LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Tube

Model: 16T8U6/840/DIR/R

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19050049a

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

Review by: April Zou

Engineer: April Zou
Jun. 04, 2019

Approved by:

Manager: Jim Zhang
Jun. 04, 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: **16T8U6/840/DIR/R**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
133.6	2464.0	18.44	0.9913

CCT (K)	CRI	Stabilization Time (Light & Power)
4085	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 : May 30, 2019

Date of Test : Jun. 04, 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

SAMPLE PHOTO

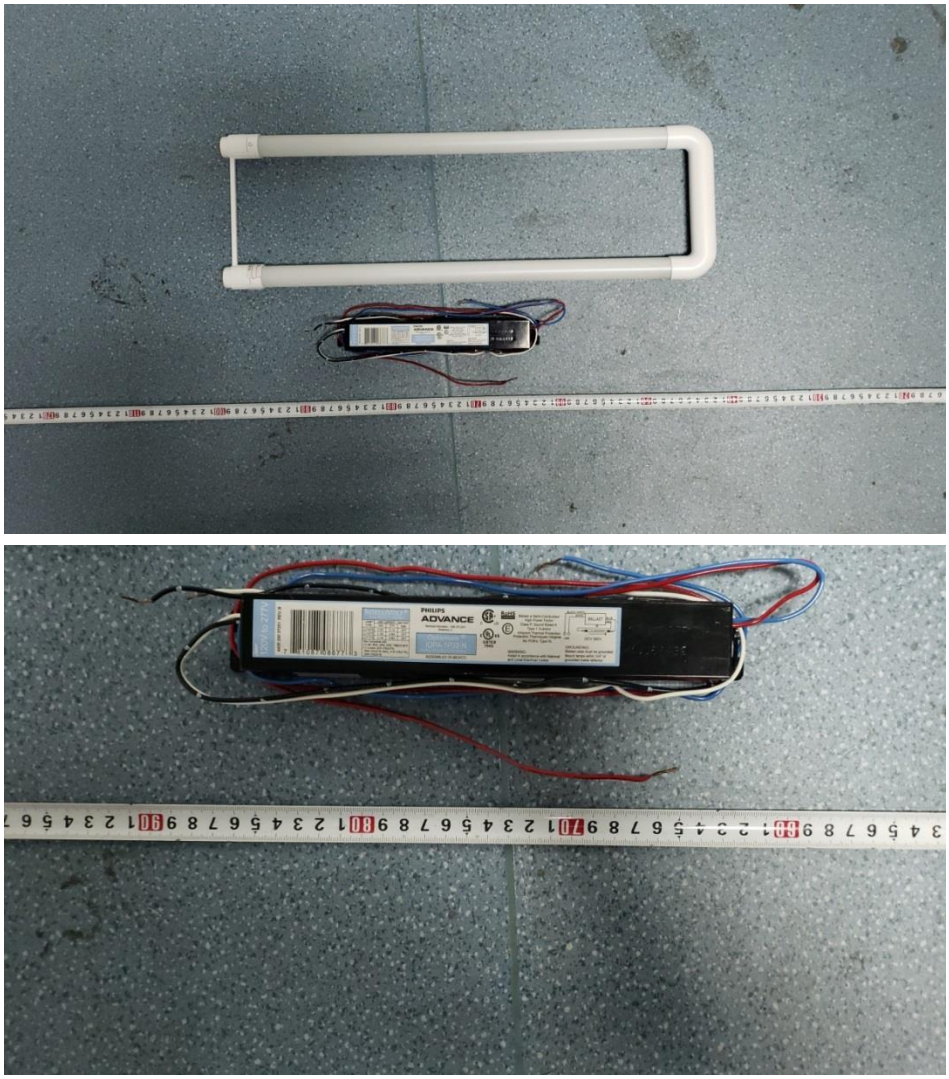


Figure 1- Overview of the sample

Equipment Under Test(EUT)	
Name	: LED Tube
Model	: 16T8U6/840/DIR/R
Electrical Ratings	: 120-277V, 60Hz, 16W
Product Description	: 4000K LED Tube supplied by a high frequency fluorescent lamp ballast: IOPA-1P32-N
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 26.0 ℃.

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)	0.155	0.070
Power Factor	0.9913	0.9560
Test Power (W)	18.44	18.40
THD A%	6.47	11.24
Luminous Efficacy (lm/W)	133.6	134.1
Total Luminous Flux (lm)	2464.0	2467.0
Color Rendering Index (CRI)	82.1	
R9	1.7	
Correlated Color Temperature (CCT)(K)	4085	
Chromaticity Chroma x	0.3786	
Chromaticity Chroma y	0.3820	
Chromaticity Chroma u	0.2218	
Chromaticity Chroma v	0.3357	
Duv	0.0024	
Chromaticity Chroma u ’	0.2218	
Chromaticity Chroma v’	0.5036	

Special Color Rendering Indices	
R1	79.7
R2	88.6
R3	95.4
R4	80.4
R5	79.8
R6	84.4
R7	85.8
R8	62.4
R9	1.7
R10	73.3
R11	79.1
R12	59.6
R13	82
R14	97.7

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 24.7 ℃.

