



## 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: 9290018770**

### 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](http://www.ledtestlab.com)

Report No.: HZ18030033c

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: **9290018770**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
163.8	1951.0	11.91	0.9803
CCT (K)	CRI	Stabilization Time (Light & Power)	
3979	82.0	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** : Mar. 20, 2018

**Date of Test** : Mar. 21, 2018

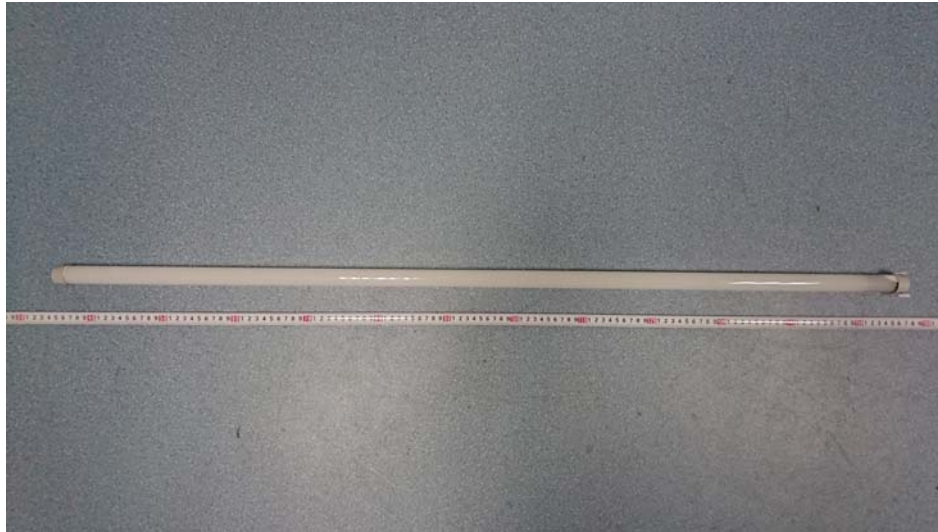
**Test item** : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

**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>	: 9290018770
<b>Electrical Ratings</b>	: 120-277V, 60HZ
<b>Product Description</b>	: 12T8/PRO/48-840/BB18/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	0.9803	0.9575
Test Power (W)	11.91	12.29
THD A%	17.95	13.75
Luminous Efficacy (lm/W)	163.8	159.3
Total Luminous Flux (lm)	1951.0	1958.0
Color Rendering Index (CRI)	82.0	
R9	2.1	
Correlated Color Temperature (CCT)(K)	3979	
Chromaticity Chroma x	0.3833	
Chromaticity Chroma y	0.3846	
Chromaticity Chroma u	0.2238	
Chromaticity Chroma v	0.3369	
Duv	0.0028	
Chromaticity Chroma u'	0.2238	
Chromaticity Chroma v'	0.5054	

Special Color Rendering Indices	
R1	79.7
R2	88.5
R3	95.3
R4	80.4
R5	79.7
R6	84.2
R7	85.7
R8	62.2
R9	2.1
R10	72.8
R11	79.1
R12	59.3
R13	81.9
R14	97.6
Rf	82
Rg	94

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)	0.102
Power Factor	0.9804
Power (W)	11.95
Luminous Efficacy (lm/W)	160.6
Total Luminous Flux (lm)	1918.7
Beam Angle (°)	113.2 (0°-180°) / 206.6 (90°-270°)
Center Beam Candle Power (cd)	332
Maximum Beam Candle Power (cd)	332.4 (At: C=300.0, Gamma=2.5)
Spacing Criteria	1.26 (0°-180°) / 1.44 (90°-270°)
Zonal Lumens in the 0°-60°Zone	44.54%
Zonal Lumens in the 60°-90°Zone	26.97%
Zonal Lumens in the 90°-120°Zone	16.72%
Zonal Lumens in the 120°-180°Zone	11.77%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

