

LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Tube

Model: 16T8/4F/840/GL/BYP

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, YuhangDist,
Hangzhou, Zhejiang Province, China 311100

Tel: +86571 86376106

www.ledtestlab.com

Report No.: HZ190700321

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

Review by:



Engineer: April Zou

Jul. 25, 2019

Approved by:



Manager: Jim Zhang

Jul. 25, 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: 16T8/4F/840/GL/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
140.2	2240.7	15.98	0.9791
CCT (K)	CRI	Stabilization Time (Light & Power)	
4013	82.9	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	: Jul. 22, 2019
Date of Test	: Jul. 23, 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 ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

TABLE OF CONTENT

LM-79-08 TEST REPORT	1
TEST SUMMARY	2
SAMPLE PHOTO	4
TEST RESULTS	5
Sphere-Spectroradiometer Method.....	5
Goniophotometer Method	6
Spectral Power Distribution - Sphere Spectroradiometer Method	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method	9
Color Rendition Report – Sphere Spectroradiometer Method	10
Zonal Lumen Tabulation- Goniophotometer Method	11
Illuminance Plots- Goniophotometer Method	12
Luminous Intensity Distribution Plots- Goniophotometer Method.....	13
Luminous Intensity Data- Goniophotometer Method	14
EQUIPMENT LIST	16
TEST METHODS	16
Seasoning of SSL Product.....	16
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	16
Goniophotometer Method	17
Photometric and Electrical Measurements	17
Color Characteristics Measurements.....	17
Color Spatial Uniformity	17

SAMPLE PHOTO

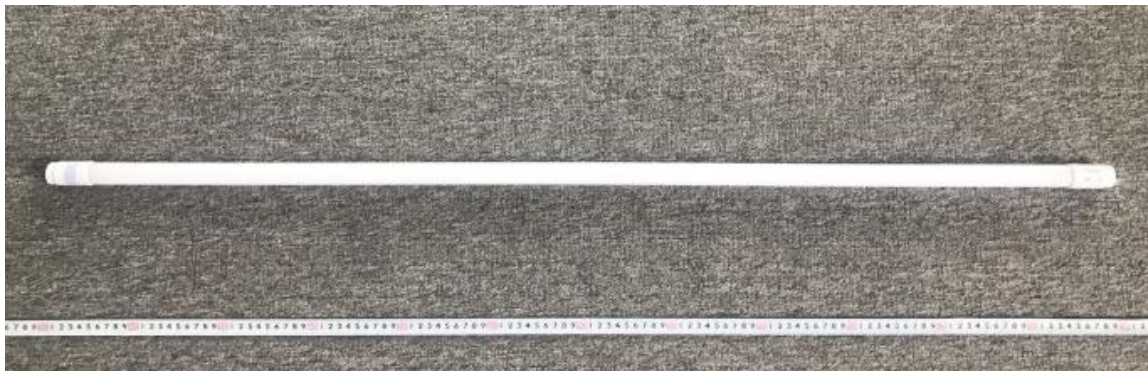


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 16T8/4F/840/GL/BYP
Electrical Ratings	: 120-277V, 50/60Hz, 16W
Product Description	: 4000K
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 65 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.136	0.062
Power Factor	0.9791	0.9039
Test Power (W)	15.98	15.89
THD A%	17.45	11.64
Luminous Efficacy (lm/W)	140.2	141.8
Total Luminous Flux (lm)	2240.7	2252.6
Color Rendering Index (CRI)	82.9	
R9	8.7	
Correlated Color Temperature (CCT)(K)	4013	
Chromaticity Chroma x	0.3804	
Chromaticity Chroma y	0.3789	
Chromaticity Chroma u	0.2243	
Chromaticity Chroma v	0.3350	
Duv	0.0010	
Chromaticity Chroma u'	0.2243	
Chromaticity Chroma v'	0.5025	

Special Color Rendering Indices	
R1	81.5
R2	91.5
R3	95.7
R4	78.9
R5	80.8
R6	87
R7	84.6
R8	63.3
R9	8.7
R10	78.5
R11	77.2
R12	59.5
R13	84.4
R14	98.2

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 24.8 °C.

The photometric distance is 30 m.

