

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 10.5T8/4F/835/DIR/RD**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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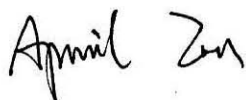
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Report No.: HZ19050020a

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

Review by:



Engineer: April Zou  
May 23, 2019

Approved by:



Manager: Jim Zhang  
May 23, 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: 10.5T8/4F/835/DIR/RD

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
134.1	1859.0	13.86	0.9922
CCT (K)	CRI	Stabilization Time (Light & Power)	
3485	82.0	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

### Test specifications:

<b>Date of Receipt</b>	: May 16, 2019
<b>Date of Test</b>	: May 21, 2019
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: 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

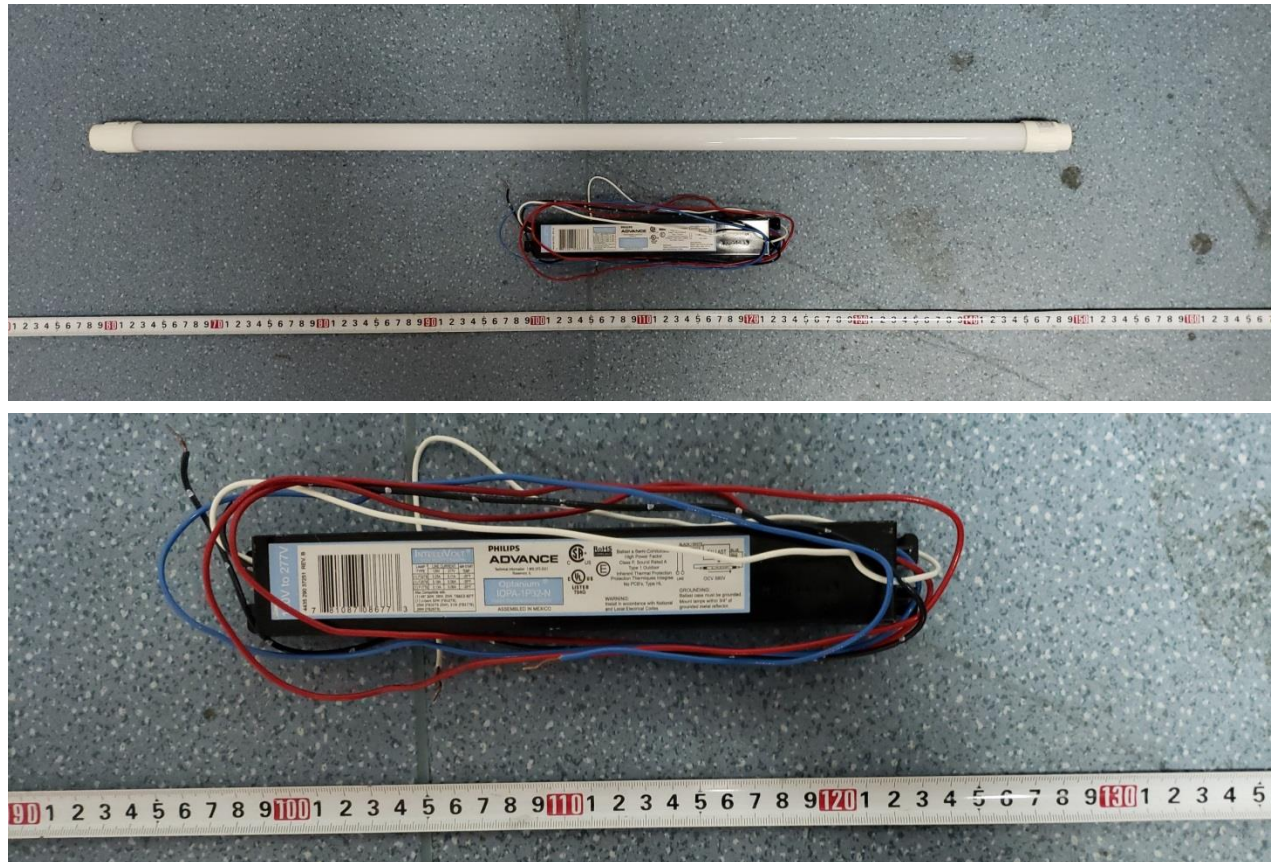


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 10.5T8/4F/835/DIR/RD
<b>Electrical Ratings</b>	: 120-277V, 60Hz, 10.5W
<b>Product Description</b>	: 3500K LED Tubes supplied by a high frequency fluorescent lamp ballast: IOPA-1P32-N
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

## TEST RESULTS

Test ambient temperature was 25.0°C.

