



## LM-79-08 Test Report

for

**Ilsung Ltd.**

NO. 501, DAEJI BLDG, 1125-15, HWAGOK-DONG, KANGSEO-GU, SEOUL, KOREA

**LED Low Profile Square Light**

**Model: SFR6-15-927**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ16060033h

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

Review by:

Engineer: April Zou  
Jul. 15, 2016

Approved by:



Manager: Jim Zhang  
Jul. 15, 2016

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: **SFR6-15-927**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
62.7	907.3	14.47	0.9819
CCT (K)	CRI	Stabilization Time (Light & Power)	
2602	91.0	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** : Jun. 21, 2016

**Date of Test** : Jul. 08, 2016

**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 Photos .....	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
Zonal Lumen Tabulation- Goniophotometer Method .....	10
Illuminance Plots- Goniophotometer Method .....	错误！未定义书签。
Luminous Intensity Distribution Plots- Goniophotometer Method.....	12
Luminous Intensity Data- Goniophotometer Method .....	13
EQUIPMENT LIST .....	20
TEST METHODS .....	20
Seasoning of SSL Product.....	20
Sphere-Spectroradiometer Method- Photometric and Electrical Measurements.....	20
Goniophotometer Method .....	21
Photometric and Electrical Measurements .....	21
Color Characteristics Measurements.....	21

## Sample Photos



Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: LED Low Profile Square Light
<b>Model</b>	: SFR6-15-927
<b>Electrical Ratings</b>	: 120V, 50/60Hz, 15W
<b>Product Description</b>	: LED Luminaire, Dimmable, CRI90 Manufacturer of LED light source: Lumens Model of LED light source: LM2835S3Wx9xxxx
<b>Manufacturer</b>	: Ilsung Ltd.
<b>Address</b>	: NO. 501, DAEJI BLDG, 1125-15, HWAGOK-DONG, KANGSEO-GU, SEOUL, KOREA

## TEST RESULTS

Test ambient temperature was 25.1 °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
Test Current (A)	0.123
Power Factor	0.9819
Test Power (W)	14.47
THD A%	18.80
Luminous Efficacy (lm/W)	62.7
Total Luminous Flux (lm)	907.3
Color Rendering Index (CRI)	91.0
R9	48.9
Correlated Color Temperature (CCT)(K)	2602
Chromaticity Chroma x	0.4684
Chromaticity Chroma y	0.4131
Chromaticity Chroma u	0.2669
Chromaticity Chroma v	0.3531
Duv	0.0002
Chromaticity Chroma u'	0.2669
Chromaticity Chroma v'	0.5296

Special Color Rendering Indices	
R1	91.1
R2	97.2
R3	96.9
R4	90.3
R5	91.5
R6	97.4
R7	88.3
R8	75.4
R9	48.9
R10	93.3
R11	91.8
R12	87
R13	92.8
R14	99.2

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 24.4°C.

The photometric distance is 2.47m.

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)	0.123
Power Factor	0.9811
Test Power (W)	14.42
Luminous Efficacy (lm/W)	65.1
Total Luminous Flux (lm)	938.2
Beam Angle (°)	96.1
Center Beam Candle Power (cd)	374
Spacing Criteria	1.25 (0°-180°)/ 1.37 (90°-270°)
Zonal Lumens in the 0°-60°Zone	84.00%
Zonal Lumens in the 60°-90°Zone	15.92%
Zonal Lumens in the 90°-120°Zone	0.02%
Zonal Lumens in the 120°-180°Zone	0.06%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