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)	0.156
Power Factor	0.9860
Power (W)	18.48
Luminous Efficacy (lm/W)	132.8
Total Luminous Flux (lm)	2453.5
Beam Angle (°)	105.3 (0^o-180^o) / 167.0 (90^o-270^o)
Center Beam Candle Power (cd)	475
Maximum Beam Candle Power (cd)	475.7 (At: C=270.0, Gamma=4.0)
Spacing Criteria	1.21 (0^o-180^o) / 1.42 (90^o-270^o)
Zonal Lumens in the 0 °-60 °Zone	47.57%
Zonal Lumens in the 60 °-90 °Zone	25.41%
Zonal Lumens in the 90 °-120 °Zone	14.75%
Zonal Lumens in the 120 °-180 °Zone	12.27%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

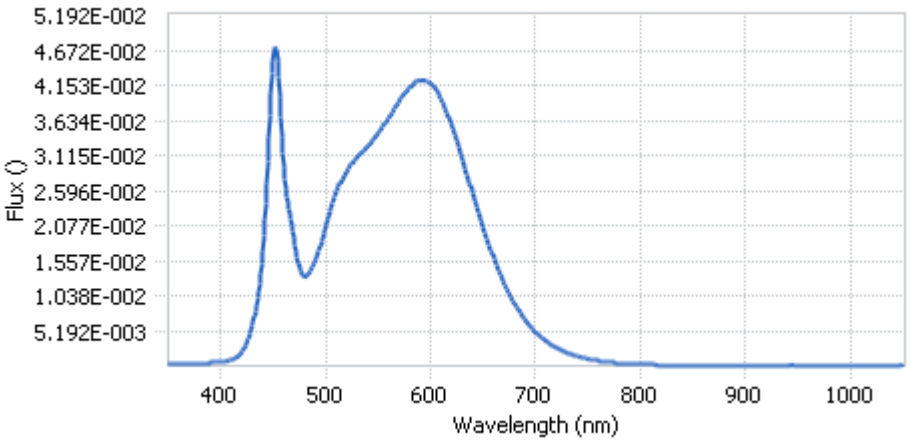
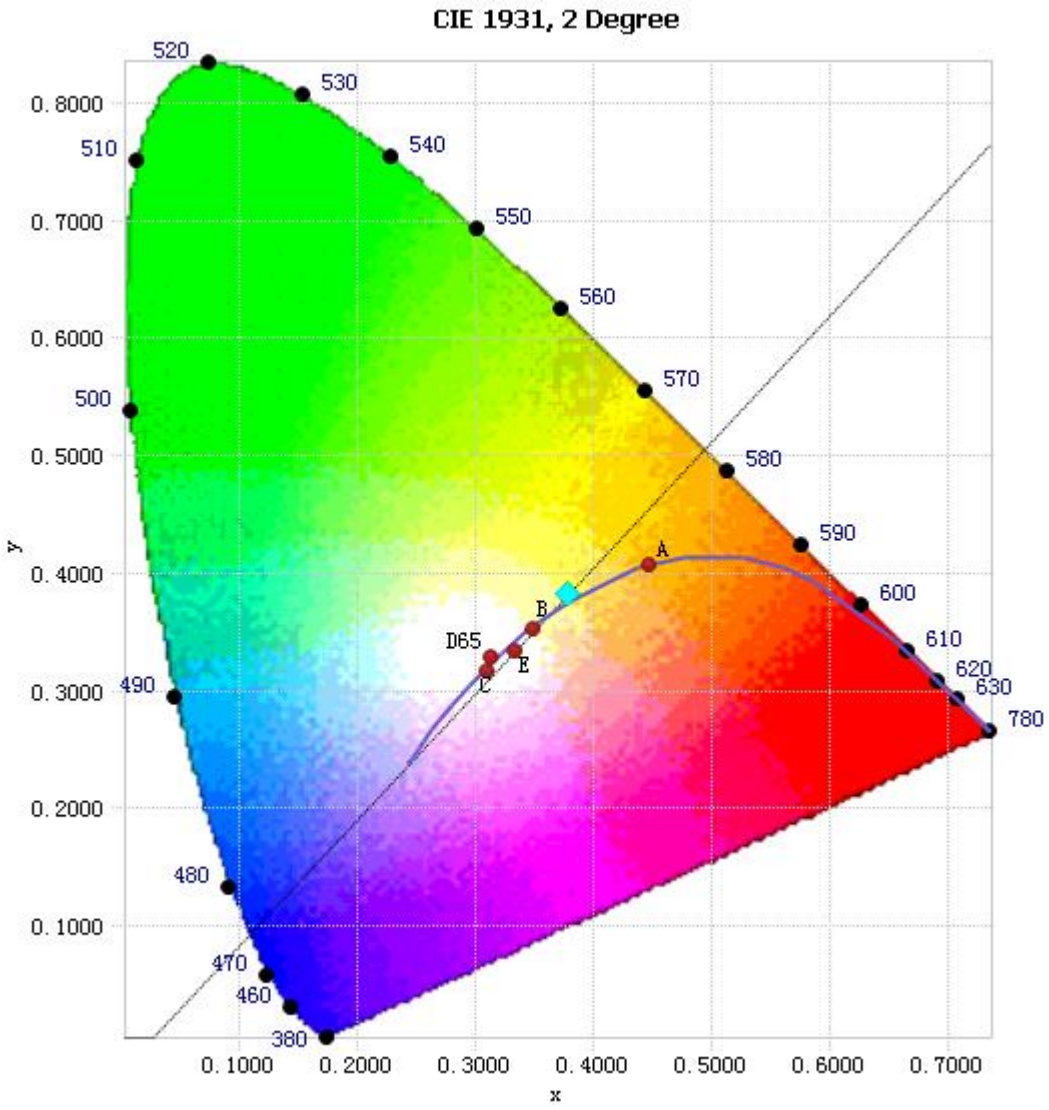


