

LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 14.5T8/4F/840/DEB/RC

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18120037e

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/840/DEB/RC

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
147.4	2242.0	15.21	0.9841
CCT (K)	CRI	Stabilization Time (Light & Power)	
4076	82.9	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	: Dec. 26, 2018
Date of Test	: Dec. 29, 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/840/DEB/RC
Electrical Ratings	: 120-277V, 50/60Hz, 14.5W
Product Description	: G13 base, 4000K
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)	0.129	0.059
Power Factor	0.9841	0.9223
Test Power (W)	15.21	15.11
THD A%	16.79	20.18
Luminous Efficacy (lm/W)	147.4	146.3
Total Luminous Flux (lm)	2242.0	2211.0
Color Rendering Index (CRI)	82.9	
R9	8.3	
Correlated Color Temperature (CCT)(K)	4076	
Chromaticity Chroma x	0.3780	
Chromaticity Chroma y	0.3784	
Chromaticity Chroma u	0.2228	
Chromaticity Chroma v	0.3346	
Duv	0.0009	
Chromaticity Chroma u'	0.2228	
Chromaticity Chroma v'	0.5020	

Special Color Rendering Indices	
R1	80.9
R2	89.1
R3	95.0
R4	81.3
R5	80.8
R6	84.7
R7	86.4
R8	64.7
R9	8.3
R10	74.0
R11	79.9
R12	60.5
R13	83.0
R14	97.4
Rf	82
Rg	95

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 24.9°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)	0.130
Power Factor	0.9805
Test Power (W)	15.29
Luminous Efficacy (lm/W)	144.5
Total Luminous Flux (lm)	2209.9
Beam Angle (°)	155.5
Center Beam Candle Power (cd)	393
Spacing Criteria	1.24(0 °-180 °)/ 1.39 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	44.62%
Zonal Lumens in the 60 °-90 °Zone	26.45%
Zonal Lumens in the 90 °-120 °Zone	16.69%
Zonal Lumens in the 120 °-180 °Zone	12.24%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

