LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube System

Model: 22T5HO/4F/840/EXT/A2

(LED tube model: 22T5HO/4F/840/EXT 2pcs and LED driver model: 24T5HODRIVER/2CH 1pcs)

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18080024x

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: Jim Zhang

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.

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Sample Photos

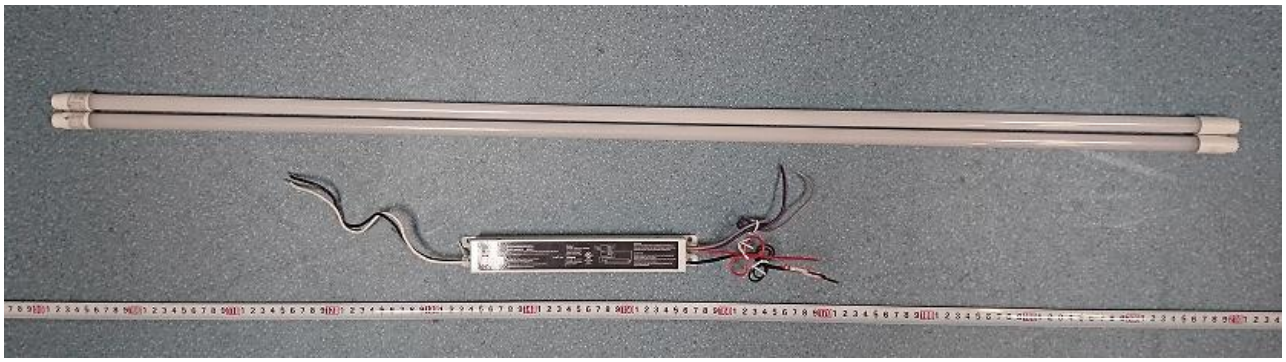


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED Tube System
Model	: 22T5HO/4F/840/EXT/A2
Electrical Ratings	: 120-277V, 50/60Hz
Product Description	: 4000K LED tube model: 22T5HO/4F/840/EXT 2 LED tubes supplied by a LED driver: 24T5HODRIVER/2CH
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

Test specifications:	
Date of Receipt	: Jul. 30, 2018
Date of Test	: Aug. 09, 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

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.

The LED driver has 2 channels, the tests were conducted at each channel with the same lamps.

Sphere-Spectroradiometer Method

Parameter	Result	
	CH1	CH2
Test Voltage (V)	120.0	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.429	0.428
Power Factor	0.9956	0.9956
Test Power (W)/2	25.60	25.56
THD A%	4.99	5.04
Luminous Efficacy (lm/W)	138.6	137.0
Luminous Flux per lamp (lm)	3549.0	3500.0
Color Rendering Index (CRI)	81.5	81.5
R9	1.2	1.2
Correlated Color Temperature (CCT)(K)	4048	4047
Chromaticity Chroma x	0.3795	0.3795
Chromaticity Chroma y	0.3801	0.3802
Chromaticity Chroma u	0.2231	0.2231
Chromaticity Chroma v	0.3353	0.3353
Duv	0.0012	0.0012
Chromaticity Chroma u ’	0.2231	0.2231
Chromaticity Chroma v’	0.5029	0.5029

Special Color Rendering Indices of CH1	
R1	79.2
R2	87.2
R3	93.9
R4	81.1
R5	79.6
R6	82.8
R7	85.7
R8	62.6
R9	1.2
R10	70.2
R11	80.1
R12	61.4
R13	81
R14	96.7
Rf	82
Rg	96

Table 1: 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 30m.

Luminous data was taken at 0.5 °vertical intervals and 10 °horizontal intervals.

The LED driver has 2 channels, the tests were conducted at each channel with the same lamps.

