

LM-79-08 Test Report

for

GREEN CREATIVE LTD

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

LED Tube System

Model: 11.5T8/4F/840/EXT/A4

(LED tube model: 11.5T8/4F/840/EXT 4pcs and LED driver model: 15T8T5HEDRIVER/4CH 1pcs)

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

3rd Floor, Bld. 2, NO. 96 Longchuanwu Rd Qianjiang Economy Dev. Zone, Yuhang Dist,
Hangzhou, Zhejiang Province, China 311100

Tel: +86 571 86376106

www.ledtestlab.com

Report No.: HZ18080024y

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

Review by:



Engineer: April Zou
Aug. 28, 2018

Approved by:



Manager: Jim Zhang
Aug. 28, 2018

Note: This report does not imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

TABLE OF CONTENT

LM-79-08 Test Report.....	1
Sample Photos.....	3
TEST RESULTS	4
Goniophotometer Method	5
Spectral Power Distribution - Sphere Spectroradiometer Method of CH1.....	6
Chromaticity Diagram - Sphere Spectroradiometer Method of CH1	7
Nominal CCT Quadrangles – Sphere Spectroradiometer Method of CH1.....	8
Zonal Lumen Tabulation- Goniophotometer Method of CH1.....	9
Luminous Intensity Distribution Plots- Goniophotometer Method of CH1	11
Luminous Intensity Data- Goniophotometer Method of CH1.....	12
EQUIPMENT LIST	14
TEST METHODS	14
Seasoning of SSL Product.....	14
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	14
Goniophotometer Method	15
Photometric and Electrical Measurements	15
Color Characteristics Measurements.....	15
Color Spatial Uniformity.....	15

Sample Photos

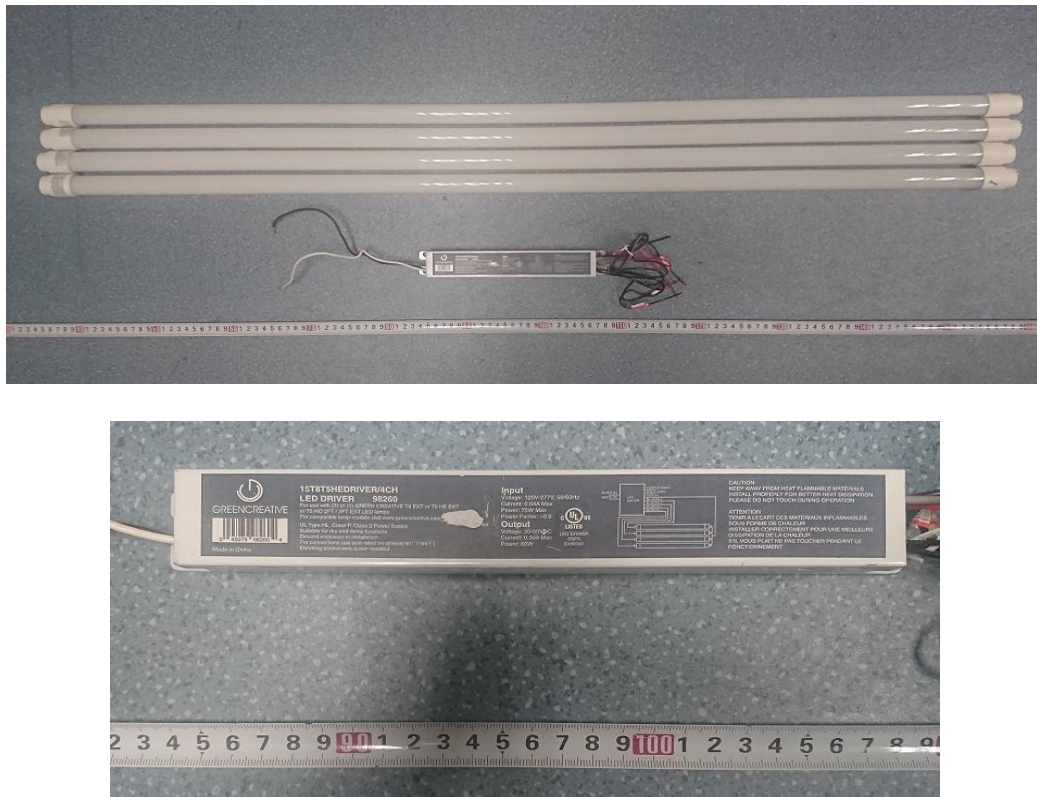


Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: LED Tube System
Model	: 11.5T8/4F/840/EXT/A4
Electrical Ratings	: 120-277V, 50/60Hz
Product Description	: 4000K LED tube model: 11.5T8/4F/840/EXT 4 LED tubes supplied by a LED driver: 15T8T5HEDRIVER/4CH
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

Test specifications:

Date of Receipt	: Jul. 30, 2018
Date of Test	: Aug. 09, 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

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.

