



## LM-79-08 Test Report

for

### Philips Lighting (China) Investment Co., Ltd.

Building 9 #, Lane 888, Tianlin Road, Minhang District, Shanghai City.

### LED Tube

**Model: 9290018768**

### Laboratory: Leading Testing Laboratories

**NVLAP CODE: 200960-0**

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Report No.: HZ18030033a

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

Review by:

*April Zou*

Engineer: April Zou  
Mar. 22, 2018

*Jim Zhang*

Approved by:

Manager: Jim Zhang  
Mar. 22, 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: **9290018768**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
153.8	1827.0	11.88	0.9808
CCT (K)	CRI	Stabilization Time (Light & Power)	
3068	82.1	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** : Mar. 20, 2018

**Date of Test** : Mar. 20, 2018

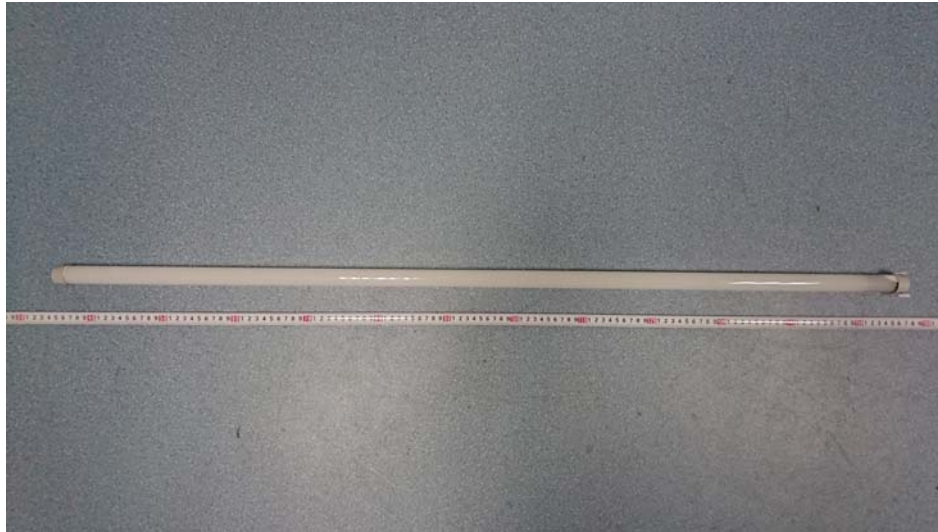
**Test item** : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

**Reference Standard** : IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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## Sample Photo



Sample view

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 9290018768
<b>Electrical Ratings</b>	: 120-277V, 60HZ
<b>Product Description</b>	: 12T8/PRO/48-830/BB17/G 10/1 FB
<b>Manufacturer</b>	: Philips Lighting (China) Investment Co., Ltd.
<b>Address</b>	: Building 9 #, Lane 888, Tianlin Road, Minhang District, Shanghai City

## 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 65 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.101	0.046
Power Factor	0.9808	0.9597
Test Power (W)	11.88	12.18
THD A%	17.67	13.80
Luminous Efficacy (lm/W)	153.8	149.9
Total Luminous Flux (lm)	1827.0	1826.0
Color Rendering Index (CRI)	82.1	
R9	3.8	
Correlated Color Temperature (CCT)(K)	3068	
Chromaticity Chroma x	0.4349	
Chromaticity Chroma y	0.4084	
Chromaticity Chroma u	0.2474	
Chromaticity Chroma v	0.3485	
Duv	0.0020	
Chromaticity Chroma u'	0.2474	
Chromaticity Chroma v'	0.5227	

Special Color Rendering Indices	
R1	79.9
R2	89.8
R3	97
R4	80.2
R5	80
R6	87.5
R7	83.4
R8	58.5
R9	3.8
R10	76.8
R11	79.5
R12	67.7
R13	82.2
R14	98.8
Rf	83
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 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)	0.101
Power Factor	0.9801
Power (W)	11.86
Luminous Efficacy (lm/W)	152.2
Total Luminous Flux (lm)	1805.1
Beam Angle (°)	112.7 (0°-180°) / 200.6 (90°-270°)
Center Beam Candle Power (cd)	319
Maximum Beam Candle Power (cd)	319.8 (At: C=130.0, Gamma=1.5)
Spacing Criteria	1.27 (0°-180°) / 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	45.21%
Zonal Lumens in the 60°-90°Zone	26.89%
Zonal Lumens in the 90°-120°Zone	16.34%
Zonal Lumens in the 120°-180°Zone	11.56%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

