



## 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: 9290018771**

### 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.: HZ18030033d

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: **9290018771**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
161.2	1933.0	11.99	0.9808
CCT (K)	CRI	Stabilization Time (Light & Power)	
4871	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** : Mar. 20, 2018

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

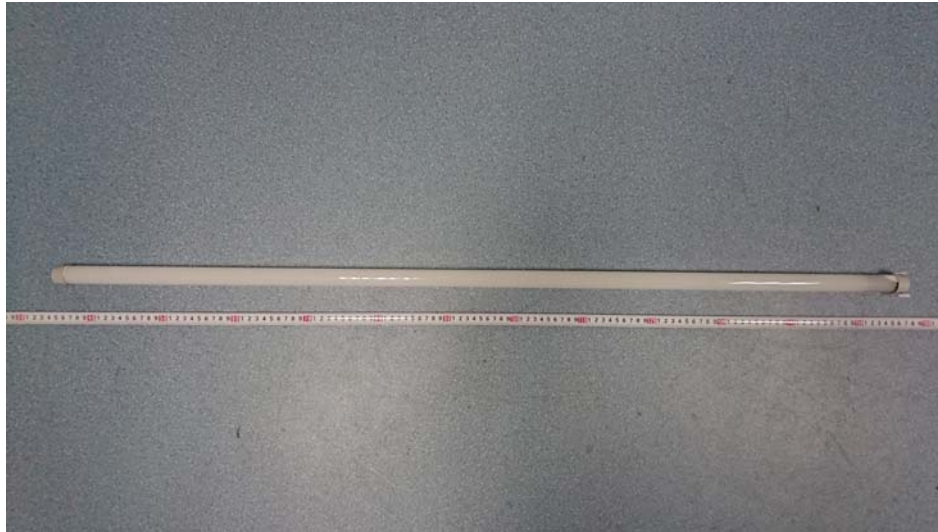
**Test item** : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters

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

## 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
Zonal Lumen Tabulation- Goniophotometer Method .....	10
Luminous Intensity Distribution Plots- Goniophotometer Method.....	12
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



Sample view

### Equipment Under Test (EUT)

<b>Name</b>	: LED Tube
<b>Model</b>	: 9290018771
<b>Electrical Ratings</b>	: 120-277V, 60HZ
<b>Product Description</b>	: 12T8/PRO/48-850/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)	0.102	0.047
Power Factor	0.9808	0.9581
Test Power (W)	11.99	12.36
THD A%	17.71	13.60
Luminous Efficacy (lm/W)	161.2	156.9
Total Luminous Flux (lm)	1933.0	1939.0
Color Rendering Index (CRI)	81.7	
R9	1.4	
Correlated Color Temperature (CCT)(K)	4871	
Chromaticity Chroma x	0.3497	
Chromaticity Chroma y	0.3636	
Chromaticity Chroma u	0.2099	
Chromaticity Chroma v	0.3274	
Duv	0.0040	
Chromaticity Chroma u'	0.2099	
Chromaticity Chroma v'	0.4911	

Special Color Rendering Indices	
R1	79.2
R2	86.9
R3	92.9
R4	80.8
R5	79.4
R6	81.8
R7	87.4
R8	65.3
R9	1.4
R10	69.1
R11	79.4
R12	55.7
R13	81.1
R14	96.3
Rf	81
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	0.9811
Power (W)	12.02
Luminous Efficacy (lm/W)	160.1
Total Luminous Flux (lm)	1923.7
Beam Angle (°)	112.0 (0°-180°) / 195.5 (90°-270°)
Center Beam Candle Power (cd)	346
Maximum Beam Candle Power (cd)	346.6 (At: C=100.0, Gamma=0.5)
Spacing Criteria	1.27 (0°-180°) / 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	45.79%
Zonal Lumens in the 60°-90°Zone	26.86%
Zonal Lumens in the 90°-120°Zone	16.10%
Zonal Lumens in the 120°-180°Zone	11.25%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