The LED driver has 4 channels, the tests were conducted at each channel with the same lamps.

Sphere-Spectroradiometer Method

Parameter	Result				Special Color Rendering Indices of CH1	
	CH1	CH2	CH3	CH4		
Test Voltage (V)	120.0	120.0	120.0	120.0	R1	79.2
Voltage frequency (Hz)	60	60	60	60	R2	86.1
Test Current (A)	0.436	0.436	0.436	0.436	R3	92.8
Power Factor	0.9968	0.9968	0.9968	0.9968	R4	83.4
Test Power (W)/4	13.02	13.02	13.03	13.03	R5	81.7
THD A %	3.42	3.40	3.52	3.50	R6	84.4
Luminous Efficacy (lm/W)	132.3	135.5	135.9	135.6	R7	85.2
Luminous Flux per lamp (lm)	1723.0	1764.0	1768.0	1766.0	R8	63.1
Color Rendering Index (CRI)	82.0	82.0	82.0	81.9	R9	3.5
R9	3.5	3.3	3.5	3.2	R10	68.8
Correlated Color Temperature (CCT)(K)	4074	4074	4074	4074	R11	83.0
Chromaticity Chroma x	0.3791	0.3791	0.3791	0.3791	R12	58.9
Chromaticity Chroma y	0.3812	0.3813	0.3814	0.3813	R13	80.1
Chromaticity Chroma u	0.2225	0.2225	0.2224	0.2225	R14	95.9
Chromaticity Chroma v	0.3356	0.3356	0.3356	0.3356	Rf	82
Duv	0.0025	0.0025	0.0026	0.0025	Rg	96
Chromaticity Chroma u'	0.2225	0.2225	0.2224	0.2225		
Chromaticity Chroma v'	0.5034	0.5034	0.5034	0.5034		

Table 1: 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 24.7°C.

The photometric distance is 30m.

Luminous data was taken at 0.5° vertical intervals and 10° horizontal intervals.

The LED driver has 4 channels, the tests were conducted at each channel with the same lamps.

Parameter	Result			
	CH1	CH2	CH3	CH4
Test Voltage (V)	120.0	120.0	120.0	120.0
Voltage frequency (Hz)	60	60	60	60
Test Current (A)	0.436	0.436	0.437	0.437
Power Factor	0.9953	0.9954	0.9953	0.9954
Test Power (W)/4	13.03	13.03	13.04	13.04
Luminous Efficacy (lm/W)	130.2	133.3	133.6	133.1
Luminous Flux per lamp (lm)	1697.2	1737.6	1741.2	1735.8
Beam Angle (°)	173.6	174.5	175.4	173.3
Center Beam Candle Power (cd)	270	276	277	276
Spacing Criteria	1.29 (0°-180°)/ 1.45 (90°-270°)	1.29 (0°-180°)/ 1.45 (90°-270°)	1.29 (0°-180°)/ 1.45 (90°-270°)	1.29 (0°-180°)/ 1.45 (90°-270°)
Zonal Lumens in the 0°-60° Zone	41.83%	41.85%	41.85%	41.90%
Zonal Lumens in the 60°-90° Zone	26.98%	27.01%	27.01%	27.01%
Zonal Lumens in the 90°-120° Zone	18.07%	18.08%	18.08%	18.06%
Zonal Lumens in the 120°-180° Zone	13.11%	13.06%	13.07%	13.03%

