

LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Tube

Model: 13T8/4F/DIM/840/BYP

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19050008d

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

Review by:



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May 17, 2019

Approved by:



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May 17, 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: **13T8/4F/DIM/840/BYP**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
152.6	1979.0	12.97	0.9836
CCT (K)	CRI	Stabilization Time (Light & Power)	
4016	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	: May 08, 2019
Date of Test	: May 14, 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

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SAMPLE PHOTO

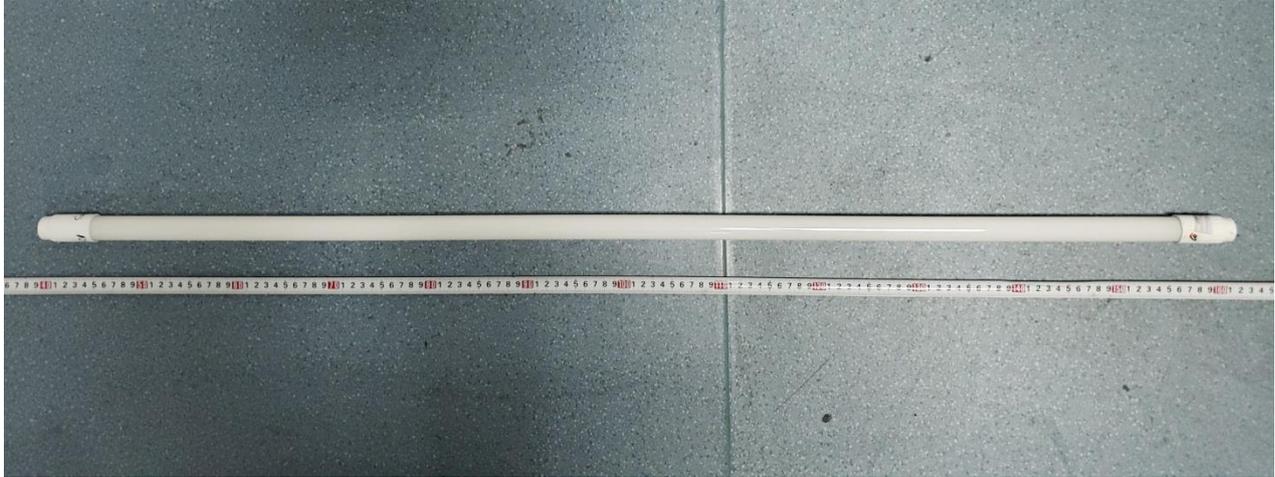


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 13T8/4F/DIM/840/BYP
Electrical Ratings	: 120V, 60Hz, 13W
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
Voltage frequency (Hz)	60
Test Current (A)	0.110
Power Factor	0.9836
Test Power (W)	12.97
THD A%	13.29
Luminous Efficacy (lm/W)	152.6
Total Luminous Flux (lm)	1979.0
Color Rendering Index (CRI)	81.8
R9	2.3
Correlated Color Temperature (CCT)(K)	4016
Chromaticity Chroma x	0.3812
Chromaticity Chroma y	0.3822
Chromaticity Chroma u	0.2235
Chromaticity Chroma v	0.3361
Duv	0.0016
Chromaticity Chroma u'	0.2235
Chromaticity Chroma v'	0.5041

Special Color Rendering Indices	
R1	79.6
R2	87.9
R3	94.5
R4	80.7
R5	79.7
R6	83.4
R7	85.9
R8	62.7
R9	2.3
R10	71.6
R11	79.5
R12	58.9
R13	81.6
R14	97.1

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 24.9°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)	0.111
Power Factor	0.9835
Power (W)/2	13.03
Luminous Efficacy (lm/W)	149.5
Total Luminous Flux (lm)	1948.4
Beam Angle (°)	116.8 (0°-180°) / 250.8 (90°-270°)
Center Beam Candle Power (cd)	288
Maximum Beam Candle Power (cd)	288.0 (At: C=350.0, Gamma=2.5)
Spacing Criteria	1.29 (0°-180°) /1.47 (90°-270°)
Zonal Lumens in the 0°-60° Zone	39.58%
Zonal Lumens in the 60°-90° Zone	26.53%
Zonal Lumens in the 90°-120° Zone	18.77%
Zonal Lumens in the 120°-180° Zone	15.12%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

