



## LM-79-08 Test Report

for

### Revolution Lighting Technologies, Inc.

2280 Ward Ave. Simi Valley, CA 93065

### LED Tube

Model: 202100-112

### 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.: HZ18110016i

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

Review by:

Engineer: April Zou  
Nov. 21, 2018

Approved by:



Manager: Jim Zhang  
Nov. 21, 2018

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: 202100-112

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
141.0	1296.0	9.19	0.9842
CCT (K)	CRI	Stabilization Time (Light & Power)	
3391	81.7	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** : Nov. 12, 2018

**Date of Test** : Nov. 14, 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

## TABLE OF CONTENT

LM-79-08 Test Report.....	1
Test Summary.....	2
Sample Photo.....	4
TEST RESULTS .....	5
Goniophotometer Method .....	6
Spectral Power Distribution - Sphere Spectroradiometer Method .....	7
Chromaticity Diagram - Sphere Spectroradiometer Method.....	8
Nominal CCT Quadrangles – Sphere Spectroradiometer Method .....	9
Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.Zonal	
Lumen Tabulation- Goniophotometer Method.....	9
Zonal Lumen Tabulation- Goniophotometer Method .....	10
Luminous Intensity Data- Goniophotometer Method.....	13
EQUIPMENT LIST .....	15
TEST METHODS .....	15
Seasoning of SSL Product.....	15
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	15
Goniophotometer Method .....	16
Photometric and Electrical Measurements.....	16
Color Characteristics Measurements.....	16
Color Spatial Uniformity .....	16

## Sample Photo

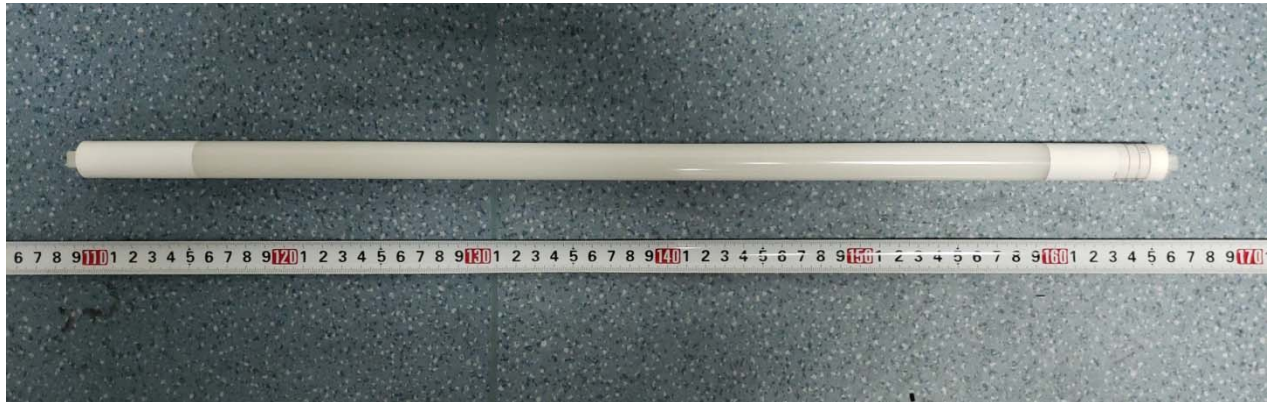


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 202100-112
<b>Electrical Ratings</b>	: 120-277V, 60Hz
<b>Product Description</b>	: 3500K
<b>Manufacturer</b>	: Revolution Lighting Technologies, Inc.
<b>Address</b>	: 2280 Ward Ave. Simi Valley, CA 93065

## 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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
	Test Voltage (V)	120.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.078	0.038
Power Factor	0.9842	0.9221
Test Power (W)	9.19	9.62
THD A%	15.28	28.08
Luminous Efficacy (lm/W)	141.0	134.9
Total Luminous Flux (lm)	1296.0	1298.0
Color Rendering Index (CRI)	81.7	
R9	0.6	
Correlated Color Temperature (CCT)(K)	3391	
Chromaticity Chroma x	0.4126	
Chromaticity Chroma y	0.3965	
Chromaticity Chroma u	0.2380	
Chromaticity Chroma v	0.3432	
Duv	0.0005	
Chromaticity Chroma u'	0.2380	
Chromaticity Chroma v'	0.5147	

Special Color Rendering Indices	
R1	79.9
R2	90.7
R3	95.9
R4	78.8
R5	80
R6	87.8
R7	82.6
R8	58
R9	0.6
R10	78.2
R11	77.5
R12	65.6
R13	82.6
R14	98.3

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 25.0 °C.

