



LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 15T5HE/4F/830/GL/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020012j

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: 15T5HE/4F/830/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
125.5	1938.0	15.45	0.9912
CCT (K)	CRI	Stabilization Time (Light & Power)	
3048	82.1	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 : Mar. 01, 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

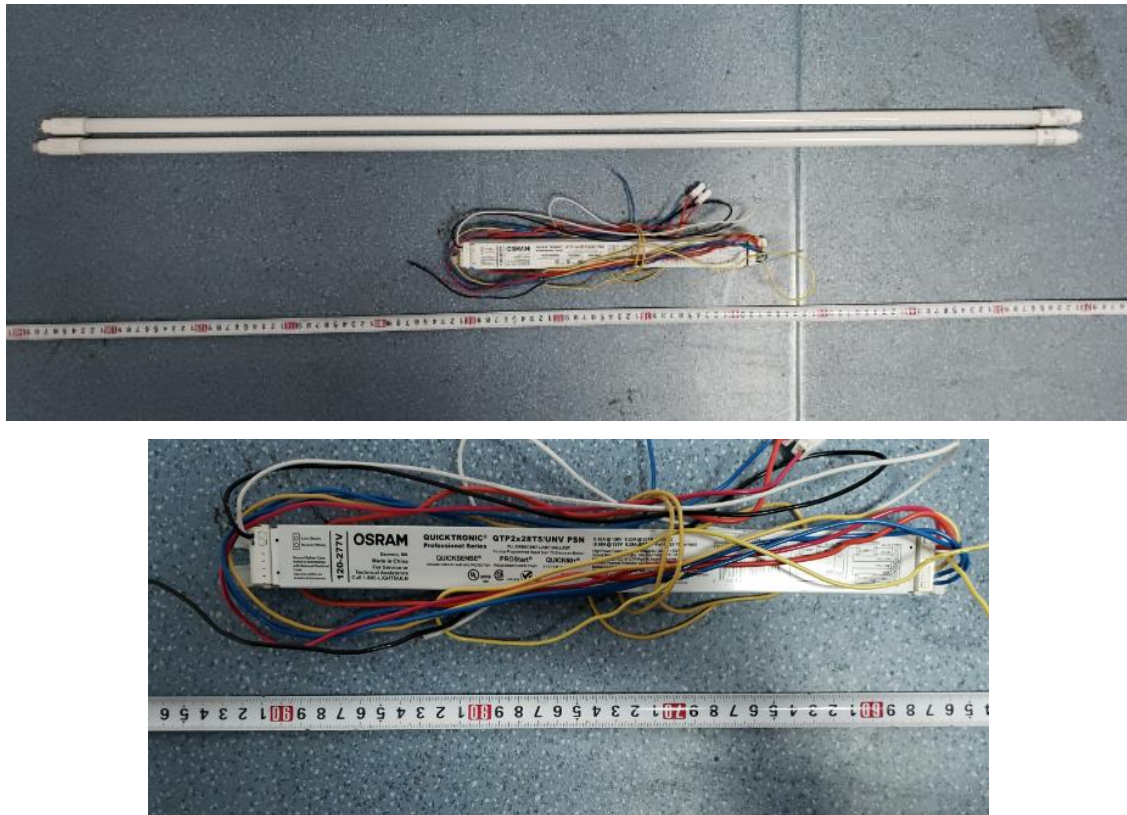


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 15T5HE/4F/830/GL/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 15W
Product Description	: 3000K LED Tubes supplied by a high frequency fluorescent lamp ballast: QTP2X28T5/UNV PSN
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 horizontal. 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)	0.260	0.119
Power Factor	0.9912	0.9370
Test Power (W)/2	15.45	15.45
THD A%	4.29	8.32
Luminous Efficacy (lm/W)	125.5	125.6
Total Luminous Flux (lm)	1938.0	1941.0
Color Rendering Index (CRI)	82.1	
R9	3.5	
Correlated Color Temperature (CCT)(K)	3048	
Chromaticity Chroma x	0.4334	
Chromaticity Chroma y	0.4029	
Chromaticity Chroma u	0.2488	
Chromaticity Chroma v	0.3469	
Duv	0	
Chromaticity Chroma u'	0.2488	
Chromaticity Chroma v'	0.5204	

Special Color Rendering Indices	
R1	80.5
R2	91.3
R3	95.5
R4	79.6
R5	80.9
R6	89.6
R7	81.8
R8	57.3
R9	3.5
R10	80.4
R11	79
R12	70.9
R13	83.2
R14	98.2
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 25.2°C.

