



LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube

Model: 15T5HE/4F/835/GL/DIR

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ19020012k

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

Review by:

Engineer: April Zou
Mar. 08, 2019

Approved by:



Manager: Jim Zhang
Mar. 08, 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: 15T5HE/4F/835/GL/DIR

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)/2	Power Factor
133.3	2050.0	15.38	0.9910
CCT (K)	CRI	Stabilization Time (Light & Power)	
3413	81.6	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 : Feb. 21, 2019

Date of Test : Mar. 01, 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

TABLE OF CONTENT

LM-79-08 Test Report.....	1
Test Summary.....	2
Sample Photo.....	4
TEST RESULTS	5
Spectral Power Distribution - Sphere Spectroradiometer Method	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method	9
Color Vector – Sphere Spectroradiometer Method	10
Zonal Lumen Tabulation- Goniophotometer Method	11
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

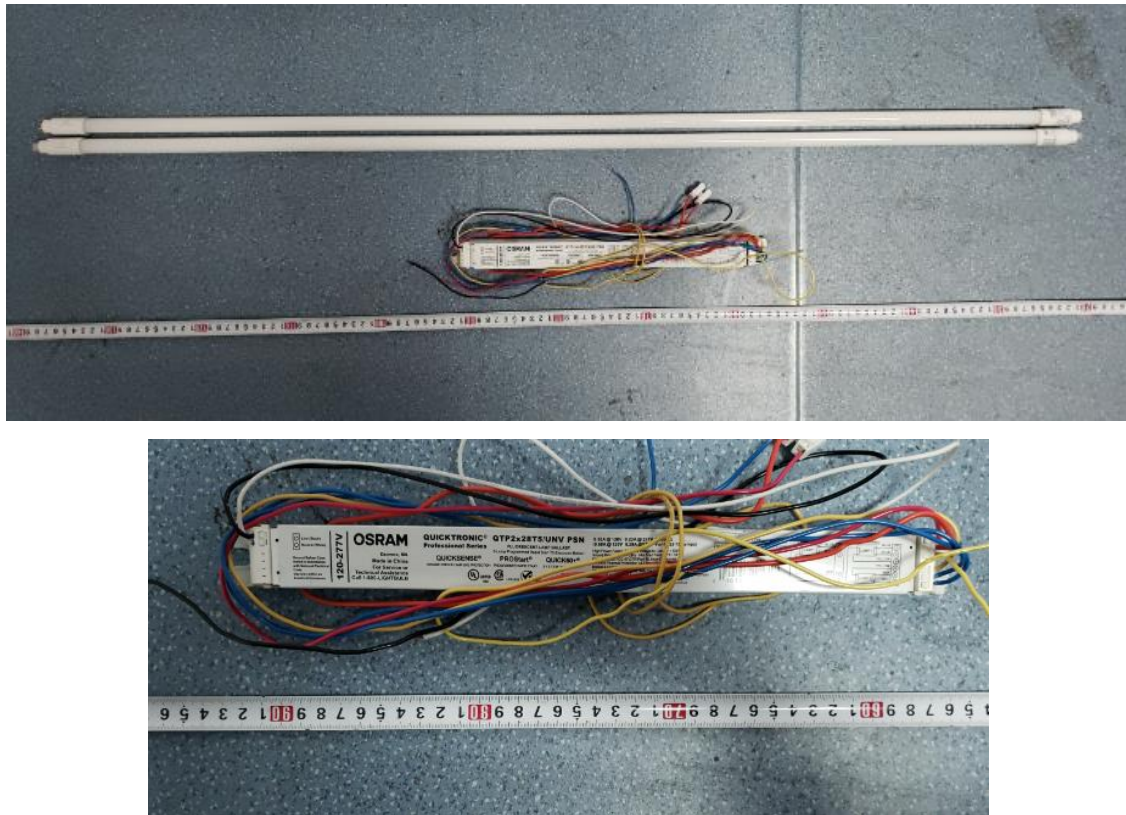


Figure 1- Overview of the sample

Equipment Under Test(EUT)