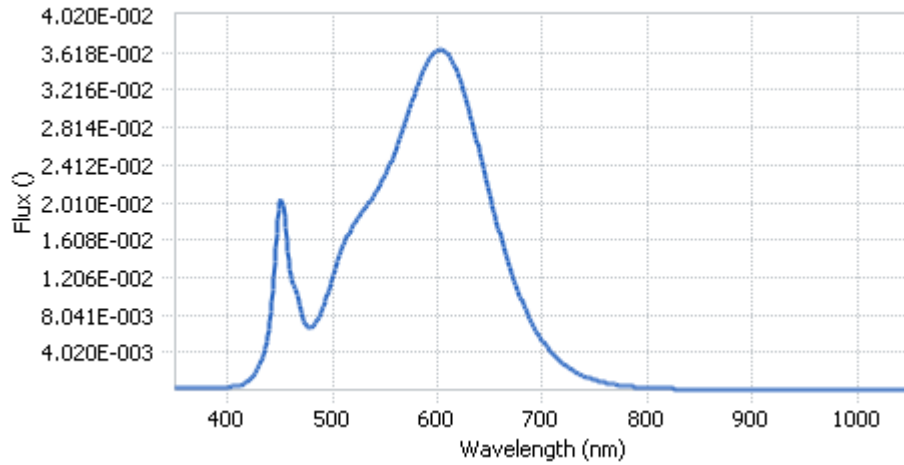
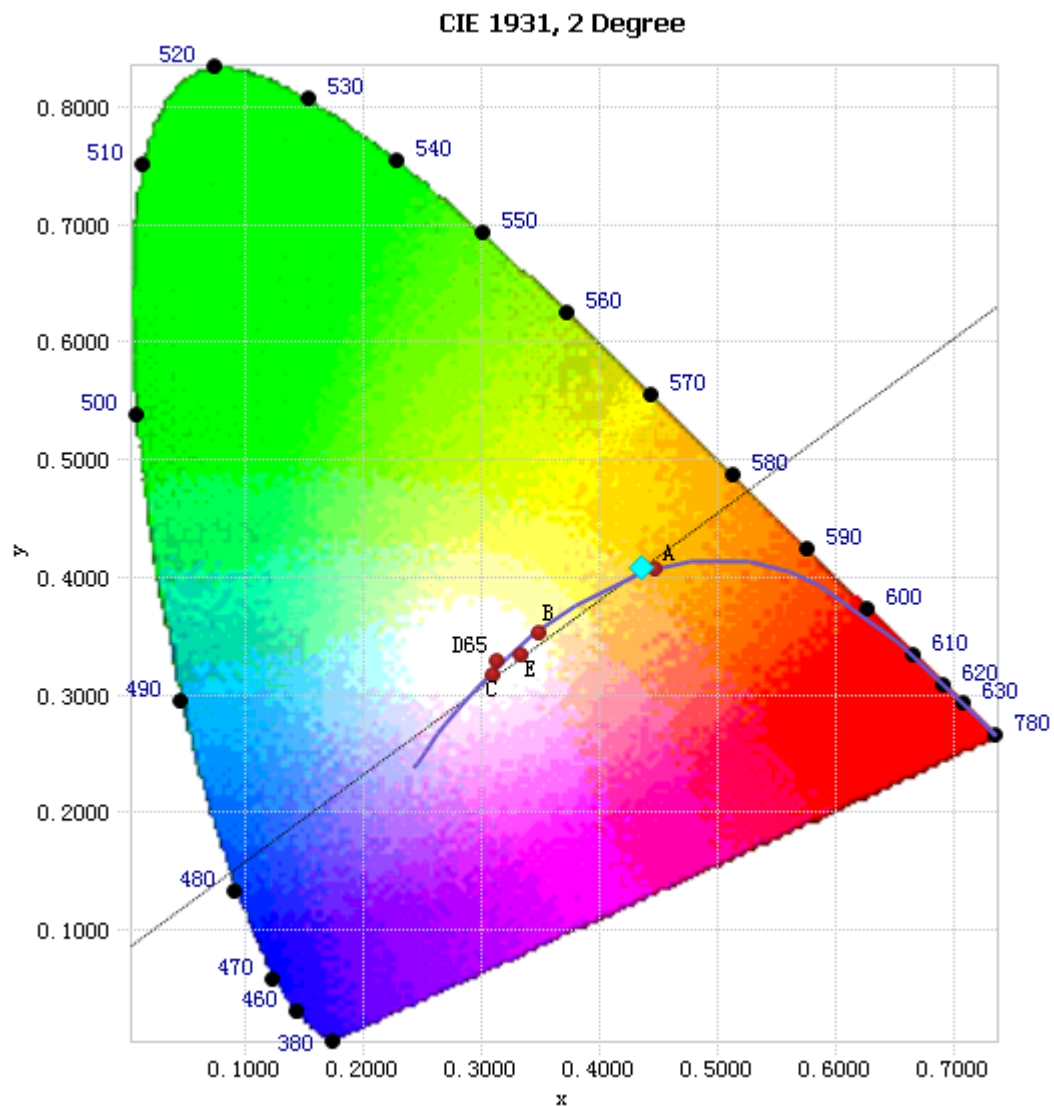