Parameter	Result	
	CH1	CH2
Test Voltage (V)	120.0	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.428	0.428
Power Factor	0.9966	0.9966
Test Power (W)/2	25.62	25.58
Luminous Efficacy (lm/W)	136.3	134.7
Luminous Flux per lamp (lm)	3490.8	3444.2
Beam Angle (°)	119.5	119.6
Center Beam Candle Power (cd)	953	939
Spacing Criteria	1.23 (0 °-180 °)/ 1.31 (90 °-270 °)	1.23 (0 °-180 °)/ 1.31 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	63.36%	63.35%
Zonal Lumens in the 60 °-90 °Zone	25.89%	25.89%
Zonal Lumens in the 90 °-120 °Zone	7.93%	7.94%
Zonal Lumens in the 120 °-180 °Zone	2.82%	2.82%

Table 2: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method of CH1

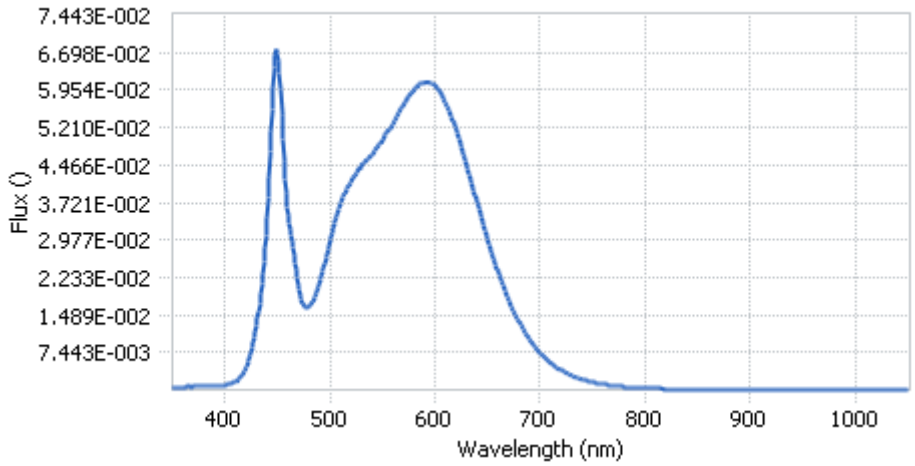
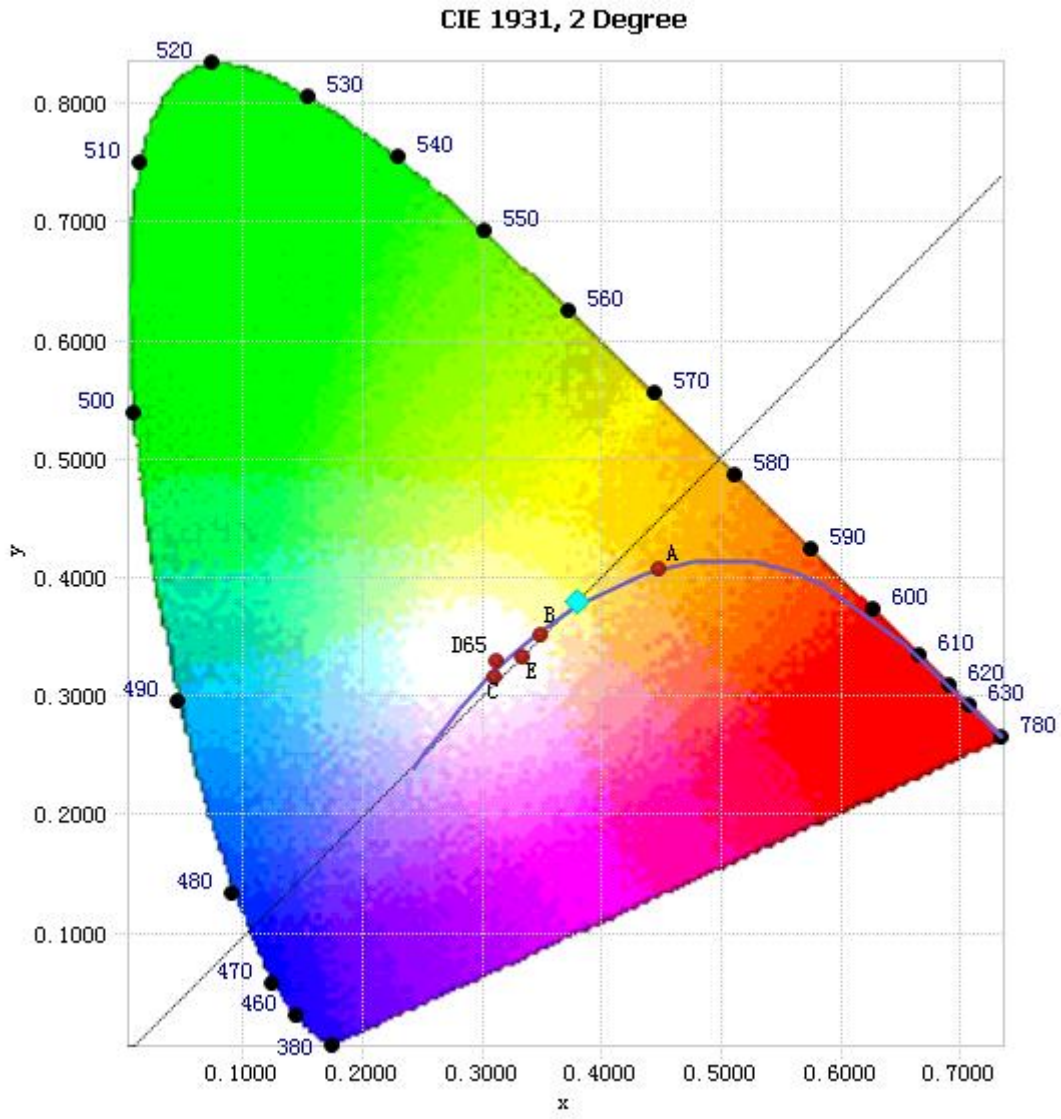


