

LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 14.5PLL/840/GL/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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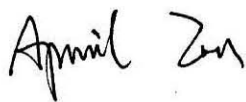
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Report No.: HZ19020002r

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

Review by:



Engineer: April Zou
Feb. 21, 2019

Approved by:



Manager: Jim Zhang
Feb. 21, 2019

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: 14.5PLL/840/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
108.1	2196.0	20.32	0.9934
CCT (K)	CRI	Stabilization Time (Light & Power)	
3985	82.8	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 : Feb. 01, 2019

Date of Test : Feb. 14, 2019

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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Sample Photo

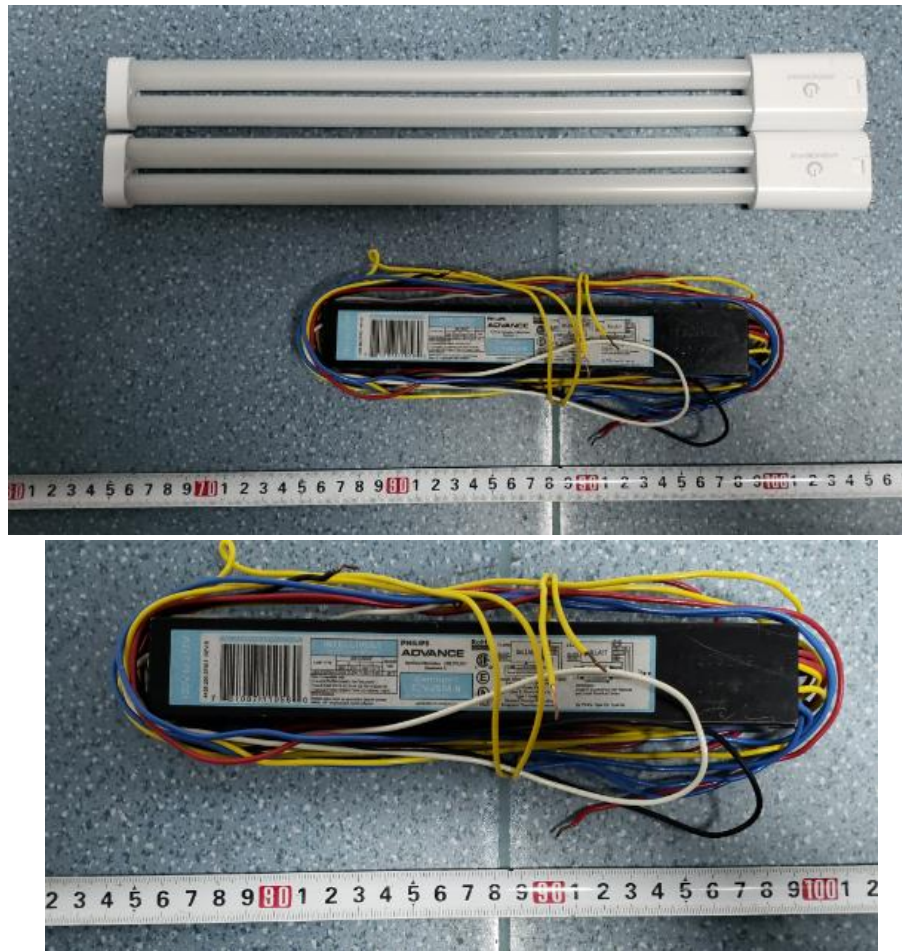


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 14.5PLL/840/GL/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast: ICN-2S54-N
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 26.0°C.

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)	0.341	0.156
Power Factor	0.9934	0.9564
Test Power (W)/2	20.32	20.62
THD A%	9.38	12.11
Luminous Efficacy (lm/W)	108.1	107.4
Total Luminous Flux (lm)	2196.0	2214.0
Color Rendering Index (CRI)	82.8	
R9	8.1	
Correlated Color Temperature (CCT)(K)	3985	
Chromaticity Chroma x	0.3827	
Chromaticity Chroma y	0.3836	
Chromaticity Chroma u	0.2239	
Chromaticity Chroma v	0.3366	
Duv	0.0025	
Chromaticity Chroma u'	0.2239	
Chromaticity Chroma v'	0.5049	

Special Color Rendering Indices	
R1	80.7
R2	88.5
R3	94.9
R4	81.9
R5	80.8
R6	84.5
R7	86.8
R8	64.8
R9	8.1
R10	72.9
R11	80.7
R12	63.2
R13	82.5
R14	97.2
Rf	85
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 24.9°C.

