LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED tube

Model: 16T8/4F/830/BYP/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18040014g

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

Review by: April Zou

Engineer: April Zou
Apr. 27, 2018

Approved by: Zhang

Manager: Jim Zhang
Apr. 27, 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: **16T8/4F/830/BYP/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
127.2	2095.0	16.47	0.9806

CCT (K)	CRI	Stabilization Time (Light & Power)
3133	81.7	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	: Apr. 09, 2018
Date of Test	: Apr. 13, 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

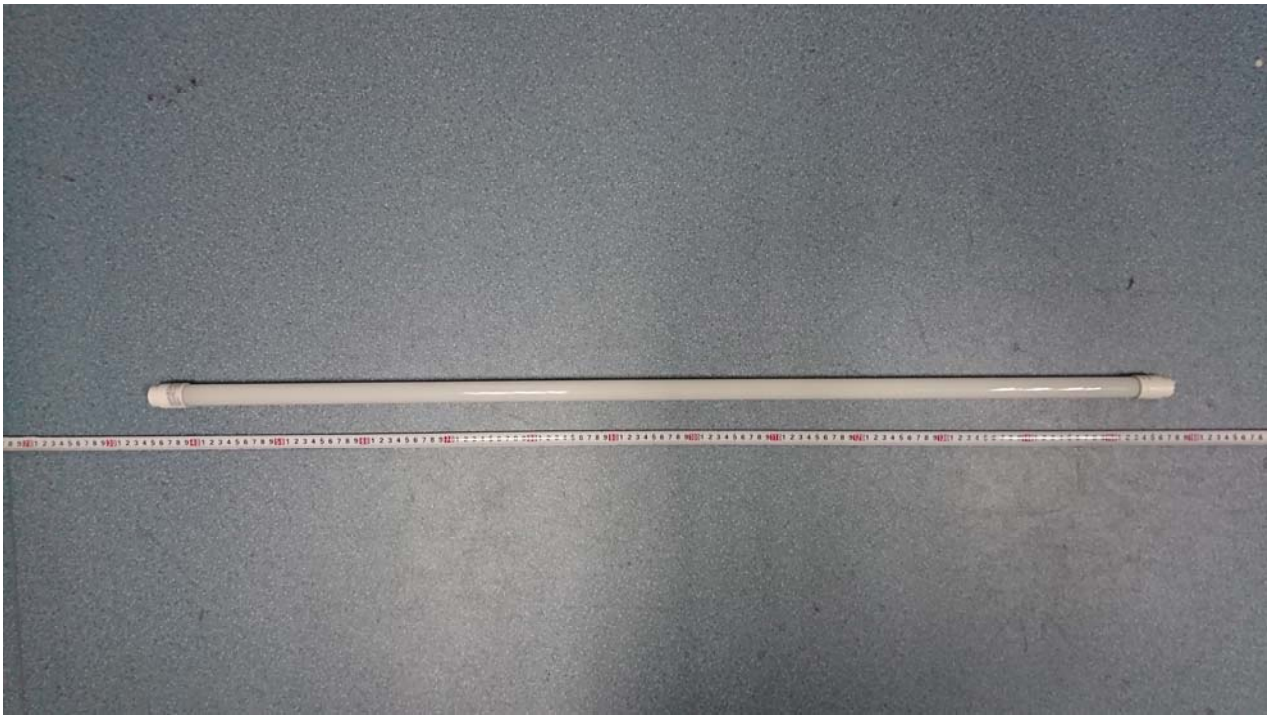


Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED tube
Model	: 16T8/4F/830/BYP/R
Electrical Ratings	: 120-277V, 50/60Hz, 16W
Product Description	: 3000K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 24.9℃.

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)	0.140	0.064
Power Factor	0.9806	0.9323
Test Power (W)	16.47	16.46
THD A%	18.57	16.61
Luminous Efficacy (lm/W)	127.2	128.9
Total Luminous Flux (lm)	2095.0	2121.0
Color Rendering Index (CRI)	81.7	
R9	4.4	
Correlated Color Temperature (CCT)(K)	3133	
Chromaticity Chroma x	0.4308	
Chromaticity Chroma y	0.4077	
Chromaticity Chroma u	0.2451	
Chromaticity Chroma v	0.3479	
Duv	0.0020	
Chromaticity Chroma u ’	0.2451	
Chromaticity Chroma v’	0.5219	

Special Color Rendering Indices	
R1	79.2
R2	88.6
R3	96.8
R4	80.2
R5	79.2
R6	85.6
R7	84.3
R8	59.6
R9	4.4
R10	74.1
R11	79
R12	66.5
R13	81.2
R14	98.3
Rf	83
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 25.0℃.