Name	: LED Tube
Model	: 15T5HE/4F/835/GL/DIR
Electrical Ratings	: 120-277V, 50/60Hz, 15W
Product Description	: 3500K LED Tubes supplied by a high frequency fluorescent lamp ballast: QTP2X28T5/UNV PSN
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)	0.259	0.119
Power Factor	0.9910	0.9363
Test Power (W)/2	15.38	15.38
THD A%	4.21	8.13
Luminous Efficacy (lm/W)	133.3	133.5
Total Luminous Flux (lm)	2050.0	2053.0
Color Rendering Index (CRI)	81.6	
R9	0.9	
Correlated Color Temperature (CCT)(K)	3413	
Chromaticity Chroma x	0.4114	
Chromaticity Chroma y	0.3963	
Chromaticity Chroma u	0.2374	
Chromaticity Chroma v	0.3430	
Duv	0.0007	
Chromaticity Chroma u'	0.2374	
Chromaticity Chroma v'	0.5145	

Special Color Rendering Indices	
R1	79.6
R2	89.6
R3	96.3
R4	79.3
R5	79.6
R6	86.3
R7	83.5
R8	58.8
R9	0.9
R10	75.6
R11	78
R12	63.4
R13	82
R14	98.4
Rf	84
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 25.2°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)	0.259
Power Factor	0.9902
Test Power (W)/2	15.41
Luminous Efficacy (lm/W)	131.1
Total Luminous Flux (lm)	2020.4
Beam Angle (°)	168.2
Center Beam Candle Power (cd)	333
Spacing Criteria	1.27 (0 °-180 °)/ 1.46 (90 °-270 °)
Zonal Lumens in the 0 °-60 °Zone	43.56%
Zonal Lumens in the 60 °-90 °Zone	27.65%
Zonal Lumens in the 90 °-120 °Zone	17.22%
Zonal Lumens in the 120 °-180 °Zone	11.58%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

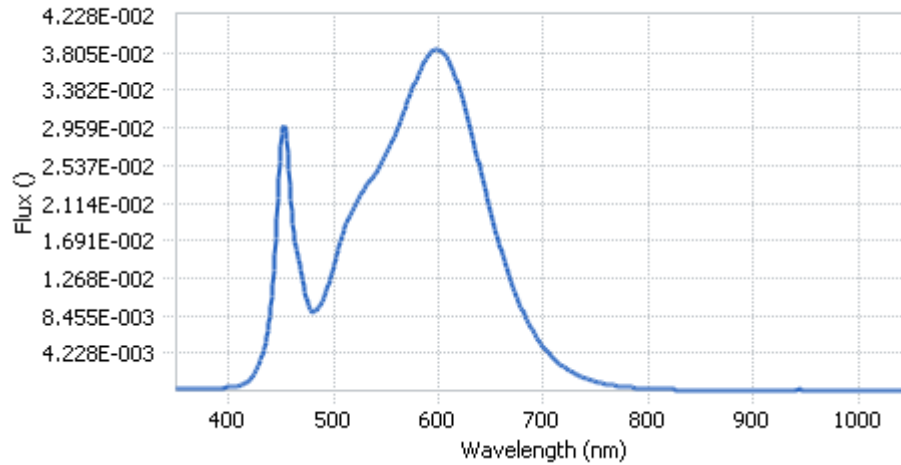
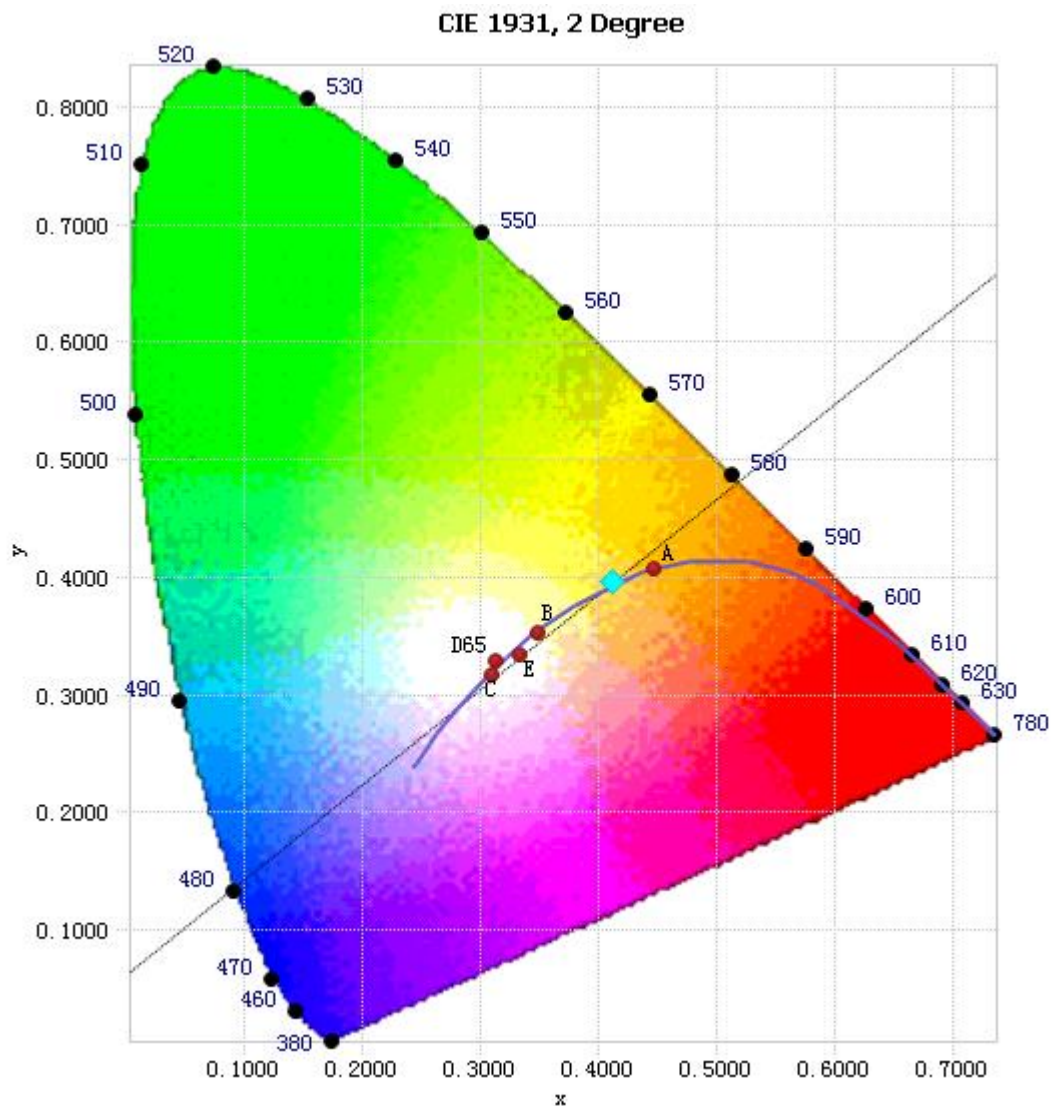


