

LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 14.5T8/4F/850/DEB/RC

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18120037f

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

Review by:



Engineer: April Zou
Jan. 09, 2019

Approved by:



Manager: Jim Zhang
Jan. 09, 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: 14.5T8/4F/850/DEB/RC

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
148.4	2233.0	15.05	0.9844
CCT (K)	CRI	Stabilization Time (Light & Power)	
5071	83.3	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 : Dec. 26, 2018

Date of Test : Dec. 28, 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	: LED Tube
Model	: 14.5T8/4F/850/DEB/RC
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: G13 base, 5000K
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 24.9°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)	0.127	0.059
Power Factor	0.9844	0.9212
Test Power (W)	15.05	14.98
THD A%	16.64	20.40
Luminous Efficacy (lm/W)	148.4	147.1
Total Luminous Flux (lm)	2233.0	2204.0
Color Rendering Index (CRI)	83.3	
R9	9.1	
Correlated Color Temperature (CCT)(K)	5071	
Chromaticity Chroma x	0.3433	
Chromaticity Chroma y	0.3538	
Chromaticity Chroma u	0.2094	
Chromaticity Chroma v	0.3236	
Duv	0.0011	
Chromaticity Chroma u'	0.2094	
Chromaticity Chroma v'	0.4855	

Special Color Rendering Indices	
R1	81.7
R2	87.4
R3	91.8
R4	84.2
R5	83.0
R6	83.2
R7	86.5
R8	68.3
R9	9.1
R10	70.6
R11	84.3
R12	67.2
R13	82.9
R14	95.6
Rf	82
Rg	97

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 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)	0.128
Power Factor	0.9848
Test Power (W)	15.13
Luminous Efficacy (lm/W)	145.4
Total Luminous Flux (lm)	2199.2
Beam Angle (°)	156.1
Center Beam Candle Power (cd)	388
Spacing Criteria	1.26(0 °-180 °)/ 1.40 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	44.47%
Zonal Lumens in the 60 °-90 °Zone	26.47%
Zonal Lumens in the 90 °-120 °Zone	16.79%
Zonal Lumens in the 120 °-180 °Zone	12.27%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