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)	0.261
Power Factor	0.9904
Test Power (W)/2	15.49
Luminous Efficacy (lm/W)	123.1
Total Luminous Flux (lm)	1906.4
Beam Angle (°)	168.9
Center Beam Candle Power (cd)	313
Spacing Criteria	1.29 (0 °-180 °)/ 1.47 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	43.52%
Zonal Lumens in the 60 °-90 °Zone	27.74%
Zonal Lumens in the 90 °-120 °Zone	17.23%
Zonal Lumens in the 120 °-180 °Zone	11.50%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

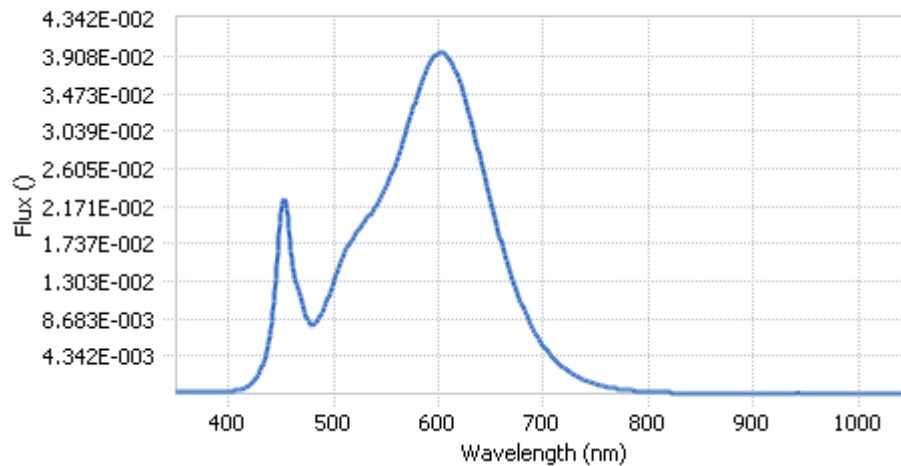
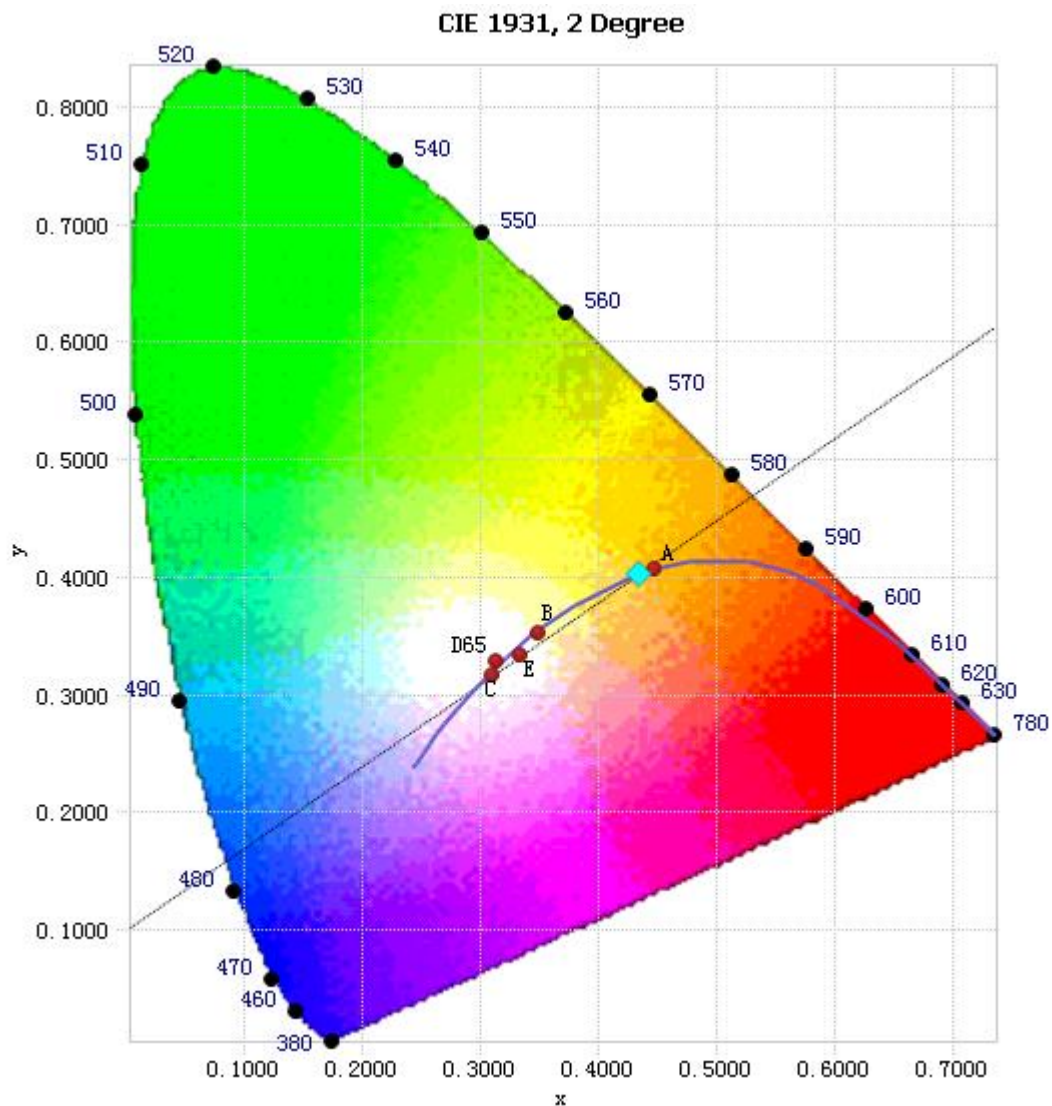