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.05E-04	485	9.26E-03	590	3.77E-02	695	5.74E-03
385	2.83E-04	490	1.02E-02	595	3.83E-02	700	4.93E-03
390	3.25E-04	495	1.20E-02	600	3.84E-02	705	4.21E-03
395	3.36E-04	500	1.41E-02	605	3.80E-02	710	3.58E-03
400	3.63E-04	505	1.63E-02	610	3.70E-02	715	3.06E-03
405	4.30E-04	510	1.81E-02	615	3.57E-02	720	2.61E-03
410	5.69E-04	515	1.97E-02	620	3.39E-02	725	2.24E-03
415	8.07E-04	520	2.09E-02	625	3.19E-02	730	1.91E-03
420	1.22E-03	525	2.19E-02	630	2.96E-02	735	1.63E-03
425	2.02E-03	530	2.28E-02	635	2.73E-02	740	1.39E-03
430	3.33E-03	535	2.37E-02	640	2.48E-02	745	1.18E-03
435	5.55E-03	540	2.45E-02	645	2.23E-02	750	1.02E-03
440	9.46E-03	545	2.56E-02	650	2.00E-02	755	8.72E-04
445	1.73E-02	550	2.67E-02	655	1.77E-02	760	7.50E-04
450	2.77E-02	555	2.78E-02	660	1.57E-02	765	6.38E-04
455	2.82E-02	560	2.94E-02	665	1.37E-02	770	5.59E-04
460	2.00E-02	565	3.08E-02	670	1.19E-02	775	4.76E-04
465	1.58E-02	570	3.25E-02	675	1.04E-02	780	4.09E-04
470	1.29E-02	575	3.39E-02	680	9.01E-03		
475	9.96E-03	580	3.55E-02	685	7.79E-03		
480	8.87E-03	585	3.68E-02	690	6.70E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4114, 0.3963)