Base orientation was light down. 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)	0.116	0.054
Power Factor	0.9922	0.9314
Test Power (W)	13.86	14.00
THD A%	9.05	14.96
Luminous Efficacy (lm/W)	134.1	132.8
Total Luminous Flux (lm)	1859.0	1859.0
Color Rendering Index (CRI)	82.0	
R9	2.3	
Correlated Color Temperature (CCT)(K)	3485	
Chromaticity Chroma x	0.4065	
Chromaticity Chroma y	0.3923	
Chromaticity Chroma u	0.2358	
Chromaticity Chroma v	0.3414	
Duv	0.0002	
Chromaticity Chroma u'	0.2358	
Chromaticity Chroma v'	0.5121	

Special Color Rendering Indices	
R1	80
R2	89.4
R3	96.1
R4	80.4
R5	80.3
R6	86.1
R7	83.8
R8	59.8
R9	2.3
R10	75.5
R11	79.5
R12	65.4
R13	82.3
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 25.2°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)	0.117
Power Factor	0.9927
Power (W)	13.89
Luminous Efficacy (lm/W)	131.6
Total Luminous Flux (lm)	1828.4
Beam Angle ( ° )	116.9 (0°-180°) / 241.2 (90°-270°)
Center Beam Candle Power (cd)	278
Maximum Beam Candle Power (cd)	278.1 (At: C=90.0, Gamma=1.0)
Spacing Criteria	1.28 (0°-180°) / 1.47 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	40.63%
Zonal Lumens in the 60 °-90 °Zone	26.96%
Zonal Lumens in the 90 °-120 °Zone	18.49%
Zonal Lumens in the 120 °-180 °Zone	13.92%

Table 3: Test data per Goniophotometer Method



## Spectral Power Distribution - Sphere Spectroradiometer Method

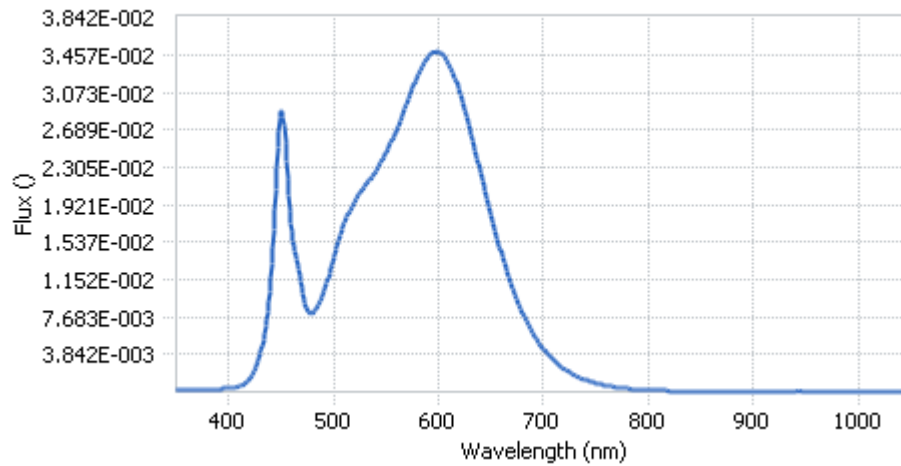
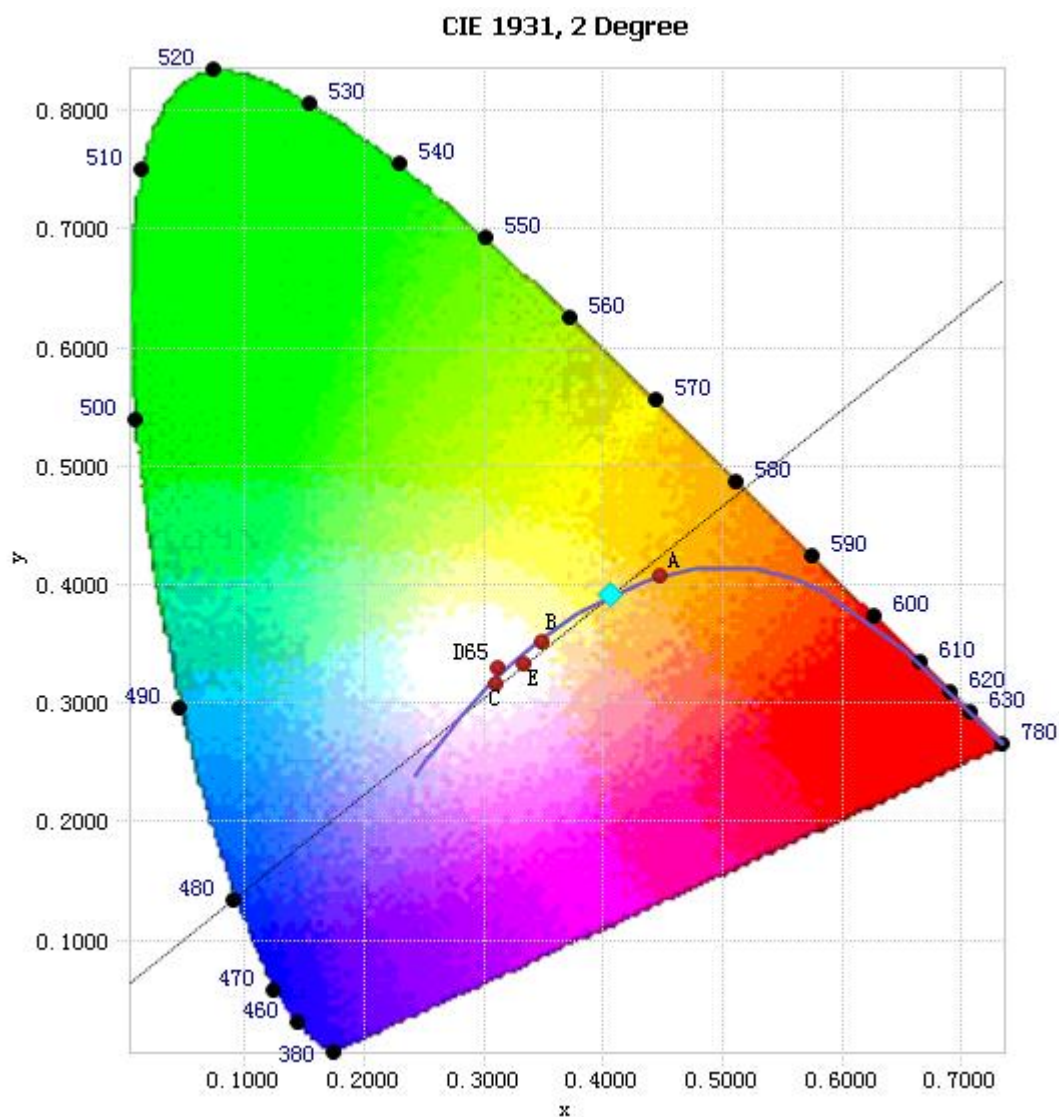