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)	0.141
Power Factor	0.9775
Test Power (W)	16.53
Luminous Efficacy (lm/W)	125.5
Total Luminous Flux (lm)	2075.1
Beam Angle (°)	176.5
Center Beam Candle Power (cd)	322
Spacing Criteria	1.28 (0°-180°)/ 1.45 (90°-270°)
Zonal Lumens in the 0°-60°Zone	40.95%
Zonal Lumens in the 60°-90°Zone	26.66%
Zonal Lumens in the 90°-120°Zone	18.23%
Zonal Lumens in the 120°-180°Zone	14.16%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

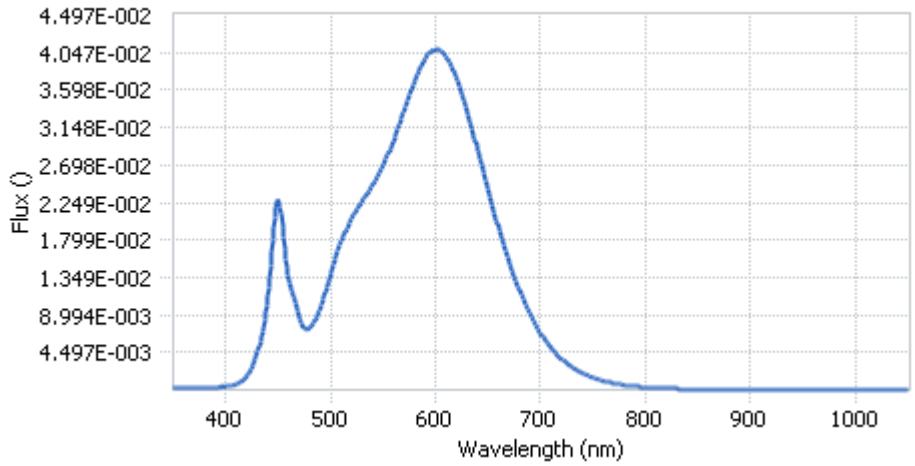
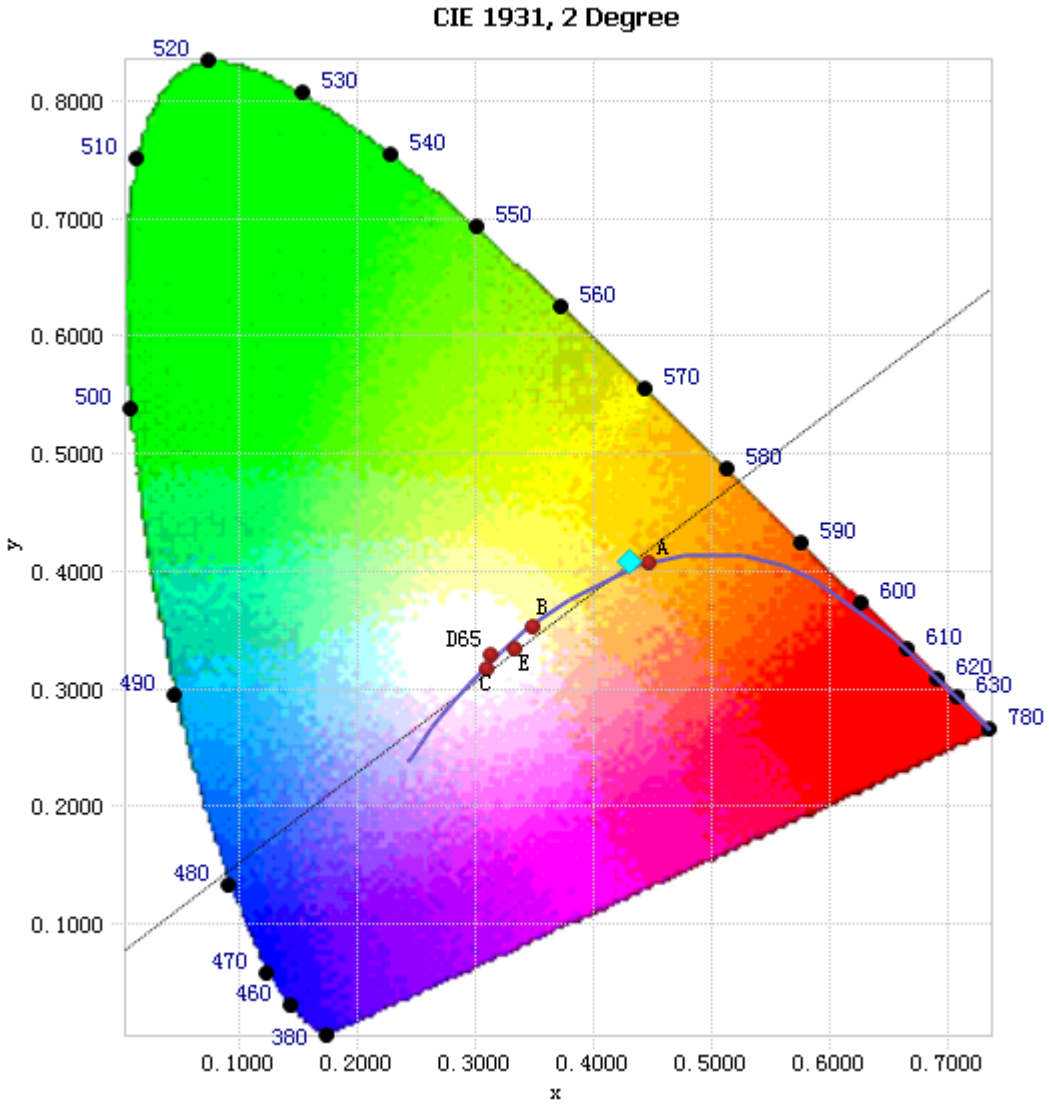


