



LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 14.5T5HO/3F/840/BYP

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020002aa

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

Review by:

April Zou

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Feb. 22, 2019

Approved by:



Jim Zhang

Manager: Jim Zhang
Feb. 22, 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: 14.5T5HO/3F/840/BYP

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
136.2	1961.0	14.40	0.9814
CCT (K)	CRI	Stabilization Time (Light & Power)	
4023	82.1	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 : Feb. 01, 2019

Date of Test : Feb. 13, 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

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Sample Photo



Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 14.5T5HO/3F/840/BYP
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: 4000K
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 Horizontal. 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)	0.122	0.056
Power Factor	0.9814	0.9467
Test Power (W)	14.40	14.76
THD A%	17.53	14.56
Luminous Efficacy (lm/W)	136.2	132.9
Total Luminous Flux (lm)	1961.0	1961.0
Color Rendering Index (CRI)	82.1	
R9	3.2	
Correlated Color Temperature (CCT)(K)	4023	
Chromaticity Chroma x	0.3811	
Chromaticity Chroma y	0.3827	
Chromaticity Chroma u	0.2232	
Chromaticity Chroma v	0.3362	
Duv	0.0019	
Chromaticity Chroma u'	0.2232	
Chromaticity Chroma v'	0.5043	

Special Color Rendering Indices	
R1	79.8
R2	87.3
R3	94.1
R4	82
R5	80.3
R6	83.3
R7	86.1
R8	63.5
R9	3.2
R10	70.9
R11	81.4
R12	62.9
R13	81.4
R14	96.8
Rf	84
Rg	96

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 30m.

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)	0.123
Power Factor	0.9791
Test Power (W)	14.48
Luminous Efficacy (lm/W)	133.6
Total Luminous Flux (lm)	1935.0
Beam Angle (°)	117.8
Center Beam Candle Power (cd)	537
Spacing Criteria	1.23 (0 °-180 °)/ 1.32 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	63.47%
Zonal Lumens in the 60 °-90 °Zone	25.85%
Zonal Lumens in the 90 °-120 °Zone	8.13%
Zonal Lumens in the 120 °-180 °Zone	2.55%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