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

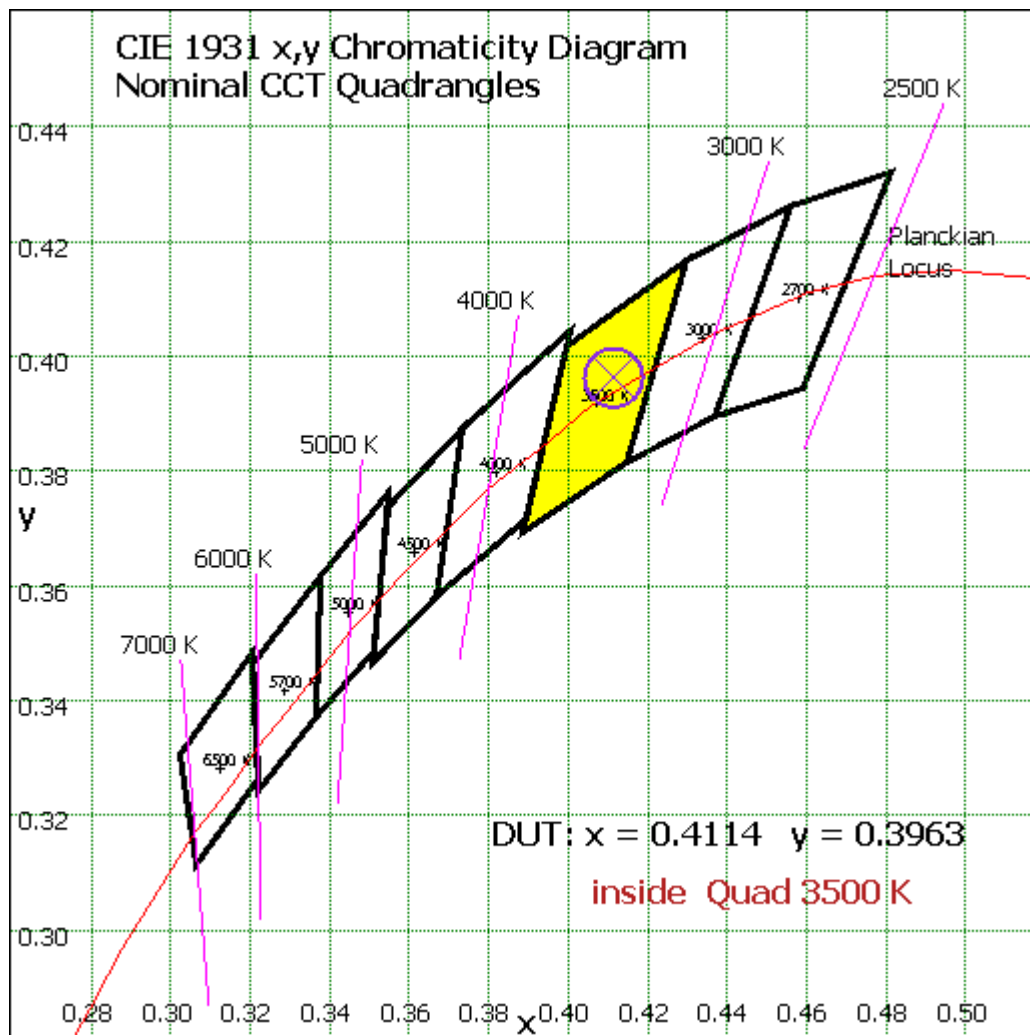


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Color Vector – Sphere Spectroradiometer Method