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.33E-04	485	8.37E-03	590	3.97E-02	695	7.87E-03
385	3.18E-04	490	9.75E-03	595	4.05E-02	700	6.82E-03
390	3.36E-04	495	1.18E-02	600	4.08E-02	705	5.86E-03
395	3.78E-04	500	1.41E-02	605	4.06E-02	710	5.06E-03
400	4.07E-04	505	1.60E-02	610	4.00E-02	715	4.34E-03
405	4.97E-04	510	1.79E-02	615	3.89E-02	720	3.72E-03
410	7.14E-04	515	1.94E-02	620	3.73E-02	725	3.20E-03
415	1.04E-03	520	2.06E-02	625	3.54E-02	730	2.74E-03
420	1.69E-03	525	2.16E-02	630	3.35E-02	735	2.34E-03
425	2.77E-03	530	2.26E-02	635	3.12E-02	740	2.01E-03
430	4.49E-03	535	2.36E-02	640	2.88E-02	745	1.71E-03
435	7.01E-03	540	2.47E-02	645	2.64E-02	750	1.47E-03
440	1.12E-02	545	2.57E-02	650	2.40E-02	755	1.26E-03
445	1.81E-02	550	2.69E-02	655	2.17E-02	760	1.08E-03
450	2.28E-02	555	2.85E-02	660	1.94E-02	765	9.26E-04
455	1.83E-02	560	3.00E-02	665	1.73E-02	770	7.97E-04
460	1.32E-02	565	3.18E-02	670	1.54E-02	775	6.81E-04
465	1.12E-02	570	3.35E-02	675	1.36E-02	780	5.84E-04
470	8.96E-03	575	3.53E-02	680	1.19E-02		
475	7.42E-03	580	3.71E-02	685	1.04E-02		
480	7.47E-03	585	3.87E-02	690	9.09E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4308, 0.4077)