Table 2: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method of CH1

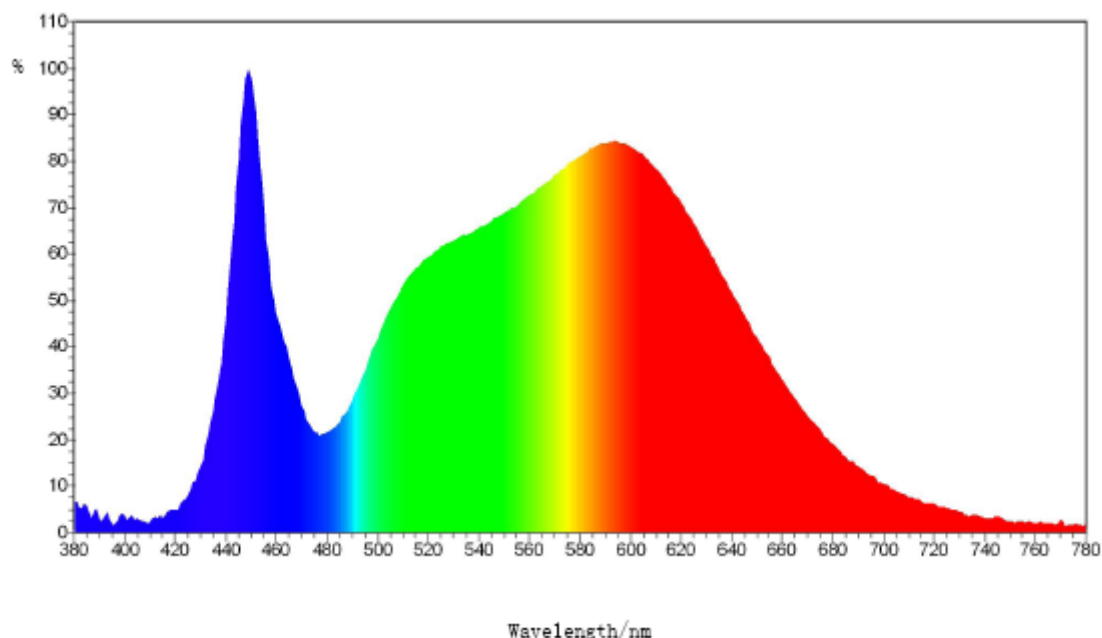
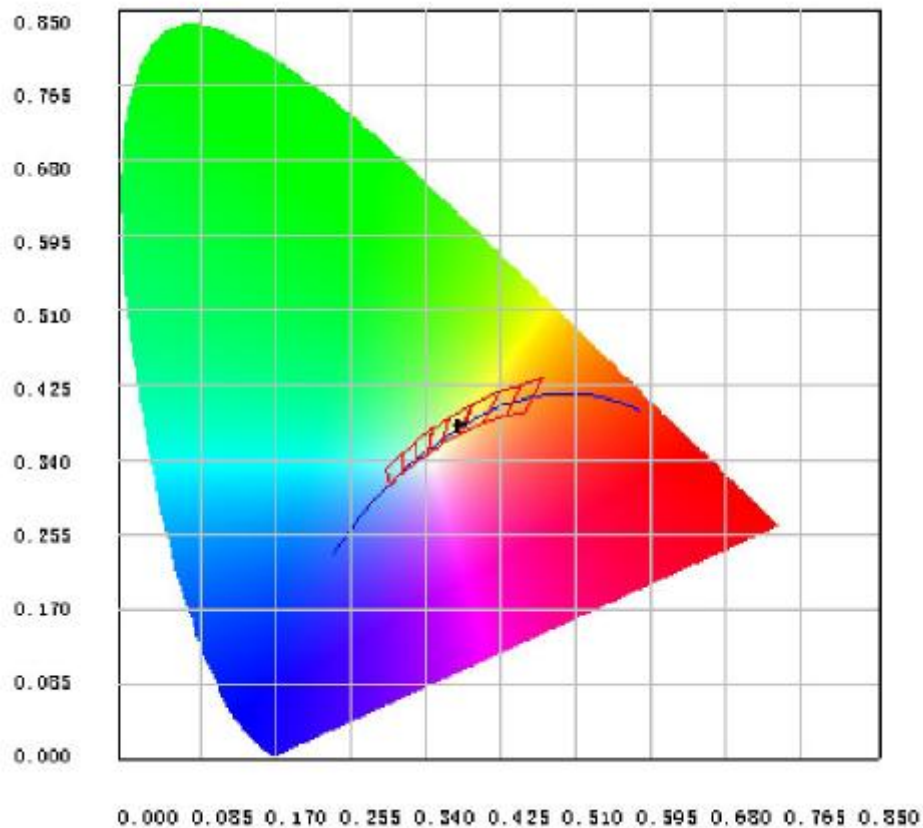


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.27E-03	485	8.38E-03	590	2.94E-02	695	4.33E-03
385	2.09E-03	490	1.00E-02	595	2.95E-02	700	3.71E-03
390	1.06E-03	495	1.22E-02	600	2.91E-02	705	3.15E-03
395	6.18E-04	500	1.46E-02	605	2.86E-02	710	2.72E-03
400	1.25E-03	505	1.68E-02	610	2.76E-02	715	2.46E-03
405	1.07E-03	510	1.86E-02	615	2.63E-02	720	2.21E-03
410	7.62E-04	515	2.00E-02	620	2.50E-02	725	1.89E-03
415	1.07E-03	520	2.08E-02	625	2.34E-02	730	1.63E-03
420	1.70E-03	525	2.17E-02	630	2.17E-02	735	1.32E-03
425	2.82E-03	530	2.20E-02	635	1.99E-02	740	1.15E-03
430	5.05E-03	535	2.25E-02	640	1.82E-02	745	1.20E-03
435	9.18E-03	540	2.30E-02	645	1.64E-02	750	9.11E-04
440	1.62E-02	545	2.35E-02	650	1.47E-02	755	9.01E-04
445	2.82E-02	550	2.41E-02	655	1.32E-02	760	7.94E-04
450	3.43E-02	555	2.47E-02	660	1.16E-02	765	7.46E-04
455	2.43E-02	560	2.54E-02	665	1.02E-02	770	9.44E-04
460	1.67E-02	565	2.62E-02	670	8.86E-03	775	5.62E-04
465	1.34E-02	570	2.70E-02	675	7.79E-03	780	6.75E-04
470	9.62E-03	575	2.78E-02	680	6.70E-03		
475	7.56E-03	580	2.84E-02	685	5.71E-03		
480	7.54E-03	585	2.91E-02	690	4.98E-03		