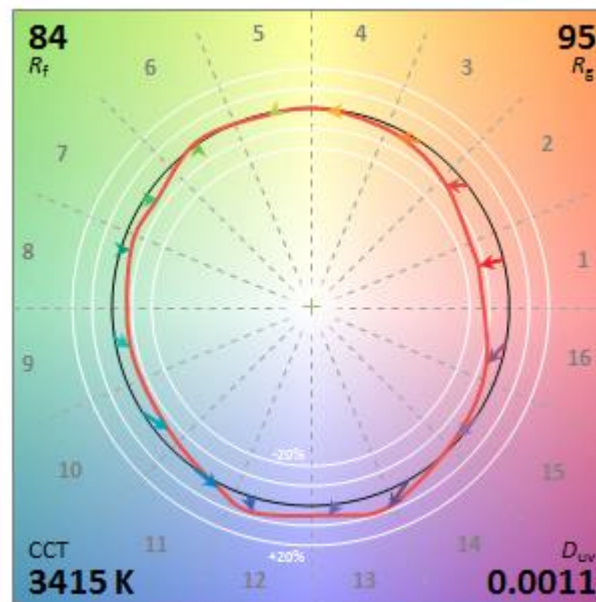


Chart 4: Color Vector Diagram of TM-30-18

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	31.664	1.57%
10- 20	92.262	4.57%
20- 30	144.855	7.17%
30- 40	184.943	9.15%
40- 50	209.391	10.36%
50- 60	216.916	10.74%
60- 70	208.593	10.32%
70- 80	187.981	9.30%
80- 90	162.038	8.02%
90-100	137.956	6.83%
100-110	115.099	5.70%
110-120	94.809	4.69%
120-130	77.038	3.81%
130-140	60.586	3.00%
140-150	45.174	2.24%
150-160	30.45	1.51%
160-170	16.135	0.80%
170-180	4.551	0.23%
Total	2020.4	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	880.031	43.56%
60- 90	558.612	27.65%
0-90	1438.643	71.20%
90- 180	581.798	28.80%
0- 180	2020.4	100%