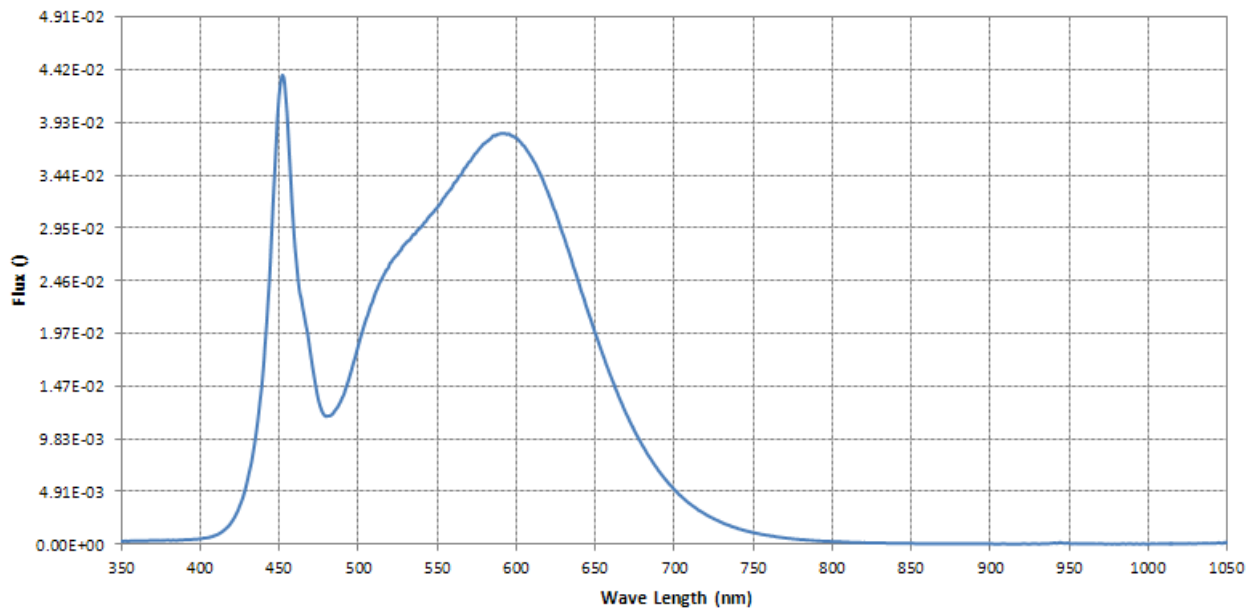
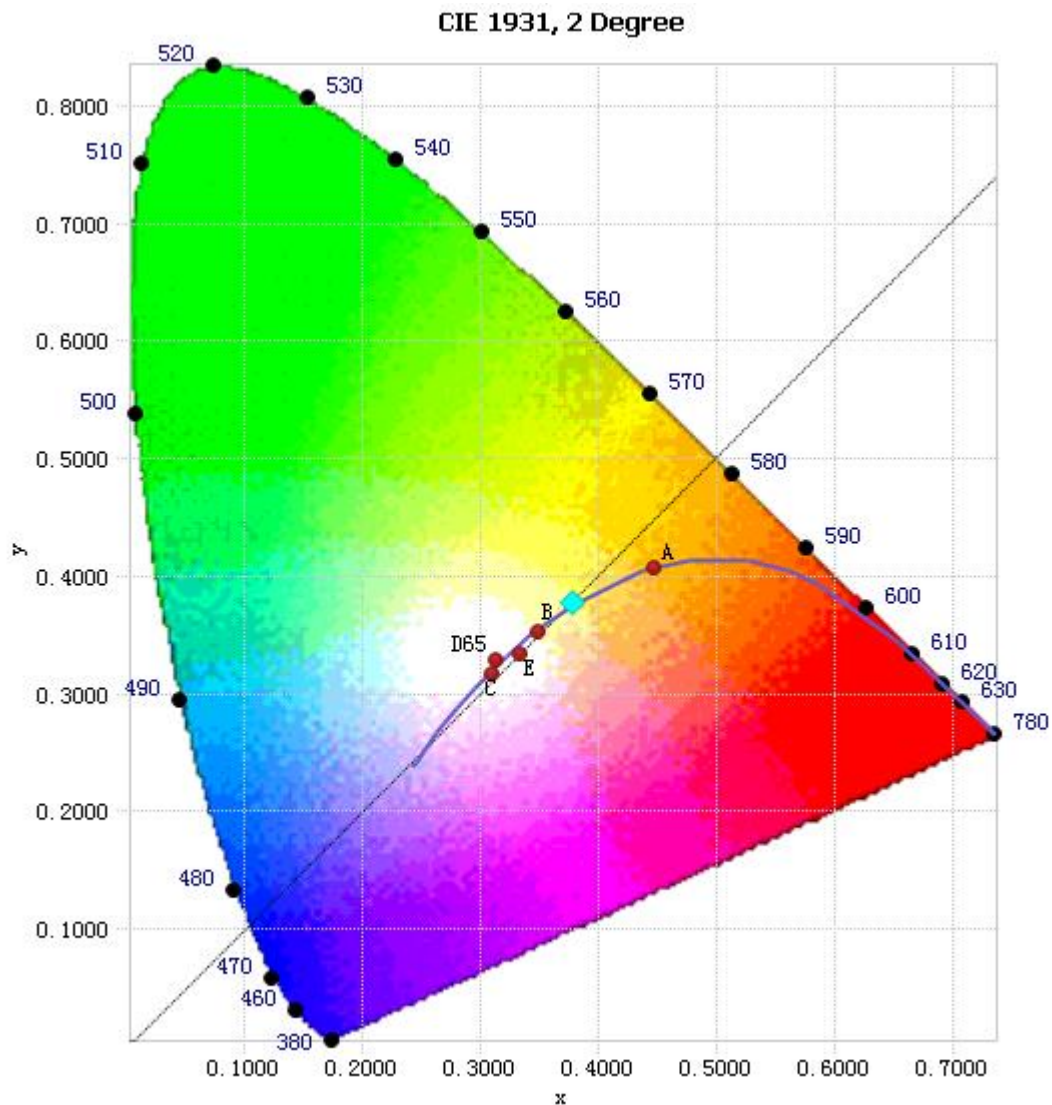


