



LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

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

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020012i

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

Review by:

Engineer: April Zou
Mar. 08, 2019

Approved by:



Manager: Jim Zhang
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/850/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
117.2	3661.0	31.23	0.9982
CCT (K)	CRI	Stabilization Time (Light & Power)	
4987	82.3	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

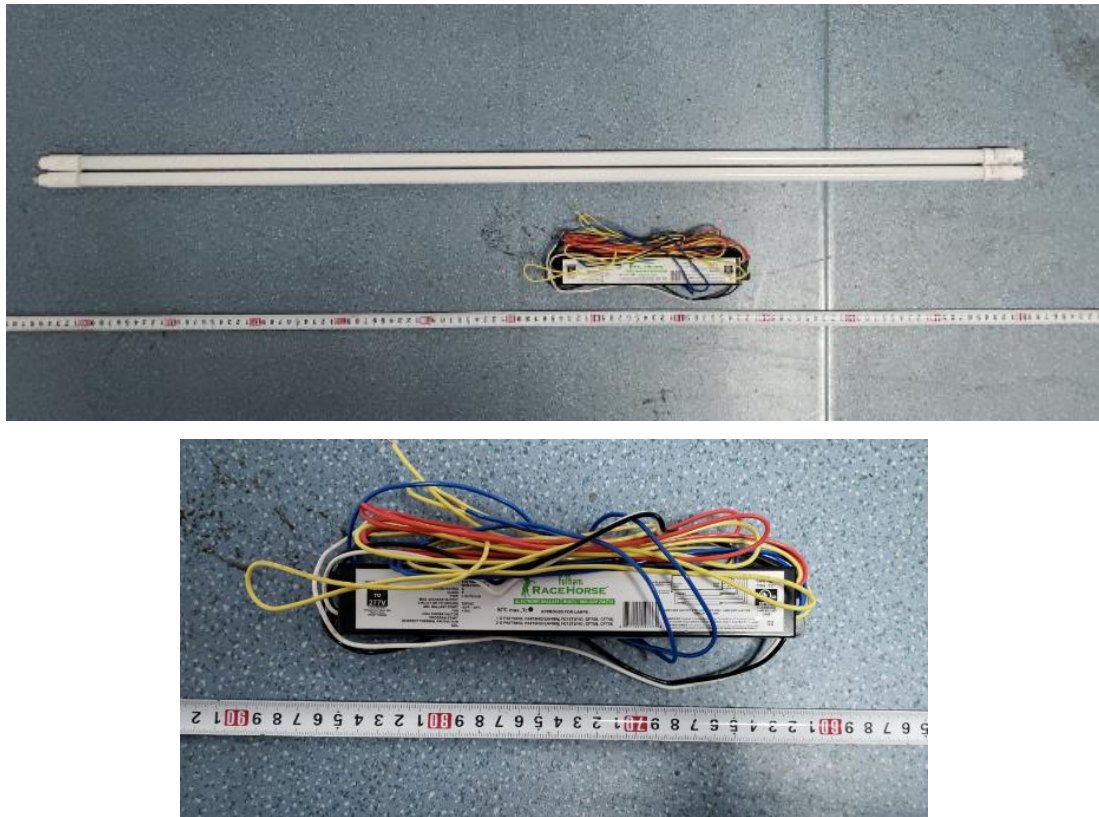


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 24T5HO/4F/850/GL/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 24W
Product Description	: 5000K 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)	0.522	0.229
Power Factor	0.9982	0.9736
Test Power (W)/2	31.23	30.89
THD A%	4.63	7.10
Luminous Efficacy (lm/W)	117.2	118.5
Total Luminous Flux (lm)	3661.0	3661.0
Color Rendering Index (CRI)	82.3	
R9	3.7	
Correlated Color Temperature (CCT)(K)	4987	
Chromaticity Chroma x	0.3461	
Chromaticity Chroma y	0.3594	
Chromaticity Chroma u	0.2091	
Chromaticity Chroma v	0.3257	
Duv	0.0035	
Chromaticity Chroma u'	0.2091	
Chromaticity Chroma v'	0.4885	