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.94E-04	485	7.47E-03	590	3.51E-02	695	6.13E-03
385	2.61E-04	490	8.53E-03	595	3.59E-02	700	5.27E-03
390	2.70E-04	495	1.03E-02	600	3.64E-02	705	4.50E-03
395	3.14E-04	500	1.22E-02	605	3.64E-02	710	3.82E-03
400	3.19E-04	505	1.39E-02	610	3.60E-02	715	3.26E-03
405	3.62E-04	510	1.55E-02	615	3.51E-02	720	2.78E-03
410	4.52E-04	515	1.67E-02	620	3.36E-02	725	2.38E-03
415	6.40E-04	520	1.78E-02	625	3.19E-02	730	2.02E-03
420	9.92E-04	525	1.86E-02	630	3.00E-02	735	1.72E-03
425	1.60E-03	530	1.94E-02	635	2.78E-02	740	1.46E-03
430	2.66E-03	535	2.02E-02	640	2.55E-02	745	1.24E-03
435	4.31E-03	540	2.11E-02	645	2.31E-02	750	1.06E-03
440	7.39E-03	545	2.20E-02	650	2.08E-02	755	9.04E-04
445	1.37E-02	550	2.30E-02	655	1.86E-02	760	7.75E-04
450	2.03E-02	555	2.44E-02	660	1.65E-02	765	6.60E-04
455	1.74E-02	560	2.57E-02	665	1.45E-02	770	5.61E-04
460	1.23E-02	565	2.74E-02	670	1.27E-02	775	4.81E-04
465	1.07E-02	570	2.90E-02	675	1.11E-02	780	4.13E-04
470	8.67E-03	575	3.07E-02	680	9.62E-03		
475	6.83E-03	580	3.24E-02	685	8.29E-03		
480	6.74E-03	585	3.39E-02	690	7.16E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4349, 0.4084)

