130	134	130	121	106	85.8	63.0	39.8	20.9	9.34	4.01
120	5.69	8.98	17.2	31.9	50.4	69.7	86.5	99.8	108	111	109	101	87.8	71.4	52.5	34.2	19.3	10.0	4.99
125	6.68	9.66	16.5	27.7	42.5	58.0	72.0	82.8	89.9	92.5	90.5	83.8	73.2	59.8	44.6	30.1	18.4	10.8	5.96
130	7.62	10.8	16.3	24.9	36.4	48.7	60.1	69.1	74.8	76.8	75.2	70.1	61.4	50.5	38.5	27.0	17.8	11.4	6.86
135	8.45	11.7	16.2	22.9	31.7	41.3	50.3	57.5	62.2	64.1	62.7	58.4	51.4	42.9	33.5	24.7	17.3	11.8	7.55
140	9.13	12.2	16.2	21.5	28.0	35.3	42.2	47.9	51.6	53.0	52.0	48.7	43.3	36.6	29.5	22.8	16.9	12.1	8.26
145	9.66	11.2	15.5	20.3	25.2	30.6	35.6	39.8	42.7	43.8	43.1	40.6	36.6	31.6	26.4	21.2	16.5	12.5	8.87
150	10.1	11.0	15.9	19.2	22.7	26.8	30.4	33.4	35.4	36.3	35.8	34.0	31.0	27.6	23.7	19.8	15.4	12.9	9.37
155	10.4	10.7	16.0	17.8	20.9	23.6	26.2	28.3	29.6	30.2	29.9	28.7	26.7	24.5	21.6	18.5	15.2	11.2	9.69
160	10.6	9.18	14.6	17.7	19.1	21.4	23.0	24.2	25.0	25.2	25.1	24.4	23.3	21.8	19.0	15.6	13.1	10.8	9.87
165	10.7	9.01	12.1	16.1	18.4	19.3	20.1	21.2	21.7	22.0	21.8	21.5	20.5	17.4	15.4	12.8	11.2	9.91	9.95
170	11.4	10.7	10.1	12.8	15.6	16.9	18.4	19.1	19.3	19.4	19.5	17.9	15.1	12.6	12.4	11.5	11.7	9.54	10.6
175	14.1	13.7	12.9	12.1	13.0	13.4	13.8	14.4	16.0	16.0	10.9	8.85	11.4	13.5	13.4	13.5	12.7	13.0	13.8
180	4.43	4.42	4.40	4.37	4.32	4.27	4.21	4.14	4.07	4.00	4.03	4.06	4.09	4.12	4.15	4.17	4.19	4.20	4.20

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	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895	895		
5	890	890	890	890	890	891	891	891	891	892	892	892	892	892	892	892	892		
10	877	878	878	879	880	881	881	882	882	883	883	882	882	882	882	882	882		
15	858	858	859	861	863	864	866	867	868	868	868	867	866	865	865	864	864		
20	831	832	834	837	839	842	845	847	848	848	847	846	844	842	840	839	839		
25	797	799	802	806	811	815	819	822	823	823	822	820	816	813	810	807	806		
30	756	759	764	770	777	783	788	792	794	794	792	788	783	778	773	769	767		
35	710	714	721	729	738	746	753	758	760	760	757	752	745	737	730	724	721		
40	657	663	672	683	695	706	714	721	723	723	718	712	702	692	682	674	669		
45	600	607	619	633	648	662	673	680	683	682	677	668	656	642	629	618	612		
50	537	547	563	581	599	616	629	638	641	640	633	622	607	590	573	558	549		
55	470	483	503	526	548	568	584	594	598	596	588	574	556	535	513	494	482		
60	399	417	443	471	497	520	537	549	553	551	541	526	504	479	452	427	410		
65	326	350	382	415	446	472	491	503	508	505	495	477	453	423	390	359	336		
70	251	283	322	361	396	424	445	458	463	460	448	429	402	368	330	291	260		
75	179	219	266	310	347	378	400	414	419	415	403	383	353	316	273	226	186		
80	112	163	214	262	302	334	357	371	376	372	360	338	307	268	220	168	118		
85	59.5	115	170	219	260	292	315	330	335	331	318	296	264	223	175	119	63.5		