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.73E-04	485	8.82E-03	590	3.44E-02	695	5.14E-03
385	2.95E-04	490	1.00E-02	595	3.48E-02	700	4.40E-03
390	3.00E-04	495	1.18E-02	600	3.48E-02	705	3.76E-03
395	3.40E-04	500	1.38E-02	605	3.45E-02	710	3.21E-03
400	3.67E-04	505	1.57E-02	610	3.36E-02	715	2.74E-03
405	4.40E-04	510	1.72E-02	615	3.24E-02	720	2.33E-03
410	5.89E-04	515	1.86E-02	620	3.07E-02	725	1.99E-03
415	8.66E-04	520	1.95E-02	625	2.88E-02	730	1.70E-03
420	1.37E-03	525	2.04E-02	630	2.69E-02	735	1.45E-03
425	2.28E-03	530	2.11E-02	635	2.46E-02	740	1.23E-03
430	3.94E-03	535	2.18E-02	640	2.24E-02	745	1.05E-03
435	6.72E-03	540	2.27E-02	645	2.02E-02	750	9.01E-04
440	1.17E-02	545	2.36E-02	650	1.80E-02	755	7.72E-04
445	2.08E-02	550	2.45E-02	655	1.61E-02	760	6.64E-04
450	2.89E-02	555	2.57E-02	660	1.41E-02	765	5.68E-04
455	2.37E-02	560	2.69E-02	665	1.24E-02	770	4.91E-04
460	1.64E-02	565	2.83E-02	670	1.08E-02	775	4.19E-04
465	1.36E-02	570	2.96E-02	675	9.37E-03	780	3.63E-04
470	1.06E-02	575	3.11E-02	680	8.10E-03		
475	8.34E-03	580	3.24E-02	685	6.99E-03		
480	8.11E-03	585	3.36E-02	690	6.00E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4065, 0.3923)

