

LM-79-08 TEST REPORT

for

GREEN CREATIVE LTD

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

LED Tube

Model: 5.5PLH/840/BYP/E26

5.5PLH/840/BYP/GU24

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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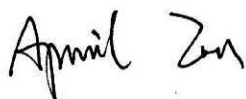
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Report No.: HZ19060003c

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: 5.5PLH/840/BYP/E26

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
110.3	655.3	5.94	0.9674
CCT (K)	CRI	Stabilization Time (Light & Power)	
3991	83.9	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	: Jun. 04, 2019
Date of Test	: Jun. 05, 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

LM-79-08 TEST REPORT.....	1
TEST SUMMARY	2
SAMPLE PHOTO	4
TEST RESULTS	4
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



5.5PLH/840/BYP/E26



5.5PLH/840/BYP/GU24

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 5.5PLH/840BYP/E26
Electrical Ratings	: 120-277V, 60Hz, 5.5W
Product Description	: 4000K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

Note: 5.5PLH/840/BYP/E26 is identical with 5.5PLH/840/BYP/GU24 except its base type;

5.5PLH/840/BYP/E26 is E26 base and 5.5PLH/840/BYP/GU24 is GU24 base.

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)	0.051	0.024
Power Factor	0.9674	0.8953
Test Power (W)	5.94	6.03
THD A%	21.55	21.83
Luminous Efficacy (lm/W)	110.3	108.6
Total Luminous Flux (lm)	655.3	654.7
Color Rendering Index (CRI)	83.9	
R9	11.8	
Correlated Color Temperature (CCT)(K)	3991	
Chromaticity Chroma x	0.3808	
Chromaticity Chroma y	0.3771	
Chromaticity Chroma u	0.2252	
Chromaticity Chroma v	0.3345	
Duv	0.0001	
Chromaticity Chroma u'	0.2252	
Chromaticity Chroma v'	0.5018	

Special Color Rendering Indices	
R1	82.2
R2	90.7
R3	95.9
R4	82
R5	82.4
R6	86.9
R7	85.9
R8	65.2
R9	11.8
R10	77.7
R11	80.8
R12	65.5
R13	84.5
R14	98.1

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 24.8 °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)	0.051
Power Factor	0.9697
Power (W)	5.93
Luminous Efficacy (lm/W)	112.6
Total Luminous Flux (lm)	667.7
Beam Angle (°)	102.8 (0°-180°) / 128.3 (90°-270°)
Center Beam Candle Power (cd)	197
Maximum Beam Candle Power (cd)	196.8 (At: C=140.0, Gamma=3.5)
Spacing Criteria	1.21 (0°-180°) / 1.29 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	66.05%
Zonal Lumens in the 60 °-90 °Zone	25.26%
Zonal Lumens in the 90 °-120 °Zone	7.43%
Zonal Lumens in the 120 °-180 °Zone	1.25%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

