

LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

Horizontally-Mounted Lamps

Model: 14.5PLH/835/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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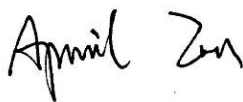
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Report No.: HZ18050045c

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

Review by:



Engineer: April Zou
Jun. 05, 2018

Approved by:



Manager: Jim Zhang
Jun. 05, 2018

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: 14.5PLH/835/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
114.8	1970.0	17.16	0.9958
CCT (K)	CRI	Stabilization Time (Light & Power)	
3397	82.6	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 25, 2018

Date of Test : May 30, 2018

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

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Sample Photos

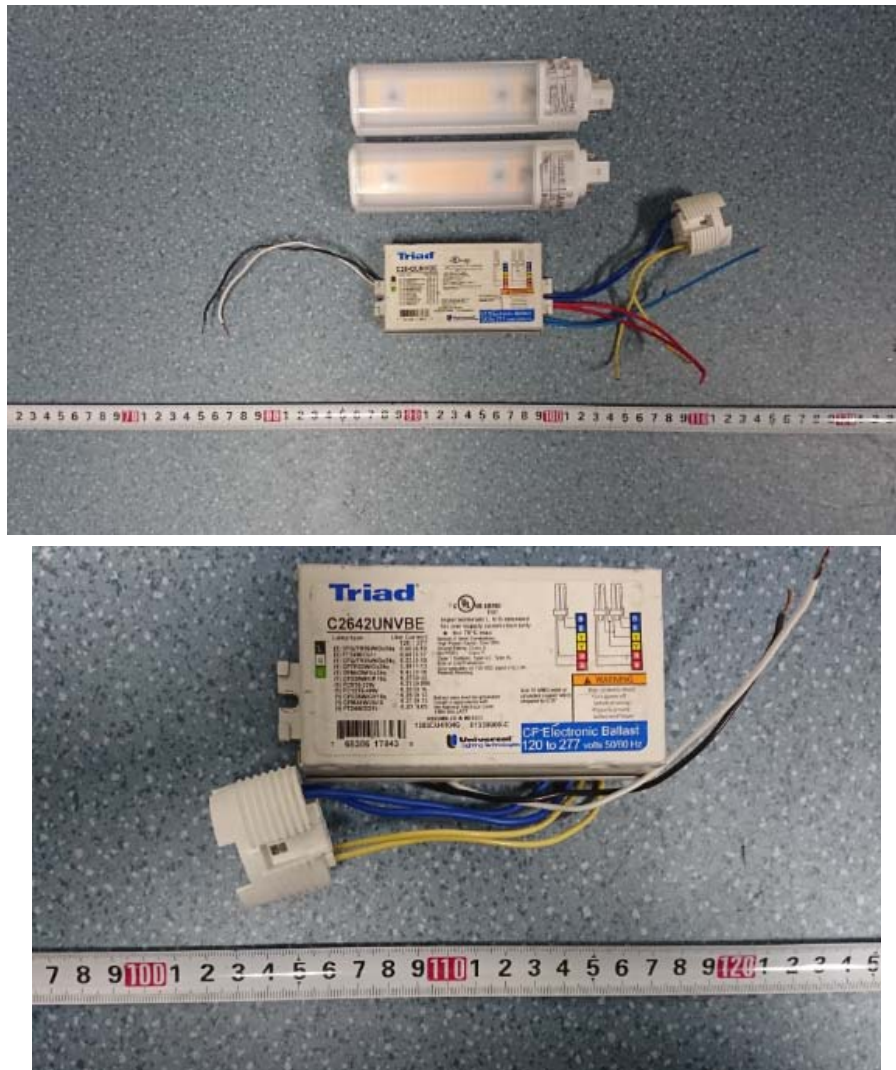


Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: Horizontally-Mounted Lamps
Model	: 14.5PLH/835/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: 3500K LED Tubes supplied by a high frequency fluorescent lamp ballast:
	C2642UNVBE
Manufacturer	: GREEN CREATIVE LTD
Address	: 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 70 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.287	0.124
Power Factor	0.9958	0.9873
Test Power (W)/2	17.16	17.01
THD A%	6.33	7.44
Luminous Efficacy (lm/W)	114.8	115.8
Total Luminous Flux (lm)	1970.0	1970.0
Color Rendering Index (CRI)	82.6	
R9	6.6	
Correlated Color Temperature (CCT)(K)	3397	
Chromaticity Chroma x	0.4116	
Chromaticity Chroma y	0.3948	
Chromaticity Chroma u	0.2381	
Chromaticity Chroma v	0.3426	
Duv	0	
Chromaticity Chroma u'	0.2381	
Chromaticity Chroma v'	0.5139	

Special Color Rendering Indices	
R1	81.9
R2	93.9
R3	93
R4	78.2
R5	82
R6	91.8
R7	81.3
R8	58.9
R9	6.6
R10	85.4
R11	77.2
R12	69.5
R13	85.4
R14	96.7
Rf	81
Rg	92

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 2.47m.