The photometric distance is 2.47 m.

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)	0.078
Power Factor	0.9852
Power (W)	9.22
Luminous Efficacy (lm/W)	139.8
Total Luminous Flux (lm)	1289.1
Beam Angle (°)	102.2 (0°-180°) /127.9(90°-270°)
Center Beam Candle Power (cd)	371
Maximum Beam Candle Power (cd)	371.3 (At: C=330.0, Gamma=3.0)
Spacing Criteria	1.18 (0°-180°) /1.29 (90°-270°)
Zonal Lumens in the 0°-60°Zone	64.83%
Zonal Lumens in the 60°-90°Zone	25.36%
Zonal Lumens in the 90°-120°Zone	7.51%
Zonal Lumens in the 120°-180°Zone	2.30%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

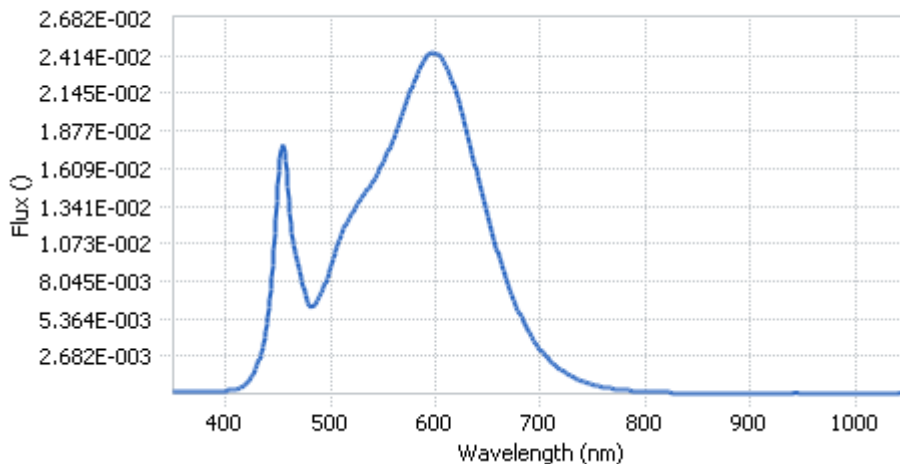
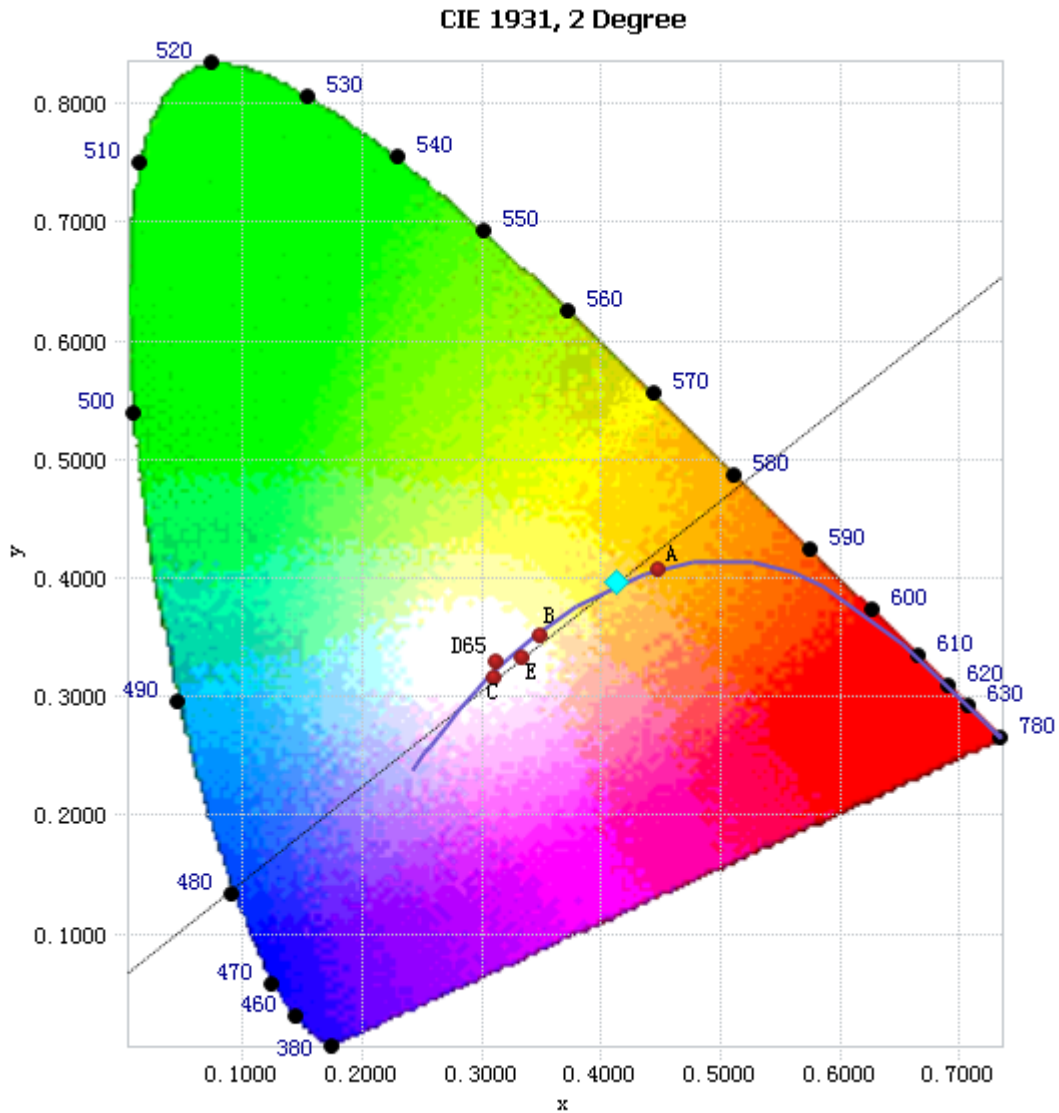