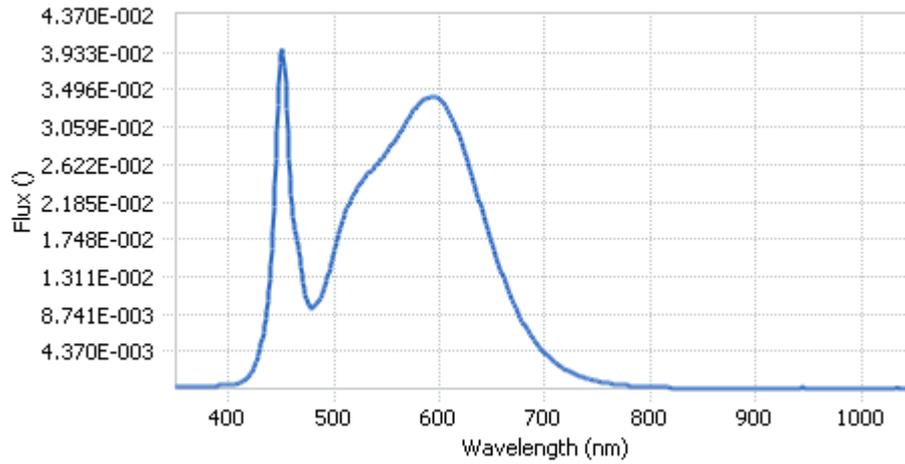
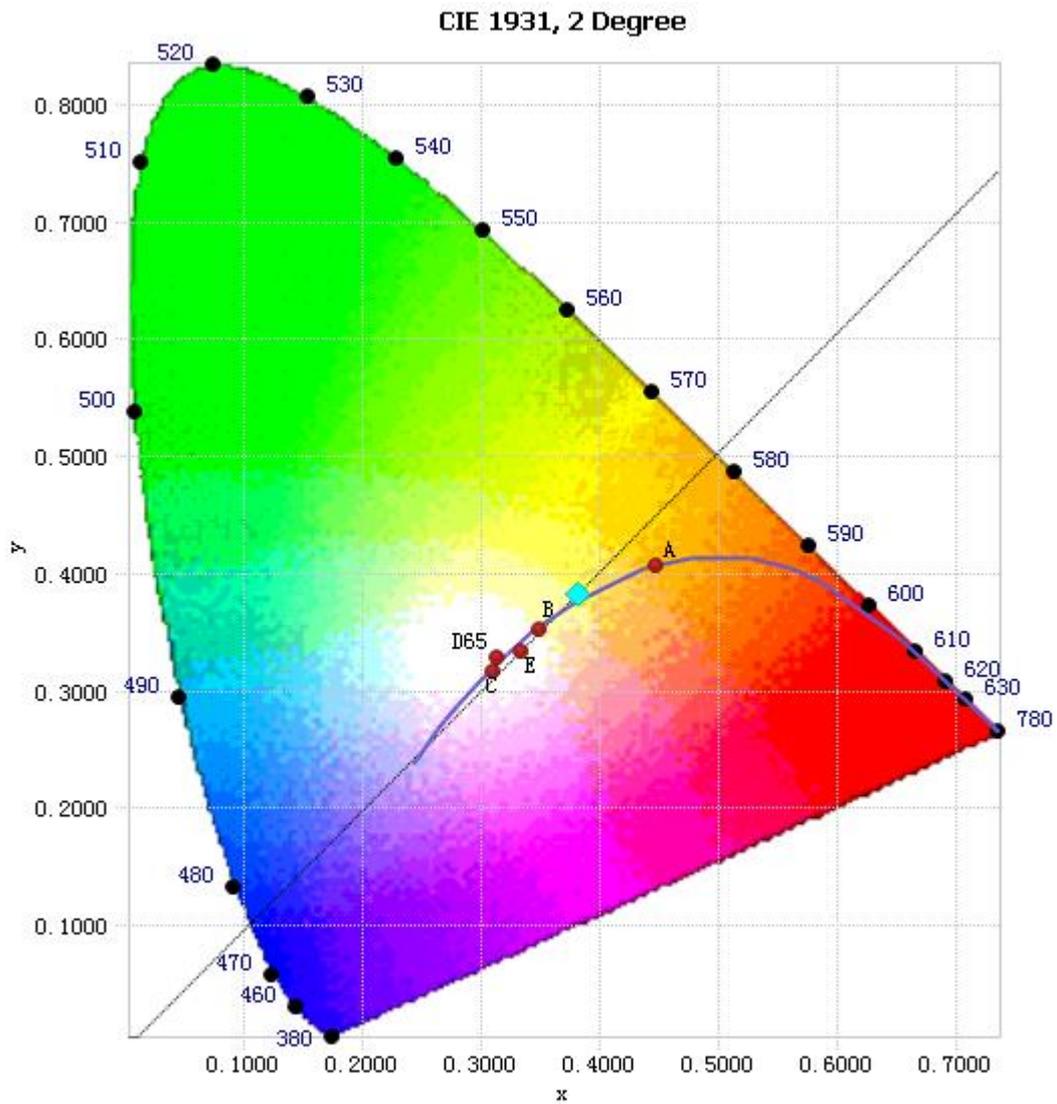