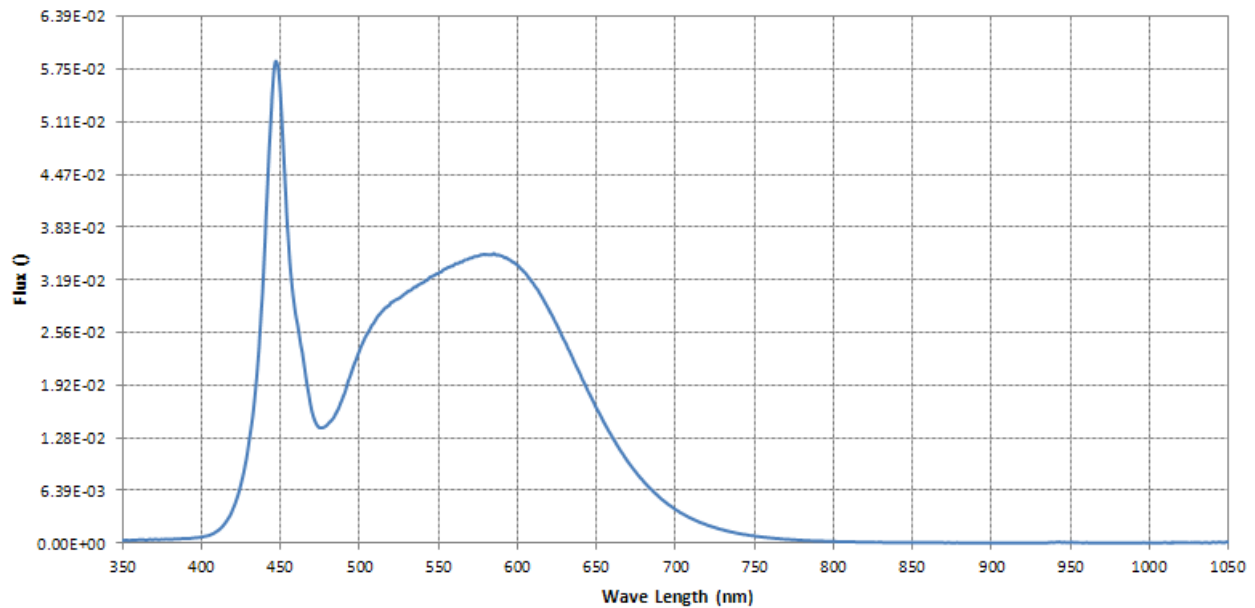
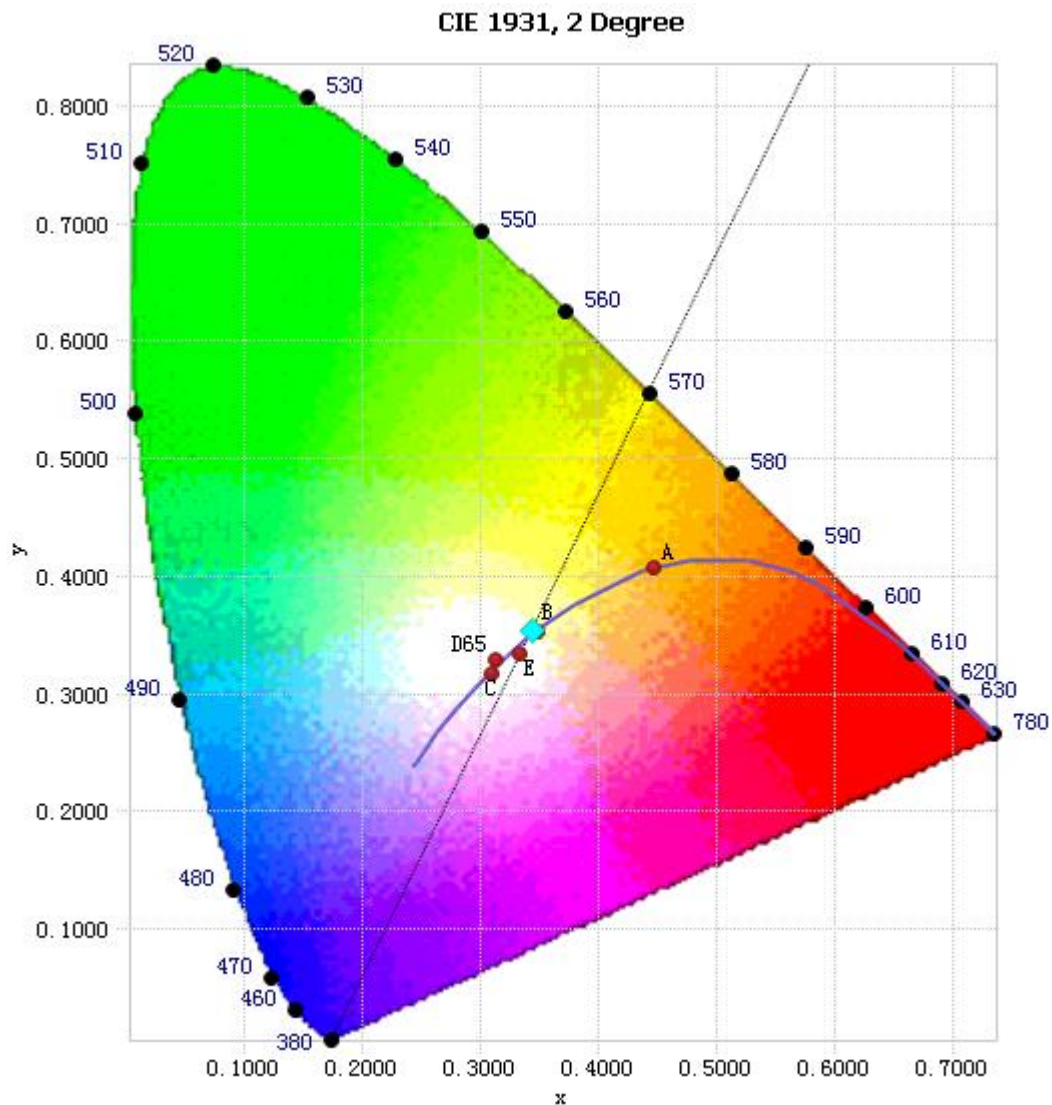


