

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

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

### LED Tube

**Model: 9.5PLV/830/DIR/RC**

### 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](http://www.ledtestlab.com)

Report No.: HZ190600031

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

Review by:



Engineer: April Zou  
Jun. 10, 2019

Approved by:



Manager: Jim Zhang  
Jun. 10, 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: **9.5PLV/830/DIR/RC**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
100.1	1127.0	11.26	0.9949
CCT (K)	CRI	Stabilization Time (Light & Power)	
3029	82.6	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>	: Jun. 04, 2019
<b>Date of Test</b>	: Jun. 06, 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

## 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

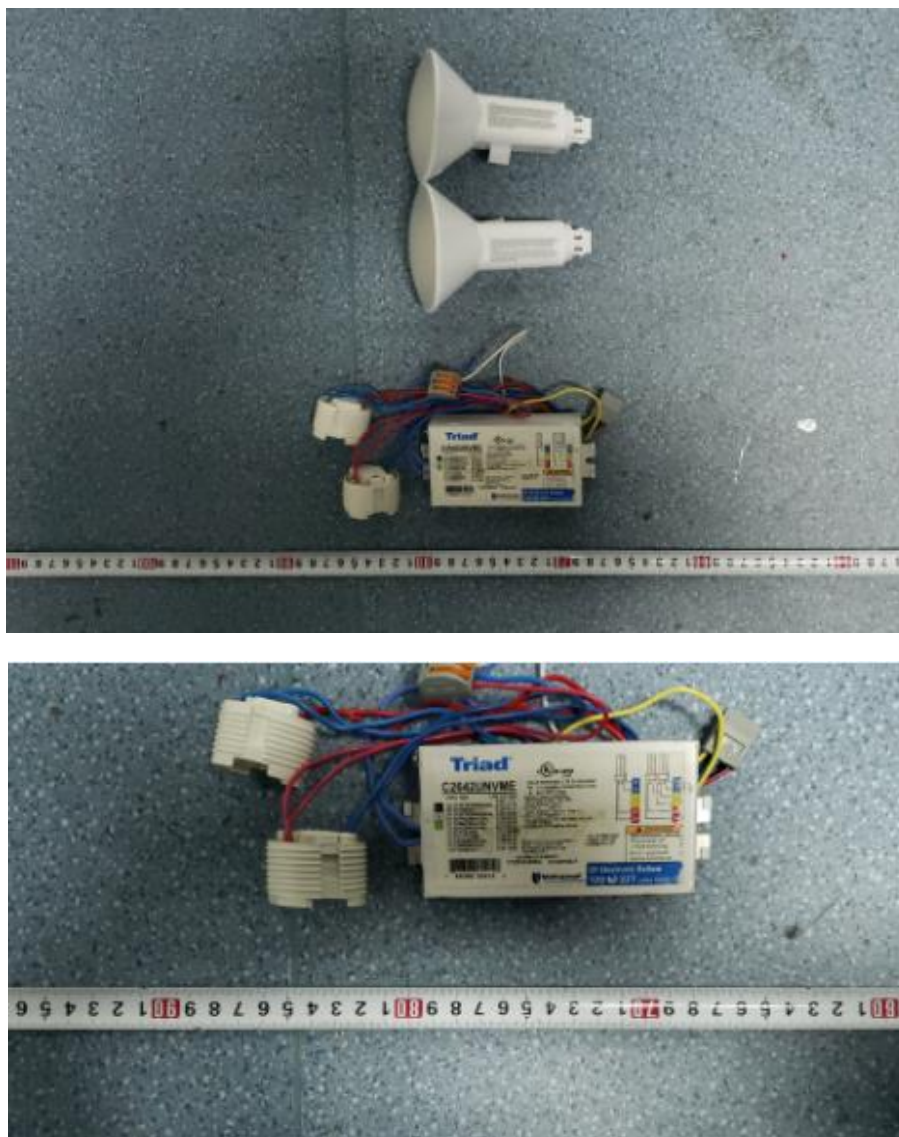


Figure 1- Overview of the sample

### Equipment Under Test(EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 9.5PLV/830/DIR/RC
<b>Electrical Ratings</b>	: 120-277V, 60Hz, 9.5W
<b>Product Description</b>	: 3000K LED Tubes supplied by a high frequency fluorescent lamp ballast: C2642UNVME
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

