

## LM-79-08 TEST REPORT

for

### GREEN CREATIVE LTD

Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL,  
Hong Kong

### LED Tube

**Model: 11.5T5HO/2F/850/BYP**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ20100014b

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

Review by:



Engineer: April Zou  
Oct. 23, 2020

Approved by:



Manager: Jim Zhang  
Oct. 23, 2020

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: 11.5T5HO/2F/850/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
146.8	1590.1	10.83	0.9771
CCT (K)	CRI	Stabilization Time (Light & Power)	
5052	83.2	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>	: Oct. 20, 2020
<b>Date of Test</b>	: Oct. 21, 2020
<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>	: 11.5T5HO/2F/850/BYP
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 11.5W
<b>Product Description</b>	: 5000K
<b>Manufacturer</b>	: GREEN CREATIVE LTD
<b>Address</b>	: Room 3603, Level 36, Tower 1, Enterprise Square Five, 38 Wang Chiu Road, Kowloon Bay, KL, Hong Kong

## TEST RESULTS

Test ambient temperature was 24.8 °C.

Base orientation was base up. 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)	0.093	0.044
Power Factor	0.9771	0.9130
Test Power (W)	10.83	11.13
THD A%	19.63	17.85
Luminous Efficacy (lm/W)	146.8	142.5
Total Luminous Flux (lm)	1590.1	1586.2
Color Rendering Index (CRI)	83.2	
R9	5.9	
Correlated Color Temperature (CCT)(K)	5052	
Chromaticity Chroma x	0.3442	
Chromaticity Chroma y	0.3588	
Chromaticity Chroma u	0.2081	
Chromaticity Chroma v	0.3253	
Duv	0.0039	
Chromaticity Chroma u'	0.2081	
Chromaticity Chroma v'	0.4880	

Special Color Rendering Indices	
R1	81.1
R2	87.8
R3	93.1
R4	83.6
R5	82.3
R6	83.7
R7	87
R8	67
R9	5.9
R10	71.7
R11	83.4
R12	64.6
R13	82.7
R14	96.4

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 25.1 °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)	0.093
Power Factor	0.9771
Power (W)	10.85
Luminous Efficacy (lm/W)	146.4
Total Luminous Flux (lm)	1588.0
Beam Angle ( ° )	103.0 (0°-180°) / 131.4 (90°-270°)
Center Beam Candle Power (cd)	445
Maximum Beam Candle Power (cd)	445.9 (At: C=100.0, Gamma=1.0)
Spacing Criteria	1.21 (0°-180°) / 1.32 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	63.93%
Zonal Lumens in the 60 °-90 °Zone	25.81%
Zonal Lumens in the 90 °-120 °Zone	7.83%
Zonal Lumens in the 120 °-180 °Zone	2.43%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