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.95E-04	485	1.57E-02	590	3.48E-02	695	4.79E-03
385	5.03E-04	490	1.79E-02	595	3.44E-02	700	4.10E-03
390	5.59E-04	495	2.07E-02	600	3.37E-02	705	3.53E-03
395	6.35E-04	500	2.33E-02	605	3.28E-02	710	3.02E-03
400	7.35E-04	505	2.54E-02	610	3.15E-02	715	2.58E-03
405	9.55E-04	510	2.70E-02	615	3.01E-02	720	2.21E-03
410	1.47E-03	515	2.82E-02	620	2.83E-02	725	1.91E-03
415	2.42E-03	520	2.92E-02	625	2.65E-02	730	1.63E-03
420	4.14E-03	525	2.97E-02	630	2.45E-02	735	1.39E-03
425	7.08E-03	530	3.04E-02	635	2.25E-02	740	1.18E-03
430	1.21E-02	535	3.11E-02	640	2.04E-02	745	1.03E-03
435	2.01E-02	540	3.16E-02	645	1.83E-02	750	8.82E-04
440	3.53E-02	545	3.23E-02	650	1.64E-02	755	7.57E-04
445	5.47E-02	550	3.27E-02	655	1.46E-02	760	6.55E-04
450	5.47E-02	555	3.33E-02	660	1.29E-02	765	5.58E-04
455	3.70E-02	560	3.38E-02	665	1.13E-02	770	4.83E-04
460	2.74E-02	565	3.41E-02	670	9.89E-03	775	4.16E-04
465	2.17E-02	570	3.46E-02	675	8.62E-03	780	3.60E-04
470	1.60E-02	575	3.48E-02	680	7.46E-03		
475	1.40E-02	580	3.50E-02	685	6.48E-03		
480	1.44E-02	585	3.51E-02	690	5.58E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y) : (0.3433, 0.3538)

