



LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 24T5HO/4F/840/GL/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020012g

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

Review by:

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Mar. 08, 2019

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Jim Zhang

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Mar. 08, 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: 24T5HO/4F/840/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
120.0	3747.0	31.22	0.9982
CCT (K)	CRI	Stabilization Time (Light & Power)	
4100	81.8	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. 21, 2019

Date of Test : Feb. 28, 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

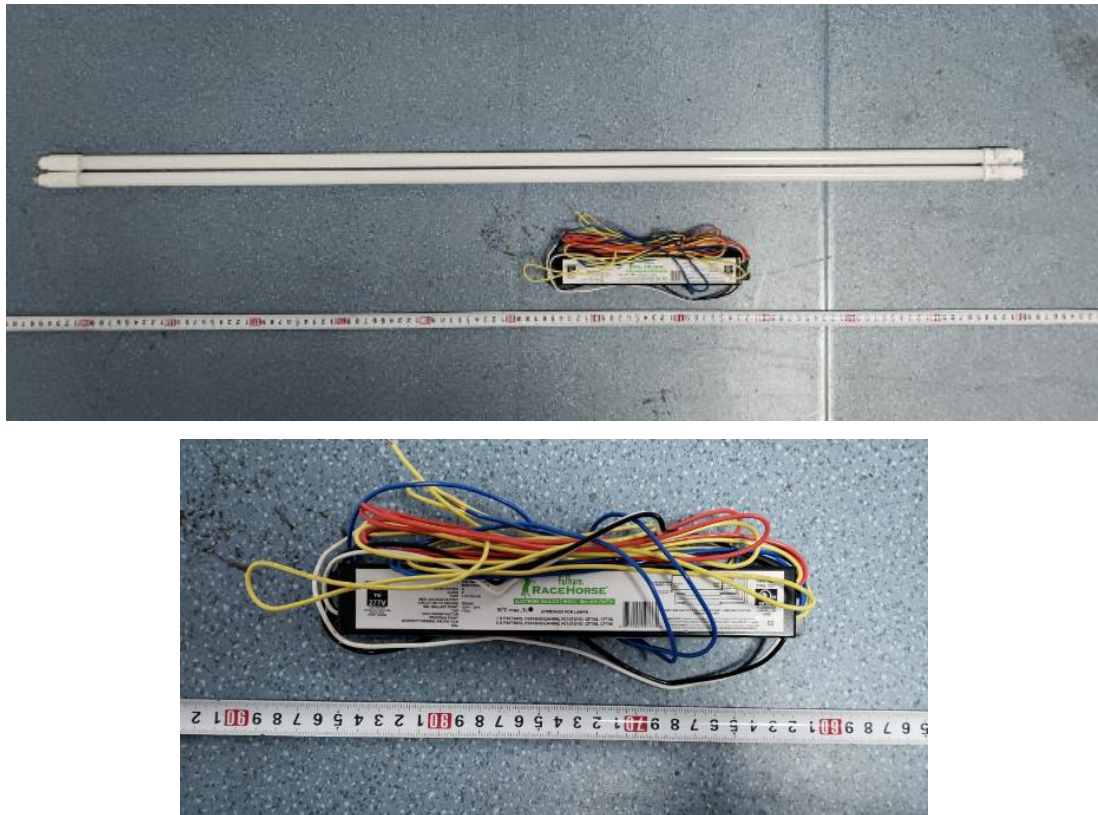


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 24T5HO/4F/840/GL/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 24W
Product Description	: 4000K LED Tubes supplied by a high frequency fluorescent lamp ballast: RHA-UNV-254-LT5
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.0°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)	0.521	0.229
Power Factor	0.9982	0.9736
Test Power (W)/2	31.22	30.90
THD A%	4.57	7.08
Luminous Efficacy (lm/W)	120.0	121.3
Total Luminous Flux (lm)	3747.0	3747.0
Color Rendering Index (CRI)	81.8	
R9	2.9	
Correlated Color Temperature (CCT)(K)	4100	
Chromaticity Chroma x	0.3769	
Chromaticity Chroma y	0.3773	
Chromaticity Chroma u	0.2225	
Chromaticity Chroma v	0.3342	
Duv	0.0008	
Chromaticity Chroma u'	0.2225	
Chromaticity Chroma v'	0.5013	