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)	0.136
Power Factor	0.9788
Power (W)	16.02
Luminous Efficacy (lm/W)	137.8
Total Luminous Flux (lm)	2207.5
Beam Angle (°)	116.8 (0°-180°) / 255.2 (90°-270°)
Center Beam Candle Power (cd)	322
Maximum Beam Candle Power (cd)	321.9 (At: C=0.0, Gamma=0.0)
Spacing Criteria	1.29 (0°-180°) / 1.48 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	39.13%
Zonal Lumens in the 60 °-90 °Zone	26.55%
Zonal Lumens in the 90 °-120 °Zone	18.96%
Zonal Lumens in the 120 °-180 °Zone	15.36%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

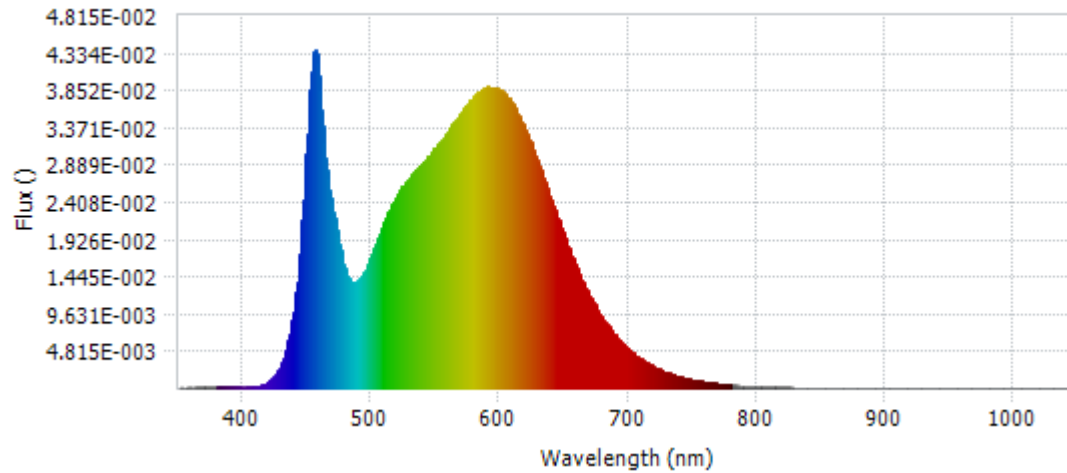
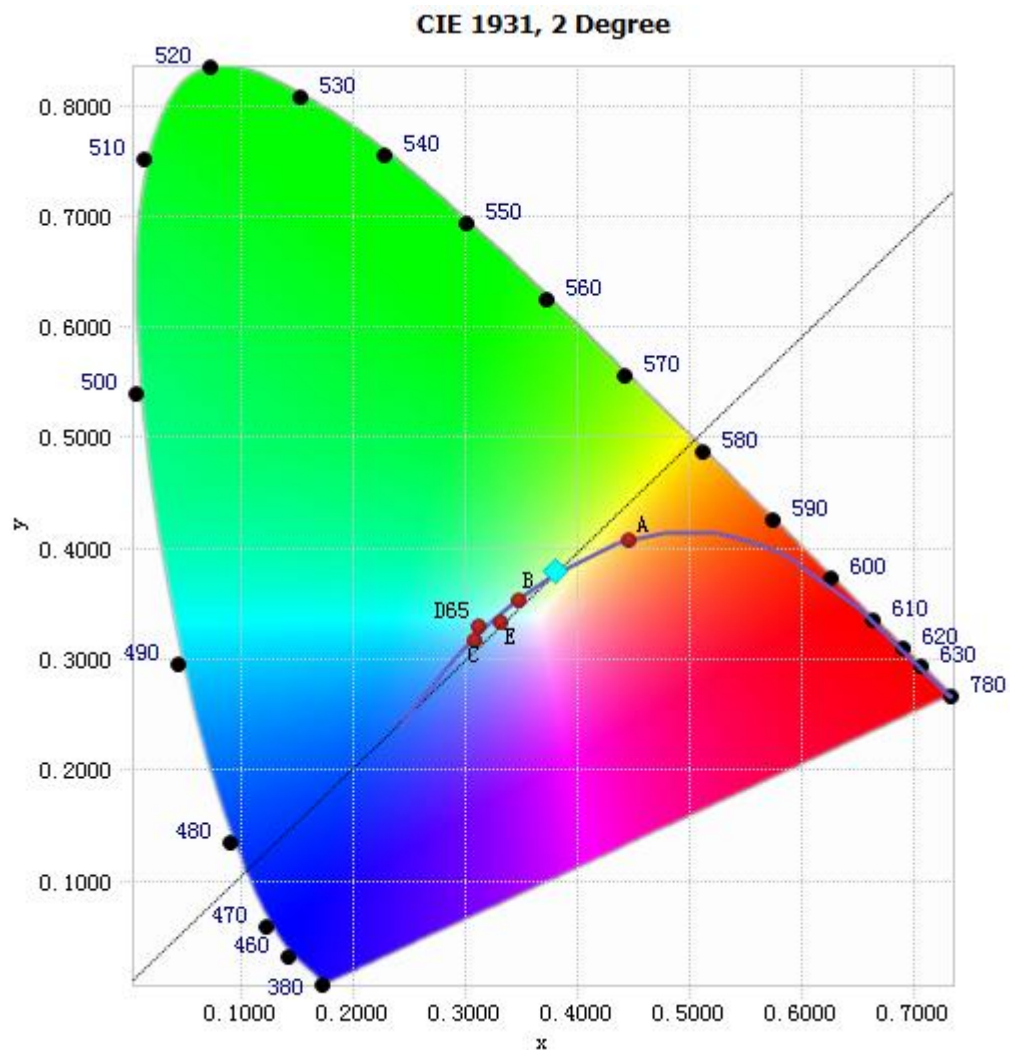