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.75E-04	485	6.38E-03	590	2.39E-02	695	3.66E-03
385	1.72E-04	490	7.00E-03	595	2.43E-02	700	3.14E-03
390	1.88E-04	495	7.90E-03	600	2.43E-02	705	2.69E-03
395	2.04E-04	500	9.09E-03	605	2.41E-02	710	2.31E-03
400	2.11E-04	505	1.03E-02	610	2.34E-02	715	1.96E-03
405	2.56E-04	510	1.13E-02	615	2.25E-02	720	1.68E-03
410	3.40E-04	515	1.22E-02	620	2.13E-02	725	1.45E-03
415	4.86E-04	520	1.29E-02	625	2.01E-02	730	1.23E-03
420	7.55E-04	525	1.35E-02	630	1.86E-02	735	1.04E-03
425	1.23E-03	530	1.41E-02	635	1.71E-02	740	8.94E-04
430	2.04E-03	535	1.46E-02	640	1.56E-02	745	7.60E-04
435	3.36E-03	540	1.52E-02	645	1.41E-02	750	6.54E-04
440	5.51E-03	545	1.58E-02	650	1.26E-02	755	5.66E-04
445	9.25E-03	550	1.65E-02	655	1.12E-02	760	4.87E-04
450	1.50E-02	555	1.73E-02	660	9.88E-03	765	4.17E-04
455	1.77E-02	560	1.83E-02	665	8.70E-03	770	3.60E-04
460	1.38E-02	565	1.93E-02	670	7.60E-03	775	3.07E-04
465	1.06E-02	570	2.03E-02	675	6.62E-03	780	2.65E-04
470	9.01E-03	575	2.14E-02	680	5.73E-03		
475	7.28E-03	580	2.25E-02	685	4.96E-03		
480	6.26E-03	585	2.33E-02	690	4.26E-03		

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

**Chromaticity Diagram - Sphere Spectroradiometer Method**



Tristimulus values(x, y): (0.4126, 0.3965)