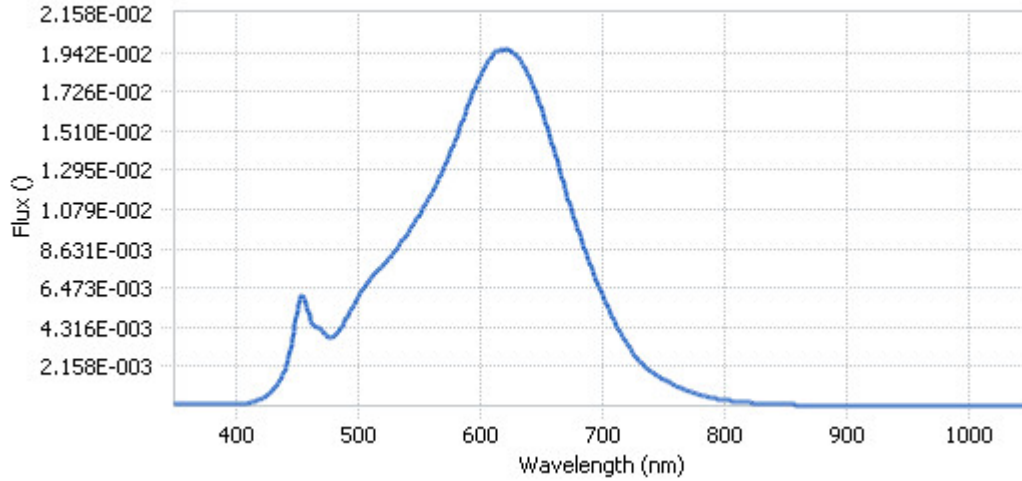
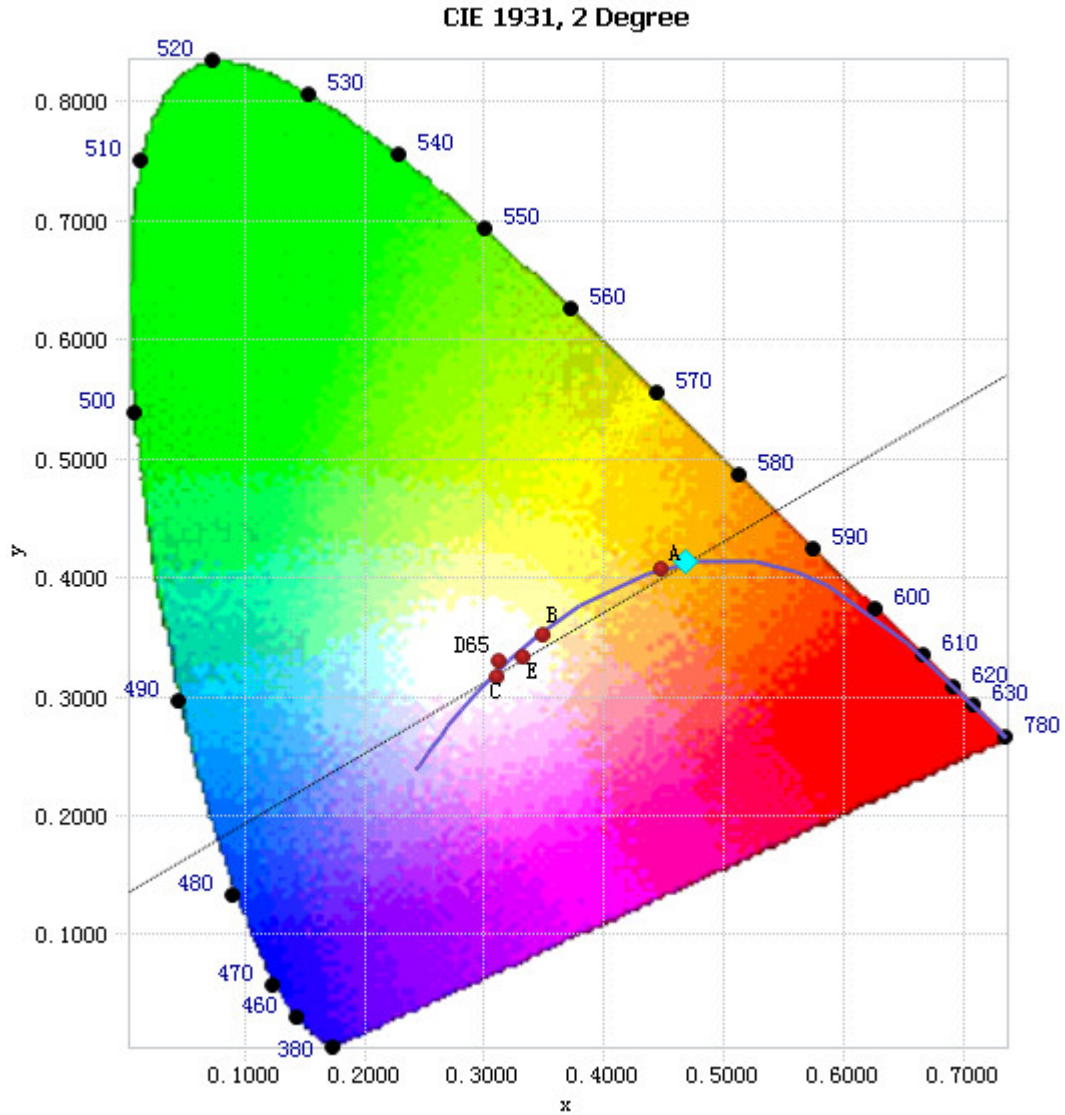