The photometric distance is 2.47m.

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)	0.341
Power Factor	0.9927
Test Power (W)/2	20.33
Luminous Efficacy (lm/W)	106.4
Total Luminous Flux (lm)	2163.1
Beam Angle (°)	112.2
Center Beam Candle Power (cd)	616
Spacing Criteria	1.20 (0 °-180 °)/ 1.33 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	64.98%
Zonal Lumens in the 60 °-90 °Zone	22.57%
Zonal Lumens in the 90 °-120 °Zone	7.55%
Zonal Lumens in the 120 °-180 °Zone	4.90%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

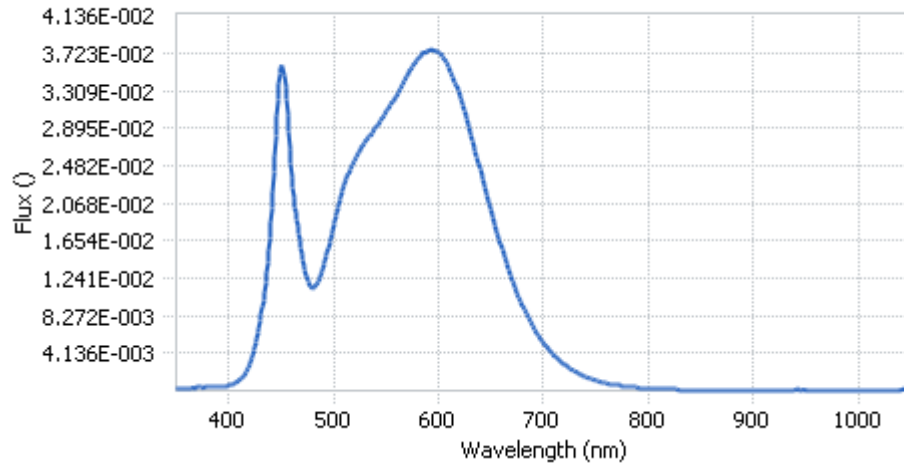
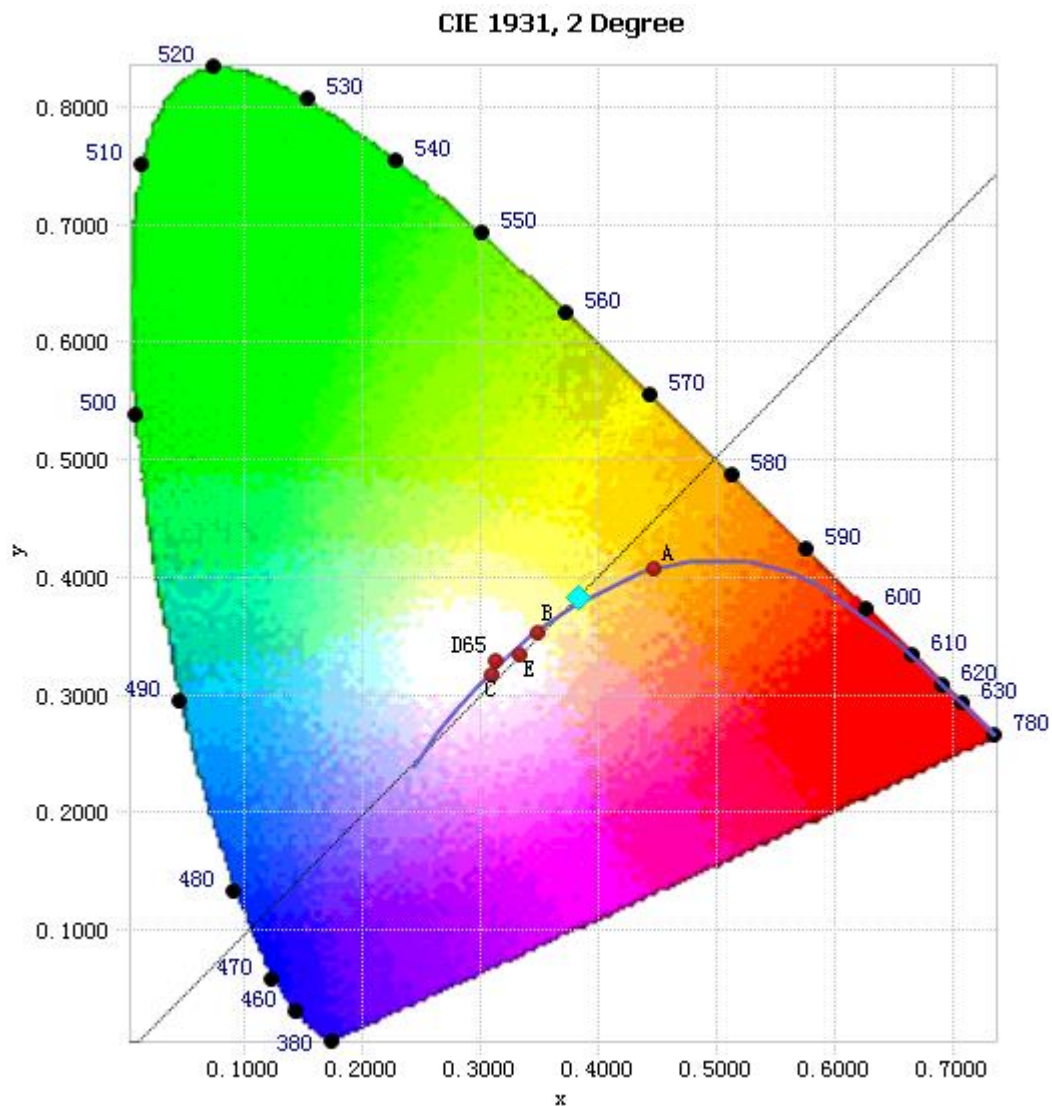


