LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube System

Model: 22T5HO/4F/830/EXT/A2

(LED tube model: 22T5HO/4F/830/EXT 2pcs and LED driver model: 24T5HODRIVER/2CH 1pcs)

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18080024aa

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. 29, 2018

Approved by: Jim Zhang

Manager: Jim Zhang

Aug. 29, 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: **22T5HO/4F/830/EXT/A2**

Luminous Efficacy (Lumens /Watt)	Luminous Flux per lamp (Lumens)	Power (Watts)/2	Power Factor
125.3	3203.0	25.56	0.9956

CCT (K)	CRI	Stabilization Time (Light & Power)
2937	82.0	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. 03, 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

TABLE OF CONTENT

Sample Photos

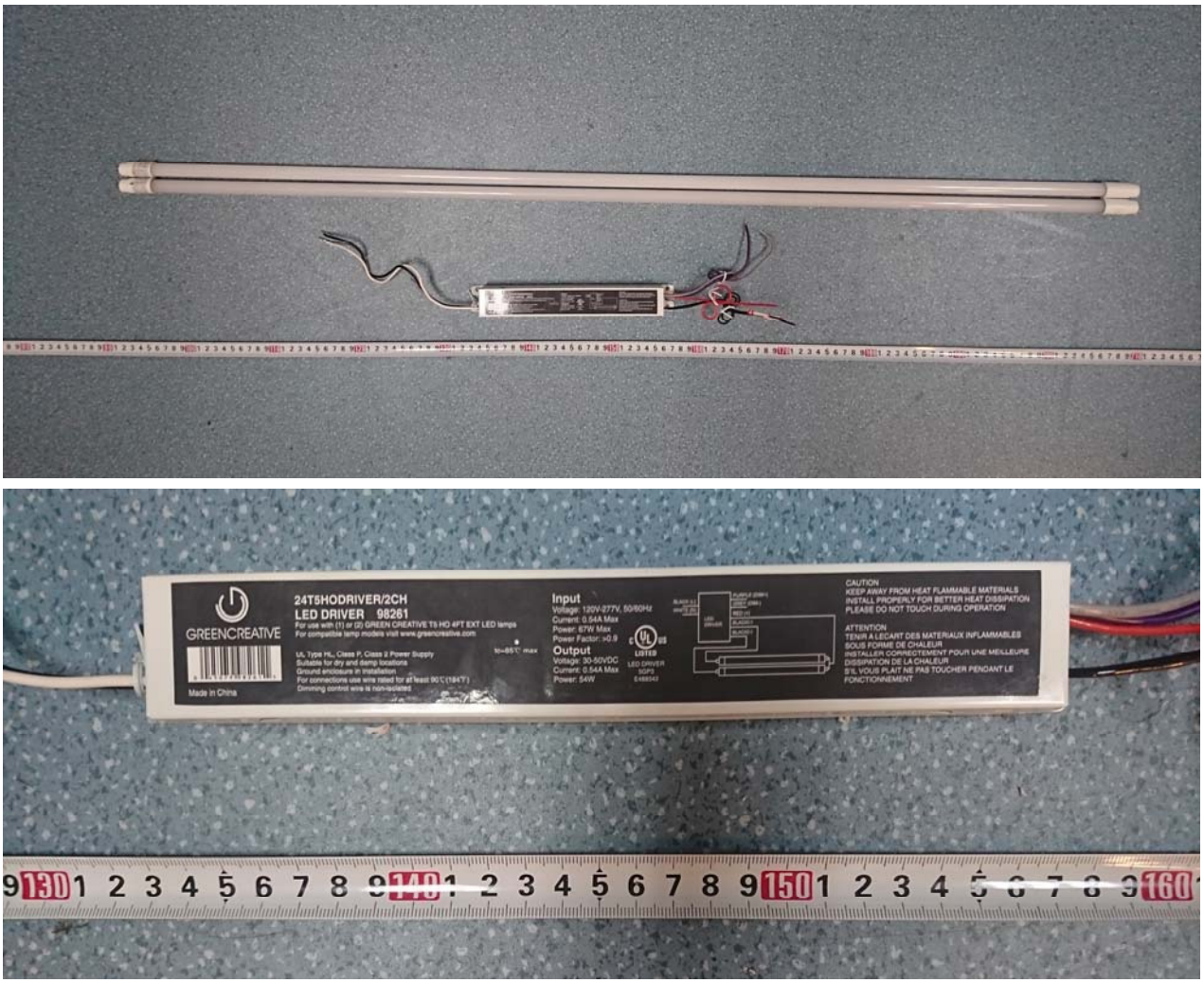


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED Tube System
Model	: 22T5HO/4F/830/EXT/A2
Electrical Ratings	: 120-277V, 50/60Hz
Product Description	: 3000K LED tube model: 22T5HO/4F/830/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 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)	0.428	0.193
Power Factor	0.9956	0.9559
Test Power (W)/2	25.56	25.58
THD A%	4.81	6.92
Luminous Efficacy (lm/W)	125.3	125.2
Luminous Flux per lamp (lm)	3203.0	3203.0
Color Rendering Index (CRI)	82.0	
R9	5	
Correlated Color Temperature (CCT)(K)	2937	
Chromaticity Chroma x	0.4402	
Chromaticity Chroma y	0.4033	
Chromaticity Chroma u	0.2530	
Chromaticity Chroma v	0.3477	
Duv	0.0010	
Chromaticity Chroma u ’	0.2530	
Chromaticity Chroma v’	0.5216	

Special Color Rendering Indices	
R1	80.8
R2	92.1
R3	94.5
R4	79.1
R5	81.2
R6	90.8
R7	81
R8	56.9
R9	5
R10	82.2
R11	78.4
R12	73.1
R13	83.6
R14	97.7
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 25.1℃.

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)	0.429
Power Factor	0.9964
Test Power (W)/2	25.63
Luminous Efficacy (lm/W)	120.0
Luminous Flux per lamp (lm)	3075.6
Beam Angle (°)	128.0
Center Beam Candle Power (cd)	772
Spacing Criteria	1.26 (0°-180°)/ 1.32 (90°-270°)
Zonal Lumens in the 0°-60°Zone	60.02%
Zonal Lumens in the 60°-90°Zone	27.52%
Zonal Lumens in the 90°-120°Zone	9.60%
Zonal Lumens in the 120°-180°Zone	2.86%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