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.07E-04	485	4.13E-03	590	1.64E-02	695	7.04E-03
385	1.02E-04	490	4.72E-03	595	1.73E-02	700	6.18E-03
390	1.12E-04	495	5.26E-03	600	1.80E-02	705	5.43E-03
395	1.09E-04	500	5.91E-03	605	1.87E-02	710	4.73E-03
400	1.07E-04	505	6.45E-03	610	1.93E-02	715	4.08E-03
405	1.33E-04	510	6.95E-03	615	1.95E-02	720	3.51E-03
410	1.50E-04	515	7.33E-03	620	1.95E-02	725	2.98E-03
415	2.33E-04	520	7.65E-03	625	1.96E-02	730	2.55E-03
420	3.59E-04	525	8.06E-03	630	1.93E-02	735	2.21E-03
425	5.40E-04	530	8.44E-03	635	1.88E-02	740	1.93E-03
430	8.16E-04	535	8.90E-03	640	1.82E-02	745	1.69E-03
435	1.24E-03	540	9.38E-03	645	1.74E-02	750	1.49E-03
440	1.91E-03	545	9.92E-03	650	1.65E-02	755	1.31E-03
445	3.12E-03	550	1.04E-02	655	1.54E-02	760	1.13E-03
450	4.92E-03	555	1.10E-02	660	1.43E-02	765	9.93E-04
455	6.02E-03	560	1.16E-02	665	1.31E-02	770	8.47E-04
460	5.16E-03	565	1.23E-02	670	1.19E-02	775	7.26E-04
465	4.39E-03	570	1.30E-02	675	1.09E-02	780	6.27E-04
470	4.22E-03	575	1.37E-02	680	9.85E-03		
475	3.88E-03	580	1.46E-02	685	8.85E-03		
480	3.78E-03	585	1.55E-02	690	7.90E-03		

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

### Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4684, 0.4131)