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)	0.284
Power Factor	0.9956
Test Power (W)/2	16.98
Luminous Efficacy (lm/W)	116.7
Total Luminous Flux (lm)	1980.2
Beam Angle (°)	105.4
Center Beam Candle Power (cd)	700
Spacing Criteria	1.20 (0°-180°)/ 1.26 (90°-270°)
Zonal Lumens in the 0°-60°Zone	75.89%
Zonal Lumens in the 60°-90°Zone	20.96%
Zonal Lumens in the 90°-120°Zone	2.70%
Zonal Lumens in the 120°-180°Zone	0.44%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

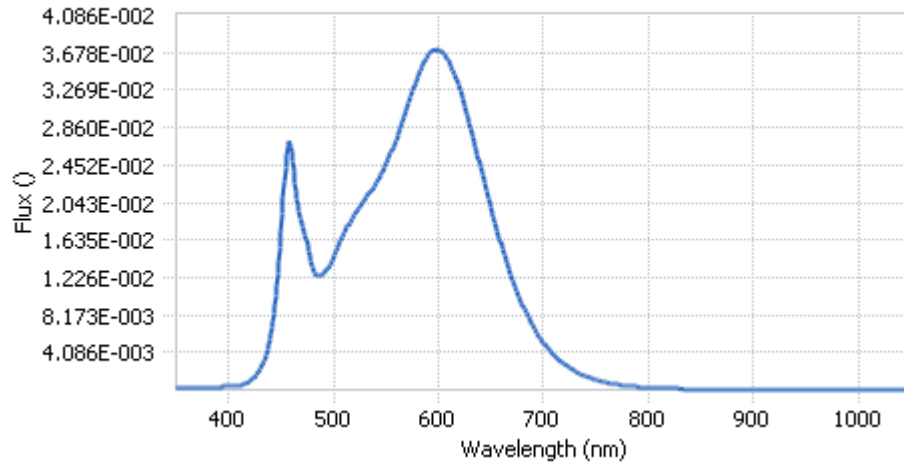


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.93E-04	485	1.24E-02	590	3.64E-02	695	5.98E-03
385	2.90E-04	490	1.27E-02	595	3.70E-02	700	5.12E-03
390	3.21E-04	495	1.34E-02	600	3.70E-02	705	4.40E-03
395	3.39E-04	500	1.46E-02	605	3.67E-02	710	3.78E-03
400	3.53E-04	505	1.59E-02	610	3.59E-02	715	3.24E-03
405	3.91E-04	510	1.71E-02	615	3.45E-02	720	2.78E-03
410	4.80E-04	515	1.82E-02	620	3.28E-02	725	2.38E-03
415	6.42E-04	520	1.92E-02	625	3.09E-02	730	2.04E-03
420	9.43E-04	525	1.99E-02	630	2.87E-02	735	1.74E-03
425	1.42E-03	530	2.08E-02	635	2.65E-02	740	1.49E-03
430	2.29E-03	535	2.15E-02	640	2.43E-02	745	1.28E-03
435	3.71E-03	540	2.25E-02	645	2.20E-02	750	1.10E-03
440	6.09E-03	545	2.35E-02	650	1.98E-02	755	9.46E-04
445	1.02E-02	550	2.47E-02	655	1.76E-02	760	8.13E-04
450	1.73E-02	555	2.60E-02	660	1.57E-02	765	7.04E-04
455	2.55E-02	560	2.74E-02	665	1.38E-02	770	6.03E-04
460	2.59E-02	565	2.91E-02	670	1.21E-02	775	5.16E-04
465	2.07E-02	570	3.08E-02	675	1.06E-02	780	4.49E-04
470	1.82E-02	575	3.26E-02	680	9.22E-03		
475	1.57E-02	580	3.41E-02	685	8.01E-03		
480	1.32E-02	585	3.55E-02	690	6.92E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method