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.88E-04	485	1.24E-02	590	3.83E-02	695	5.97E-03
385	3.72E-04	490	1.37E-02	595	3.82E-02	700	5.14E-03
390	4.22E-04	495	1.58E-02	600	3.79E-02	705	4.42E-03
395	4.56E-04	500	1.85E-02	605	3.71E-02	710	3.78E-03
400	5.16E-04	505	2.10E-02	610	3.60E-02	715	3.23E-03
405	6.15E-04	510	2.30E-02	615	3.46E-02	720	2.79E-03
410	8.55E-04	515	2.47E-02	620	3.29E-02	725	2.40E-03
415	1.30E-03	520	2.61E-02	625	3.09E-02	730	2.04E-03
420	2.10E-03	525	2.70E-02	630	2.87E-02	735	1.76E-03
425	3.56E-03	530	2.80E-02	635	2.65E-02	740	1.50E-03
430	6.02E-03	535	2.89E-02	640	2.42E-02	745	1.28E-03
435	9.90E-03	540	2.96E-02	645	2.19E-02	750	1.10E-03
440	1.65E-02	545	3.06E-02	650	1.97E-02	755	9.44E-04
445	2.80E-02	550	3.14E-02	655	1.76E-02	760	8.28E-04
450	4.19E-02	555	3.24E-02	660	1.56E-02	765	7.02E-04
455	4.01E-02	560	3.34E-02	665	1.38E-02	770	6.02E-04
460	2.77E-02	565	3.44E-02	670	1.21E-02	775	5.17E-04
465	2.20E-02	570	3.56E-02	675	1.06E-02	780	4.41E-04
470	1.77E-02	575	3.65E-02	680	9.20E-03		
475	1.34E-02	580	3.74E-02	685	8.01E-03		
480	1.19E-02	585	3.80E-02	690	6.90E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y) : (0.3780, 0.3784)