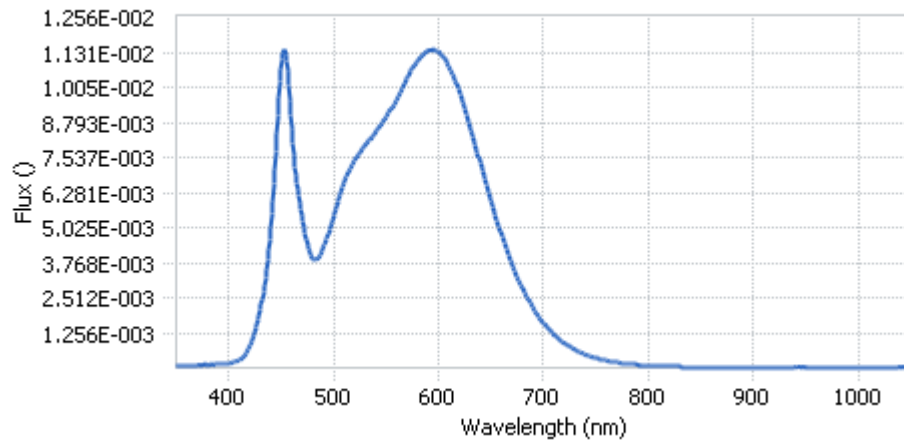
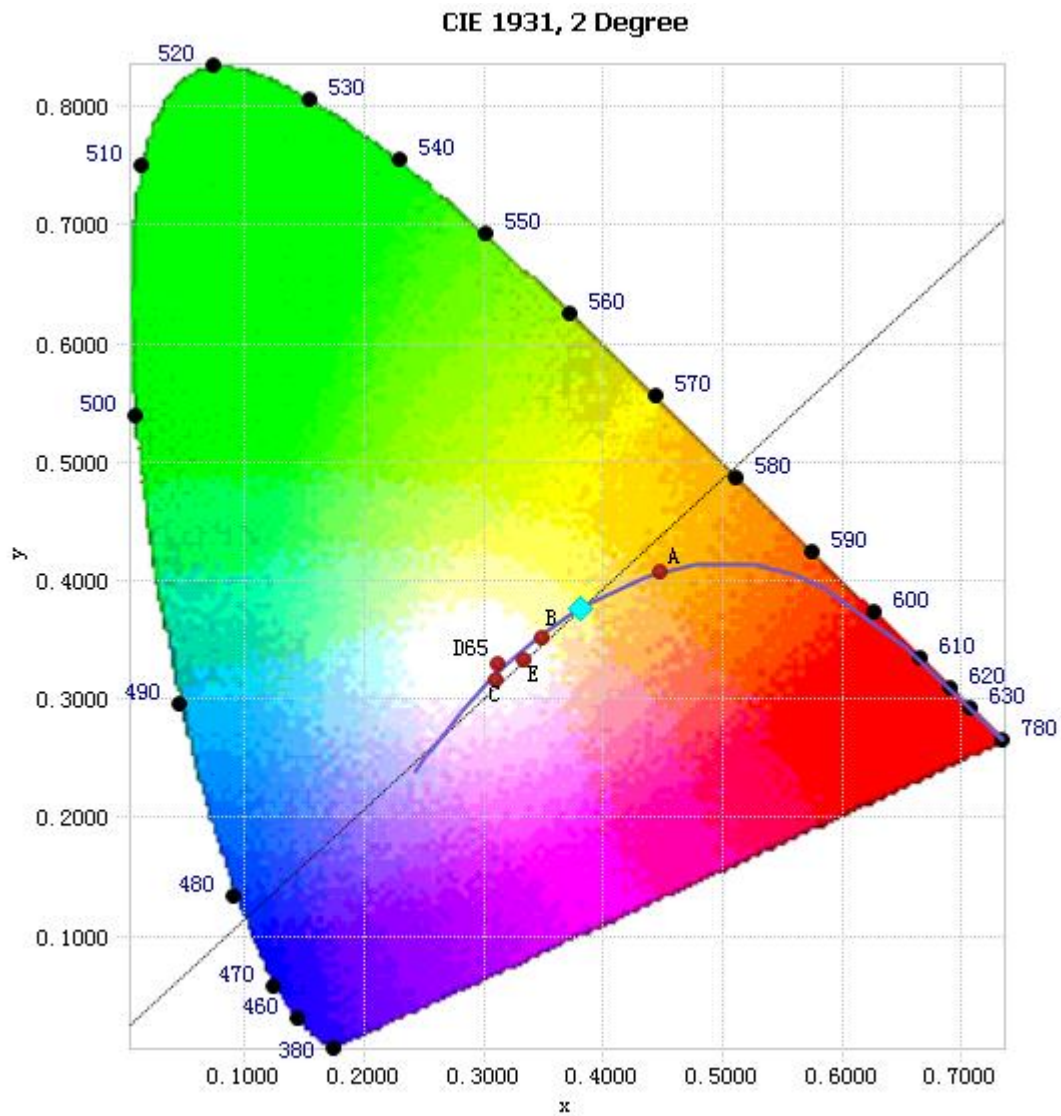


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.07E-04	485	3.95E-03	590	1.14E-02	695	1.87E-03
385	1.13E-04	490	4.28E-03	595	1.14E-02	700	1.60E-03
390	1.32E-04	495	4.83E-03	600	1.13E-02	705	1.38E-03
395	1.41E-04	500	5.46E-03	605	1.11E-02	710	1.19E-03
400	1.59E-04	505	6.11E-03	610	1.08E-02	715	1.02E-03
405	1.97E-04	510	6.64E-03	615	1.04E-02	720	8.83E-04
410	2.97E-04	515	7.10E-03	620	9.84E-03	725	7.62E-04
415	4.66E-04	520	7.45E-03	625	9.26E-03	730	6.53E-04
420	7.80E-04	525	7.72E-03	630	8.62E-03	735	5.62E-04
425	1.28E-03	530	7.96E-03	635	7.97E-03	740	4.82E-04
430	2.09E-03	535	8.19E-03	640	7.32E-03	745	4.15E-04
435	3.25E-03	540	8.47E-03	645	6.62E-03	750	3.51E-04
440	5.03E-03	545	8.71E-03	650	5.99E-03	755	3.07E-04
445	7.74E-03	550	8.98E-03	655	5.35E-03	760	2.68E-04
450	1.07E-02	555	9.29E-03	660	4.78E-03	765	2.29E-04
455	1.10E-02	560	9.64E-03	665	4.24E-03	770	1.98E-04
460	8.53E-03	565	1.00E-02	670	3.71E-03	775	1.69E-04
465	6.61E-03	570	1.04E-02	675	3.25E-03	780	1.50E-04
470	5.43E-03	575	1.07E-02	680	2.84E-03		
475	4.42E-03	580	1.10E-02	685	2.48E-03		
480	3.88E-03	585	1.12E-02	690	2.15E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3808, 0.3771)