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

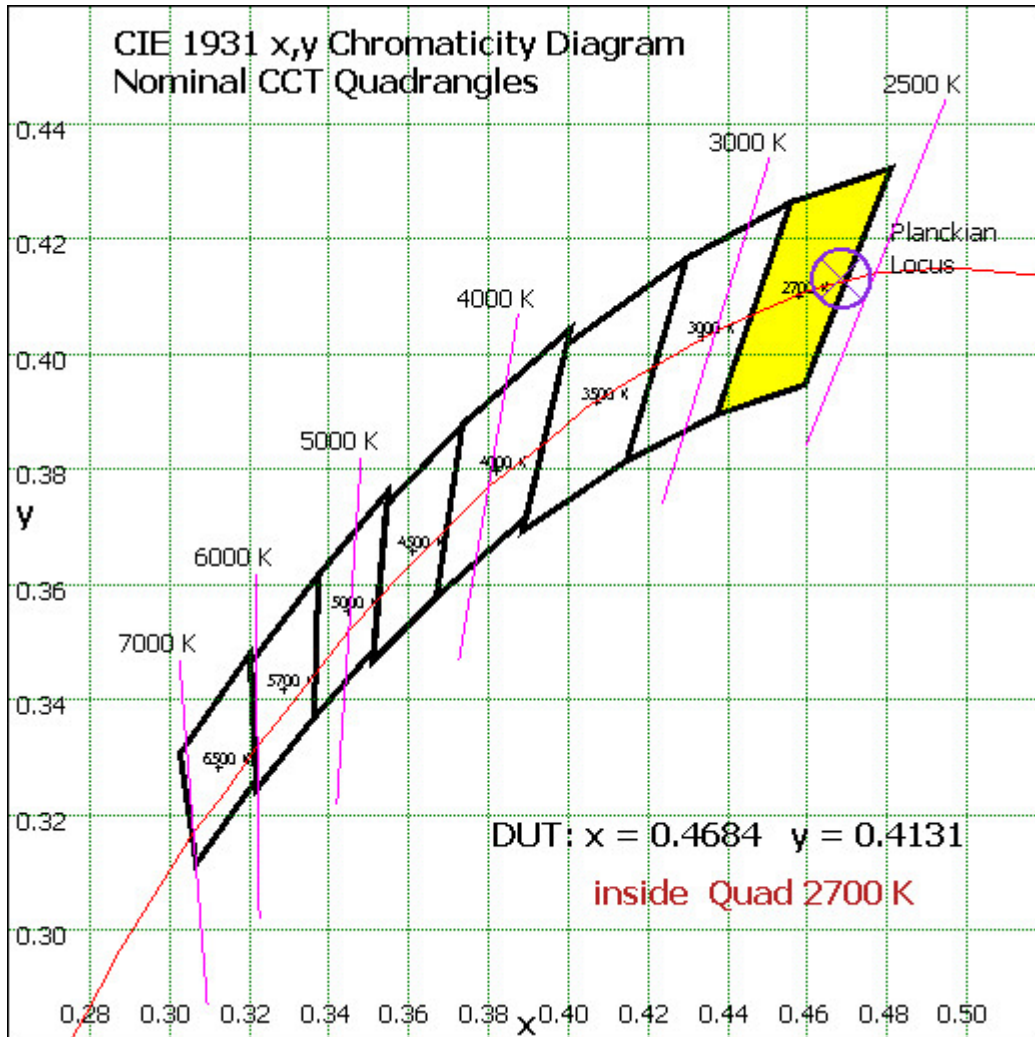


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	35.713	3.81%
10- 20	106.032	11.30%
20- 30	167.894	17.90%
30- 40	195.835	20.87%
40- 50	166.038	17.70%
50- 60	116.545	12.42%
60- 70	82.767	8.82%
70- 80	53.245	5.68%
80- 90	13.393	1.43%
90-100	0.042	0.00%
100-110	0.058	0.01%
110-120	0.08	0.01%
120-130	0.102	0.01%
130-140	0.127	0.01%
140-150	0.131	0.01%
150-160	0.105	0.01%
160-170	0.068	0.01%
170-180	0.024	0.00%
Total	938.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	788.057	84.00%
60- 90	149.405	15.92%
0-90	937.462	99.92%
90- 180	0.737	0.08%
0- 180	938.2	100%

Table 5: Zonal Lumen Data

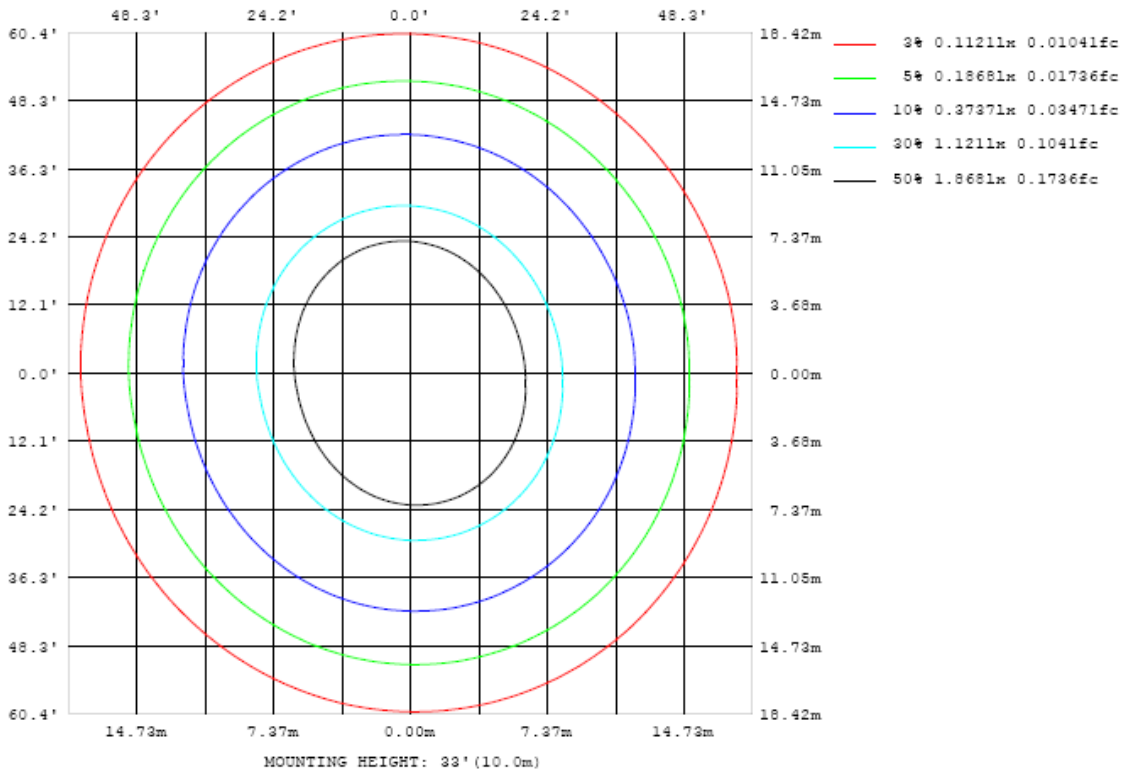


Chart 4: Illuminance Plot (Footcandles)