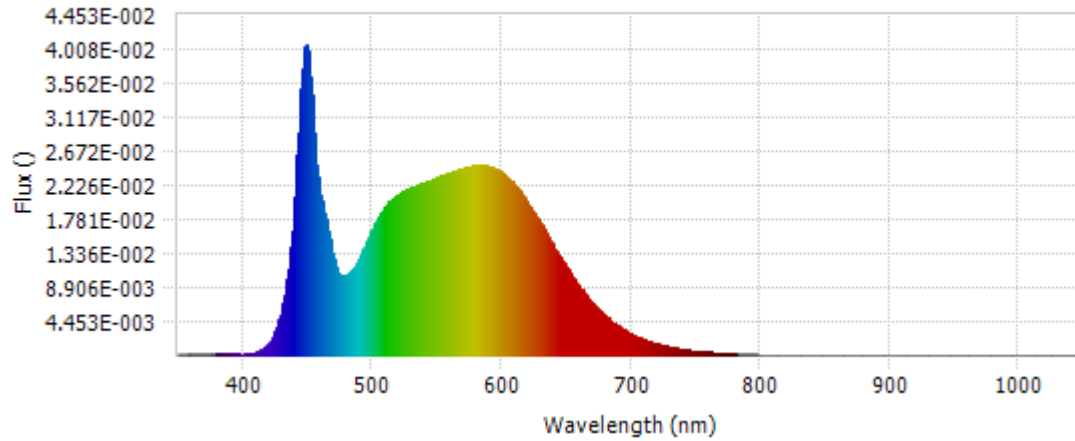
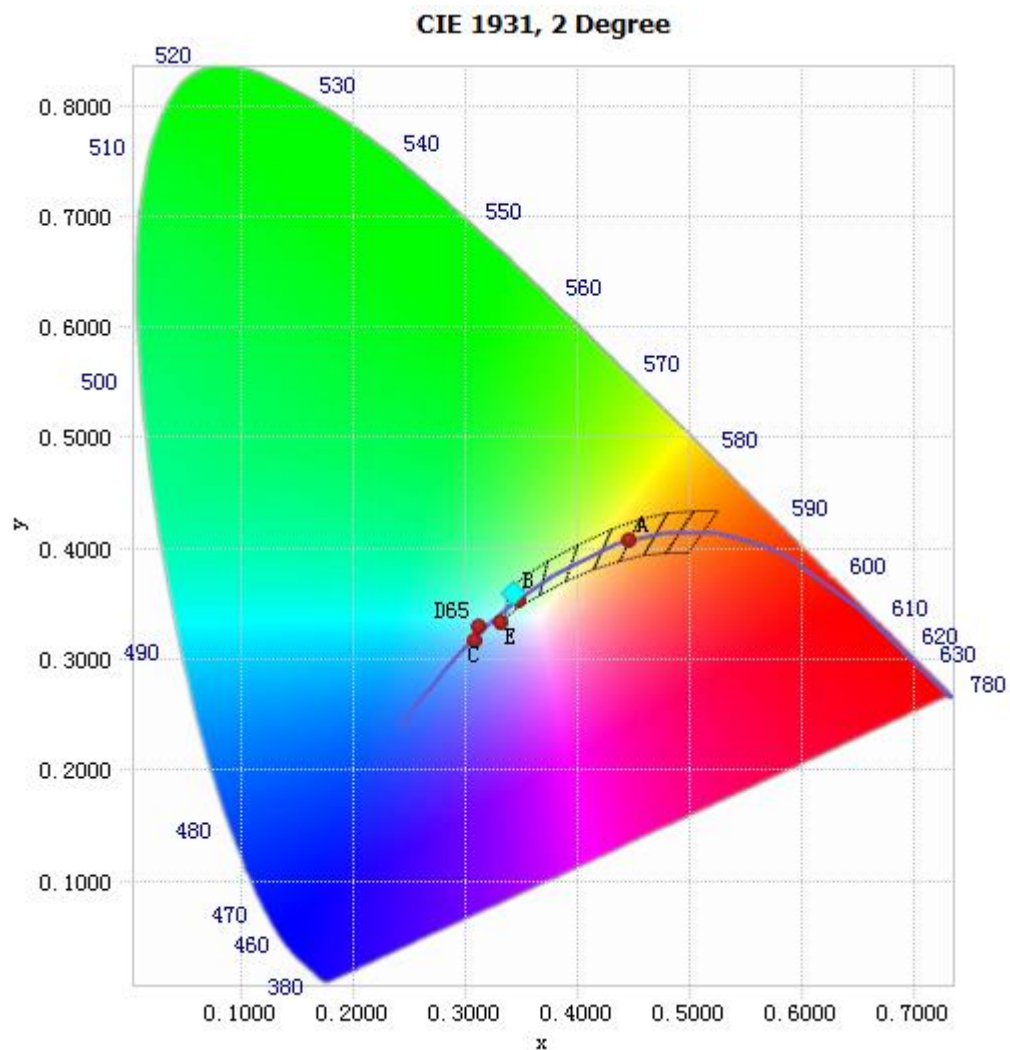


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.78E-04	485	1.13E-02	590	2.47E-02	695	3.29E-03
385	1.67E-04	490	1.27E-02	595	2.44E-02	700	2.82E-03
390	1.74E-04	495	1.47E-02	600	2.39E-02	705	2.40E-03
395	1.43E-04	500	1.65E-02	605	2.32E-02	710	2.05E-03
400	1.27E-04	505	1.82E-02	610	2.23E-02	715	1.76E-03
405	1.82E-04	510	1.94E-02	615	2.12E-02	720	1.50E-03
410	3.64E-04	515	2.05E-02	620	2.00E-02	725	1.28E-03
415	7.95E-04	520	2.11E-02	625	1.86E-02	730	1.09E-03
420	1.59E-03	525	2.15E-02	630	1.72E-02	735	9.28E-04
425	3.17E-03	530	2.20E-02	635	1.58E-02	740	7.92E-04
430	6.09E-03	535	2.22E-02	640	1.43E-02	745	6.75E-04
435	1.13E-02	540	2.26E-02	645	1.29E-02	750	5.77E-04
440	2.06E-02	545	2.29E-02	650	1.15E-02	755	4.93E-04
445	3.48E-02	550	2.32E-02	655	1.02E-02	760	4.21E-04
450	3.97E-02	555	2.36E-02	660	8.99E-03	765	3.60E-04
455	2.90E-02	560	2.38E-02	665	7.89E-03	770	3.10E-04
460	2.11E-02	565	2.41E-02	670	6.87E-03	775	2.63E-04
465	1.70E-02	570	2.45E-02	675	5.98E-03	780	2.27E-04
470	1.27E-02	575	2.47E-02	680	5.16E-03		
475	1.05E-02	580	2.48E-02	685	4.45E-03		
480	1.05E-02	585	2.49E-02	690	3.84E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3442, 0.3588)