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.17E-04	485	1.40E-02	590	4.23E-02	695	5.84E-03
385	4.27E-04	490	1.55E-02	595	4.23E-02	700	5.02E-03
390	4.39E-04	495	1.80E-02	600	4.18E-02	705	4.30E-03
395	5.04E-04	500	2.08E-02	605	4.09E-02	710	3.67E-03
400	5.58E-04	505	2.35E-02	610	3.95E-02	715	3.13E-03
405	6.79E-04	510	2.57E-02	615	3.78E-02	720	2.66E-03
410	9.08E-04	515	2.76E-02	620	3.56E-02	725	2.26E-03
415	1.30E-03	520	2.88E-02	625	3.32E-02	730	1.94E-03
420	2.09E-03	525	2.99E-02	630	3.08E-02	735	1.66E-03
425	3.47E-03	530	3.08E-02	635	2.82E-02	740	1.41E-03
430	5.91E-03	535	3.17E-02	640	2.56E-02	745	1.21E-03
435	9.96E-03	540	3.26E-02	645	2.30E-02	750	1.04E-03
440	1.70E-02	545	3.34E-02	650	2.05E-02	755	8.94E-04
445	3.03E-02	550	3.45E-02	655	1.82E-02	760	7.70E-04
450	4.51E-02	555	3.55E-02	660	1.61E-02	765	6.60E-04
455	4.27E-02	560	3.67E-02	665	1.41E-02	770	5.56E-04
460	2.93E-02	565	3.79E-02	670	1.22E-02	775	4.82E-04
465	2.33E-02	570	3.91E-02	675	1.06E-02	780	4.11E-04
470	1.89E-02	575	4.04E-02	680	9.21E-03		
475	1.44E-02	580	4.12E-02	685	7.95E-03		
480	1.32E-02	585	4.20E-02	690	6.83E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3786, 0.3820)