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

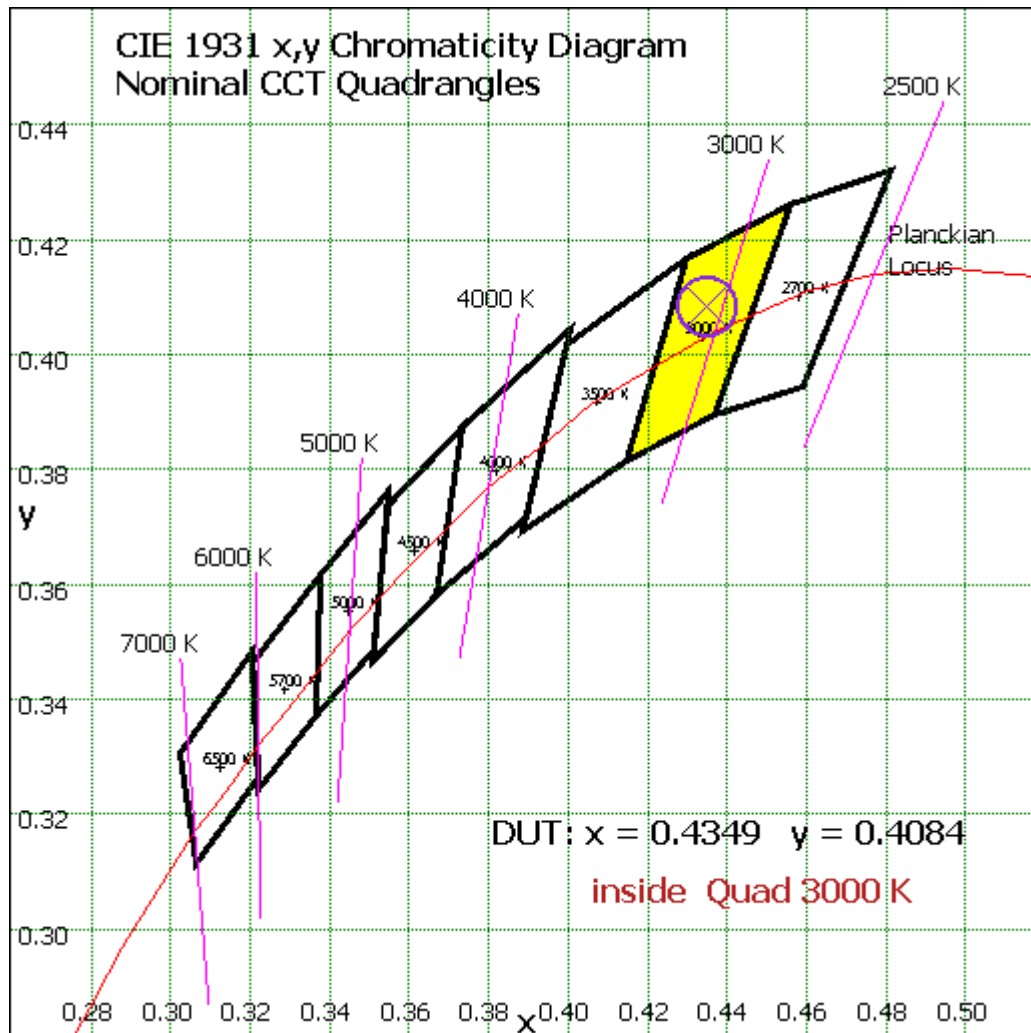


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	30.319	1.68%
10- 20	87.951	4.87%
20- 30	136.892	7.58%
30- 40	172.646	9.56%
40- 50	192.495	10.66%
50- 60	195.868	10.85%
60- 70	184.621	10.23%
70- 80	162.978	9.03%
80- 90	137.807	7.63%
90-100	116.104	6.43%
100-110	97.672	5.41%
110-120	81.184	4.50%
120-130	66.578	3.69%
130-140	53.487	2.96%
140-150	40.787	2.26%
150-160	28.103	1.56%
160-170	15.14	0.84%
170-180	4.493	0.25%
Total	1805.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	816.171	45.21%
60- 90	485.406	26.89%
0-90	1301.577	72.10%
90- 180	503.548	27.90%
0- 180	1805.1	100%