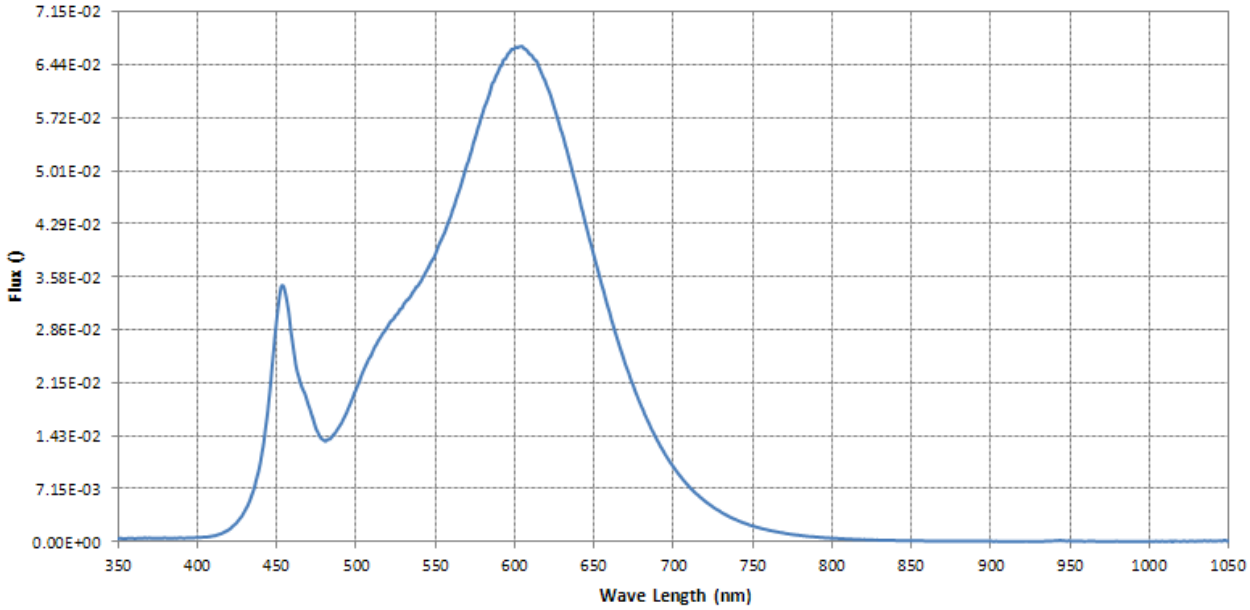
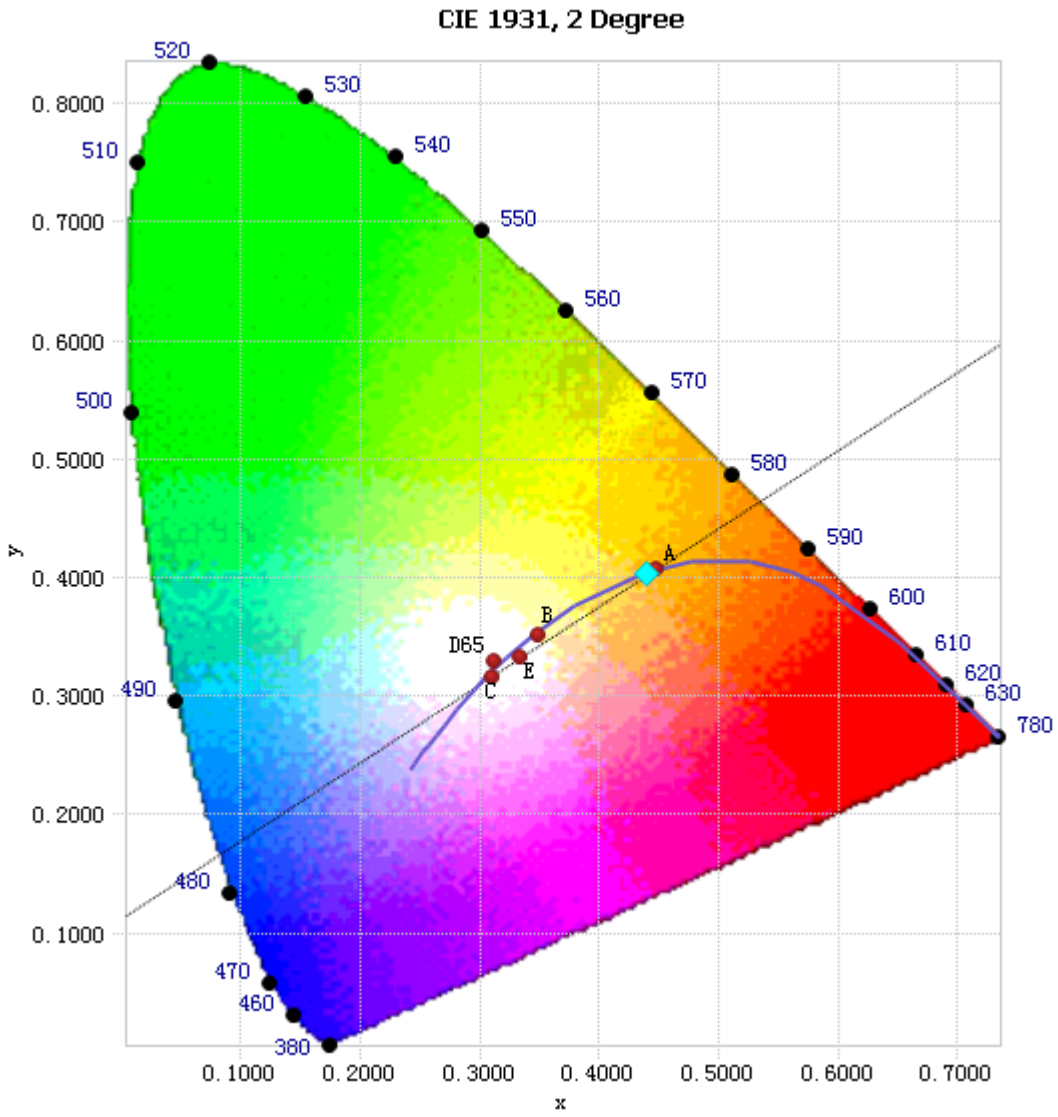


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	5.25E-04	485	1.42E-02	590	6.36E-02	695	1.18E-02
385	4.60E-04	490	1.57E-02	595	6.54E-02	700	1.01E-02
390	5.08E-04	495	1.79E-02	600	6.66E-02	705	8.71E-03
395	5.23E-04	500	2.05E-02	605	6.69E-02	710	7.45E-03
400	5.73E-04	505	2.32E-02	610	6.57E-02	715	6.42E-03
405	6.16E-04	510	2.53E-02	615	6.43E-02	720	5.50E-03
410	7.71E-04	515	2.74E-02	620	6.17E-02	725	4.71E-03
415	1.08E-03	520	2.90E-02	625	5.86E-02	730	4.02E-03
420	1.65E-03	525	3.06E-02	630	5.51E-02	735	3.42E-03
425	2.60E-03	530	3.20E-02	635	5.12E-02	740	2.93E-03
430	4.15E-03	535	3.33E-02	640	4.71E-02	745	2.51E-03
435	6.65E-03	540	3.48E-02	645	4.27E-02	750	2.15E-03
440	1.09E-02	545	3.67E-02	650	3.86E-02	755	1.84E-03
445	1.86E-02	550	3.87E-02	655	3.46E-02	760	1.57E-03
450	2.97E-02	555	4.13E-02	660	3.09E-02	765	1.35E-03
455	3.41E-02	560	4.41E-02	665	2.72E-02	770	1.16E-03
460	2.70E-02	565	4.73E-02	670	2.38E-02	775	9.93E-04
465	2.15E-02	570	5.09E-02	675	2.10E-02	780	8.56E-04
470	1.85E-02	575	5.44E-02	680	1.82E-02		
475	1.52E-02	580	5.79E-02	685	1.59E-02		
480	1.37E-02	585	6.11E-02	690	1.37E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4402, 0.4033)