## TEST RESULTS

Test ambient temperature was 26.0 °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)	0.189	0.084
Power Factor	0.9949	0.9761
Test Power (W)/2	11.26	11.34
THD A%	8.56	8.69
Luminous Efficacy (lm/W)	100.1	99.4
Total Luminous Flux (lm)	1127.0	1127.0
Color Rendering Index (CRI)	82.6	
R9	7.1	
Correlated Color Temperature (CCT)(K)	3029	
Chromaticity Chroma x	0.4351	
Chromaticity Chroma y	0.4039	
Chromaticity Chroma u	0.2494	
Chromaticity Chroma v	0.3474	
Duv	0.0001	
Chromaticity Chroma u'	0.2494	
Chromaticity Chroma v'	0.5210	

Special Color Rendering Indices	
R1	81.1
R2	91.7
R3	95.6
R4	79.8
R5	81.3
R6	90.1
R7	82.3
R8	58.7
R9	7.1
R10	81.1
R11	79
R12	72.3
R13	83.7
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 25.0 °C.

The photometric distance is 2.47 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)	0.188
Power Factor	0.9951
Power (W)/2	11.25
Luminous Efficacy (lm/W)	101.8
Total Luminous Flux (lm)	1144.8
Beam Angle ( ° )	90.5 (0°-180°) / 90.5 (90°-270°)
Center Beam Candle Power (cd)	514
Maximum Beam Candle Power (cd)	514.7 (At: C=60.0, Gamma=1.0)
Spacing Criteria	1.13 (0°-180°) / 1.13 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	83.05%
Zonal Lumens in the 60 °-90 °Zone	15.92%
Zonal Lumens in the 90 °-120 °Zone	0.93%
Zonal Lumens in the 120 °-180 °Zone	0.09%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