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

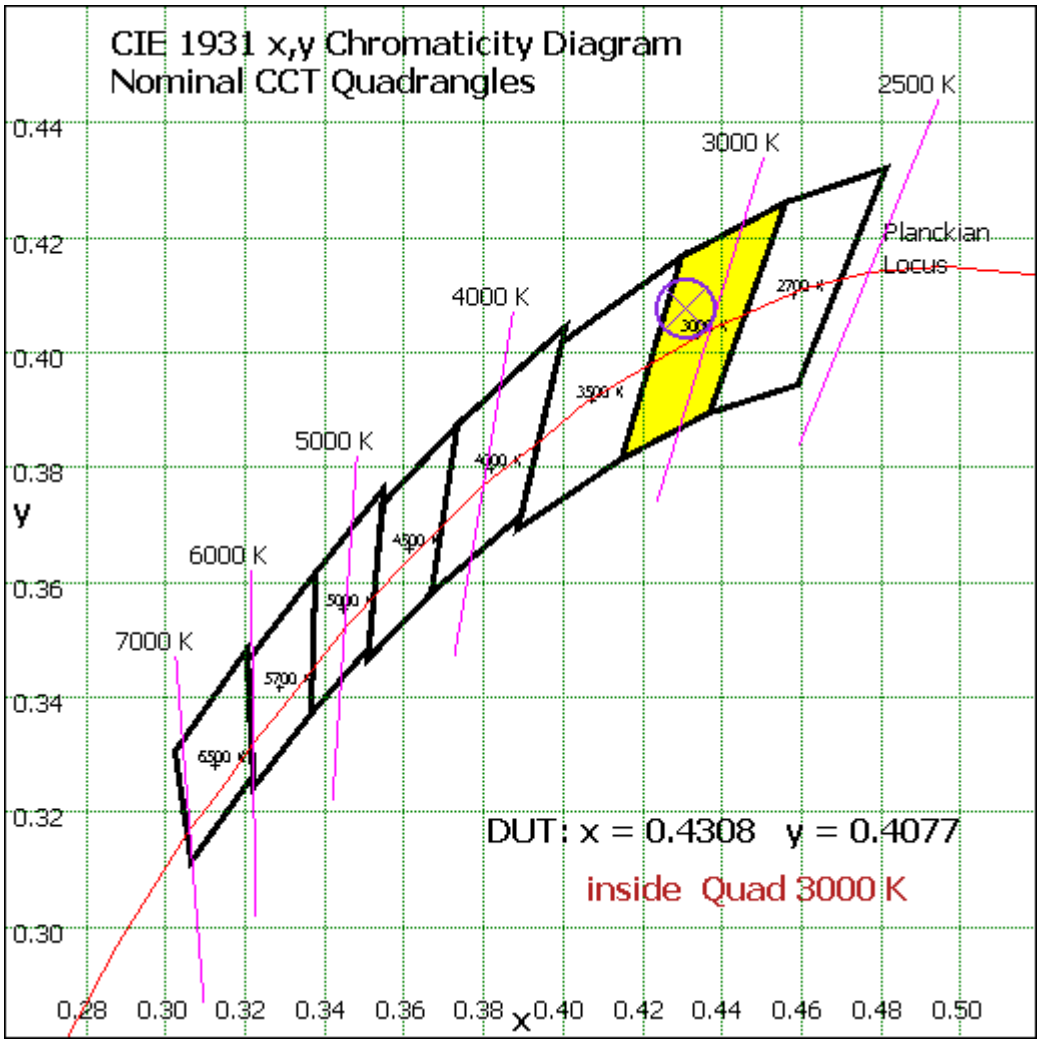


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	30.554	1.47%
10- 20	88.968	4.29%
20- 30	139.636	6.73%
30- 40	178.331	8.59%
40- 50	202.172	9.74%
50- 60	210.165	10.13%
60- 70	203.517	9.81%
70- 80	185.85	8.96%
80- 90	163.78	7.89%
90-100	144.114	6.94%
100-110	125.839	6.06%
110-120	108.263	5.22%
120-130	91.397	4.40%
130-140	74.892	3.61%
140-150	58.137	2.80%
150-160	40.684	1.96%
160-170	22.135	1.07%
170-180	6.646	0.32%
Total	2075.1	100%

γ(°)	Lumens	% Total
0- 60	849.826	40.95%
60- 90	553.147	26.66%
0-90	1402.973	67.61%
90- 180	672.107	32.39%
0- 180	2075.1	100%