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.27E-04	485	1.02E-02	590	3.40E-02	695	4.82E-03
385	3.28E-04	490	1.15E-02	595	3.41E-02	700	4.15E-03
390	3.60E-04	495	1.36E-02	600	3.38E-02	705	3.55E-03
395	3.93E-04	500	1.61E-02	605	3.32E-02	710	3.03E-03
400	4.32E-04	505	1.84E-02	610	3.20E-02	715	2.59E-03
405	5.18E-04	510	2.03E-02	615	3.07E-02	720	2.20E-03
410	6.84E-04	515	2.20E-02	620	2.91E-02	725	1.90E-03
415	1.01E-03	520	2.30E-02	625	2.71E-02	730	1.62E-03
420	1.62E-03	525	2.40E-02	630	2.52E-02	735	1.39E-03
425	2.74E-03	530	2.48E-02	635	2.30E-02	740	1.19E-03
430	4.75E-03	535	2.55E-02	640	2.10E-02	745	1.02E-03
435	8.24E-03	540	2.62E-02	645	1.89E-02	750	8.58E-04
440	1.45E-02	545	2.69E-02	650	1.68E-02	755	7.46E-04
445	2.68E-02	550	2.76E-02	655	1.50E-02	760	6.38E-04
450	3.93E-02	555	2.86E-02	660	1.32E-02	765	5.57E-04
455	3.26E-02	560	2.94E-02	665	1.15E-02	770	4.75E-04
460	2.12E-02	565	3.04E-02	670	1.01E-02	775	4.09E-04
465	1.73E-02	570	3.15E-02	675	8.74E-03	780	3.55E-04
470	1.33E-02	575	3.25E-02	680	7.58E-03		
475	9.93E-03	580	3.32E-02	685	6.55E-03		
480	9.51E-03	585	3.38E-02	690	5.64E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3812, 0.3822)