Table 3: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method

Chromaticity Diagram - Sphere Spectroradiometer Method of CH1



Tristimulus values(x, y): (0.3791, 0.3812)

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 of CH1

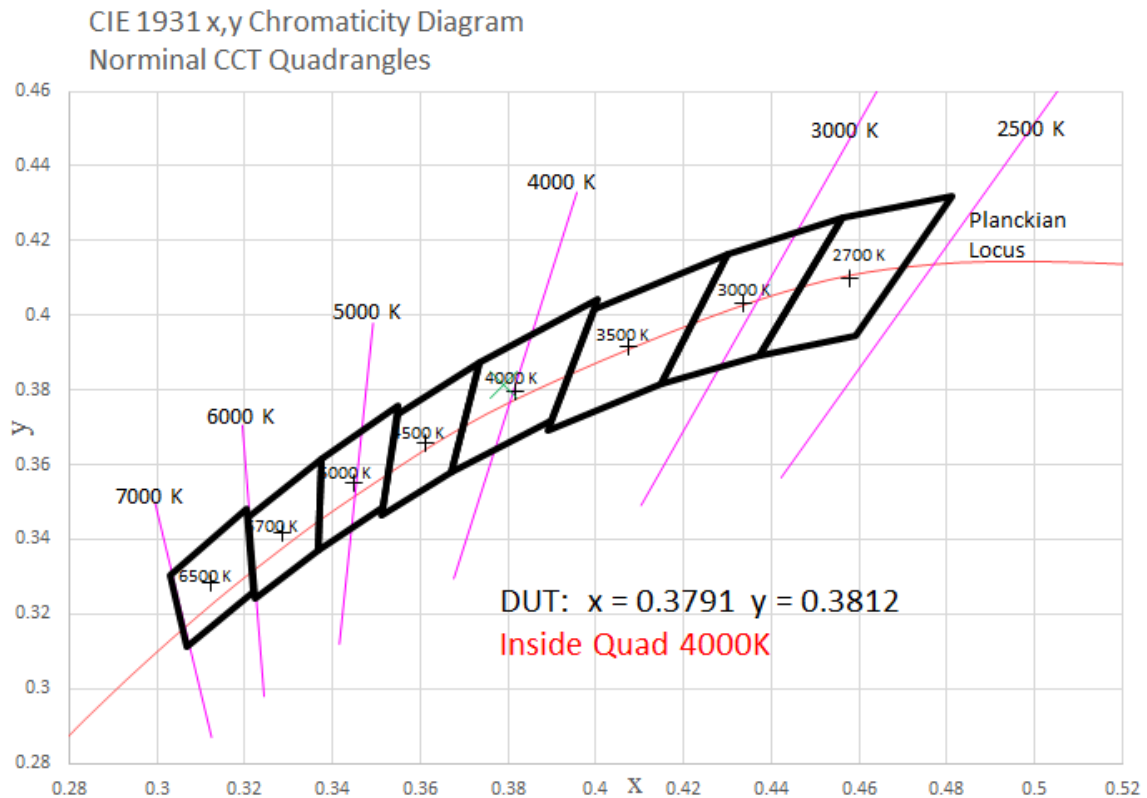


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method of CH1

$\gamma(^{\circ})$	Lumens	% Total
0- 10	25.601	1.51%
10- 20	74.519	4.39%
20- 30	116.869	6.89%
30- 40	149.081	8.78%
40- 50	168.768	9.94%
50- 60	175.132	10.32%
60- 70	169.11	9.96%
70- 80	153.875	9.07%
80- 90	134.996	7.95%
90-100	118.072	6.96%
100-110	102.116	6.02%
110-120	86.506	5.10%
120-130	71.625	4.22%
130-140	57.535	3.39%
140-150	43.756	2.58%
150-160	29.85	1.76%
160-170	15.559	0.92%
170-180	4.238	0.25%
Total	1697.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	709.97	41.83%
60- 90	457.981	26.98%
0-90	1167.951	68.82%
90- 180	529.257	31.18%
0- 180	1697.2	100%