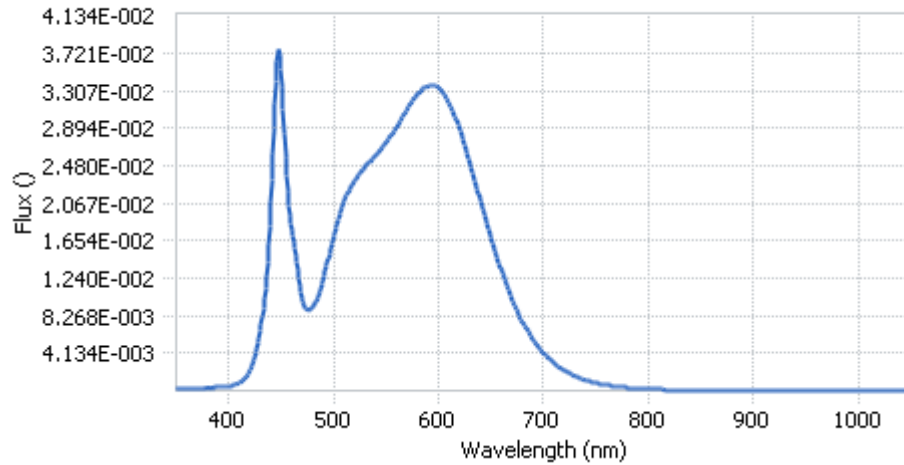
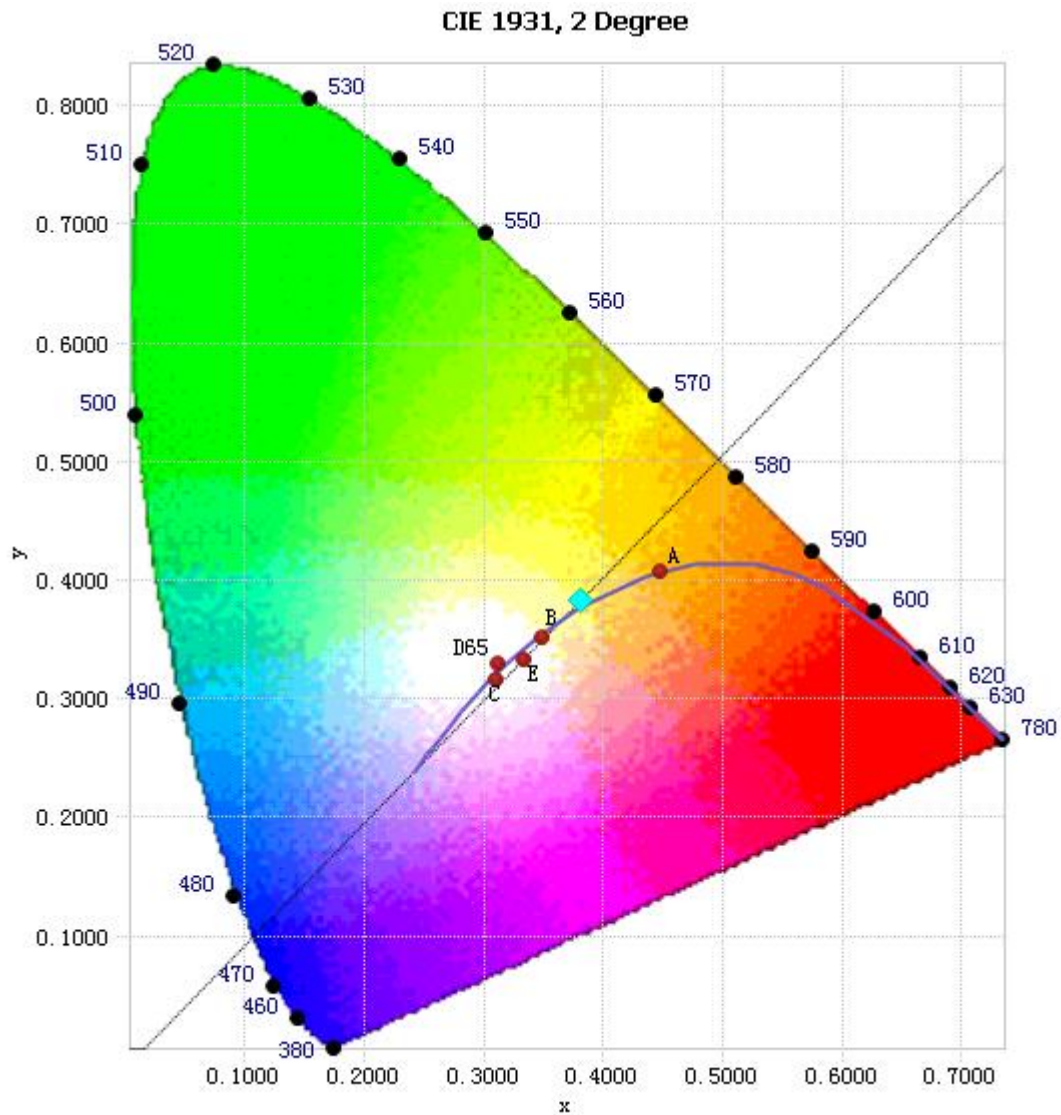