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

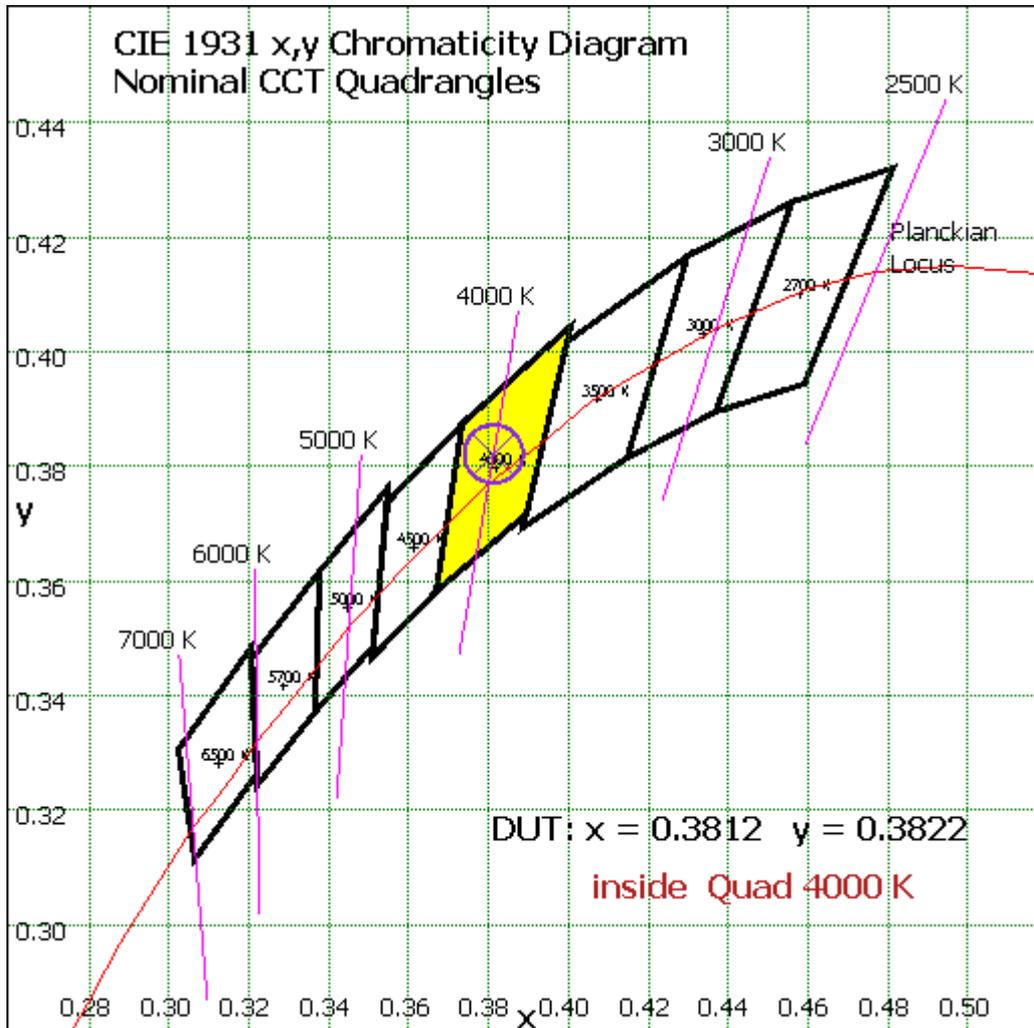
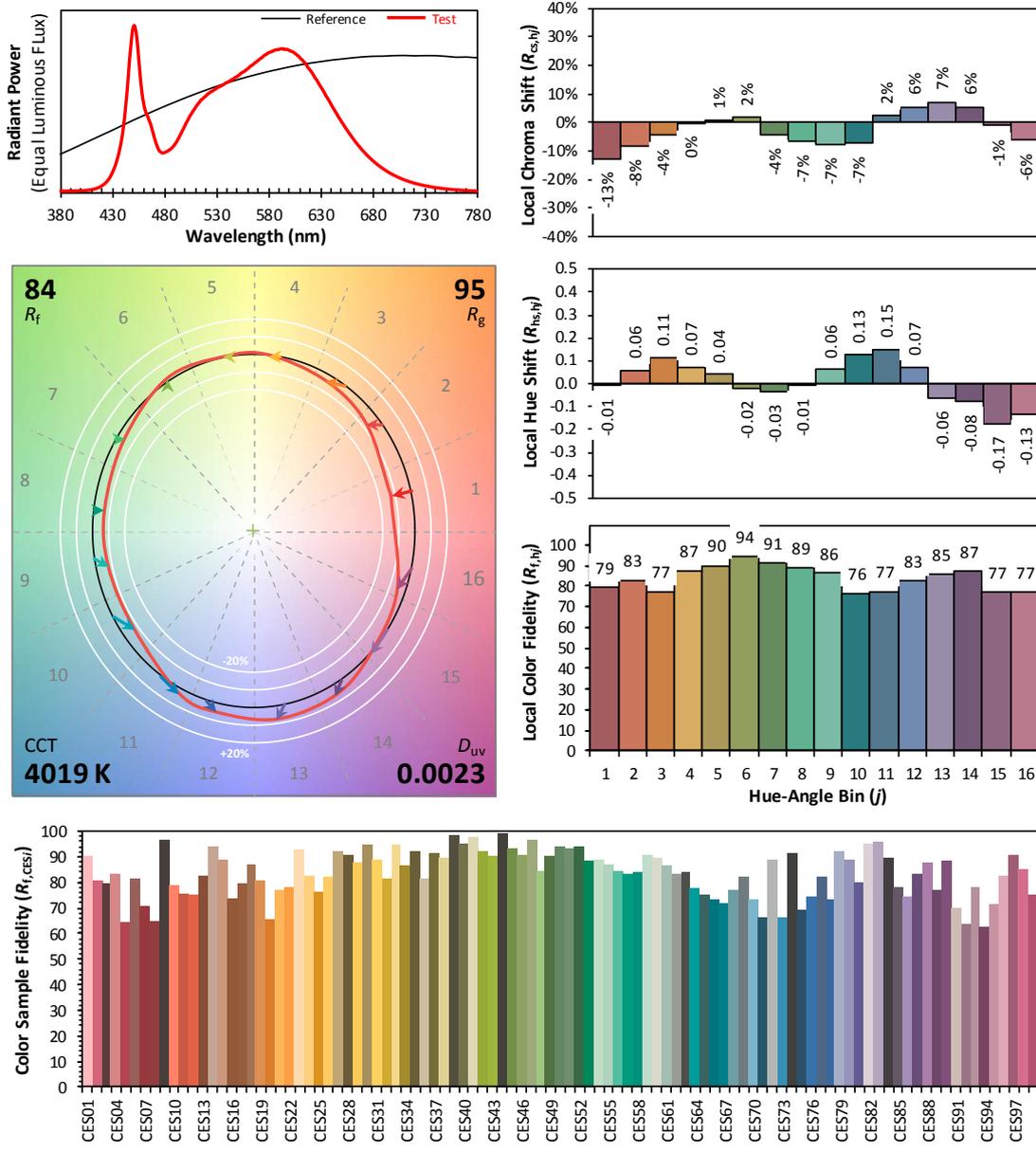