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.68E-04	485	1.37E-02	590	3.89E-02	695	5.92E-03
385	1.54E-04	490	1.41E-02	595	3.89E-02	700	5.11E-03
390	1.70E-04	495	1.53E-02	600	3.86E-02	705	4.40E-03
395	1.62E-04	500	1.73E-02	605	3.79E-02	710	3.76E-03
400	1.23E-04	505	1.95E-02	610	3.67E-02	715	3.24E-03
405	1.30E-04	510	2.16E-02	615	3.52E-02	720	2.79E-03
410	2.23E-04	515	2.35E-02	620	3.34E-02	725	2.41E-03
415	4.82E-04	520	2.51E-02	625	3.13E-02	730	2.06E-03
420	9.39E-04	525	2.62E-02	630	2.91E-02	735	1.76E-03
425	1.85E-03	530	2.73E-02	635	2.67E-02	740	1.52E-03
430	3.46E-03	535	2.82E-02	640	2.45E-02	745	1.29E-03
435	6.27E-03	540	2.92E-02	645	2.21E-02	750	1.13E-03
440	1.11E-02	545	3.01E-02	650	1.98E-02	755	9.63E-04
445	1.94E-02	550	3.11E-02	655	1.76E-02	760	8.37E-04
450	3.30E-02	555	3.22E-02	660	1.56E-02	765	7.18E-04
455	4.36E-02	560	3.33E-02	665	1.37E-02	770	6.13E-04
460	3.83E-02	565	3.45E-02	670	1.20E-02	775	5.28E-04
465	2.82E-02	570	3.57E-02	675	1.05E-02	780	4.56E-04
470	2.29E-02	575	3.67E-02	680	9.14E-03		
475	1.85E-02	580	3.77E-02	685	7.93E-03		
480	1.49E-02	585	3.85E-02	690	6.88E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3804, 0.3789)