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

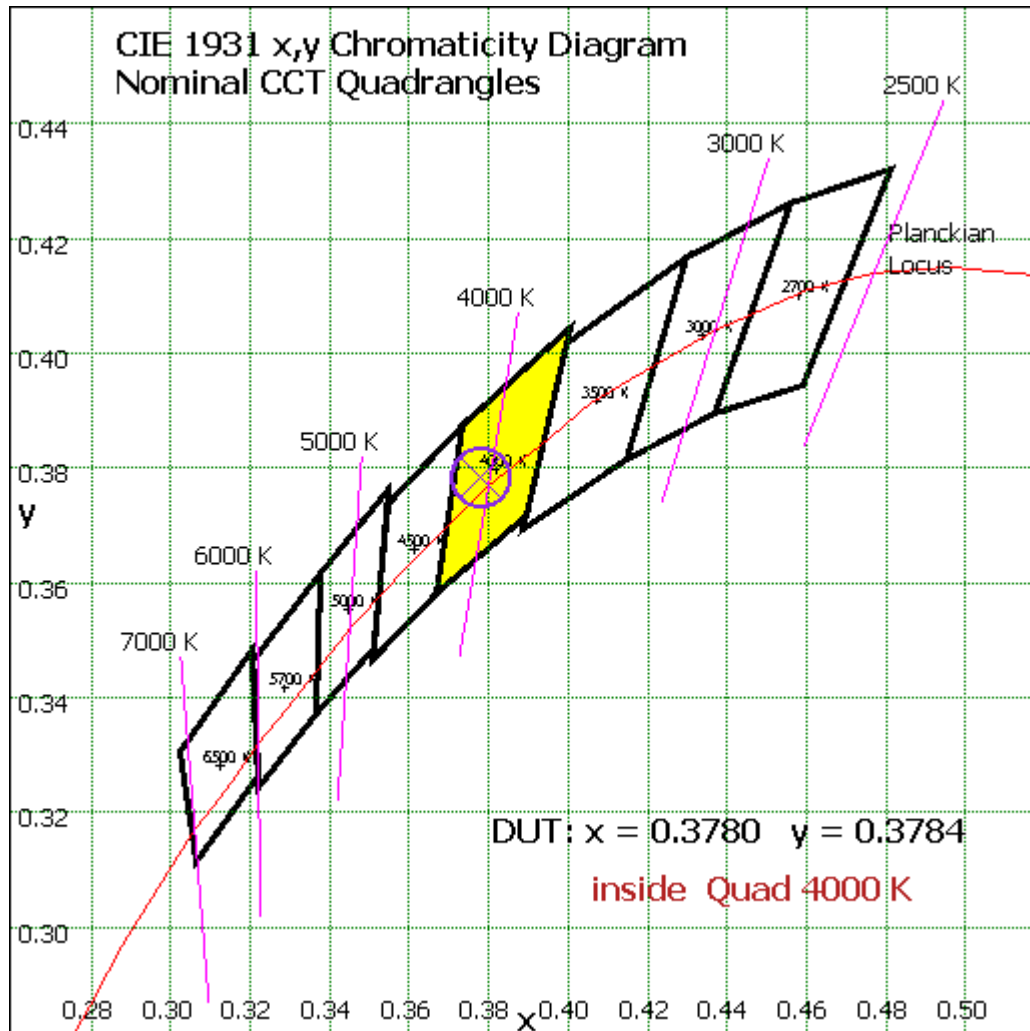


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	37.223	1.68%
10- 20	107.626	4.87%
20- 30	166.644	7.54%
30- 40	208.814	9.45%
40- 50	231.373	10.47%
50- 60	234.465	10.61%
60- 70	220.867	9.99%
70- 80	195.969	8.87%
80- 90	167.645	7.59%
90-100	143.566	6.50%
100-110	122.354	5.54%
110-120	102.808	4.65%
120-130	85.132	3.85%
130-140	68.983	3.12%
140-150	53.141	2.40%
150-160	37.091	1.68%
160-170	20.272	0.92%
170-180	5.911	0.27%
Total	2209.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	986.145	44.62%
60- 90	584.481	26.45%
0-90	1570.626	71.07%
90- 180	639.258	28.93%
0- 180	2209.9	100%