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

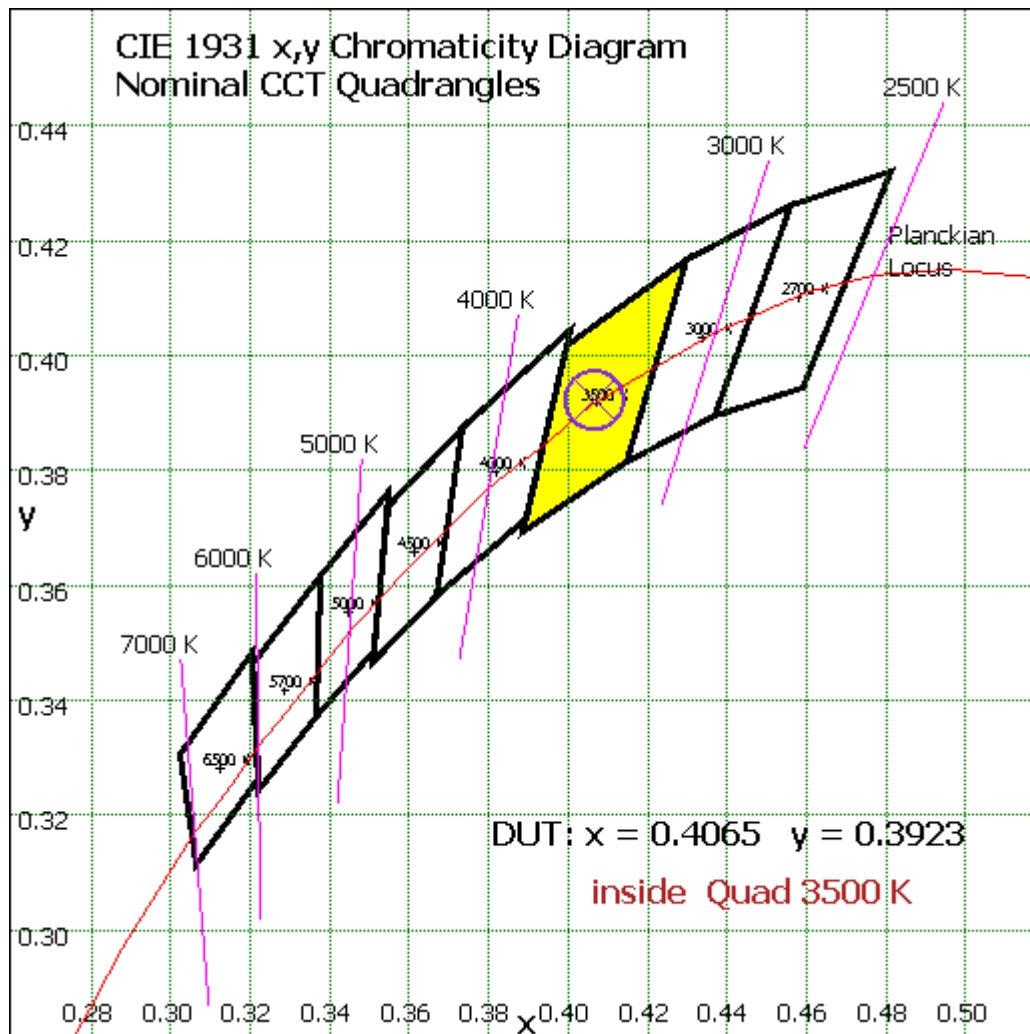
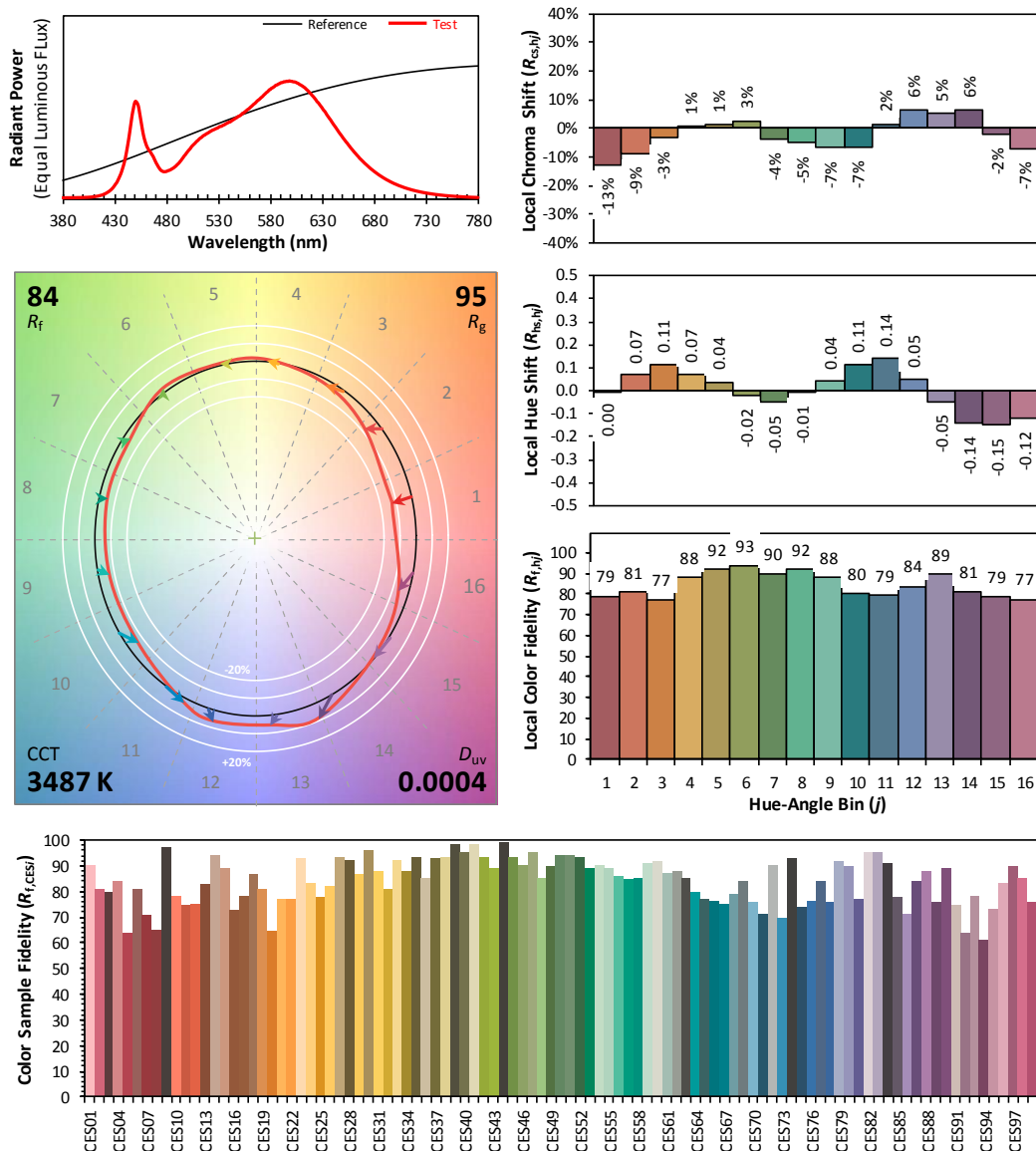