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

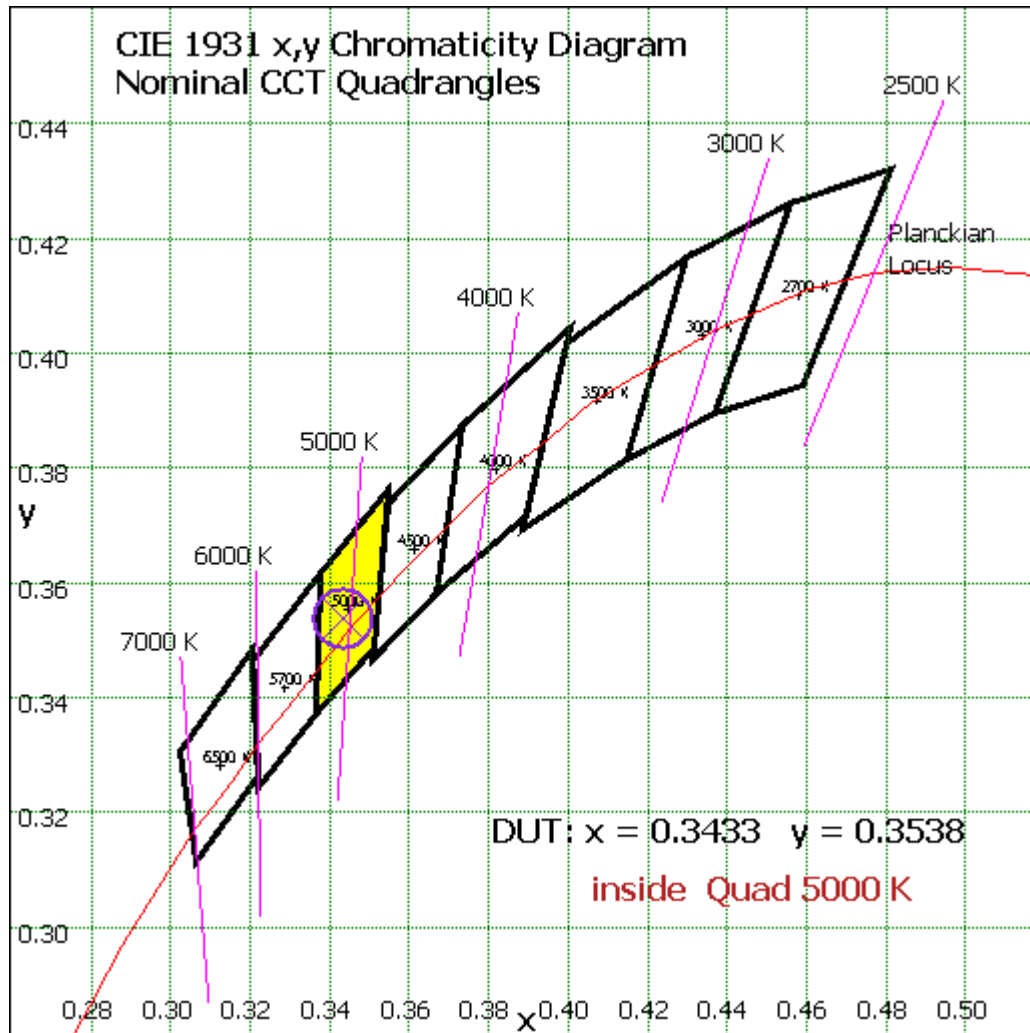


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	36.834	1.67%
10- 20	106.576	4.85%
20- 30	165.147	7.51%
30- 40	207.066	9.42%
40- 50	229.559	10.44%
50- 60	232.75	10.58%
60- 70	219.524	9.98%
70- 80	195.163	8.87%
80- 90	167.386	7.61%
90-100	143.716	6.54%
100-110	122.523	5.57%
110-120	103.101	4.69%
120-130	85.351	3.88%
130-140	69.023	3.14%
140-150	53.022	2.41%
150-160	36.904	1.68%
160-170	19.874	0.90%
170-180	5.654	0.26%
Total	2199.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	977.932	44.47%
60- 90	582.073	26.47%
0-90	1560.005	70.94%
90- 180	639.168	29.06%
0- 180	2199.2	100%