Table 5: Zonal Lumen Data

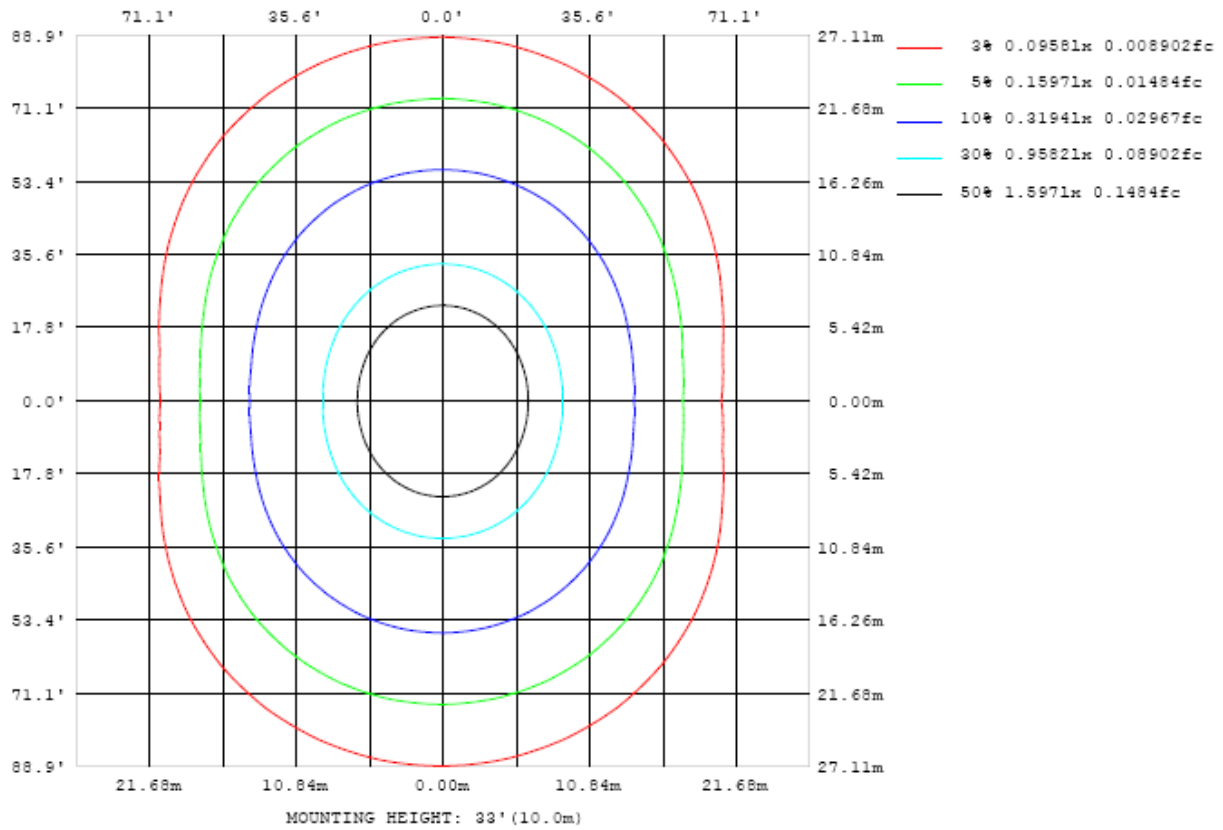


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

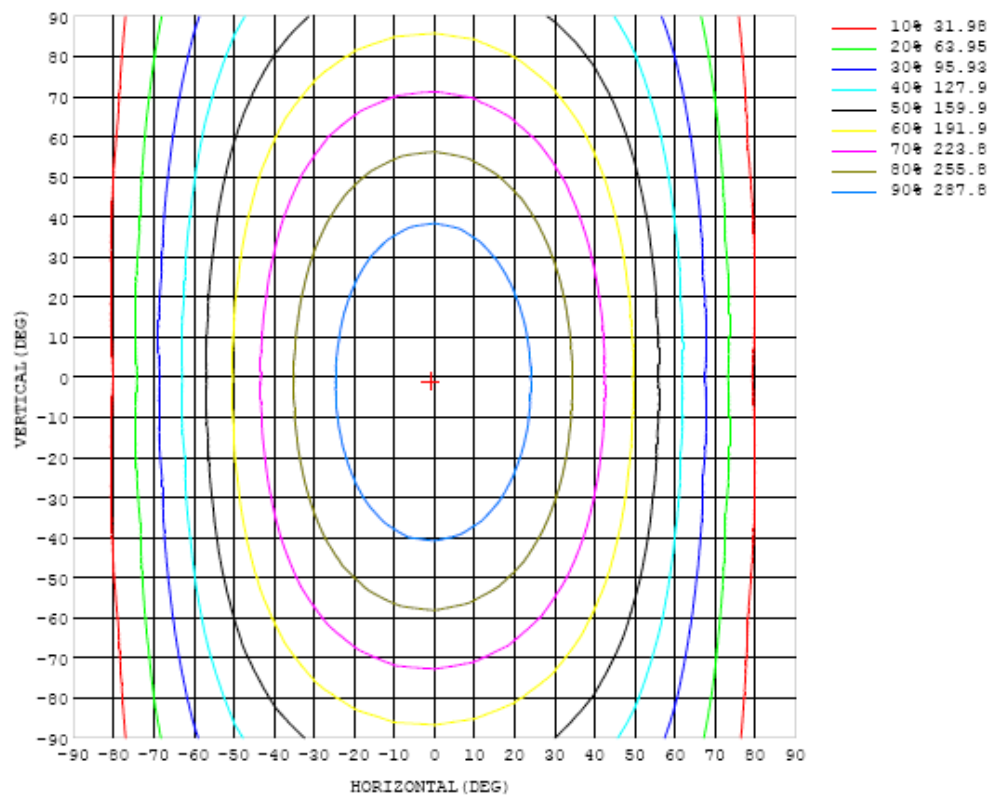


Chart 5: Isocandela Plot

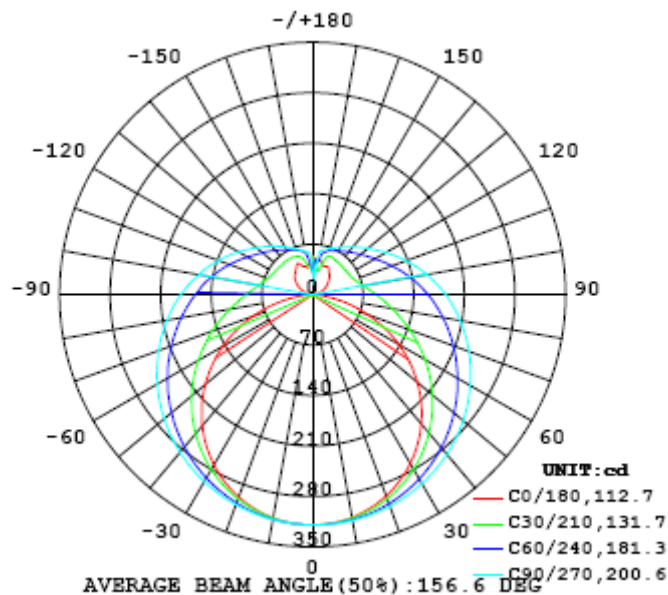


Chart 6: Polar Candela Distribution

## 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	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319
5	318	318	318	318	318	319	319	319	319	319	319	319	319	319	319	319	318	318	318
10	314	314	314	315	316	316	317	317	318	318	318	318	317	317	316	315	315	315	314
15	307	307	308	309	311	312	313	315	315	316	316	315	314	313	311	310	309	308	308
20	297	298	300	302	304	306	309	310	312	312	312	311	310	307	305	302	301	299	299
25	285	286	288	292	295	299	302	305	307	308	308	306	304	300	297	293	290	288	287
30	270	272	275	279	285	290	295	299	302	302	302	300	297	292	287	282	277	274	273
35	253	255	260	266	273	280	287	292	295	296	296	293	288	282	275	268	262	258	256
40	234	236	242	250	260	269	277	283	287	289	288	285	279	272	263	253	245	240	237
45	212	216	223	234	246	257	267	274	279	281	280	276	269	260	249	237	227	219	217
50	189	193	203	216	230	244	255	264	270	272	271	266	258	248	234	220	207	197	194