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.46E-04	485	1.03E-02	590	3.36E-02	695	4.84E-03
385	3.45E-04	490	1.22E-02	595	3.36E-02	700	4.16E-03
390	3.94E-04	495	1.47E-02	600	3.33E-02	705	3.56E-03
395	4.26E-04	500	1.70E-02	605	3.27E-02	710	3.03E-03
400	4.72E-04	505	1.91E-02	610	3.17E-02	715	2.59E-03
405	5.95E-04	510	2.09E-02	615	3.03E-02	720	2.22E-03
410	8.55E-04	515	2.22E-02	620	2.87E-02	725	1.90E-03
415	1.35E-03	520	2.32E-02	625	2.70E-02	730	1.62E-03
420	2.26E-03	525	2.39E-02	630	2.50E-02	735	1.38E-03
425	3.86E-03	530	2.47E-02	635	2.29E-02	740	1.19E-03
430	6.57E-03	535	2.52E-02	640	2.09E-02	745	1.01E-03
435	1.14E-02	540	2.59E-02	645	1.88E-02	750	8.65E-04
440	2.08E-02	545	2.66E-02	650	1.68E-02	755	7.42E-04
445	3.41E-02	550	2.74E-02	655	1.50E-02	760	6.37E-04
450	3.54E-02	555	2.82E-02	660	1.32E-02	765	5.44E-04
455	2.37E-02	560	2.90E-02	665	1.16E-02	770	4.73E-04
460	1.78E-02	565	3.01E-02	670	1.01E-02	775	4.04E-04
465	1.41E-02	570	3.10E-02	675	8.78E-03	780	3.52E-04
470	1.02E-02	575	3.19E-02	680	7.61E-03		
475	8.91E-03	580	3.27E-02	685	6.58E-03		
480	9.30E-03	585	3.34E-02	690	5.66E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3811, 0.3827)