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

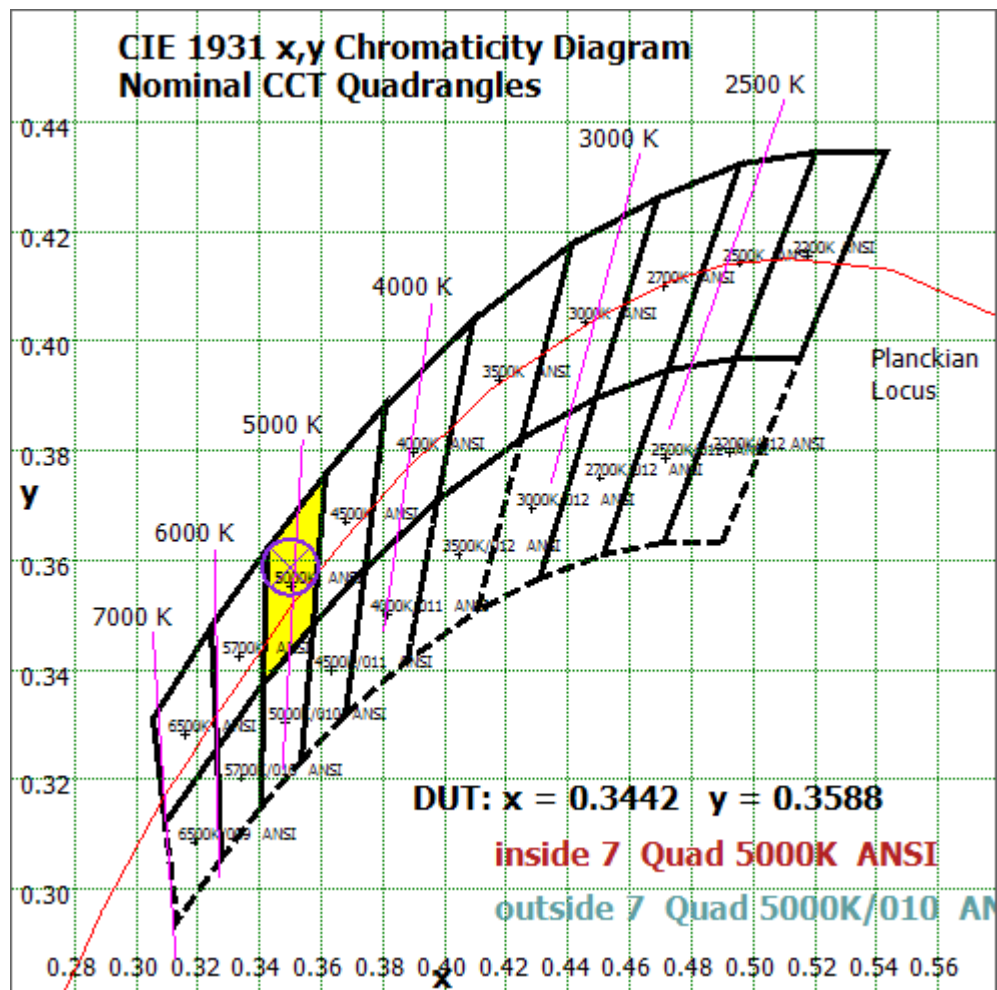


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

# Color Rendition Report – Sphere Spectroradiometer Method

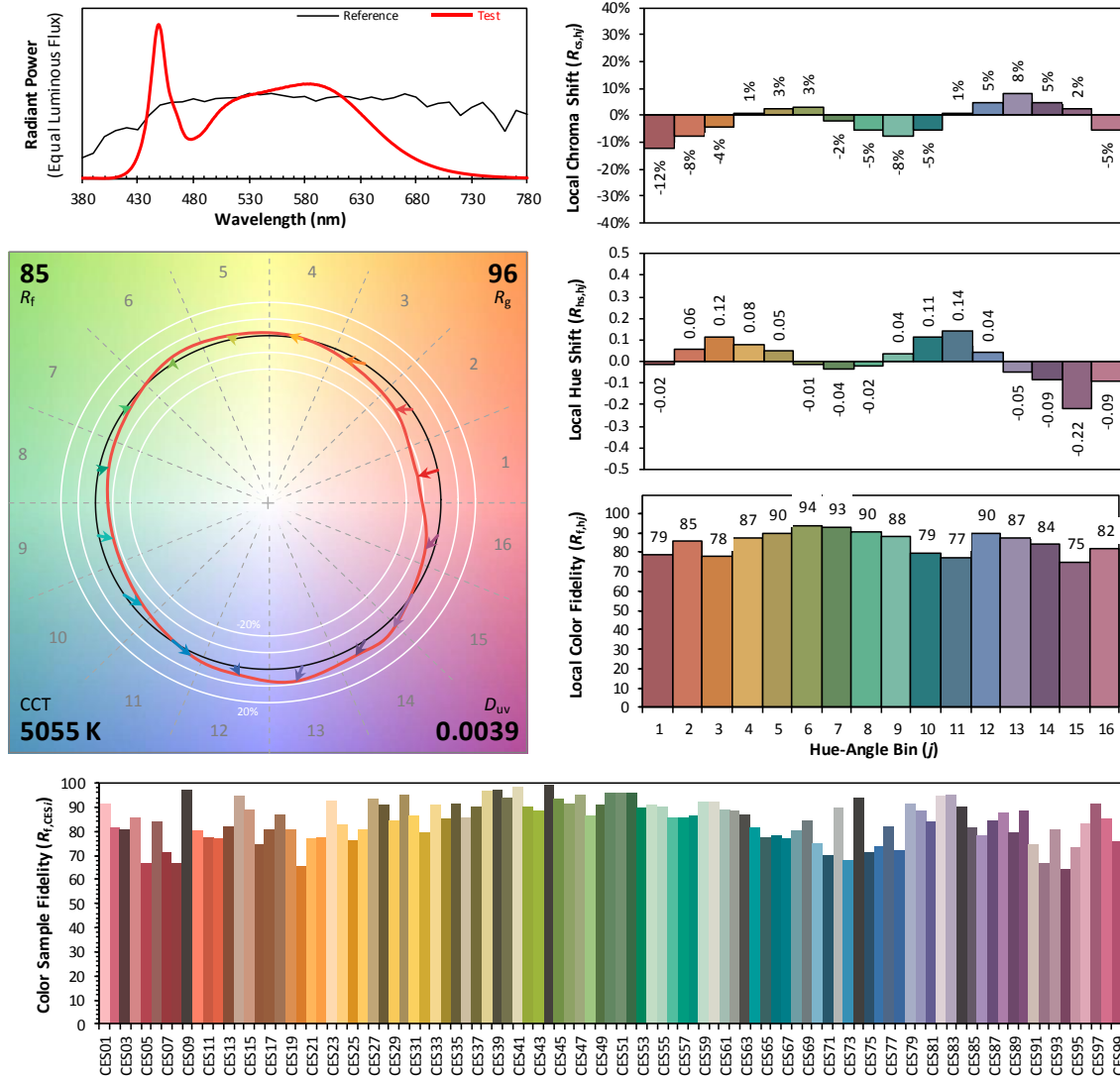
## ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: GREEN CREATIVE LTD

Date: 2020/10/21

Model: 11.5T5HO/2F/850/BYP



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

$x$  0.3442  
 $y$  0.3588  
 $u'$  0.2081  
 $v'$  0.4880

CIE 13.3-1995  
(CRI)

$R_a$  83  
 $R_g$  6

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

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	42.08	2.65%
10- 20	120.521	7.59%
20- 30	182.79	11.51%
30- 40	221.153	13.93%
40- 50	231.964	14.61%
50- 60	216.699	13.65%
60- 70	181.528	11.43%
70- 80	136	8.56%
80- 90	92.296	5.81%
90-100	60.534	3.81%
100-110	39.332	2.48%
110-120	24.5	1.54%
120-130	15.582	0.98%
130-140	10.115	0.64%
140-150	6.477	0.41%
150-160	3.936	0.25%
160-170	2.025	0.13%
170-180	0.461	0.03%
Total	1588.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1015.207	63.93%
60- 90	409.824	25.81%
0-90	1425.031	89.74%
90- 180	162.962	10.26%
0- 180	1588.0	100%