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	7.69E-04	485	1.82E-02	590	6.11E-02	695	8.59E-03
385	7.17E-04	490	2.10E-02	595	6.10E-02	700	7.38E-03
390	8.00E-04	495	2.52E-02	600	6.04E-02	705	6.28E-03
395	8.85E-04	500	2.97E-02	605	5.92E-02	710	5.36E-03
400	1.00E-03	505	3.38E-02	610	5.70E-02	715	4.59E-03
405	1.21E-03	510	3.69E-02	615	5.46E-02	720	3.94E-03
410	1.74E-03	515	3.96E-02	620	5.16E-02	725	3.37E-03
415	2.67E-03	520	4.16E-02	625	4.82E-02	730	2.87E-03
420	4.46E-03	525	4.32E-02	630	4.47E-02	735	2.45E-03
425	7.59E-03	530	4.46E-02	635	4.09E-02	740	2.09E-03
430	1.29E-02	535	4.56E-02	640	3.72E-02	745	1.79E-03
435	2.10E-02	540	4.68E-02	645	3.35E-02	750	1.53E-03
440	3.43E-02	545	4.82E-02	650	2.99E-02	755	1.31E-03
445	5.58E-02	550	4.96E-02	655	2.66E-02	760	1.14E-03
450	6.69E-02	555	5.13E-02	660	2.35E-02	765	9.69E-04
455	4.98E-02	560	5.28E-02	665	2.05E-02	770	8.29E-04
460	3.47E-02	565	5.48E-02	670	1.79E-02	775	7.17E-04
465	2.81E-02	570	5.67E-02	675	1.55E-02	780	6.19E-04
470	2.09E-02	575	5.82E-02	680	1.34E-02		
475	1.67E-02	580	5.97E-02	685	1.16E-02		
480	1.66E-02	585	6.07E-02	690	9.99E-03		

Table 3: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method of CH1



Tristimulus values(x, y): (0.3795, 0.3801)