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

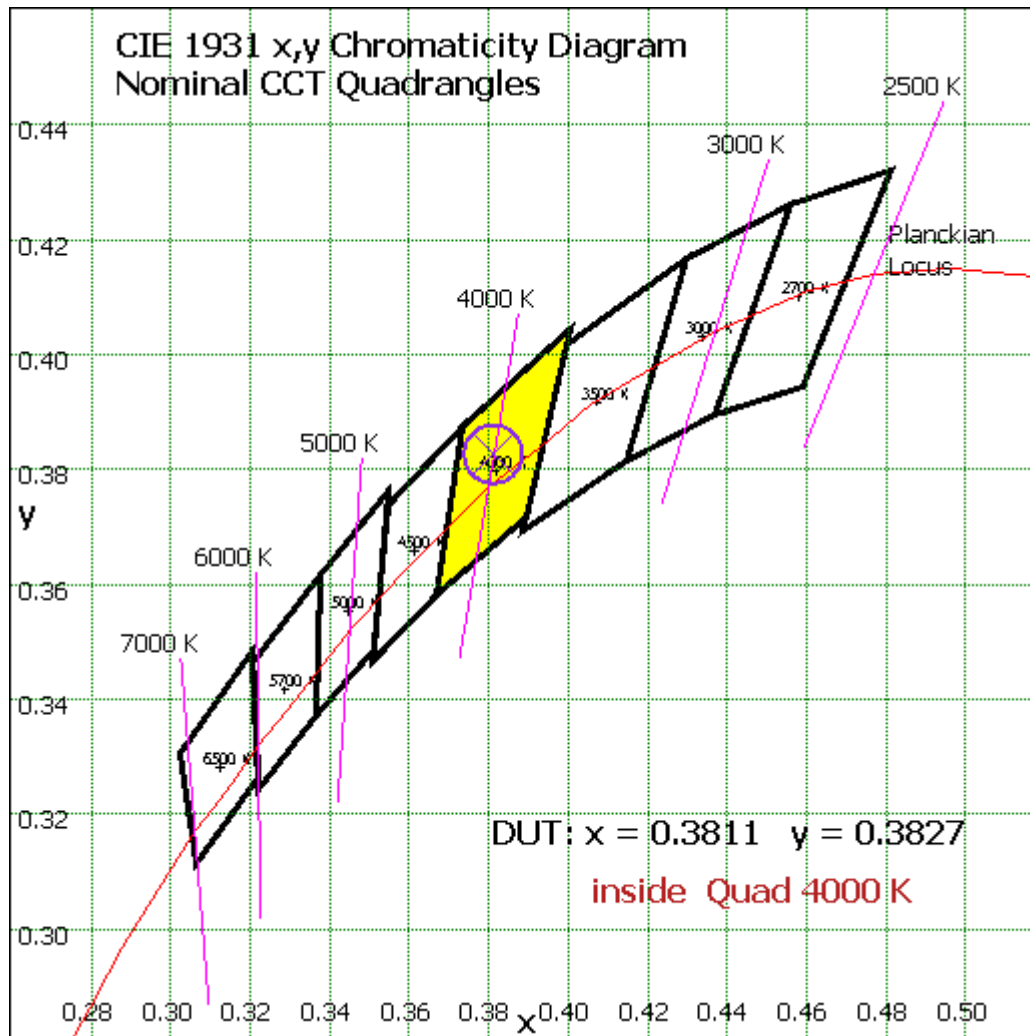


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

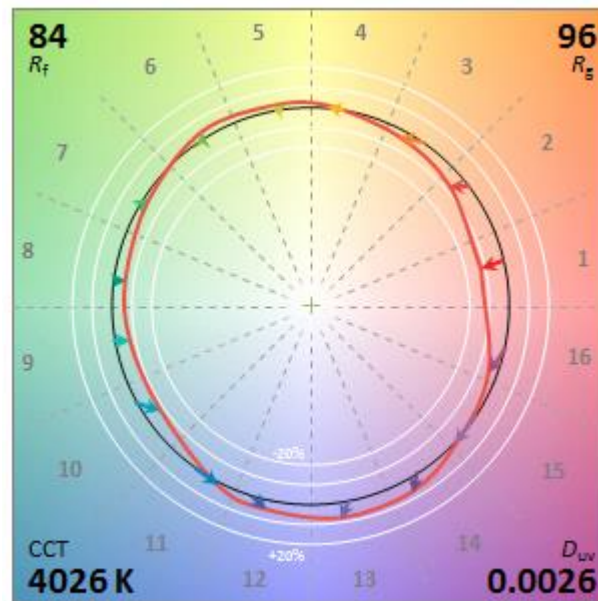


Chart 4: Color Vector Diagram of TM-30-18

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	50.798	2.63%
10- 20	145.518	7.52%
20- 30	220.769	11.41%
30- 40	267.343	13.82%
40- 50	280.866	14.52%
50- 60	262.902	13.59%
60- 70	220.747	11.41%
70- 80	166.05	8.58%
80- 90	113.45	5.86%
90-100	75.419	3.90%
100-110	49.833	2.58%
110-120	31.983	1.65%
120-130	20.531	1.06%
130-140	13.129	0.68%
140-150	8.119	0.42%
150-160	4.671	0.24%
160-170	2.252	0.12%
170-180	0.578	0.03%
Total	1935.0	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1228.196	63.47%
60- 90	500.247	25.85%
0-90	1728.443	89.33%
90- 180	206.515	10.67%
0- 180	1935.0	100%