Special Color Rendering Indices	
R1	79.9
R2	87
R3	92.5
R4	82
R5	80.5
R6	82.2
R7	87.6
R8	66.5
R9	3.7
R10	69.3
R11	80.9
R12	59.7
R13	81.6
R14	96
Rf	84
Rg	96

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	0.9977
Test Power (W)/2	31.26
Luminous Efficacy (lm/W)	111.4
Total Luminous Flux (lm)	3607.5
Beam Angle (°)	166.4
Center Beam Candle Power (cd)	608
Spacing Criteria	1.29 (0 °-180 °)/ 1.46 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	44.43%
Zonal Lumens in the 60 °-90 °Zone	27.97%
Zonal Lumens in the 90 °-120 °Zone	16.94%
Zonal Lumens in the 120 °-180 °Zone	10.66%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

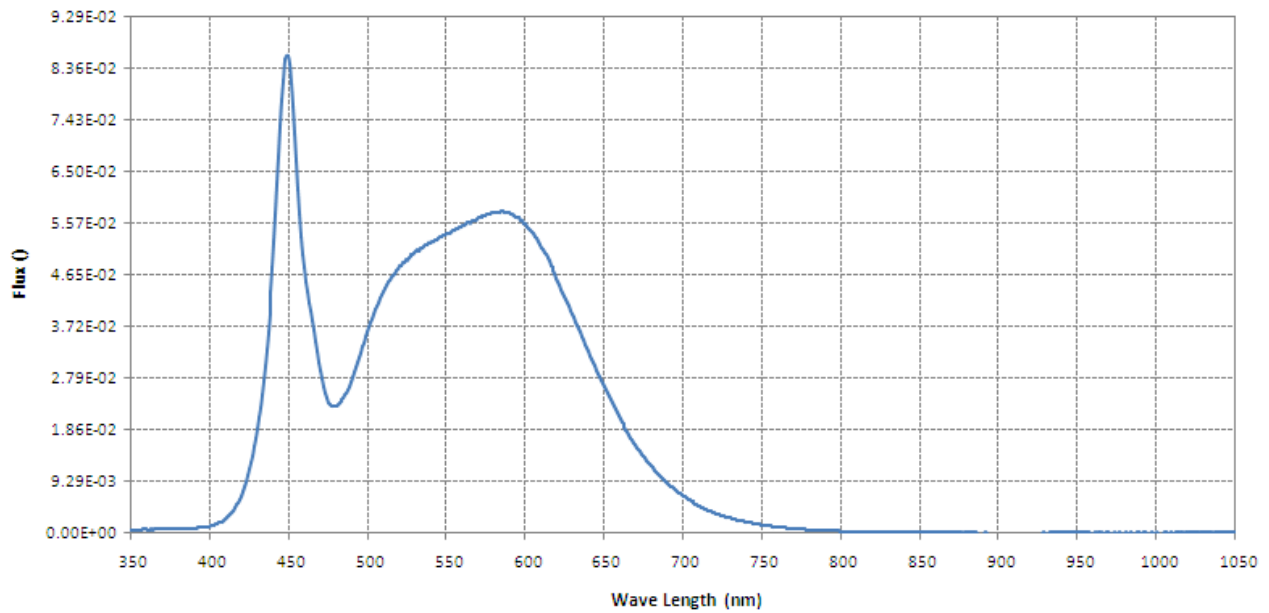
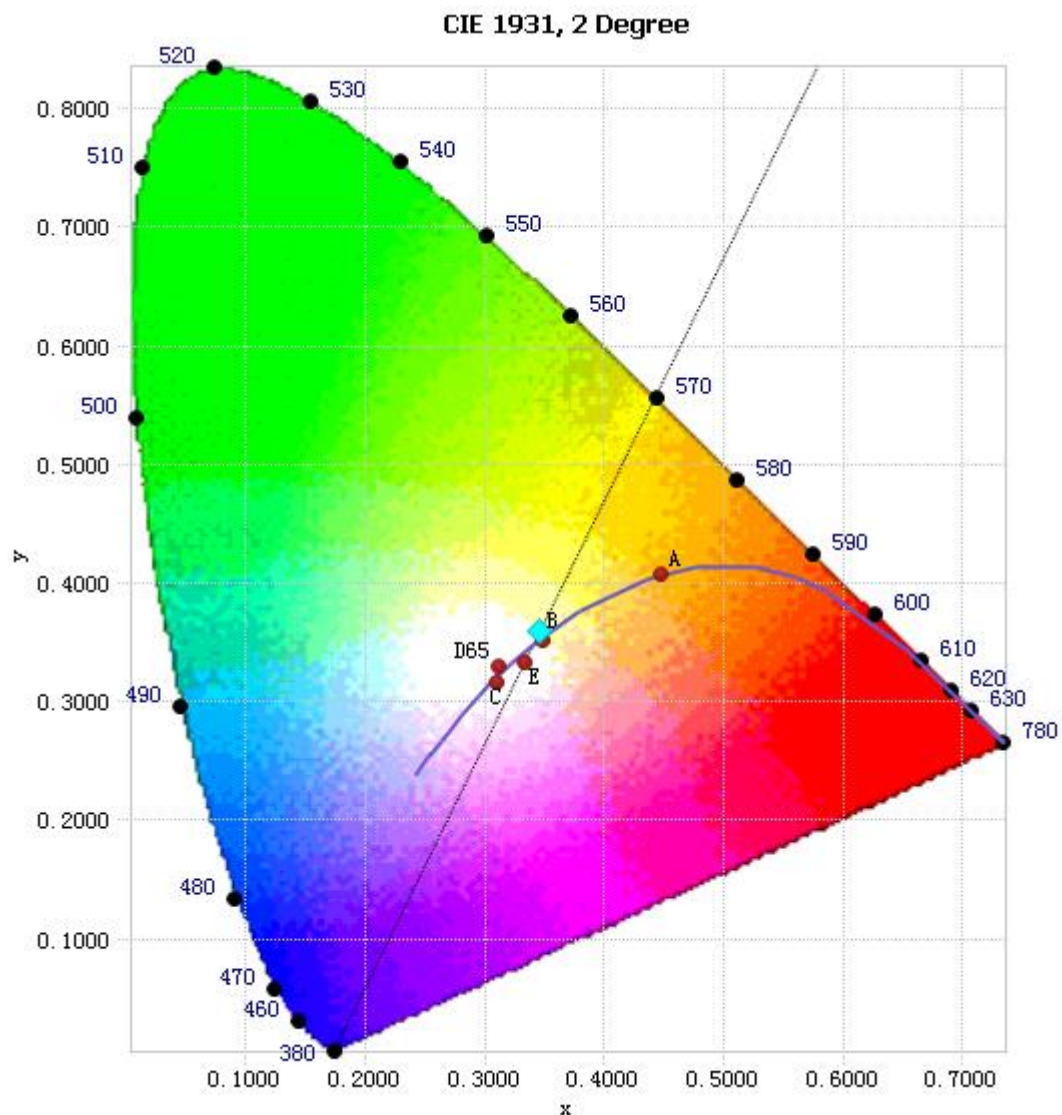