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

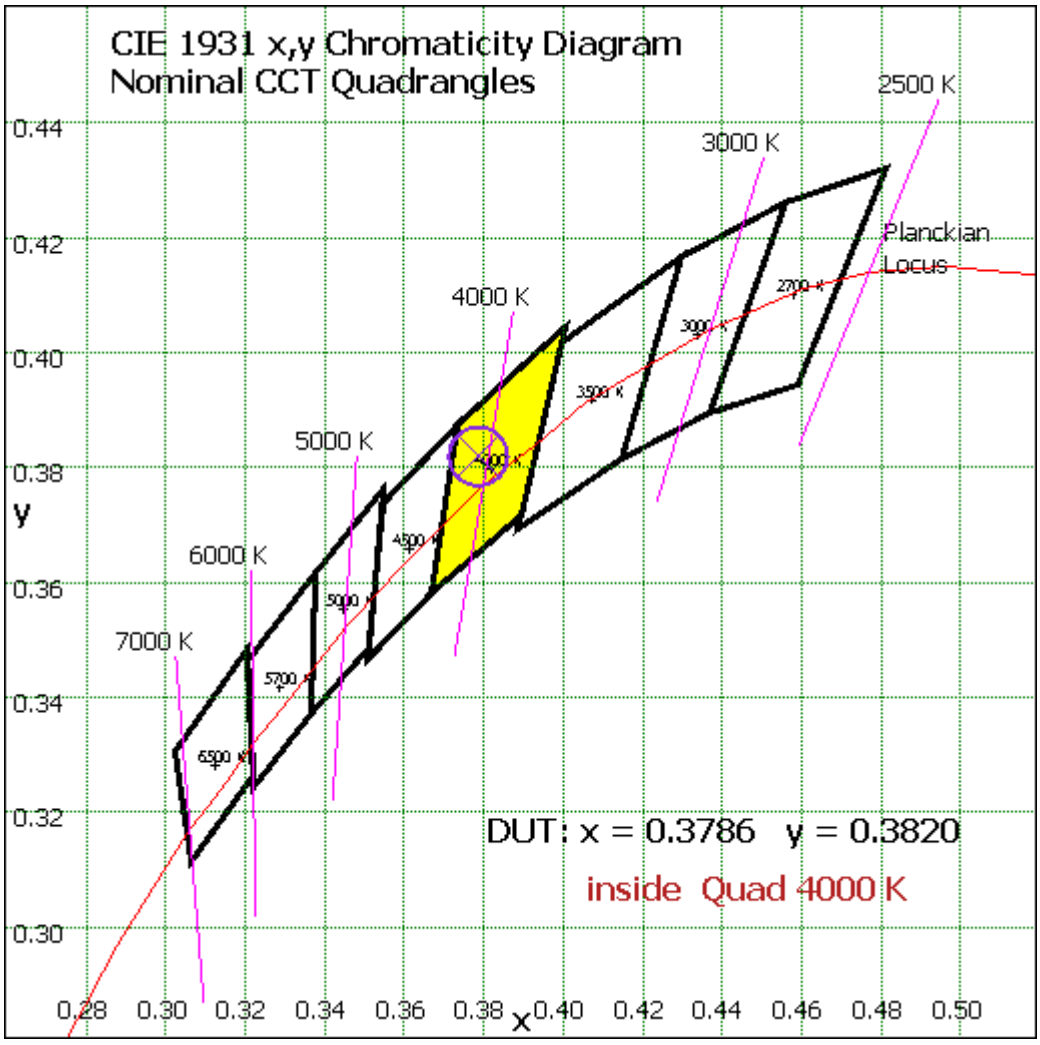
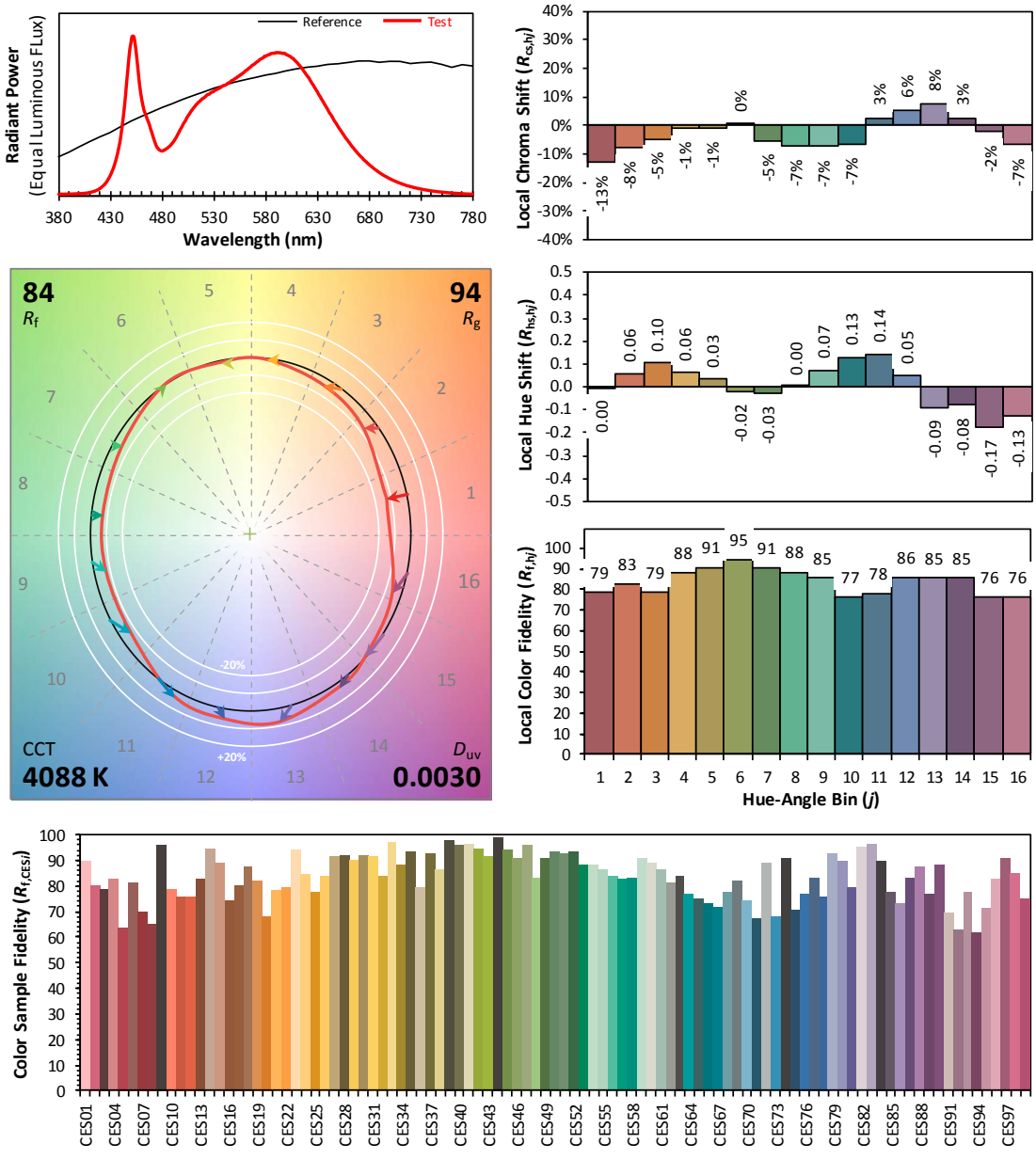