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

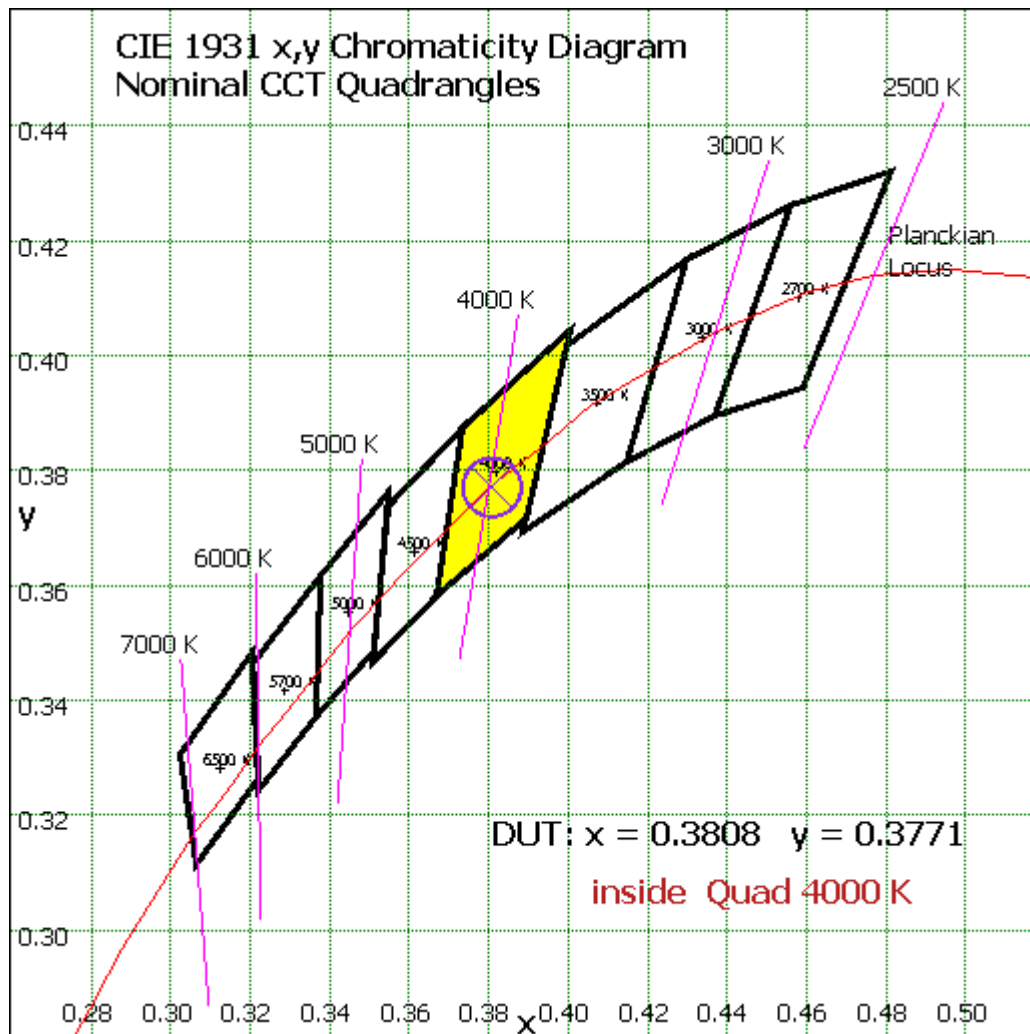
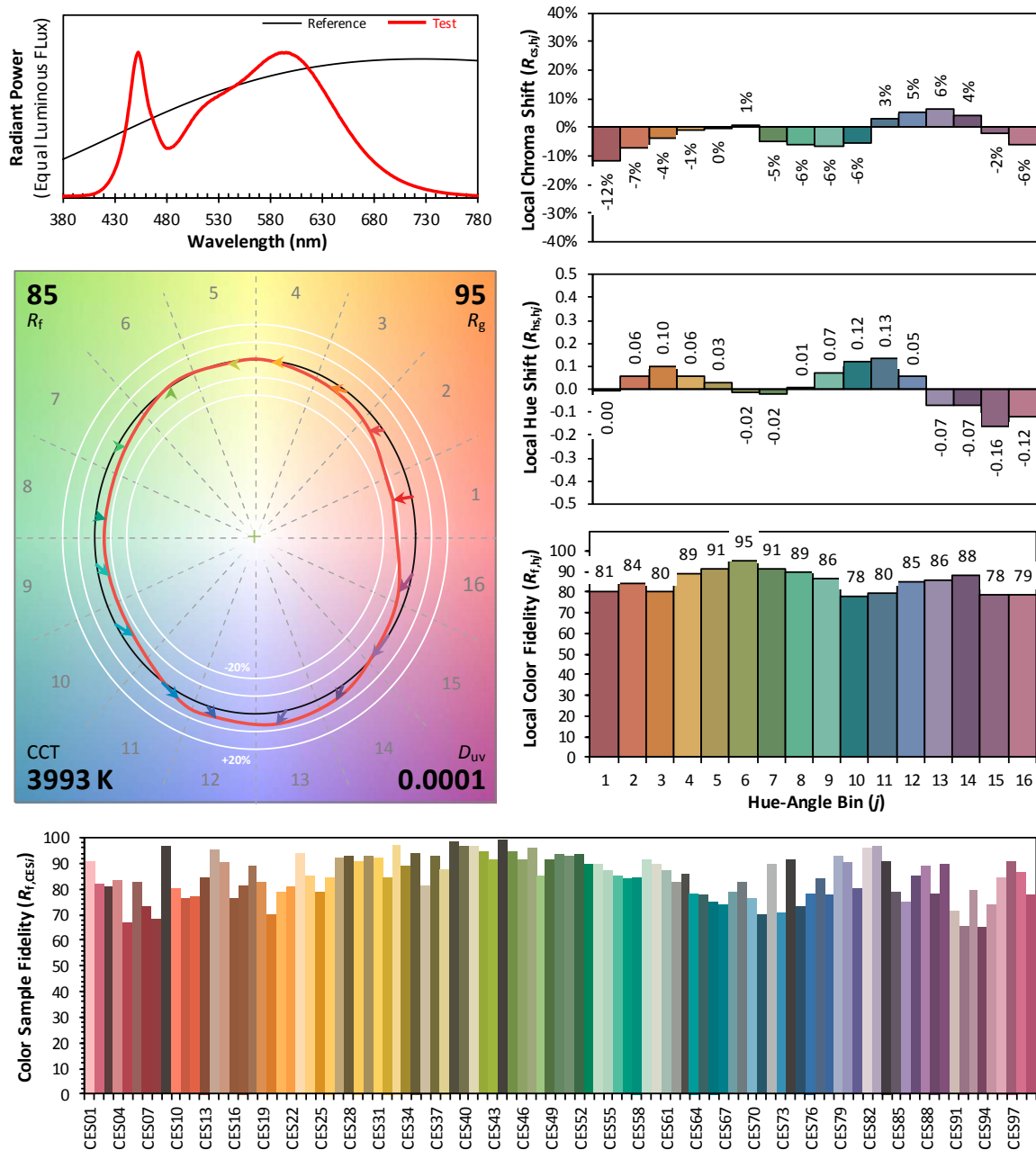