Table 5: Zonal Lumen Data

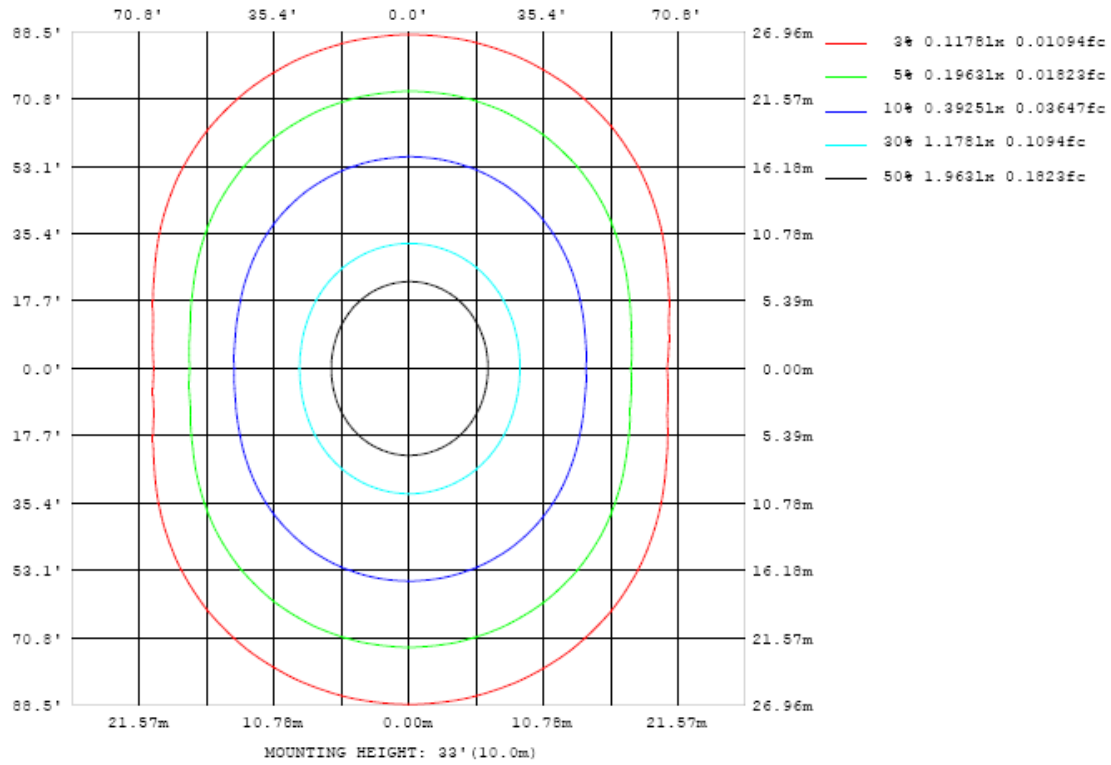


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

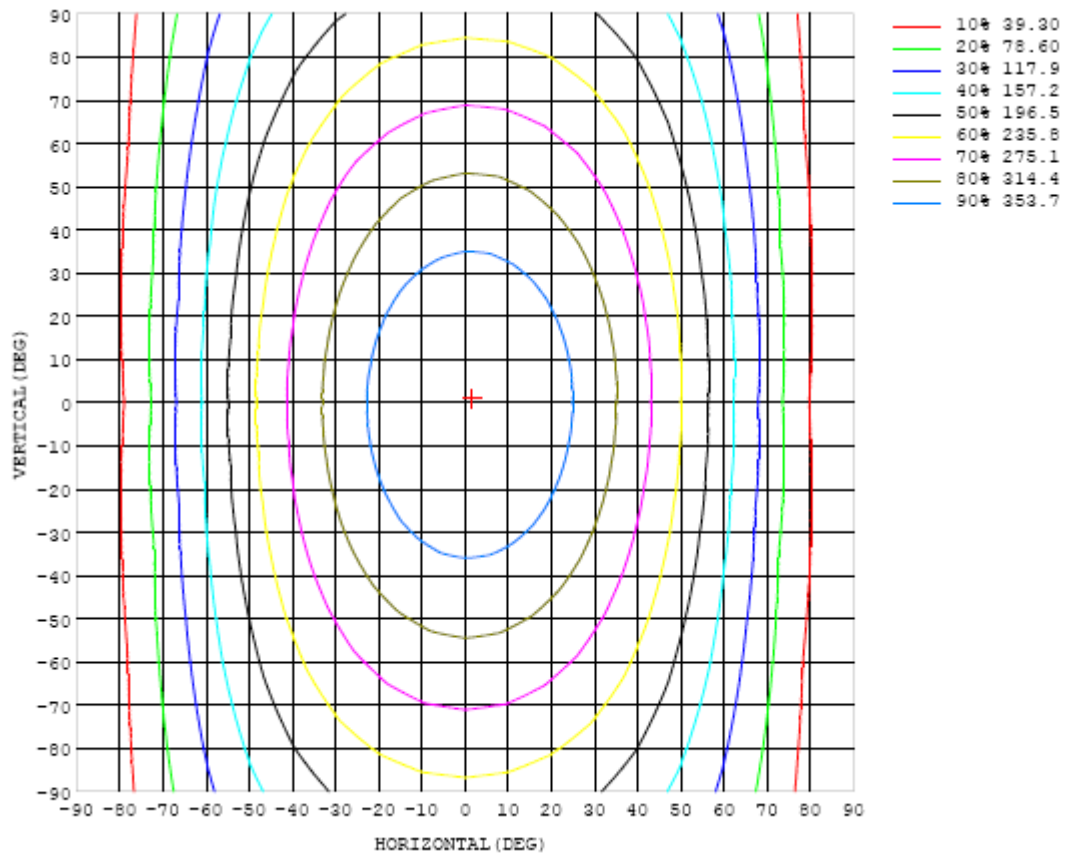


Chart 5: Isocandela Plot

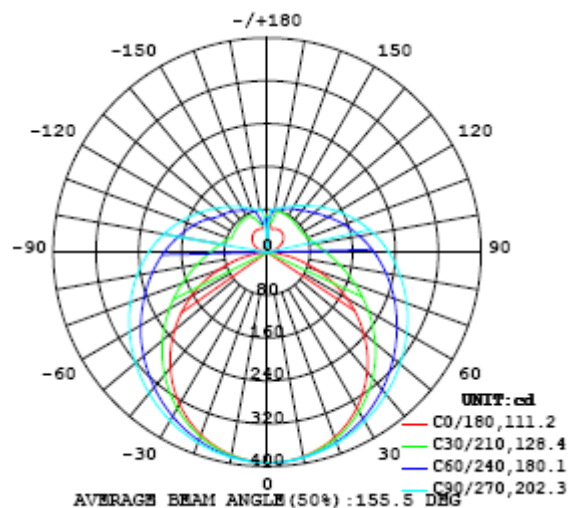


Chart 6: Polar Candela Distribution

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	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393
5	392	392	392	392	392	392	392	392	392	392	392	391	391	391	391	390	390	390	390
10	387	387	387	388	388	389	389	389	389	389	389	388	388	387	386	385	385	384	384
15	379	380	380	381	382	383	384	385	385	385	384	383	382	380	379	377	376	375	375
20	368	368	369	371	373	375	377	379	379	379	379	377	375	372	369	366	364	362	362
25	353	354	356	358	362	365	369	371	373	372	372	369	366	362	357	353	350	347	346
30	335	336	339	343	348	354	358	362	364	365	363	360	356	350	343	337	332	329	328
35	315	316	320	326	333	340	347	352	355	356	354	350	344	336	328	319	312	308	306
40	291	293	298	307	316	326	335	341	345	346	344	339	331	322	311	300	290	284	282
45	264	267	274	286	299	311	321	329	334	335	333	327	318	307	293	279	267	258	255
50	236	239	249	264	280	295	308	317	323	324	322	315	305	291	275	257	241	230	226