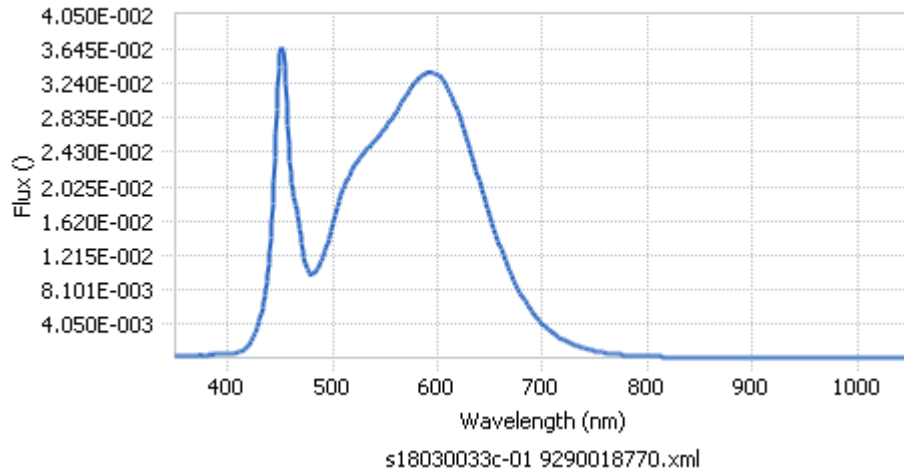
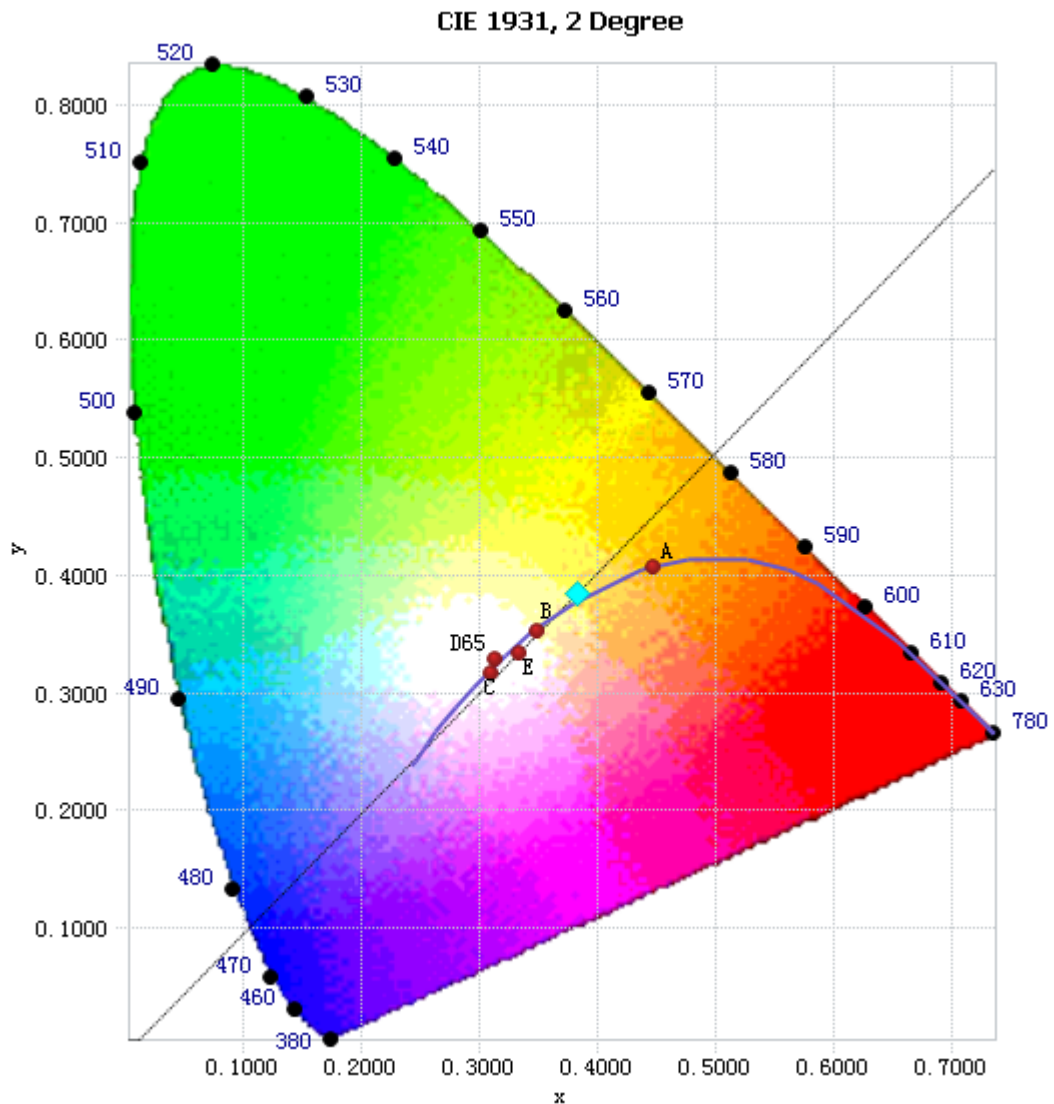