Table 5: Zonal Lumen

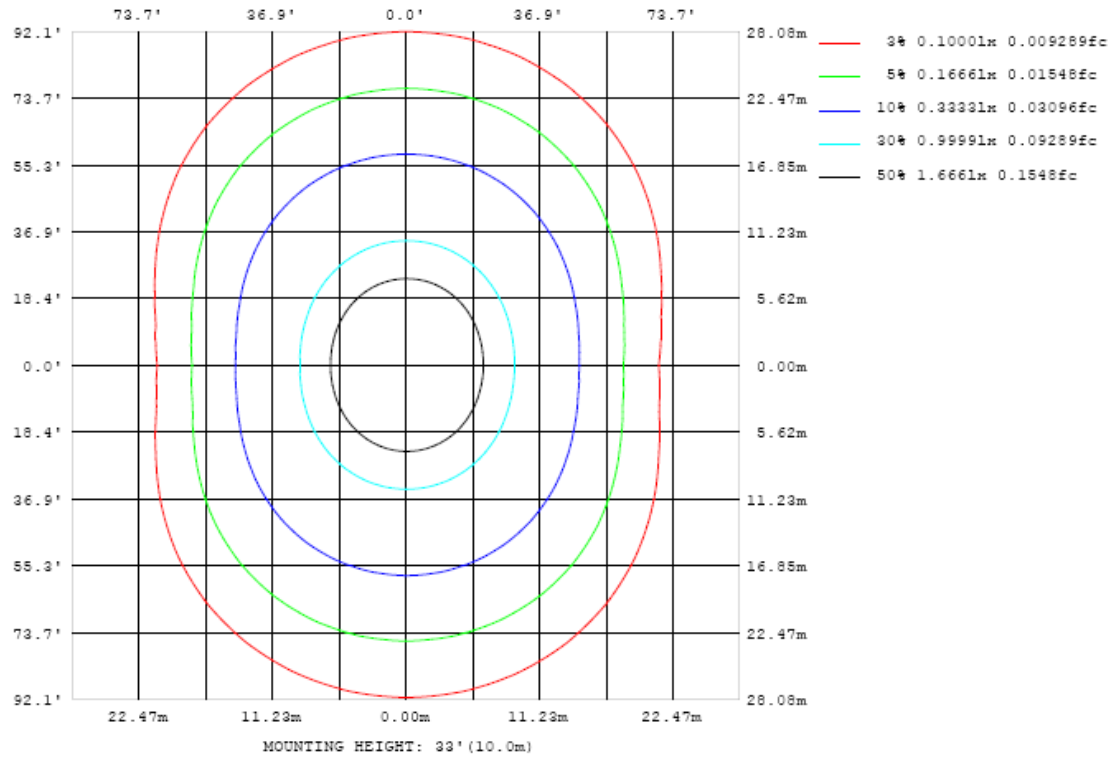


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

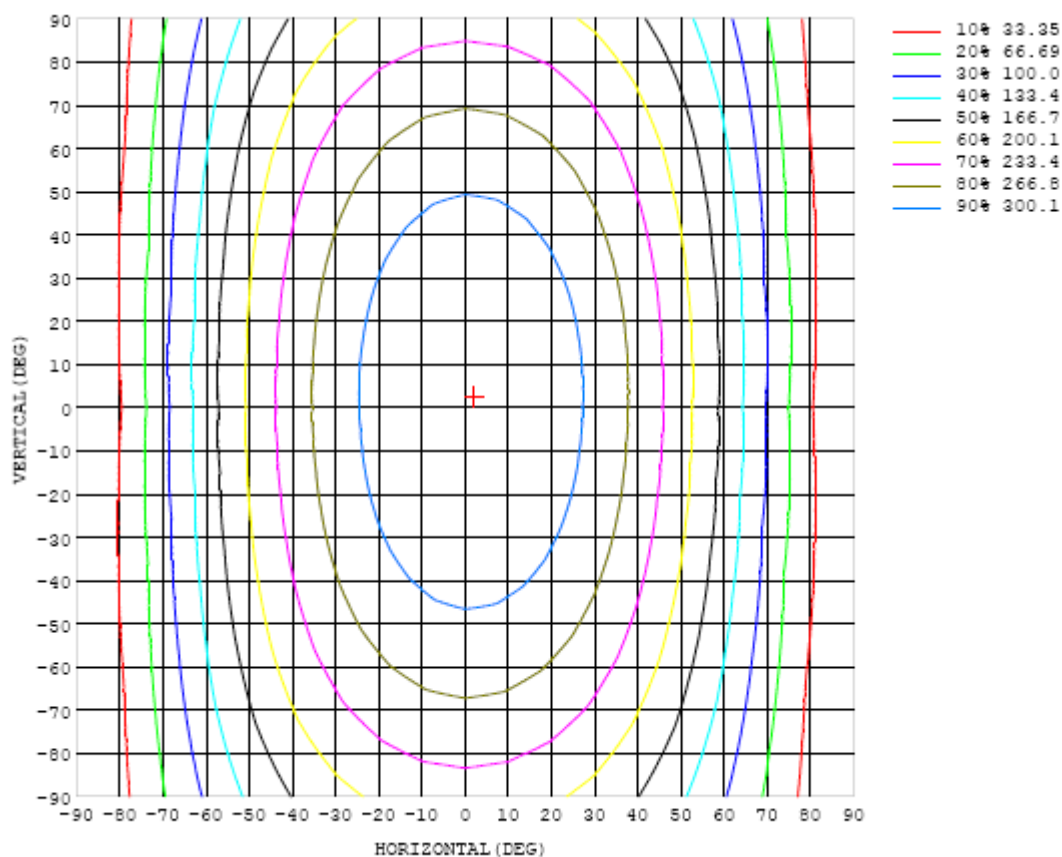


Chart 6: Isocandela Plot

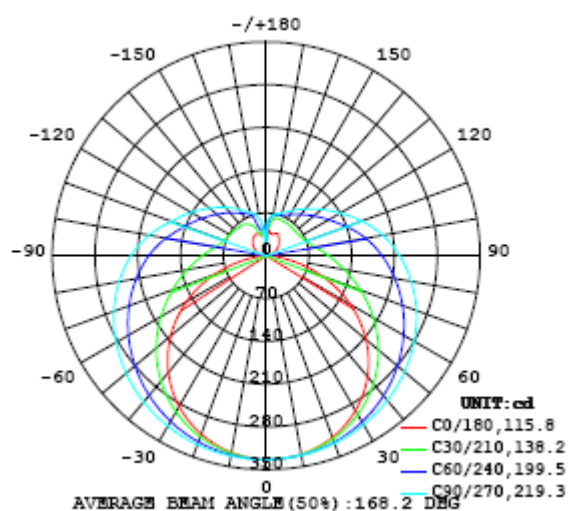


Chart 7: Polar Candela Distribution

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	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333
5	333	333	333	333	333	333	333	333	333	333	332	332	332	332	332	331	331	331	331
10	330	330	330	330	331	331	331	331	331	331	331	330	330	329	328	328	327	327	327
15	324	324	325	326	327	328	329	329	329	329	329	328	326	325	323	322	321	320	320
20	316	316	317	319	321	323	325	326	327	327	326	324	322	319	317	314	312	311	311
25	306	306	308	310	314	317	320	322	323	323	322	320	317	313	309	305	301	299	299
30	292	293	296	300	305	309	314	317	319	319	318	314	310	305	299	293	289	286	285
35	276	277	281	287	294	301	307	311	314	314	312	308	303	296	288	280	274	269	268
40	258	259	265	273	282	291	299	304	308	308	306	302	295	286	276	266	257	251	249
45	237	239	246	257	269	280	290	297	301	302	300	295	286	275	263	250	239	230	228
50	213	216	226	240	255	269	281	289	294	295	293	287	277	264	249	233	218	208	204
55	187	191	204	221	240	257	270	280	286	288	285	278	267	252	235	215	197	183	178
60	159	164	181	202	224	244	260	271	278	280	277	269	257	240	220	197	175	157	151
65	129	136	157	183	209	231	249	261	269	271	268	260	246	228	205	179	152	130	122
70	97.4	107	133	164	193	218	237	251	259	261	258	250	236	216	191	161	130	102	90.7
75	66.1	78.9	111	146	178	205	226	240	249	251	248	239	224	204	177	145	109	75.4	60.0
80	36.4	53.8	90.6	130	164	192	214	229	238	241	238	228	213	191	163	129	90.5	52.3	31.3
85	12.3	33.5	74.1	115	151	180	202	217	227	230	227	217	202	179	151	116	75.6	34.6	9.15