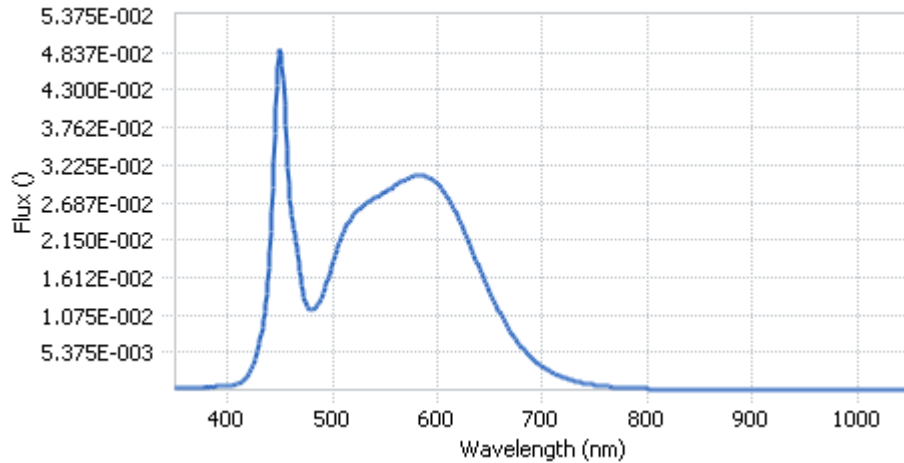
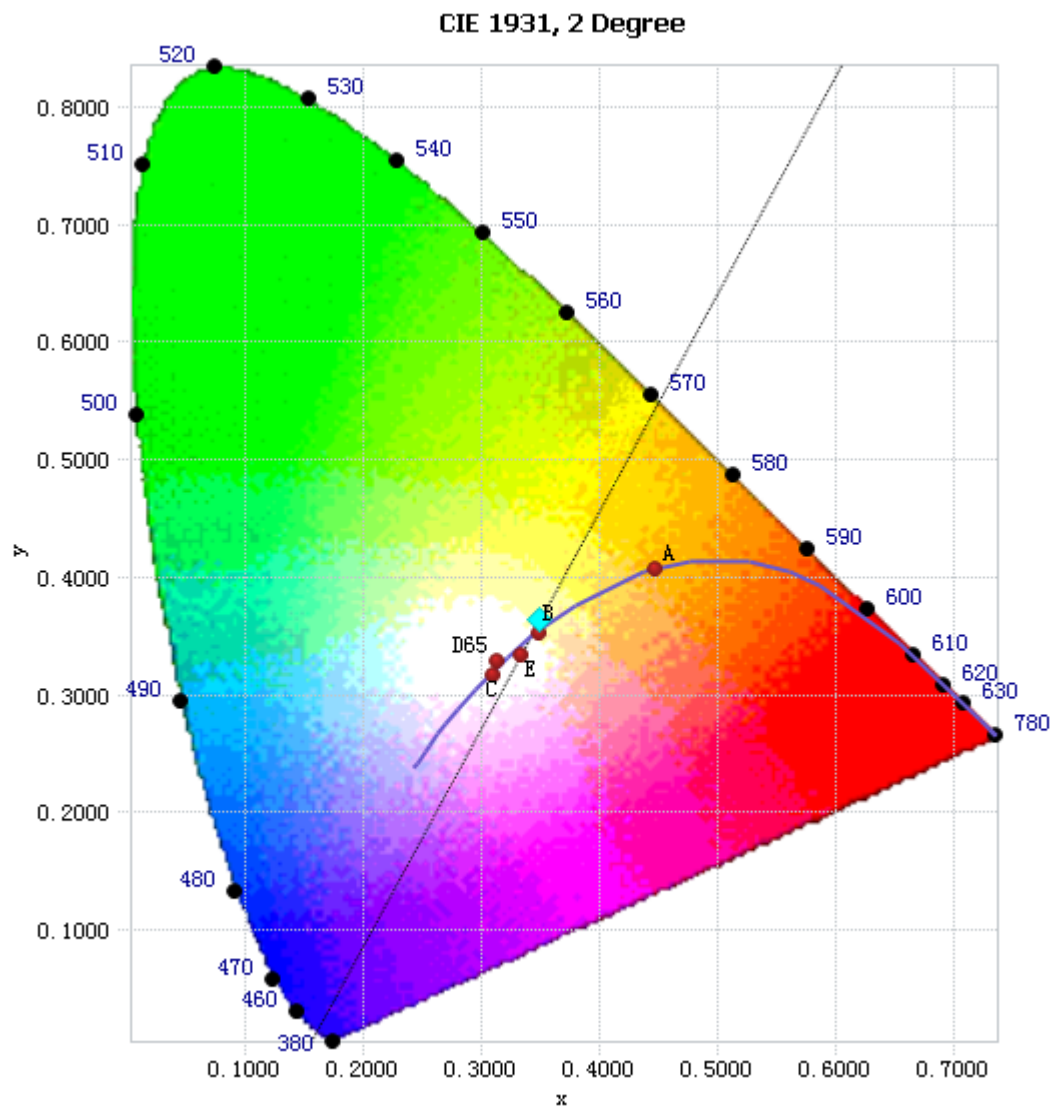