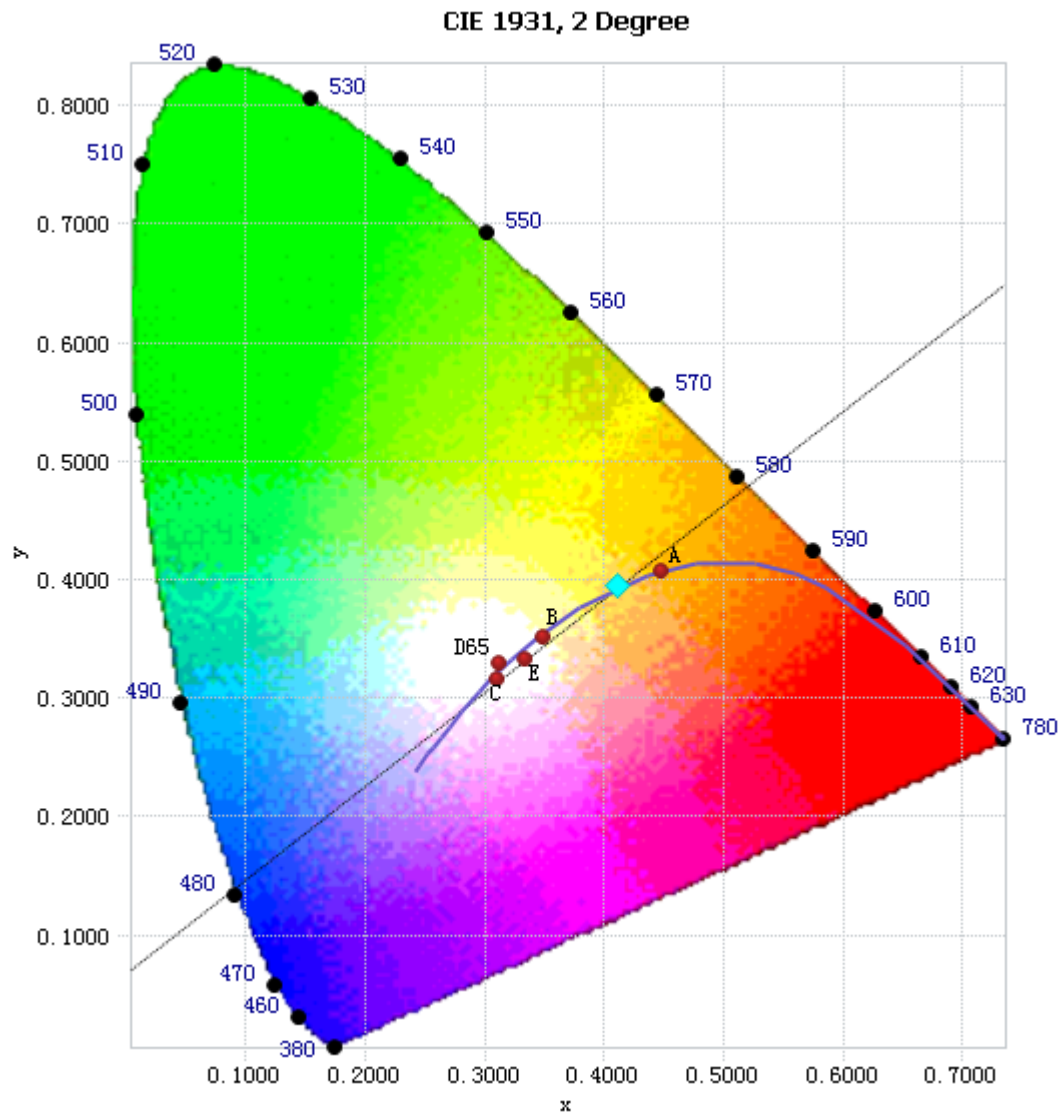


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

Nominal CCT Quadrangles – Sphere Spectroradiometer Method

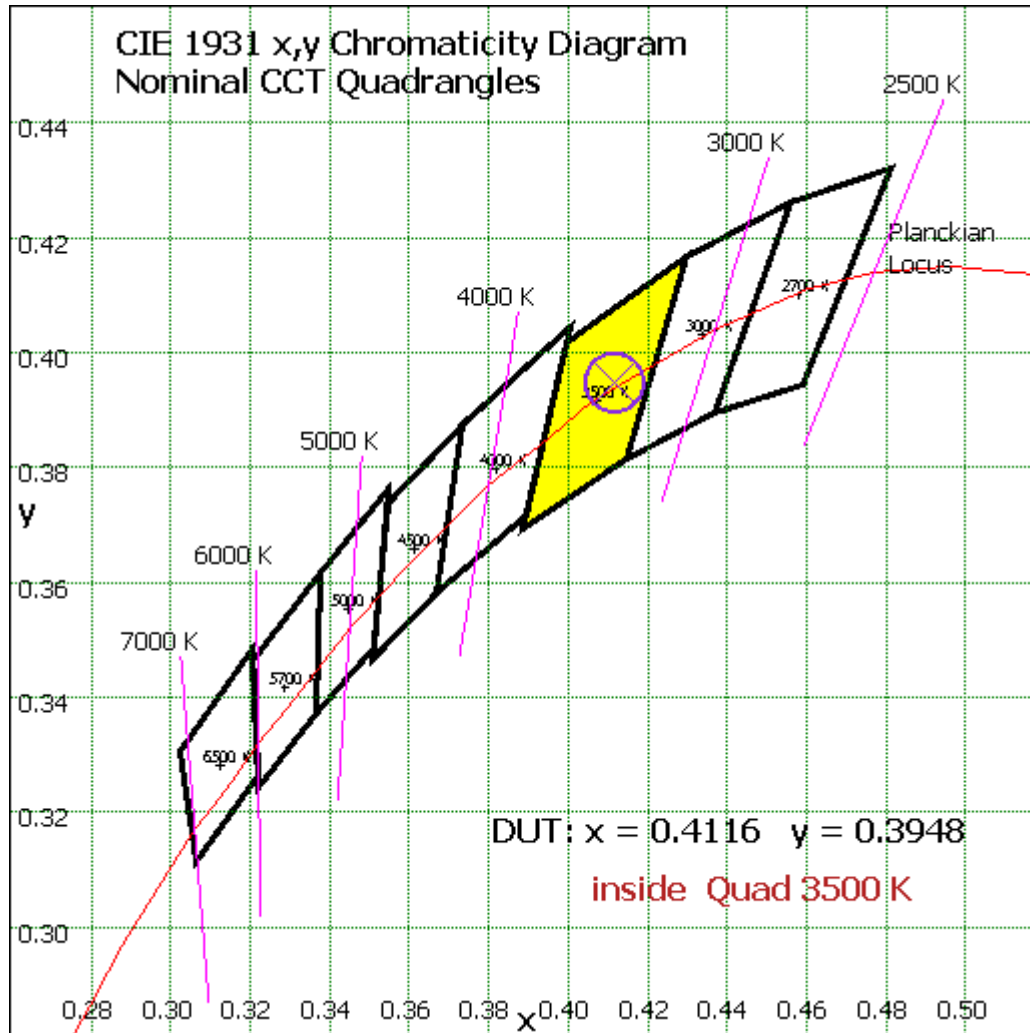


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	66.468	3.36%
10- 20	190.803	9.64%
20- 30	285.392	14.41%
30- 40	335.314	16.93%
40- 50	334.728	16.90%
50- 60	290.163	14.65%
60- 70	218.464	11.03%
70- 80	134.744	6.80%
80- 90	61.938	3.13%
90-100	28.294	1.43%
100-110	15.943	0.81%
110-120	9.244	0.47%
120-130	4.902	0.25%
130-140	2.284	0.12%
140-150	0.87	0.04%
150-160	0.372	0.02%
160-170	0.227	0.01%
170-180	0.079	0.00%
Total	1980.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1502.868	75.89%
60- 90	415.146	20.96%
0-90	1918.014	96.86%
90- 180	62.215	3.14%
0- 180	1980.2	100%