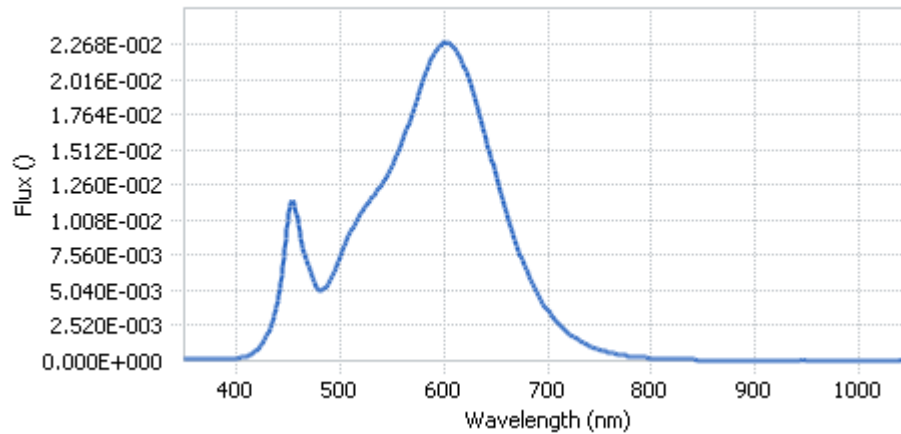


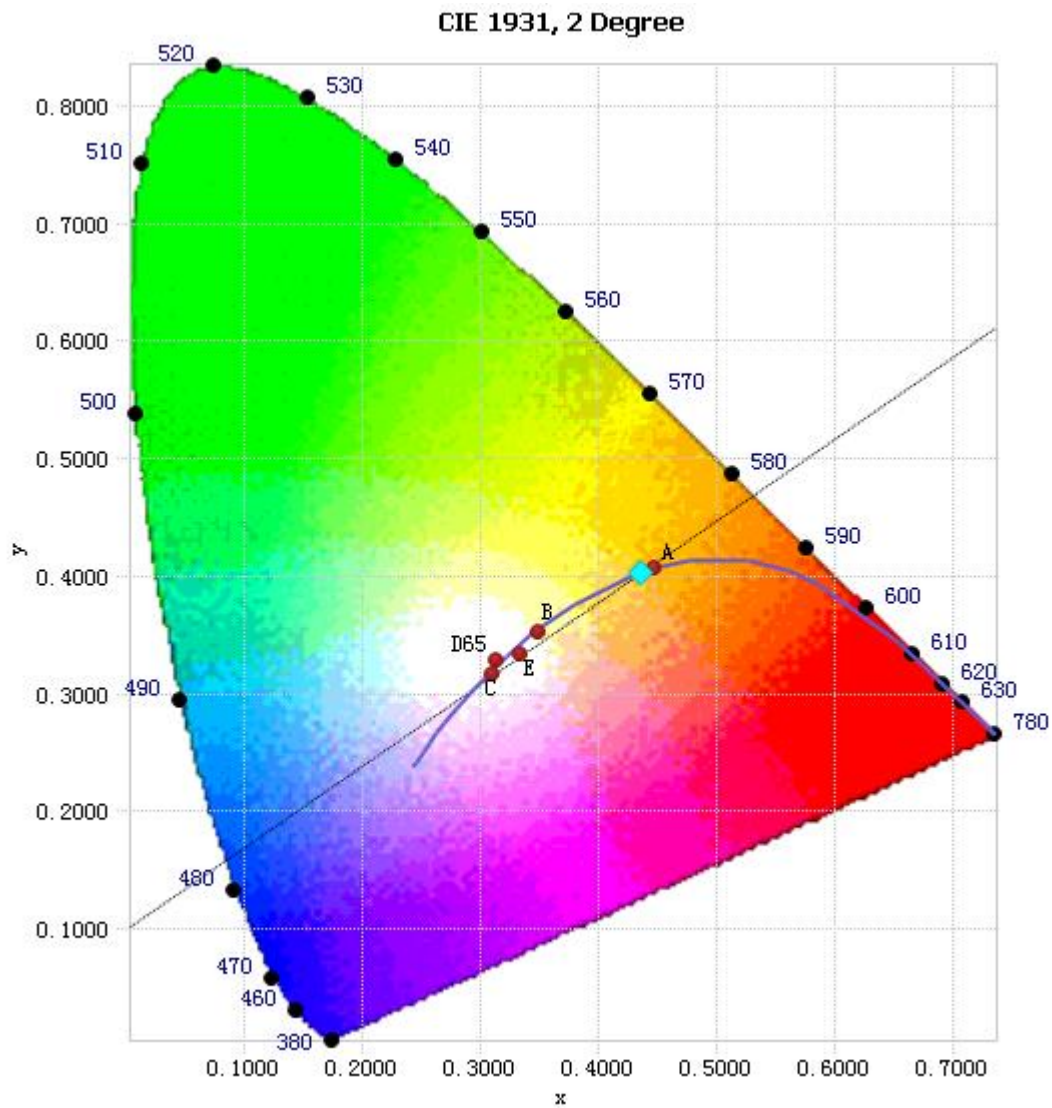
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.43E-04	485	5.22E-03	590	2.19E-02	695	4.19E-03
385	1.34E-04	490	5.71E-03	595	2.25E-02	700	3.61E-03
390	1.49E-04	495	6.46E-03	600	2.28E-02	705	3.11E-03
395	1.56E-04	500	7.41E-03	605	2.28E-02	710	2.66E-03
400	1.82E-04	505	8.38E-03	610	2.25E-02	715	2.30E-03
405	2.32E-04	510	9.21E-03	615	2.19E-02	720	1.99E-03
410	3.17E-04	515	9.98E-03	620	2.11E-02	725	1.71E-03
415	4.76E-04	520	1.06E-02	625	2.00E-02	730	1.46E-03
420	7.69E-04	525	1.11E-02	630	1.88E-02	735	1.25E-03
425	1.20E-03	530	1.16E-02	635	1.76E-02	740	1.07E-03
430	1.88E-03	535	1.21E-02	640	1.62E-02	745	9.15E-04
435	2.87E-03	540	1.27E-02	645	1.48E-02	750	7.82E-04
440	4.37E-03	545	1.33E-02	650	1.34E-02	755	6.75E-04
445	6.75E-03	550	1.40E-02	655	1.20E-02	760	5.81E-04
450	1.01E-02	555	1.48E-02	660	1.08E-02	765	5.00E-04
455	1.15E-02	560	1.57E-02	665	9.52E-03	770	4.28E-04
460	9.72E-03	565	1.68E-02	670	8.40E-03	775	3.68E-04
465	7.80E-03	570	1.79E-02	675	7.34E-03	780	3.21E-04
470	6.75E-03	575	1.90E-02	680	6.43E-03		
475	5.70E-03	580	2.01E-02	685	5.61E-03		
480	5.09E-03	585	2.12E-02	690	4.85E-03		

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



# Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4351, 0.4039)