Table 5: Zonal Lumen Data

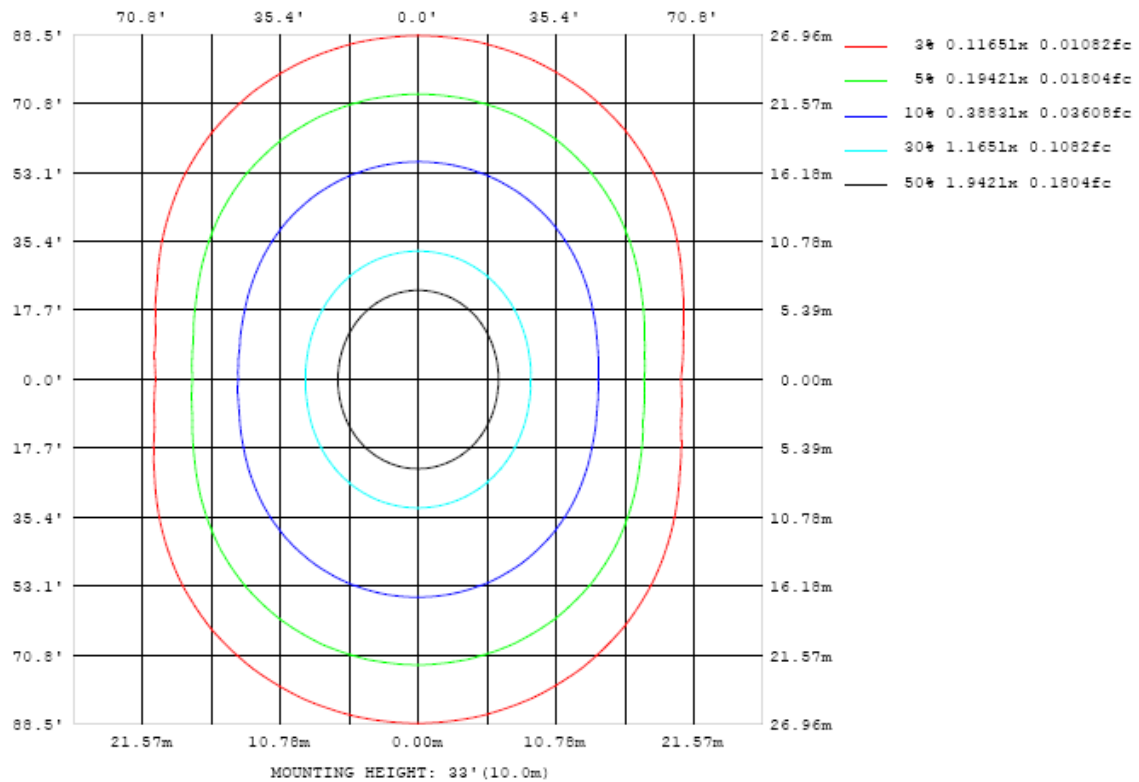


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

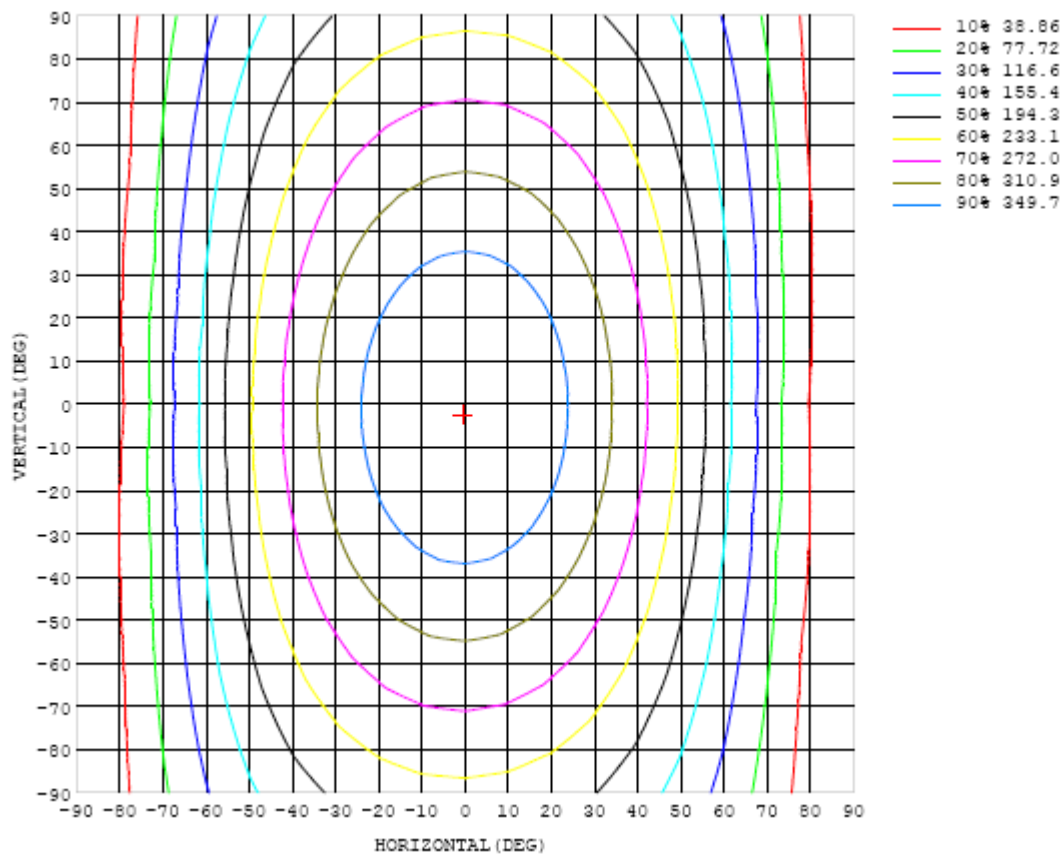


Chart 5: Isocandela Plot

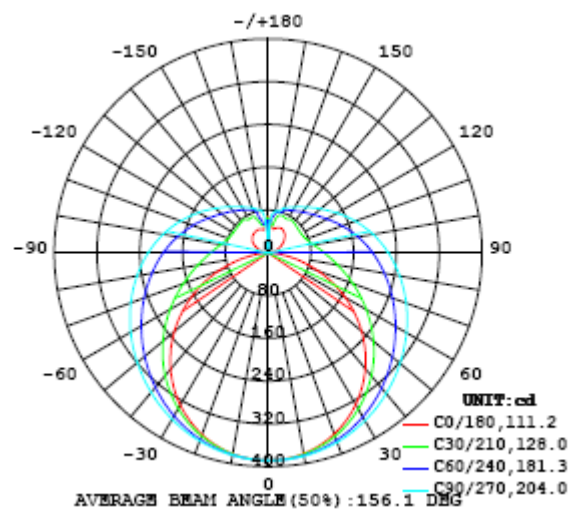


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388
5	386	386	387	387	387	388	388	388	388	388	388	388	388	388	387	387	387	387	387
10	381	381	382	383	383	384	385	385	386	386	386	386	386	385	384	383	382	382	382
15	373	373	374	375	377	378	380	381	382	382	382	382	380	379	377	376	375	374	373
20	361	361	363	365	368	370	373	375	377	377	377	376	374	372	369	366	364	362	362
25	346	346	349	352	357	361	365	367	370	370	370	368	365	362	358	353	350	348	347
30	327	329	332	337	343	349	354	358	361	362	362	359	355	350	344	339	333	330	329
35	306	308	313	320	328	335	343	348	352	353	353	349	344	337	329	321	314	309	308
40	283	285	291	300	311	321	330	337	342	343	343	338	332	323	313	302	293	286	284
45	256	259	268	279	293	306	317	326	331	333	332	327	319	308	295	282	270	261	258
50	228	232	242	257	274	290	303	313	320	322	321	315	305	293	277	260	245	233	229
55	198	202	216	235	255	273	289	301	308	311	309	302	292	277	259	239	219	204	198