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

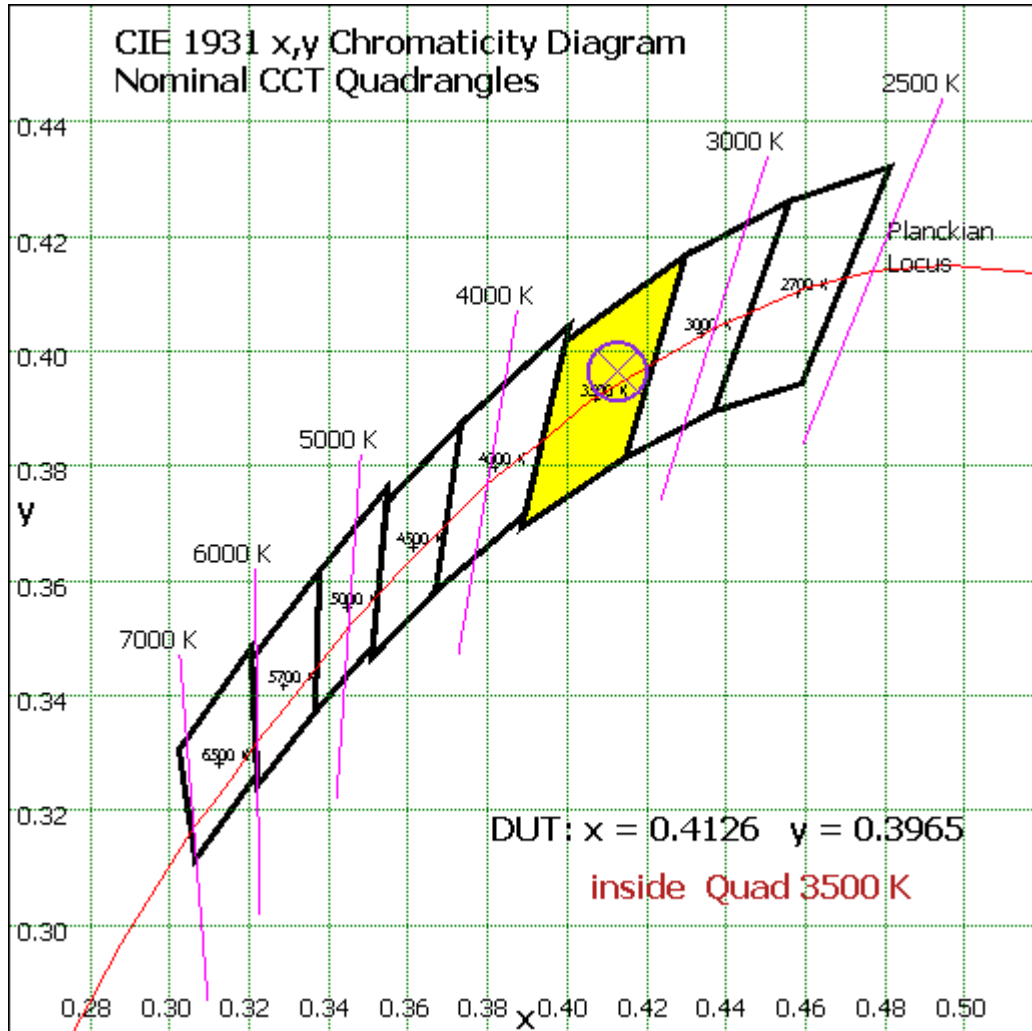


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Note: The location on the diagram of the tristimulus coordinates are indicated by the blue diamond.

**Zonal Lumen Tabulation- Goniophotometer Method**

$\gamma(^{\circ})$	Lumens	% Total
0- 10	35.08	2.72%
10- 20	100.348	7.78%
20- 30	151.701	11.77%
30- 40	182.529	14.16%
40- 50	190.036	14.74%
50- 60	175.999	13.65%
60- 70	146.03	11.33%
70- 80	108.253	8.40%
80- 90	72.606	5.63%
90-100	47.314	3.67%
100-110	30.41	2.36%
110-120	19.118	1.48%
120-130	12.104	0.94%
130-140	7.817	0.61%
140-150	4.943	0.38%
150-160	2.946	0.23%
160-170	1.476	0.11%
170-180	0.355	0.03%
Total	1289.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	835.693	64.83%
60- 90	326.889	25.36%
0-90	1162.582	90.19%
90- 180	126.483	9.81%
0- 180	1289.1	100%