### Luminous Intensity Distribution Plots- Goniophotometer Method

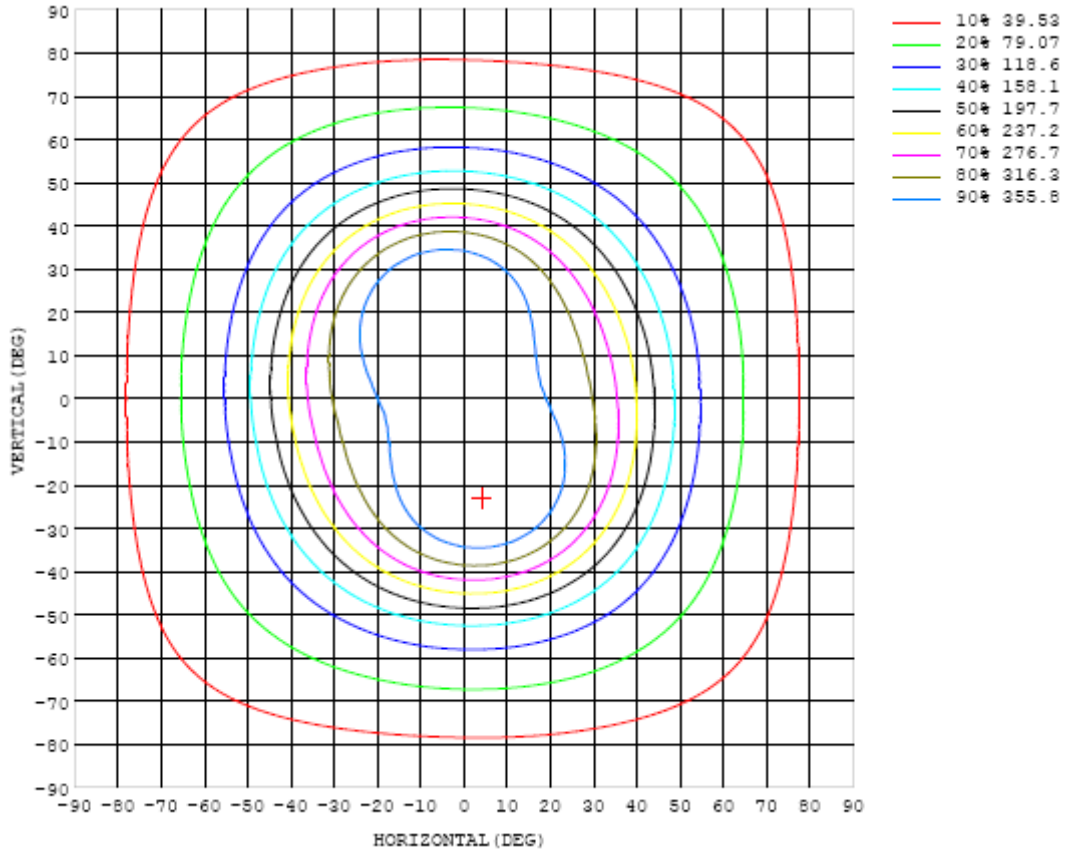


Chart 5: Isocandela Plot

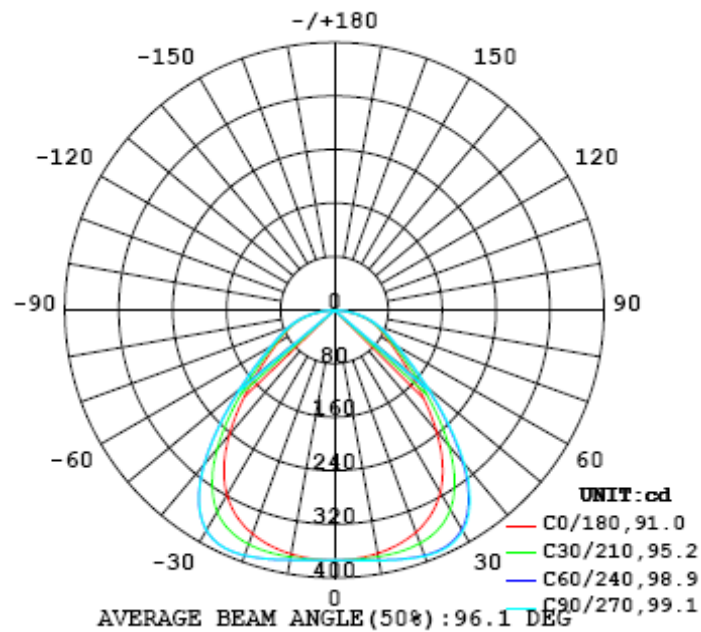


Chart 6: Polar Candela Distribution

**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	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374
5	372	373	373	374	374	375	375	375	375	375	375	375	374	374	373	373	373	373	373
10	369	370	372	374	376	378	379	380	380	380	379	377	375	373	372	370	370	369	370
15	363	366	369	374	378	382	385	387	387	386	383	380	376	371	368	365	363	363	365
20	353	358	364	371	378	385	390	393	393	391	387	381	374	367	361	356	353	353	356
25	338	344	352	362	373	383	390	394	395	392	386	377	367	357	348	342	338	338	341
30	314	321	332	344	357	369	378	384	385	381	373	362	349	337	327	319	315	315	319
35	280	287	298	311	325	337	347	353	354	351	342	331	318	305	294	286	281	281	286
40	235	242	252	264	276	287	296	302	303	300	293	283	271	260	249	242	238	238	243
45	188	193	201	210	220	228	235	240	241	238	233	226	217	208	200	194	191	191	195
50	147	151	156	162	169	175	179	183	184	182	178	174	168	161	156	152	150	150	153
55	116	119	122	126	130	134	137	139	140	138	136	133	129	125	122	120	119	119	121
60	94.2	95.6	97.4	99.7	102	105	107	108	109	108	107	105	102	100.0	98.1	96.6	96.0	96.0	97.5
65	78.1	78.7	79.8	81.2	82.9	84.6	86.2	87.0	87.4	87.0	86.0	84.6	83.0	81.7	80.7	80.0	79.5	79.6	80.7
70	64.2	64.5	64.9	65.6	66.7	68.0	69.3	70.0	70.2	70.0	69.1	69.0	67.3	66.5	66.0	65.6	66.2	65.9	66.4
75	48.5	48.4	48.7	49.2	50.0	50.9	52.0	52.8	53.1	52.8	52.0	51.4	50.8	50.4	50.3	50.3	50.4	50.5	50.9
80	29.9	29.8	29.9	30.2	30.7	31.5	32.3	33.3	33.6	33.1	32.6	32.1	31.8	31.6	31.7	32.0	32.4	32.4	32.5
85	9.89	9.65	9.62	9.73	10.1	10.5	10.9	11.2	11.5	11.2	11.0	11.0	11.2	11.2	11.4	11.7	12.1	12.1	11.9
90	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
95	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
100	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05
105	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.05	0.06
110	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.07
115	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08
120	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.10
125	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.12
130	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.15
135	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.18
140	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.22
145	0.16	0.17	0.17	0.17	0.17	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.17	0.24
150	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.26
155	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.27
160	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.19	0.20	0.20	0.28
165	0.21	0.21	0.20	0.21	0.21	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.28
170	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.22	0.22	0.23	0.28
175	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.28