Table 5: Zonal Lumen

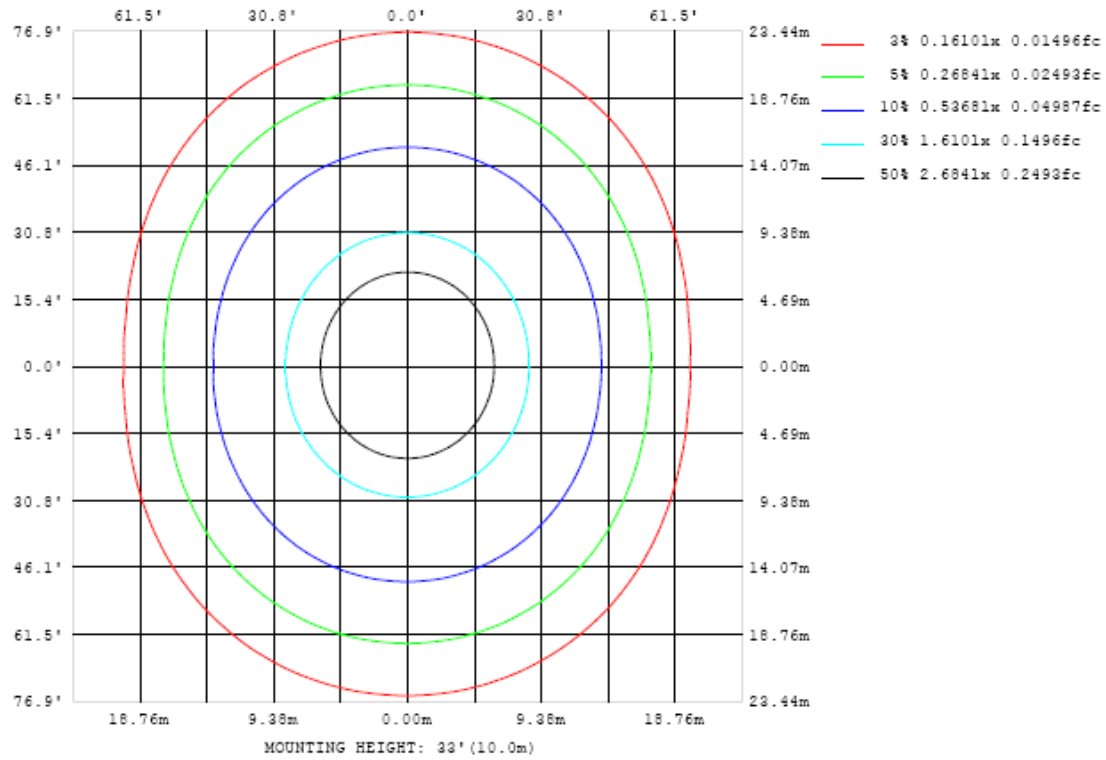


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

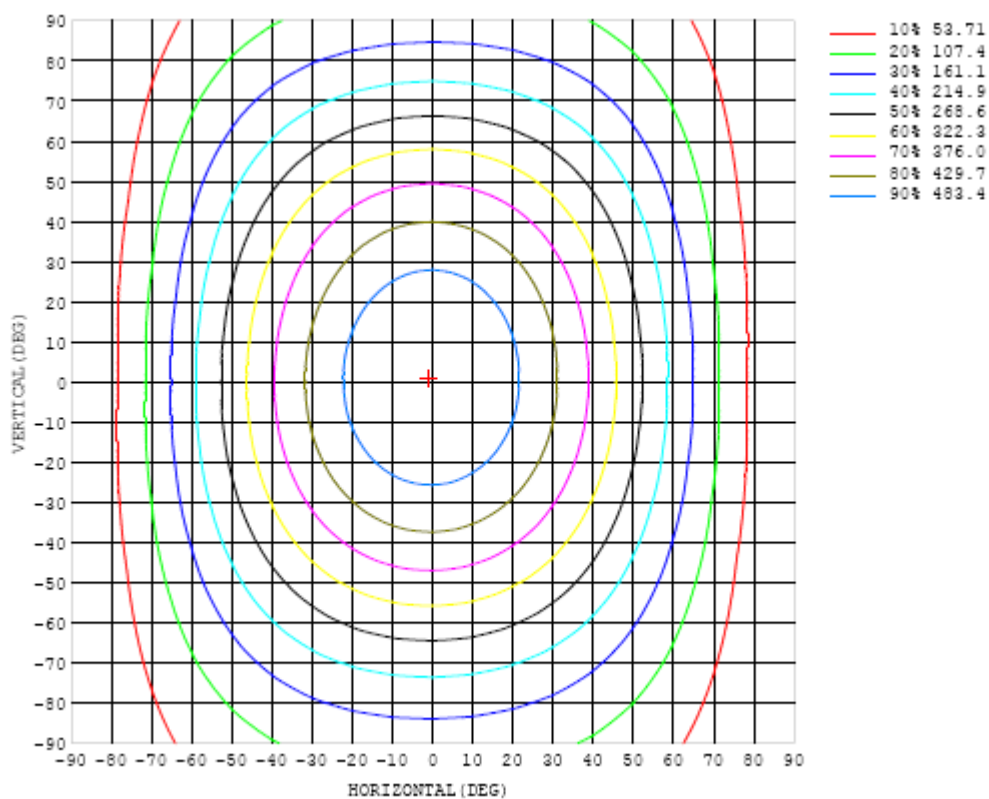


Chart 6: Isocandela Plot

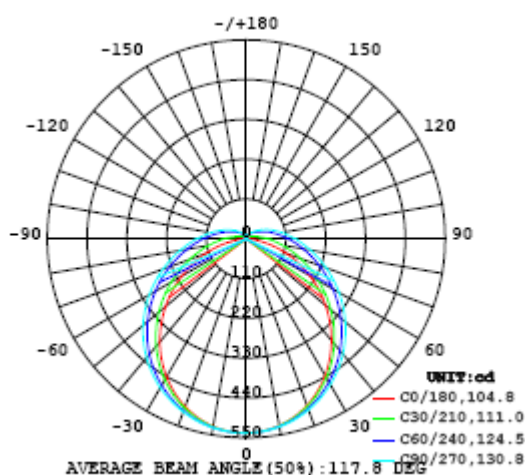


Chart 7: Polar Candela Distribution

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	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537
5	533	533	533	534	534	534	534	534	534	534	534	534	535	534	535	534	534	535	535
10	525	525	525	525	526	526	527	527	527	528	528	528	528	527	527	527	526	526	527
15	510	510	511	512	513	514	515	516	517	517	517	517	517	516	515	514	513	513	513
20	491	491	492	493	495	497	500	501	503	503	503	503	502	500	498	496	495	494	494
25	466	466	468	470	473	477	480	483	485	486	486	485	483	480	477	474	472	470	470
30	436	437	439	443	448	453	457	461	464	465	465	463	460	456	452	448	444	442	441
35	403	404	407	412	419	425	431	437	440	442	442	439	435	430	423	418	413	409	408
40	367	368	372	379	387	395	403	410	414	415	415	412	407	400	392	385	378	373	372
45	327	329	334	343	353	363	373	380	386	387	387	383	377	368	359	349	341	335	333
50	287	288	295	305	318	330	341	350	356	358	357	353	345	336	324	312	302	294	291