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

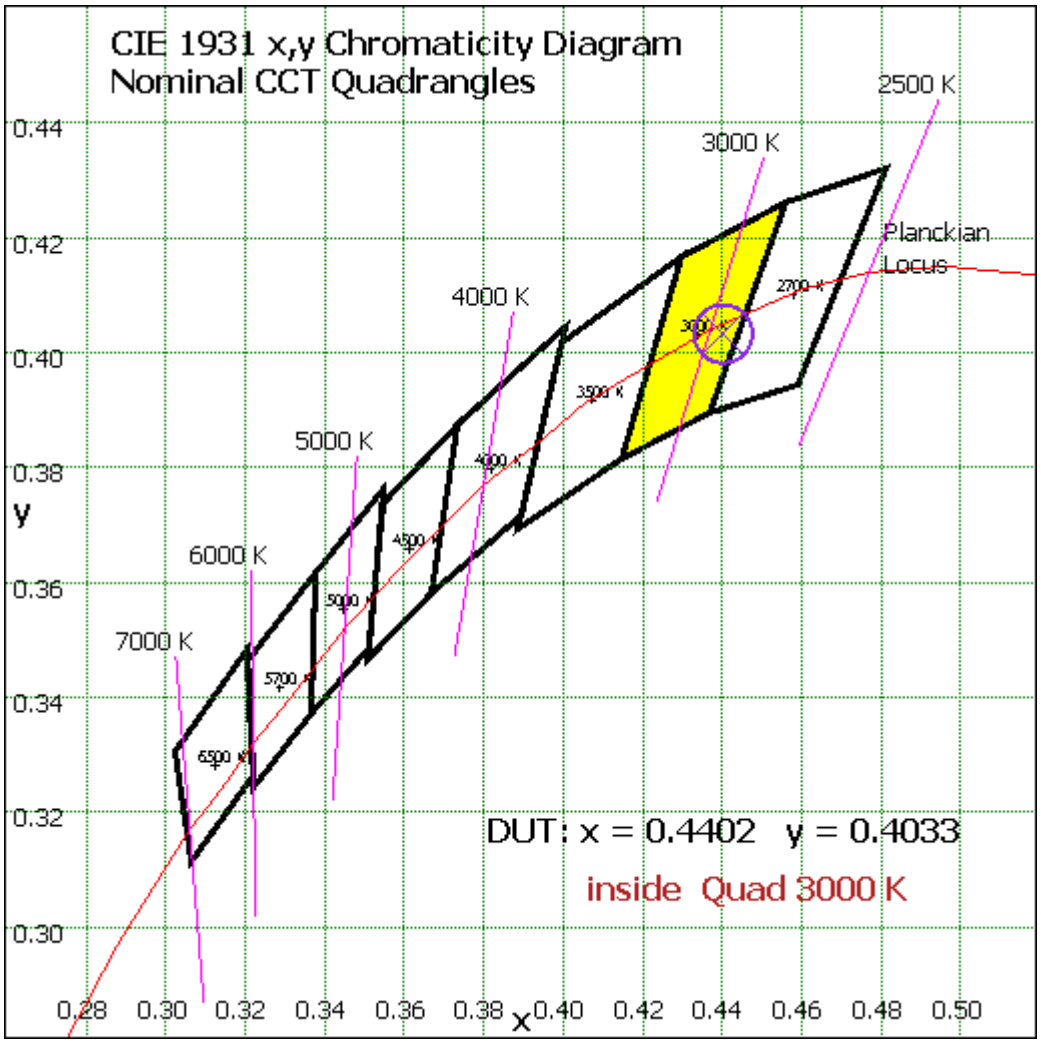


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	73.158	2.38%
10- 20	210.669	6.85%
20- 30	323.116	10.51%
30- 40	397.86	12.94%
40- 50	428.023	13.92%
50- 60	413.248	13.44%
60- 70	360.401	11.72%
70- 80	283.176	9.21%
80- 90	202.686	6.59%
90-100	140.038	4.55%
100-110	94.338	3.07%
110-120	60.919	1.98%
120-130	38.622	1.26%
130-140	23.678	0.77%
140-150	13.838	0.45%
150-160	7.571	0.25%
160-170	3.403	0.11%
170-180	0.854	0.03%
Total	3075.6	100%