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

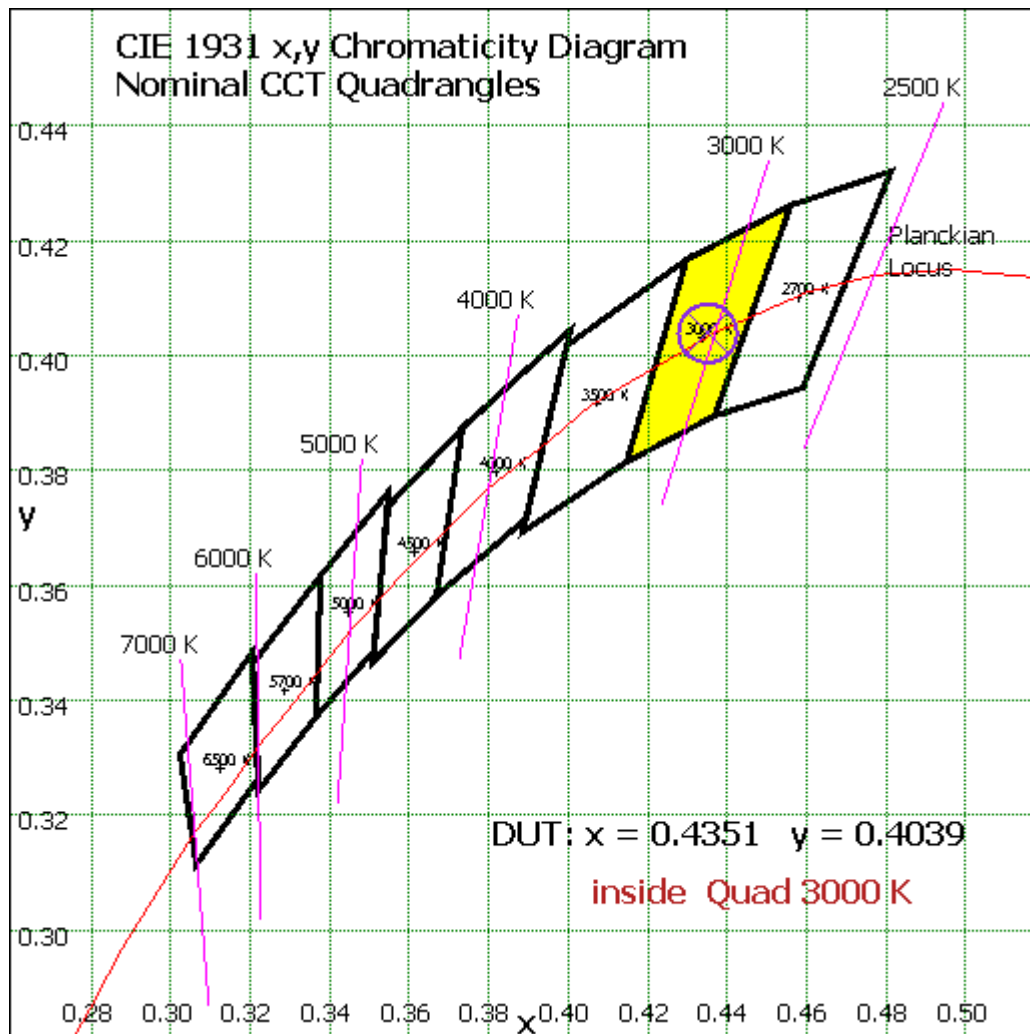
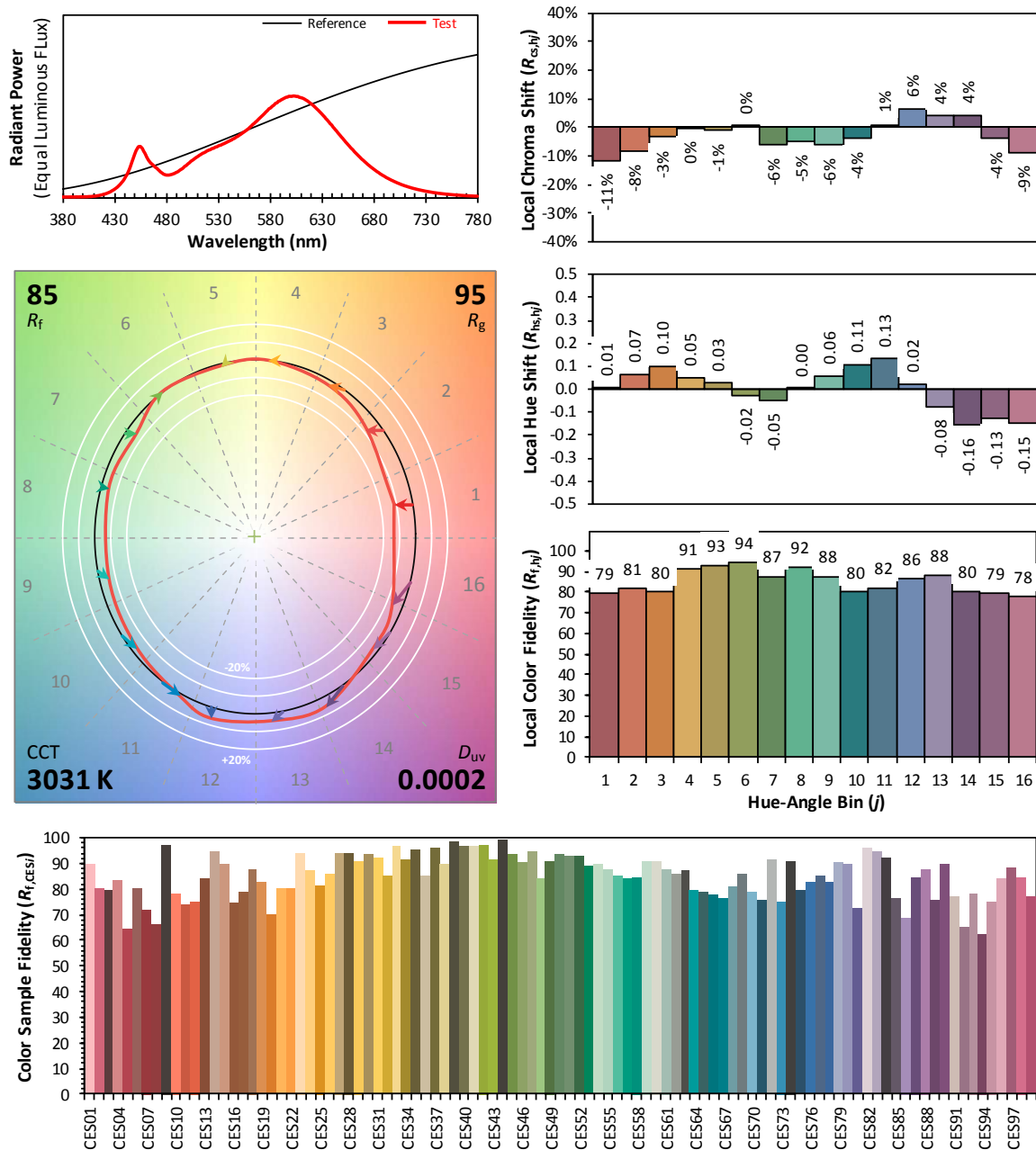