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

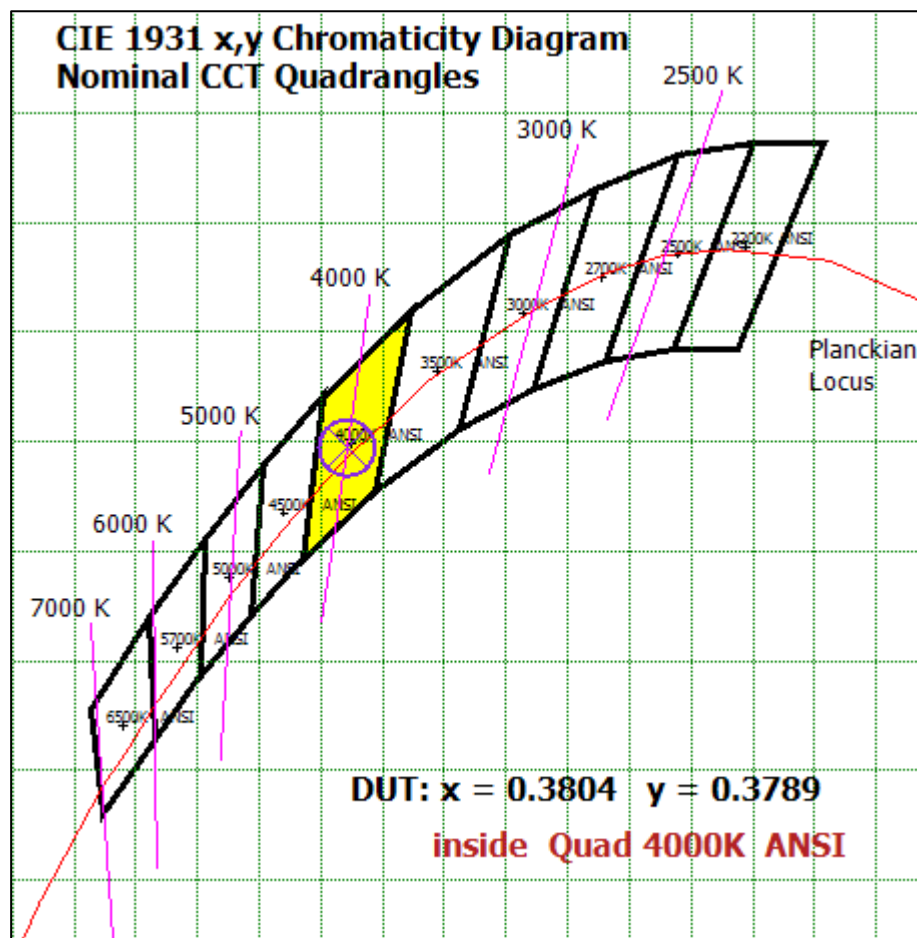
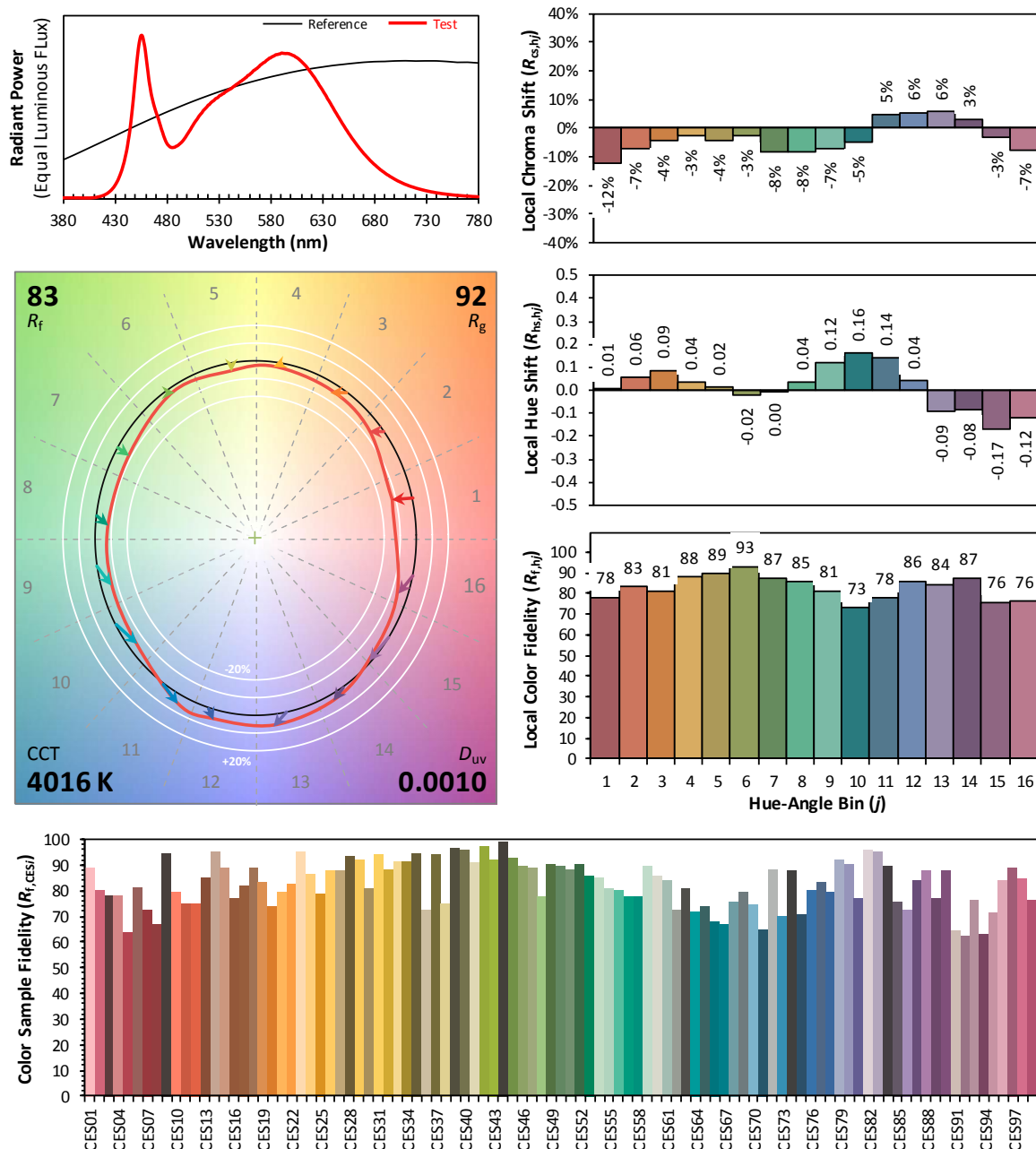