55	205	209	223	241	261	279	294	305	311	313	311	303	291	275	256	235	215	200	196
60	172	178	195	218	242	263	280	292	299	301	299	291	278	260	238	213	189	170	164
65	138	146	168	196	224	248	266	280	287	290	287	278	264	244	220	192	162	139	131
70	103	114	142	175	206	233	253	267	275	278	275	266	251	230	203	171	137	108	97.2
75	68.5	83.0	117	156	190	218	239	254	263	265	262	253	238	216	188	153	115	79.1	64.2
80	37.3	56.3	96.3	138	174	204	226	241	250	253	250	241	225	202	173	137	94.8	54.4	33.9
85	12.4	35.4	79.3	123	160	190	213	228	237	240	237	228	212	190	160	123	79.3	35.5	10.3
90	0.62	23.6	67.0	111	148	178	200	215	225	228	225	216	200	177	148	111	68.2	25.4	0.68
95	2.35	19.7	59.5	100	136	166	188	203	212	215	212	204	188	166	137	101	61.4	22.1	2.47
100	6.38	20.6	54.5	91.8	126	154	176	190	199	202	199	191	176	155	127	93.5	56.8	23.3	6.56
105	11.9	24.0	52.3	85.1	117	143	164	178	187	189	187	179	165	144	118	87.3	54.8	26.9	12.0
110	17.9	28.5	52.0	80.4	109	133	152	166	174	177	175	167	153	134	110	82.8	55.0	31.8	18.0
115	24.3	34.0	53.2	77.2	102	124	142	154	162	165	162	155	143	125	104	79.6	56.5	37.1	24.2
120	30.5	40.6	55.7	75.2	96.5	116	132	143	150	153	151	144	133	117	98.3	78.0	58.8	42.5	29.4