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.08E-04	485	1.20E-02	590	3.74E-02	695	6.12E-03
385	3.96E-04	490	1.35E-02	595	3.75E-02	700	5.30E-03
390	4.35E-04	495	1.58E-02	600	3.73E-02	705	4.55E-03
395	5.13E-04	500	1.83E-02	605	3.66E-02	710	3.91E-03
400	5.90E-04	505	2.06E-02	610	3.56E-02	715	3.36E-03
405	7.80E-04	510	2.27E-02	615	3.42E-02	720	2.89E-03
410	1.16E-03	515	2.43E-02	620	3.25E-02	725	2.48E-03
415	1.81E-03	520	2.55E-02	625	3.07E-02	730	2.14E-03
420	2.91E-03	525	2.65E-02	630	2.86E-02	735	1.82E-03
425	4.86E-03	530	2.75E-02	635	2.64E-02	740	1.56E-03
430	7.72E-03	535	2.82E-02	640	2.43E-02	745	1.34E-03
435	1.20E-02	540	2.90E-02	645	2.20E-02	750	1.15E-03
440	1.85E-02	545	2.99E-02	650	1.99E-02	755	9.89E-04
445	2.81E-02	550	3.07E-02	655	1.78E-02	760	8.59E-04
450	3.57E-02	555	3.17E-02	660	1.58E-02	765	7.39E-04
455	3.21E-02	560	3.26E-02	665	1.40E-02	770	6.39E-04
460	2.35E-02	565	3.37E-02	670	1.23E-02	775	5.50E-04
465	1.87E-02	570	3.47E-02	675	1.08E-02	780	4.76E-04
470	1.51E-02	575	3.56E-02	680	9.43E-03		
475	1.22E-02	580	3.66E-02	685	8.19E-03		
480	1.14E-02	585	3.73E-02	690	7.09E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3827, 0.3836)