γ(°)	Lumens	% Total
0- 60	1846.074	60.02%
60- 90	846.263	27.52%
0-90	2692.337	87.54%
90- 180	383.261	12.46%
0- 180	3075.6	100%

Table 5: Zonal Lumen Data

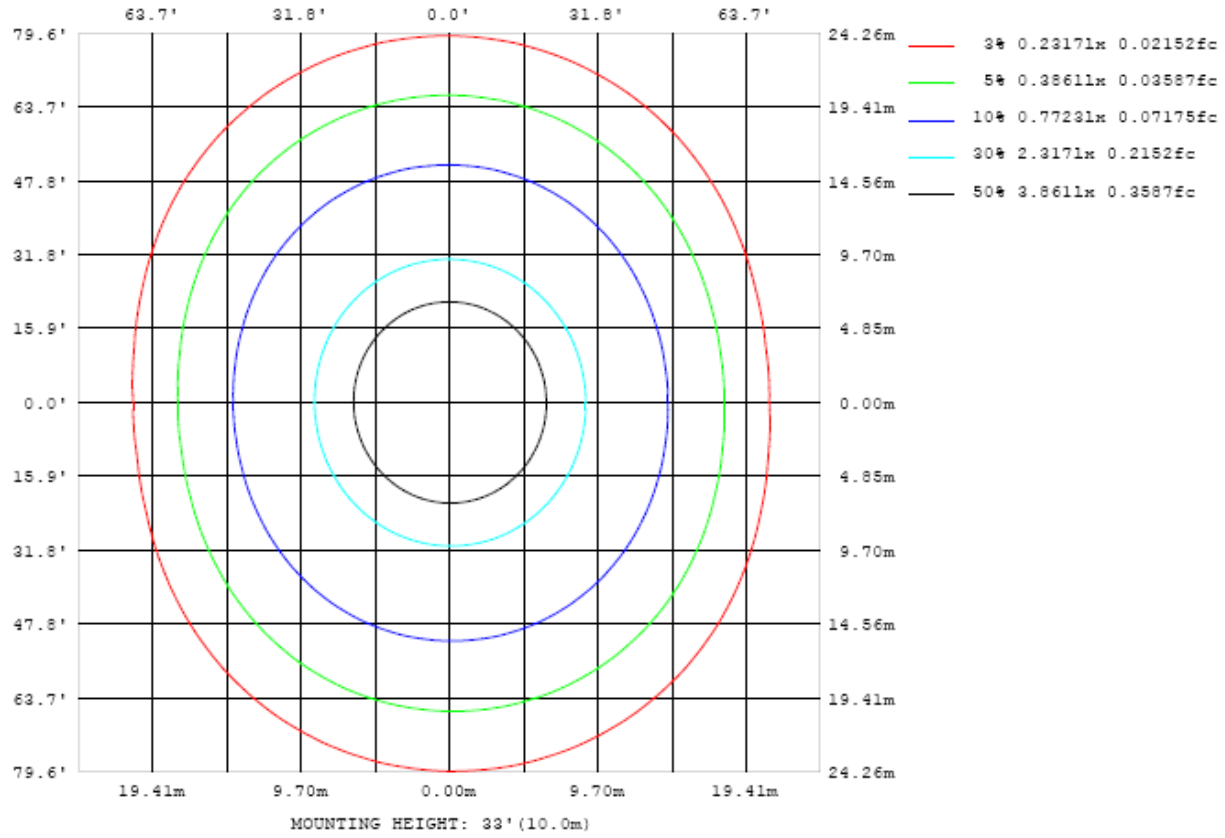


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

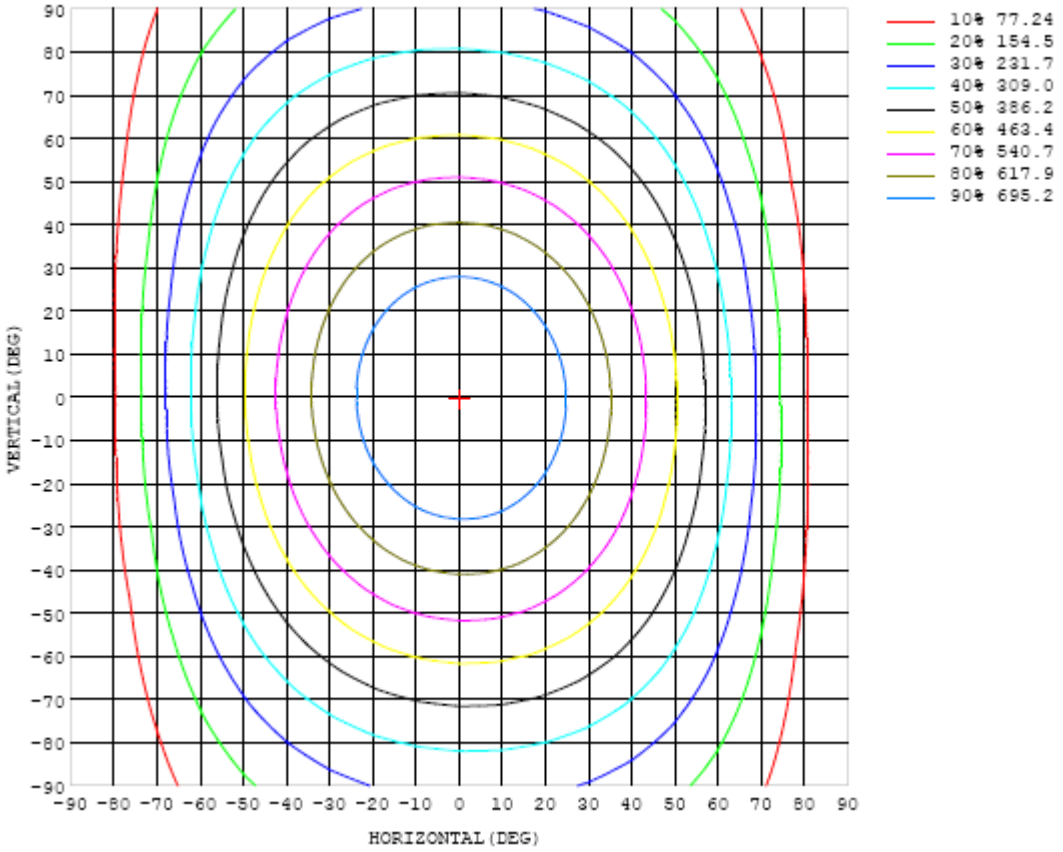


Chart 5: Isocandela Plot

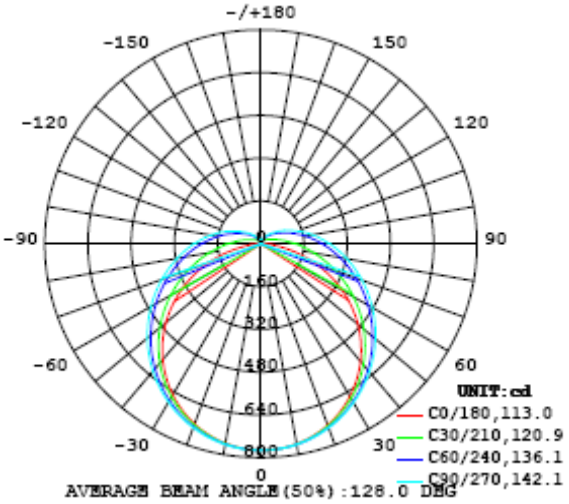


Chart 6: Polar Candela Distribution

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	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772
5	770	770	770	770	770	770	770	770	770	770	769	770	769	769	769	769	768	768	768
10	760	761	761	761	761	762	762	762	762	762	762	761	761	760	759	759	758	758	758
15	744	745	745	746	747	748	749	750	750	749	749	748	747	745	743	742	741	741	741
20	722	723	724	726	728	730	731	732	733	733	732	730	728	725	722	720	718	718	717
25	694	695	697	699	703	706	709	711	712	711	710	707	704	699	696	692	689	688	688
30	659	661	664	668	673	677	681	685	686	686	684	680	675	669	664	659	655	652	652
35	619	621	625	631	638	645	651	655	657	657	654	649	643	635	627	620	615	612	611
40	574	576	582	591	600	609	616	622	625	625	622	616	607	597	586	577	570	566	565
45	523	527	535	545	558	569	579	587	591	591	586	579	568	556	542	530	520	515	514