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

x 0.3804
 y 0.3789
 u' 0.2243
 v' 0.5025

Chart 4: Full Report Created with the IES TM-30 Calculator

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	30.57	1.38%
10- 20	89.199	4.04%
20- 30	140.551	6.37%
30- 40	180.55	8.18%
40- 50	206.343	9.35%
50- 60	216.69	9.82%
60- 70	212.467	9.62%
70- 80	196.994	8.92%
80- 90	176.593	8.00%
90-100	157.639	7.14%
100-110	139.443	6.32%
110-120	121.499	5.50%
120-130	103.934	4.71%
130-140	85.976	3.89%
140-150	67.373	3.05%
150-160	47.513	2.15%
160-170	26.166	1.19%
170-180	8.048	0.36%
Total	2207.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	863.903	39.13%
60- 90	586.054	26.55%
0-90	1449.957	65.68%
90- 180	757.591	34.32%
0- 180	2207.5	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

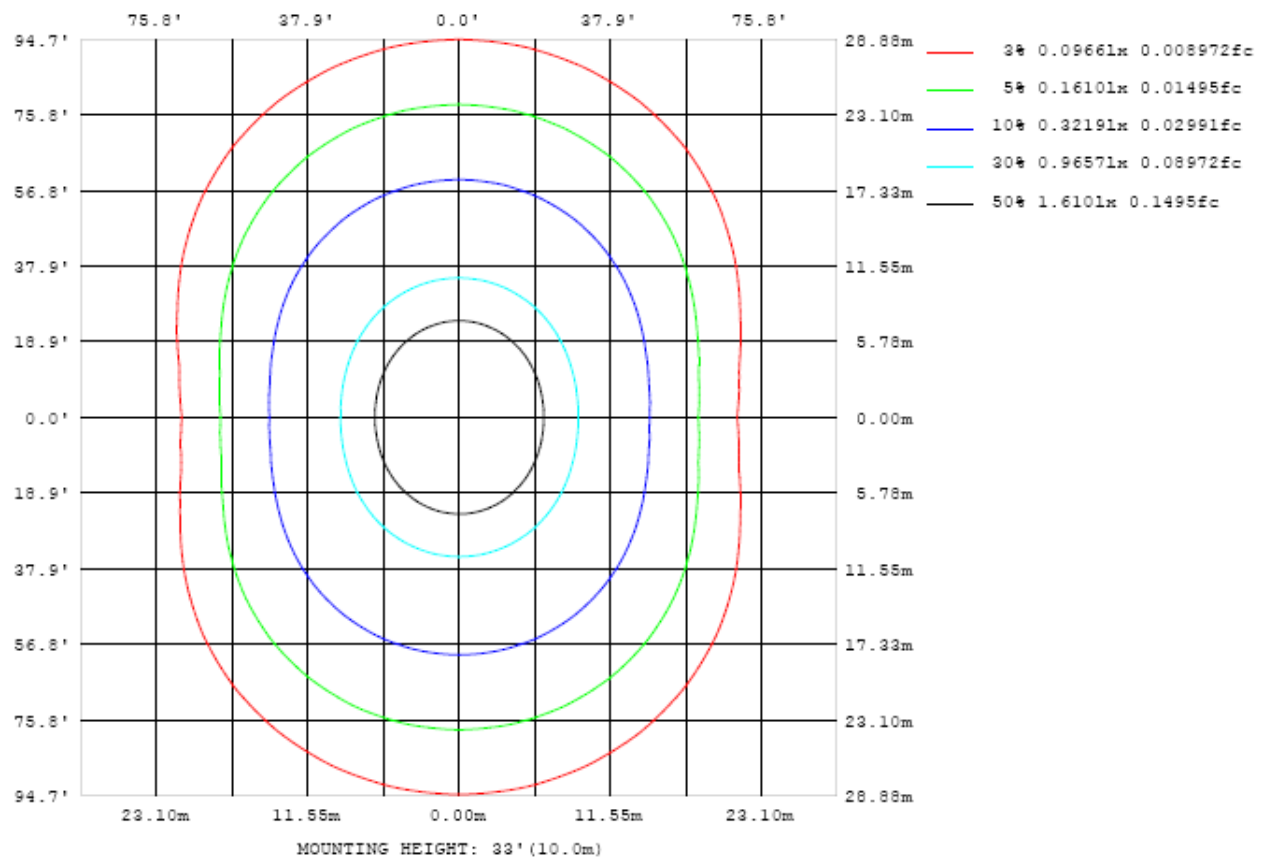


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

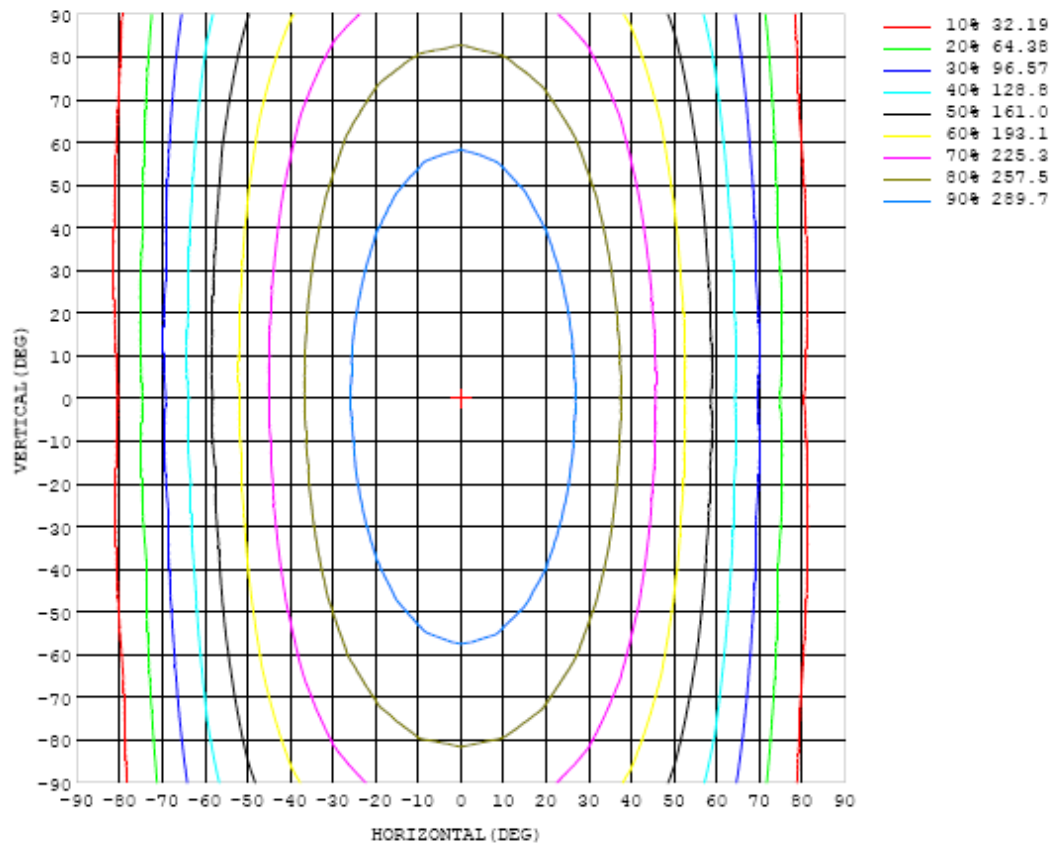


Chart 6: Isocandela Plot

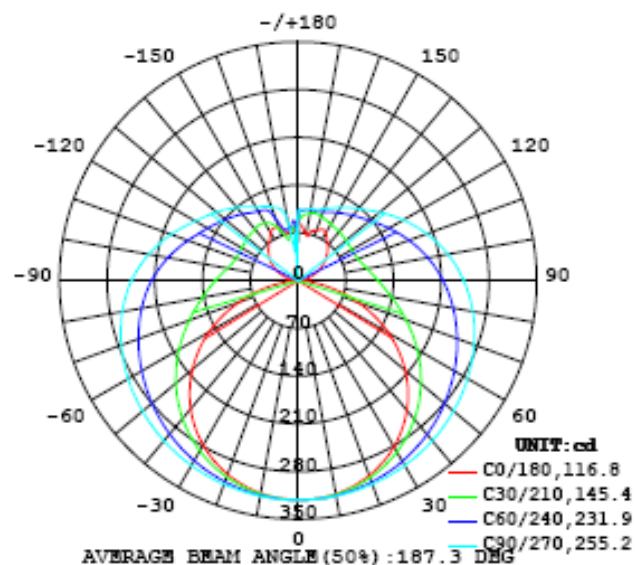


Chart 7: Polar Candela Distribution

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	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	322	321	321	321	321	321	321	321	321	320	320	320	320
10	318	318	318	319	319	320	320	320	321	321	321	321	320	319	319	318	317	317	317
15	312	312	313	314	315	317	318	319	319	320	319	318	317	316	314	312	311	311	310