Table 5: Zonal Lumen Data

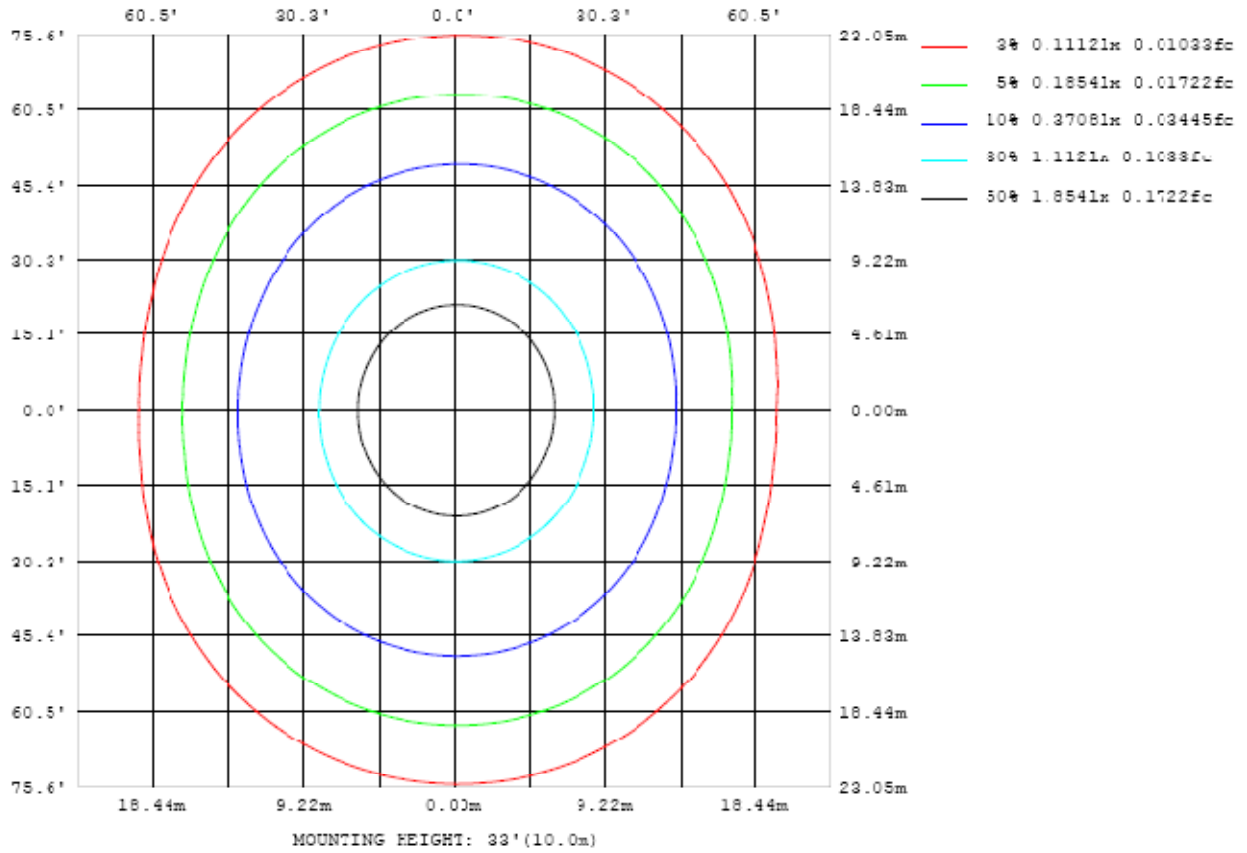


Chart 4: Beam Angle

### Luminous Intensity Distribution Plots- Goniophotometer Method

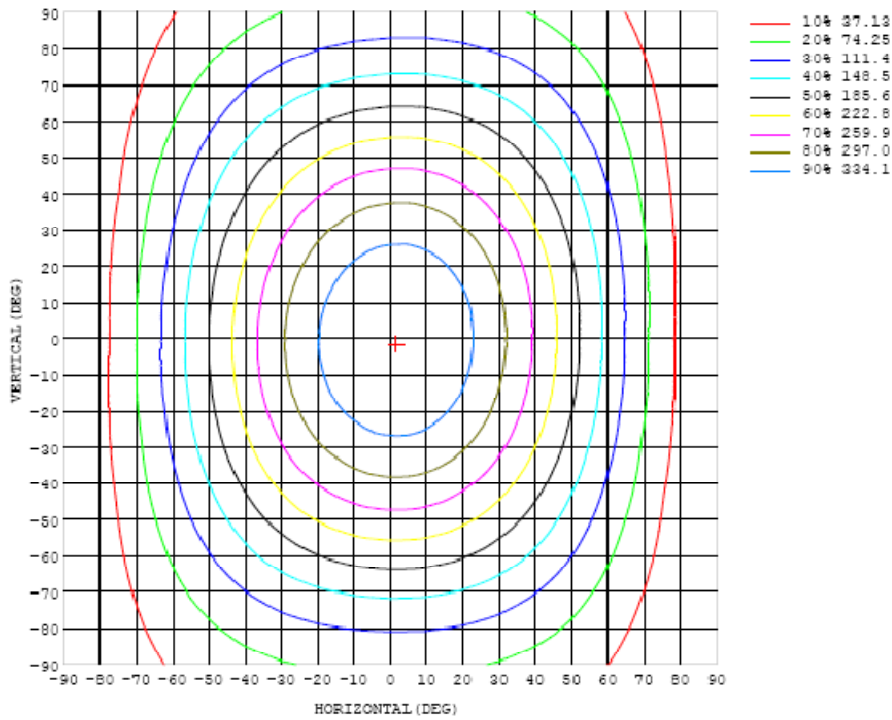


Chart 5: Illuminance Plot (Footcandles)