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

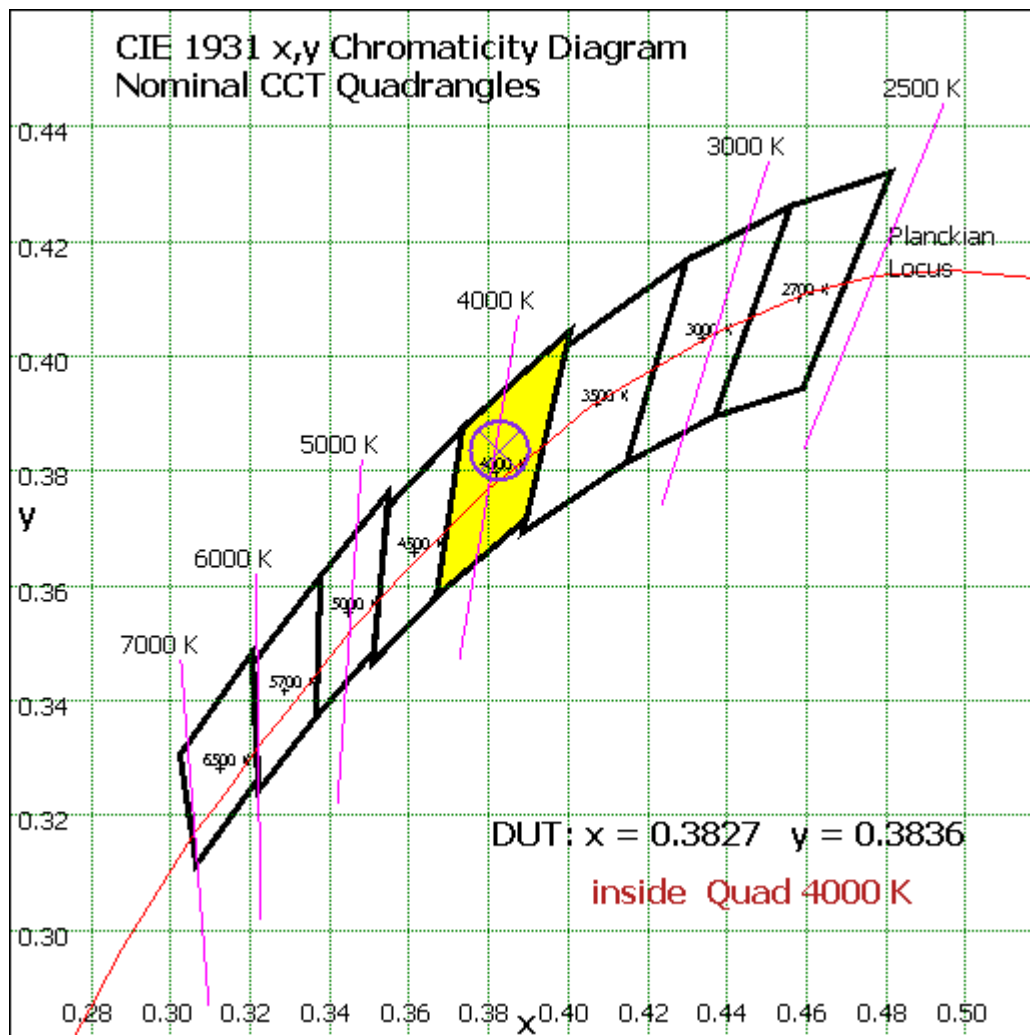


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

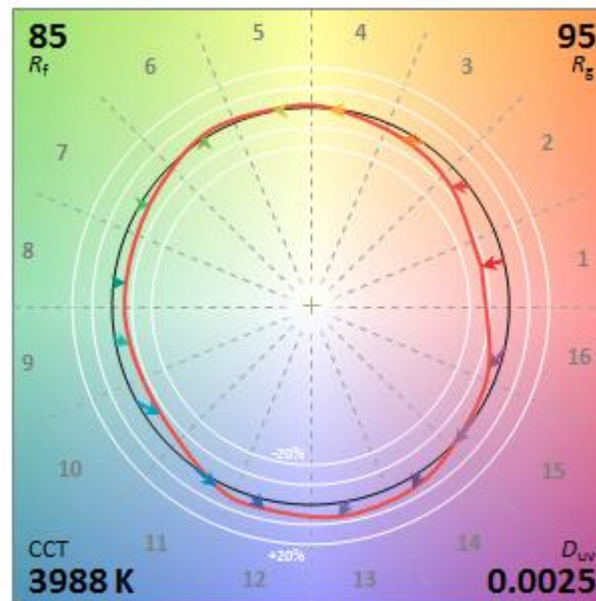


Chart 4: Color Vector Diagram of TM-30-18

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	58.329	2.70%
10- 20	167.682	7.75%
20- 30	255.582	11.82%
30- 40	310.369	14.35%
40- 50	323.407	14.95%
50- 60	290.121	13.41%
60- 70	226.66	10.48%
70- 80	159.823	7.39%
80- 90	101.728	4.70%
90-100	68.783	3.18%
100-110	52.447	2.42%
110-120	42.183	1.95%
120-130	35.675	1.65%
130-140	28.753	1.33%
140-150	20.784	0.96%
150-160	12.918	0.60%
160-170	6.34	0.29%
170-180	1.468	0.07%
Total	2163.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1405.49	64.98%
60- 90	488.211	22.57%
0-90	1893.701	87.55%
90- 180	269.351	12.45%
0- 180	2163.1	100%