55	164	169	181	198	215	231	244	253	260	262	261	256	247	235	219	202	186	174	169
60	137	144	159	180	199	217	232	242	249	252	251	245	236	222	204	184	164	149	144
65	110	118	137	161	184	203	219	231	238	241	240	234	223	208	189	166	143	123	116
70	81.3	91.6	116	143	169	190	207	219	227	230	229	222	211	195	174	149	121	97.0	88.0
75	54.0	67.2	95.8	127	154	177	195	208	216	219	217	211	200	183	160	132	101	71.9	59.5
80	28.3	45.3	78.3	112	141	165	183	196	204	207	206	199	187	170	146	117	83.0	49.6	33.0
85	8.42	28.7	64.6	99.0	129	153	171	184	192	196	194	188	176	158	134	104	68.8	31.8	11.3
90	0.27	19.5	54.3	88.2	118	141	160	173	181	184	183	176	164	146	123	92.8	58.0	21.4	0.71
95	1.76	16.0	46.9	78.9	107	131	149	161	169	173	171	165	153	135	112	83.3	50.1	17.1	1.64
100	4.72	16.6	42.3	71.2	98.0	120	138	150	158	161	159	153	142	125	103	75.3	45.0	17.3	4.70
105	8.45	18.9	40.3	65.7	89.8	110	127	139	146	149	148	142	131	115	94.0	69.0	42.5	19.7	8.70
110	12.5	22.4	40.0	61.6	82.7	102	117	128	135	138	137	131	120	106	86.6	64.9	42.5	23.1	13.1
115	17.0	26.2	40.9	59.1	77.3	94.0	108	118	125	127	126	121	111	97.4	80.6	62.3	43.5	27.0	17.7
120	21.2	29.7	42.5	57.6	73.1	87.5	99.6	109	115	117	116	111	102	90.5	76.3	60.8	45.2	30.7	22.6