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	4.37E-04	485	1.21E-02	590	3.06E-02	695	3.88E-03
385	4.16E-04	490	1.34E-02	595	3.01E-02	700	3.34E-03
390	4.72E-04	495	1.57E-02	600	2.95E-02	705	2.85E-03
395	5.05E-04	500	1.83E-02	605	2.86E-02	710	2.42E-03
400	5.47E-04	505	2.06E-02	610	2.75E-02	715	2.07E-03
405	6.55E-04	510	2.25E-02	615	2.61E-02	720	1.76E-03
410	9.17E-04	515	2.40E-02	620	2.45E-02	725	1.51E-03
415	1.35E-03	520	2.52E-02	625	2.28E-02	730	1.29E-03
420	2.23E-03	525	2.59E-02	630	2.11E-02	735	1.10E-03
425	3.79E-03	530	2.65E-02	635	1.92E-02	740	9.38E-04
430	6.65E-03	535	2.70E-02	640	1.74E-02	745	7.98E-04
435	1.11E-02	540	2.75E-02	645	1.55E-02	750	6.79E-04
440	1.99E-02	545	2.79E-02	650	1.39E-02	755	5.88E-04
445	3.67E-02	550	2.83E-02	655	1.23E-02	760	5.06E-04
450	4.89E-02	555	2.89E-02	660	1.08E-02	765	4.36E-04
455	3.79E-02	560	2.93E-02	665	9.44E-03	770	3.71E-04
460	2.60E-02	565	2.98E-02	670	8.20E-03	775	3.20E-04
465	2.13E-02	570	3.02E-02	675	7.11E-03	780	2.75E-04
470	1.60E-02	575	3.05E-02	680	6.16E-03		
475	1.21E-02	580	3.07E-02	685	5.30E-03		
480	1.15E-02	585	3.09E-02	690	4.55E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3497, 0.3636)