Special Color Rendering Indices	
R1	79.7
R2	88.2
R3	94.4
R4	80.3
R5	79.7
R6	83.5
R7	85.7
R8	63
R9	2.9
R10	71.8
R11	78.7
R12	59.9
R13	81.8
R14	97
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 25.3°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)	0.522
Power Factor	0.9979
Test Power (W)/2	31.26
Luminous Efficacy (lm/W)	118.1
Total Luminous Flux (lm)	3691.9
Beam Angle (°)	164.0
Center Beam Candle Power (cd)	635
Spacing Criteria	1.29 (0 °-180 °)/ 1.45 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	45.09%
Zonal Lumens in the 60 °-90 °Zone	28.01%
Zonal Lumens in the 90 °-120 °Zone	16.65%
Zonal Lumens in the 120 °-180 °Zone	10.26%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

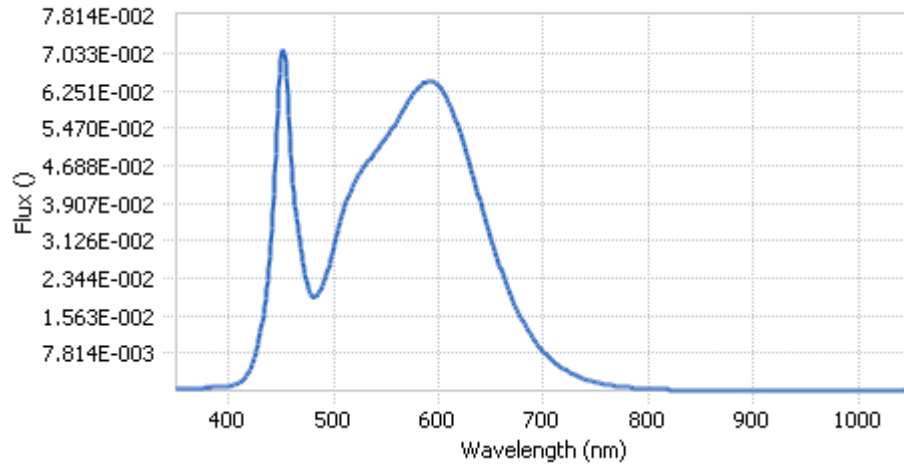
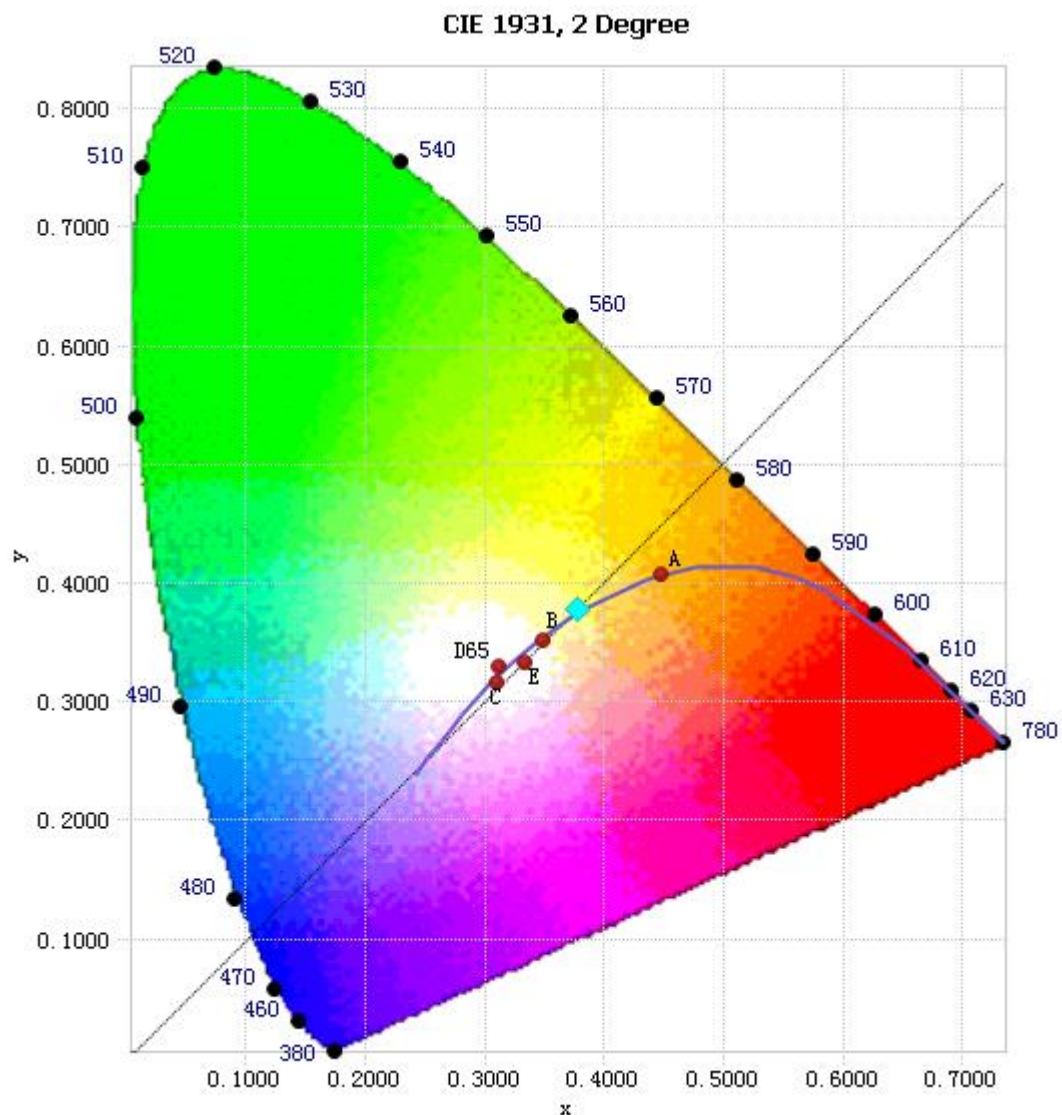