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.52E-04	485	1.05E-02	590	3.37E-02	695	4.69E-03
385	3.77E-04	490	1.15E-02	595	3.37E-02	700	4.00E-03
390	3.74E-04	495	1.36E-02	600	3.35E-02	705	3.41E-03
395	4.09E-04	500	1.59E-02	605	3.28E-02	710	2.91E-03
400	4.33E-04	505	1.81E-02	610	3.19E-02	715	2.48E-03
405	5.15E-04	510	1.99E-02	615	3.05E-02	720	2.11E-03
410	6.74E-04	515	2.14E-02	620	2.88E-02	725	1.80E-03
415	9.73E-04	520	2.26E-02	625	2.69E-02	730	1.53E-03
420	1.55E-03	525	2.34E-02	630	2.50E-02	735	1.31E-03
425	2.56E-03	530	2.42E-02	635	2.29E-02	740	1.11E-03
430	4.38E-03	535	2.49E-02	640	2.08E-02	745	9.46E-04
435	7.27E-03	540	2.57E-02	645	1.87E-02	750	8.10E-04
440	1.26E-02	545	2.63E-02	650	1.67E-02	755	6.92E-04
445	2.37E-02	550	2.71E-02	655	1.48E-02	760	5.93E-04
450	3.61E-02	555	2.81E-02	660	1.30E-02	765	5.09E-04
455	3.24E-02	560	2.90E-02	665	1.14E-02	770	4.34E-04
460	2.18E-02	565	3.00E-02	670	9.89E-03	775	3.75E-04
465	1.79E-02	570	3.10E-02	675	8.58E-03	780	3.19E-04
470	1.44E-02	575	3.19E-02	680	7.43E-03		
475	1.07E-02	580	3.28E-02	685	6.38E-03		
480	9.86E-03	585	3.35E-02	690	5.47E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3833, 0.3846)