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

x	0.3786
y	0.3820
u'	0.2218
v'	0.5036

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

γ(°)	Lumens	% Total
0- 10	45.03	1.84%
10- 20	129.762	5.29%
20- 30	199.574	8.13%
30- 40	247.847	10.10%
40- 50	271.958	11.08%
50- 60	272.971	11.13%
60- 70	254.392	10.37%
70- 80	220.05	8.97%
80- 90	148.977	6.07%
90-100	116.598	4.75%
100-110	131.349	5.35%
110-120	113.999	4.65%
120-130	95.264	3.88%
130-140	77.068	3.14%
140-150	58.929	2.40%
150-160	40.625	1.66%
160-170	23.027	0.94%
170-180	6.098	0.25%
Total	2453.5	100%

γ(°)	Lumens	% Total
0- 60	1167.142	47.57%
60- 90	623.419	25.41%
0-90	1790.561	72.98%
90- 180	662.957	27.02%
0- 180	2453.5	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

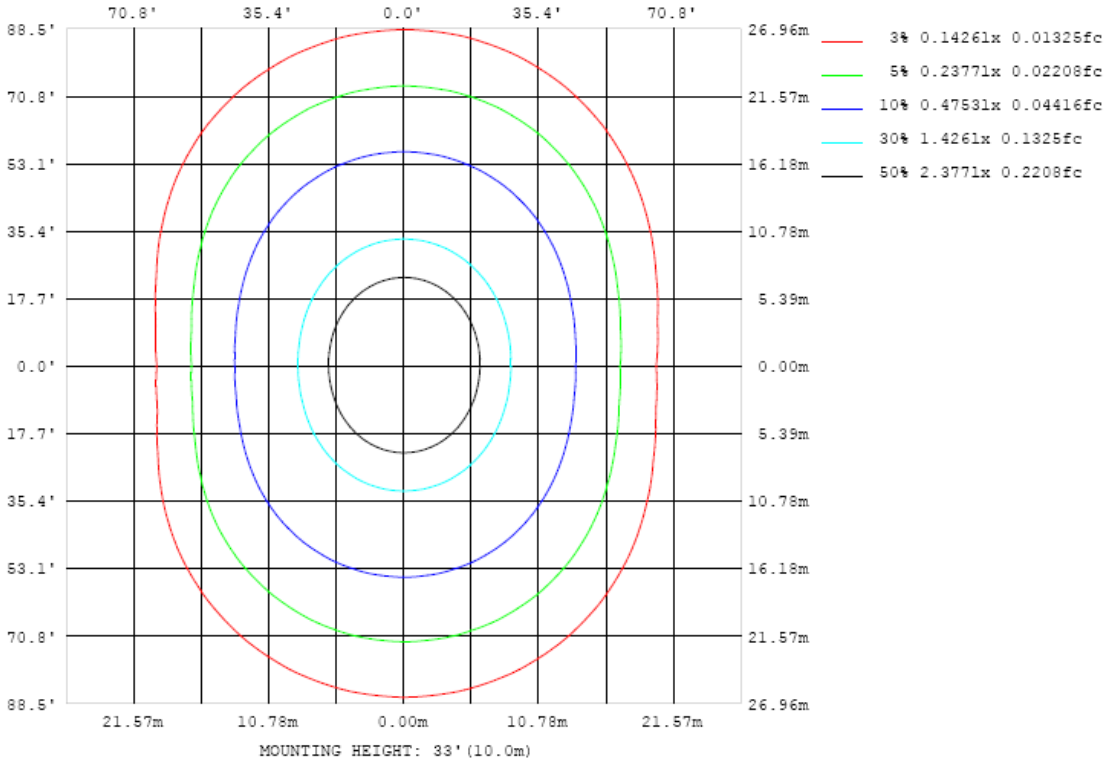


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

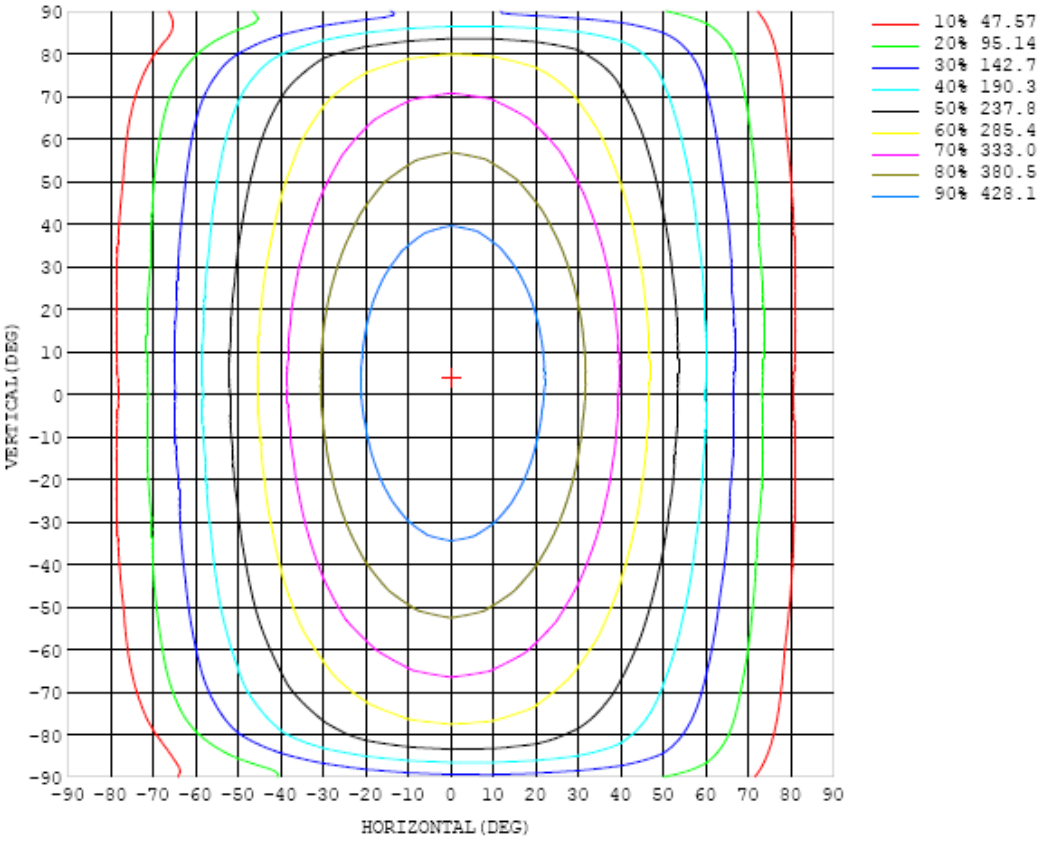


Chart 6: Isocandela Plot

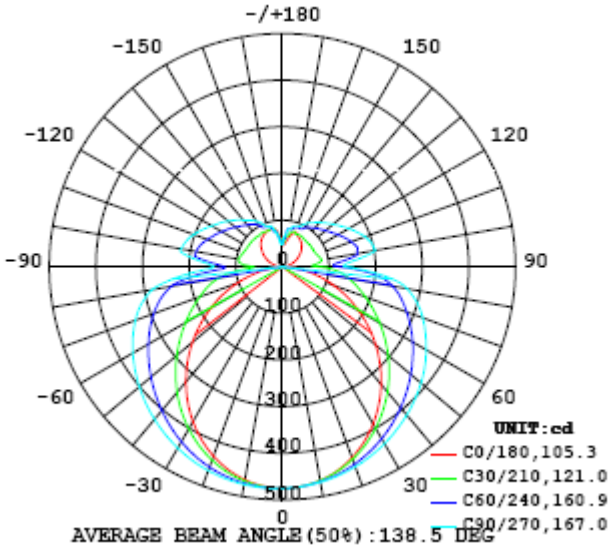


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475
5	473	473	473	473	473	473	473	473	473	473	473	473	473	472	472	472	472	472	472
10	466	465	465	466	467	467	468	469	469	469	469	468	467	466	465	464	464	464	464
15	453	453	453	455	457	459	461	462	463	464	463	462	460	457	455	452	451	450	451
20	436	435	437	440	443	447	451	454	456	457	456	453	450	445	441	437	433	432	432