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.79E-04	485	2.01E-02	590	6.45E-02	695	9.44E-03
385	6.93E-04	490	2.22E-02	595	6.43E-02	700	8.15E-03
390	7.76E-04	495	2.57E-02	600	6.36E-02	705	6.99E-03
395	8.38E-04	500	3.00E-02	605	6.21E-02	710	6.01E-03
400	9.69E-04	505	3.43E-02	610	5.99E-02	715	5.16E-03
405	1.23E-03	510	3.79E-02	615	5.73E-02	720	4.46E-03
410	1.75E-03	515	4.11E-02	620	5.40E-02	725	3.82E-03
415	2.72E-03	520	4.35E-02	625	5.06E-02	730	3.28E-03
420	4.35E-03	525	4.52E-02	630	4.69E-02	735	2.81E-03
425	7.24E-03	530	4.70E-02	635	4.30E-02	740	2.41E-03
430	1.20E-02	535	4.83E-02	640	3.91E-02	745	2.09E-03
435	1.93E-02	540	4.98E-02	645	3.53E-02	750	1.80E-03
440	3.07E-02	545	5.13E-02	650	3.16E-02	755	1.55E-03
445	4.95E-02	550	5.27E-02	655	2.82E-02	760	1.34E-03
450	6.92E-02	555	5.43E-02	660	2.50E-02	765	1.16E-03
455	6.52E-02	560	5.61E-02	665	2.20E-02	770	9.90E-04
460	4.62E-02	565	5.79E-02	670	1.92E-02	775	8.70E-04
465	3.58E-02	570	6.00E-02	675	1.68E-02	780	7.40E-04
470	2.84E-02	575	6.14E-02	680	1.46E-02		
475	2.18E-02	580	6.30E-02	685	1.27E-02		
480	1.95E-02	585	6.42E-02	690	1.10E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3769, 0.3773)