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 of CH1

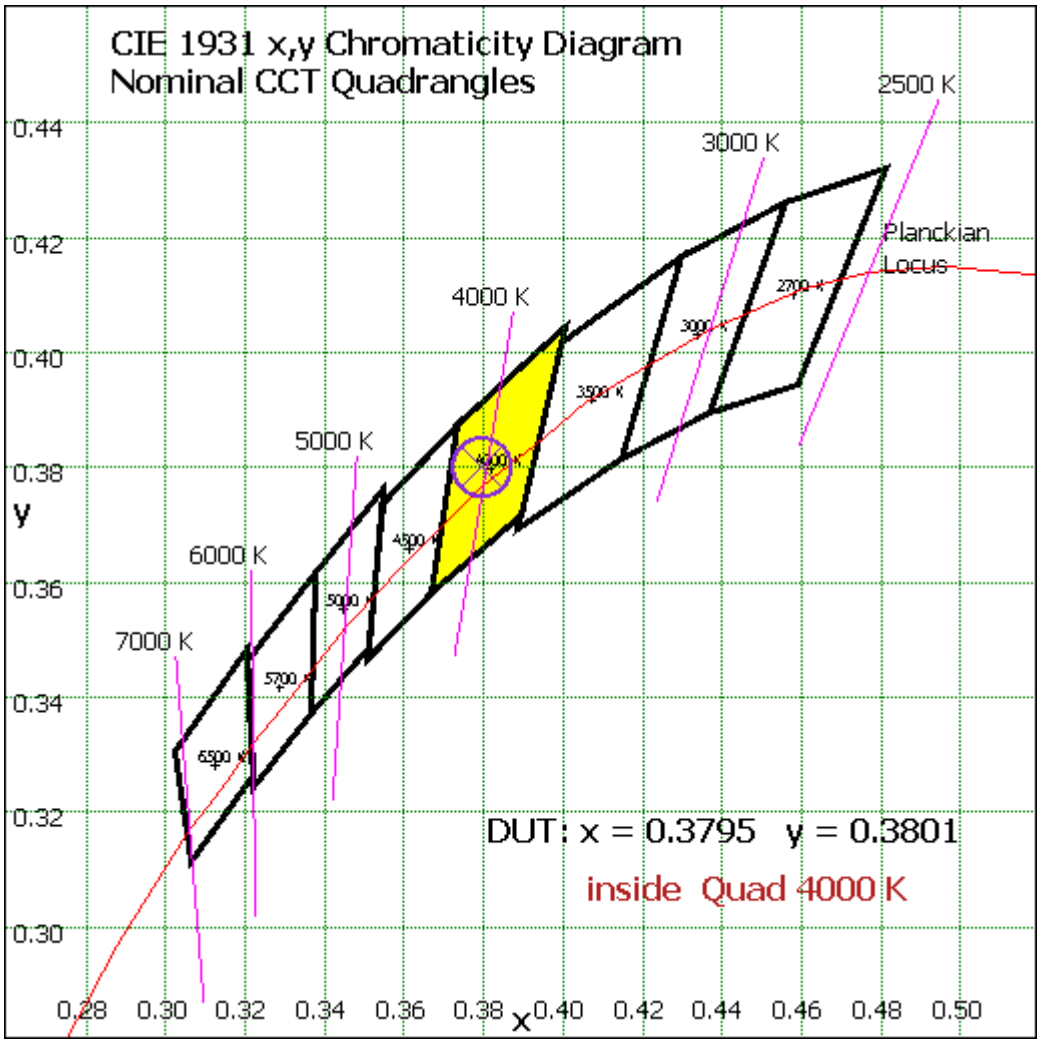


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method of CH1

γ(°)	Lumens	% Total
0- 10	90.186	2.58%
10- 20	259	7.42%
20- 30	394.78	11.31%
30- 40	480.96	13.78%
40- 50	508.487	14.57%
50- 60	478.24	13.70%
60- 70	401.82	11.51%
70- 80	300.16	8.60%
80- 90	201.76	5.78%
90-100	132.276	3.79%
100-110	87.26	2.50%
110-120	57.43	1.65%
120-130	38.77	1.11%
130-140	26.055	0.75%
140-150	17.015	0.49%
150-160	10.266	0.29%
160-170	4.986	0.14%
170-180	1.361	0.04%
Total	3490.8	100%

γ(°)	Lumens	% Total
0- 60	2211.653	63.36%
60- 90	903.74	25.89%
0-90	3115.393	89.25%
90- 180	375.419	10.75%
0- 180	3490.8	100%