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

x	0.3812
y	0.3822
u'	0.2235
v'	0.5041

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	27.357	1.40%
10- 20	79.818	4.10%
20- 30	125.718	6.45%
30- 40	161.358	8.28%
40- 50	184.119	9.45%
50- 60	192.86	9.90%
60- 70	188.322	9.67%
70- 80	173.656	8.91%
80- 90	154.84	7.95%
90-100	137.913	7.08%
100-110	121.823	6.25%
110-120	106.022	5.44%
120-130	90.414	4.64%
130-140	74.82	3.84%
140-150	58.513	3.00%
150-160	41.478	2.13%
160-170	22.739	1.17%
170-180	6.631	0.34%
Total	1948.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	771.23	39.58%
60- 90	516.818	26.53%
0-90	1288.048	66.11%
90- 180	660.353	33.89%
0- 180	1948.4	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

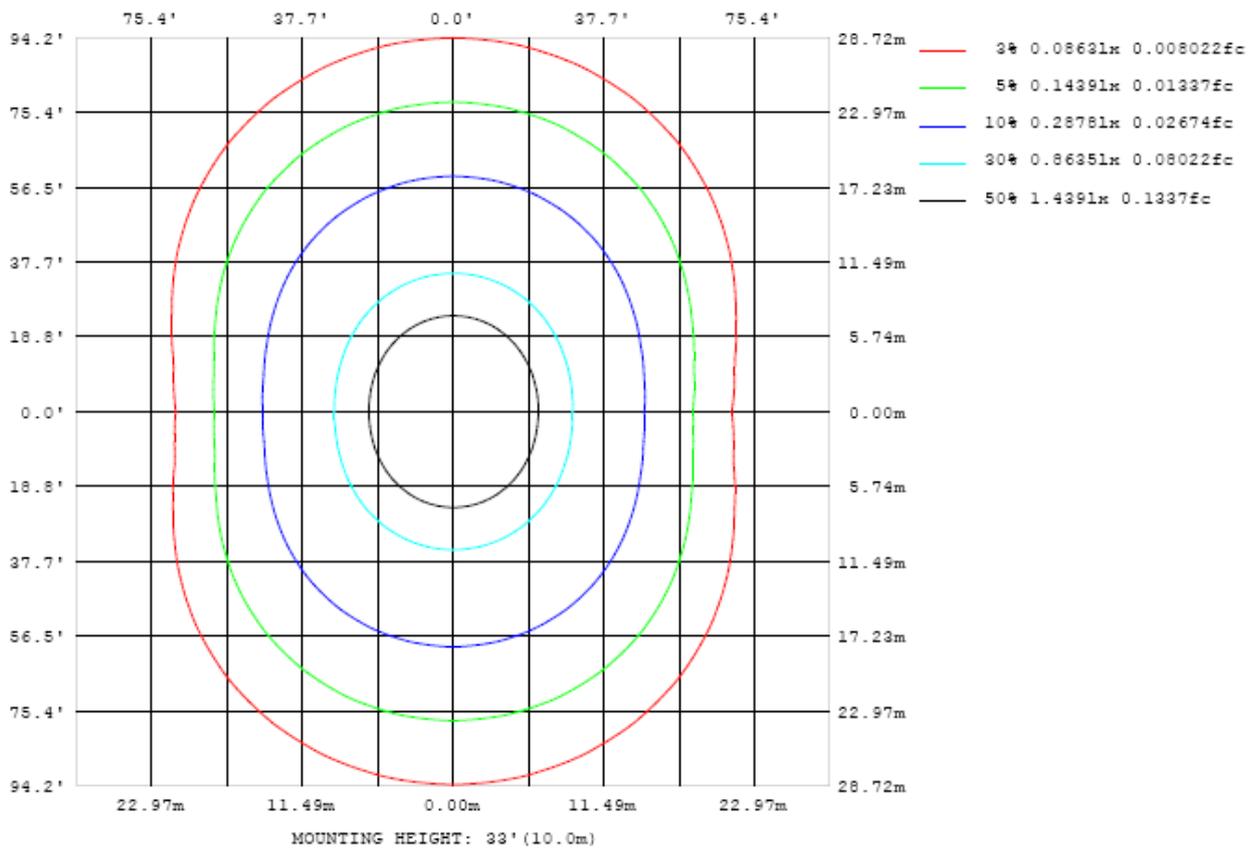


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

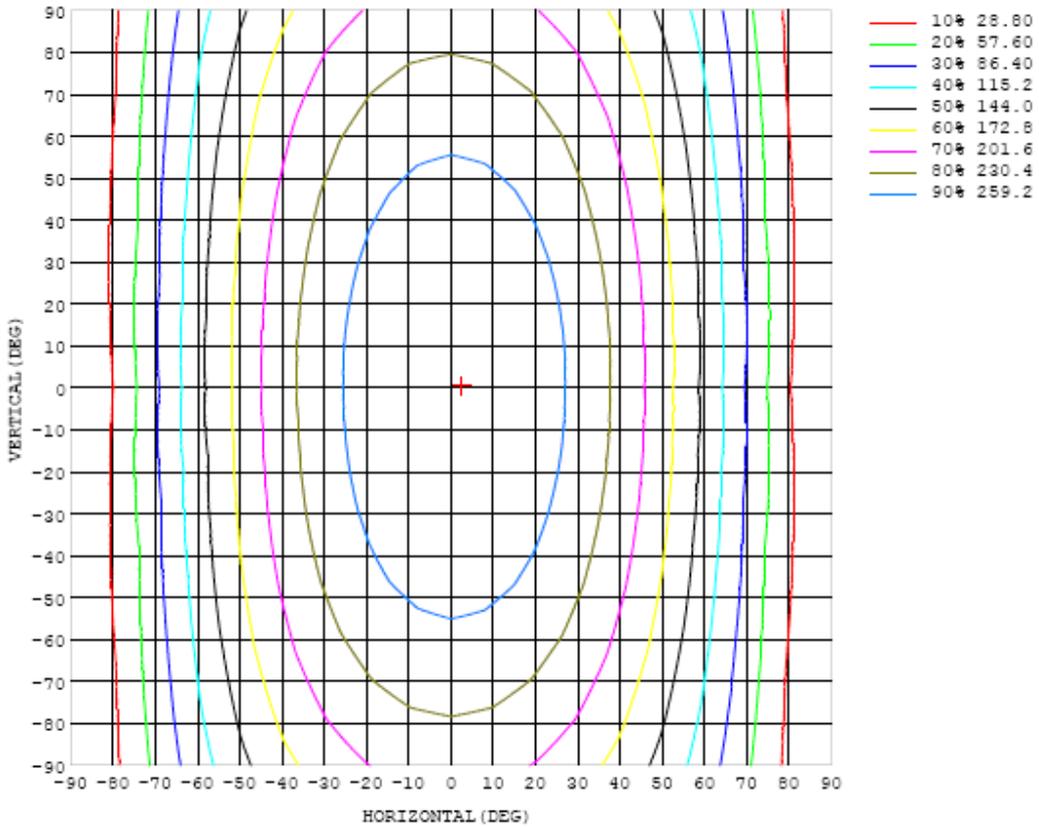


Chart 6: Isocandela Plot

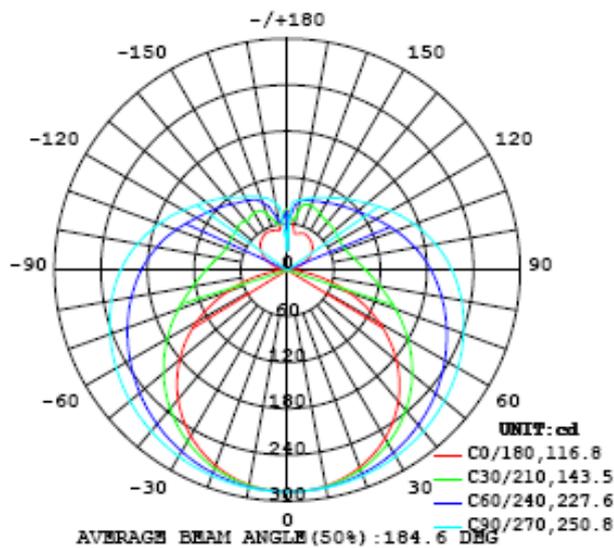


Chart 7: Polar Candela Distribution

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	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288
5	287	287	287	287	287	287	288	288	288	288	287	287	287	287	287	287	287	286	287
10	284	285	285	285	285	286	286	287	287	287	287	286	286	285	284	284	283	283	283
15	280	280	280	281	282	283	284	285	286	286	285	285	283	282	281	279	278	278	278
20	273	273	274	276	278	280	282	283	284	284	284	282	280	278	276	273	272	270	270