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

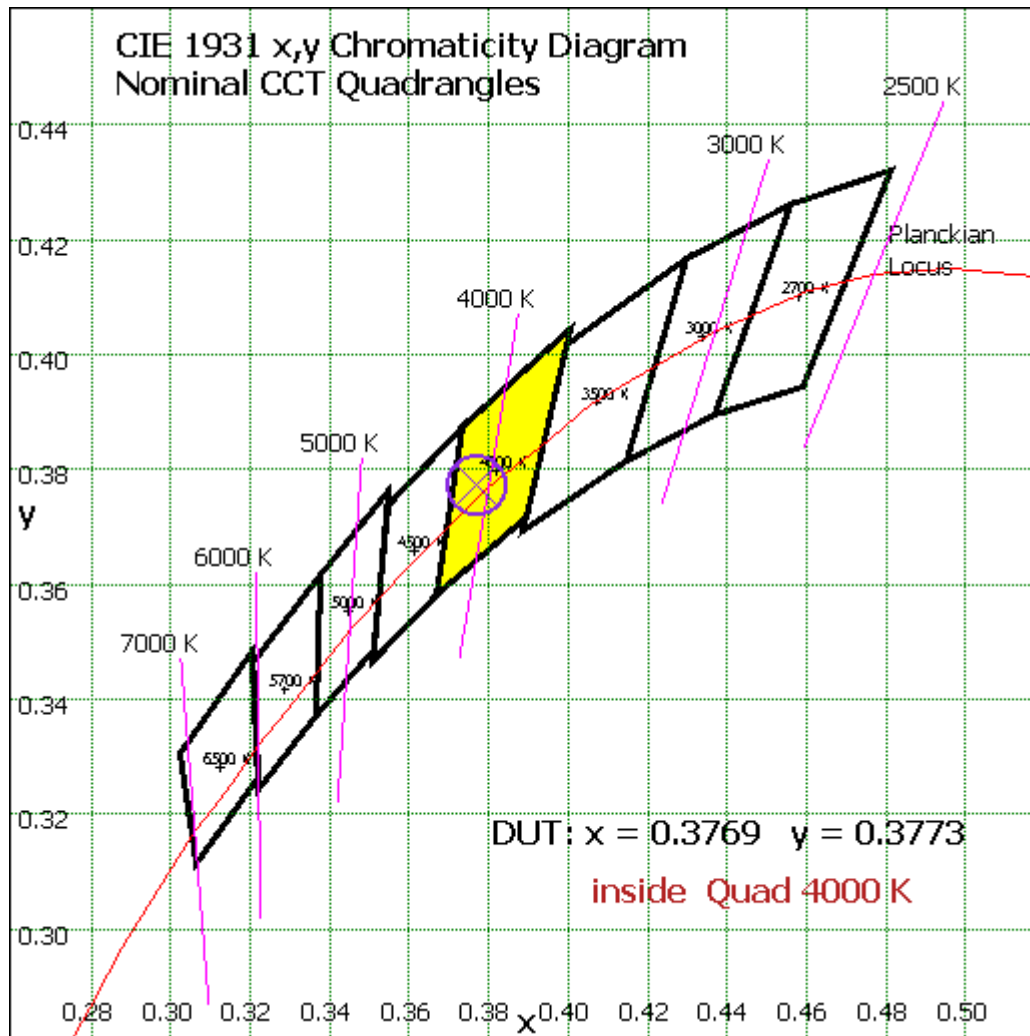


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

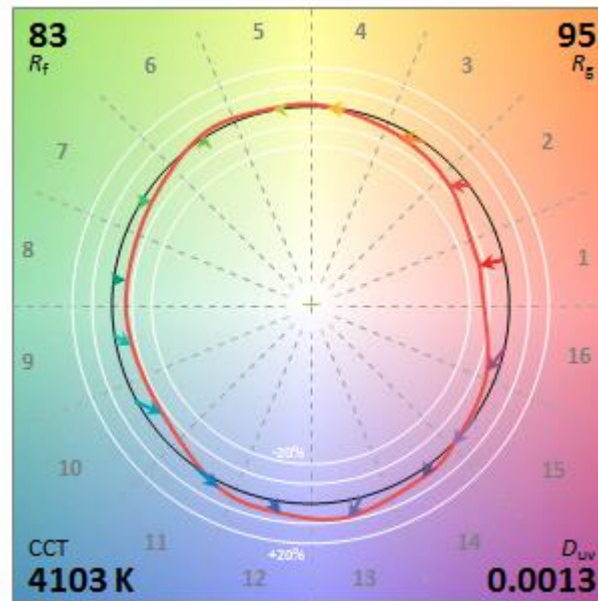


Chart 4: Color Vector Diagram of TM-30-18

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	60.286	1.63%
10- 20	175.5	4.75%
20- 30	275.098	7.45%
30- 40	350.406	9.49%
40- 50	395.452	10.71%
50- 60	407.848	11.05%
60- 70	389.592	10.55%
70- 80	347.916	9.42%
80- 90	296.496	8.03%
90-100	248.884	6.74%
100-110	203.275	5.51%
110-120	162.401	4.40%
120-130	128.041	3.47%
130-140	98.841	2.68%
140-150	72.222	1.96%
150-160	48.022	1.30%
160-170	24.933	0.68%
170-180	6.732	0.18%
Total	3691.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1664.59	45.09%
60- 90	1034.004	28.01%
0-90	2698.594	73.09%
90- 180	993.351	26.91%
0- 180	3691.9	100%