Table 5: Zonal Lumen Data

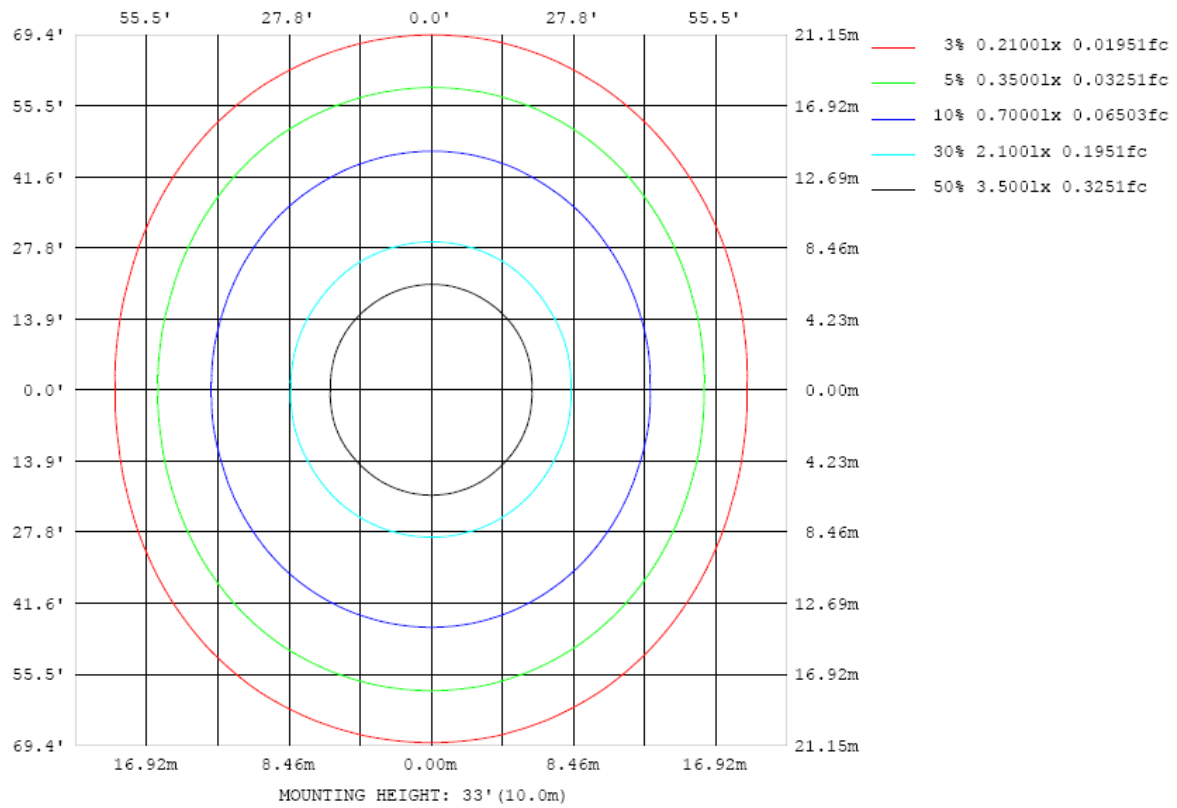


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

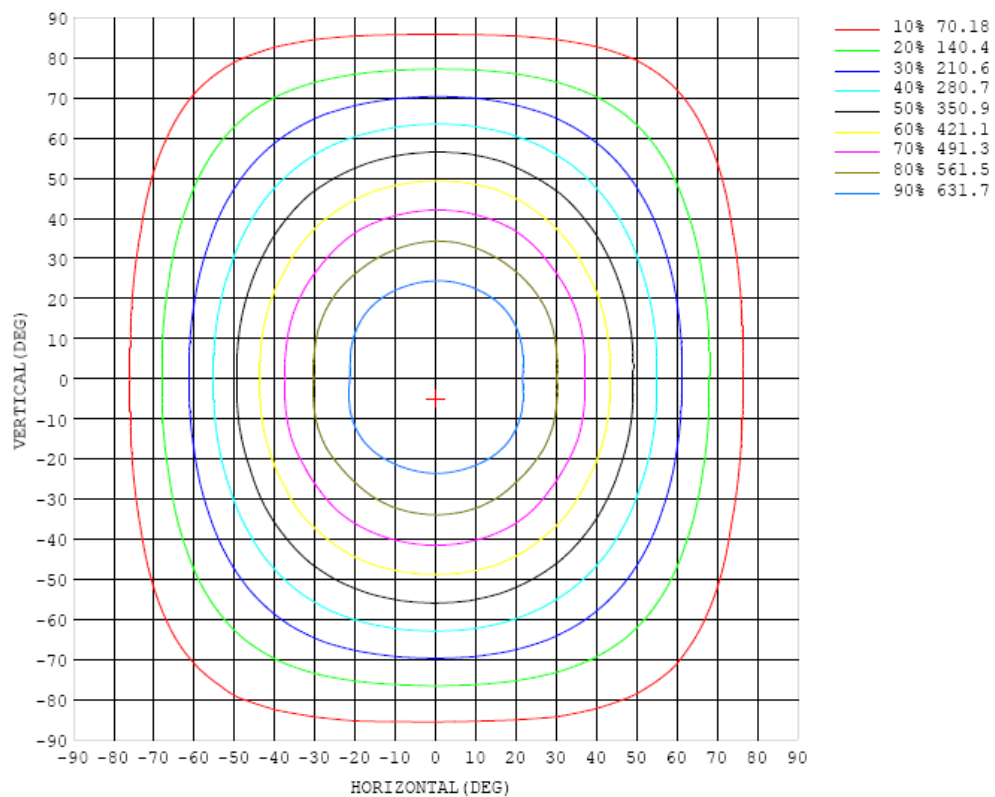


Chart 5: Isocandela Plot

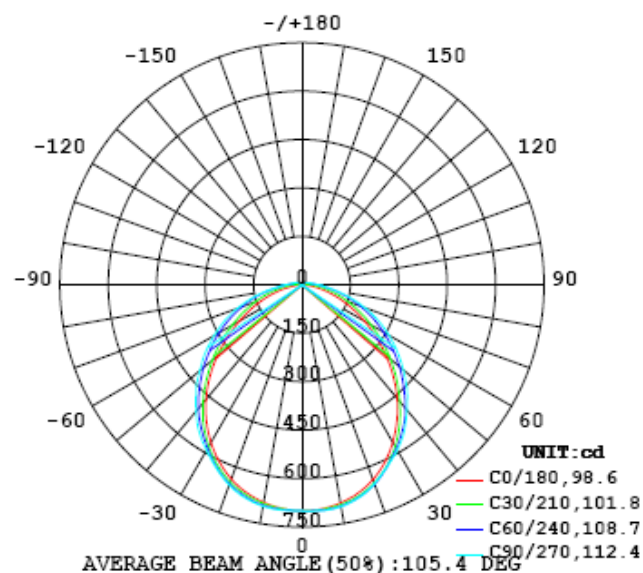


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
5	697	697	698	698	699	700	701	701	702	702	701	701	700	699	698	697	696	696	695
10	686	687	689	691	693	695	696	697	697	697	697	696	695	693	692	690	687	685	684
15	668	670	674	677	679	680	681	682	682	682	682	681	680	679	677	675	672	668	666
20	642	645	650	654	656	657	657	656	656	656	655	655	656	655	654	652	648	643	640
25	606	610	616	620	623	623	622	622	622	623	622	621	621	621	621	619	615	609	605
30	563	567	573	578	580	581	585	588	590	591	589	587	584	581	579	578	575	569	564
35	513	518	524	527	530	537	545	550	552	553	552	550	545	538	532	530	528	522	516
40	458	464	469	471	479	490	498	503	505	505	504	502	499	493	483	476	474	468	463
45	400	406	410	415	427	436	446	455	459	460	459	455	448	440	432	420	414	410	405
50	340	345	348	358	370	382	394	403	408	410	408	404	398	388	375	364	353	349	343
55	280	285	289	301	314	329	342	353	359	360	359	354	346	335	321	306	293	287	283