55	245	247	255	268	282	296	309	318	325	327	326	321	313	302	288	274	262	253	249
60	202	205	215	230	247	263	277	287	294	296	295	290	281	268	253	236	222	211	206
65	160	164	176	194	213	230	245	256	263	265	264	259	249	235	219	200	183	169	163
70	118	124	140	160	181	199	215	226	233	235	234	228	218	204	186	166	146	129	120
75	78.2	85.9	106	129	151	171	186	197	204	207	205	200	190	175	156	135	112	90.9	79.5
80	41.7	52.4	76.1	102	125	145	160	171	178	180	179	173	163	149	130	107	81.5	57.2	43.0
85	13.3	26.6	52.2	78.4	102	122	137	148	154	156	155	150	140	126	106	83.3	57.2	30.9	13.7
90	0.22	11.6	35.0	59.9	82.6	102	116	127	133	135	134	129	119	105	86.6	64.1	39.1	15.1	0.53
95	0.34	5.14	23.6	45.6	66.7	84.6	98.5	108	115	117	115	110	101	87.5	70.1	49.2	26.8	7.16	0.36
100	0.54	3.66	16.0	34.9	53.7	70.1	83.0	92.4	98.0	100	98.7	93.8	85.2	72.7	56.6	37.9	18.4	4.59	0.53
105	0.95	3.23	11.9	26.1	43.0	57.9	69.9	78.4	83.8	85.6	84.3	79.7	71.7	60.2	45.5	28.7	13.5	3.84	0.83
110	1.41	3.44	9.88	20.8	33.6	46.8	58.0	66.1	71.1	72.9	71.6	67.3	59.7	48.9	35.7	22.4	10.8	3.73	1.26
115	1.89	3.63	8.76	17.3	27.6	37.8	46.8	54.3	59.1	60.8	59.5	55.3	48.2	39.2	28.9	18.4	9.23	3.80	1.66
120	2.44	4.05	8.16	14.8	23.0	31.5	38.9	44.6	48.2	49.5	48.5	45.2	39.7	32.4	24.0	15.4	8.41	4.15	2.14