60	166	172	189	212	236	257	275	288	296	299	297	290	278	261	240	217	193	174	166
65	133	140	162	190	217	242	261	275	284	287	285	277	264	246	223	195	167	142	133
70	99.3	109	136	169	200	226	247	262	271	275	273	265	251	231	206	175	142	112	98.1
75	66.4	78.8	112	149	183	212	234	249	259	262	260	252	238	217	190	157	119	82.7	64.4
80	36.4	52.5	90.8	132	168	198	221	237	246	250	248	239	225	204	175	140	99.1	58.1	33.6
85	12.1	31.8	74.3	117	155	185	208	224	234	237	235	227	212	191	162	126	83.7	39.5	9.84
90	0.97	20.4	62.9	105	142	172	195	211	221	225	223	214	200	178	150	114	72.4	29.1	0.63
95	2.28	16.6	54.8	95.2	131	161	183	199	209	212	210	202	188	167	139	104	64.7	25.0	2.55
100	6.25	17.9	49.9	86.7	121	149	171	186	196	199	197	189	175	155	128	95.7	59.4	25.5	6.67
105	11.6	22.1	48.0	80.0	111	138	159	174	183	186	184	177	163	144	119	88.7	57.0	28.6	12.1
110	17.6	27.8	48.2	75.6	103	128	147	162	170	173	172	164	152	134	110	83.7	56.8	33.5	18.2
115	23.7	33.9	49.9	72.9	96.9	119	137	150	158	161	159	152	141	124	104	80.7	58.0	39.1	24.6
120	29.5	38.2	53.1	71.6	92.0	111	127	139	146	149	147	141	130	116	98.4	78.8	60.1	44.6	30.6