125	35.5	47.2	58.5	74.4	92.1	109	123	133	139	142	140	134	124	110	94.3	77.1	61.3	48.0	33.3
130	39.6	53.3	61.6	74.6	88.9	103	115	124	129	131	129	124	116	104	91.0	77.0	63.7	53.4	36.7
135	42.8	58.7	64.9	75.0	86.7	98.0	108	115	120	122	120	116	109	99.4	88.6	77.0	66.2	58.4	39.6
140	45.3	63.2	68.2	75.8	85.2	94.3	102	108	112	113	112	109	103	95.3	86.6	77.2	68.8	62.7	42.1
145	46.6	66.9	71.5	76.7	83.9	91.2	97.3	102	105	106	105	102	98.0	91.8	84.8	77.3	70.4	65.9	44.1
150	47.2	69.4	74.2	77.4	82.9	88.5	93.2	96.8	99.2	99.9	99.3	97.0	93.4	88.6	83.2	77.5	72.6	69.2	45.6
155	47.4	68.5	76.3	78.7	81.8	85.9	89.4	92.0	93.7	94.2	93.7	92.0	89.2	85.8	81.9	74.3	72.4	67.7	45.9
160	46.6	60.0	77.5	79.4	81.5	83.6	85.7	87.6	88.8	89.2	88.8	87.7	85.8	83.5	75.2	70.1	65.3	61.4	46.0
165	45.2	50.6	65.3	79.3	80.8	82.3	83.3	84.1	84.6	84.8	84.7	84.1	82.4	69.1	64.7	59.5	56.9	54.1	45.6
170	44.5	45.1	49.9	63.5	74.7	77.3	79.9	81.6	81.9	82.0	81.9	76.1	60.6	54.6	57.3	56.3	54.3	47.5	46.6
175	58.6	58.0	56.6	56.8	61.0	64.0	65.3	67.5	77.8	78.5	57.6	42.9	51.3	58.6	57.8	60.6	58.4	59.7	60.1
180	11.0	11.0	11.0	11.0	11.0	11.0	10.9	10.9	10.9	10.8	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9