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

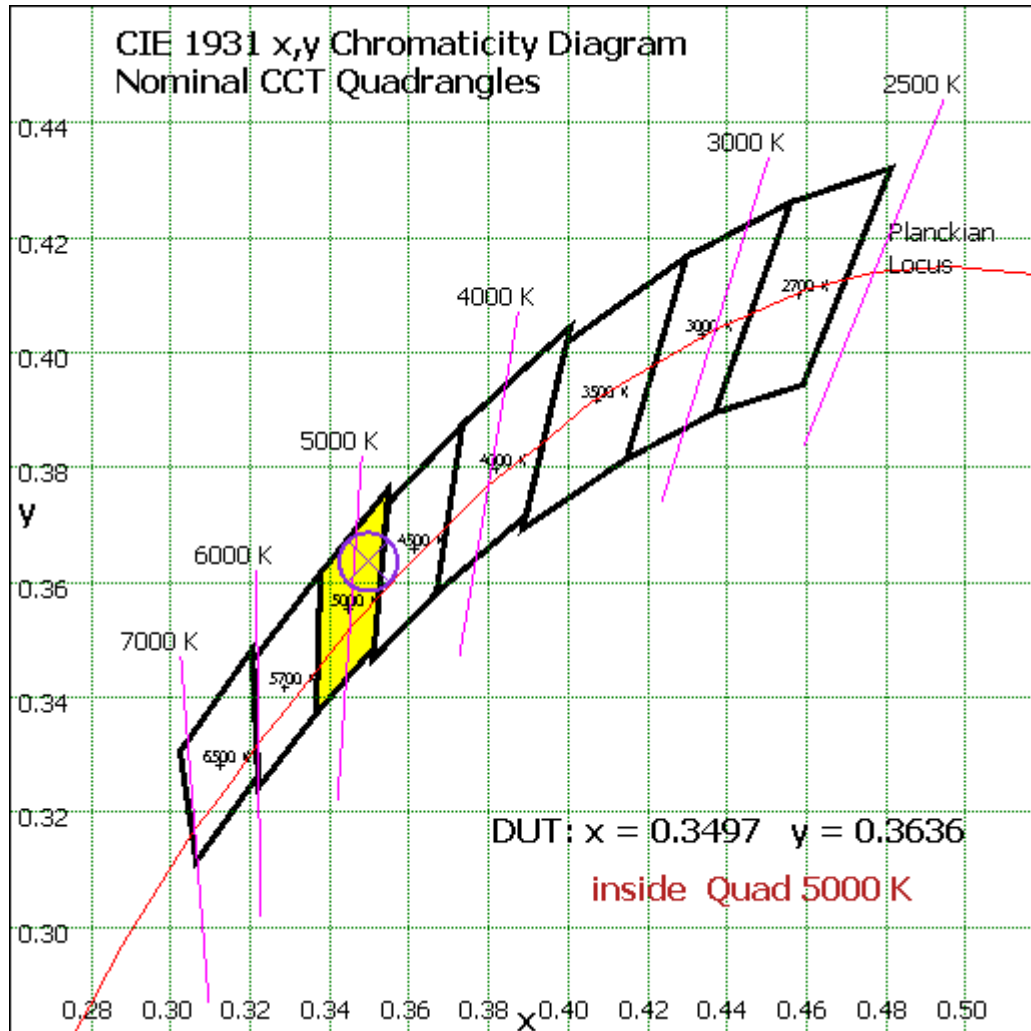


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	32.879	1.71%
10- 20	95.308	4.95%
20- 30	148.189	7.70%
30- 40	186.587	9.70%
40- 50	207.524	10.79%
50- 60	210.415	10.94%
60- 70	197.449	10.26%
70- 80	173.426	9.02%
80- 90	145.842	7.58%
90-100	122.164	6.35%
100-110	102.45	5.33%
110-120	85.064	4.42%
120-130	69.557	3.62%
130-140	55.391	2.88%
140-150	41.992	2.18%
150-160	28.316	1.47%
160-170	15.706	0.82%
170-180	5.483	0.29%
Total	1923.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	880.902	45.79%
60- 90	516.717	26.86%
0-90	1397.619	72.65%
90- 180	526.123	27.35%
0- 180	1923.7	100%