125	3.00	4.50	7.79	13.1	19.7	26.4	32.5	37.3	40.3	41.3	40.5	37.7	33.2	27.1	20.3	13.4	7.98	4.62	2.69
130	3.50	4.92	7.53	11.8	17.1	22.5	27.4	31.2	33.8	34.7	33.9	31.6	27.9	22.9	17.4	12.0	7.80	5.10	3.25
135	3.89	5.31	7.41	10.8	14.9	19.2	23.1	26.2	28.3	29.1	28.5	26.6	23.5	19.6	15.1	11.0	7.66	5.57	3.86
140	4.36	5.76	7.40	10.0	13.2	16.6	19.7	22.1	23.8	24.4	23.9	22.4	20.0	16.9	13.5	10.2	7.66	6.05	4.47
145	4.85	6.19	7.43	9.39	11.9	14.4	16.8	18.7	20.0	20.4	20.0	18.8	17.0	14.6	12.0	9.65	7.77	6.49	5.08
150	5.26	6.49	7.38	8.84	10.7	12.6	14.3	15.8	16.7	17.1	16.8	15.9	14.4	12.7	10.8	9.16	7.87	6.87	5.61
155	5.40	6.66	7.43	8.45	9.67	11.0	12.2	13.3	13.9	14.2	14.0	13.4	12.4	11.0	9.84	8.83	7.96	7.23	6.17
160	5.42	6.93	7.48	7.72	8.77	9.74	10.5	11.0	11.4	11.6	11.4	11.1	10.6	9.88	9.15	8.53	7.98	7.48	6.46
165	5.20	6.02	6.86	7.56	7.65	8.67	9.28	9.60	9.85	9.95	9.92	9.75	9.45	9.06	8.63	8.27	7.94	7.62	6.25
170	4.70	5.15	5.59	6.12	6.80	7.42	8.16	8.59	8.71	8.78	8.78	8.72	8.60	8.41	8.19	8.00	7.82	7.50	5.88
175	4.70	4.69	4.71	4.81	5.15	5.71	6.42	7.06	7.55	7.86	7.93	7.91	7.87	7.80	7.72	7.65	7.43	6.61	5.37
180	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24