180	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.25	0.26	0.26	0.26

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	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374		
5	373	373	374	374	375	375	375	375	375	375	374	374	373	373	372	372	372		
10	371	373	375	376	378	379	380	380	379	378	376	374	372	371	369	369	369		
15	367	371	375	379	382	385	386	386	385	382	378	374	370	366	363	362	362		
20	360	365	372	379	385	390	392	392	390	385	379	372	365	358	354	351	351		
25	347	355	365	375	384	391	394	394	391	384	374	364	354	345	339	336	336		
30	326	336	348	360	371	380	385	384	380	371	359	347	334	324	316	312	311		
35	293	304	317	330	341	351	356	355	350	341	328	315	301	290	282	278	277		
40	249	259	271	282	293	301	305	305	300	292	281	268	256	246	238	234	234		
45	200	208	217	226	234	240	243	243	239	232	224	215	205	197	191	188	187		
50	157	162	168	174	179	183	186	185	183	178	173	166	160	154	150	148	148		
55	123	126	130	134	138	140	142	141	140	137	133	129	124	121	118	117	117		
60	98.9	101	103	105	108	109	110	110	109	107	104	102	99.2	97.1	95.6	94.9	94.9		
65	81.3	82.3	83.6	85.1	86.7	87.9	88.4	88.4	87.6	86.1	84.4	82.6	81.0	79.9	79.1	78.7	78.7		
70	66.6	67.1	67.8	68.8	69.8	70.8	71.2	71.1	70.5	69.2	67.9	66.7	65.8	65.1	64.8	64.7	64.6		
75	50.6	50.6	51.1	51.8	52.5	53.3	53.7	53.6	52.8	51.7	50.8	49.9	49.4	49.0	49.0	49.2	49.2		
80	31.9	31.7	31.8	32.3	33.1	33.7	34.3	34.1	33.3	32.3	31.5	30.9	30.5	30.3	30.4	30.7	30.8		
85	11.4	11.2	11.0	11.1	11.5	12.0	12.2	12.0	11.3	10.9	10.5	10.1	9.57	9.58	9.83	10.2	10.3		
90	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
95	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04		
100	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		
105	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.06	0.06		
110	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07		
115	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09		
120	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10		
125	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.12	0.12	0.12		
130	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15		
135	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19		
140	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22		
145	0.25	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.24	0.24		
150	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26		
155	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.27	0.27	0.27		
160	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28		
165	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.28		
170	0.29	0.29	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.28		
175	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28	0.28	0.28		
180	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26		

Table 7: Luminous Intensity Data

### Color Spatial Uniformity- Goniophotometer Method

Color uniformity was measured at two horizontal angles,  $0^\circ$  and  $90^\circ$ , the vertical intervals was  $1^\circ$ .