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.62E-04	485	8.58E-03	590	3.79E-02	695	6.46E-03
385	2.57E-04	490	9.66E-03	595	3.89E-02	700	5.53E-03
390	2.79E-04	495	1.12E-02	600	3.94E-02	705	4.73E-03
395	2.94E-04	500	1.30E-02	605	3.94E-02	710	4.03E-03
400	3.21E-04	505	1.48E-02	610	3.87E-02	715	3.45E-03
405	3.71E-04	510	1.62E-02	615	3.77E-02	720	2.95E-03
410	4.66E-04	515	1.74E-02	620	3.61E-02	725	2.51E-03
415	6.59E-04	520	1.84E-02	625	3.42E-02	730	2.14E-03
420	9.89E-04	525	1.92E-02	630	3.20E-02	735	1.81E-03
425	1.62E-03	530	2.00E-02	635	2.96E-02	740	1.55E-03
430	2.67E-03	535	2.08E-02	640	2.70E-02	745	1.32E-03
435	4.49E-03	540	2.17E-02	645	2.45E-02	750	1.13E-03
440	7.57E-03	545	2.28E-02	650	2.20E-02	755	9.60E-04
445	1.34E-02	550	2.40E-02	655	1.97E-02	760	8.36E-04
450	2.09E-02	555	2.54E-02	660	1.74E-02	765	7.10E-04
455	2.15E-02	560	2.70E-02	665	1.53E-02	770	6.10E-04
460	1.55E-02	565	2.87E-02	670	1.33E-02	775	5.23E-04
465	1.27E-02	570	3.08E-02	675	1.17E-02	780	4.51E-04
470	1.08E-02	575	3.27E-02	680	1.01E-02		
475	8.62E-03	580	3.47E-02	685	8.75E-03		
480	7.99E-03	585	3.65E-02	690	7.53E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4334, 0.4029)