125	35.0	43.7	56.7	71.2	88.5	105	118	129	135	138	136	131	122	109	94.4	77.9	62.6	47.3	35.6
130	40.0	49.2	60.5	71.8	85.8	99.4	111	120	126	128	127	122	115	104	91.2	77.6	65.3	51.2	39.1
135	44.4	52.4	63.3	73.0	84.0	95.2	105	112	117	119	118	114	108	99.2	88.8	77.7	67.8	54.4	41.9
140	48.0	54.7	63.7	74.4	83.0	91.7	99.7	106	110	112	111	108	102	95.2	86.7	78.0	68.6	58.3	43.8
145	50.0	56.6	66.4	75.4	82.2	88.9	95.1	99.9	103	105	104	102	97.3	91.7	85.2	78.3	67.1	60.9	45.4
150	52.1	56.6	69.2	72.8	81.8	86.7	91.3	95.1	97.5	98.6	98.2	96.3	93.0	88.9	84.0	76.5	67.2	62.6	46.4
155	51.2	55.7	69.9	73.2	77.8	84.9	88.2	90.9	92.5	93.4	93.1	91.7	89.5	86.6	81.3	72.4	68.6	62.8	47.0
160	49.4	49.6	66.3	74.9	75.8	78.5	83.5	87.2	88.5	89.1	88.9	88.1	86.0	81.5	73.6	65.7	61.0	54.8	46.8
165	46.9	45.7	51.7	71.0	75.9	76.7	77.9	78.3	79.8	80.9	81.2	80.9	80.4	68.7	61.0	55.1	54.1	48.3	45.2
170	46.3	44.3	45.6	52.6	67.1	70.6	73.7	77.5	78.6	78.9	78.9	74.5	61.2	51.4	53.2	53.9	50.9	43.9	44.0
175	57.5	56.4	54.3	53.4	57.5	56.4	59.7	62.4	67.8	70.5	53.9	37.4	45.1	52.3	53.1	57.1	55.2	56.5	56.6
180	6.17	6.13	6.03	5.86	5.63	5.35	5.04	4.71	4.37	4.03	4.21	4.39	4.58	4.75	4.91	5.05	5.15	5.21	5.23