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

## Color Rendition Report – Sphere Spectroradiometer Method



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

$x$  0.4351  
 $y$  0.4039  
 $u'$  0.2494  
 $v'$  0.5210

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	48.405	4.23%
10- 20	135.433	11.83%
20- 30	194.876	17.02%
30- 40	216.709	18.93%
40- 50	200.375	17.50%
50- 60	155.02	13.54%
60- 70	100.28	8.76%
70- 80	55.641	4.86%
80- 90	26.385	2.30%
90-100	8.944	0.78%
100-110	1.545	0.13%
110-120	0.182	0.02%
120-130	0.157	0.01%
130-140	0.218	0.02%
140-150	0.249	0.02%
150-160	0.221	0.02%
160-170	0.149	0.01%
170-180	0.052	0.00%
Total	1144.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	950.818	83.05%
60- 90	182.306	15.92%
0-90	1133.124	98.98%
90- 180	11.717	1.02%
0- 180	1144.8	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

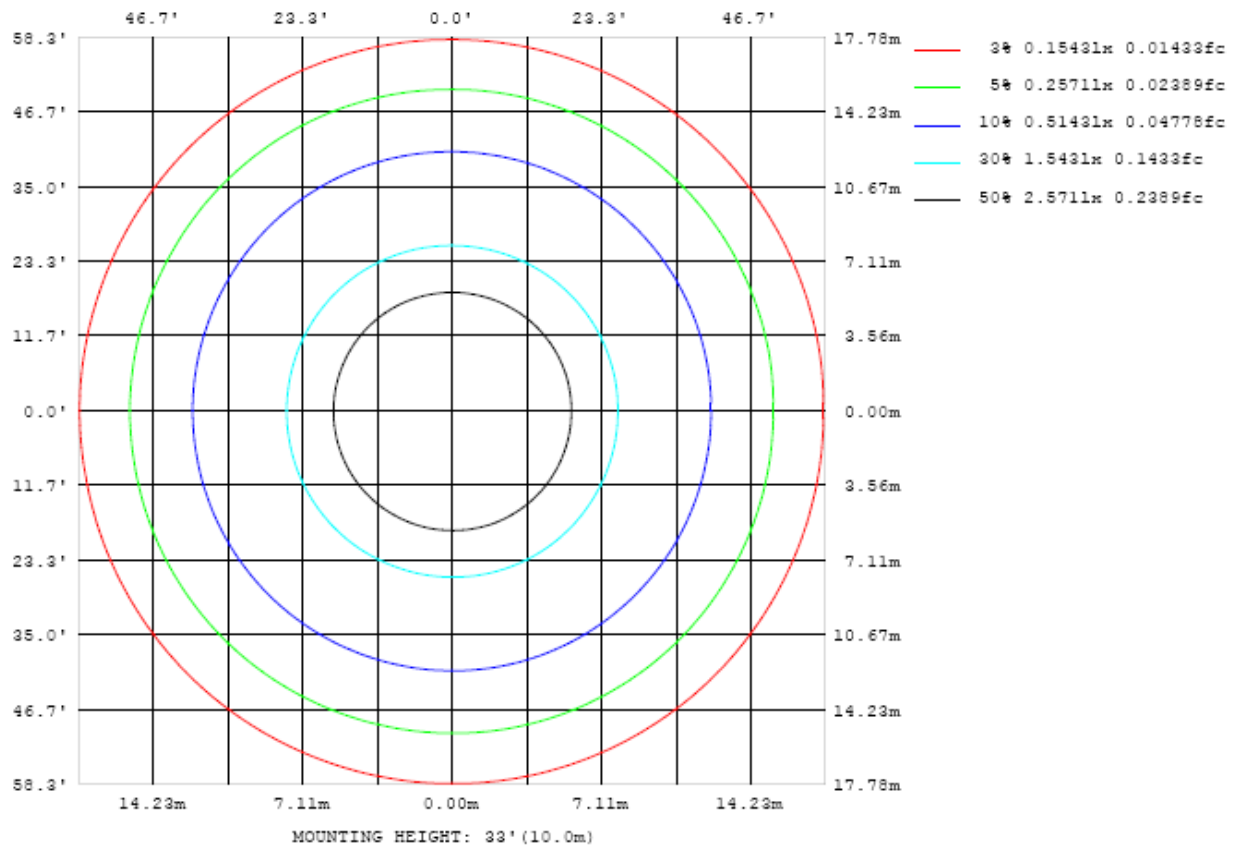


Chart 5: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots- Goniophotometer Method