25	415	414	417	421	427	434	439	444	447	448	447	443	437	431	424	417	412	410	410
30	389	389	393	400	409	418	426	432	437	438	436	431	424	415	405	395	388	384	384
35	361	361	367	376	388	400	411	420	425	427	425	418	409	397	383	371	361	355	354
40	329	331	339	351	365	381	394	406	413	415	412	404	392	377	361	345	331	323	322
45	296	299	309	324	342	360	377	391	399	402	399	389	375	357	337	317	301	290	288
50	262	265	278	296	318	340	359	375	385	388	384	374	358	337	313	290	269	255	252
55	226	230	246	268	294	319	341	359	369	373	369	358	340	316	289	262	237	219	215
60	190	196	215	241	270	298	323	341	352	356	352	339	320	296	266	234	205	183	178
65	153	161	184	214	247	278	303	323	335	339	334	321	300	274	243	208	174	148	141
70	118	128	155	190	225	257	284	304	316	320	315	302	281	253	219	183	146	114	104
75	83.0	96.0	128	166	203	236	264	284	296	299	294	280	259	231	197	158	119	83.1	68.2
80	51.2	68.7	104	145	183	215	240	258	268	272	267	253	232	203	170	133	93.0	56.2	36.4
85	23.2	45.0	83.3	121	155	181	199	211	217	217	210	197	178	153	125	92.9	59.2	28.0	10.5
90	5.59	23.0	52.1	76.5	95.5	110	121	128	134	135	131	124	112	96.2	77.5	56.9	34.3	13.1	2.26
95	5.51	20.2	47.5	73.7	93.9	112	126	139	149	155	156	153	145	132	112	82.8	51.3	23.4	8.26
100	10.3	22.8	50.7	85.2	115	140	164	183	195	203	201	191	174	150	120	89.0	54.8	28.0	14.3
105	16.5	26.6	49.2	81.9	114	142	166	182	193	198	195	185	168	146	118	87.1	55.7	32.6	21.5