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	8.15E-04	485	2.44E-02	590	5.76E-02	695	7.76E-03
385	8.48E-04	490	2.73E-02	595	5.69E-02	700	6.69E-03
390	9.41E-04	495	3.16E-02	600	5.56E-02	705	5.76E-03
395	1.07E-03	500	3.62E-02	605	5.38E-02	710	4.93E-03
400	1.24E-03	505	4.02E-02	610	5.15E-02	715	4.25E-03
405	1.70E-03	510	4.35E-02	615	4.89E-02	720	3.65E-03
410	2.57E-03	515	4.61E-02	620	4.59E-02	725	3.13E-03
415	4.07E-03	520	4.80E-02	625	4.28E-02	730	2.71E-03
420	6.75E-03	525	4.92E-02	630	3.94E-02	735	2.32E-03
425	1.14E-02	530	5.05E-02	635	3.61E-02	740	1.99E-03
430	1.89E-02	535	5.13E-02	640	3.27E-02	745	1.72E-03
435	3.02E-02	540	5.23E-02	645	2.94E-02	750	1.47E-03
440	4.77E-02	545	5.32E-02	650	2.63E-02	755	1.27E-03
445	7.33E-02	550	5.38E-02	655	2.34E-02	760	1.11E-03
450	8.60E-02	555	5.45E-02	660	2.07E-02	765	9.67E-04
455	6.71E-02	560	5.53E-02	665	1.81E-02	770	8.18E-04
460	4.78E-02	565	5.59E-02	670	1.58E-02	775	7.08E-04
465	3.83E-02	570	5.67E-02	675	1.39E-02	780	6.09E-04
470	2.92E-02	575	5.72E-02	680	1.20E-02		
475	2.36E-02	580	5.77E-02	685	1.04E-02		
480	2.30E-02	585	5.80E-02	690	9.04E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3461, 0.3594)