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Rendition Report – Sphere Spectroradiometer Method



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

x 0.3808
 y 0.3771
 u' 0.2252
 v' 0.5018

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	18.569	2.78%
10- 20	52.955	7.93%
20- 30	79.756	11.95%
30- 40	95.988	14.38%
40- 50	100.299	15.02%
50- 60	93.46	14.00%
60- 70	77.594	11.62%
70- 80	55.764	8.35%
80- 90	35.319	5.29%
90-100	23.418	3.51%
100-110	16.075	2.41%
110-120	10.125	1.52%
120-130	5.115	0.77%
130-140	1.975	0.30%
140-150	0.796	0.12%
150-160	0.327	0.05%
160-170	0.125	0.02%
170-180	0.03	0.00%
Total	667.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	441.027	66.05%
60- 90	168.677	25.26%
0-90	609.704	91.32%
90- 180	57.986	8.68%
0- 180	667.7	100%

Table 5: Zonal Lumen

Illuminance Plots- Goniophotometer Method

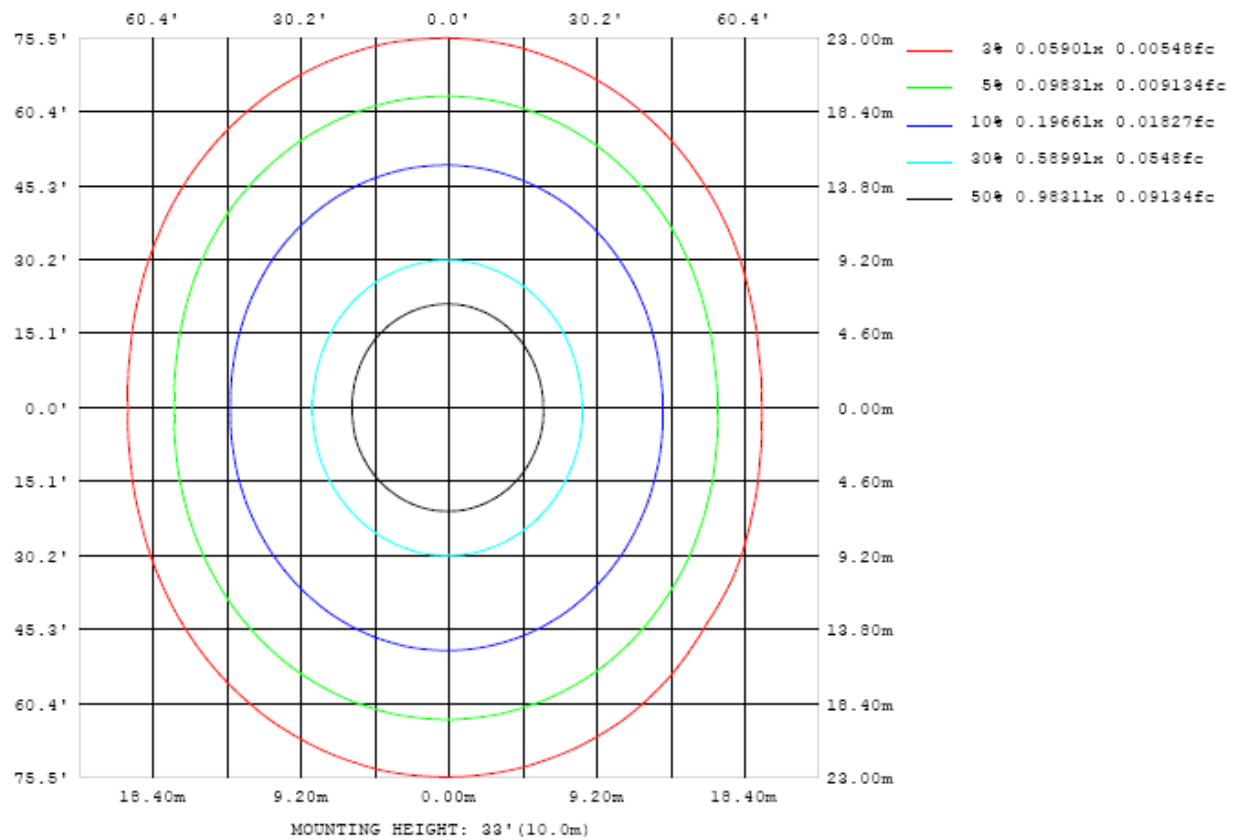


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

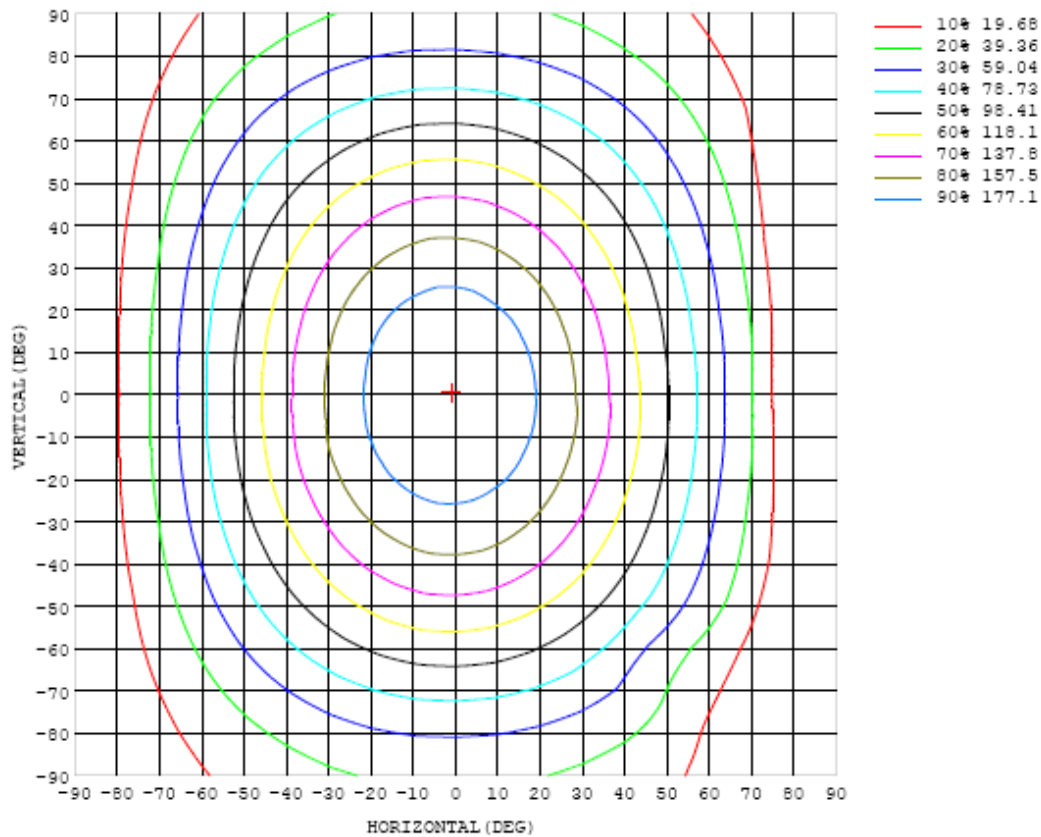


Chart 6: Isocandela Plot

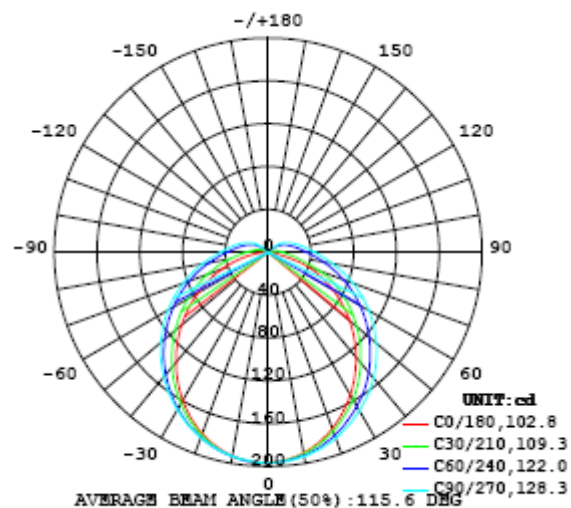


Chart 7: Polar Candela Distribution

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	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197
5	195	194	195	195	195	195	195	195	196	196	196	196	196	196	196	196	196	196	196
10	190	190	191	191	192	192	193	193	193	194	194	194	194	194	194	193	193	193	193
15	184	184	185	185	186	187	188	188	190	190	190	190	190	189	189	189	188	188	188
20	175	176	177	178	179	181	182	183	184	185	185	185	184	184	182	182	181	180	180
25	165	166	167	168	170	173	174	176	177	178	179	178	177	176	175	173	172	171	171
30	154	155	157	159	161	164	166	168	170	171	171	170	169	167	165	164	163	160	160
35	141	143	145	147	150	154	157	160	162	163	163	162	160	158	155	153	151	148	147
40	128	130	132	135	139	143	146	149	152	153	154	152	150	146	143	140	138	135	134
45	114	116	118	122	126	131	135	139	142	143	143	141	138	135	131	127	124	122	120