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	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537		
5	535	535	535	535	535	536	536	536	536	535	535	535	535	535	534	534	534		
10	527	527	528	528	529	530	530	531	531	530	530	529	528	527	526	525	525		
15	513	514	516	517	519	520	521	522	522	521	520	519	517	515	513	512	511		
20	495	496	498	501	504	506	508	509	509	508	507	505	502	499	496	493	492		
25	471	473	476	480	485	488	491	493	494	493	490	487	483	478	474	470	467		
30	442	446	450	456	462	468	472	475	475	474	471	466	460	454	447	442	438		
35	410	414	421	428	436	444	449	453	454	452	448	442	434	426	417	410	405		
40	374	379	388	397	408	417	423	428	429	427	423	416	406	395	385	376	369		
45	335	342	352	365	377	387	395	401	402	400	395	386	375	362	350	339	331		
50	294	303	315	330	344	356	365	371	373	370	365	355	343	328	313	300	290		
55	253	263	277	294	310	324	333	340	341	339	333	323	309	293	276	260	249		
60	210	222	239	258	275	290	301	307	309	307	301	290	275	257	238	221	207		
65	168	183	202	223	242	257	268	275	277	275	268	257	242	223	202	182	166		
70	127	145	167	189	209	225	236	243	245	243	236	225	209	190	168	145	126		
75	88.1	109	134	158	178	194	206	212	214	212	206	195	179	159	136	111	88.6		
80	54.1	78.7	105	130	150	166	177	184	186	184	178	167	152	132	108	81.5	56.2		
85	27.3	54.2	81.0	105	125	141	151	158	160	158	152	142	127	108	84.2	57.9	30.7		
90	11.5	35.9	61.7	84.7	104	119	129	135	137	135	130	120	106	87.4	64.9	39.8	15.1		
95	4.90	23.5	46.5	67.6	85.7	99.7	109	115	117	115	110	101	87.8	70.4	50.0	27.3	7.14		
100	3.19	15.6	34.5	54.0	70.2	83.3	92.3	97.6	99.4	98.1	93.2	84.8	72.4	56.9	37.9	18.4	5.03		
105	2.62	11.6	25.8	41.9	57.1	68.9	77.3	82.4	84.3	83.0	78.5	70.4	59.4	44.6	28.4	14.1	4.05		
110	2.56	9.29	20.3	33.2	45.5	56.2	63.9	68.6	70.4	69.2	64.5	57.8	47.5	35.6	23.0	11.5	3.94		
115	3.06	7.94	16.7	27.1	37.3	46.1	52.6	56.7	58.3	57.3	53.6	47.6	39.3	29.4	19.0	9.99	4.08		
120	3.40	7.25	14.1	22.5	31.0	38.4	43.9	47.5	48.8	48.0	45.0	39.8	32.7	24.4	16.1	9.04	4.27		
125	3.74	6.64	12.1	19.0	25.9	32.0	36.8	39.8	41.0	40.2	37.7	33.3	27.4	20.7	14.0	8.38	4.53		
130	4.24	6.48	10.7	16.2	21.8	26.9	30.8	33.3	34.3	33.7	31.5	27.9	23.2	17.8	12.4	7.85	4.74		
135	4.54	6.81	9.65	13.9	18.5	22.6	25.8	27.9	28.7	28.2	26.4	23.5	19.6	15.3	11.1	7.58	4.93		
140	4.81	6.94	8.86	12.0	15.8	19.1	21.6	23.3	24.0	23.6	22.1	19.8	16.8	13.3	9.96	7.54	5.06		
145	4.95	6.97	8.65	10.7	13.2	16.0	18.0	19.4	19.9	19.6	18.5	16.6	14.2	11.5	9.17	7.39	5.06		
150	4.81	7.14	8.41	9.88	11.4	13.1	14.8	15.9	16.4	16.1	15.1	13.7	12.0	10.3	8.75	7.31	4.98		
155	4.51	7.16	8.16	9.22	10.4	11.4	12.2	12.8	13.0	12.9	12.4	11.6	10.7	9.22	8.26	7.35	4.81		
160	4.38	5.97	7.64	8.68	9.41	10.2	10.8	11.2	11.3	11.2	10.9	10.4	9.16	8.46	7.58	6.57	4.59		
165	4.61	4.73	5.46	7.22	8.62	9.15	9.51	9.73	9.82	9.79	9.42	8.12	6.94	6.42	5.91	5.10	4.75		
170	4.49	4.18	4.36	4.43	4.84	5.89	7.43	8.53	8.59	7.32	5.27	5.25	4.98	4.89	4.77	4.67	4.67		
175	4.75	4.68	4.54	4.97	5.55	5.91	6.04	5.50	2.30	5.71	6.22	6.18	5.82	5.54	5.24	4.83	4.68		
180	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24		

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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