Table 4: Zonal Lumen Data

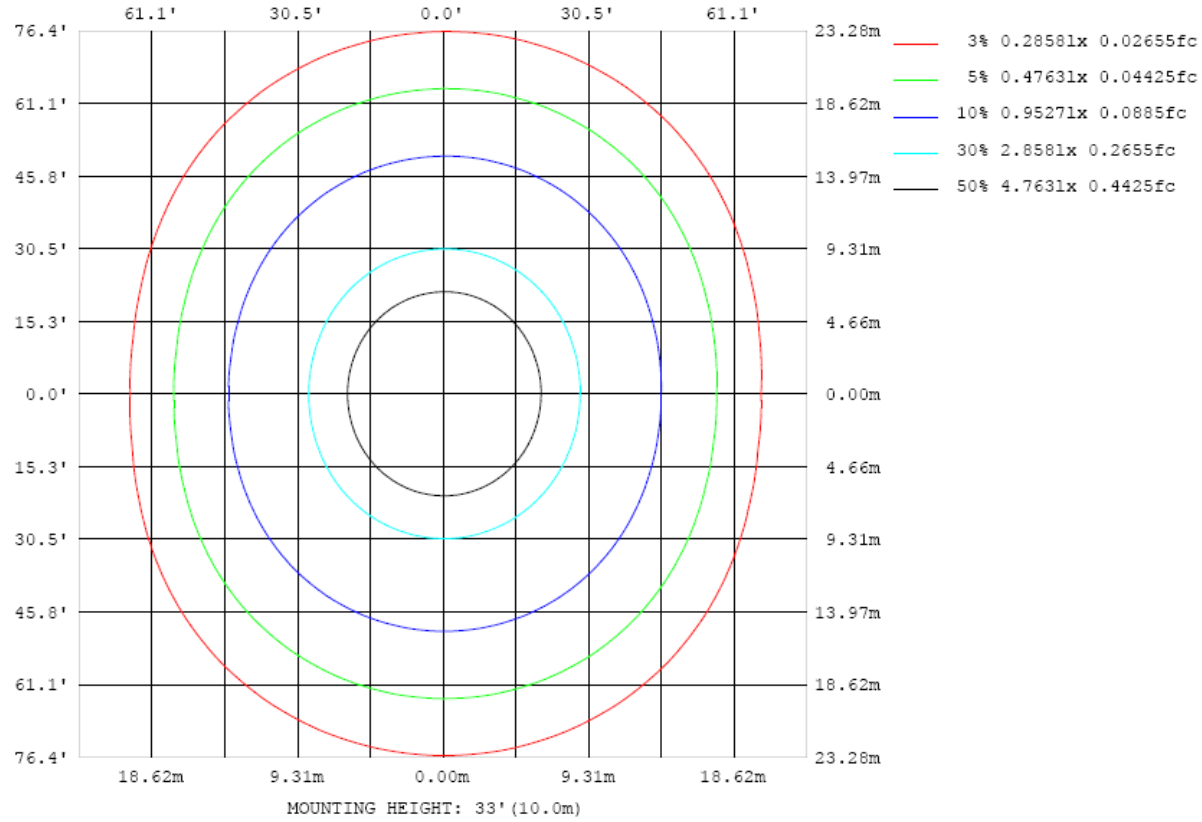


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method of CH1

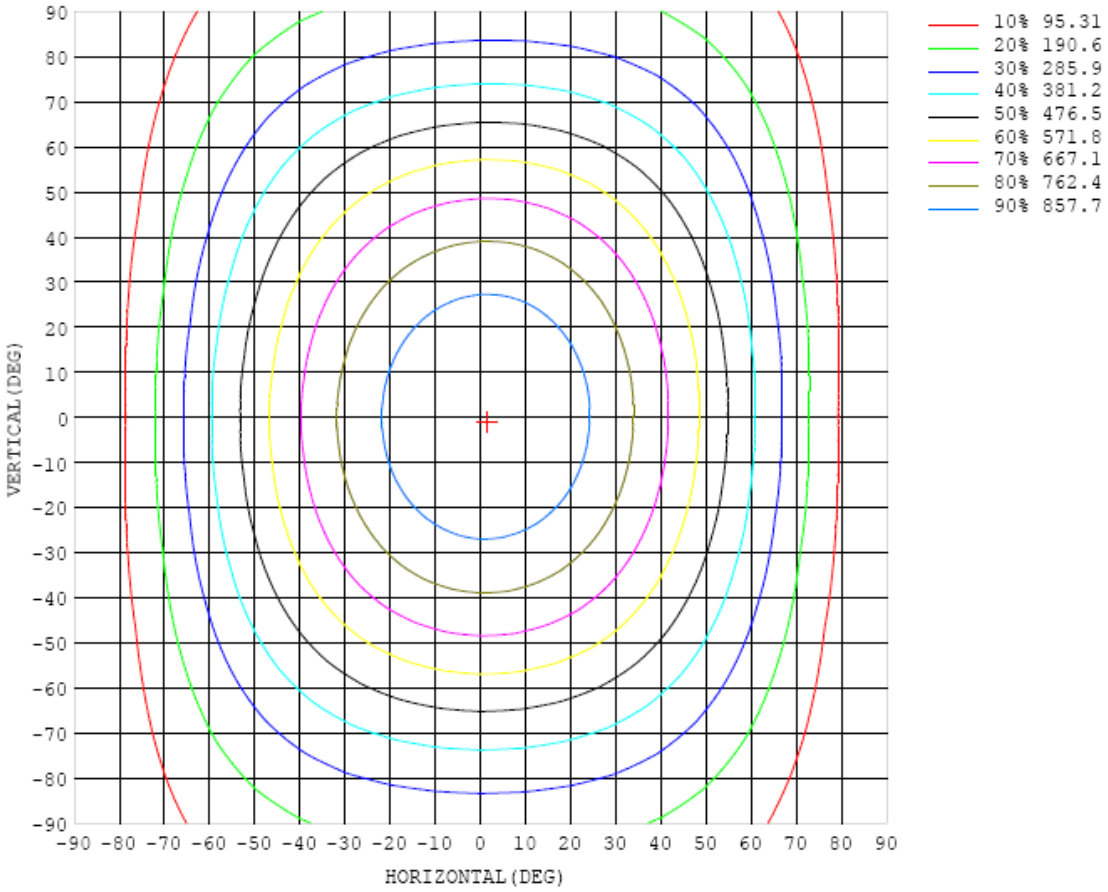


Chart 5: Isocandela Plot

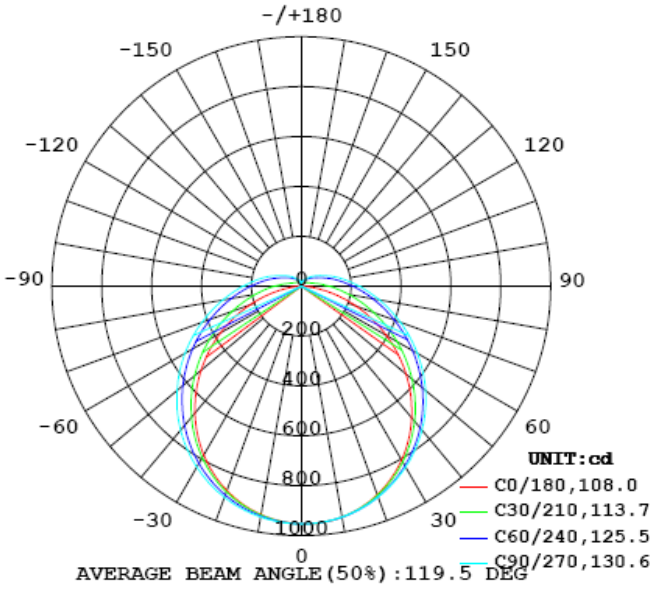


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method of CH1

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	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953
5	951	951	950	950	950	950	950	950	949	949	949	948	948	947	947	946	946	946	946
10	940	939	939	940	940	940	940	940	940	939	939	937	936	934	933	932	930	930	930
15	919	919	919	920	921	922	923	923	923	923	921	919	917	914	911	909	907	906	905
20	890	889	891	893	895	897	899	900	900	900	898	894	891	887	882	878	875	873	872
25	851	851	854	857	861	864	868	870	871	871	868	864	859	853	846	840	835	832	831
30	804	805	808	813	819	825	831	835	837	837	834	828	821	813	804	795	788	783	782
35	750	751	756	763	772	780	789	794	797	797	794	787	779	768	756	744	734	727	726
40	688	690	697	706	719	730	741	748	752	753	749	741	731	718	702	687	675	666	663
45	621	623	632	645	661	676	689	698	703	703	699	691	679	664	645	627	610	599	596
50	548	551	563	580	599	618	633	643	650	650	646	637	624	606	585	563	543	529	525