25	263	264	266	269	272	275	278	280	282	282	281	279	277	273	269	266	263	261	260
30	252	253	256	260	264	269	274	277	279	279	278	276	272	267	262	257	252	249	249
35	238	240	244	249	256	262	268	273	276	276	275	272	267	261	253	246	240	236	235
40	222	224	230	237	246	255	263	268	272	273	271	267	261	253	244	234	226	220	219
45	204	207	214	224	236	247	256	263	268	269	267	262	255	245	233	221	211	203	201
50	184	187	197	210	224	238	249	258	263	264	262	257	248	236	222	207	194	184	181
55	161	166	178	195	213	229	242	252	257	259	257	251	241	227	211	193	175	162	159
60	137	143	159	180	200	219	234	245	252	254	251	245	233	218	199	177	156	140	135
65	111	119	139	164	188	210	226	238	246	248	245	238	226	209	187	162	137	116	109
70	83.6	93.9	119	149	176	200	218	231	239	242	239	231	218	199	176	147	117	91.4	81.6
75	56.6	69.9	100	134	165	190	210	224	232	235	232	224	210	190	165	134	99.3	68.1	54.4
80	30.7	48.1	83.6	121	154	181	202	217	225	228	225	217	202	182	155	121	83.5	47.1	29.0
85	9.97	30.9	70.9	110	144	172	194	209	217	220	218	209	194	173	145	111	71.6	31.2	8.86
90	0.28	21.6	61.7	101	135	164	185	200	209	212	209	201	186	165	137	102	63.1	23.0	0.60
95	2.22	18.8	55.7	93.5	127	155	176	191	200	204	201	192	177	156	129	95.4	57.8	20.8	2.85
100	6.82	20.8	52.2	87.3	119	146	167	182	191	194	191	183	168	148	122	89.8	54.9	23.2	8.09
105	12.8	25.5	51.2	82.4	112	138	158	172	181	184	182	173	159	140	115	85.4	54.2	28.1	14.9