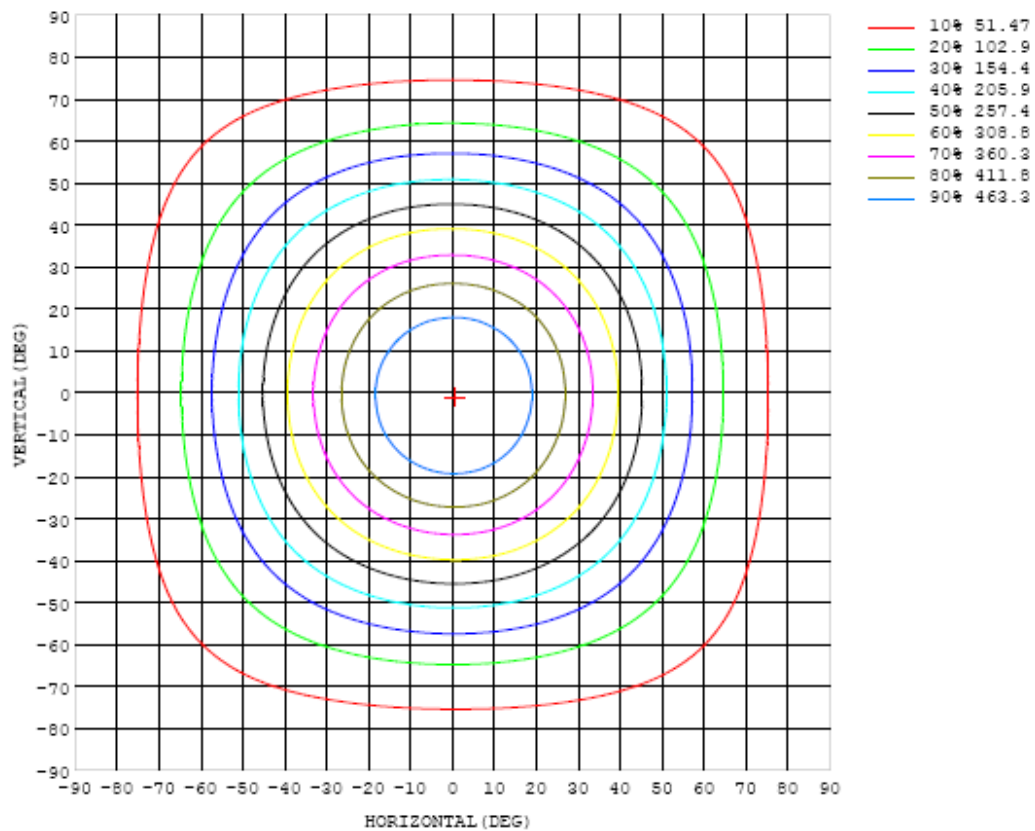


Chart 6: Isocandela Plot

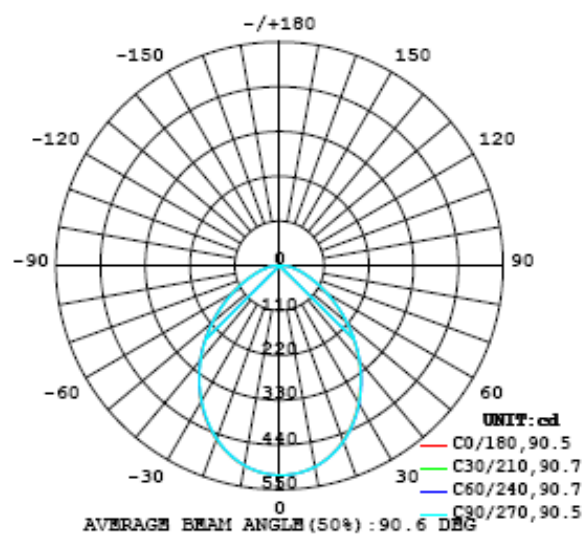


Chart 7: Polar Candela Distribution

## 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	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514
5	511	511	511	511	512	511	511	512	512	511	511	511	511	511	511	511	511	510	510
10	501	501	501	501	501	501	502	502	501	501	501	501	501	501	500	500	500	499	499
15	483	483	483	484	484	484	484	484	484	484	483	483	483	483	482	482	481	481	480
20	457	458	458	459	459	459	459	460	459	459	459	458	458	458	457	456	456	455	454
25	425	426	426	427	427	428	428	429	428	427	427	427	426	426	426	425	424	423	423
30	388	388	389	390	390	391	392	392	391	391	390	390	389	389	389	388	387	386	386
35	347	348	348	349	350	350	351	351	351	350	350	349	349	349	348	348	347	346	346
40	304	305	305	306	307	307	307	308	308	307	306	306	306	306	306	305	305	304	304
45	259	260	260	261	261	262	262	262	262	262	261	261	261	261	261	261	261	260	260
50	215	215	215	216	216	217	217	217	217	217	217	217	217	217	217	217	216	216	216
55	172	172	173	173	174	174	174	174	174	174	174	174	174	174	175	175	174	173	173
60	133	134	134	135	135	135	135	135	135	135	135	135	135	136	136	136	135	135	135
65	100	101	101	101	101	101	101	102	102	101	101	102	102	102	102	102	101	101	101
70	73.1	73.6	73.9	74.4	73.9	74.2	74.1	74.0	73.9	73.7	73.7	73.3	73.6	73.7	74.2	73.9	73.8	73.3	73.5
75	52.5	53.0	53.5	53.7	53.8	53.7	53.4	53.3	53.1	53.0	52.8	52.8	52.8	52.9	52.9	52.9	52.8	52.5	52.3
80	36.5	36.9	37.3	37.5	37.6	37.4	37.3	37.1	36.9	36.7	36.6	36.5	36.4	36.5	36.6	36.6	36.6	36.5	36.3