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

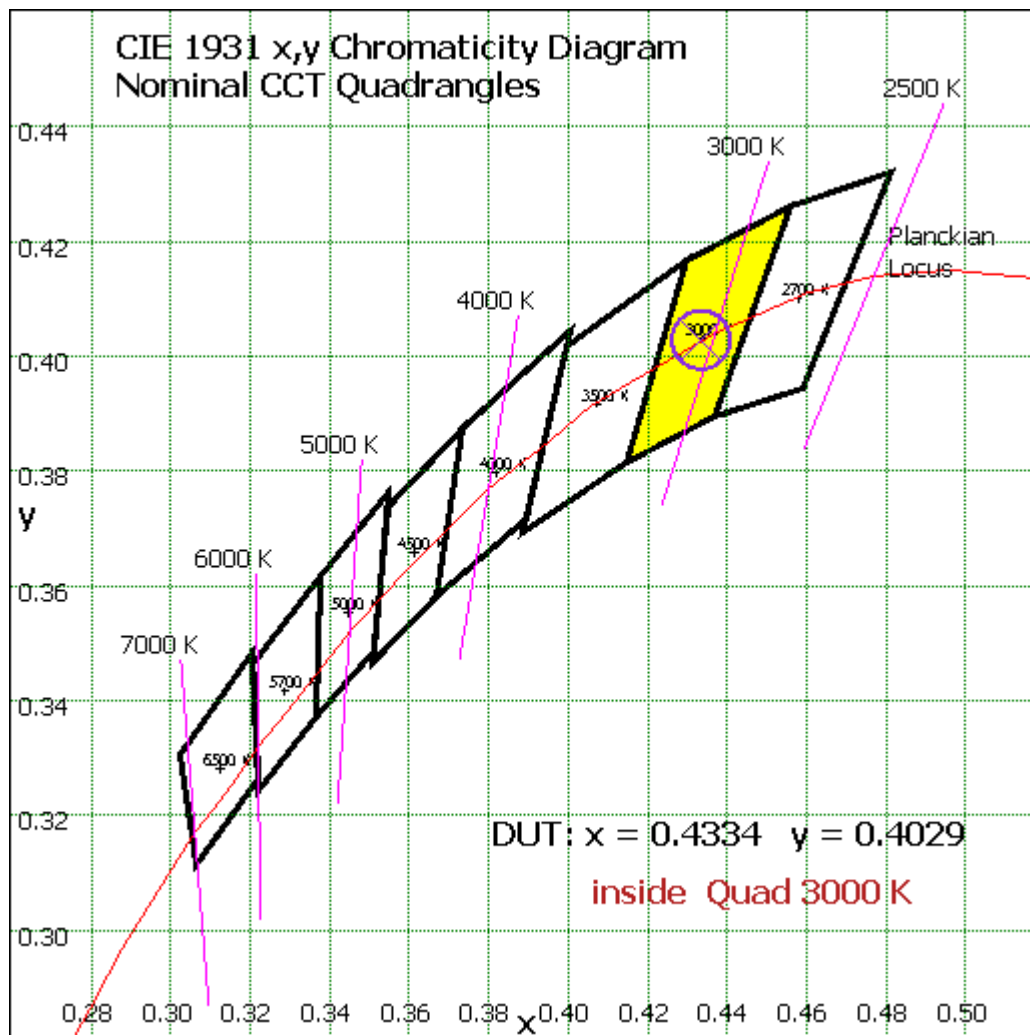


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

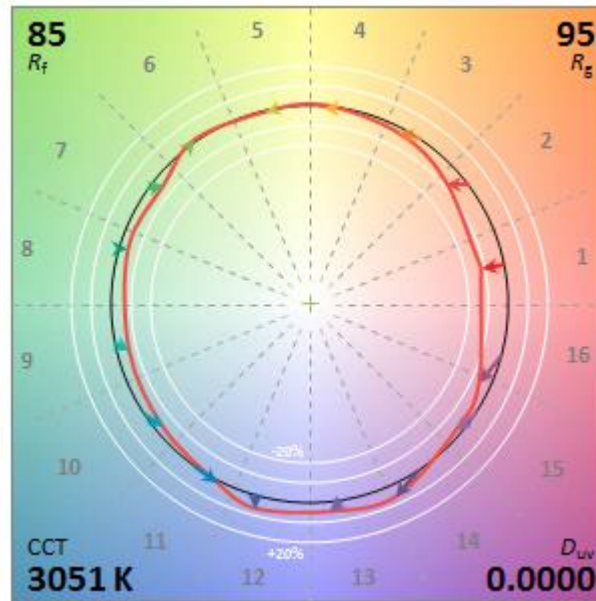


Chart 4: Color Vector Diagram of TM-30-18

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	29.792	1.56%
10- 20	86.83	4.55%
20- 30	136.411	7.16%
30- 40	174.3	9.14%
40- 50	197.527	10.36%
50- 60	204.865	10.75%
60- 70	197.236	10.35%
70- 80	177.969	9.34%
80- 90	153.67	8.06%
90-100	130.372	6.84%
100-110	108.733	5.70%
110-120	89.414	4.69%
120-130	72.139	3.78%
130-140	56.493	2.96%
140-150	42.031	2.20%
150-160	28.876	1.51%
160-170	15.374	0.81%
170-180	4.372	0.23%
Total	1906.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	829.725	43.52%
60- 90	528.875	27.74%
0-90	1358.6	71.27%
90- 180	547.804	28.73%
0- 180	1906.4	100%