20	304	305	306	308	310	312	314	316	317	318	317	315	314	311	309	306	303	303	302
25	294	295	297	300	304	307	310	313	315	316	315	312	310	306	301	298	294	292	292
30	281	282	285	290	296	301	306	310	312	313	312	309	304	299	293	287	282	279	279
35	266	267	272	278	286	293	300	305	309	310	309	305	299	292	283	276	268	264	263
40	248	250	256	265	276	286	294	301	305	306	304	300	293	283	273	262	253	247	245
45	228	231	239	251	264	277	288	296	301	302	300	294	286	275	261	248	235	227	225
50	205	209	220	235	252	267	280	290	296	298	295	289	279	265	249	232	216	205	202
55	180	185	200	219	239	257	273	284	290	293	290	283	271	255	236	216	196	182	178
60	153	160	178	202	226	247	265	277	285	287	284	276	263	245	223	198	174	156	151
65	124	133	156	185	213	237	256	270	279	281	278	269	255	235	210	181	152	129	122
70	93.7	106	134	168	200	227	248	263	272	275	272	262	247	225	197	165	131	102	92.0
75	63.4	79.0	114	153	188	217	240	255	265	268	265	254	238	215	186	150	110	75.2	62.0
80	34.6	55.4	96.1	139	177	207	231	247	257	260	257	247	230	206	175	136	92.8	51.7	33.3
85	11.4	36.9	82.0	127	166	198	222	239	249	252	249	238	221	197	165	125	79.1	33.9	11.1
90	0.53	26.8	72.2	117	156	188	213	230	240	243	240	229	212	187	155	116	70.3	24.9	1.39
95	3.23	23.8	66.3	110	148	179	203	220	230	233	231	220	203	179	147	108	65.0	23.1	4.10
100	8.72	25.6	62.5	103	139	170	193	210	220	223	220	210	193	170	139	102	62.0	26.0	10.1