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

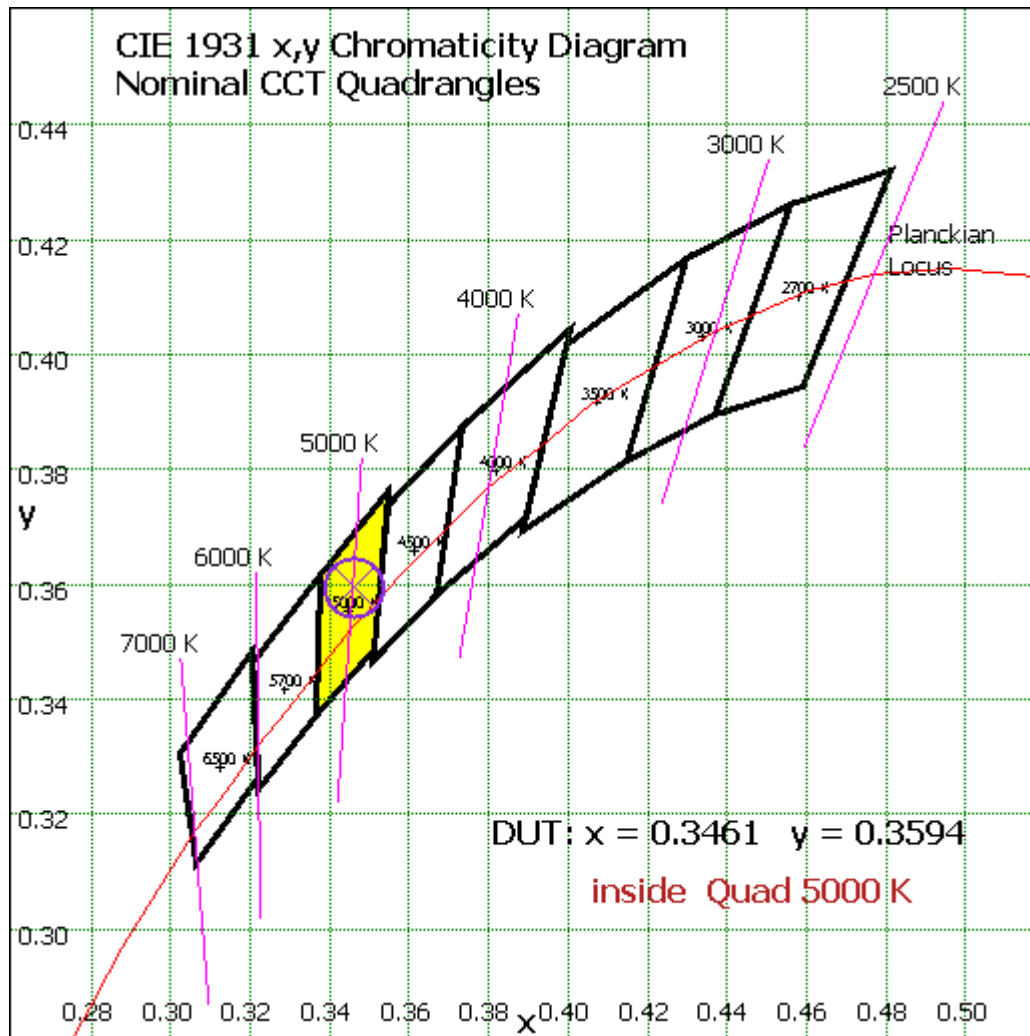


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

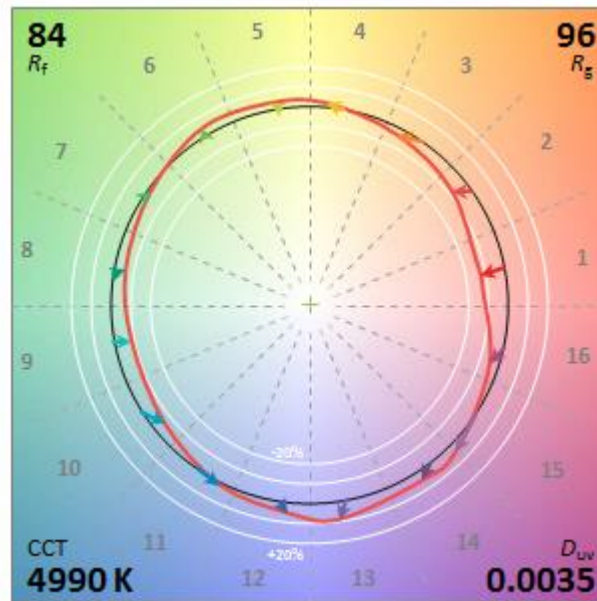


Chart 4: Color Vector Diagram of TM-30-18

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	57.752	1.60%
10- 20	168.233	4.66%
20- 30	264.059	7.32%
30- 40	337.001	9.34%
40- 50	381.283	10.57%
50- 60	394.498	10.94%
60- 70	378.375	10.49%
70- 80	339.665	9.42%
80- 90	291.038	8.07%
90-100	245.097	6.79%
100-110	202.458	5.61%
110-120	163.58	4.53%
120-130	129.164	3.58%
130-140	99.976	2.77%
140-150	73.582	2.04%
150-160	48.806	1.35%
160-170	25.212	0.70%
170-180	7.671	0.21%
Total	3607.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1602.826	44.43%
60- 90	1009.078	27.97%
0-90	2611.904	72.40%
90- 180	995.546	27.60%
0- 180	3607.5	100%