50	99.5	101	104	108	113	119	123	128	131	132	132	130	126	122	118	113	110	107	106
55	84.7	86.6	89.9	94.7	100	106	111	116	119	121	120	118	114	109	104	99.6	95.7	92.6	90.8
60	69.8	71.8	75.7	81.1	87.1	93.2	99.1	104	107	109	108	106	102	96.7	91.2	85.7	81.1	77.6	75.6
65	54.9	57.0	61.7	67.6	71.7	80.0	86.9	91.9	95.1	96.6	96.1	93.6	89.3	83.9	77.9	72.0	66.6	62.7	61.0
70	40.2	42.8	48.4	51.4	55.8	66.8	74.9	79.7	83.1	84.3	83.9	81.2	76.9	71.3	65.1	58.5	52.5	47.9	45.9
75	28.8	28.3	33.2	34.7	44.3	56.8	63.4	67.9	71.2	72.2	71.9	69.2	65.0	59.2	52.8	45.9	39.2	33.9	31.5
80	0.54	12.4	16.4	25.4	37.6	46.7	52.6	57.1	60.0	61.0	60.6	58.0	53.9	48.2	41.6	34.5	27.4	21.4	18.7
85	0.00	1.15	4.73	17.2	30.8	37.8	43.4	47.6	50.3	51.1	50.6	48.4	44.3	38.8	32.2	25.1	17.7	11.1	8.34
90	0.02	1.95	5.90	13.6	24.3	30.9	36.2	40.1	42.5	43.3	42.9	40.6	36.8	31.6	25.3	18.4	11.1	4.85	0.99
95	0.02	1.01	6.10	10.9	18.6	25.8	30.7	34.3	36.6	37.3	36.9	34.7	31.2	26.3	20.4	13.9	7.50	2.24	0.39
100	0.08	1.20	4.83	7.83	14.1	21.9	26.4	29.7	31.8	32.5	32.0	30.0	26.7	22.2	16.8	10.9	5.41	1.67	0.46
105	0.14	1.15	2.69	4.72	11.4	18.5	22.6	25.7	27.7	28.3	27.8	25.9	22.8	18.7	13.8	8.66	4.06	1.27	0.32
110	0.18	0.81	2.21	2.86	7.27	14.5	19.3	22.1	23.9	24.5	24.0	22.2	19.5	15.7	11.3	6.76	3.11	0.74	0.19
115	0.23	0.64	1.59	1.80	5.80	11.3	16.3	18.9	20.5	21.0	20.6	18.9	16.4	12.9	8.79	4.65	1.82	0.42	0.06
120	0.31	0.60	1.08	0.93	2.64	9.85	13.3	15.7	17.3	17.8	17.4	15.8	13.5	9.98	5.68	2.80	1.05	0.26	0.09
125	0.43	0.61	0.73	0.59	1.86	6.00	9.85	12.5	14.0	14.5	14.1	12.6	9.89	5.71	3.28	1.83	0.76	0.24	0.12
130	0.52	0.60	0.49	0.44	1.80	3.91	5.62	7.70	9.66	10.3	9.62	7.60	5.43	3.46	2.23	1.32	0.60	0.24	0.15
135	0.50	0.55	0.44	0.49	1.40	2.65	3.67	4.73	5.47	5.63	5.33	4.55	3.45	2.36	1.60	0.98	0.50	0.25	0.19
140	0.30	0.41	0.46	0.57	1.14	1.93	2.53	3.06	3.42	3.55	3.41	2.97	2.28	1.64	1.16	0.76	0.44	0.28	0.23
145	0.26	0.27	0.34	0.51	0.84	1.22	1.62	1.99	2.26	2.38	2.30	2.04	1.59	1.18	0.87	0.60	0.41	0.30	0.27