Table 5: Zonal Lumen Data

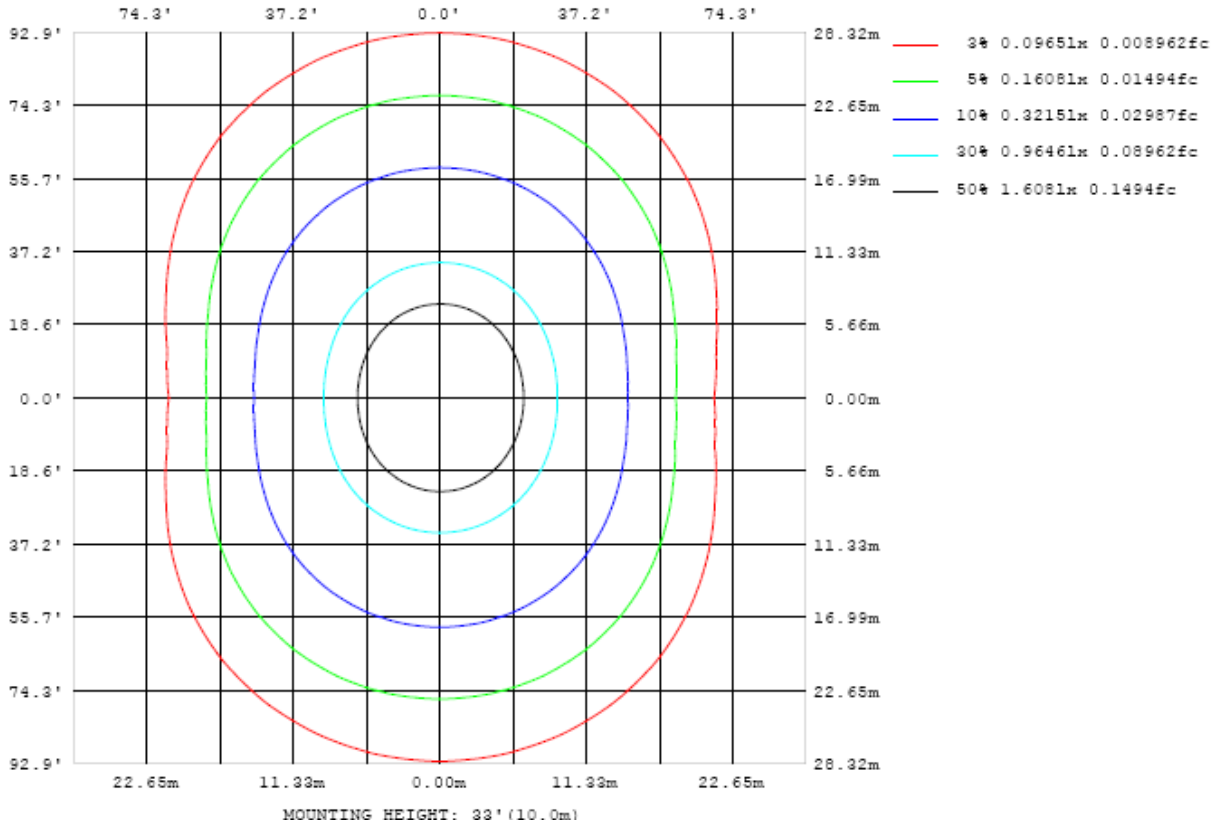


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

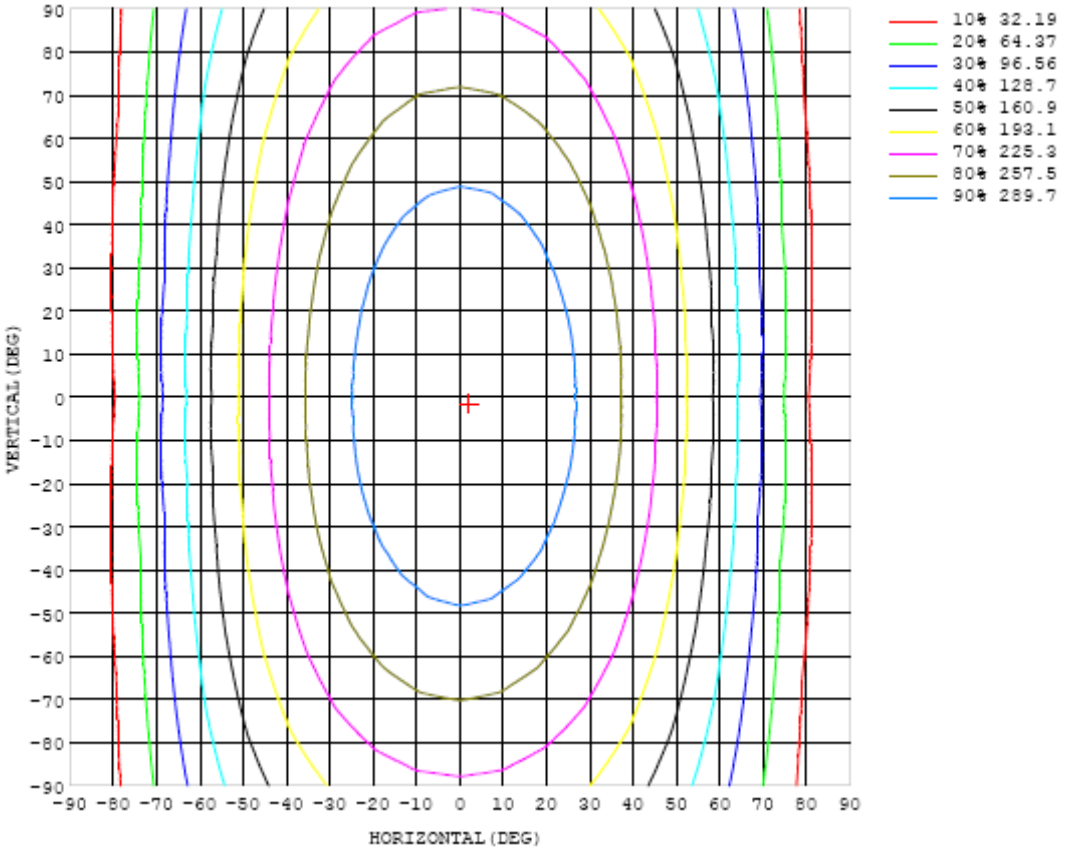


Chart 5: Isocandela Plot

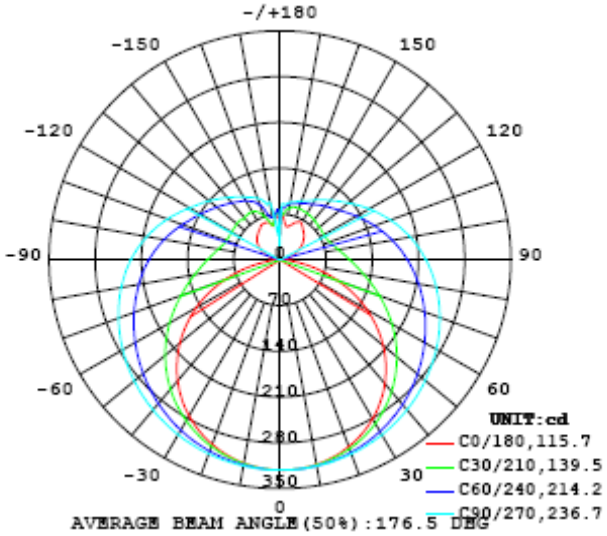


Chart 6: Polar Candela Distribution

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	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322
5	321	321	321	321	321	321	321	321	321	322	321	321	321	321	320	320	320	320	320
10	318	318	318	319	319	319	320	320	320	320	320	320	319	318	318	317	316	316	316
15	312	312	313	314	315	316	317	318	319	319	318	317	316	315	313	312	310	309	309
20	304	305	306	308	310	312	313	315	316	316	315	314	312	309	307	304	302	301	300
25	294	294	296	299	303	306	309	311	312	313	312	310	307	303	300	296	292	290	289
30	281	282	285	289	294	299	303	306	308	309	308	305	301	296	291	285	280	277	276
35	265	267	271	277	283	290	296	301	304	305	303	300	294	288	280	273	266	261	260
40	247	250	255	263	272	281	289	295	298	299	298	294	287	279	269	259	250	244	241
45	227	230	237	248	259	271	281	288	292	294	292	287	279	269	257	244	232	224	221
50	204	208	218	231	246	260	272	280	286	287	285	280	271	258	244	228	213	202	198