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	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393	393		
5	390	390	390	391	391	391	391	391	391	392	392	392	392	392	392	392	392		
10	384	384	385	386	387	387	388	388	389	389	389	389	389	388	388	387	387		
15	375	375	377	378	380	382	383	384	384	385	384	384	383	382	381	380	379		
20	363	364	366	368	371	374	376	378	379	379	378	377	375	373	371	370	369		
25	347	349	352	356	360	365	368	370	371	372	370	368	365	362	359	356	354		
30	329	331	336	342	348	354	358	361	363	363	361	358	354	349	344	340	337		
35	307	312	318	326	334	342	348	352	354	354	351	347	341	334	327	321	317		
40	284	289	299	309	319	329	336	341	344	343	340	334	326	317	308	300	294		
45	258	266	278	291	304	315	324	330	333	332	328	321	311	299	287	276	268		
50	230	241	256	272	288	302	312	319	322	321	316	307	295	281	265	251	241		
55	201	214	233	254	272	288	299	307	310	309	303	293	279	262	243	225	211		
60	170	188	211	235	256	273	286	294	297	296	290	279	263	243	220	198	180		
65	140	162	190	217	240	259	272	281	285	283	277	265	247	224	198	171	149		
70	109	137	169	199	224	244	259	268	272	271	263	250	232	207	177	145	117		
75	80.0	114	150	182	210	231	246	256	260	258	250	237	217	190	157	121	86.2		
80	54.4	93.2	133	167	196	218	234	243	247	245	237	223	202	175	140	99.5	59.0		
85	34.6	76.9	119	154	183	205	221	230	234	233	225	210	189	160	125	82.4	38.1		
90	23.5	65.2	107	143	171	193	209	218	222	220	212	198	176	149	113	70.0	26.1		
95	19.9	57.8	97.2	132	159	181	196	205	209	207	199	185	164	137	102	61.3	21.1		
100	19.6	52.9	89.2	122	149	169	184	193	196	194	186	173	153	126	92.7	55.0	19.2		
105	24.4	46.4	82.6	113	139	157	172	180	183	181	174	161	142	116	85.3	48.5	24.0		
110	29.9	49.0	74.6	105	129	147	160	168	171	169	162	149	131	108	77.6	49.5	28.5		
115	35.0	52.3	71.5	95.2	119	137	149	156	159	157	150	138	122	98.8	74.0	51.9	33.3		
120	40.6	55.3	72.4	89.4	108	125	137	145	147	145	139	129	113	93.6	73.6	54.1	38.3		
125	46.1	58.6	72.8	88.0	102	115	126	134	137	135	130	120	107	90.6	73.1	56.7	43.6		
130	50.9	61.8	73.5	86.6	98.8	110	118	124	127	126	121	113	101	87.4	73.1	59.4	49.1		
135	56.2	64.4	74.3	85.2	95.8	105	112	117	119	118	113	106	96.3	84.9	73.1	62.0	55.8		
140	60.6	66.7	74.8	83.6	92.3	99.9	106	109	111	110	106	100	92.1	82.9	73.2	64.7	60.2		
145	64.3	69.0	75.7	82.1	88.9	95.0	99.7	103	104	103	100	95.3	88.6	81.1	74.0	67.4	63.7		
150	67.6	69.4	76.5	80.7	85.7	90.5	94.2	96.6	97.6	96.9	94.4	90.6	85.5	80.0	74.5	70.4	66.3		
155	64.0	70.0	74.4	79.8	83.1	86.2	88.9	91.0	91.7	91.2	89.4	86.8	83.3	79.3	75.6	74.3	65.6		
160	53.8	63.0	66.9	73.8	80.7	83.0	84.9	86.2	86.7	86.6	85.6	83.9	81.6	79.0	77.7	76.2	59.0		
165	48.1	53.2	56.7	59.9	67.3	74.2	81.9	82.5	82.8	82.9	82.4	81.4	80.3	79.6	78.9	75.1	52.3		
170	46.6	46.4	53.0	56.3	56.2	55.2	63.8	77.7	81.6	81.5	81.1	81.1	78.6	76.4	71.6	55.8	44.9		
175	60.0	59.5	58.1	60.9	58.0	59.4	52.8	42.5	53.0	80.0	77.0	67.4	63.0	60.5	60.9	56.3	56.6		
180	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.8	10.9	10.9	10.9	11.0	11.0	11.0	11.0	11.0		

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

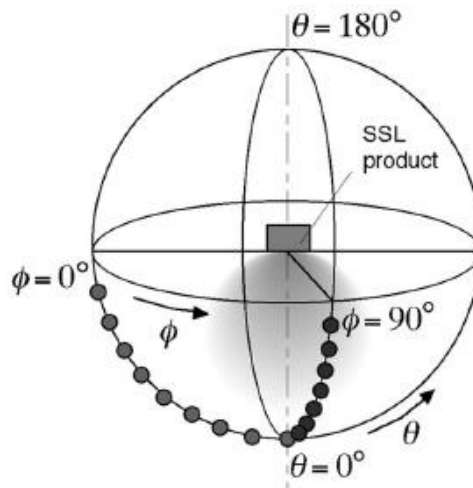
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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