55	472	476	491	512	535	557	574	586	593	594	590	580	566	547	523	497	473	455	450
60	394	399	417	443	471	495	515	528	536	537	533	523	507	486	460	431	403	381	374
65	314	321	344	375	406	434	455	469	477	479	475	465	449	427	398	366	333	306	297
70	234	243	272	309	345	375	397	412	421	422	418	408	392	369	339	304	266	233	219
75	156	169	206	248	287	319	342	358	366	368	364	355	339	315	284	246	204	164	145
80	84.3	103	147	195	235	268	292	307	316	318	314	305	289	266	235	196	150	103	76.3
85	27.2	51.3	100.0	149	190	223	246	261	270	272	269	260	245	223	192	153	106	57.3	23.3
90	1.44	21.1	66.4	112	152	184	207	221	230	232	229	221	207	185	156	118	73.5	29.1	0.79
95	0.80	9.29	43.6	84.6	122	152	173	188	196	198	195	188	174	154	126	91.2	51.9	15.4	0.84
100	1.57	6.56	29.6	63.1	96.7	125	145	159	167	169	167	159	147	128	102	69.9	36.9	11.0	1.57
105	2.60	6.21	22.6	48.6	75.8	101	120	134	141	144	142	135	123	104	80.5	55.0	28.7	9.60	2.53
110	3.84	6.81	18.8	39.2	61.8	81.9	98.5	110	118	121	119	112	101	85.5	66.7	44.8	24.1	9.79	3.54
115	5.17	7.53	17.0	32.8	51.3	68.8	82.5	92.7	99.1	101	99.7	94.3	84.9	72.0	55.7	37.8	21.5	10.2	4.71
120	6.59	8.73	16.1	28.4	43.5	58.0	70.2	78.6	84.2	86.2	84.8	80.1	72.2	61.2	47.4	32.9	20.0	10.6	5.82