Table 4: Zonal Lumen Data

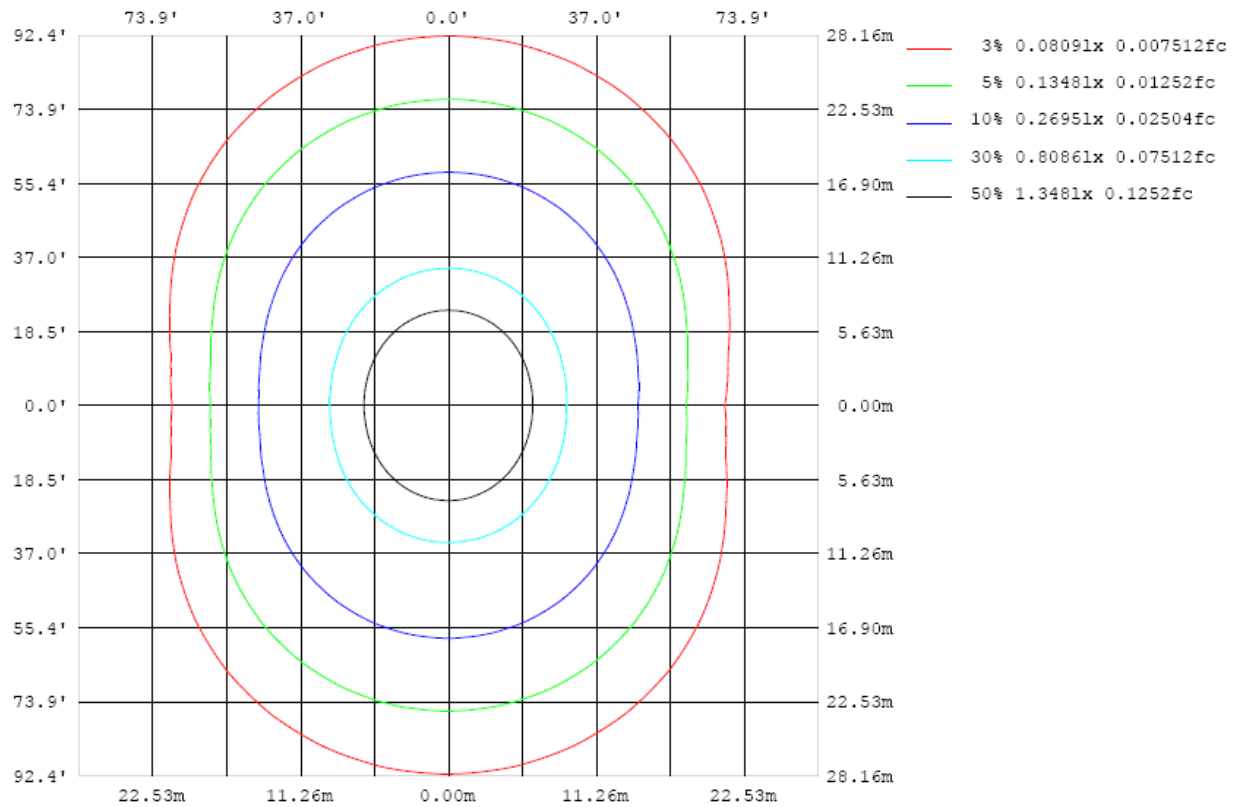


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method of CH1

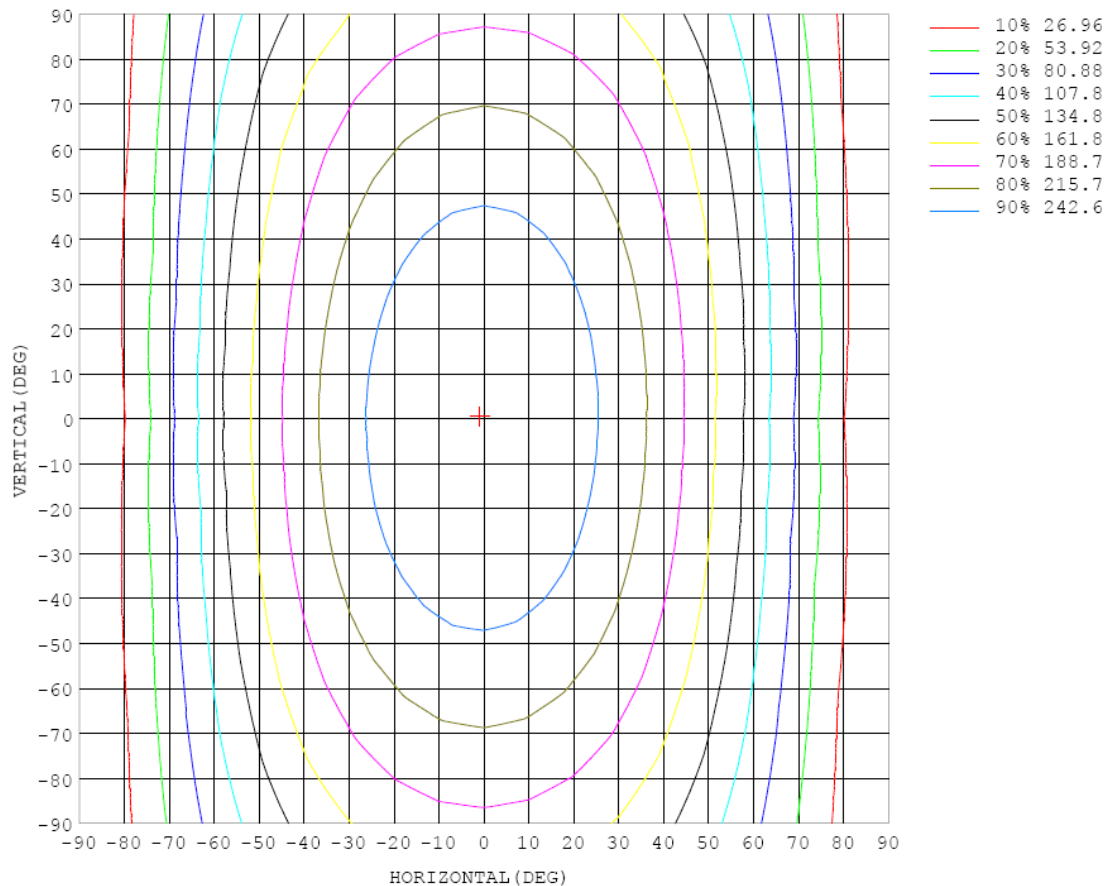


Chart 5: Isocandela Plot

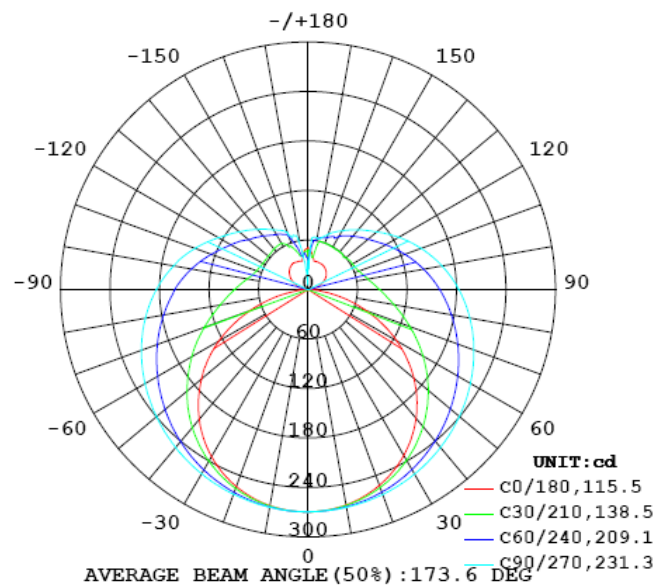


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method of CH1

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	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270
5	268	268	268	268	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
10	265	265	265	266	266	267	267	268	268	268	268	268	268	268	267	267	266	266	266
15	260	260	261	261	262	264	265	266	266	266	267	266	266	265	264	263	262	261	261
20	253	253	254	255	257	260	261	263	264	265	264	264	262	261	259	257	255	254	254
25	243	244	246	248	251	254	257	259	261	262	262	260	258	256	253	250	247	245	245
30	232	233	235	239	243	248	252	255	257	258	258	256	253	250	245	241	237	235	234
35	219	220	223	229	234	241	246	250	253	254	254	252	248	243	237	231	225	222	221
40	204	205	210	217	225	233	240	245	249	250	249	246	241	235	227	219	212	207	205
45	187	189	195	204	214	224	233	239	243	245	244	240	234	226	216	206	197	190	188
50	168	170	179	190	203	215	225	233	238	239	238	234	227	217	205	192	180	171	169