110	23.5	31.1	50.3	78.2	107	134	157	174	185	189	186	176	160	138	112	84.5	57.1	37.9	29.0
115	30.8	36.7	52.2	76.0	101	126	147	163	172	177	174	165	150	130	107	82.5	59.4	43.9	36.7
120	38.1	42.5	55.0	75.3	96.2	118	138	152	161	164	162	154	140	123	103	81.8	62.4	50.1	44.3
125	45.4	48.0	57.2	75.4	93.5	112	129	142	150	153	150	143	132	117	99.5	81.6	64.7	56.1	51.7
130	52.4	54.2	60.7	75.3	91.1	107	121	132	139	142	140	135	125	112	97.0	81.6	67.6	61.8	58.6
135	58.6	59.2	63.0	74.4	89.0	102	114	124	130	133	131	127	118	108	94.8	80.1	70.4	67.4	65.2
140	64.0	63.4	67.3	75.3	86.2	98.2	109	117	122	124	123	119	112	103	91.9	79.4	73.6	72.7	71.0
145	67.9	66.0	69.5	76.7	83.2	94.0	103	110	114	115	115	112	106	98.0	85.7	81.1	77.7	76.8	76.1
150	71.6	70.2	70.9	77.1	83.5	87.9	95.9	103	107	108	107	104	98.2	90.1	86.9	82.9	79.6	79.0	79.7
155	75.4	71.5	73.9	76.5	83.9	87.9	90.1	93.2	96.1	97.1	96.3	94.1	91.9	90.4	86.8	83.2	80.5	81.2	82.5
160	79.2	71.8	75.0	78.8	81.8	86.9	90.3	92.5	93.6	93.8	93.7	93.0	91.5	88.9	85.7	81.0	79.4	82.2	84.4
165	70.3	70.0	68.7	77.5	81.8	81.3	85.0	87.4	89.3	89.8	89.6	88.9	86.0	81.9	80.3	79.0	78.9	81.6	85.9
170	58.1	65.8	64.6	68.1	76.2	82.7	83.0	83.4	83.2	82.8	81.9	81.3	80.7	79.1	75.9	76.1	78.1	79.7	79.5
175	49.5	53.3	52.1	56.3	58.0	60.4	62.4	63.2	65.5	67.5	68.8	70.0	71.0	71.4	71.2	69.4	67.0	65.1	64.4
180	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8