Table 5: Zonal Lumen

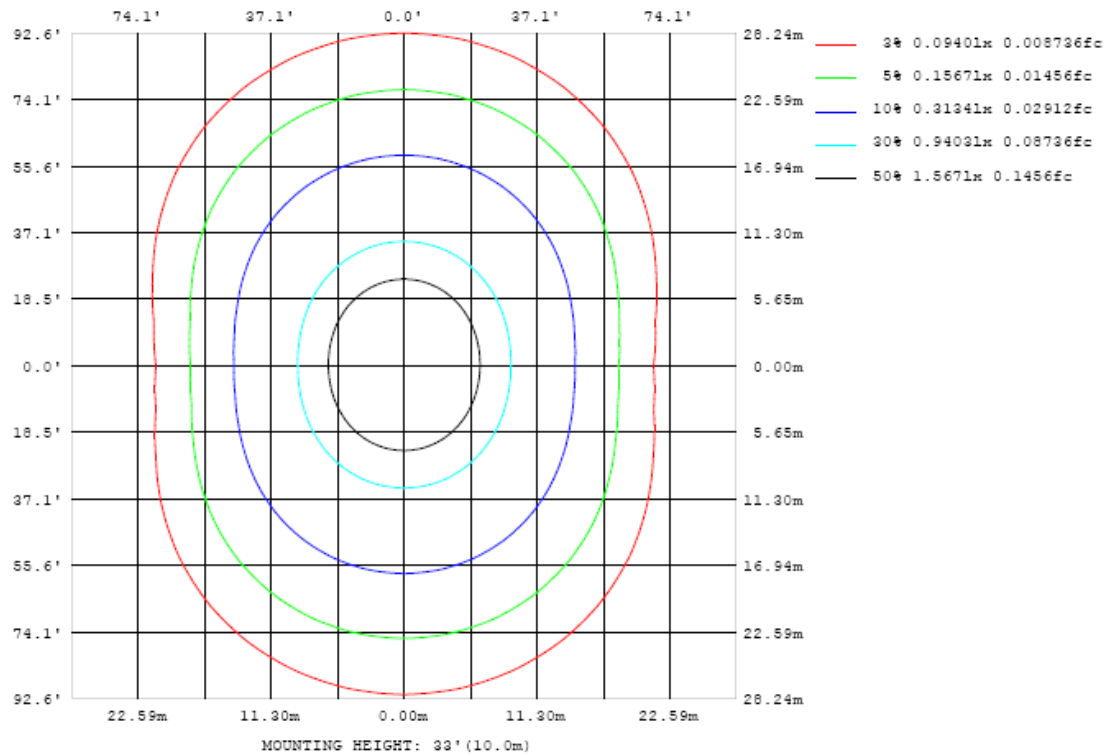


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

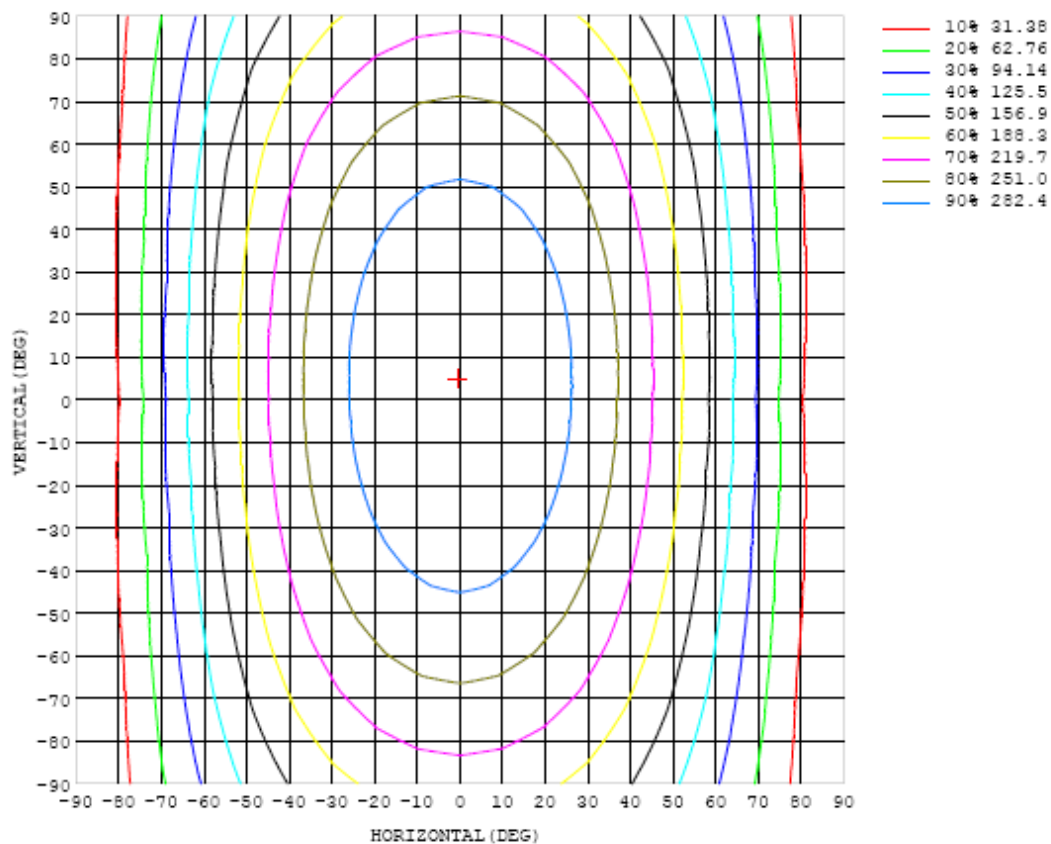


Chart 6: Isocandela Plot

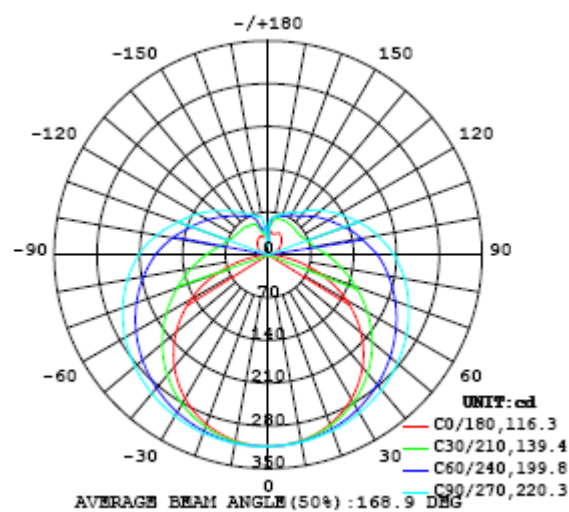


Chart 7: Polar Candela Distribution

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	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313
5	312	312	312	312	312	313	313	313	313	313	313	313	313	313	312	312	312	312	312
10	309	309	309	309	310	310	311	311	311	311	311	311	311	310	310	309	309	309	309
15	303	303	304	304	305	306	307	308	309	309	309	308	308	306	305	304	304	303	303
20	295	295	296	298	300	302	303	305	306	306	306	305	304	302	300	298	296	295	295
25	285	285	287	289	292	295	298	301	302	303	302	301	298	295	292	289	287	285	285
30	272	273	275	279	283	288	292	296	298	299	298	296	293	288	283	279	275	272	272
35	257	258	262	267	273	280	285	290	293	294	293	290	286	280	273	267	261	257	256
40	240	241	246	253	262	270	278	283	287	288	287	284	278	270	262	253	245	240	239
45	220	222	229	238	249	260	269	276	281	283	281	277	270	260	249	238	228	221	219
50	198	201	210	222	236	249	261	269	274	276	274	269	261	249	236	222	209	199	196