55	146	150	161	176	191	206	217	226	232	234	232	227	219	208	193	178	163	151	148
60	124	129	143	161	179	196	210	219	225	227	226	220	211	198	182	163	144	129	125
65	100	106	124	146	168	186	201	212	218	221	219	213	203	188	170	148	125	107	100
70	75.2	83.6	105	131	156	177	193	205	211	214	212	206	195	179	158	134	107	84.0	74.8
75	50.9	61.9	88.1	118	145	168	185	197	204	207	205	198	186	169	147	120	90.2	62.6	49.4
80	27.6	41.8	72.7	106	135	159	176	189	197	199	197	190	178	160	137	108	75.5	43.3	26.0
85	9.00	26.4	61.2	95.4	125	150	168	181	189	191	189	182	169	152	128	98.2	64.4	28.9	7.76
90	0.66	18.2	52.7	86.8	117	141	160	173	180	183	181	173	161	143	119	89.8	56.1	21.3	0.51
95	2.18	15.5	47.0	79.6	109	133	151	164	171	174	172	165	152	135	111	82.7	50.6	18.8	2.26
100	5.87	16.8	43.4	73.8	101	124	142	155	162	165	163	156	144	126	104	76.8	47.1	19.8	5.89
105	10.4	19.4	41.9	69.3	94.5	116	134	146	153	156	154	147	135	118	97.2	72.5	45.5	22.3	10.5
110	14.8	22.8	42.4	65.6	88.5	109	125	137	144	146	144	138	126	111	91.1	68.8	45.7	25.3	14.9
115	19.3	27.7	43.7	63.4	83.2	102	117	128	134	136	135	128	118	104	85.8	66.4	46.9	29.0	19.1
120	23.4	32.9	44.8	62.4	79.0	95.2	109	119	125	127	125	120	110	97.0	81.4	65.2	47.6	31.8	23.1