55	179	184	196	214	232	249	263	273	279	280	278	272	261	247	230	211	193	179	173
60	152	158	174	196	218	237	253	264	271	274	271	264	252	236	216	194	171	153	147
65	123	131	152	178	203	226	243	256	263	266	263	256	243	225	203	177	150	127	118
70	93.0	103	130	160	189	214	233	247	255	258	255	247	234	214	190	160	128	100	88.2
75	63.0	76.5	109	144	176	203	223	238	246	249	247	238	224	204	177	144	108	74.4	58.4
80	34.9	52.5	89.7	129	164	192	214	228	238	240	238	229	214	193	165	131	90.8	51.9	30.5
85	11.9	33.4	74.8	116	152	181	203	218	228	231	228	219	205	183	154	119	77.1	34.7	8.82
90	0.62	22.6	64.0	106	142	171	193	209	218	221	219	210	194	173	144	108	67.3	25.5	0.29
95	2.47	19.2	57.7	97.2	132	161	183	199	208	211	209	200	185	163	135	100	61.2	22.5	2.71
100	7.22	20.2	53.4	90.0	123	151	173	188	197	201	198	189	174	154	126	93.5	57.3	23.9	7.87
105	13.6	24.7	51.5	84.3	115	142	163	177	187	189	187	179	164	144	119	88.0	55.7	28.5	14.5
110	20.9	30.6	52.1	80.1	108	133	152	167	175	178	176	168	154	136	112	84.1	56.7	33.4	21.6
115	28.1	37.4	54.7	77.7	102	125	143	156	164	167	165	157	145	127	106	81.8	59.1	40.0	28.8