Table 5: Zonal Lumen

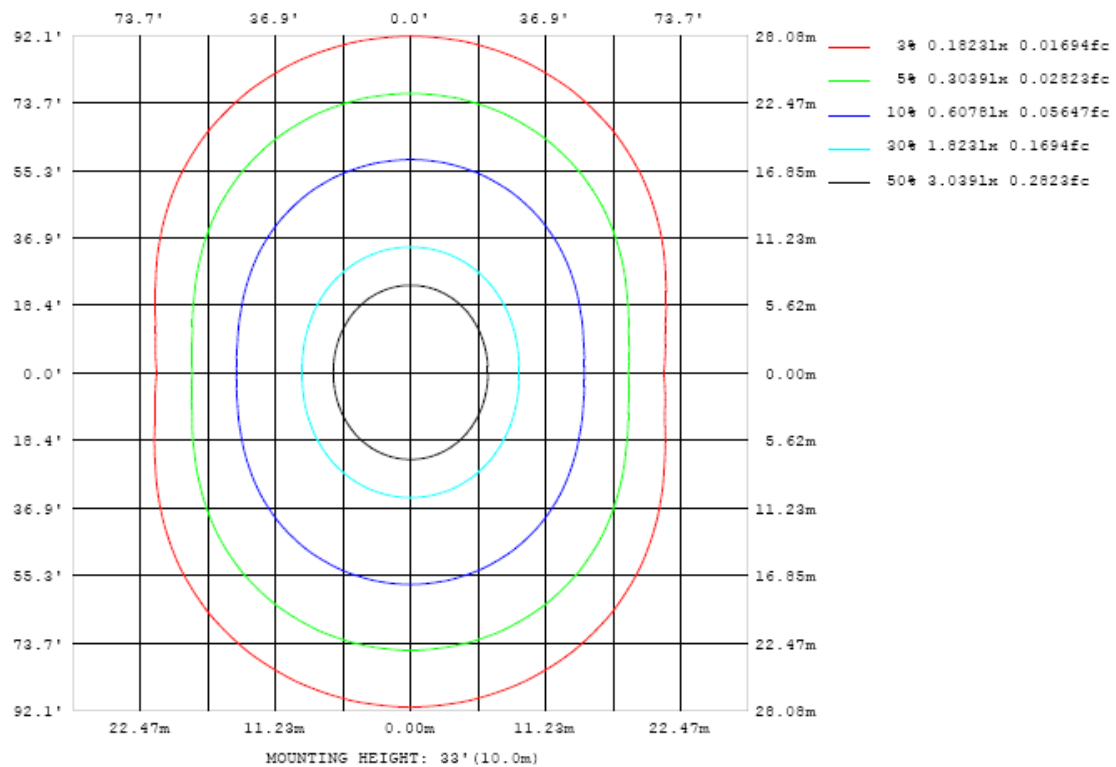


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

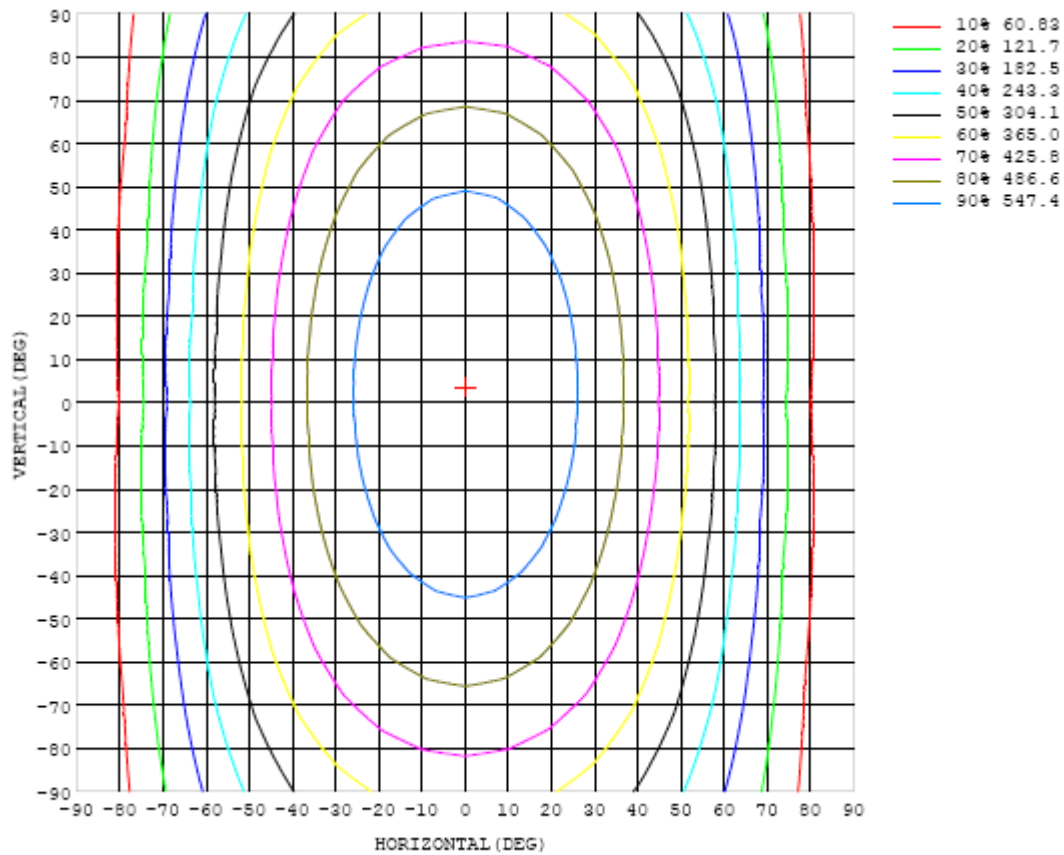


Chart 6: Isocandela Plot

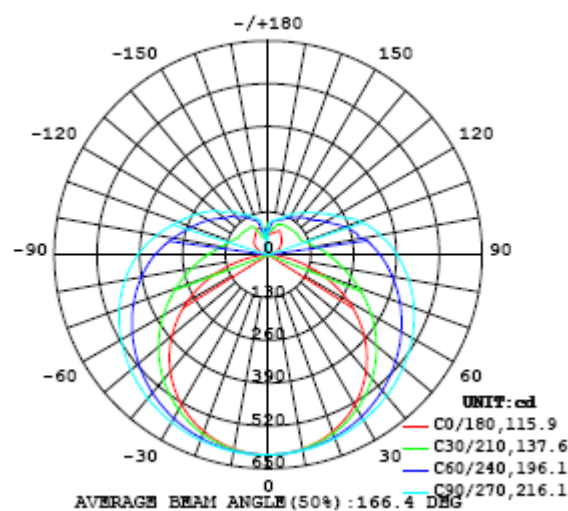


Chart 7: Polar Candela Distribution

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	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608
5	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	606	605	606
10	599	599	599	600	601	602	603	603	604	604	604	603	602	601	600	600	599	599	599
15	588	588	589	591	593	595	597	599	599	600	599	598	596	595	592	590	588	587	587
20	572	572	575	578	581	585	589	592	594	594	593	592	589	585	581	577	574	572	572
25	552	553	556	561	567	573	579	584	586	588	586	584	579	573	567	561	555	552	551
30	527	528	534	541	550	559	568	574	578	580	578	574	568	559	550	541	533	528	526
35	497	500	507	517	530	543	554	563	568	570	568	563	554	543	530	518	507	499	497
40	462	466	477	491	508	525	539	550	557	560	557	550	540	525	508	492	477	466	463
45	424	429	442	461	483	505	523	536	545	548	545	537	523	506	485	463	444	429	424
50	380	387	405	430	457	483	505	521	531	535	531	522	506	485	459	432	407	388	381
55	333	342	365	396	430	461	487	505	517	521	517	506	488	463	433	399	368	344	334
60	281	293	323	362	402	438	467	488	501	505	501	489	469	440	405	366	327	296	283
65	227	242	280	327	374	415	447	470	484	489	484	471	449	417	378	332	285	246	229
70	170	190	237	293	346	391	426	451	466	471	466	452	428	394	350	298	243	196	173
75	114	140	197	261	319	368	405	431	447	453	447	432	407	370	323	266	204	147	116
80	61.1	94.7	162	232	293	344	383	411	427	433	428	412	385	347	298	237	168	102	64.2
85	19.9	60.1	133	206	269	322	362	390	407	413	407	391	364	325	274	211	140	66.5	21.3
90	1.16	40.3	112	183	247	300	340	368	385	392	386	370	342	303	251	188	117	44.8	1.34
95	3.61	29.7	95.8	165	226	278	318	346	363	369	364	348	320	281	231	169	101	34.2	3.97
100	8.97	30.1	81.3	146	205	253	289	324	341	347	342	326	299	261	211	153	87.4	32.3	8.97
105	16.2	33.7	73.8	129	186	234	270	287	317	323	318	302	276	239	191	136	79.3	35.2	15.6