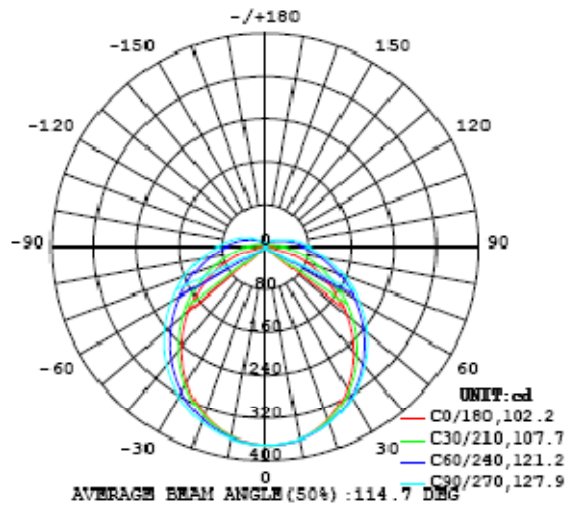


Chart 6: Polar Candela Distribution

**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	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371
5	370	370	370	370	370	370	370	370	370	369	369	369	368	368	367	367	368	367	367
10	365	365	366	366	366	367	367	367	366	366	365	365	363	363	362	361	360	360	360
15	356	357	357	358	358	359	360	360	360	359	359	357	355	354	352	350	349	349	349
20	344	344	344	346	347	349	350	351	351	350	349	347	345	343	340	337	335	334	333
25	326	327	328	330	333	335	338	339	340	339	337	334	331	328	324	320	317	316	314
30	305	306	308	311	315	319	322	324	326	325	323	320	316	312	306	301	297	294	293
35	282	282	285	289	295	300	304	308	309	308	307	303	298	292	286	279	274	270	268
40	255	256	260	266	272	279	284	289	290	290	288	284	278	271	264	256	249	244	242
45	227	229	233	239	248	256	263	268	271	270	268	263	257	249	240	231	223	217	214
50	198	200	205	213	222	232	240	246	249	249	247	242	235	226	215	205	196	189	186
55	168	170	176	186	197	207	216	223	226	226	224	219	212	202	191	179	169	161	157
60	139	141	148	159	171	183	192	199	203	203	201	196	188	178	166	153	142	133	129
65	109	112	120	133	146	159	169	176	179	180	177	173	165	155	142	129	116	106	101
70	80.6	83.6	94.2	108	123	136	146	153	156	157	155	150	143	133	120	106	92.3	80.1	74.5
75	54.0	57.9	70.2	86.1	101	114	124	131	135	135	133	129	122	112	99.8	85.8	70.4	56.9	49.1
80	29.5	34.7	50.0	66.6	81.9	94.8	105	111	114	115	113	109	103	94.1	81.9	68.6	52.3	36.5	26.3
85	10.3	16.8	33.3	50.4	66.2	77.8	87.2	93.4	96.8	97.2	95.8	92.2	86.5	77.8	66.6	52.9	37.0	20.8	8.63
90	1.01	6.46	21.1	37.3	52.0	63.9	72.3	78.2	81.5	81.9	80.8	77.5	72.1	64.5	53.8	40.6	25.7	10.8	0.80