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

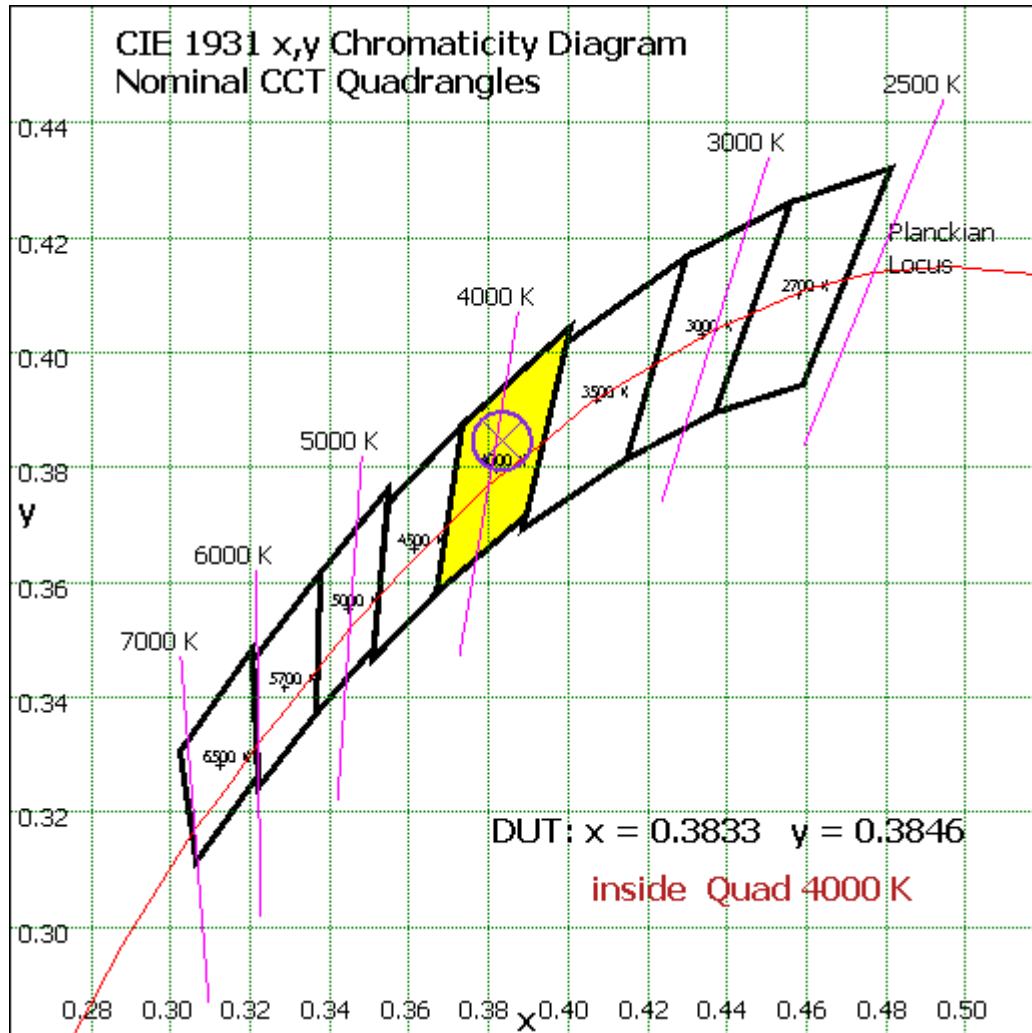


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	31.531	1.64%
10- 20	91.526	4.77%
20- 30	142.7	7.44%
30- 40	180.471	9.41%
40- 50	201.949	10.53%
50- 60	206.42	10.76%
60- 70	195.596	10.19%
70- 80	173.761	9.06%
80- 90	148.121	7.72%
90-100	125.86	6.56%
100-110	106.352	5.54%
110-120	88.515	4.61%
120-130	72.408	3.77%
130-140	57.909	3.02%
140-150	44.045	2.30%
150-160	30.184	1.57%
160-170	16.223	0.85%
170-180	5.087	0.27%
Total	1918.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	854.597	44.54%
60- 90	517.478	26.97%
0-90	1372.075	71.51%
90- 180	546.583	28.49%
0- 180	1918.7	100%