Table 5: Zonal Lumen

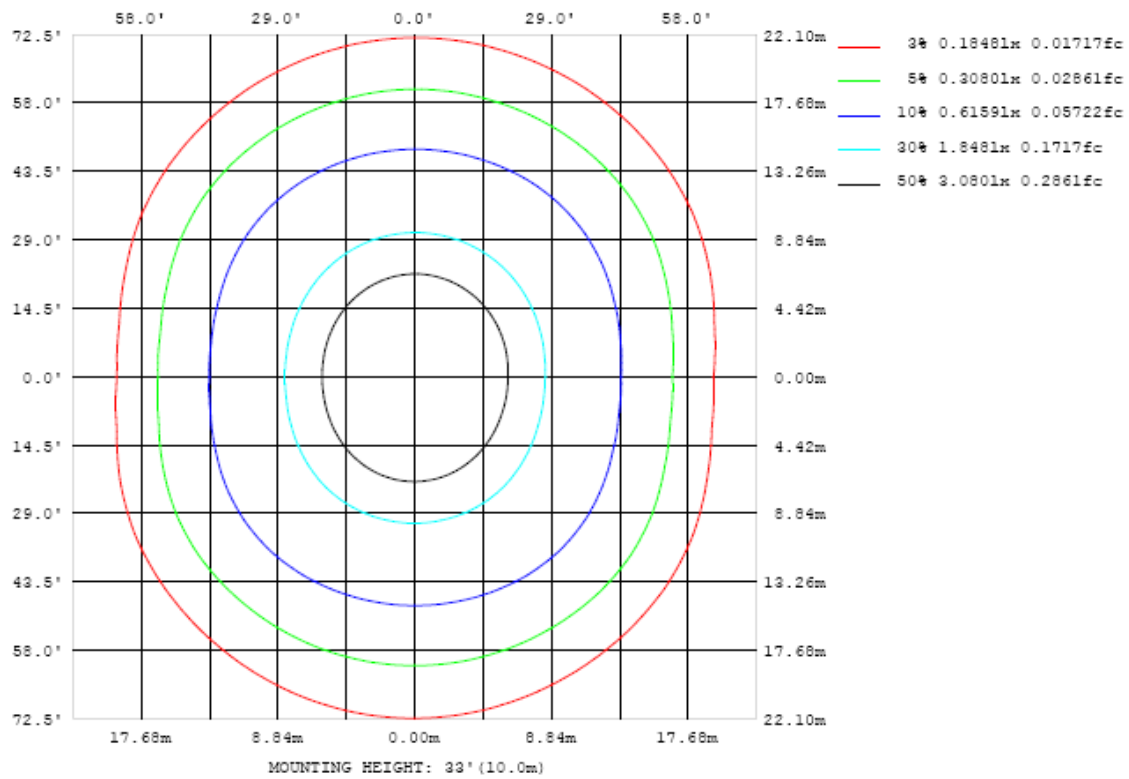


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

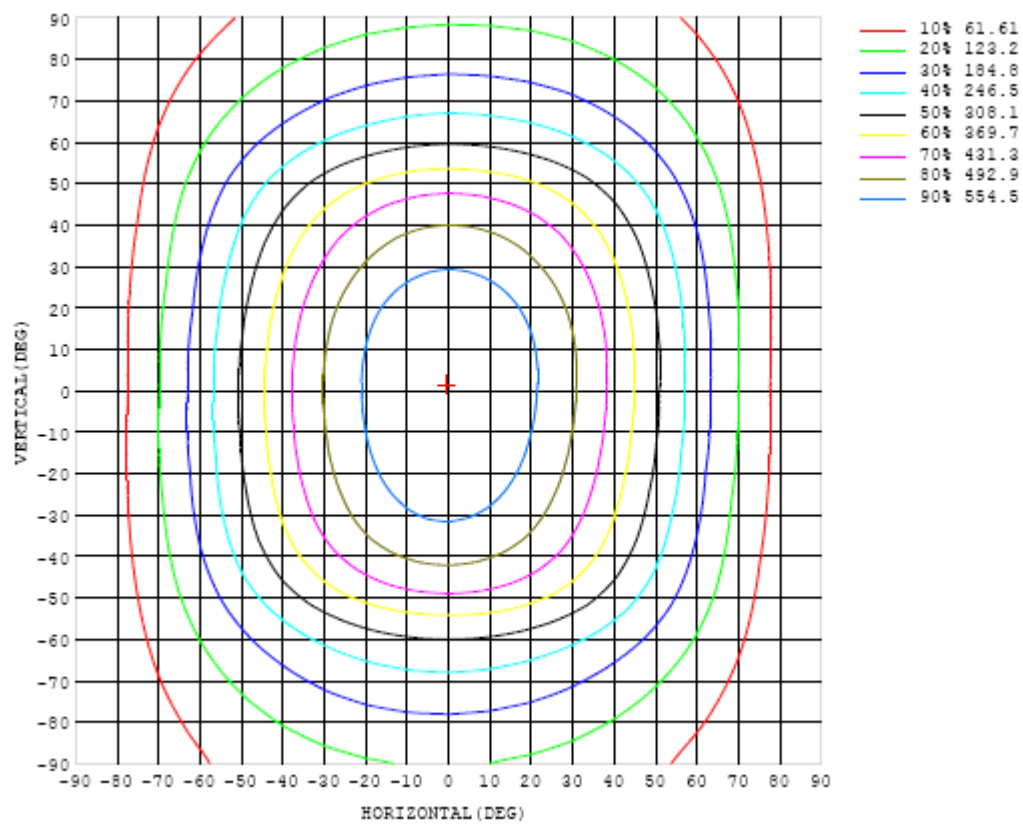


Chart 6: Isocandela Plot

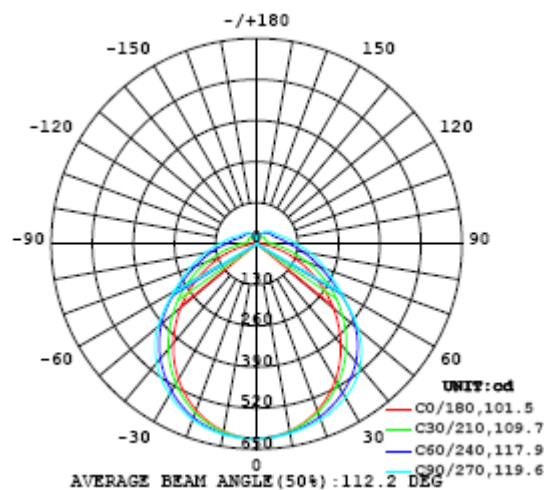


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616
5	612	612	612	612	613	613	613	613	613	614	614	614	614	613	613	613	613	612	613
10	601	601	602	603	604	605	607	608	608	609	609	608	607	606	604	603	603	602	602
15	585	585	586	588	590	594	596	599	601	602	602	600	598	595	591	588	586	584	584
20	562	562	564	567	572	578	583	587	590	592	591	588	585	579	573	568	564	561	560
25	533	533	536	542	550	558	565	572	576	578	577	574	568	560	551	543	536	531	530
30	499	499	504	513	523	534	544	553	558	561	560	555	547	536	524	513	503	496	495
35	459	460	467	478	492	506	519	529	536	539	538	532	522	509	494	479	467	458	455
40	414	416	425	440	458	475	489	499	506	508	507	501	492	478	460	442	426	415	411
45	367	369	381	399	420	438	452	461	467	469	468	463	454	441	423	402	383	368	363
50	317	321	334	355	378	396	408	415	419	420	419	416	409	398	381	360	337	320	314
55	266	271	287	311	333	348	357	360	360	360	360	358	356	349	335	315	291	271	264
60	216	221	240	265	284	296	301	305	308	309	308	305	301	295	285	269	246	223	214
65	167	174	195	218	234	245	253	260	265	267	266	262	254	245	234	221	201	177	166
70	122	129	151	171	187	201	213	223	230	233	232	226	216	204	190	174	157	134	121
75	80.0	88.5	111	129	147	165	180	192	200	203	201	195	184	170	152	134	116	95.3	79.3
80	44.8	54.6	74.4	94.6	115	134	150	163	171	174	173	166	155	140	121	101	80.4	61.2	43.9
85	17.6	26.1	46.0	67.8	88.2	108	124	137	145	149	147	141	129	114	95.4	74.8	53.5	32.5	17.5
90	1.93	9.46	28.0	48.7	69.2	87.6	104	115	123	126	125	119	109	94.4	76.5	57.1	36.3	16.4	1.53
95	2.05	5.87	21.4	40.6	59.6	76.5	90.9	102	109	112	111	105	95.9	82.6	66.9	48.5	29.4	11.5	2.14
100	3.60	7.37	18.0	34.5	51.7	67.6	80.1	89.9	96.2	98.9	97.8	93.1	84.6	73.5	59.1	42.7	25.7	11.9	3.88