Table 5: Zonal Lumen

## Illuminance Plots- Goniophotometer Method

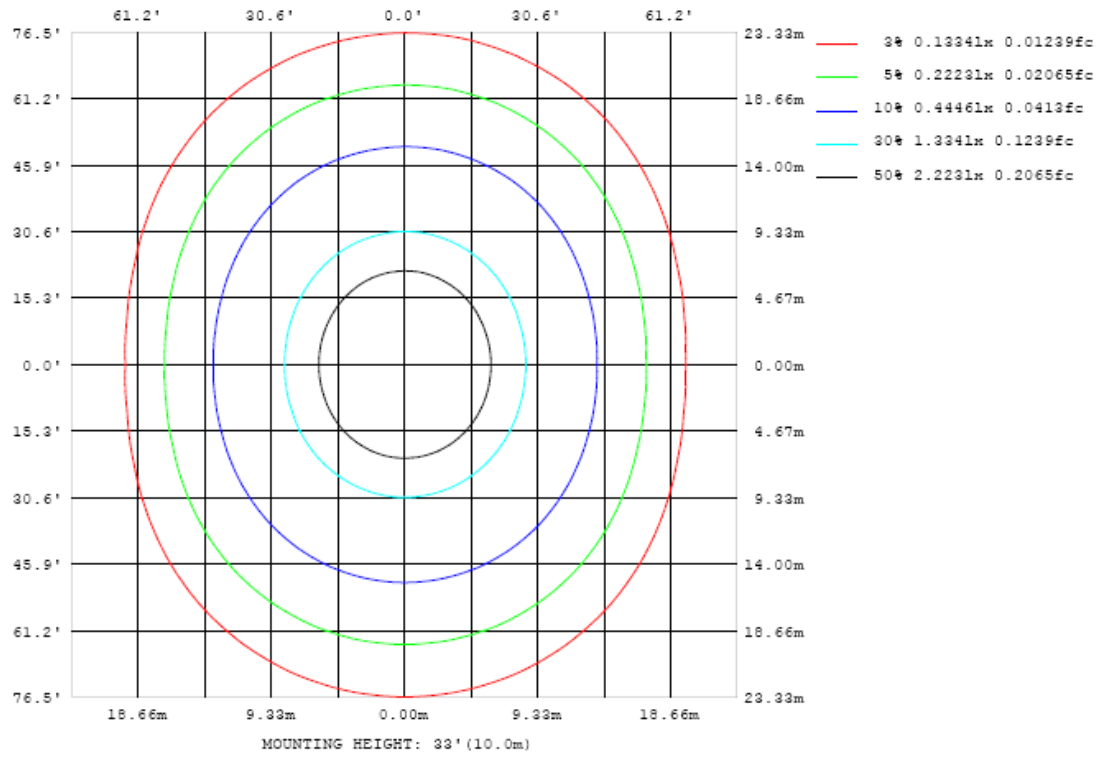


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

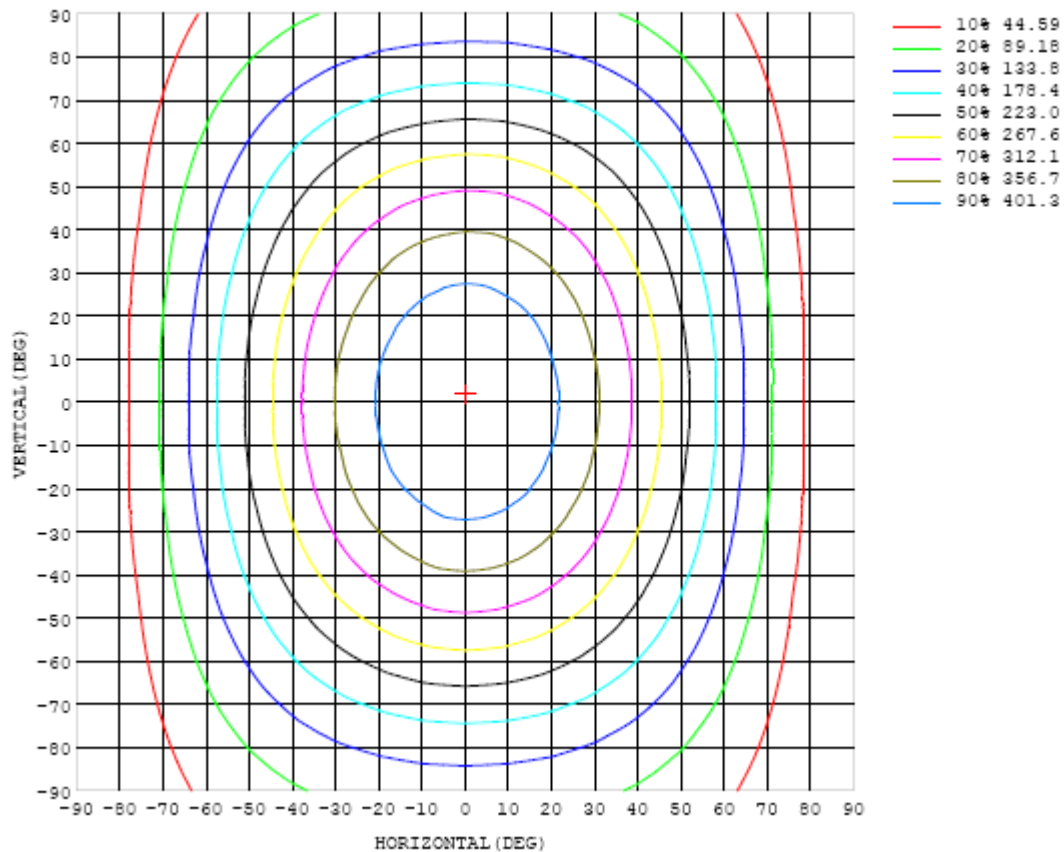


Chart 6: Isocandela Plot

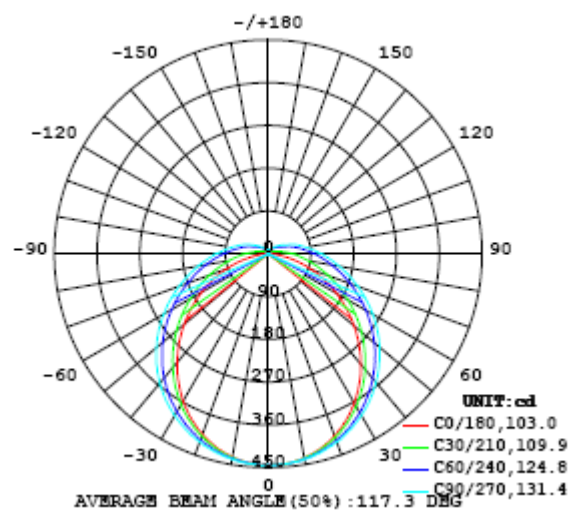


Chart 7: Polar Candela Distribution

## 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	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445
5	443	443	444	443	443	443	444	443	443	443	444	443	443	443	442	442	441	441	442
10	436	437	437	437	437	438	438	439	438	439	439	437	437	437	436	435	434	434	434
15	425	425	425	426	427	428	430	431	431	432	432	430	428	427	425	424	421	422	422
20	407	409	410	412	413	416	419	420	420	421	422	419	416	414	411	408	405	405	404
25	387	388	390	393	396	400	404	406	407	408	408	405	401	398	393	389	385	384	383
30	362	364	366	370	376	381	385	390	391	392	392	387	383	378	373	367	361	359	358
35	334	336	340	345	352	359	365	370	372	374	372	369	363	356	349	341	335	330	329
40	303	305	310	317	326	334	342	348	352	353	352	347	340	332	322	313	305	300	299
45	271	273	279	287	298	308	318	325	328	330	329	323	316	306	294	283	274	268	265
50	236	239	246	256	269	281	291	300	304	306	304	298	289	278	265	253	241	234	231