55	174	178	189	205	222	238	251	261	267	269	267	261	252	238	222	205	188	176	172
60	148	153	168	188	208	226	241	252	259	262	259	253	242	227	208	187	166	151	146
65	120	127	146	170	194	215	231	244	251	253	251	244	232	215	194	169	144	124	118
70	90.3	99.7	124	152	180	203	221	234	242	245	242	235	222	203	180	152	122	97.2	88.0
75	61.3	73.5	103	136	166	191	211	225	233	236	233	225	211	192	166	136	102	71.2	58.4
80	33.5	50.4	85.0	121	153	180	200	215	223	226	224	215	201	180	154	121	84.2	48.6	30.8
85	11.1	32.2	71.2	108	141	169	190	204	213	216	213	205	190	169	142	108	70.0	31.1	9.21
90	0.68	21.6	59.6	97.1	130	158	179	194	203	206	203	194	179	158	130	96.8	59.3	21.4	0.61
95	2.01	16.7	50.7	85.3	117	144	166	181	190	194	191	183	167	146	119	86.9	51.3	17.5	1.94
100	4.87	17.3	45.3	77.8	109	134	155	169	178	182	179	171	157	136	110	79.0	46.2	18.4	4.47
105	8.49	19.8	43.4	71.7	99.6	124	144	158	167	170	167	159	145	126	101	73.0	44.6	20.4	7.61
110	12.5	23.5	42.8	67.7	92.0	114	133	146	155	158	155	147	134	115	93.0	69.1	43.4	24.0	11.2
115	16.5	26.9	42.4	64.7	86.3	106	122	134	142	145	142	135	123	107	87.4	66.0	42.1	28.2	14.5
120	20.5	31.1	44.1	61.9	81.5	98.9	113	124	131	133	131	125	114	100	82.4	62.3	45.4	32.1	17.5