95	0.41	2.37	12.5	27.0	40.7	51.9	60.2	65.7	68.6	69.1	68.2	65.3	60.6	53.1	43.0	30.8	17.2	4.73	0.41
100	0.50	1.48	7.86	18.5	30.6	41.2	49.2	54.7	57.8	58.7	57.7	55.1	50.2	43.2	33.6	22.1	11.1	3.44	0.45
105	0.60	1.32	5.51	13.5	22.7	31.5	38.8	44.3	47.4	48.4	47.8	45.2	40.3	33.5	24.9	16.6	8.49	2.60	0.68
110	0.87	1.53	4.27	10.4	17.7	24.6	30.4	34.7	37.6	38.6	38.1	35.7	31.6	26.4	20.3	13.2	6.94	2.59	0.99
115	1.16	1.74	3.92	8.38	14.2	20.0	24.9	28.6	30.8	31.5	31.1	29.3	26.2	21.9	16.5	10.9	5.98	2.68	1.33
120	1.48	1.99	3.86	7.07	11.7	16.5	20.6	23.7	25.7	26.4	26.0	24.5	21.8	18.2	13.8	9.34	5.45	2.80	1.69
125	1.81	2.25	3.89	6.34	9.85	13.8	17.2	19.8	21.5	22.1	21.8	20.5	18.3	15.3	11.8	8.20	5.14	2.98	2.07
130	2.25	2.53	3.91	5.90	8.59	11.6	14.5	16.7	18.1	18.6	18.3	17.3	15.4	13.0	10.2	7.36	4.94	3.19	2.43
135	2.66	2.78	3.97	5.61	7.71	10.0	12.3	14.1	15.2	15.7	15.5	14.6	13.1	11.1	8.84	6.63	4.77	3.31	2.72
140	3.07	2.96	4.05	5.39	7.02	8.82	10.5	11.9	12.8	13.2	13.1	12.4	11.2	9.62	7.85	6.09	4.71	3.44	2.99
145	3.37	3.03	4.05	5.22	6.36	7.74	9.04	10.1	10.8	11.1	11.0	10.5	9.58	8.41	7.05	5.74	4.73	3.57	3.29
150	3.55	3.00	3.92	5.14	5.91	6.86	7.82	8.63	9.19	9.41	9.35	8.96	8.28	7.36	6.36	5.51	4.76	3.54	3.50
155	3.76	3.08	3.88	5.01	5.63	6.22	6.81	7.40	7.82	7.97	7.93	7.66	7.16	6.53	5.93	5.36	4.64	3.32	3.79
160	4.06	3.20	3.65	4.69	5.39	5.77	6.14	6.45	6.68	6.78	6.75	6.60	6.35	5.98	5.61	5.19	4.41	3.16	3.93
165	4.08	3.49	3.02	3.60	4.49	5.36	5.65	5.83	5.97	6.02	6.01	5.93	5.80	5.40	4.96	4.46	3.64	3.26	3.92
170	3.69	3.25	2.82	2.62	2.79	2.78	3.19	4.21	5.22	5.34	4.83	3.70	3.45	3.31	3.11	3.05	3.07	3.22	3.30
175	3.27	2.62	2.48	2.53	2.54	2.60	2.81	2.82	2.01	1.09	2.15	2.91	3.05	2.90	2.92	2.91	2.91	2.90	2.98
180	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57