150	0.28	0.29	0.34	0.44	0.55	0.83	1.16	1.38	1.55	1.63	1.59	1.44	1.19	0.90	0.66	0.51	0.39	0.32	0.30
155	0.30	0.30	0.33	0.34	0.43	0.63	0.83	0.96	1.07	1.14	1.15	1.06	0.92	0.74	0.56	0.45	0.39	0.35	0.34
160	0.31	0.31	0.33	0.38	0.39	0.49	0.59	0.67	0.73	0.75	0.75	0.71	0.64	0.55	0.46	0.41	0.38	0.36	0.36
165	0.32	0.31	0.33	0.34	0.35	0.39	0.43	0.48	0.51	0.52	0.52	0.50	0.48	0.45	0.39	0.36	0.35	0.36	0.36
170	0.30	0.31	0.32	0.33	0.33	0.34	0.35	0.36	0.38	0.39	0.39	0.39	0.38	0.37	0.37	0.36	0.35	0.35	0.34
175	0.31	0.32	0.32	0.31	0.31	0.31	0.31	0.32	0.33	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.33	0.33
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197	197		
5	196	196	196	196	196	196	196	196	196	196	196	195	195	195	195	195	195		
10	193	194	193	194	194	194	194	194	193	193	193	192	191	191	190	190	190		
15	188	188	189	189	189	189	190	190	189	189	188	187	186	186	185	184	184		
20	180	181	182	183	183	184	185	185	184	184	182	181	180	178	177	176	175		
25	171	172	173	175	176	177	178	178	178	177	175	173	171	169	168	166	165		
30	160	161	163	165	167	169	170	170	170	169	167	165	162	159	157	155	154		
35	148	150	152	155	157	159	161	162	161	160	158	155	152	148	145	143	141		
40	135	137	140	143	146	149	151	152	152	151	148	144	140	137	133	130	128		
45	121	123	127	131	135	138	141	142	142	140	137	133	129	124	120	116	114		
50	107	110	114	118	122	127	129	131	131	129	126	122	117	111	107	103	99.8		
55	92.2	95.6	100	105	110	114	118	120	120	118	114	110	104	98.6	93.2	88.5	85.2		
60	77.5	81.4	86.7	92.5	97.6	102	106	108	108	106	103	97.7	92.0	85.8	79.6	74.2	70.6		
65	63.2	67.8	73.3	79.4	85.1	90.3	94.1	96.3	96.4	94.6	90.8	85.7	79.8	73.2	66.9	60.9	56.2		
70	48.6	54.0	60.6	67.2	72.7	78.1	82.2	84.3	84.5	82.9	79.0	74.1	68.3	61.4	54.1	47.3	41.9		
75	34.7	40.9	48.0	55.1	61.5	67.0	70.6	72.9	72.9	71.4	68.1	63.2	56.8	49.7	42.1	34.9	24.4		
80	22.3	29.1	36.6	44.0	50.5	55.9	60.0	62.0	62.3	60.8	57.5	52.6	46.3	39.2	31.5	23.7	9.07		