55	201	204	212	225	239	252	264	274	278	281	279	272	262	250	236	222	208	200	196
60	166	169	179	194	210	225	238	247	252	254	252	245	235	222	207	191	176	165	162
65	131	135	147	164	181	197	210	220	225	227	225	218	208	195	179	161	144	132	128
70	96.8	102	117	135	154	170	183	194	199	201	199	192	182	169	152	133	115	99.9	93.9
75	64.5	71.6	88.8	109	129	146	159	168	174	176	174	168	158	144	127	108	87.6	70.0	61.7
80	35.5	44.6	64.8	85.9	106	123	136	145	150	152	150	144	135	122	105	85.7	64.2	44.1	32.9
85	12.8	23.1	44.9	66.9	86.0	103	115	124	129	131	129	123	115	102	85.9	66.6	45.3	23.6	10.8
90	1.60	10.3	30.0	51.0	69.7	85.1	97.4	106	110	112	110	105	96.8	85.1	69.8	51.6	31.0	11.4	0.84
95	0.12	4.68	19.1	38.0	55.8	70.1	81.3	89.4	93.7	95.2	94.0	89.4	81.4	70.7	56.5	39.1	20.5	5.14	0.27
100	0.35	3.02	12.5	27.8	43.7	57.4	68.0	75.0	79.2	80.7	79.6	75.4	68.1	58.4	44.8	28.9	13.5	3.67	0.47
105	0.69	2.62	9.07	20.4	33.4	46.0	56.3	63.3	67.3	69.4	67.5	63.7	56.7	46.8	34.2	21.4	10.2	2.94	0.92
110	1.15	2.64	7.02	15.8	25.8	35.8	44.5	51.4	55.5	57.0	55.8	51.8	45.0	36.4	27.1	17.0	8.53	3.13	1.39
115	1.62	2.94	6.32	12.9	20.9	29.0	35.8	41.0	44.2	45.4	44.5	41.3	36.5	30.0	22.1	14.2	7.64	3.49	1.88