90	27.6	78.6	132	181	221	254	277	291	296	293	280	257	226	185	136	81.9	29.7		
95	13.7	53.7	103	149	188	219	242	256	261	257	244	222	191	152	106	56.0	14.3		
100	9.34	37.8	78.1	121	158	187	209	223	227	223	211	190	161	124	80.7	38.9	9.73		
105	8.34	29.3	61.2	96.3	130	158	178	191	196	192	180	161	132	98.1	62.2	29.7	8.78		
110	9.02	24.5	49.7	78.9	107	131	149	160	164	161	150	132	108	79.9	50.5	24.5	9.22		
115	9.62	21.5	41.8	65.6	89.3	110	125	135	139	136	126	111	90.3	66.3	41.9	21.8	9.95		
120	10.6	19.9	34.3	55.3	74.9	92.3	106	114	117	114	106	93.1	75.6	55.7	35.9	20.3	10.9		
125	11.6	19.2	30.9	47.3	63.3	77.7	89.0	96.2	98.7	96.4	89.5	78.3	63.7	47.3	31.7	19.7	11.9		
130	12.6	18.8	28.0	38.6	53.8	65.4	74.8	80.8	82.9	81.0	75.1	65.9	54.0	40.9	28.7	19.2	12.8		
135	13.2	18.6	25.7	34.5	45.6	55.3	62.8	67.7	69.4	67.8	63.1	55.7	46.2	35.8	26.6	19.1	13.6		
140	14.1	18.6	24.0	31.3	38.1	46.8	52.8	56.7	57.9	56.7	52.9	47.1	39.6	32.0	24.9	19.1	14.3		
145	15.0	18.6	22.7	28.1	33.7	37.4	44.4	47.4	48.4	47.2	44.4	39.9	34.6	28.8	23.6	19.1	15.0		
150	15.7	18.5	21.4	25.3	29.6	33.4	35.3	39.6	40.4	39.6	37.4	34.4	30.5	26.4	22.6	19.2	15.3		
155	14.8	17.5	20.1	23.2	26.0	28.8	31.0	31.5	33.8	33.4	32.0	29.8	27.3	24.5	21.8	19.2	15.0		
160	12.7	15.2	17.2	19.3	23.2	24.8	26.6	27.5	26.7	28.4	27.7	26.4	24.8	22.9	21.1	19.2	13.6		
165	11.0	12.5	14.0	15.1	17.1	20.7	22.9	23.6	24.0	22.7	24.0	23.7	22.8	21.5	19.9	18.3	12.0		
170	10.6	10.9	12.9	14.1	14.2	13.8	15.6	19.8	21.1	21.0	19.6	20.6	19.8	19.1	17.4	13.6	11.2		
175	13.8	13.9	13.7	14.4	13.8	14.2	12.7	10.4	12.3	19.3	18.8	16.2	15.0	14.4	14.5	13.5	13.5		
180	4.20	4.19	4.17	4.15	4.12	4.09	4.06	4.03	4.00	4.07	4.14	4.21	4.27	4.32	4.37	4.40	4.42		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	PF2010A	HZTE028-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	DPS1060	HZTE001-06	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	WY12010	HZTE004-03	Dec. 25, 2016	Dec. 24, 2017
Temperature Meter	TES1310	HZTE017-01	Aug. 08, 2016	Aug. 07, 2017
Standard source	D908	HZTE012-01	Jul. 28, 2016	Jul. 27, 2017
Integrate Sphere system	2M	HZTE015-01	Jul. 26, 2016	Jul. 25, 2017
Digital Power Meter	WT210	HZTE008-01	Jul. 26, 2016	Jul. 25, 2017
AC Power Supply	PCR 500L	HZTE001-07	Dec. 25, 2016	Dec. 24, 2017
DC Power Supply	IT6154	HZTE004-04	Jul. 27, 2016	Jul. 26, 2017
Temperature and humidity recorder	JR900	HZTE018-01	Dec. 25, 2016	Dec. 24, 2017
Standard source	SCL-1400	HZTE012-02	Jul. 28, 2016	Jul. 27, 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 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

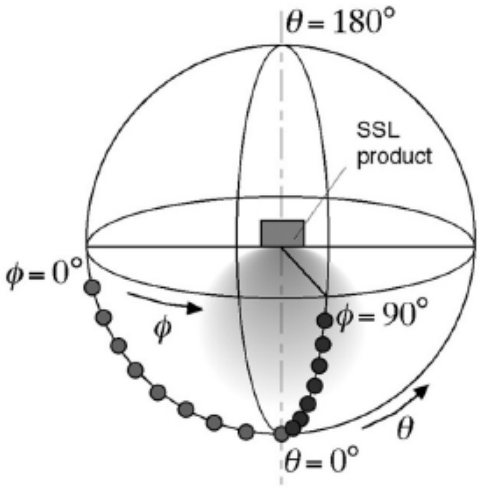
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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