Table 5: Zonal Lumen Data

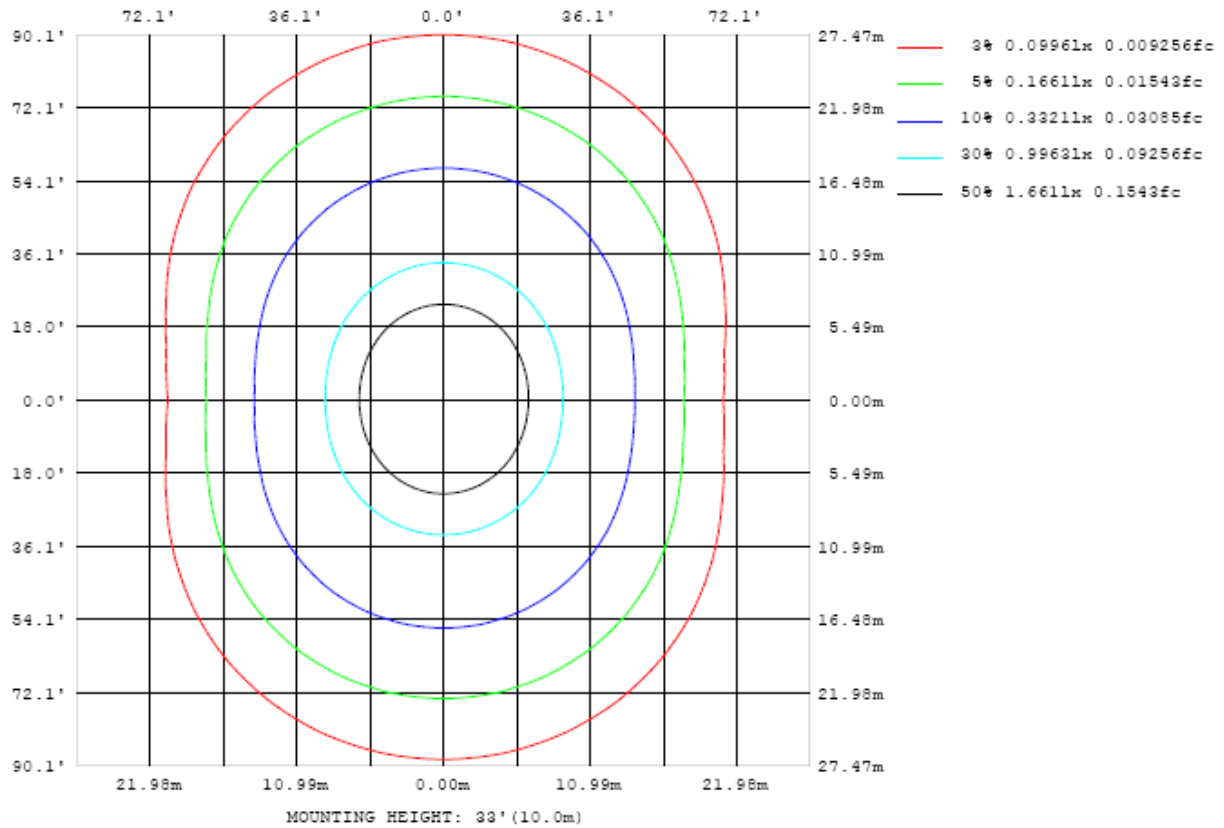


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

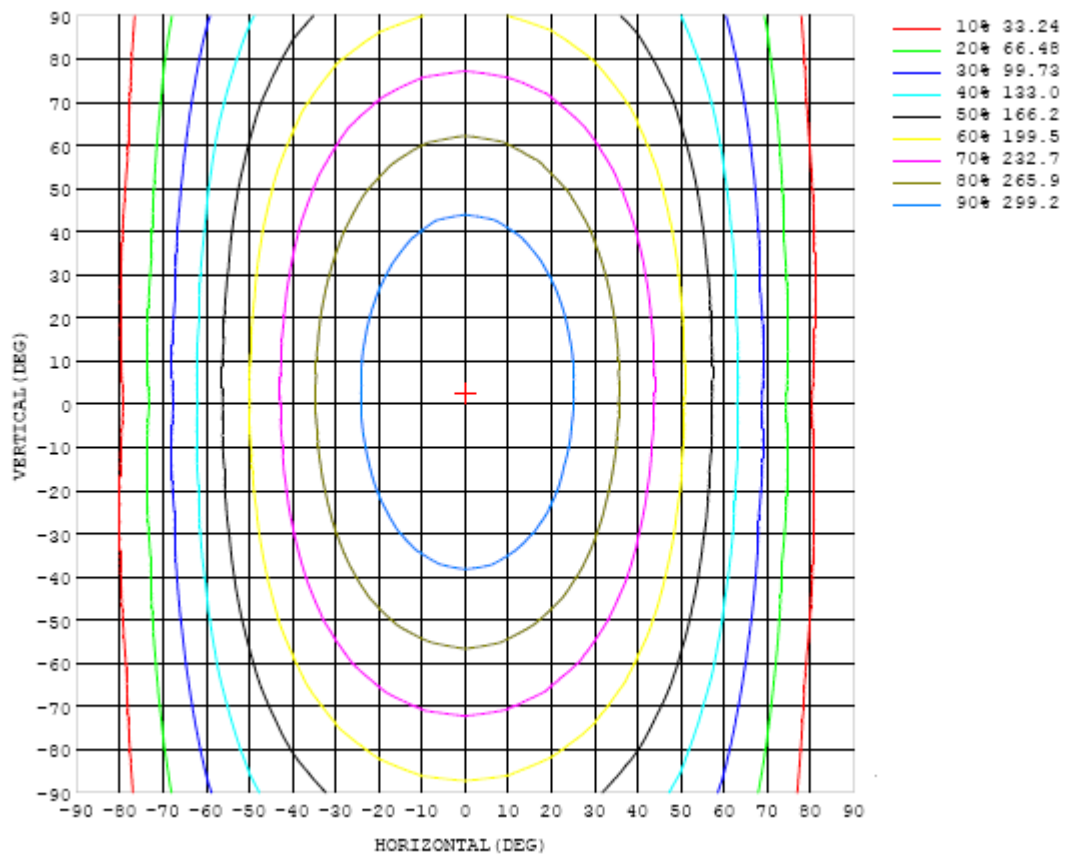


Chart 5: Isocandela Plot

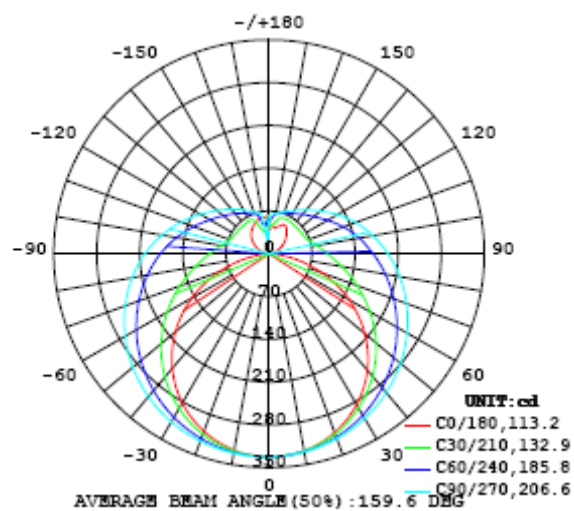


Chart 6: Polar Candela Distribution

## 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	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332
5	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331	331
10	327	327	327	327	328	328	329	329	329	329	329	329	328	328	328	327	327	326	326
15	321	320	321	321	322	324	325	325	326	326	326	325	324	323	322	320	319	319	319
20	311	311	312	314	315	318	319	321	321	322	321	320	318	316	314	312	310	310	309
25	299	299	301	303	307	310	313	315	316	317	316	314	312	308	305	302	299	297	297
30	285	285	288	291	296	301	305	308	310	311	310	308	304	299	294	289	285	283	282
35	268	268	272	277	284	291	296	300	303	304	303	300	295	289	282	275	269	265	265
40	249	250	255	262	271	279	286	291	295	296	295	291	285	277	269	259	251	246	245
45	227	228	235	245	256	267	275	282	287	288	286	282	275	265	254	243	232	225	223
50	203	206	215	227	241	254	264	272	277	279	277	272	264	252	239	225	211	202	199