90	0.80	21.5	62.0	102	138	167	190	206	215	218	215	206	190	168	139	104	64.7	24.5	0.45
95	1.88	16.5	53.0	91.7	126	155	178	194	203	207	203	194	179	157	128	94.3	56.4	19.9	2.26
100	4.04	16.6	46.7	81.9	115	143	165	181	190	194	191	182	167	145	118	85.0	50.5	20.5	5.37
105	7.09	19.3	44.0	74.3	105	131	153	168	177	180	178	169	154	134	107	77.7	48.3	22.7	9.40
110	11.2	23.6	43.3	69.9	96.0	120	140	154	163	167	164	155	142	122	99.0	73.4	47.9	26.8	13.9
115	15.0	28.0	43.8	66.6	89.4	111	128	141	149	153	150	142	130	113	92.8	70.6	48.5	31.1	17.8
120	19.4	32.9	45.5	64.2	84.1	103	118	130	137	140	138	131	120	105	87.4	68.4	49.8	35.5	21.7
125	23.2	37.2	47.8	62.9	79.7	95.8	110	120	126	129	127	121	112	98.7	83.0	66.9	51.7	39.8	25.2
130	26.7	41.4	50.0	62.4	76.1	89.9	102	111	116	119	117	112	104	92.6	79.3	66.0	53.3	43.4	28.4
135	29.8	44.9	52.7	62.3	73.2	84.7	94.6	102	107	109	108	103	96.7	87.2	76.3	65.6	55.4	46.8	31.4
140	33.1	48.3	54.8	62.4	71.6	80.2	88.4	94.7	98.7	100	99.3	95.8	90.2	82.5	73.7	65.1	57.4	49.7	34.3
145	36.2	51.2	56.9	63.1	69.9	76.4	82.8	87.8	91.1	92.5	91.7	88.9	84.6	78.5	72.0	65.2	58.8	51.2	36.5
150	39.2	53.6	58.4	63.4	68.3	73.3	78.1	81.9	84.4	85.4	84.9	82.8	79.7	75.0	70.0	65.2	60.0	52.2	38.3
155	40.7	54.1	59.6	63.7	67.7	71.0	74.1	76.8	78.7	79.5	79.0	77.5	75.1	72.2	68.9	64.2	59.2	51.5	39.1
160	37.3	51.5	60.7	63.5	66.4	69.1	71.3	72.7	74.0	74.4	74.0	73.0	71.9	70.4	66.0	60.6	53.7	45.9	38.2
165	37.4	47.4	58.8	64.3	66.1	67.5	68.8	69.9	70.5	70.8	70.8	70.4	69.7	66.2	59.2	52.5	45.6	40.1	35.9
170	36.6	39.7	50.6	58.7	62.6	65.6	67.0	67.5	68.0	68.0	67.9	67.9	62.2	53.6	47.6	41.9	40.7	37.6	33.3
175	44.7	44.3	44.7	47.2	52.0	55.7	58.6	60.8	61.9	61.7	61.8	53.3	40.5	35.2	37.1	40.1	41.2	42.5	41.8
180	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5