$\gamma$ Angle ( $^\circ$ )	C Angle = $0^\circ$		C Angle = $90^\circ$	
	Chromaticity Coordinate u'	Chromaticity Coordinate v'	Chromaticity Coordinate u'	Chromaticity Coordinate v'
0	0.2655	0.5297	0.2655	0.5297
1	0.2655	0.5296	0.2655	0.5296
2	0.2655	0.5296	0.2655	0.5296
3	0.2655	0.5296	0.2655	0.5295
4	0.2655	0.5296	0.2655	0.5296
5	0.2655	0.5297	0.2655	0.5296
6	0.2655	0.5296	0.2655	0.5295
7	0.2655	0.5296	0.2655	0.5296
8	0.2655	0.5297	0.2655	0.5295
9	0.2655	0.5297	0.2655	0.5296
10	0.2656	0.5297	0.2655	0.5295
11	0.2656	0.5297	0.2655	0.5295
12	0.2656	0.5297	0.2655	0.5295
13	0.2656	0.5297	0.2655	0.5296
14	0.2656	0.5297	0.2655	0.5296
15	0.2656	0.5297	0.2655	0.5296
16	0.2656	0.5297	0.2656	0.5296
17	0.2657	0.5297	0.2656	0.5296
18	0.2657	0.5297	0.2656	0.5296
19	0.2657	0.5297	0.2656	0.5296
20	0.2658	0.5297	0.2657	0.5296
21	0.2658	0.5297	0.2658	0.5296
22	0.2658	0.5297	0.2657	0.5296
23	0.2659	0.5298	0.2658	0.5296
24	0.2659	0.5298	0.2659	0.5296
25	0.2659	0.5298	0.2659	0.5297

26	0.266	0.5298	0.266	0.5297
27	0.266	0.5298	0.2661	0.5297
28	0.2661	0.5298	0.266	0.5297
29	0.2661	0.5298	0.2661	0.5297
30	0.2662	0.5299	0.2661	0.5298
31	0.2662	0.5299	0.2662	0.5298
32	0.2661	0.5299	0.2663	0.5298
33	0.2661	0.5299	0.2664	0.5298
34	0.2662	0.5299	0.2664	0.5299
35	0.2662	0.5299	0.2665	0.5299
36	0.2663	0.53	0.2666	0.5299
37	0.2664	0.53	0.2667	0.5299
38	0.2664	0.5299	0.2667	0.5299
39	0.2663	0.5299	0.2668	0.5299
40	0.2663	0.53	0.2669	0.53
41	0.2664	0.53	0.2666	0.5299
42	0.2665	0.53	0.2667	0.53
43	0.2663	0.53	0.2668	0.53
44	0.2664	0.53	0.2667	0.53
45	0.2664	0.53	0.2668	0.53
46	0.2665	0.53	0.2667	0.53
47	0.2663	0.53	0.2668	0.53
48	0.2664	0.53	0.2667	0.53
49	0.2665	0.53	0.2668	0.53
50	0.2666	0.53	0.2668	0.53
51	0.2665	0.53	0.2669	0.53
52	0.2666	0.53	0.2668	0.53
53	0.2666	0.5301	0.2669	0.53
54	0.2667	0.5301	0.267	0.5301
55	0.2666	0.5301	0.2671	0.5301
56	0.2667	0.5301	0.2671	0.5301
57	0.2668	0.5301	0.2669	0.5301



58	0.2668	0.5301	0.2669	0.5301
59	0.2667	0.5301	0.267	0.5301
60	0.2667	0.5301	0.2671	0.5301
61	0.2668	0.5301	0.2671	0.5301
62	0.2669	0.5301	0.2672	0.5302
63	0.2667	0.5301	0.2669	0.5301
64	0.2667	0.5301	0.2669	0.5301
65	0.2668	0.5301	0.267	0.5301
66	0.2668	0.5302	0.2669	0.5301
67	0.2669	0.5302	0.2669	0.5301
68	0.2667	0.5301	0.2669	0.5302
69	0.2667	0.5302	0.267	0.5301
70	0.2668	0.5301	0.267	0.5301
71	0.2668	0.5302	0.2671	0.5302
72	0.2666	0.5301	0.2667	0.5301
73	0.2666	0.5301	0.2667	0.5301
74	0.2667	0.5301	0.2667	0.5301
75	0.2667	0.5301	0.2667	0.5301
76	0.2666	0.5301	0.2668	0.5301
77	0.2667	0.5301	0.2668	0.5301
78	0.2667	0.5301	0.2669	0.5301
79	0.2668	0.5301	0.267	0.5301
80	0.2669	0.5301	0.267	0.5301

Table 8: Chromaticity per Measurement Angle

Weighted Average	
u'	v'
0.2663	0.5299

The chromaticity measurements need to be made only for the  $\gamma$  angles where the average luminous intensity is more than 10 % of the peak intensity.