Table 5: Zonal Lumen

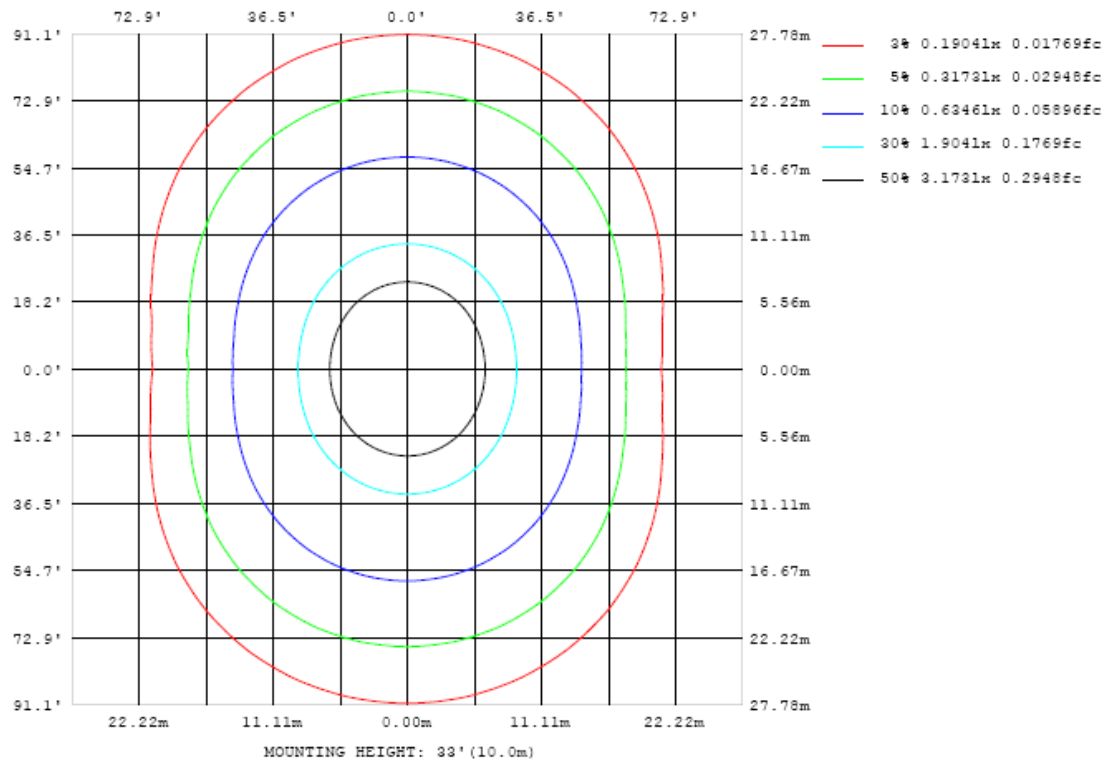


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

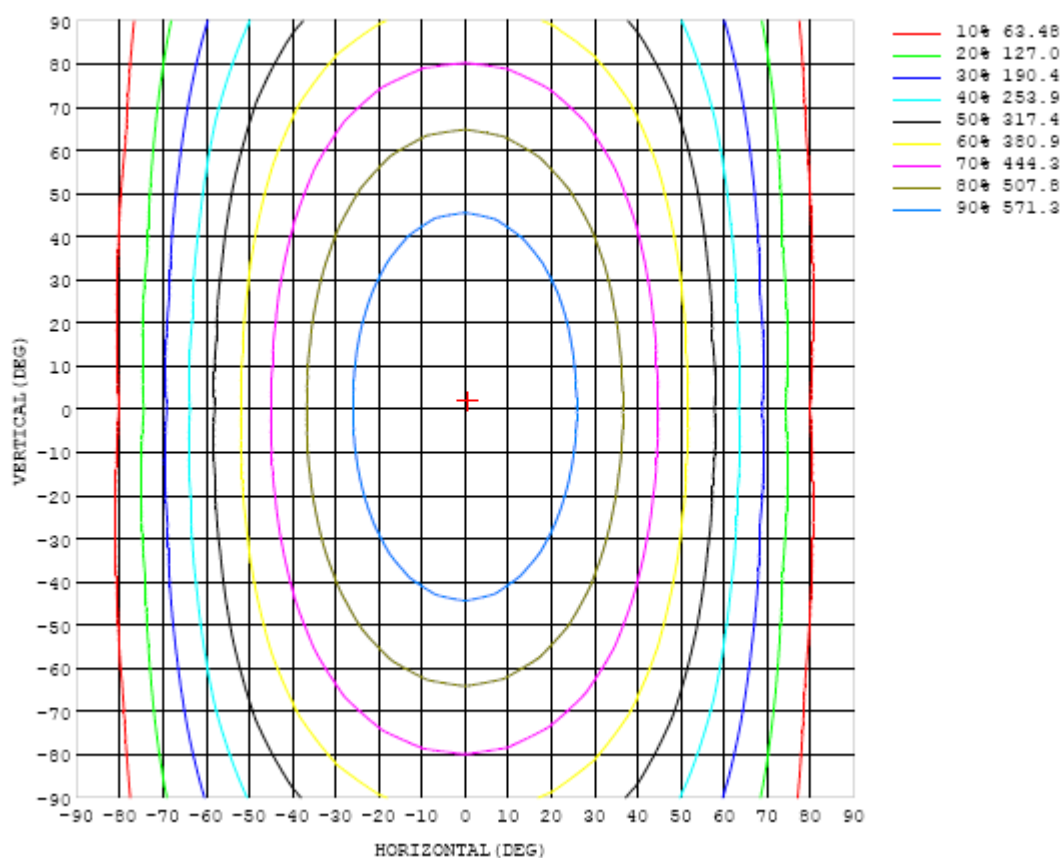


Chart 6: Isocandela Plot

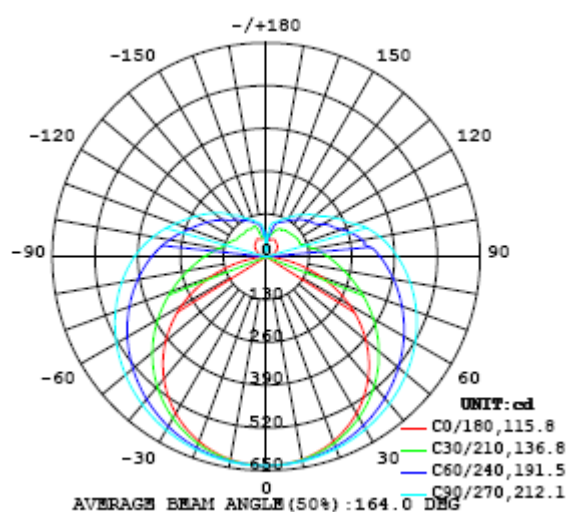


Chart 7: Polar Candela Distribution

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	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635
5	632	632	632	633	633	633	633	633	633	634	633	633	633	633	633	632	632	632	632
10	625	625	626	627	627	628	629	630	631	631	631	630	629	629	628	627	626	625	625
15	613	614	615	617	619	621	623	625	626	627	626	625	623	621	619	617	615	614	613
20	597	598	600	603	607	611	615	618	620	621	620	618	615	611	607	603	600	598	597
25	575	577	580	585	591	598	604	609	612	613	612	610	605	599	592	586	581	577	576
30	549	551	556	564	573	583	591	598	603	604	603	599	592	584	575	565	558	552	550
35	518	521	528	539	552	565	577	586	592	594	593	587	578	567	554	541	530	522	519
40	482	486	496	511	529	546	561	572	580	583	580	573	562	548	531	514	499	488	484
45	441	446	460	481	503	525	543	557	566	569	567	559	545	527	506	484	464	450	444