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	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371	371		
5	367	368	368	368	368	369	369	369	369	370	371	371	370	371	370	370	370		
10	360	360	361	361	362	363	364	365	365	366	366	366	366	367	366	366	366		
15	348	349	350	361	363	364	366	367	368	369	369	369	369	369	368	368	367		
20	333	334	336	338	340	343	345	347	348	350	350	350	348	347	347	345	343		
25	315	317	318	321	325	329	332	335	336	338	338	337	335	333	331	329	326		
30	293	296	298	303	308	313	317	320	322	324	323	321	319	315	312	309	307		
35	269	272	276	282	288	294	299	303	306	307	307	304	300	295	291	287	283		
40	243	247	252	259	267	274	280	285	287	289	288	285	279	273	267	262	258		
45	216	220	226	234	244	252	260	265	268	269	267	264	257	249	242	235	230		
50	187	192	200	210	220	230	238	244	247	248	246	242	234	225	216	208	202		
55	159	165	174	184	196	207	216	222	225	227	224	219	211	200	190	180	173		
60	132	138	149	161	173	184	194	200	203	204	201	196	187	176	164	153	144		
65	104	112	124	137	151	162	172	178	181	182	179	173	164	152	139	126	115		
70	77.3	87.4	101	116	130	142	151	157	160	161	158	152	142	130	115	100	88.0		
75	52.8	65.0	80.3	95.9	110	122	131	137	140	141	138	132	122	109	93.4	77.2	62.7		
80	31.3	45.9	62.3	78.3	92.5	104	113	119	122	122	119	113	103	89.9	74.2	57.0	40.3		
85	15.2	30.6	47.4	63.2	77.0	88.1	96.6	102	104	105	102	95.8	86.4	73.6	58.1	40.7	23.0		
90	5.86	20.0	35.8	50.8	63.9	74.3	82.1	87.1	89.5	89.7	86.6	81.9	72.0	59.8	44.9	28.3	11.8		
95	2.55	13.1	27.0	40.7	52.8	62.5	69.7	74.2	76.3	76.4	73.6	68.1	59.8	48.4	34.8	19.8	6.18		
100	1.80	8.58	20.5	32.7	43.6	52.5	59.1	63.3	65.2	65.0	62.4	57.2	49.6	39.2	26.9	13.8	3.68		
105	1.67	6.45	15.2	26.2	36.0	44.0	50.0	53.9	55.6	55.5	52.8	48.1	41.1	31.7	20.6	9.76	2.86		
110	1.95	5.43	11.6	20.3	29.3	36.7	42.3	45.8	47.3	47.1	44.7	40.3	33.7	24.9	15.4	7.49	2.56		
115	2.28	4.96	9.84	16.3	23.1	29.8	35.1	38.3	39.7	39.4	37.2	32.9	26.5	19.3	12.2	6.33	2.69		
120	2.61	4.78	8.56	13.5	19.0	23.8	27.9	30.9	32.2	31.9	29.6	25.9	21.2	15.7	10.3	5.58	2.89		
125	2.95	4.72	7.71	11.6	16.0	19.9	23.1	25.1	26.0	25.7	24.1	21.3	17.6	13.2	8.89	5.24	3.07		
130	3.27	4.75	7.12	10.2	13.5	16.7	19.3	21.0	21.6	21.4	20.0	17.8	14.7	11.3	7.85	5.09	3.36		
135	3.53	4.81	6.70	9.11	11.7	14.1	16.3	17.6	18.1	17.9	16.8	14.9	12.5	9.86	7.18	5.04	3.68		
140	3.66	4.75	6.38	8.23	10.2	12.1	13.6	14.7	15.2	15.0	14.0	12.6	10.8	8.73	6.72	4.98	3.91		
145	3.90	4.79	6.03	7.44	8.96	10.4	11.6	12.4	12.7	12.6	11.9	10.9	9.46	7.89	6.29	4.79	4.08		
150	4.15	4.68	5.70	6.85	7.97	9.05	9.93	10.5	10.7	10.7	10.2	9.35	8.33	7.17	5.97	4.91	4.25		
155	4.46	4.98	5.42	6.16	7.11	7.89	8.51	8.94	9.10	9.03	8.69	8.13	7.41	6.59	5.61	4.88	4.46		
160	4.57	5.00	5.35	5.71	6.25	6.87	7.33	7.60	7.73	7.69	7.48	7.17	6.66	5.96	5.31	5.00	4.54		
165	4.51	4.88	5.07	5.09	5.60	5.95	6.18	6.36	6.47	6.54	6.44	6.21	5.89	5.61	5.31	5.07	4.42		
170	4.00	4.49	4.85	5.11	5.25	5.30	5.63	5.81	5.77	5.73	5.68	5.59	5.43	5.33	5.19	4.88	4.43		
175	3.16	3.38	3.55	3.90	4.36	4.63	4.59	4.54	4.53	4.60	4.71	4.78	4.76	4.73	4.66	4.53	4.08		
180	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57		

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	2M	HZTE015-01	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  $4\pi$ . 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.

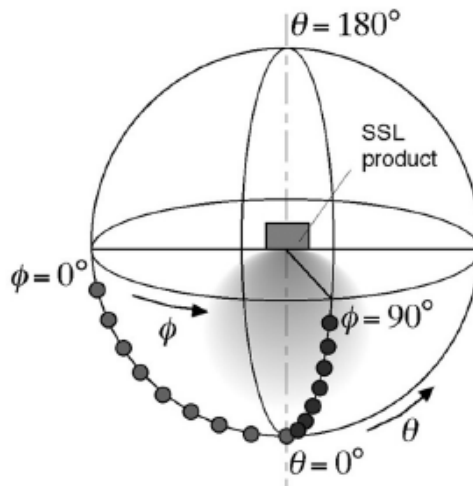
### **Color Spatial Uniformity**

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  $10^\circ$  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.