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4065

$y$  0.3923

$u'$  0.2358

$v'$  0.5121

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	26.421	1.45%
10- 20	77.054	4.21%
20- 30	121.284	6.63%
30- 40	155.514	8.51%
40- 50	177.209	9.69%
50- 60	185.329	10.14%
60- 70	180.519	9.87%
70- 80	165.788	9.07%
80- 90	146.712	8.02%
90-100	129.289	7.07%
100-110	112.648	6.16%
110-120	96.14	5.26%
120-130	80.295	4.39%
130-140	65.243	3.57%
140-150	50.173	2.74%
150-160	34.629	1.89%
160-170	18.613	1.02%
170-180	5.554	0.30%
Total	1828.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	742.811	40.63%
60- 90	493.019	26.96%
0-90	1235.83	67.59%
90- 180	592.584	32.41%
0- 180	1828.4	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

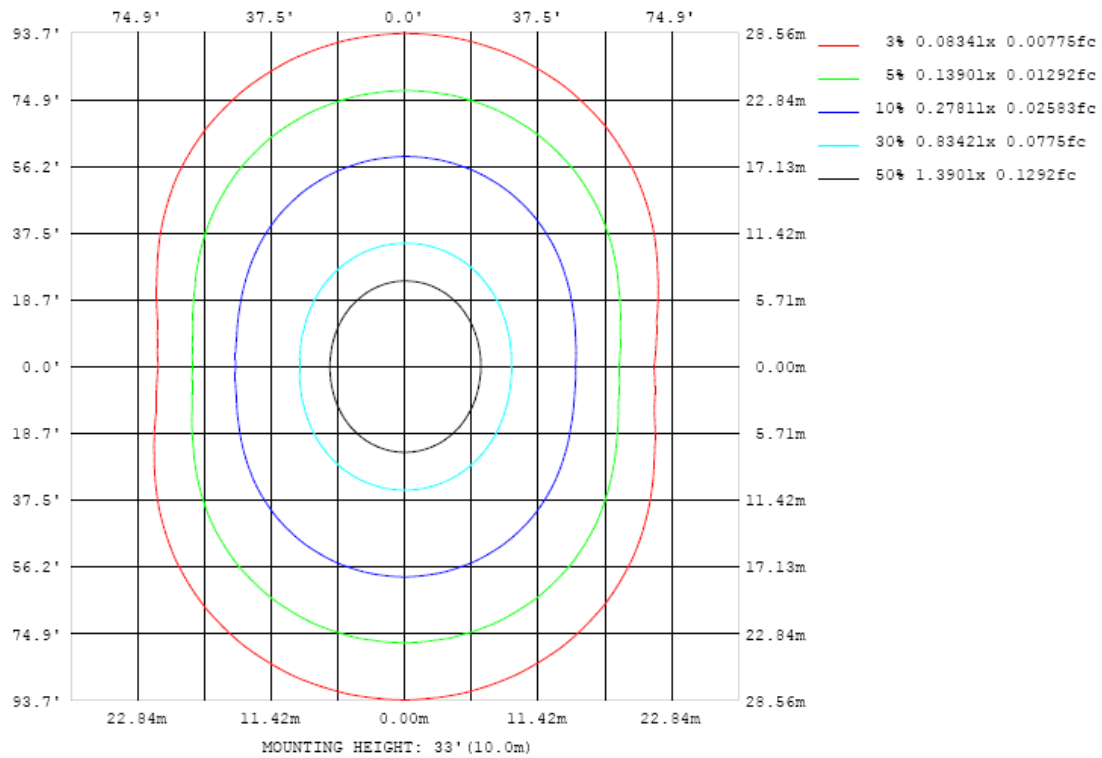


Chart 5: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots- Goniophotometer Method