125	24.1	34.8	46.2	60.1	76.6	92.5	105	115	121	123	121	115	106	93.7	77.3	59.2	47.6	35.7	20.3
130	27.7	38.8	48.3	60.0	72.4	86.0	97.6	106	111	113	112	107	98.7	88.1	70.6	61.0	49.6	38.8	22.8
135	30.9	42.4	50.6	60.6	70.5	78.7	90.2	97.2	102	104	102	97.4	91.8	80.0	72.4	62.1	51.5	42.3	25.0
140	33.9	45.9	53.2	60.9	69.3	75.8	81.1	86.7	92.3	94.1	93.2	89.5	83.4	77.5	70.2	61.6	53.6	44.9	27.1
145	36.8	48.8	54.8	61.4	67.8	73.6	78.5	81.6	83.5	83.9	83.2	81.1	78.1	73.9	68.1	61.0	54.2	47.5	29.5
150	39.0	50.9	56.8	61.8	66.7	71.0	74.8	78.4	80.4	81.0	80.4	78.4	75.1	71.1	65.4	61.2	53.2	47.0	31.3
155	39.6	51.6	58.1	61.7	65.4	67.9	71.2	73.4	75.3	76.0	75.4	73.6	71.5	67.7	64.1	60.0	55.3	47.5	32.4
160	37.1	50.9	59.4	61.5	64.1	65.9	67.4	69.0	70.1	70.6	70.2	69.1	67.6	65.9	62.3	54.5	48.3	43.5	32.6
165	35.4	45.6	57.4	61.8	63.2	64.5	65.7	66.6	67.0	67.2	67.0	66.6	65.8	62.2	55.1	47.6	41.4	34.6	29.6
170	34.9	39.6	50.8	57.9	60.5	62.6	63.5	63.7	63.8	63.8	63.7	63.9	59.1	49.8	43.0	39.1	37.3	35.0	30.1
175	40.3	41.4	43.5	47.5	51.9	54.5	57.0	59.5	60.7	60.7	61.0	53.2	40.3	33.7	34.3	37.5	38.7	40.6	39.7
180	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0