105	4.43	7.61	19.0	31.3	45.9	59.7	71.2	79.7	85.1	87.4	86.6	82.4	75.0	65.5	52.9	38.9	25.7	14.2	5.24
110	5.52	8.95	19.2	31.1	42.8	54.2	64.1	71.5	75.8	77.7	77.0	74.3	68.0	59.5	48.9	38.1	26.5	15.4	6.60
115	6.76	10.0	20.5	31.2	42.0	51.5	59.2	65.3	69.1	70.8	70.3	67.5	62.6	55.7	47.8	37.4	27.6	15.9	8.00
120	8.06	11.5	22.1	30.5	40.0	50.0	57.0	61.7	64.6	66.0	65.5	63.4	59.8	54.4	46.3	37.8	28.4	16.4	8.98
125	9.23	12.2	22.3	31.9	38.6	47.4	54.4	59.5	62.1	63.3	62.9	61.1	57.8	51.9	45.5	37.7	27.5	16.8	10.2
130	10.2	12.8	22.0	31.3	39.2	44.9	51.8	56.1	58.6	60.0	59.9	58.3	54.9	50.3	43.5	36.6	26.7	17.0	10.9
135	11.1	12.8	21.9	30.2	37.7	43.7	49.0	53.7	56.6	57.7	57.4	55.7	52.0	47.4	41.8	33.4	26.1	17.7	11.5
140	11.9	13.2	21.3	29.2	35.3	41.0	45.5	48.9	52.4	54.2	53.9	52.0	48.5	44.0	37.8	31.1	24.3	17.1	12.3
145	12.4	13.9	21.0	28.0	33.5	37.9	41.4	44.6	46.8	48.7	49.1	47.5	44.4	39.8	34.9	29.8	24.1	18.1	13.0
150	12.8	14.0	20.0	25.8	30.9	35.0	37.8	40.3	42.0	42.8	43.0	42.0	39.8	36.8	32.8	28.4	23.3	17.3	13.4
155	13.2	13.9	18.8	25.1	28.1	31.6	34.2	36.1	37.3	37.9	37.8	37.4	35.8	33.7	30.7	25.8	20.4	16.1	13.5
160	13.7	13.5	15.9	20.6	25.1	27.3	29.6	32.0	33.2	33.8	33.8	33.2	32.3	29.9	26.6	23.4	17.8	15.1	12.6
165	14.3	14.1	17.0	19.5	21.4	23.3	26.2	27.7	29.4	29.9	29.6	29.2	28.2	26.5	23.6	20.8	17.8	14.1	10.2
170	14.0	13.9	13.9	15.4	18.1	22.0	23.7	24.7	25.7	26.4	26.9	26.2	25.4	23.3	19.2	15.3	12.1	9.81	8.84
175	12.8	13.6	13.6	13.5	13.5	13.4	13.3	14.2	17.8	19.9	14.0	11.7	11.5	10.8	10.1	9.62	9.35	9.05	8.95
180	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) Y (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616	616		
5	613	613	613	614	615	615	615	615	616	615	615	615	614	614	613	613	612		
10	603	603	605	606	608	610	611	612	612	612	611	610	608	607	605	604	602		
15	585	587	590	593	597	600	603	604	605	604	603	601	598	595	592	589	586		
20	562	564	569	575	580	585	589	591	592	591	589	586	582	577	573	568	564		
25	532	536	543	550	558	564	569	573	574	573	571	566	561	554	548	541	536		