60	223	227	234	246	261	277	291	302	309	310	309	304	296	283	267	251	238	228	224
65	170	174	183	197	212	227	242	252	258	260	258	254	246	233	217	200	185	174	171
70	122	126	136	151	167	181	193	201	207	207	207	203	197	185	171	154	138	126	121
75	79.5	83.9	95.6	111	125	137	146	152	155	156	155	153	148	140	128	113	96.6	83.2	77.6
80	44.0	49.1	61.7	75.4	87.7	96.8	103	107	109	109	109	108	104	98.3	89.1	76.5	62.0	48.0	41.1
85	17.8	22.9	34.9	47.4	57.8	65.4	70.6	72.1	72.4	73.2	73.2	73.6	70.6	66.5	58.8	46.1	31.3	21.5	15.8
90	3.20	8.12	18.4	29.2	38.2	44.6	48.7	50.6	51.1	50.9	51.3	51.3	49.8	46.0	39.4	28.6	17.4	7.14	1.43
95	0.26	2.86	10.0	18.9	26.8	32.6	36.4	38.2	38.8	38.7	39.0	38.9	37.5	33.9	27.8	18.9	9.82	3.17	0.14
100	0.14	1.39	5.97	12.8	19.4	24.6	28.1	30.0	30.8	30.8	31.0	30.6	29.1	25.6	20.2	12.7	6.03	1.26	0.15
105	0.17	0.72	3.63	8.94	14.4	18.9	22.3	24.2	25.1	25.2	25.2	24.6	22.9	19.7	15.1	9.42	2.57	0.73	0.16
110	0.21	0.63	2.37	6.05	10.7	14.8	17.8	19.7	20.6	20.8	20.7	20.0	18.4	15.4	11.4	5.37	2.20	0.56	0.23
115	0.25	0.46	1.58	4.15	7.77	11.4	14.2	16.0	17.0	17.2	17.0	16.2	14.6	12.0	7.18	4.31	1.42	0.40	0.24
120	0.28	0.38	1.17	2.92	5.55	8.44	11.0	12.7	13.7	13.9	13.7	12.9	11.4	7.88	5.70	2.89	1.30	0.33	0.29