125	25.0	32.9	44.6	56.9	70.0	82.4	92.9	101	106	108	107	103	95.1	85.2	73.1	60.0	47.1	33.9	27.0
130	28.9	35.8	46.9	56.7	67.5	78.0	87.0	93.8	98.3	100.0	99.2	95.4	89.2	80.6	70.5	59.6	49.2	36.6	31.1
135	32.8	37.9	49.1	56.7	66.1	74.5	81.9	87.7	91.5	93.0	92.4	89.2	83.9	76.6	68.4	59.4	51.3	38.6	34.9
140	36.4	38.6	51.2	57.0	64.7	71.5	77.5	82.3	85.4	86.7	86.2	83.5	79.1	73.3	66.7	59.1	52.6	39.7	37.9
145	39.7	37.4	53.2	57.5	63.3	69.0	73.6	77.5	79.9	81.1	80.7	78.5	74.9	70.5	65.3	59.1	54.5	39.9	40.9
150	43.6	34.6	53.5	58.1	62.2	66.7	70.5	73.2	75.2	76.0	75.8	74.1	71.4	68.3	62.2	58.7	55.6	38.2	45.0
155	43.3	31.1	46.8	58.7	61.6	64.6	67.1	69.6	71.0	71.7	71.6	70.4	68.7	63.5	60.2	56.2	51.4	35.3	48.2
160	42.9	32.1	37.6	54.0	61.1	63.2	65.2	66.6	67.6	68.4	68.3	67.9	61.7	56.2	51.7	48.7	42.3	35.4	42.8
165	46.8	31.9	31.1	36.2	47.1	58.9	60.5	62.6	64.9	65.0	65.1	54.3	47.6	45.1	43.0	40.0	35.2	34.7	40.9
170	48.4	37.9	33.7	36.7	38.3	42.1	46.5	51.4	56.3	61.7	38.1	40.9	43.6	41.8	39.6	36.5	35.0	34.6	38.0
175	49.8	45.6	44.3	43.9	43.3	45.5	48.2	50.4	49.7	15.7	49.3	49.5	48.1	46.5	45.2	43.4	42.3	42.2	41.9
180	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1