30	497	503	511	520	530	538	545	549	551	550	546	541	534	526	518	510	503		
35	457	465	475	486	497	508	517	522	525	523	519	512	504	494	484	473	464		
40	414	423	435	448	462	475	484	490	493	491	487	480	470	458	445	432	421		
45	367	377	392	408	424	436	446	452	455	453	449	442	433	419	403	387	375		
50	317	330	347	366	382	394	401	406	408	407	404	400	390	377	359	341	326		
55	268	282	302	321	336	345	350	352	354	353	352	351	344	332	314	294	277		
60	218	235	256	274	286	293	298	302	304	303	301	298	293	284	268	247	228		
65	171	190	211	226	237	247	254	259	261	260	257	252	245	235	222	202	180		
70	127	148	167	181	195	206	216	223	226	224	220	213	203	190	176	160	137		
75	87.7	109	127	143	160	173	183	190	194	192	187	179	168	153	136	119	98.4		
80	54.1	73.3	92.5	111	129	143	155	162	165	163	159	150	137	121	102	82.8	63.5		
85	26.3	45.1	65.2	84.6	103	118	129	136	139	138	133	124	110	93.6	74.6	54.4	34.1		
90	9.56	27.0	46.0	64.6	81.6	95.8	107	113	116	115	110	101	88.8	72.7	54.3	34.8	16.1		
95	5.97	20.4	38.1	55.6	71.4	84.4	94.1	100	103	101	97.2	89.2	77.5	62.5	45.3	27.1	10.3		
100	7.97	17.2	31.9	47.6	62.1	74.0	82.9	88.4	90.8	89.6	85.7	78.3	67.5	53.8	38.0	22.1	9.87		
105	9.25	18.0	28.7	41.7	53.9	64.4	72.3	77.2	79.2	78.2	74.6	68.0	58.4	46.4	33.1	20.7	11.0		
110	9.86	20.4	28.7	38.3	48.3	57.0	63.5	67.5	69.3	68.4	65.3	59.7	51.7	41.8	31.1	21.4	11.2		
115	10.8	21.1	29.9	37.7	45.4	51.8	57.1	60.5	61.8	61.1	58.5	53.9	47.4	39.7	31.0	23.0	12.3		
120	11.4	20.9	30.9	37.7	44.3	49.6	53.5	55.8	56.8	56.2	54.3	50.9	45.7	38.9	31.7	23.7	13.5		
125	12.1	20.7	30.4	37.6	43.3	48.1	51.5	53.5	54.3	53.8	52.0	49.1	44.4	38.6	32.5	23.6	14.7		
130	12.6	20.5	29.2	37.1	42.4	46.5	49.5	51.4	52.2	51.6	50.0	47.4	43.3	38.5	32.1	23.9	15.5		
135	12.6	19.3	28.0	35.3	41.0	44.8	47.4	49.0	49.7	49.2	47.9	45.7	42.5	37.7	30.9	24.3	15.7		
140	13.0	18.7	26.8	32.9	38.7	42.9	45.3	46.8	47.3	47.0	45.8	44.0	40.8	35.3	30.2	24.3	16.0		
145	13.6	18.7	24.8	30.9	35.5	39.6	42.6	44.2	44.8	44.5	43.2	41.0	37.6	33.5	29.7	22.6	15.0		