$\gamma$ Angle (°)	C Angle = 0°/180°		C Angle = 90°/270°	
	$\Delta u'$	$\Delta v'$	$\Delta u'$	$\Delta v'$
0	0.0008	0.0002	0.0008	0.0002

1	0.0008	0.0003	0.0008	0.0003
2	0.0008	0.0003	0.0008	0.0003
3	0.0008	0.0003	0.0008	0.0004
4	0.0008	0.0003	0.0008	0.0003
5	0.0008	0.0002	0.0008	0.0003
6	0.0008	0.0003	0.0008	0.0004
7	0.0008	0.0003	0.0008	0.0003
8	0.0008	0.0002	0.0008	0.0004
9	0.0008	0.0002	0.0008	0.0003
10	0.0007	0.0002	0.0008	0.0004
11	0.0007	0.0002	0.0008	0.0004
12	0.0007	0.0002	0.0008	0.0004
13	0.0007	0.0002	0.0008	0.0003
14	0.0007	0.0002	0.0008	0.0003
15	0.0007	0.0002	0.0008	0.0003
16	0.0007	0.0002	0.0007	0.0003
17	0.0006	0.0002	0.0007	0.0003
18	0.0006	0.0002	0.0007	0.0003
19	0.0006	0.0002	0.0007	0.0003
20	0.0005	0.0002	0.0006	0.0003
21	0.0005	0.0002	0.0005	0.0003
22	0.0005	0.0002	0.0006	0.0003
23	0.0004	0.0001	0.0005	0.0003
24	0.0004	0.0001	0.0004	0.0003
25	0.0004	0.0001	0.0004	0.0002
26	0.0003	0.0001	0.0003	0.0002
27	0.0003	0.0001	0.0002	0.0002
28	0.0002	0.0001	0.0003	0.0002
29	0.0002	0.0001	0.0002	0.0002
30	0.0001	0.0000	0.0002	0.0001
31	0.0001	0.0000	0.0001	0.0001
32	0.0002	0.0000	0.0000	0.0001
33	0.0002	0.0000	0.0001	0.0001
34	0.0001	0.0000	0.0001	0.0000
35	0.0001	0.0000	0.0002	0.0000
36	0.0000	0.0001	0.0003	0.0000
37	0.0001	0.0001	0.0004	0.0000
38	0.0001	0.0000	0.0004	0.0000
39	0.0000	0.0000	0.0005	0.0000
40	0.0000	0.0001	0.0006	0.0001
41	0.0001	0.0001	0.0003	0.0000
42	0.0002	0.0001	0.0004	0.0001

43	0.0000	0.0001	0.0005	0.0001
44	0.0001	0.0001	0.0004	0.0001
45	0.0001	0.0001	0.0005	0.0001
46	0.0002	0.0001	0.0004	0.0001
47	0.0000	0.0001	0.0005	0.0001
48	0.0001	0.0001	0.0004	0.0001
49	0.0002	0.0001	0.0005	0.0001
50	0.0003	0.0001	0.0005	0.0001
51	0.0002	0.0001	0.0006	0.0001
52	0.0003	0.0001	0.0005	0.0001
53	0.0003	0.0002	0.0006	0.0001
54	0.0004	0.0002	0.0007	0.0002
55	0.0003	0.0002	0.0008	0.0002
56	0.0004	0.0002	0.0008	0.0002
57	0.0005	0.0002	0.0006	0.0002
58	0.0005	0.0002	0.0006	0.0002
59	0.0004	0.0002	0.0007	0.0002
60	0.0004	0.0002	0.0008	0.0002

Table 9: Chromatic Spatial Uniformity

**Spatial non-uniformity of chromaticity  $\Delta u'v'$ : 0.0008**

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 17, 2015	Jul. 16, 2016
Digital Power Meter	PF2010A	HZTE028-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-08	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	WY12010	HZTE004-03	Jul. 17, 2015	Jul. 16, 2016
Temperature Meter	TES1310	HZTE017-01	Jul. 17, 2015	Jul. 16, 2016
Standard source	D908	HZTE012-01	Jul. 23, 2015	Jul. 22, 2016
Integrate Sphere system	2M	HZTE015-01	Jul. 16, 2015	Jul. 15, 2016
Digital Power Meter	WT210	HZTE008-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-07	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	6154	HZTE004-04	Jul. 17, 2015	Jul. 16, 2016
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 21, 2015	Jul. 20, 2016
Standard source	SCL-1400	HZTE012-02	Oct. 21, 2015	Oct. 20, 2016

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 1.06% 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 1.94% with a coverage factor  $k=2$ .

### **Color Characteristics Measurements**

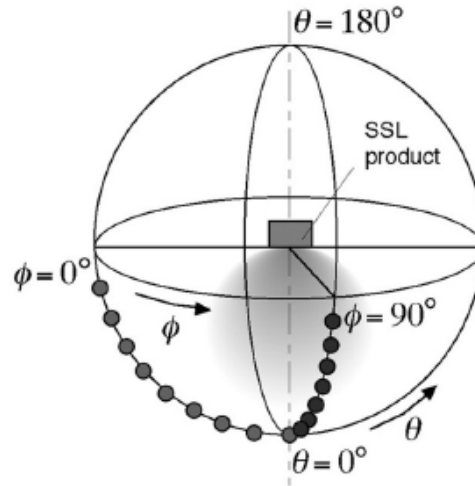
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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

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