120	35.0	43.2	57.8	76.7	97.7	117	134	146	153	156	154	147	136	120	101	81.1	62.0	44.8	35.6
125	41.1	49.4	61.5	77.2	94.3	111	125	136	143	145	144	137	127	114	97.9	81.2	64.5	50.8	41.2
130	46.5	55.8	65.4	77.8	92.3	106	118	127	133	135	134	128	120	109	95.6	81.4	68.3	56.5	45.9
135	51.4	61.5	68.8	78.7	90.8	102	112	120	125	127	125	121	114	105	93.8	81.3	70.8	60.0	49.4
140	55.6	66.6	72.1	80.4	89.3	99.0	107	113	117	119	118	114	109	101	91.6	82.4	73.1	63.5	52.3
145	60.0	71.7	75.0	81.4	88.6	95.8	102	108	111	112	111	109	104	97.3	90.0	83.1	73.7	66.3	55.2
150	64.6	75.8	77.4	82.2	88.2	93.4	98.0	102	105	106	105	103	98.6	94.2	89.3	83.0	76.0	71.7	58.8
155	63.8	76.2	80.2	82.9	87.1	91.7	95.2	97.4	99.0	99.7	99.3	97.8	95.5	92.7	88.3	81.4	75.2	72.2	60.7
160	59.1	75.8	82.0	83.6	86.3	89.0	91.8	93.8	95.2	96.1	95.8	94.7	92.8	90.5	87.0	78.9	69.6	66.0	61.3
165	53.6	68.9	80.9	83.8	85.6	87.5	88.9	90.1	91.1	92.0	92.0	91.4	90.7	87.3	78.3	68.0	62.4	60.6	57.7
170	53.1	61.1	74.8	79.8	81.6	84.8	86.9	88.1	88.8	89.3	89.2	89.2	83.7	72.3	62.9	58.8	60.9	61.7	56.5
175	63.4	64.5	66.2	72.5	78.3	80.0	80.3	83.1	84.6	84.6	84.9	77.1	62.4	54.1	55.1	61.0	63.7	64.1	64.6
180	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1