85	24.1	24.5	24.7	25.0	25.0	25.0	24.8	24.6	24.5	24.3	24.2	24.1	24.0	24.1	24.1	24.2	24.2	24.2	24.1
90	14.7	15.0	15.2	15.4	15.4	15.4	15.3	15.2	15.0	14.9	14.8	14.7	14.7	14.7	14.7	14.8	14.9	14.8	14.8
95	8.01	8.21	8.36	8.44	8.48	8.44	8.34	8.23	8.11	8.01	7.92	7.85	7.81	7.85	7.90	7.97	8.03	8.03	7.97
100	3.63	3.78	3.88	3.94	3.93	3.88	3.78	3.67	3.57	3.48	3.40	3.35	3.33	3.35	3.39	3.45	3.51	3.54	3.58
105	1.37	1.48	1.55	1.59	1.57	1.51	1.42	1.32	1.23	1.15	1.09	1.06	1.04	1.05	1.08	1.13	1.17	1.21	1.24
110	0.49	0.57	0.62	0.63	0.61	0.56	0.49	0.42	0.36	0.31	0.27	0.24	0.23	0.24	0.26	0.30	0.34	0.37	0.39
115	0.18	0.22	0.24	0.24	0.23	0.20	0.16	0.13	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.12	0.13	0.15
120	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.13	0.12	0.13	0.13	0.13	0.13	0.13	0.14
125	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.19
130	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.25
135	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.32
140	0.30	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.30	0.39
145	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.46
150	0.38	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.38	0.52
155	0.42	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.42	0.55
160	0.46	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.46	0.58
165	0.49	0.47	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.49	0.58
170	0.52	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.52	0.58
175	0.56	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.56	0.57
180	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56