110	23.4	41.0	74.0	119	166	211	248	272	279	297	292	277	252	216	173	125	75.8	41.7	23.3
115	31.2	47.8	75.6	109	153	189	223	246	261	265	265	251	227	195	159	115	75.8	48.4	31.4
120	38.7	54.6	78.9	108	138	174	200	223	236	238	239	227	206	179	145	110	78.4	55.7	40.2
125	46.1	61.1	81.3	108	134	157	183	201	213	216	214	206	188	162	137	108	81.4	62.8	48.6
130	52.3	66.7	84.0	107	130	151	168	184	191	198	195	187	170	153	131	106	85.0	69.6	56.5
135	57.4	71.1	86.3	105	125	144	159	171	179	180	179	171	161	145	126	106	88.7	75.4	60.5
140	63.6	76.0	88.5	104	120	136	149	159	166	168	164	157	149	137	122	106	92.1	81.2	64.7
145	68.8	82.4	91.5	102	116	128	139	148	153	154	152	146	138	127	117	105	94.1	86.5	69.2
150	75.8	84.4	90.6	102	111	121	130	137	141	142	140	137	130	122	112	104	96.2	90.4	76.0
155	80.5	86.4	92.7	102	108	115	121	126	129	129	128	126	122	117	110	104	98.0	92.3	81.3
160	74.5	84.3	88.2	97.8	106	110	114	117	119	120	118	116	114	112	108	104	99.9	96.2	86.8
165	70.7	78.3	82.3	90.3	102	106	109	110	111	112	111	111	109	107	105	103	101	94.1	84.1
170	66.5	71.4	76.1	79.2	87.8	101	105	106	106	107	106	106	105	104	103	102	96.0	87.3	84.3
175	62.2	63.9	68.6	73.9	78.6	83.5	90.5	97.2	101	103	104	104	103	102	102	99.4	92.7	82.7	76.6
180	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608	608		
5	606	606	606	607	607	607	608	608	608	608	608	607	607	607	606	606	606		
10	599	600	601	602	604	605	606	606	607	607	606	605	604	603	602	600	600		
15	588	590	592	595	598	600	602	603	604	604	603	601	598	595	593	590	589		
20	573	576	580	584	589	594	597	599	600	599	597	594	590	585	580	576	574		
25	553	557	563	571	578	585	590	593	594	593	590	585	579	571	564	558	554		
30	529	535	544	554	565	574	581	585	587	586	582	574	565	555	545	536	530		
35	500	509	521	535	549	561	571	577	579	577	571	562	550	536	522	510	501		
40	467	479	495	513	532	547	559	566	569	567	559	548	532	514	496	480	467		
45	430	445	466	490	512	531	546	554	557	555	546	532	513	491	467	446	430		
50	389	408	435	464	491	514	531	541	545	542	531	515	492	465	436	409	388		
55	344	369	402	437	469	496	515	527	531	527	516	496	470	438	403	369	343		