125	0.32	0.37	0.85	2.07	4.04	6.18	8.19	9.73	10.6	10.9	10.7	9.91	7.97	6.15	4.05	1.88	0.87	0.37	0.37
130	0.37	0.39	0.70	1.46	2.83	4.53	6.05	7.27	8.08	8.34	8.06	7.21	5.92	4.63	2.49	1.25	0.48	0.42	0.44
135	0.43	0.45	0.54	1.03	1.93	3.09	4.25	5.36	5.95	6.00	5.82	5.29	4.36	2.67	1.75	0.89	0.57	0.48	0.56
140	0.49	0.51	0.55	0.68	1.21	2.12	2.99	3.49	3.83	3.99	3.82	3.17	2.60	2.04	1.24	0.71	0.58	0.53	0.65
145	0.54	0.55	0.57	0.64	0.77	1.25	1.69	2.31	2.62	2.60	2.55	2.28	1.53	1.05	0.84	0.59	0.59	0.57	0.73
150	0.61	0.58	0.59	0.62	0.67	0.74	1.09	1.36	1.44	1.41	1.33	1.17	0.87	0.67	0.61	0.59	0.60	0.57	0.78
155	0.70	0.67	0.63	0.63	0.65	0.67	0.69	0.77	0.81	0.78	0.75	0.75	0.67	0.63	0.64	0.64	0.63	0.62	0.81
160	0.80	0.80	0.76	0.71	0.68	0.67	0.68	0.68	0.67	0.66	0.69	0.70	0.68	0.65	0.65	0.64	0.65	0.65	0.83
165	0.89	0.90	0.90	0.86	0.82	0.78	0.74	0.72	0.70	0.69	0.70	0.70	0.71	0.71	0.71	0.70	0.69	0.68	0.82
170	0.95	0.98	1.00	1.00	0.96	0.92	0.88	0.84	0.80	0.77	0.74	0.73	0.73	0.73	0.73	0.73	0.73	0.72	0.82
175	0.77	0.78	0.99	1.00	0.99	0.97	0.95	0.92	0.90	0.87	0.85	0.83	0.82	0.80	0.80	0.79	0.78	0.78	0.79
180	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71