105	15.8	30.5	61.4	97.5	132	160	183	199	209	212	209	200	183	161	132	97.6	61.6	31.8	17.7
110	23.3	36.5	62.6	93.8	125	152	173	189	198	201	198	189	173	152	125	94.4	63.7	39.1	25.8
115	31.2	43.4	65.4	91.7	119	143	163	178	186	189	187	178	164	144	120	92.7	67.3	46.6	34.3
120	39.4	51.1	68.7	91.0	114	136	154	167	175	178	176	167	155	137	115	92.6	71.7	54.8	42.2
125	47.1	59.3	72.2	91.3	111	129	145	157	164	167	165	157	146	130	112	93.3	76.0	62.9	49.5
130	54.2	66.6	76.1	91.9	108	124	137	147	154	156	154	148	138	125	110	94.6	80.3	70.0	55.7
135	61.1	73.0	79.7	92.8	107	120	131	139	144	146	145	140	131	121	109	96.0	83.8	76.6	61.6
140	67.7	79.6	84.1	93.7	105	116	125	132	136	138	137	133	126	117	107	97.3	87.9	82.5	66.9
145	74.2	85.8	88.2	94.8	104	112	120	125	129	131	130	126	121	114	107	98.9	91.9	88.3	73.6
150	81.1	90.5	91.8	96.1	103	109	115	120	122	124	123	120	116	111	106	101	95.6	92.4	81.0
155	82.8	93.3	95.7	97.7	102	107	111	114	117	118	117	115	113	110	106	102	96.4	91.8	84.8
160	77.9	97.1	98.3	100	102	104	107	110	111	112	112	112	110	108	106	102	96.3	87.7	82.7
165	75.4	96.0	101	102	103	104	105	106	107	108	108	108	108	107	104	94.4	84.1	79.0	74.5
170	70.2	90.2	98.0	100	103	105	106	106	107	107	107	107	106	100	90.7	80.8	76.0	77.5	75.0
175	78.1	84.0	92.9	96.7	98.5	102	104	104	104	104	105	104	95.9	84.8	73.8	70.2	72.7	74.9	75.0
180	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1