60	295	327	368	409	446	477	498	511	516	512	499	477	447	410	369	327	294		
65	244	284	333	381	423	457	480	494	499	495	480	457	424	382	334	285	243		
70	192	241	299	353	399	436	461	476	481	477	461	436	400	355	301	243	191		
75	141	201	266	326	375	414	441	456	462	457	441	414	376	327	269	203	142		
80	94.5	164	236	299	351	391	419	436	441	437	420	392	353	301	239	168	97.1		
85	59.5	134	208	273	327	368	397	414	420	415	398	369	329	276	212	139	64.0		
90	38.3	110	183	249	302	344	373	390	396	391	374	345	305	252	188	115	43.7		
95	29.9	91.8	161	224	277	319	348	365	371	365	349	320	280	228	166	97.3	35.2		
100	30.0	81.9	144	203	253	293	321	338	344	339	323	295	256	206	149	88.0	34.6		
105	32.6	75.5	131	185	231	268	296	311	317	312	296	270	234	189	137	82.6	36.9		
110	38.7	72.1	120	170	213	248	272	287	292	288	273	249	216	175	127	78.9	40.8		
115	44.3	75.0	113	156	197	229	251	265	270	265	252	231	200	162	120	79.4	45.0		
120	48.3	74.3	105	145	179	210	231	244	249	245	233	212	183	149	111	79.2	48.1		
125	52.4	77.7	105	135	164	192	212	224	228	224	212	193	165	139	108	78.5	51.2		
130	53.5	81.6	103	129	154	172	189	201	208	205	195	176	157	130	104	82.6	53.3		
135	53.8	85.0	102	122	143	165	176	182	184	182	177	165	145	122	102	83.5	53.8		
140	53.0	87.2	100	119	133	149	163	170	172	170	161	146	133	119	99.4	85.9	53.1		
145	54.4	85.2	100	111	129	141	148	151	153	151	142	135	128	113	99.6	84.2	54.4		
150	60.0	80.9	98.0	109	120	132	138	141	141	138	135	131	120	105	97.4	76.0	58.9		
155	64.0	82.3	88.5	107	114	120	126	130	132	130	126	119	100	92.8	85.8	61.9	65.4		
160	64.7	84.2	84.6	86.2	108	113	117	120	121	121	105	85.5	79.8	75.6	68.7	55.5	64.5		
165	76.5	86.4	82.7	89.1	64.3	80.5	100	103	110	79.1	71.6	73.8	71.2	60.8	54.3	55.8	63.8		
170	82.4	74.7	62.8	61.1	68.5	76.8	76.9	73.0	56.4	78.2	82.7	77.6	70.0	64.6	59.7	60.2	63.9		
175	76.7	75.3	77.2	79.8	77.2	72.4	62.5	48.8	10.6	55.9	69.4	74.1	71.6	70.2	70.4	67.9	64.5		
180	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5		

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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