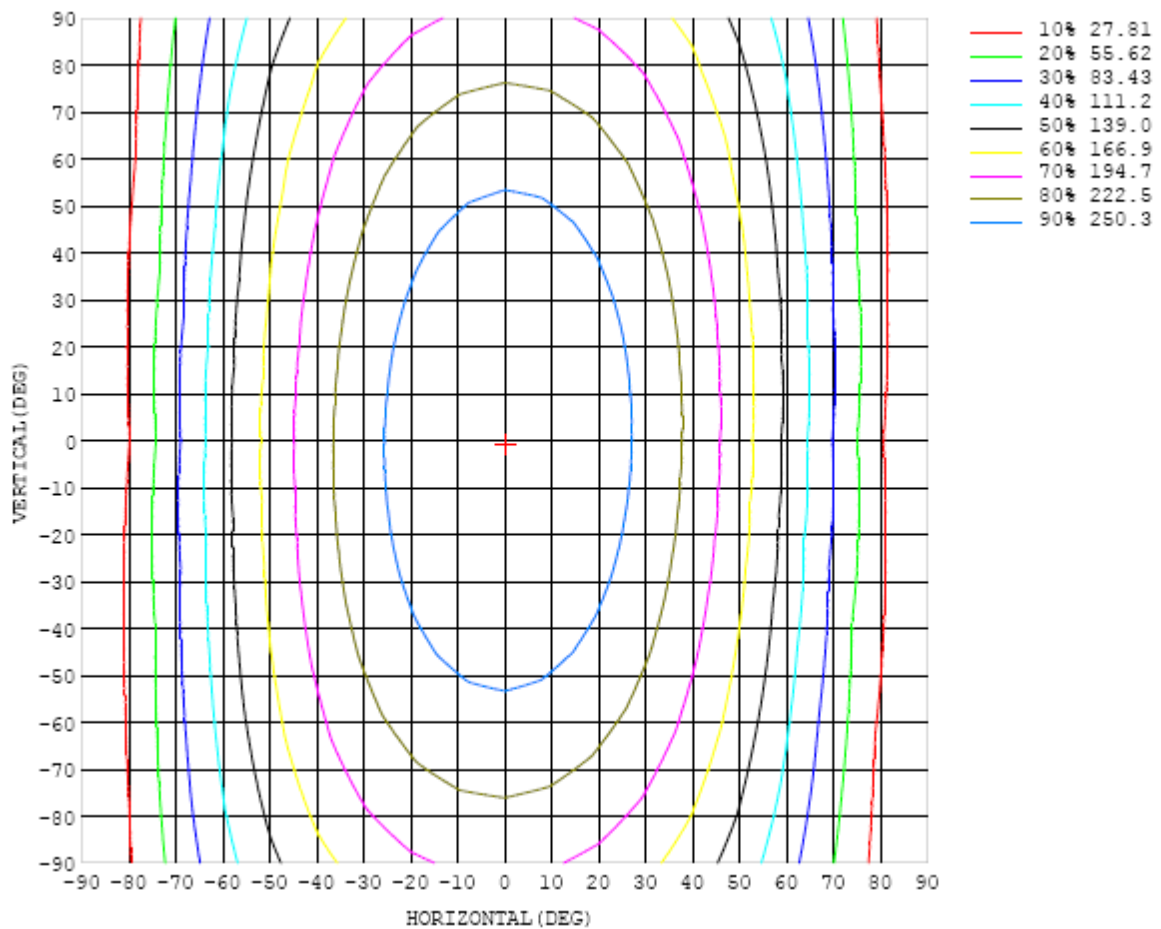


Chart 6: Isocandela Plot

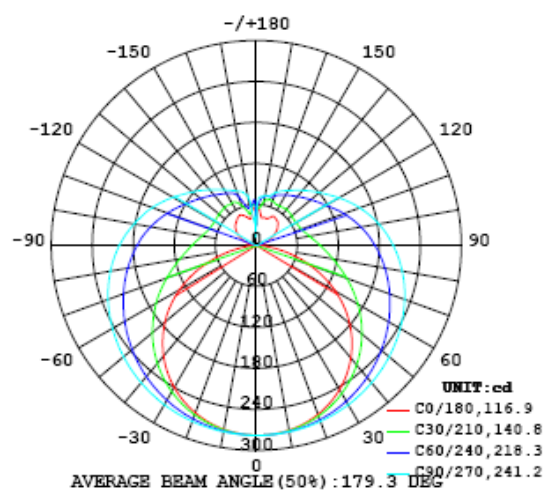


Chart 7: Polar Candela Distribution

## 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	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278
5	277	277	278	278	278	278	278	278	278	278	278	278	277	277	277	277	277	277	277
10	275	275	275	275	276	276	277	277	277	277	277	277	276	276	275	274	274	274	273
15	270	270	271	271	272	274	275	275	276	276	276	275	274	273	271	270	269	268	268
20	263	264	265	266	268	270	272	273	274	274	274	272	271	269	267	264	263	261	261
25	254	255	256	259	262	265	268	270	271	272	271	270	267	264	260	257	254	252	252
30	243	244	246	250	255	259	263	266	268	269	268	266	263	258	253	248	244	241	240
35	230	231	235	240	246	253	258	262	265	266	265	262	258	252	245	238	232	228	227
40	215	216	221	228	237	245	252	258	261	262	261	258	252	245	236	227	219	213	211
45	198	200	206	216	226	237	246	252	257	258	257	253	246	237	226	215	204	197	194
50	178	181	189	202	215	228	239	247	252	254	252	247	239	229	215	201	188	178	174
55	157	160	171	187	203	219	231	241	246	249	247	242	232	220	205	187	170	158	153
60	133	138	152	171	191	209	224	234	241	243	241	235	225	211	193	173	152	136	130
65	108	114	133	156	179	200	216	227	235	237	235	229	218	202	182	159	134	113	105
70	82.1	90.1	113	141	168	190	208	220	228	231	229	222	210	193	171	145	116	90.1	78.3
75	56.0	66.8	94.5	127	156	181	200	213	221	224	222	215	203	185	161	132	99.0	68.2	51.8
80	30.9	45.0	78.1	114	146	171	191	205	213	217	215	207	195	176	151	120	84.3	48.5	27.3
85	10.4	27.8	65.4	103	136	162	182	197	205	209	207	199	186	167	142	110	73.1	33.8	7.94
90	0.75	18.3	56.1	93.5	127	153	174	188	197	200	198	191	178	159	133	101	64.7	25.9	0.49