55	177	181	193	209	225	240	253	261	267	269	267	261	252	239	224	206	190	177	173
60	150	156	170	189	209	226	240	250	257	259	257	251	240	226	208	187	167	151	145
65	122	129	147	170	193	212	228	239	246	248	246	239	228	212	192	169	145	125	116
70	92.1	101	125	152	177	199	216	228	235	238	235	228	216	199	177	151	123	97.8	85.7
75	62.3	75.1	104	136	163	186	204	216	224	227	224	217	204	186	163	135	102	72.0	56.5
80	34.7	51.3	84.9	120	150	173	192	205	213	216	213	205	193	174	150	120	84.2	49.1	29.5
85	11.9	32.7	69.8	106	137	161	180	193	202	204	202	194	181	162	138	107	69.8	31.8	8.44
90	0.46	21.9	58.8	95.1	126	151	169	182	191	193	191	183	170	152	127	96.1	59.6	22.1	0.43
95	1.58	17.8	51.5	86.3	116	141	159	171	180	182	180	172	160	142	117	87.5	52.8	18.7	2.23
100	4.39	17.9	46.7	78.8	107	131	149	161	169	171	169	162	150	132	109	80.2	48.2	19.2	5.84
105	8.34	20.7	44.1	72.6	99.1	121	139	151	158	160	158	152	140	123	101	74.1	45.8	22.0	10.6
110	12.8	24.2	43.7	67.8	91.7	112	129	140	148	150	148	141	130	114	93.2	69.4	45.4	25.8	15.6
115	18.2	29.3	44.8	64.7	85.3	104	119	130	137	139	137	131	120	105	86.8	66.3	45.8	30.2	20.9
120	23.5	34.1	46.4	63.1	80.3	96.4	110	120	126	128	127	121	111	97.8	81.7	64.6	47.5	34.5	26.1