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	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475		
5	472	473	473	474	474	475	475	475	476	476	475	475	475	474	474	474	473		
10	465	466	467	468	470	472	473	474	474	474	473	472	471	470	469	467	466		
15	452	453	456	459	463	466	468	470	471	470	469	467	464	461	459	456	455		
20	434	437	442	447	452	457	461	464	465	465	463	459	454	449	445	441	438		
25	412	417	423	431	439	447	452	456	458	457	454	448	442	434	427	421	417		
30	386	393	402	413	423	433	441	447	449	448	443	436	427	416	407	398	393		
35	358	366	378	392	406	419	429	436	439	437	431	421	409	396	383	372	365		
40	326	337	352	369	386	403	415	424	427	425	417	405	390	374	358	344	335		
45	293	306	324	345	366	386	401	411	414	412	403	388	371	351	332	314	302		
50	258	274	296	321	346	368	386	397	401	397	387	371	350	327	304	283	269		
55	223	241	268	297	325	350	370	382	386	382	371	353	330	303	276	252	234		
60	187	209	240	273	305	332	353	366	371	367	354	335	309	279	249	220	199		
65	152	178	214	251	285	314	335	349	354	350	337	317	289	256	222	190	165		
70	117	150	189	229	264	294	316	331	336	332	319	297	269	234	197	161	132		
75	84.6	123	166	206	242	271	294	308	314	311	299	278	248	213	174	134	99.8		
80	56.5	96.9	138	177	212	242	264	278	284	282	272	253	226	192	153	110	71.1		
85	29.5	60.8	94.2	125	153	175	194	207	214	216	212	202	186	161	129	88.5	47.2		
90	13.7	38.4	64.0	88.1	109	126	138	146	148	144	135	124	111	96.4	78.4	53.9	24.6		
95	24.6	56.5	90.5	127	154	172	184	189	188	181	169	152	135	110	82.9	51.5	22.2		
100	29.3	58.7	95.7	131	162	188	207	218	221	215	202	182	158	126	91.1	55.4	25.3		
105	33.7	59.4	92.4	127	158	182	200	211	214	208	196	178	155	123	88.3	54.1	28.8		
110	38.9	60.9	89.4	120	149	171	189	199	202	197	187	169	146	115	84.3	54.8	32.7		
115	44.5	62.8	87.2	114	140	161	177	186	189	185	175	159	136	109	81.8	55.2	37.1		
120	50.3	65.6	86.1	109	132	151	165	173	176	172	163	148	128	104	79.8	57.1	41.4		
125	56.4	68.5	85.7	105	124	141	154	162	164	161	152	138	120	99.7	78.3	58.9	47.0		
130	62.1	71.2	85.6	102	118	132	144	151	153	150	142	129	113	95.0	77.7	60.6	54.0		
135	67.8	73.3	84.8	99.2	112	124	134	140	142	139	132	121	107	93.1	77.1	62.1	60.4		
140	72.6	77.1	84.4	96.0	108	117	125	129	130	128	122	113	103	89.9	74.7	66.5	65.1		
145	76.2	79.5	84.0	91.9	103	111	117	121	122	120	115	108	98.0	85.6	74.3	69.7	69.0		
150	81.2	82.6	85.1	90.4	94.5	103	110	113	113	112	108	101	90.5	82.3	76.5	71.6	71.8		
155	84.2	84.8	83.8	89.9	91.7	93.3	96.0	100	101	99.6	96.4	91.1	87.8	83.3	75.1	70.7	73.2		
160	85.2	85.3	82.9	84.4	90.0	91.8	92.1	92.0	90.5	92.3	91.9	89.6	87.6	79.7	71.8	70.9	75.2		
165	86.6	85.8	85.7	83.1	81.0	82.7	86.2	88.9	89.9	88.4	86.3	83.8	77.2	69.7	68.5	69.1	63.9		
170	78.6	76.9	75.4	75.0	76.0	75.5	74.0	74.2	72.7	68.8	64.5	63.1	62.4	62.2	58.8	46.7	49.5		
175	65.0	64.3	62.0	60.6	59.3	57.6	55.5	52.8	50.0	47.6	44.9	43.4	44.0	46.9	48.4	46.1	42.7		
180	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8	49.8		

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.

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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

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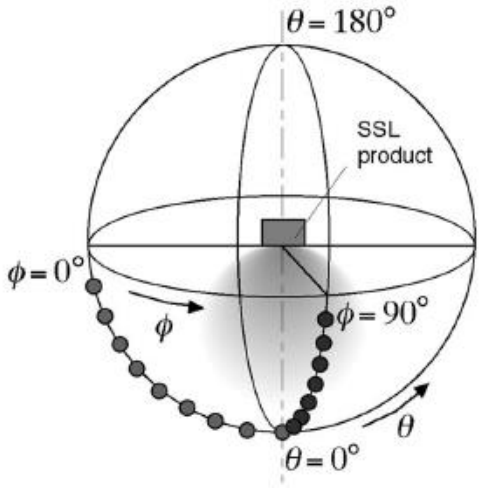
was calculated from these points. The data was then analyzed to check for delta color differences of the u', v' chromaticity coordinates. The spatial non-uniformity of chromaticity, Δu'v', is determined as the maximum deviation (distance on the CIE (u', v') diagram) among all measured points from the spatially averaged chromaticity coordinate.

The geometry for the chromaticity measurement using gonio-spectroradiometer is shown as following.



*** End of Report ***