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	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388	388		
5	387	387	387	387	387	387	387	387	387	387	387	387	387	387	387	386	387		
10	381	382	382	383	383	384	384	384	384	384	384	384	383	382	382	381	381		
15	373	374	375	376	377	378	379	380	380	380	379	378	377	376	374	373	373		
20	362	363	365	367	369	371	373	374	375	374	373	371	369	367	364	362	361		
25	347	349	352	355	359	363	365	367	368	367	365	363	359	355	351	348	347		
30	329	332	336	342	347	352	356	359	359	359	356	352	347	342	337	332	329		
35	309	313	319	326	334	341	346	349	350	349	347	341	334	327	320	313	308		
40	285	291	300	309	319	328	335	339	341	339	336	329	320	311	301	292	285		
45	260	268	279	292	304	315	323	329	330	329	324	316	306	293	280	269	260		
50	232	242	257	273	288	301	311	317	319	318	312	303	290	275	259	244	233		
55	203	216	234	254	273	288	299	306	308	306	300	290	275	257	237	219	204		
60	172	189	212	236	257	274	286	294	297	295	288	276	260	239	216	193	175		
65	140	162	190	217	241	260	274	282	285	283	276	263	245	222	195	167	145		
70	108	136	169	200	226	247	261	270	273	271	263	250	230	205	175	143	115		
75	78.0	112	150	184	212	234	249	258	261	259	251	237	216	189	156	120	85.5		
80	51.3	91.8	134	169	199	221	236	246	249	247	239	224	203	174	141	99.9	59.7		
85	31.5	75.6	119	156	186	208	224	233	237	234	226	211	190	161	126	83.8	39.8		
90	21.4	64.5	108	145	174	196	212	221	224	222	214	199	177	149	114	71.8	28.2		
95	18.3	57.1	98.1	134	162	184	200	209	212	210	202	187	166	139	104	63.4	23.4		
100	20.0	52.7	90.1	124	151	173	187	197	200	197	189	175	154	128	95.0	57.5	22.9		
105	24.0	51.1	83.7	115	141	161	175	184	187	184	177	163	144	119	87.6	54.2	25.6		
110	29.7	51.7	79.2	107	131	150	163	171	174	172	164	152	134	110	82.0	53.4	30.4		
115	36.0	53.9	76.8	100	122	139	151	159	162	160	153	141	124	102	78.3	54.1	35.7		
120	41.9	56.3	75.6	95.7	114	129	141	148	150	148	142	131	115	96.7	76.2	56.1	41.2		
125	45.9	59.5	75.4	92.0	108	121	131	137	139	137	132	122	108	92.6	75.1	59.0	47.1		
130	51.3	62.9	75.3	89.3	102	114	122	127	129	128	123	114	103	89.4	75.0	62.0	51.3		
135	56.2	65.4	76.0	87.1	98.0	107	114	119	120	119	115	108	98.2	87.0	75.6	64.9	56.3		
140	60.1	66.6	76.9	85.5	94.2	102	108	111	113	111	108	102	94.2	85.3	76.1	67.3	60.8		
145	63.5	68.7	76.5	84.2	90.9	96.9	102	105	106	105	102	97.1	91.0	83.9	76.9	69.1	64.9		
150	66.6	71.0	72.7	83.2	88.3	92.8	96.2	98.6	99.3	98.6	96.5	93.0	88.1	82.9	77.2	71.9	67.2		
155	65.2	71.4	73.3	79.2	85.8	89.1	91.6	93.4	94.0	93.4	91.9	89.3	86.1	82.1	77.2	74.5	66.8		
160	54.4	64.4	69.8	73.0	80.9	86.0	87.7	89.0	89.4	89.1	88.3	86.4	83.8	80.5	78.3	76.7	60.9		
165	47.0	54.3	58.1	61.8	67.2	71.6	74.3	74.9	74.3	74.2	73.8	72.8	71.5	70.3	70.9	70.3	53.8		
170	44.3	45.6	52.6	56.3	57.0	55.9	61.5	74.7	79.8	81.4	81.2	80.8	78.4	76.5	72.5	59.4	48.5		
175	56.5	56.4	55.3	57.9	55.2	56.6	50.1	42.1	54.0	76.1	75.1	67.4	64.4	60.3	59.9	56.3	55.6		
180	5.21	5.15	5.05	4.91	4.75	4.58	4.39	4.21	4.03	4.37	4.71	5.04	5.35	5.63	5.86	6.03	6.13		

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able 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

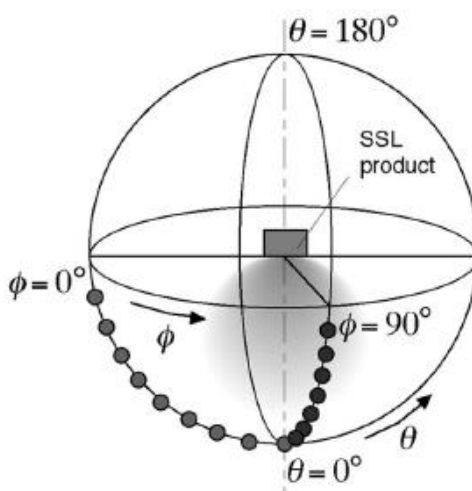
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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