125	7.94	9.91	15.5	25.5	37.4	49.4	59.7	67.4	72.2	73.9	72.7	68.8	61.8	52.3	41.0	29.3	19.0	11.3	6.77
130	9.16	10.9	15.7	23.3	32.8	42.6	51.1	57.6	61.8	63.4	62.4	58.9	53.0	45.0	35.8	26.5	18.2	11.5	7.66
135	10.4	12.0	15.6	21.3	29.3	37.0	43.9	49.3	52.9	54.3	53.5	50.5	45.6	39.2	31.8	24.4	17.9	12.1	8.70
140	11.3	12.9	16.1	20.6	26.2	32.6	38.0	42.3	45.2	46.4	45.7	43.4	39.5	34.4	28.6	22.5	17.4	13.3	9.73
145	11.9	13.3	16.4	19.7	23.8	28.6	33.0	36.4	38.7	39.6	39.1	37.3	34.3	30.4	25.5	21.4	17.1	13.7	10.5
150	12.2	13.1	16.4	19.0	22.2	25.2	28.3	31.3	33.1	33.8	33.5	32.1	29.8	26.4	23.4	20.5	15.5	14.1	11.2
155	11.6	12.5	16.2	18.4	20.8	23.1	25.0	26.5	27.8	28.4	28.2	27.2	25.8	24.0	21.8	18.9	16.5	14.6	11.5
160	11.1	12.6	16.5	17.9	19.4	21.0	22.4	23.7	24.5	24.8	24.7	24.2	23.1	21.9	19.6	15.8	13.7	12.9	11.4
165	11.2	11.3	14.5	17.5	18.3	19.0	20.1	20.8	21.4	21.6	21.6	21.3	20.7	18.5	15.8	13.9	12.8	11.6	10.8
170	11.6	11.4	12.0	15.1	16.5	17.0	18.1	18.6	18.8	18.9	19.0	18.7	16.5	14.1	12.7	13.0	12.9	11.8	11.2
175	14.5	14.1	13.4	13.2	14.6	15.3	15.8	16.8	17.8	17.8	17.3	13.7	10.6	10.8	12.3	13.3	14.0	14.1	14.2
180	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19