120	2.04	3.28	6.07	10.8	17.5	23.9	29.6	34.0	36.7	37.7	36.9	34.4	30.3	24.9	18.5	12.3	7.18	3.81	2.38
125	2.45	3.57	6.10	9.67	14.7	20.1	24.8	28.4	30.7	31.6	30.9	28.8	25.4	21.0	15.9	11.0	6.95	4.17	2.87
130	2.92	4.03	6.16	9.01	12.8	17.1	20.9	23.9	25.8	26.6	26.0	24.2	21.4	17.8	13.8	9.95	6.76	4.46	3.24
135	3.33	4.32	6.28	8.58	11.5	14.7	17.8	20.2	21.8	22.4	22.0	20.5	18.2	15.3	12.2	9.16	6.65	4.77	3.64
140	3.57	4.01	6.29	8.27	10.5	13.0	15.3	17.2	18.4	18.9	18.6	17.5	15.7	13.5	11.0	8.68	6.72	5.13	4.09
145	3.82	3.85	6.30	7.99	9.67	11.5	13.2	14.7	15.6	16.0	15.8	14.9	13.5	11.9	10.1	8.28	6.82	5.44	4.48
150	4.06	3.71	6.15	7.70	8.98	10.3	11.6	12.7	13.3	13.6	13.5	12.8	11.9	10.6	9.28	8.01	6.88	5.56	4.70
155	4.33	3.87	5.87	7.39	8.46	9.37	10.2	11.0	11.5	11.7	11.6	11.1	10.4	9.60	8.70	7.74	6.68	5.33	4.81
160	4.53	4.24	5.70	7.20	7.92	8.57	9.19	9.66	9.97	10.1	10.1	9.78	9.35	8.81	8.19	7.21	6.12	5.15	4.55
165	4.47	4.14	5.58	6.92	7.63	7.92	8.23	8.55	8.75	8.89	8.84	8.66	8.42	8.10	7.38	6.49	5.06	4.07	4.45
170	4.11	3.48	3.65	4.20	5.15	6.73	7.15	7.39	7.54	7.62	7.58	7.36	6.76	5.75	5.08	4.82	4.66	4.37	4.30
175	3.52	3.33	3.13	3.13	3.02	2.83	3.03	3.57	4.56	5.05	4.21	4.12	4.15	4.15	4.15	4.14	4.13	4.08	4.09
180	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55