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	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333		
5	331	332	332	332	332	333	333	333	333	333	333	333	333	333	333	333	333		
10	327	328	328	329	330	331	332	332	333	333	333	332	332	332	331	330	330		
15	320	321	323	325	326	328	329	331	331	331	331	330	329	328	327	326	325		
20	311	313	316	318	321	324	326	328	329	329	328	327	325	323	320	318	317		
25	300	303	306	310	315	319	322	325	326	326	325	322	319	316	312	309	307		
30	286	290	295	301	307	313	317	321	322	322	320	317	312	307	302	297	294		
35	270	275	282	290	299	306	312	316	317	317	314	310	304	297	289	283	278		
40	252	259	268	278	289	298	305	310	312	311	308	302	294	285	275	267	261		
45	231	240	252	265	278	289	298	304	306	305	301	294	284	272	260	249	240		
50	209	220	235	252	267	280	290	297	299	298	293	284	273	258	243	229	218		
55	184	198	217	237	255	270	282	289	292	290	284	274	261	244	225	207	193		
60	158	176	199	222	243	260	273	281	284	282	275	264	248	228	206	184	167		
65	131	154	180	207	231	250	263	272	275	273	266	253	235	213	187	161	139		
70	103	131	163	193	219	239	253	262	265	263	255	242	223	198	169	138	111		
75	75.6	110	146	179	206	227	243	252	255	253	244	230	210	183	152	116	82.8		
80	51.3	90.7	131	165	194	216	232	241	244	242	233	218	197	169	136	96.2	57.3		
85	32.9	75.3	117	153	182	204	220	230	233	230	221	206	184	156	121	79.5	37.4		
90	22.6	63.6	105	141	170	192	208	218	221	219	209	194	172	144	108	66.8	25.2		
95	18.3	54.0	93.5	129	158	180	196	205	209	206	197	181	159	131	95.8	56.2	19.0		
100	18.7	49.1	83.6	117	145	166	182	191	195	192	183	167	146	118	84.9	49.4	18.7		
105	22.1	47.2	77.6	107	133	153	168	177	180	177	168	154	133	107	77.5	46.7	21.4		
110	25.6	47.0	73.5	99.6	123	142	155	162	165	162	155	141	123	99.2	72.6	45.5	25.1		
115	28.4	48.2	70.8	93.6	114	131	144	151	153	151	143	131	114	92.6	68.8	46.3	27.7		
120	31.1	49.5	68.8	88.6	107	122	133	140	142	140	133	121	106	87.0	66.4	48.1	31.0		
125	34.5	50.3	67.5	84.4	100	114	123	129	131	129	123	113	99.1	82.4	65.3	49.4	33.9		
130	36.2	51.5	66.3	80.8	94.3	106	114	120	121	119	114	105	93.0	79.0	64.8	51.0	37.0		
135	37.7	51.3	64.4	77.6	89.0	98.6	106	110	112	110	105	97.8	87.8	76.3	64.0	51.8	39.0		
140	38.7	51.8	64.3	74.0	84.0	92.2	98.2	102	103	102	97.7	91.4	83.0	73.2	63.9	53.3	40.6		
145	39.0	52.6	63.3	71.9	79.8	86.2	91.0	94.2	95.1	93.9	90.8	85.4	78.1	71.4	63.3	53.5	40.5		
150	39.0	52.6	59.1	68.0	75.5	80.5	83.7	85.8	87.0	85.9	83.5	80.3	75.1	69.1	63.2	52.9	38.4		
155	37.8	47.5	55.0	63.2	71.0	75.7	78.7	80.6	80.9	80.4	78.7	75.8	71.8	67.7	63.2	51.5	35.8		
160	34.8	39.6	46.2	53.0	61.0	69.4	73.3	74.1	74.8	74.6	73.8	72.1	69.2	66.0	63.0	47.7	32.9		
165	34.0	35.1	37.1	41.0	45.6	50.1	60.9	68.7	69.3	69.3	69.0	68.1	66.1	64.1	56.1	38.5	31.1		
170	35.0	36.1	36.9	41.2	40.2	42.5	40.2	45.4	59.4	62.4	63.0	61.3	57.7	49.7	39.1	32.3	35.1		
175	44.6	45.6	45.8	45.9	46.1	46.9	46.0	43.0	27.9	39.0	41.8	44.2	43.5	41.8	43.7	46.2	46.0		
180	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.5		

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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