125	28.7	38.5	48.2	62.3	76.7	90.1	102	110	116	118	116	111	103	91.5	78.1	63.3	49.2	38.9	31.7
130	34.0	43.3	50.6	62.0	74.0	85.2	94.9	102	107	109	107	103	95.9	86.6	75.3	62.7	51.7	43.5	36.5
135	39.3	47.5	53.1	61.8	71.6	81.2	89.3	95.3	99.4	101	99.7	96.1	90.2	82.4	72.5	62.6	53.9	47.0	40.9
140	44.5	50.4	55.4	62.3	69.9	77.4	84.3	89.4	92.7	93.9	93.1	90.0	85.1	78.2	70.6	63.1	55.8	49.9	45.2
145	49.6	53.7	57.1	62.9	68.8	74.4	79.5	83.7	86.6	87.6	86.8	84.2	79.9	75.0	69.4	63.2	57.9	53.4	48.6
150	53.0	56.3	58.3	63.4	68.0	72.3	76.0	78.8	80.8	81.5	80.9	79.1	76.3	72.7	68.2	63.6	58.9	56.5	51.8
155	52.3	57.6	58.7	63.3	67.4	70.5	73.2	75.3	76.7	77.2	76.9	75.5	73.2	70.3	67.3	63.7	60.6	59.0	54.2
160	48.0	55.2	58.9	62.5	66.7	68.8	70.7	72.1	73.0	73.2	72.9	71.9	70.4	68.5	66.2	63.7	62.1	61.2	56.9
165	45.0	49.9	53.9	59.8	64.7	67.0	68.3	69.2	69.7	69.9	69.8	69.2	68.1	66.7	65.3	64.3	63.3	62.6	61.2
170	44.6	47.0	48.8	52.0	57.5	63.6	66.5	66.7	66.8	67.0	66.8	66.4	66.1	65.8	65.3	64.6	63.9	62.5	60.7
175	46.2	44.5	43.8	45.7	48.7	54.1	60.4	64.6	65.3	65.1	65.1	65.0	64.9	64.8	64.7	64.7	64.2	62.4	60.2
180	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5