50	396	403	421	447	475	502	524	541	552	555	552	542	527	505	479	452	426	407	399
55	346	355	380	412	447	478	504	523	535	540	536	525	507	481	451	418	385	361	350
60	293	305	336	376	417	454	483	505	518	523	519	507	486	457	422	382	342	311	297
65	236	251	291	340	387	429	461	485	500	505	501	487	465	433	393	346	298	258	240
70	177	197	247	304	358	404	439	464	480	485	481	467	442	408	364	311	255	205	181
75	118	146	206	271	329	378	416	443	459	465	460	445	420	383	335	278	213	153	121
80	62.5	98.6	169	240	302	354	393	421	438	444	439	423	396	358	308	246	176	106	66.2
85	19.9	62.5	139	212	276	329	370	398	416	422	417	401	373	333	282	218	145	68.7	21.6
90	1.10	41.6	115	188	252	306	346	375	393	399	394	378	350	310	258	194	121	45.7	1.26
95	3.26	29.9	97.3	168	228	276	321	352	370	376	371	355	327	287	235	173	102	33.7	3.57
100	8.20	29.6	82.0	145	207	258	296	314	345	351	346	330	302	263	212	153	87.1	31.9	7.93
105	14.9	33.8	70.7	130	180	233	272	298	307	324	319	303	276	238	190	136	76.3	34.7	13.5
110	21.7	39.5	74.3	112	166	207	244	269	285	290	290	275	249	214	172	121	75.3	41.0	20.1
115	28.4	45.6	75.8	112	145	190	220	244	258	261	262	248	226	195	154	114	75.8	47.3	26.4