95	2.10	15.1	49.8	85.8	118	145	165	179	188	192	190	182	169	150	125	94.0	58.6	22.7	2.38
100	6.20	16.6	45.5	78.8	110	136	155	170	178	182	180	173	160	141	117	87.3	54.4	23.7	6.50
105	11.6	20.3	44.2	73.9	102	127	146	160	168	172	170	163	150	133	109	81.6	52.6	26.9	12.3
110	17.6	24.9	44.9	70.2	95.4	118	136	150	158	161	159	153	141	124	102	77.9	52.9	31.7	18.6
115	23.6	29.7	46.5	68.2	89.8	110	127	139	147	150	149	142	131	116	96.3	75.6	54.4	37.1	25.1
120	29.7	35.8	49.4	67.2	85.8	103	118	129	137	140	138	132	122	109	92.1	74.3	56.6	40.4	30.9
125	35.4	41.3	52.2	66.8	82.8	97.9	111	120	127	129	128	123	115	103	88.7	73.6	59.2	44.6	35.4
130	40.5	46.0	55.0	67.7	81.1	93.4	104	113	118	121	119	115	108	97.9	85.9	73.5	61.6	52.1	40.1
135	45.0	49.1	56.3	68.4	79.0	89.4	98.7	106	111	113	112	108	102	93.6	83.6	73.7	62.7	54.8	43.3
140	47.3	50.9	59.3	69.0	78.0	86.0	93.5	99.7	104	105	105	102	96.5	89.6	81.7	74.1	62.4	54.6	45.7
145	48.9	53.2	61.5	68.1	76.8	83.3	89.2	93.9	97.1	98.6	98.0	95.7	91.7	86.4	80.1	72.8	64.9	58.6	48.4
150	49.4	54.8	63.1	67.0	75.1	80.6	85.5	89.2	91.8	92.9	92.5	90.7	87.6	83.4	79.0	69.9	65.0	61.2	50.3
155	44.4	55.7	67.0	67.2	71.4	77.8	81.7	84.7	86.8	87.7	87.4	86.0	83.7	80.4	73.7	68.8	64.0	56.8	49.1
160	42.0	55.9	66.5	68.9	70.0	72.7	76.8	79.6	81.8	82.7	82.4	81.1	78.0	73.4	70.4	68.0	61.5	52.2	45.2
165	42.4	44.9	65.4	69.7	71.0	72.8	74.6	74.7	73.7	74.4	74.2	73.2	73.1	72.3	66.9	58.3	51.4	45.3	40.6
170	42.5	43.8	55.0	65.9	68.4	69.9	72.9	74.3	74.6	74.6	74.5	74.9	70.8	60.9	52.4	49.6	49.1	46.9	43.4
175	52.4	52.5	52.8	55.4	60.2	63.8	66.6	70.1	71.8	71.8	72.4	65.9	52.8	45.2	45.3	49.8	51.3	52.3	54.0
180	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8