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	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319	319		
5	318	318	318	318	319	319	319	319	319	318	319	319	318	318	318	318	318		
10	314	315	315	315	316	316	317	317	317	317	316	316	315	315	315	314	314		
15	308	309	309	311	312	313	314	314	314	314	313	312	311	310	309	308	307		
20	299	300	302	304	306	308	309	310	310	310	308	307	304	302	300	299	298		
25	287	289	292	295	298	301	303	305	305	305	303	300	297	293	290	287	286		
30	273	276	280	285	289	294	297	299	299	299	296	292	288	283	278	274	271		
35	257	261	267	273	279	285	289	292	293	292	288	283	277	271	264	258	255		
40	239	244	252	260	269	276	281	284	285	284	280	274	266	257	248	241	236		
45	219	226	236	247	257	266	272	276	277	275	270	263	254	243	232	222	215		
50	197	206	219	232	244	255	262	266	268	266	260	252	241	228	214	201	193		
55	174	185	201	217	231	244	252	257	258	256	250	240	227	212	196	180	168		
60	149	164	183	201	218	232	241	246	248	246	238	228	214	197	177	158	144		
65	124	143	165	186	205	220	230	236	238	235	227	216	201	181	159	137	118		
70	97.9	121	148	172	192	208	219	225	226	224	216	204	187	166	142	115	91.8		
75	73.0	101	131	157	179	196	207	214	216	213	204	192	174	152	125	94.6	66.9		
80	50.5	83.3	116	145	167	184	196	203	205	202	193	180	162	139	110	77.1	44.8		
85	32.8	68.5	103	133	156	173	185	192	194	190	182	169	151	127	96.9	62.6	28.0		
90	21.8	57.3	92.1	122	145	162	174	181	182	179	170	157	140	115	86.0	52.0	17.9		
95	17.6	50.0	83.2	112	135	153	163	170	171	168	159	147	129	105	77.0	44.8	14.6		
100	18.2	45.8	76.0	103	126	142	154	159	160	157	149	137	119	96.6	69.8	40.9	15.7		
105	20.6	43.7	70.5	95.5	116	132	143	149	150	147	139	127	110	89.0	64.7	39.3	18.5		
110	23.9	43.4	66.1	88.6	108	122	132	138	139	136	128	117	102	82.7	61.0	39.6	22.1		
115	28.1	44.3	63.4	82.4	99.6	113	122	127	128	126	119	109	94.5	77.4	58.9	40.5	26.0		
120	32.3	45.4	61.6	77.9	92.5	105	113	118	119	116	110	101	88.2	73.6	57.7	41.7	29.9		
125	36.4	46.6	60.7	74.3	86.9	96.9	104	109	110	107	102	93.7	83.2	70.6	56.9	43.6	33.8		
130	40.6	48.8	60.0	71.5	82.1	90.8	96.9	101	101	99.7	95.0	88.2	79.1	68.2	56.4	45.6	37.7		
135	44.6	50.7	59.2	69.2	77.9	85.3	90.6	93.7	94.4	92.9	89.0	83.1	75.3	66.2	56.2	47.7	41.3		
140	46.8	52.5	59.6	67.2	74.4	80.3	84.7	87.4	88.1	86.7	83.4	78.4	72.1	64.1	56.2	49.6	44.4		
145	49.1	53.7	59.4	65.5	71.3	76.1	79.5	81.6	82.2	81.1	78.4	74.3	68.7	62.5	56.7	51.2	46.7		
150	51.8	54.6	59.2	64.2	68.5	72.2	74.8	76.5	76.9	76.0	73.7	70.2	66.0	61.5	56.9	52.8	49.1		
155	52.8	54.7	58.3	62.8	66.1	68.7	70.7	71.7	71.8	71.0	69.3	66.9	64.0	60.7	57.4	54.1	51.1		
160	47.9	54.1	56.6	61.1	64.2	65.7	67.0	67.6	67.7	67.3	66.0	64.3	62.3	60.1	57.6	55.2	53.8		
165	43.5	46.3	52.2	57.0	61.4	63.1	63.9	64.4	64.4	64.1	63.4	62.4	61.0	59.4	57.7	56.1	54.5		
170	40.4	40.4	42.7	47.2	51.9	58.8	60.9	61.1	61.3	61.1	60.7	60.1	59.4	58.2	56.5	54.1	53.3		
175	42.6	41.4	37.9	37.3	40.2	45.7	51.6	55.8	58.2	58.5	57.9	57.6	56.8	55.3	53.5	53.1	52.7		
180	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1		

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  $4\pi$ . 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.

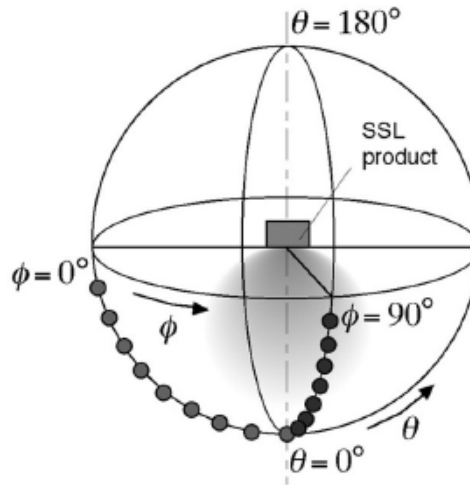
### **Color Spatial Uniformity**

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 \*\*\*

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