120	34.6	52.3	76.9	110	140	167	199	221	233	238	235	226	204	173	144	110	77.9	53.9	32.6
125	40.0	58.7	78.3	107	135	160	177	198	208	215	212	202	182	164	137	107	80.7	60.3	38.5
130	44.5	63.6	80.7	104	129	152	170	185	195	197	194	186	173	154	130	105	83.7	66.5	44.4
135	47.6	65.5	82.1	101	123	143	159	171	179	182	178	169	161	144	124	104	87.1	69.0	48.4
140	50.8	69.3	85.0	100	117	134	148	159	165	167	165	157	147	135	119	104	89.8	71.8	51.7
145	52.8	72.3	88.2	99.3	112	125	136	145	151	153	151	146	138	125	114	103	92.0	74.0	54.5
150	55.7	76.0	86.8	93.0	108	117	126	133	138	138	137	133	128	119	110	101	93.0	77.4	58.5
155	58.4	76.5	86.2	93.9	104	111	117	122	126	127	125	123	119	114	108	101	92.8	78.3	60.1
160	56.3	67.6	78.8	85.8	95.4	107	111	114	116	117	116	115	112	109	105	100	92.5	75.3	56.5
165	53.1	60.8	68.0	75.6	80.2	86.9	99.8	108	109	110	109	109	107	104	99.6	90.6	83.5	74.9	54.6
170	52.5	55.7	61.8	66.2	66.8	70.3	75.2	83.7	96.2	104	105	103	102	95.3	83.0	82.3	79.0	70.7	55.8
175	67.8	68.3	68.5	67.8	65.8	59.2	52.3	54.0	58.1	65.0	87.0	86.0	60.7	65.1	73.7	77.1	74.8	70.9	70.0
180	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2