Table 5: Zonal Lumen Data

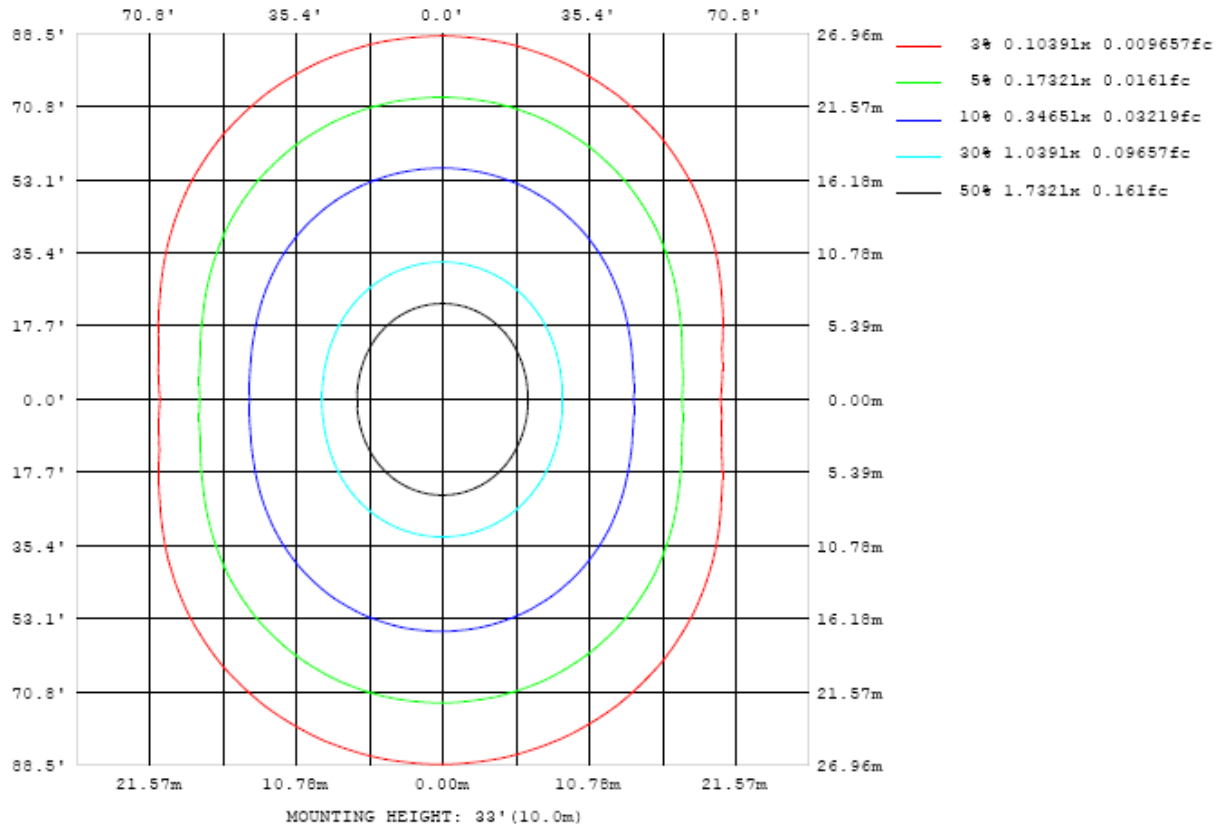


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

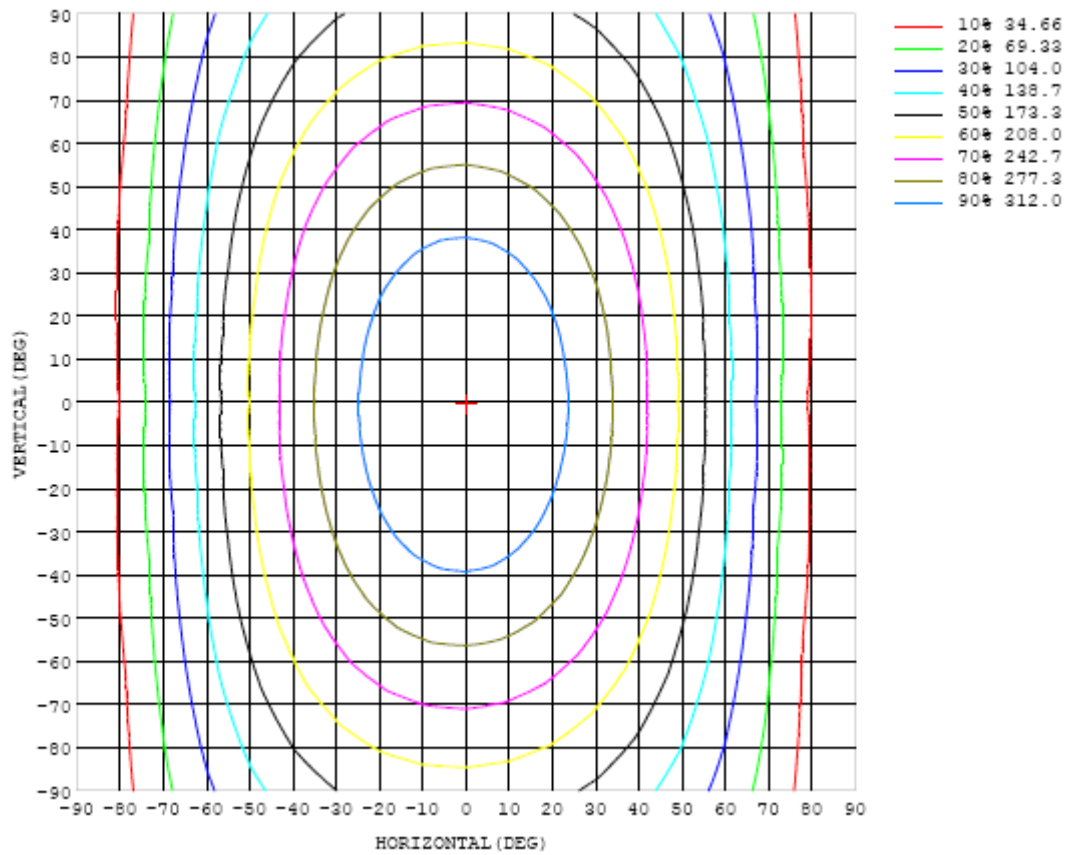


Chart 5: Isocandela Plot

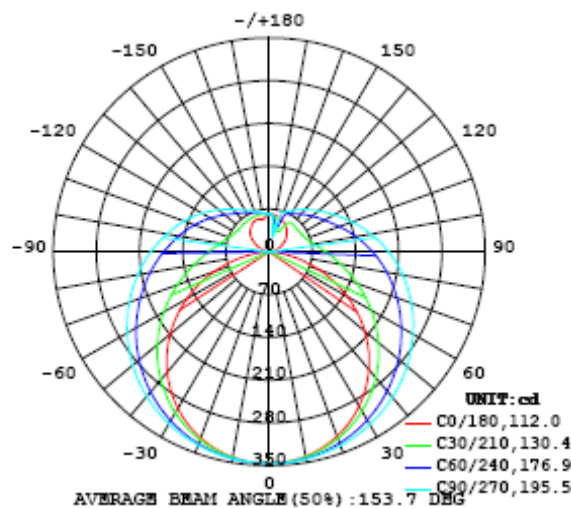


Chart 6: Polar Candela Distribution

## 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	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346
5	344	345	345	345	345	345	345	346	346	346	346	346	346	346	346	346	345	346	345
10	340	340	340	341	342	343	343	344	344	344	344	344	344	343	343	342	342	342	341
15	332	332	333	334	336	338	339	340	341	341	342	341	340	339	338	336	335	334	334
20	321	322	323	325	328	331	333	336	337	337	337	336	335	333	330	328	326	325	324
25	308	309	311	314	318	322	326	329	332	332	332	331	328	325	321	318	314	312	311
30	292	293	296	301	306	312	318	322	325	326	326	324	320	316	310	305	300	297	296
35	273	274	279	286	293	301	308	314	318	319	319	316	311	305	298	290	284	280	278
40	251	254	260	269	279	289	298	304	309	311	310	307	301	293	284	274	266	259	257
45	228	231	239	251	263	275	286	294	300	302	301	297	290	280	269	256	245	237	234
50	202	206	217	231	247	261	274	283	289	292	290	286	278	267	253	238	224	213	209
55	175	180	194	211	230	246	261	271	278	281	280	275	266	252	236	218	201	188	183
60	146	153	170	191	213	232	247	259	266	269	268	263	253	238	219	198	177	161	154
65	116	124	145	171	196	217	234	247	254	258	256	250	239	223	202	179	153	133	125