50	469	474	484	498	513	528	540	549	554	554	549	541	528	512	495	480	467	460	459
55	410	416	430	447	466	485	499	510	516	516	511	500	485	467	447	427	411	401	399
60	347	356	373	396	419	440	458	470	477	477	471	460	443	421	397	373	352	338	336
65	282	293	316	344	372	396	416	430	437	437	431	419	400	376	348	319	291	274	271
70	214	230	259	293	325	353	375	390	398	398	392	379	358	331	300	265	232	207	203
75	147	167	205	245	281	312	335	351	360	360	354	340	318	289	255	215	175	143	136
80	84.2	111	156	200	240	272	297	314	323	323	317	302	280	250	213	171	124	84.4	72.4
85	32.6	65.5	115	161	202	235	261	278	287	288	281	267	244	214	176	132	84.1	38.6	23.1
90	5.92	35.5	82.6	129	169	202	227	245	254	255	248	234	211	181	144	101	54.9	14.9	2.71
95	1.19	19.3	58.2	101	140	172	196	213	222	223	217	203	181	152	117	76.5	35.8	7.04	1.01
100	0.84	12.6	41.5	78.3	114	144	168	184	193	194	188	175	154	126	93.5	57.3	25.1	4.64	1.16
105	1.41	9.82	31.2	60.9	91.8	119	141	157	166	167	161	148	128	104	74.8	44.8	19.4	4.44	1.64
110	2.32	8.74	24.7	48.8	74.6	98.3	118	132	138	139	135	124	107	85.4	60.8	36.1	16.1	4.86	2.27
115	3.21	8.41	20.6	39.6	61.3	81.5	98.3	110	117	118	114	104	89.4	70.8	49.9	29.8	14.3	5.44	3.02
120	3.91	8.26	17.7	32.8	50.6	67.7	82.1	92.6	98.4	99.4	95.6	87.2	74.6	58.8	41.4	25.2	13.4	6.00	3.75