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	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635	635		
5	632	633	633	633	634	634	634	634	634	634	634	634	633	633	633	633	633		
10	626	626	627	629	630	631	632	632	632	632	631	630	629	628	627	626	625		
15	614	616	618	620	623	625	627	629	629	628	627	625	623	620	618	615	614		
20	598	601	605	609	613	618	621	623	623	623	620	617	613	609	604	600	598		
25	577	581	587	594	601	607	613	616	616	615	612	607	601	594	586	581	576		
30	552	558	567	576	586	595	602	607	608	606	602	595	586	576	565	557	551		
35	522	530	542	556	569	581	590	596	598	596	590	580	568	555	541	529	521		
40	488	499	515	533	550	565	577	584	586	583	576	564	549	532	513	497	485		
45	449	464	484	507	529	548	562	571	573	570	561	546	528	506	482	461	446		
50	406	425	452	480	506	529	545	555	558	555	544	527	505	478	449	422	402		
55	359	383	417	451	483	508	528	539	542	538	526	507	481	449	414	381	355		
60	308	340	380	421	458	487	509	522	525	521	508	486	456	420	378	337	304		
65	255	295	344	391	433	466	489	503	507	502	488	464	431	390	342	293	251		
70	200	250	308	361	407	443	468	483	488	482	467	441	406	361	306	249	197		
75	147	207	273	332	381	420	446	462	467	462	445	418	381	332	273	207	145		
80	98.6	169	241	304	356	396	424	441	446	440	423	395	356	305	242	171	99.2		
85	61.6	137	213	278	331	372	401	418	423	417	400	372	332	279	214	141	64.9		
90	39.7	113	188	254	307	349	378	395	400	395	377	348	308	255	191	118	44.5		
95	29.8	94.4	166	230	283	324	353	370	376	370	353	324	284	232	169	99.4	34.6		
100	29.5	82.5	146	207	258	298	327	344	349	344	327	299	260	210	150	88.0	34.5		
105	32.1	77.1	132	186	234	273	300	317	322	317	301	273	236	189	137	83.0	36.8		
110	38.2	73.5	123	171	213	248	274	289	295	290	274	249	216	175	128	80.0	40.9		
115	44.7	73.1	114	158	196	228	251	264	269	265	251	229	199	162	119	76.7	46.4		
120	49.3	73.1	105	145	181	209	230	243	247	243	231	211	184	150	112	78.8	51.0		
125	56.1	74.3	104	134	165	192	211	222	226	223	212	194	168	139	107	76.0	55.7		
130	61.0	79.8	102	126	150	176	193	203	207	203	192	177	153	128	105	79.7	60.2		
135	64.9	84.1	98.5	122	141	155	173	185	188	185	177	159	143	124	99.2	83.7	64.1		
140	71.3	85.3	99.2	113	134	149	157	162	164	165	161	149	135	113	98.2	84.6	65.7		
145	73.5	88.6	100	111	122	137	146	153	154	153	146	133	120	111	99.5	86.7	69.2		
150	72.7	90.7	95.7	108	120	128	133	135	138	137	129	122	117	108	96.8	89.9	69.0		
155	67.6	88.4	98.6	105	113	120	125	127	127	124	120	118	112	104	91.1	83.4	64.1		
160	56.3	77.8	97.6	101	107	111	116	118	119	118	114	112	102	88.3	80.3	75.0	57.6		
165	51.6	60.4	72.3	99.9	102	105	109	110	110	110	105	89.7	77.0	71.8	67.9	62.9	51.8		
170	52.6	57.3	60.0	63.9	76.6	92.5	96.4	101	103	94.0	69.5	65.2	67.7	67.7	66.6	57.7	52.4		
175	67.6	69.7	73.5	73.7	72.2	68.3	67.8	74.0	64.3	49.3	69.7	75.7	78.3	77.9	71.3	70.0	69.4		
180	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2		

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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