85	12.3	19.4	27.1	34.5	41.0	46.4	50.3	52.4	52.5	51.3	48.1	43.4	37.4	30.4	22.8	14.9	1.57		
90	6.03	12.8	20.3	27.3	33.6	38.8	42.4	44.4	44.6	43.5	40.6	36.2	30.4	23.9	16.7	9.45	0.06		
95	3.21	8.97	15.7	22.3	28.1	33.0	36.4	38.3	38.5	37.5	34.8	30.7	25.4	19.3	12.8	6.28	0.27		
100	1.93	6.46	12.4	18.4	23.8	28.3	31.5	33.3	33.5	32.6	30.0	26.3	21.4	15.8	9.89	4.35	0.58		
105	1.42	4.63	9.70	15.1	20.0	24.2	27.1	28.9	29.1	28.2	25.9	22.4	18.0	12.8	7.42	2.57	0.69		
110	0.70	2.77	7.10	12.1	16.6	20.4	23.2	24.8	25.1	24.3	22.1	19.0	14.9	9.95	4.67	1.78	0.43		
115	0.34	1.64	3.91	8.76	13.3	16.9	19.5	21.0	21.2	20.5	18.6	15.6	11.6	6.39	2.26	1.41	0.40		
120	0.27	1.09	2.46	4.85	8.80	12.8	15.6	17.1	17.4	16.8	14.9	11.7	7.18	3.42	2.21	1.02	0.44		
125	0.24	0.81	1.78	3.04	4.75	7.59	10.4	12.2	12.7	12.1	9.82	6.77	4.29	2.93	1.55	0.82	0.49		
130	0.23	0.63	1.32	2.23	3.65	5.08	6.23	7.03	7.37	7.07	5.93	4.68	3.47	2.18	1.17	0.70	0.52		
135	0.23	0.51	0.98	1.63	2.73	3.79	4.53	4.98	5.12	4.96	4.40	3.53	2.57	1.67	0.95	0.61	0.48		
140	0.24	0.42	0.75	1.20	1.97	2.73	3.25	3.57	3.64	3.47	3.08	2.54	1.93	1.30	0.79	0.50	0.34		
145	0.25	0.37	0.59	0.86	1.39	1.98	2.32	2.54	2.56	2.43	2.14	1.74	1.30	0.89	0.52	0.31	0.26		
150	0.26	0.34	0.49	0.64	0.97	1.42	1.65	1.78	1.80	1.70	1.52	1.26	0.95	0.70	0.46	0.30	0.29		
155	0.29	0.33	0.42	0.55	0.78	1.01	1.15	1.23	1.23	1.18	1.07	0.91	0.72	0.56	0.43	0.32	0.31		
160	0.34	0.33	0.39	0.52	0.63	0.71	0.78	0.83	0.83	0.80	0.74	0.65	0.54	0.44	0.36	0.32	0.32		
165	0.39	0.42	0.46	0.48	0.48	0.49	0.53	0.55	0.56	0.55	0.52	0.48	0.42	0.36	0.31	0.33	0.33		
170	0.32	0.32	0.33	0.33	0.34	0.35	0.37	0.37	0.38	0.38	0.37	0.36	0.34	0.32	0.31	0.32	0.32		
175	0.31	0.30	0.28	0.28	0.27	0.27	0.24	0.23	0.22	0.23	0.25	0.28	0.29	0.29	0.29	0.29	0.30		
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27		

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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