125	4.55	8.35	16.0	27.5	41.4	56.2	68.2	77.3	82.3	83.2	80.0	72.8	62.1	48.7	34.4	22.2	12.7	6.32	4.37
130	5.18	8.63	14.9	23.6	34.7	46.1	56.6	64.0	68.3	69.0	66.4	60.4	51.5	40.5	29.1	19.9	12.2	6.67	5.06
135	5.75	8.85	14.0	20.8	29.4	38.1	45.9	52.7	56.2	56.9	54.7	49.8	42.6	33.7	25.5	18.2	11.9	7.24	5.72
140	6.25	9.07	13.4	18.6	24.8	31.8	37.8	42.7	45.9	46.4	44.7	40.9	35.1	28.5	22.7	16.9	11.9	7.93	6.29
145	6.80	9.27	12.6	17.0	21.4	26.2	30.9	34.6	36.7	37.1	36.4	33.5	29.2	24.6	20.1	15.7	11.6	8.20	6.79
150	7.27	9.57	12.1	15.5	18.8	22.1	25.2	27.8	29.4	29.8	28.8	26.7	24.4	21.3	18.0	14.6	11.3	8.65	7.14
155	7.06	9.13	11.6	14.0	16.7	19.1	21.2	22.8	23.9	24.1	23.6	22.1	20.3	18.2	16.2	13.5	11.0	8.27	7.22
160	6.50	8.21	11.3	13.1	14.8	16.5	18.0	19.2	19.8	20.0	19.7	18.8	17.6	15.9	13.2	10.8	9.53	7.71	7.06
165	6.49	7.43	9.27	12.0	13.2	14.2	15.3	16.1	16.5	16.7	16.5	15.9	14.5	11.7	10.1	8.91	8.10	7.02	6.93
170	7.01	7.24	7.45	9.19	11.4	12.0	12.6	13.4	13.6	13.7	13.2	11.5	9.56	8.55	8.57	8.28	7.67	6.80	7.19
175	8.81	8.92	8.68	8.38	8.27	8.59	9.80	10.4	11.7	10.9	7.22	6.20	7.16	7.89	8.50	8.65	8.68	8.95	8.95
180	4.28	4.28	4.27	4.26	4.25	4.24	4.22	4.21	4.19	4.17	4.16	4.15	4.15	4.14	4.13	4.13	4.13	4.12	4.12