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	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332	332		
5	331	331	331	331	332	332	332	332	332	332	332	332	332	332	332	331	331		
10	327	327	328	328	329	330	331	331	331	331	331	330	330	329	329	328	327		
15	320	321	322	324	325	327	328	329	329	329	329	328	326	325	323	322	321		
20	310	312	314	317	320	322	324	326	326	326	325	323	321	319	316	314	312		
25	298	301	304	308	312	316	319	322	322	322	320	318	314	310	306	303	301		
30	283	287	292	298	304	309	314	317	317	317	314	311	306	300	295	290	286		
35	266	272	279	287	294	301	307	311	312	311	308	303	297	289	282	275	270		
40	247	254	263	273	283	292	299	304	305	304	300	294	286	276	267	258	251		
45	226	235	247	259	272	282	290	296	298	296	292	284	274	263	251	239	231		
50	203	214	229	245	259	272	281	288	289	288	282	274	262	248	233	219	208		
55	178	192	210	229	246	261	271	278	280	278	272	262	249	233	215	197	183		
60	151	169	192	214	233	249	261	268	271	268	262	251	236	217	196	175	157		
65	124	146	173	198	220	237	249	258	260	258	251	239	222	202	178	152	131		
70	96.6	123	154	183	206	225	238	247	249	247	239	227	209	186	159	130	104		
75	70.0	102	137	168	193	213	226	235	238	235	228	215	196	172	142	109	77.3		
80	46.9	83.7	122	154	181	201	214	223	226	224	216	202	183	158	126	90.3	54.3		
85	29.3	69.4	108	142	168	189	203	212	214	212	204	190	171	145	113	75.0	35.8		
90	20.1	58.7	96.8	130	157	177	191	199	202	200	192	178	159	133	101	64.0	25.0		
95	16.8	51.0	86.9	119	145	165	178	187	189	187	179	166	147	122	90.8	55.5	20.0		
100	18.1	46.4	78.9	109	134	153	166	174	177	174	167	154	135	111	82.2	49.8	19.4		
105	21.1	44.5	72.6	100.0	123	141	154	162	164	162	155	142	125	102	75.3	46.8	21.3		
110	24.8	44.8	68.4	92.5	114	130	142	150	152	150	143	131	115	94.1	70.2	46.3	24.2		
115	29.0	46.0	65.9	86.4	105	120	131	138	140	138	132	121	106	87.6	67.2	47.1	27.5		
120	33.0	47.8	64.3	81.9	97.9	111	121	127	129	127	121	112	98.6	82.8	65.3	48.4	30.5		
125	36.2	49.7	63.3	78.4	92.3	103	112	117	119	117	112	104	92.8	78.9	64.2	49.9	32.5		
130	38.6	51.9	63.1	75.7	87.3	97.0	104	109	110	109	105	97.2	87.5	75.8	63.5	51.9	34.5		
135	39.7	54.1	62.4	73.4	82.9	91.1	97.3	101	102	101	97.4	91.2	83.0	73.8	63.0	53.5	35.7		
140	39.4	56.1	62.4	71.2	79.2	85.9	91.0	94.2	95.2	94.2	91.0	85.9	79.1	71.8	61.6	54.8	35.8		
145	38.4	57.1	62.8	68.9	75.5	81.2	85.4	88.1	88.8	87.9	85.3	81.2	75.9	69.2	61.7	55.9	34.4		
150	40.3	56.3	63.5	67.8	71.7	76.8	80.2	82.4	83.0	82.3	80.4	76.9	72.4	63.3	61.7	52.9	36.8		
155	43.6	47.4	60.4	67.6	69.7	72.4	74.7	76.8	77.7	77.2	75.3	72.9	62.7	59.0	55.4	43.4	38.1		
160	42.6	38.9	49.2	62.3	69.0	70.0	71.3	72.4	72.5	72.6	67.0	55.9	52.2	48.8	46.7	34.9	35.5		
165	48.8	36.0	39.2	41.7	52.3	63.4	65.6	68.4	69.0	59.8	46.8	49.2	48.6	41.8	35.1	32.6	36.9		
170	54.3	42.8	38.7	43.2	47.0	48.4	52.1	52.7	53.8	46.0	48.9	46.7	43.7	41.0	38.1	35.1	39.4		
175	57.9	54.5	50.3	47.7	47.8	49.1	48.4	40.5	24.7	46.5	48.3	46.7	45.6	44.2	43.5	45.0	46.7		
180	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5		

Table 7: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Aug. 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.

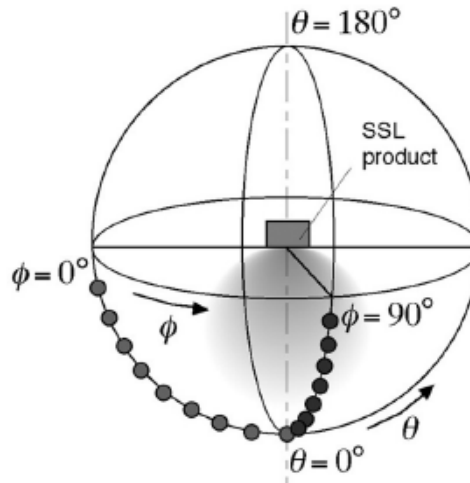
### **Color Spatial Uniformity**

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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