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	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514	514		
5	510	510	510	510	510	510	510	510	510	510	510	510	510	511	511	511	511		
10	499	498	498	498	498	497	498	498	498	498	499	499	499	500	500	500	501		
15	480	479	479	479	478	478	478	478	478	479	479	480	480	481	482	482	482		
20	454	453	453	453	452	452	452	452	452	453	453	453	454	455	456	457	457		
25	422	422	421	421	421	420	420	420	419	420	420	421	422	424	424	425	425		
30	386	385	385	385	385	384	384	383	383	383	383	384	385	387	387	388	388		
35	346	346	346	346	345	345	345	344	343	343	343	344	345	346	347	347	348		
40	304	304	304	304	304	303	303	302	301	301	301	302	303	303	304	304	305		
45	260	260	260	260	260	259	259	258	257	257	257	258	258	259	259	259	260		
50	216	216	215	215	215	215	215	214	213	213	213	213	214	214	215	215	215		
55	173	173	173	173	173	173	172	171	171	170	171	171	172	172	172	172	172		
60	135	134	134	134	134	134	133	133	132	132	132	132	133	133	133	134	134		
65	101	100	99.9	99.6	99.3	99.0	98.9	98.7	98.6	98.6	98.6	98.7	99.0	99.3	99.8	100	101		
70	73.1	72.6	72.1	71.8	71.4	71.2	71.1	71.0	70.8	70.9	71.0	71.1	71.4	71.7	72.1	72.6	73.1		
75	51.9	51.5	51.0	50.6	50.3	50.2	50.0	50.0	49.9	50.0	50.0	50.1	50.3	50.6	50.9	51.4	52.0		
80	36.0	35.6	35.2	34.9	34.6	34.5	34.4	34.3	34.3	34.3	34.3	34.4	34.5	34.7	35.0	35.5	36.1		
85	23.9	23.6	23.3	23.0	22.8	22.7	22.6	22.6	22.5	22.5	22.5	22.5	22.6	22.7	23.0	23.4	23.8		
90	14.7	14.4	14.2	14.0	13.9	13.8	13.7	13.6	13.7	13.6	13.5	13.5	13.6	13.7	13.9	14.2	14.5		
95	7.87	7.75	7.62	7.48	7.41	7.38	7.38	7.37	7.38	7.36	7.31	7.25	7.22	7.25	7.36	7.54	7.75		
100	3.54	3.46	3.37	3.30	3.26	3.26	3.28	3.30	3.31	3.31	3.26	3.21	3.16	3.17	3.24	3.36	3.51		
105	1.22	1.18	1.14	1.10	1.08	1.08	1.11	1.13	1.15	1.15	1.12	1.09	1.05	1.05	1.09	1.17	1.28		
110	0.38	0.35	0.32	0.30	0.30	0.30	0.33	0.36	0.38	0.39	0.37	0.34	0.30	0.28	0.30	0.35	0.43		
115	0.15	0.14	0.13	0.12	0.12	0.12	0.14	0.15	0.16	0.16	0.15	0.14	0.13	0.12	0.12	0.13	0.16		
120	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15		
125	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19		
130	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
135	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.32	0.32	0.32	0.32	0.32	0.32	0.32		
140	0.39	0.39	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.39	0.39	0.39	0.39	0.40		
145	0.46	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.47		
150	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52		
155	0.55	0.55	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.55	0.55	0.55	0.56		
160	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58		
165	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.58	0.58	0.59		
170	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.58	0.58	0.58		
175	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57		
180	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56		

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 \*\*\*

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.