125	26.4	36.8	46.0	61.6	76.0	89.6	101	110	116	118	116	111	103	91.4	78.3	64.3	49.4	35.1	26.5
130	29.0	39.3	48.3	60.2	74.0	85.3	95.0	102	107	109	108	103	96.2	86.8	75.0	62.8	51.3	37.5	29.6
135	31.1	41.6	49.9	59.7	71.3	81.2	89.7	95.9	99.8	101	100	96.7	90.6	81.9	72.6	63.2	50.6	39.0	32.2
140	32.7	42.6	52.0	59.8	66.6	77.3	84.5	89.9	93.3	94.6	93.8	90.8	85.6	77.8	71.2	63.3	50.7	41.0	34.2
145	34.1	46.0	52.8	59.1	65.7	72.6	79.5	84.1	87.1	88.2	87.5	85.0	79.4	74.9	70.1	60.8	52.8	43.1	35.6
150	34.9	47.6	54.4	59.4	64.8	69.7	74.0	78.8	81.0	82.2	81.8	80.1	76.1	73.2	67.6	58.0	50.2	45.1	36.8
155	35.1	46.0	55.5	59.9	62.7	66.8	71.0	74.0	75.9	77.0	77.1	75.2	72.3	67.9	61.5	56.3	49.6	43.1	36.5
160	35.4	43.0	57.4	60.1	62.1	64.4	66.9	69.3	69.5	71.2	71.1	66.4	65.1	62.9	53.4	46.8	43.3	40.0	36.2
165	35.5	40.6	47.6	60.0	61.6	64.3	64.7	64.9	65.5	65.6	65.4	62.5	60.2	48.4	45.1	39.4	37.4	36.6	35.8
170	38.4	38.5	37.3	46.4	59.2	60.3	61.8	64.6	64.1	63.7	62.7	56.0	44.8	38.6	37.1	37.8	38.7	38.0	38.3
175	45.8	46.0	45.1	42.2	40.5	44.2	53.8	56.2	62.4	63.5	45.0	32.2	32.6	38.3	42.0	43.1	45.3	46.7	47.9
180	26.1	26.1	26.1	26.0	25.9	25.7	25.5	25.3	25.1	24.9	24.9	24.8	24.8	24.7	24.7	24.7	24.7	24.6	24.6