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	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445	445		
5	442	443	443	443	442	443	443	442	444	444	442	443	443	443	441	443	444		
10	435	436	435	436	437	437	438	438	439	439	438	438	438	437	437	436	436		
15	422	423	424	426	427	428	430	430	432	432	430	430	430	427	426	425	424		
20	405	406	408	410	415	416	418	419	421	421	419	418	417	414	411	409	408		
25	384	385	389	393	397	401	405	407	408	409	406	404	400	397	393	389	388		
30	359	362	366	372	378	384	388	391	393	393	389	385	381	376	370	365	364		
35	331	335	341	347	356	364	369	373	376	375	372	366	360	352	345	339	335		
40	300	305	312	321	331	341	348	352	355	354	350	344	336	327	317	309	305		
45	267	273	283	294	306	316	324	329	332	331	326	320	310	299	288	278	273		
50	234	241	251	265	278	290	299	304	307	307	301	293	283	270	257	246	239		
55	199	208	221	235	250	262	272	278	281	280	275	265	254	240	226	212	204		
60	165	175	189	205	222	235	245	251	254	253	247	238	226	211	194	180	170		
65	132	144	160	177	193	207	217	223	226	225	220	210	198	182	164	148	136		
70	99.1	113	132	150	166	180	191	197	199	198	193	183	171	155	136	118	103		
75	68.5	85.5	106	125	143	156	165	171	173	172	167	158	146	129	110	89.4	72.5		
80	41.9	61.7	82.8	103	120	132	142	148	150	149	144	135	123	106	86.1	64.7	45.4		
85	21.7	42.4	63.7	83.0	99.5	112	121	126	128	127	122	114	102	85.9	66.4	44.8	24.3		
90	9.61	28.3	48.3	66.5	81.9	93.8	102	107	109	108	103	95.6	84.2	69.0	50.4	30.1	11.4		
95	4.71	19.0	36.7	53.4	67.6	78.6	86.3	90.8	92.7	91.5	87.3	80.0	69.4	55.1	38.2	20.1	5.24		
100	2.94	12.5	27.7	42.6	55.5	65.7	72.9	77.1	78.6	77.6	73.6	66.8	56.9	43.9	28.8	13.5	2.91		
105	2.60	9.14	20.4	33.6	45.5	54.8	61.5	65.2	66.9	65.8	62.1	55.7	46.6	34.7	21.2	9.31	2.40		
110	2.82	7.51	15.7	25.8	36.1	45.0	51.3	55.1	56.5	55.5	51.8	45.8	37.0	26.4	15.9	7.33	2.32		
115	3.14	6.69	12.9	20.8	28.6	35.5	41.5	45.0	46.4	45.5	41.8	36.0	28.8	20.8	12.8	6.30	2.71		
120	3.52	6.30	11.1	17.3	23.5	29.1	33.4	36.0	36.9	36.1	33.4	29.1	23.5	17.2	10.8	5.68	3.16		
125	3.94	6.13	9.81	14.6	19.7	24.2	27.7	29.8	30.5	29.9	27.6	24.1	19.6	14.4	9.36	5.57	3.62		
130	4.32	6.10	8.97	12.6	16.7	20.3	23.1	24.8	25.4	24.9	23.0	20.2	16.5	12.3	8.43	5.66	4.05		
135	4.65	6.04	8.28	11.0	14.1	17.1	19.4	20.8	21.3	20.8	19.3	17.0	14.0	10.8	7.91	5.82	4.49		
140	5.07	6.14	7.84	9.94	12.2	14.5	16.4	17.4	17.9	17.4	16.3	14.3	12.2	9.73	7.61	6.02	4.92		
145	5.48	6.29	7.54	9.09	10.8	12.4	13.7	14.5	14.9	14.6	13.7	12.3	10.7	9.00	7.43	6.23	5.33		
150	5.86	6.44	7.33	8.44	9.66	10.8	11.8	12.3	12.6	12.3	11.7	10.7	9.61	8.40	7.29	6.43	5.72		
155	6.12	6.48	7.04	7.89	8.75	9.54	10.2	10.6	10.7	10.6	10.2	9.54	8.79	7.97	7.22	6.61	5.88		
160	5.79	6.56	6.84	7.13	7.65	8.55	8.92	9.20	9.33	9.28	9.01	8.62	8.18	7.68	7.21	6.78	5.85		
165	5.37	6.26	6.86	7.02	7.19	7.26	7.62	8.22	8.29	8.28	8.16	7.97	7.73	7.47	7.20	6.68	5.49		
170	4.49	4.69	5.34	6.04	6.62	7.08	7.04	6.70	6.71	7.19	7.50	7.46	7.38	7.25	6.68	5.11	4.52		
175	4.08	4.07	4.05	4.04	4.11	4.28	4.59	5.48	6.72	6.86	6.74	6.42	5.49	4.16	3.51	3.47	3.50		
180	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 05, 2020	Aug. 04, 2021
Digital Power Meter	PF2010A	HZTE028-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	DPS1060	HZTE001-06	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	WY12010	HZTE004-03	Aug. 05, 2020	Aug. 04, 2021
Temperature recorder	JM624U	HZTE018-08	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 05, 2020	Aug. 04, 2021
Standard source	D908	HZTE012-01	Aug. 05, 2020	Aug. 04, 2021
Integrate Sphere system	3M	HZTE015-04	Aug. 05, 2020	Aug. 04, 2021
Digital Power Meter	WT210	HZTE008-01	Aug. 05, 2020	Aug. 04, 2021
AC Power Supply	PCR 500L	HZTE001-07	Aug. 05, 2020	Aug. 04, 2021
DC Power Supply	IT6154	HZTE004-04	Aug. 05, 2020	Aug. 04, 2021
Standard source	SCL-1400	HZTE012-02	Aug. 05, 2020	Aug. 04, 2021
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 05, 2020	Aug. 04, 2021
Temperature Meter	TES1310	HZTE017-01	Aug. 05, 2020	Aug. 04, 2021

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 Tubes) 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 Tubes) 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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