150	13.8	18.1	23.0	28.4	32.7	35.9	38.3	39.9	40.5	40.1	39.0	37.5	35.2	32.2	28.3	21.4	14.7		
155	13.5	16.4	21.7	22.7	29.7	32.7	34.6	36.0	36.5	36.3	35.6	34.7	32.8	29.4	25.3	20.0	14.7		
160	12.3	14.2	19.3	21.0	24.5	28.4	30.9	32.2	32.9	32.7	31.7	30.3	27.4	25.0	23.1	19.8	15.6		
165	10.8	12.9	16.3	19.6	21.4	21.7	26.4	27.3	27.1	26.7	26.7	25.8	24.1	24.6	22.5	19.6	16.2		
170	9.35	10.4	12.5	16.0	19.8	21.2	21.3	22.5	25.2	26.2	26.0	25.5	24.1	23.6	22.2	18.6	15.5		
175	9.48	9.69	9.76	9.94	10.4	11.0	12.8	16.5	18.0	20.5	21.4	20.1	17.5	14.2	12.1	12.4	12.4		
180	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 14, 2018	Aug. 13, 2019
Digital Power Meter	PF2010A	HZTE028-01	Sep. 12, 2018	Sep. 11, 2019
AC Power Supply	DPS1060	HZTE001-06	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	WY12010	HZTE004-03	Aug. 09, 2018	Aug. 08, 2019
Temperature recorder	JM624U	HZTE018-08	Aug. 09, 2018	Aug. 08, 2019
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 09, 2018	Aug. 08, 2019
Standard source	D908	HZTE012-01	Aug. 14, 2018	Aug. 13, 2019
Integrate Sphere system	3M	HZTE015-04	Aug. 16, 2018	Aug. 15, 2019
Digital Power Meter	WT210	HZTE008-01	Aug. 02, 2018	Aug. 01, 2019
AC Power Supply	PCR 500L	HZTE001-07	Aug. 09, 2018	Aug. 08, 2019
DC Power Supply	IT6154	HZTE004-04	Aug. 09, 2018	Aug. 08, 2019
Standard source	SCL-1400	HZTE012-02	Aug. 16, 2018	Aug. 15, 2019
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 09, 2018	Aug. 08, 2019
Temperature Meter	TES1310	HZTE017-01	Aug. 09, 2018	Aug. 08, 2019

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 expanded 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 expanded 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 ($C=0^\circ/180^\circ$ and $C=90^\circ/270^\circ$) 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, $\Delta u'v'$, 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 ***

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