110	19.3	31.2	52.7	79.2	106	130	149	163	171	174	171	164	151	132	109	82.3	56.1	34.1	22.0
115	26.0	36.8	55.6	77.7	101	123	140	153	161	164	161	154	142	125	104	81.1	59.2	40.1	29.0
120	32.5	43.4	59.2	77.6	97.4	116	132	144	151	154	152	145	134	118	100	81.1	63.0	46.6	35.3
125	37.8	50.0	62.3	78.4	95.0	111	124	135	141	144	142	136	126	113	98.1	81.9	66.5	53.0	40.9
130	42.2	56.2	65.9	79.5	93.4	107	118	127	133	135	133	128	120	109	96.3	83.0	69.9	58.8	45.3
135	45.5	61.8	68.7	80.5	92.4	103	113	120	125	127	126	122	115	106	95.2	84.0	72.6	62.6	49.0
140	48.0	66.5	72.8	81.5	91.7	101	109	115	118	120	119	116	110	103	94.3	84.9	75.9	67.1	51.7
145	49.6	71.0	76.5	81.7	89.8	98.4	105	109	113	114	113	110	106	100	93.1	85.2	77.6	70.5	53.5
150	51.3	75.5	80.5	84.4	89.5	95.4	101	105	107	108	108	106	102	97.6	92.0	85.7	74.3	73.7	55.7
155	52.0	74.7	84.1	87.2	90.7	94.1	98.1	101	103	104	103	102	99.0	94.5	90.8	84.3	78.3	74.0	55.1
160	50.7	66.5	86.0	88.6	90.9	93.4	95.6	97.4	98.9	99.4	99.0	97.9	95.5	92.4	85.7	76.5	71.4	68.3	54.7
165	49.0	57.2	73.6	88.0	90.0	92.0	93.5	94.8	95.7	95.7	95.1	94.1	91.9	82.2	73.1	66.2	61.8	58.7	53.4
170	51.0	52.0	57.8	73.4	84.9	87.0	89.8	92.3	92.2	92.0	91.6	87.4	73.8	63.9	63.1	62.0	60.1	55.4	54.6
175	66.4	65.4	63.8	65.2	69.2	72.5	75.9	79.1	89.1	89.5	73.2	52.6	55.7	64.1	65.2	67.5	66.7	66.7	67.9
180	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4