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	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700		
5	695	696	696	697	698	699	699	700	700	700	700	699	699	698	698	697	697		
10	684	686	688	690	692	694	695	696	696	696	696	695	693	692	690	688	686		
15	667	670	673	676	678	679	681	682	683	683	682	681	680	678	676	673	669		
20	641	646	650	653	655	657	658	659	660	660	660	659	658	656	653	649	644		
25	608	613	618	622	624	625	625	626	627	628	627	627	627	625	622	617	610		
30	567	574	578	582	583	585	588	590	592	592	590	588	587	585	580	575	568		
35	521	527	531	534	538	544	550	554	556	556	552	547	541	536	531	525	518		
40	467	473	478	483	491	501	506	508	511	510	508	504	494	483	476	471	465		
45	410	416	420	431	442	449	456	461	464	463	459	451	442	430	419	413	407		
50	349	355	363	376	387	399	406	411	414	413	409	400	387	375	362	353	346		
55	288	294	306	320	335	346	356	363	366	365	359	346	334	319	306	293	286		
60	229	237	251	266	282	297	305	312	315	314	307	296	282	266	251	238	229		
65	175	185	200	216	232	246	256	262	265	264	258	247	233	217	201	187	176		
70	126	138	154	170	185	198	206	211	214	213	207	198	186	172	156	141	128		
75	83.0	96.1	113	128	141	151	157	160	162	162	158	152	142	130	115	99.2	86.2		
80	47.1	60.8	76.3	89.7	99.7	107	111	112	113	113	111	107	101	91.4	79.0	64.2	50.8		
85	21.4	34.0	47.3	58.4	66.4	71.5	74.1	74.7	74.6	74.7	74.0	71.6	66.9	59.9	49.6	36.9	24.5		
90	7.21	18.0	29.3	38.7	45.5	49.6	51.5	51.8	51.3	51.4	51.0	49.2	45.4	39.3	30.6	19.9	9.18		
95	2.67	9.88	19.1	27.4	33.5	37.3	39.0	39.3	38.8	38.8	38.4	36.8	33.3	27.7	20.0	11.0	3.49		
100	1.16	5.94	12.9	20.0	25.5	29.1	30.8	31.2	31.0	30.9	30.3	28.7	25.4	20.3	13.6	6.70	1.78		
105	0.92	3.71	8.98	14.9	19.8	23.2	25.0	25.6	25.5	25.3	24.7	22.9	19.8	15.2	9.54	4.26	1.09		
110	0.63	2.35	6.31	11.0	15.4	18.6	20.5	21.2	21.2	21.0	20.2	18.4	15.5	11.3	6.76	2.79	0.75		
115	0.47	1.31	4.40	8.13	11.7	14.6	16.6	17.5	17.6	17.3	16.5	14.6	11.9	8.42	4.79	1.96	0.58		
120	0.39	1.03	2.99	5.92	8.85	11.3	13.0	13.8	14.0	13.8	12.9	11.3	9.00	6.19	3.35	1.32	0.48		
125	0.43	0.65	1.64	4.20	6.54	8.56	10.0	10.8	11.0	10.8	10.00	8.63	6.70	4.46	2.32	0.90	0.39		
130	0.49	0.62	1.18	2.73	4.71	6.35	7.56	8.25	8.43	8.24	7.58	6.43	4.88	3.10	1.46	0.57	0.43		
135	0.53	0.67	0.88	1.60	3.14	4.55	5.54	6.11	6.28	6.13	5.58	4.66	3.40	1.72	0.87	0.60	0.52		
140	0.68	0.63	0.80	1.12	1.82	2.61	3.86	4.33	4.47	4.36	3.94	2.84	1.83	1.12	0.74	0.65	0.62		
145	0.76	0.78	0.74	0.78	1.23	1.64	1.95	2.26	2.38	2.35	2.01	1.61	1.18	0.87	0.79	0.71	0.70		
150	0.82	0.83	0.79	0.83	0.95	1.13	1.27	1.39	1.36	1.32	1.21	1.04	0.89	0.81	0.79	0.83	0.83		
155	0.81	0.83	0.80	0.87	0.88	0.90	0.87	0.89	0.87	0.86	0.85	0.86	0.82	0.83	0.89	0.90	0.91		
160	0.83	0.82	0.81	0.82	0.83	0.84	0.84	0.83	0.80	0.80	0.81	0.84	0.82	0.90	0.92	0.95	0.97		
165	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.80	0.80	0.80	0.80	0.90	0.92	0.95	0.98	1.01		
170	0.83	0.83	0.82	0.82	0.82	0.81	0.80	0.79	0.81	0.79	0.79	0.80	0.80	0.93	0.96	0.98	1.01		
175	0.80	0.79	0.79	0.79	0.79	0.78	0.78	0.78	0.77	0.77	0.77	0.78	0.78	0.78	0.79	0.79	0.79		
180	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	PF2010A	HZTE028-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	DPS1060	HZTE001-06	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	WY12010	HZTE004-03	Aug. 10, 2017	Aug. 09, 2018
Temperature recorder	JM624U	HZTE018-08	Aug. 17, 2017	Aug. 16, 2018
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 16, 2017	Aug. 15, 2018
Standard source	D908	HZTE012-01	Aug. 20, 2017	Aug. 19, 2018
Integrate Sphere system	2M	HZTE015-01	Aug. 23, 2017	Aug. 22, 2018
Digital Power Meter	WT210	HZTE008-01	Aug. 10, 2017	Aug. 09, 2018
AC Power Supply	PCR 500L	HZTE001-07	Aug. 10, 2017	Aug. 09, 2018
DC Power Supply	IT6154	HZTE004-04	Aug. 10, 2017	Aug. 09, 2018
Standard source	SCL-1400	HZTE012-02	Aug. 20, 2017	Aug. 19, 2018
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 16, 2017	Aug. 15, 2018
Temperature Meter	TES1310	HZTE017-01	Aug. 17, 2017	Aug. 16, 2018

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

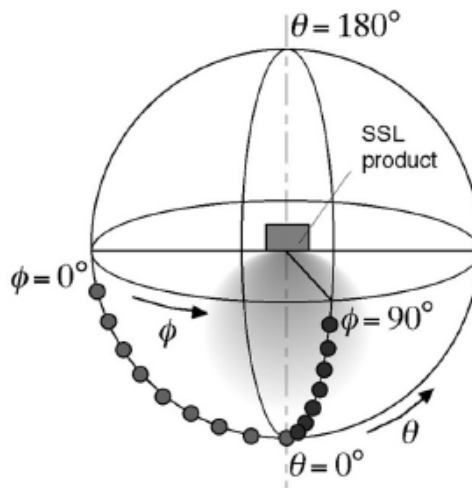
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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