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	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772	772		
5	769	769	769	769	769	769	769	769	770	770	770	770	769	770	770	770	770		
10	758	758	759	759	760	761	761	762	762	762	762	762	761	761	761	760	760		
15	741	742	743	744	746	747	748	749	749	749	749	748	747	746	745	745	744		
20	718	719	721	724	726	729	730	731	732	732	731	729	727	726	724	723	722		
25	689	691	694	698	701	705	708	709	710	709	708	706	702	699	697	695	694		
30	654	657	661	667	672	677	681	683	684	683	681	677	673	668	664	661	659		
35	613	618	624	631	639	645	650	654	654	653	650	644	638	632	626	622	619		
40	568	574	582	592	602	610	616	620	622	620	615	608	600	592	584	577	574		
45	518	526	537	549	562	572	580	585	586	584	578	570	559	548	537	529	524		
50	464	474	488	504	519	532	542	547	549	546	539	528	515	501	487	476	470		
55	406	420	438	457	475	491	502	508	510	506	498	486	470	452	435	420	411		
60	345	363	386	410	431	449	461	468	470	466	456	442	424	402	380	362	350		
65	283	306	334	362	387	407	420	428	430	425	415	399	377	353	326	302	286		
70	220	251	285	316	344	365	380	389	390	385	374	356	333	304	273	242	220		
75	158	197	237	273	303	325	342	350	352	347	335	315	290	259	222	184	155		
80	103	149	193	232	264	288	304	313	315	309	297	277	250	216	175	131	94.2		
85	59.5	108	154	195	228	253	270	279	281	275	262	241	213	177	134	87.5	45.8		
90	31.6	76.9	122	162	194	219	236	246	247	242	228	208	179	143	101	55.7	17.4		
95	17.5	54.3	95.4	133	165	189	205	215	216	211	198	177	149	115	75.3	35.0	5.79		
100	11.6	38.3	73.8	109	138	161	177	186	188	182	169	150	123	91.2	55.3	22.2	3.46		
105	9.11	28.4	57.0	86.7	114	136	151	159	161	156	144	125	100	70.6	40.3	16.4	3.13		
110	8.16	22.7	45.2	69.9	92.4	112	126	134	136	131	119	102	79.6	55.3	31.8	13.1	3.65		
115	7.80	18.5	36.4	56.5	75.9	91.8	103	110	112	107	97.2	82.6	64.7	44.9	25.8	11.3	4.28		
120	7.94	16.1	29.7	46.3	62.3	75.6	86.2	91.4	92.3	88.7	80.3	68.1	53.0	36.6	21.4	10.6	4.92		
125	8.16	14.5	24.9	38.4	51.0	62.7	71.2	75.9	76.5	73.2	66.3	56.0	43.6	30.4	18.5	10.2	5.68		
130	8.70	13.6	21.4	31.6	42.3	51.1	58.1	62.5	63.1	60.3	54.4	46.1	36.2	25.7	16.5	10.0	6.38		
135	9.24	13.0	18.7	26.2	34.5	42.1	47.7	51.2	51.6	49.5	44.8	38.1	30.1	22.0	15.2	10.2	7.07		
140	9.73	12.6	17.1	22.3	28.1	33.5	38.5	41.0	42.0	40.2	36.4	31.1	25.4	19.4	14.0	10.4	7.91		
145	10.1	12.2	15.8	19.6	23.6	27.6	30.5	32.6	33.2	32.1	29.6	26.0	21.7	17.3	13.4	10.7	8.66		
150	10.5	12.0	14.5	17.4	20.3	22.9	24.7	25.6	27.0	26.3	24.4	21.8	18.7	15.7	12.9	10.8	9.24		
155	9.93	11.1	12.5	15.4	17.5	19.3	20.7	21.1	20.8	21.2	20.2	18.5	16.4	14.4	12.6	10.8	8.88		
160	8.57	10.1	10.7	11.7	14.6	16.2	17.1	17.8	17.7	17.1	16.6	15.8	14.6	13.2	11.9	10.2	8.12		
165	7.46	8.54	9.28	9.82	10.5	12.5	14.0	14.9	15.0	14.8	14.5	13.6	12.3	11.1	10.8	9.83	7.29		
170	7.14	7.47	8.45	8.81	8.59	8.34	8.98	11.1	13.1	13.0	12.0	10.2	10.5	10.5	10.2	8.57	7.18		
175	8.93	8.85	8.83	8.99	8.74	8.57	7.32	5.91	4.24	3.22	9.80	9.69	9.56	9.31	9.27	8.93	8.82		
180	4.12	4.13	4.13	4.14	4.14	4.15	4.16	4.17	4.18	4.20	4.22	4.23	4.25	4.26	4.27	4.28	4.28		

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

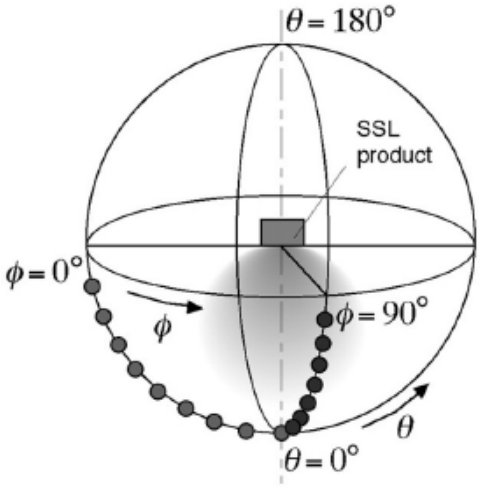
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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