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	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288	288		
5	287	287	287	287	287	287	287	288	288	288	288	288	288	287	287	287	287		
10	283	284	284	285	285	286	286	287	287	287	287	287	286	286	285	285	285		
15	278	279	280	281	282	283	285	285	286	286	285	285	284	282	281	281	280		
20	271	272	274	276	278	280	282	284	284	284	283	282	280	278	276	274	273		
25	261	263	266	270	273	277	279	281	282	282	280	278	275	272	269	266	264		
30	250	253	257	262	267	272	276	278	279	279	277	274	270	265	260	256	253		
35	236	241	247	254	261	267	272	275	276	276	273	269	263	256	250	244	240		
40	221	227	235	244	253	261	267	271	273	272	269	263	256	247	238	230	225		
45	204	211	222	234	245	255	262	267	269	268	264	257	247	236	225	215	208		
50	185	195	208	223	237	248	257	263	265	263	258	250	239	225	211	198	188		
55	164	176	194	211	228	241	251	258	260	258	252	243	230	214	196	180	167		
60	141	158	179	200	219	234	245	252	255	252	246	235	220	202	181	161	145		
65	118	139	164	188	210	227	239	246	249	247	240	228	211	190	166	141	121		
70	93.1	119	149	177	201	219	232	240	243	240	233	220	201	178	151	121	95.7		
75	69.4	101	136	167	192	212	226	234	237	234	226	212	192	167	137	102	71.3		
80	48.2	85.3	124	157	183	204	218	227	230	227	218	204	183	157	124	85.9	49.3		
85	32.2	73.0	113	148	175	196	211	220	223	219	211	196	175	147	113	72.6	32.3		
90	23.8	64.5	105	140	168	188	203	212	215	211	203	188	167	139	104	63.4	22.8		
95	21.1	58.8	97.6	132	159	180	194	203	206	203	194	179	158	130	96.0	57.0	19.5		
100	23.4	55.4	91.3	124	151	171	185	193	196	193	184	170	149	122	89.2	53.2	21.3		
105	28.3	55.1	86.5	117	142	162	175	183	186	183	174	161	141	115	84.1	52.3	25.6		
110	35.1	56.9	83.9	110	134	153	166	173	175	172	165	151	132	108	80.9	53.6	32.2		
115	41.9	60.1	83.0	106	126	143	156	163	166	163	155	142	124	103	79.4	55.8	39.0		
120	48.3	63.8	83.0	103	121	135	146	153	155	152	145	134	118	99.6	79.1	58.9	45.1		
125	54.6	67.1	83.4	100	116	129	138	144	145	143	137	127	113	97.1	78.9	64.2	51.0		
130	60.3	67.8	84.3	98.3	112	123	131	136	137	135	130	121	109	94.8	79.7	68.8	56.3		
135	65.0	74.3	85.9	96.5	108	117	124	128	130	128	123	115	105	92.5	82.5	72.3	60.6		
140	68.8	77.6	82.6	95.8	104	112	118	121	122	121	117	110	101	93.0	84.6	75.3	62.9		
145	72.5	80.4	83.9	94.6	102	107	111	114	115	114	110	105	99.7	93.1	85.8	77.9	65.9		
150	75.5	82.5	85.6	88.2	99.4	104	107	109	110	109	106	103	98.3	92.7	86.8	79.9	68.6		
155	72.6	79.6	85.1	88.9	93.7	100	103	105	105	105	103	100	96.4	92.1	87.3	80.4	65.3		
160	63.0	72.2	76.7	82.3	88.6	93.3	98.6	100	101	100	99.0	97.1	94.4	91.3	87.7	80.2	57.8		
165	54.9	61.3	66.7	69.3	75.3	80.8	88.5	93.5	96.0	95.8	95.2	94.0	92.3	89.5	85.1	76.9	50.9		
170	55.1	55.0	60.9	65.4	66.4	63.2	69.6	78.8	86.9	89.5	89.5	88.6	85.0	83.3	75.4	57.3	47.7		
175	68.1	68.0	66.7	68.7	66.9	67.4	62.0	50.6	56.8	84.5	76.9	68.5	65.7	65.4	64.9	61.2	63.3		
180	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4		

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

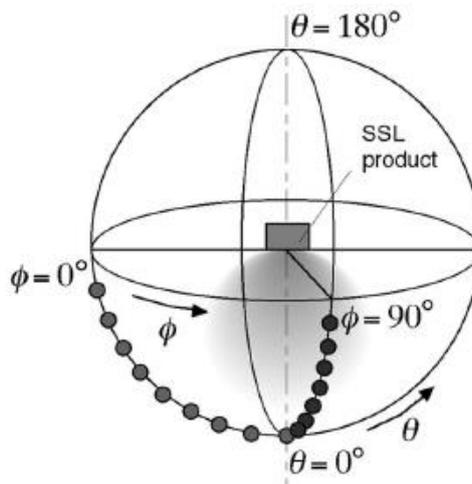
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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