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	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322		
5	320	320	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321		
10	317	317	318	318	319	319	320	321	321	321	320	320	320	319	319	318	318		
15	311	312	313	314	316	317	318	319	319	319	319	318	317	315	314	313	312		
20	303	304	306	309	311	314	316	317	318	318	316	314	312	310	308	306	305		
25	292	295	298	302	306	310	313	315	316	315	313	311	307	303	300	297	295		
30	280	283	288	294	300	305	309	312	313	312	309	306	301	295	290	285	282		
35	265	270	277	285	292	299	305	309	310	309	305	300	294	286	278	272	268		
40	248	254	264	274	284	293	300	305	306	305	300	294	285	275	265	256	250		
45	228	237	249	263	276	287	295	301	302	301	295	287	277	264	251	239	231		
50	207	218	234	251	267	280	290	296	298	296	290	280	267	251	235	220	209		
55	184	199	218	239	257	273	284	291	293	291	284	272	257	239	219	199	186		
60	159	177	202	226	247	265	278	285	288	285	277	265	247	225	202	178	161		
65	133	157	185	214	238	257	271	279	282	279	270	257	237	212	184	156	134		
70	106	136	170	201	228	249	264	273	276	273	263	249	227	200	168	134	106		
75	79.6	116	156	190	219	242	257	266	269	266	256	240	217	188	152	113	78.5		
80	56.3	99.0	142	179	210	233	249	259	262	258	248	231	208	176	138	95.2	53.8		
85	38.9	85.5	131	169	200	225	241	251	254	250	240	223	198	166	126	80.8	34.8		
90	29.7	76.1	122	160	191	215	232	242	245	241	230	213	188	156	116	70.8	24.7		
95	26.3	68.9	113	150	181	205	221	231	234	230	220	203	178	146	107	63.3	21.2		
100	28.3	64.8	105	141	171	194	210	220	222	219	208	192	168	137	99.5	59.2	23.8		
105	33.7	64.6	99.8	133	161	183	198	208	211	207	197	181	158	128	93.9	58.8	29.6		
110	40.6	66.6	97.1	126	151	172	187	196	198	195	185	170	149	121	90.8	60.7	35.9		
115	47.7	70.3	96.0	121	144	162	175	184	186	183	174	160	141	116	89.5	64.5	43.5		
120	54.4	74.1	95.8	117	137	154	166	173	175	172	164	152	134	112	89.4	67.4	49.9		
125	59.9	78.0	96.3	115	132	146	157	163	165	162	156	144	129	110	90.5	71.6	54.7		
130	64.4	82.4	97.2	113	127	139	149	155	157	154	148	138	124	108	91.3	77.1	60.1		
135	67.5	86.1	97.8	111	123	133	142	147	148	146	140	132	120	106	93.2	81.2	64.4		
140	69.8	86.7	97.6	109	119	128	135	139	140	138	133	126	116	105	95.2	83.8	67.4		
145	70.5	91.7	99.8	109	115	122	128	131	132	131	126	120	113	106	96.1	86.6	69.4		
150	69.4	94.1	97.1	102	113	118	121	124	124	123	121	117	112	105	96.8	89.8	68.4		
155	65.1	85.5	91.8	96.7	104	115	117	119	120	119	118	115	110	104	98.1	81.7	61.0		
160	64.0	70.3	80.0	84.1	87.2	95.2	112	115	115	115	113	111	108	103	96.6	68.9	58.6		
165	65.2	61.1	65.4	70.5	77.4	75.9	81.1	101	110	110	109	106	102	95.2	75.6	56.8	59.0		
170	67.9	65.0	66.9	68.6	74.1	75.9	75.9	66.9	86.0	104	95.0	88.9	77.3	69.3	61.0	61.8	61.9		
175	75.9	77.3	78.0	81.8	85.2	87.8	89.7	85.9	46.6	79.4	82.8	84.9	84.5	82.8	78.9	75.8	76.6		
180	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1	93.1		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 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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