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	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322		
5	320	320	320	320	320	321	321	321	321	321	321	321	321	321	321	321	321		
10	316	316	317	317	318	319	319	320	320	320	320	320	319	319	318	318	318		
15	309	310	311	313	314	316	317	318	318	318	318	317	316	315	314	313	313		
20	301	302	304	306	309	311	314	315	316	316	315	313	311	309	307	306	305		
25	290	292	295	299	303	307	310	312	313	312	311	309	306	302	299	296	294		
30	277	280	284	290	296	301	305	308	309	308	306	303	299	294	289	285	282		
35	261	266	272	280	287	294	300	303	304	304	301	296	290	284	277	271	267		
40	244	250	258	269	278	287	294	298	300	299	295	289	281	272	263	255	249		
45	224	232	243	256	269	279	287	292	294	293	289	281	272	260	248	238	230		
50	202	213	227	243	258	271	280	286	288	287	282	273	261	247	232	218	208		
55	178	192	210	230	248	262	273	280	282	280	274	264	250	233	215	198	184		
60	153	171	193	216	237	254	265	273	275	273	266	255	239	219	198	176	159		
65	127	149	176	203	226	245	258	266	268	266	258	245	228	205	180	154	133		
70	100	128	160	190	216	236	250	258	260	258	250	236	217	192	163	132	105		
75	73.8	108	145	178	205	226	241	250	253	250	241	226	206	179	148	112	78.8		
80	50.5	90.4	131	166	195	218	233	242	244	241	232	217	195	167	133	93.4	54.6		
85	33.1	76.8	120	156	186	208	224	233	236	232	223	207	185	156	121	78.7	36.0		
90	24.2	67.4	110	147	176	199	214	224	226	223	214	198	175	147	110	68.1	25.4		
95	21.4	60.8	102	138	167	189	204	213	216	213	203	187	165	137	101	60.5	21.1		
100	23.6	57.2	95.0	129	157	178	194	202	205	201	192	177	155	128	93.4	55.7	22.2		
105	28.7	56.8	89.6	121	147	168	183	191	194	190	181	166	146	119	87.3	54.1	26.8		
110	35.1	58.5	86.7	114	138	158	171	180	182	179	170	155	136	111	83.3	54.9	32.8		
115	41.3	61.5	85.3	109	130	148	160	168	170	167	159	146	128	106	81.2	57.4	39.3		
120	46.6	64.7	84.8	106	124	140	150	157	159	156	149	137	121	102	80.6	61.0	45.3		
125	50.7	68.0	85.1	103	118	132	142	148	149	147	140	130	115	98.6	80.9	64.7	49.7		
130	55.6	70.6	85.5	100	113	125	134	139	140	138	132	123	111	96.5	82.1	68.6	54.6		
135	59.3	73.2	85.5	98.2	109	119	126	131	132	130	125	117	107	95.1	83.4	71.8	58.7		
140	63.3	76.1	84.3	96.3	106	114	120	123	124	123	118	112	103	94.2	84.4	73.5	61.4		
145	64.3	77.7	85.0	93.6	102	109	114	117	117	116	112	107	101	93.4	84.5	74.8	64.0		
150	65.1	80.0	84.5	90.5	98.3	104	108	110	111	110	107	103	98.4	92.3	84.6	78.2	67.0		
155	61.1	75.9	81.1	87.7	91.6	98.6	103	105	105	105	103	100	96.1	90.3	85.1	77.8	63.0		
160	55.0	65.2	70.9	76.0	83.0	89.6	95.5	99.4	100	99.9	98.5	96.2	92.8	88.7	85.8	71.2	55.4		
165	52.2	55.6	59.9	63.2	67.9	70.7	81.6	87.3	92.4	94.0	93.2	91.3	88.3	86.7	81.4	58.6	49.7		
170	54.2	55.9	57.0	62.2	63.7	67.1	61.9	65.8	88.4	88.9	87.1	85.0	82.2	73.1	59.8	53.5	52.8		
175	64.6	68.2	70.3	71.5	72.2	72.4	72.4	68.9	39.7	55.3	69.2	72.0	69.0	68.9	69.4	67.6	64.8		
180	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1		

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

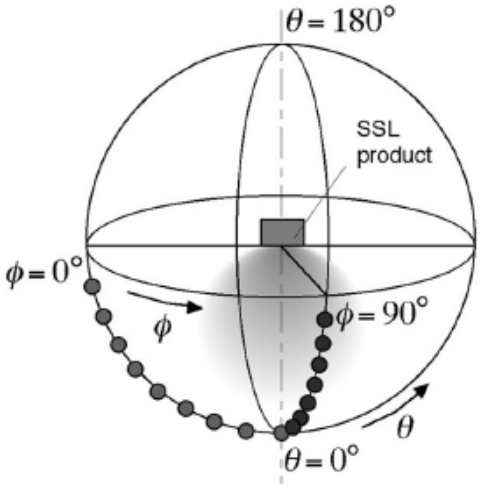
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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

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