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	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278		
5	277	277	277	277	277	277	277	278	278	278	278	278	278	278	277	277	277		
10	273	274	274	275	275	276	276	277	277	277	277	277	276	276	275	275	275		
15	268	269	270	271	272	273	275	275	276	276	275	275	274	273	272	271	270		
20	261	262	264	266	268	270	272	273	274	274	273	272	270	268	266	265	264		
25	252	254	256	260	263	266	269	271	272	272	270	268	266	263	260	257	255		
30	241	243	247	252	257	262	266	268	269	269	267	264	260	256	251	247	245		
35	228	231	237	244	250	256	261	265	266	265	263	259	254	248	241	236	232		
40	213	218	225	234	243	250	257	261	262	262	259	254	247	239	230	223	217		
45	196	202	212	224	235	244	251	256	258	257	254	247	239	229	218	208	201		
50	177	186	199	213	226	237	246	251	254	252	248	241	230	218	205	192	183		
55	157	169	184	201	217	230	240	246	248	247	242	234	221	207	190	175	163		
60	135	150	170	189	207	222	233	240	243	242	236	226	212	195	176	157	141		
65	111	130	154	177	198	215	227	234	237	235	229	218	203	184	162	138	118		
70	86.8	111	140	167	189	207	220	228	231	229	222	211	194	173	147	119	94.6		
75	63.2	92.6	126	156	180	199	213	221	224	222	215	203	185	162	133	101	71.5		
80	42.1	76.9	113	146	171	191	205	214	217	215	207	194	176	152	121	85.5	50.6		
85	26.4	64.7	103	136	163	183	197	206	209	207	199	186	168	142	110	72.7	34.2		
90	18.5	56.2	94.3	128	155	174	189	197	201	198	191	177	159	133	101	63.3	24.7		
95	16.4	50.5	86.9	119	146	166	180	188	191	189	182	169	150	124	92.7	56.6	20.9		
100	18.4	47.4	80.8	112	137	157	171	179	182	179	172	160	141	116	85.7	52.1	21.1		
105	22.4	46.7	76.1	105	129	148	161	170	172	170	163	150	132	108	80.0	49.8	23.9		
110	28.0	47.9	72.9	98.2	121	139	152	159	162	160	153	140	123	101	75.6	49.6	28.4		
115	33.8	50.3	71.3	93.0	113	129	142	149	152	149	143	131	115	95.0	72.7	50.7	33.7		
120	39.5	53.3	70.7	89.3	106	121	132	139	141	139	133	122	108	90.3	71.1	52.8	39.2		
125	44.5	56.6	70.7	86.3	101	114	123	129	131	129	123	114	102	86.7	70.5	55.8	44.5		
130	49.0	60.0	71.3	84.1	96.4	107	115	120	122	120	115	107	96.7	83.9	70.5	59.0	49.4		
135	52.5	61.7	71.6	82.4	92.5	101	108	112	114	112	108	101	92.4	81.9	71.2	62.2	53.7		
140	55.4	65.4	72.7	81.1	89.1	96.3	102	105	107	105	102	96.2	88.9	80.5	72.1	65.2	57.3		
145	57.3	68.3	72.4	79.3	86.3	91.9	96.4	99.1	100.0	99.0	96.2	91.7	85.9	79.5	73.1	68.1	60.3		
150	57.8	71.0	71.8	77.5	83.7	88.0	91.4	93.5	94.1	93.4	91.4	88.0	83.7	78.9	74.2	70.8	62.1		
155	54.2	66.3	69.8	72.1	79.0	84.6	87.2	88.7	89.1	88.7	87.3	84.9	81.9	78.5	75.7	69.9	58.2		
160	48.8	56.7	61.9	64.7	68.4	76.5	83.3	84.8	84.9	84.7	84.0	82.5	80.6	78.5	77.2	65.4	51.7		
165	45.5	47.8	52.5	54.6	57.7	59.7	67.2	78.2	81.5	81.5	81.2	80.3	78.3	76.7	74.5	53.4	45.7		
170	45.1	48.7	49.0	53.6	55.0	58.4	53.7	55.0	74.6	76.8	76.7	74.5	72.7	65.4	53.2	47.3	46.0		
175	53.6	56.3	59.9	61.3	62.1	62.3	62.8	59.7	34.7	49.6	59.5	62.8	59.6	59.3	60.1	58.1	55.0		
180	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8	41.8		

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  $4\pi$ . 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**

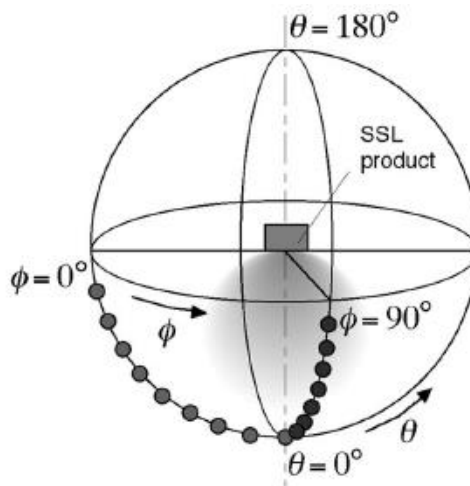
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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  $10^\circ$  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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