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	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270	270		
5	269	269	269	269	269	269	269	269	269	269	269	269	269	269	268	268	268		
10	266	266	267	267	267	268	268	268	268	268	268	267	267	266	266	265	265		
15	261	262	262	263	264	265	266	266	266	266	266	265	264	262	261	261	260		
20	254	255	257	258	260	262	263	264	264	264	263	261	260	258	256	254	253		
25	246	247	249	252	255	258	260	261	261	261	260	257	255	251	248	246	244		
30	235	237	240	245	249	253	256	257	258	257	256	252	248	244	240	236	233		
35	222	225	230	236	242	247	251	253	254	253	251	247	242	236	230	224	220		
40	207	212	218	226	234	241	246	249	250	249	246	241	234	226	218	211	206		
45	190	196	205	216	225	234	240	244	245	244	240	234	226	216	206	196	190		
50	171	180	192	205	216	226	234	238	240	239	234	227	217	205	192	181	172		
55	152	163	177	193	207	219	227	233	234	233	228	220	208	194	179	164	153		
60	130	145	163	181	198	211	220	226	228	227	221	212	199	183	164	147	132		
65	107	126	148	169	188	203	213	220	222	220	214	204	190	171	151	128	110		
70	84.3	107	134	159	179	195	206	213	215	213	207	196	180	161	136	110	87.1		
75	62.0	89.9	120	148	169	186	198	205	208	206	199	188	171	150	123	93.2	65.3		
80	42.3	74.9	108	137	161	178	190	198	200	198	191	180	163	140	111	78.2	45.7		
85	27.5	63.0	97.9	128	152	169	182	190	192	190	183	171	154	130	101	66.2	30.5		
90	19.6	54.5	89.1	119	143	162	174	181	184	182	175	163	145	122	91.9	57.3	21.9		
95	16.6	48.4	81.6	111	135	153	165	172	175	173	166	155	137	113	84.1	50.8	18.1		
100	17.8	44.4	74.9	103	126	144	156	163	166	164	157	145	128	105	77.1	46.2	18.6		
105	21.4	43.4	69.6	95.4	117	134	146	154	156	154	147	136	119	97.1	71.3	44.3	21.7		
110	26.1	44.0	66.5	88.9	109	125	137	144	146	144	137	126	110	90.3	67.5	44.2	26.2		
115	31.0	45.8	64.8	84.2	102	116	127	133	136	134	128	117	103	85.0	65.0	45.5	31.0		
120	35.5	47.5	63.4	79.5	95.9	108	118	124	126	124	118	109	96.5	80.9	63.7	47.9	35.8		
125	39.2	50.0	63.0	76.8	89.6	102	110	115	117	115	110	102	91.2	77.8	63.3	50.7	40.5		
130	42.3	52.8	62.9	74.7	85.4	94.1	103	108	109	108	103	96.4	86.8	75.4	63.7	53.5	44.7		
135	45.6	55.2	63.5	73.1	81.8	89.4	96.3	101	102	101	97.0	91.1	83.1	73.7	64.4	56.2	48.8		
140	49.6	56.7	64.3	71.4	78.7	84.9	87.2	94.2	95.3	94.2	91.2	86.4	79.9	72.5	65.2	58.8	51.6		
145	50.8	55.1	64.7	70.5	76.1	80.4	84.0	88.4	89.2	88.4	85.9	82.0	77.2	71.5	65.9	61.1	53.7		
150	52.7	58.5	64.7	69.5	73.7	77.1	79.2	80.7	83.5	82.9	81.0	78.4	74.6	70.6	66.7	62.3	54.7		
155	48.3	55.7	58.9	67.3	71.5	74.1	75.6	75.8	79.3	78.9	77.5	75.3	72.6	69.7	66.4	63.1	50.2		
160	42.8	49.3	53.9	56.6	63.1	68.6	72.2	72.6	73.2	75.0	74.1	72.7	71.2	68.3	66.5	59.4	45.0		
165	38.2	41.1	45.9	47.5	50.0	54.3	59.4	67.1	68.4	70.7	70.3	70.9	66.4	59.0	53.3	51.7	40.8		
170	38.3	38.9	41.9	44.0	44.7	40.9	41.5	45.2	53.3	60.1	66.3	50.4	46.2	49.1	51.6	45.9	38.5		
175	47.8	46.8	46.0	47.0	44.7	43.9	37.8	25.5	15.8	5.38	17.5	39.5	46.6	47.8	48.8	46.7	47.1		
180	24.6	24.7	24.7	24.7	24.7	24.8	24.8	24.9	24.9	25.1	25.3	25.5	25.7	25.9	26.0	26.1	26.1		

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

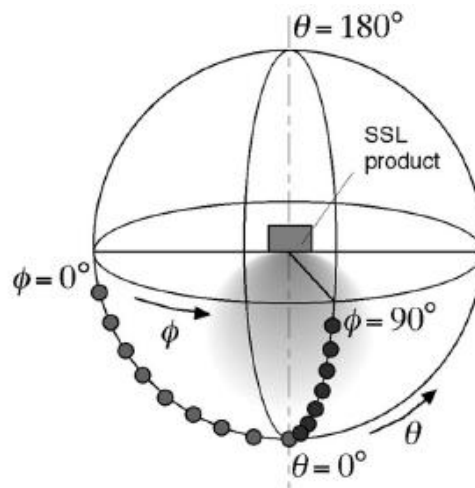
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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

This report is considered invalidated without the Special Seal for Inspection of the LTL. This report shall not be altered, increased or deleted. The results shown in this test report refer only to the sample(s) tested. Without written approval of LTL, this test report shall not be copied except in full and published as advertisement.