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	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953	953		
5	946	946	946	947	947	947	948	949	949	950	950	950	950	950	951	951	951		
10	930	931	932	933	934	936	937	939	940	940	941	941	941	940	940	940	940		
15	906	907	909	911	914	917	919	922	923	924	924	924	923	922	921	920	920		
20	873	875	878	882	886	891	895	899	901	902	902	901	899	897	894	892	891		
25	832	835	840	846	852	859	864	869	873	874	873	871	867	863	859	855	853		
30	783	787	794	803	812	821	828	834	838	839	838	835	829	823	816	811	807		
35	727	733	743	754	766	777	786	793	798	799	797	792	785	776	767	759	754		
40	665	673	685	700	714	729	740	748	753	754	752	745	735	724	712	701	693		
45	598	609	624	641	659	675	689	698	704	704	701	693	681	667	651	637	627		
50	528	540	558	580	601	620	635	645	651	652	647	638	624	606	586	568	556		
55	454	469	491	517	541	562	579	590	596	596	591	580	564	543	519	497	481		
60	379	397	424	454	481	504	521	533	539	539	533	521	503	479	451	425	404		
65	303	326	358	391	421	445	463	475	481	481	475	462	442	416	384	352	327		
70	229	258	295	332	363	389	407	418	424	425	418	404	383	355	320	283	251		
75	158	195	237	276	309	335	353	365	370	370	363	349	327	297	260	217	178		
80	95.1	140	185	226	260	285	303	314	319	319	312	298	276	245	206	161	114		
85	46.8	94.6	142	183	216	241	258	269	274	273	266	252	230	200	160	113	62.4		
90	19.7	62.4	108	148	179	203	219	229	234	233	226	212	191	162	123	76.9	30.3		
95	9.33	41.3	81.1	118	148	170	186	195	199	198	191	178	158	130	93.6	52.4	15.0		
100	6.80	28.9	60.6	93.9	122	143	158	166	170	169	163	150	131	104	70.9	36.2	9.98		
105	6.80	22.7	47.4	74.0	98.6	119	133	141	145	143	137	125	106	81.8	54.2	27.3	8.53		
110	7.65	19.5	38.7	60.7	81.0	97.5	110	118	121	120	113	102	86.0	66.0	43.5	22.5	8.74		
115	8.52	17.9	33.0	50.7	67.8	82.0	92.6	99.1	102	100	94.8	85.2	71.5	54.7	36.3	19.8	9.61		
120	9.55	17.2	29.1	43.3	57.4	69.5	78.6	84.2	86.4	85.1	80.3	71.9	60.3	46.2	31.2	18.5	10.5		
125	10.7	16.9	26.3	37.8	49.3	59.3	67.1	71.9	73.8	72.6	68.4	61.2	51.3	39.7	27.7	17.6	11.4		
130	11.7	16.9	24.3	33.3	42.4	50.9	57.5	61.6	63.1	62.1	58.5	52.4	44.2	34.7	25.4	17.8	12.5		
135	12.5	16.8	22.7	30.0	37.3	44.0	49.4	52.8	54.1	53.2	50.1	45.1	38.5	31.0	23.5	17.9	13.6		
140	13.4	16.6	21.9	27.5	33.1	38.1	42.6	45.4	46.3	45.6	43.1	39.1	33.9	28.1	22.6	18.0	14.5		
145	13.9	17.4	20.9	25.4	29.6	33.5	36.6	39.0	39.8	39.2	37.3	34.1	30.0	25.8	21.7	18.2	15.4		
150	14.8	17.9	20.3	23.6	26.8	29.6	31.9	33.6	34.2	33.8	32.2	30.0	27.2	24.1	20.9	18.5	15.9		
155	14.2	17.0	17.9	21.4	24.3	26.4	28.0	28.8	29.6	29.3	28.4	26.8	24.8	22.6	20.5	18.4	15.4		
160	12.4	14.6	16.2	16.8	19.7	22.5	24.6	25.3	25.9	25.8	25.2	24.2	23.0	21.3	19.1	17.0	14.1		
165	11.2	12.4	13.5	14.4	14.7	16.6	19.0	22.1	22.4	23.1	22.7	22.2	21.0	19.0	18.1	15.5	12.3		
170	11.5	11.7	12.4	13.5	13.7	13.8	13.2	14.5	17.6	19.1	20.3	17.6	16.7	17.2	15.0	12.6	11.9		
175	14.5	14.5	14.6	14.6	15.0	14.6	13.9	10.9	5.29	9.58	13.4	14.5	15.0	15.0	14.5	14.8	14.8		
180	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19		

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.

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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

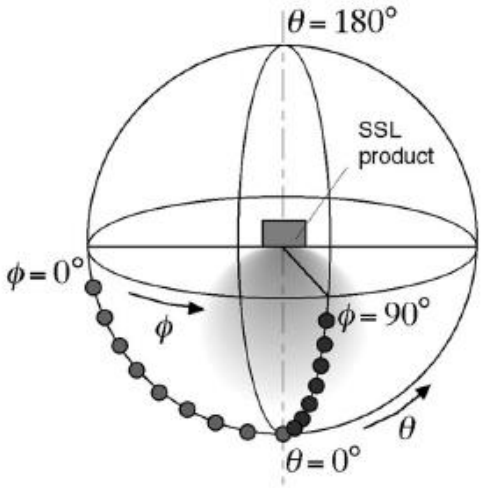
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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