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	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313	313		
5	312	313	313	313	313	314	314	314	314	314	314	314	313	313	313	313	312		
10	309	310	310	311	312	312	313	313	313	313	313	312	312	311	310	310	309		
15	304	305	306	308	309	310	311	312	312	312	311	310	309	307	306	305	304		
20	296	298	300	302	305	307	309	310	310	310	309	307	305	302	300	298	296		
25	286	288	292	296	299	303	306	307	308	307	306	303	299	296	292	289	286		
30	273	277	282	287	293	298	301	304	305	304	302	298	293	288	282	277	274		
35	259	264	270	278	285	292	297	300	301	300	297	292	285	278	271	264	259		
40	242	248	257	267	276	285	291	295	296	295	291	285	277	267	258	249	243		
45	223	231	242	255	267	277	285	289	291	289	285	277	267	255	243	232	224		
50	201	212	227	242	256	268	277	283	285	283	277	269	257	243	227	213	203		
55	178	192	210	229	246	259	270	276	278	276	270	260	246	229	211	193	180		
60	154	171	193	215	234	250	261	268	270	268	261	250	235	215	194	172	156		
65	128	150	175	201	223	240	252	260	262	260	252	240	223	201	176	151	130		
70	101	128	159	187	211	229	243	251	253	251	243	230	211	187	159	129	103		
75	74.8	108	143	173	199	219	233	241	244	241	233	219	199	173	143	108	76.2		
80	51.7	89.6	127	160	187	207	222	231	234	231	222	207	187	160	127	89.5	52.2		
85	34.0	74.4	114	148	175	196	211	220	223	220	211	196	175	148	113	73.8	33.4		
90	23.6	62.9	102	136	163	185	200	209	212	209	200	185	163	136	101	61.7	22.3		
95	18.5	52.8	90.4	124	152	172	187	196	199	196	187	172	152	123	89.5	51.6	16.7		
100	17.7	47.5	80.2	112	139	159	174	183	185	183	174	159	138	111	79.0	45.2	15.4		
105	20.1	44.7	73.9	102	126	146	160	168	171	168	160	145	125	101	71.9	41.7	18.3		
110	23.4	43.5	69.0	94.4	117	134	147	155	157	155	147	134	115	92.6	66.2	39.9	22.4		
115	27.1	44.2	65.5	87.8	108	124	136	143	145	143	136	123	106	85.2	61.6	41.1	26.3		
120	30.6	45.1	62.9	82.3	99.8	114	125	132	134	132	125	113	97.7	78.8	59.1	43.3	29.4		
125	33.1	46.8	61.5	77.6	92.6	105	115	121	123	120	114	104	90.0	73.7	58.5	45.5	33.1		
130	35.6	48.8	60.1	73.9	86.3	97.1	106	111	112	110	104	95.2	83.5	70.8	58.6	47.7	36.9		
135	38.1	50.2	59.7	70.7	81.0	90.0	96.7	101	102	100	95.4	88.1	78.8	68.5	58.7	49.7	40.2		
140	39.6	51.3	59.6	68.0	76.1	83.6	89.3	92.7	93.6	92.0	88.1	82.1	74.5	66.6	58.5	50.5	42.2		
145	40.3	53.1	55.9	65.7	72.4	77.5	82.2	85.0	85.8	84.5	81.5	76.7	71.2	65.1	58.7	52.6	43.5		
150	40.1	54.7	56.9	63.6	69.6	73.5	76.4	78.2	78.8	78.1	76.2	72.9	68.7	63.7	58.7	54.7	43.8		
155	37.1	52.1	55.7	58.6	65.0	69.5	71.8	73.4	73.9	73.4	71.9	69.5	66.7	63.3	60.4	55.1	42.5		
160	31.3	42.6	48.6	52.1	56.2	62.9	67.3	68.4	68.8	68.7	68.2	67.0	65.3	63.4	61.5	51.3	37.9		
165	28.3	32.8	38.4	41.0	44.1	47.2	57.2	64.1	64.8	65.5	65.5	64.9	63.5	62.5	56.4	42.5	33.7		
170	29.1	30.5	33.3	39.8	39.8	41.9	38.5	41.8	62.9	63.1	62.1	60.0	57.1	50.0	40.8	35.6	34.5		
175	38.9	40.4	41.8	43.6	45.5	47.0	46.5	43.6	25.1	39.2	45.1	46.4	44.2	43.1	43.5	42.4	41.1		
180	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0		

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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