70	85.9	96.1	122	152	179	202	220	234	242	245	244	238	226	209	186	159	130	104	94.4
75	56.4	69.5	100	134	163	188	207	221	229	233	231	225	213	195	171	142	108	77.4	64.4
80	29.4	46.0	81.7	118	149	174	194	208	216	220	219	212	200	181	156	125	89.0	53.2	36.3
85	8.46	28.8	67.2	104	135	161	181	195	204	207	205	199	186	168	143	111	73.3	34.3	13.0
90	0.34	19.6	55.9	91.7	123	148	168	182	190	194	192	186	173	155	130	98.4	61.6	23.1	0.63
95	2.23	16.3	48.0	81.5	112	136	155	169	177	181	179	173	160	142	118	87.6	52.7	18.2	1.59
100	5.67	17.2	43.3	73.4	101	125	143	156	164	168	166	160	148	130	107	78.8	47.2	17.8	4.57
105	10.4	19.5	41.8	67.5	92.6	114	131	144	152	155	154	148	136	120	97.9	72.2	44.8	19.4	8.86
110	15.2	22.6	41.9	63.6	85.6	105	121	133	140	143	142	136	125	110	90.2	67.8	44.6	21.6	13.4
115	20.3	25.2	43.0	61.2	80.4	97.6	112	122	129	132	130	125	115	102	84.4	65.0	45.2	24.3	19.5
120	25.6	27.0	44.3	59.8	76.2	91.3	104	113	119	122	120	116	107	94.8	79.8	63.1	46.2	26.6	26.0
125	31.2	28.1	45.9	59.0	72.8	86.0	97.0	105	111	113	111	107	99.6	89.1	76.1	61.8	47.2	28.3	32.6
130	36.2	30.4	47.0	58.3	70.2	81.5	90.9	98.1	103	104	104	99.8	93.1	84.1	73.0	60.8	47.5	31.3	38.8
135	40.5	34.6	46.8	59.0	67.9	77.5	85.5	91.6	95.6	97.1	96.3	93.1	87.3	79.6	70.0	60.1	45.8	35.5	43.7
140	44.3	40.2	43.7	59.5	66.2	73.9	80.7	85.8	89.1	90.4	89.7	86.9	82.1	75.3	67.3	60.4	42.4	40.3	47.2
145	48.4	44.7	37.0	58.7	65.1	70.7	75.7	80.2	83.2	84.2	83.7	81.4	77.2	69.6	65.4	59.7	37.8	46.6	50.7
150	52.0	49.3	39.6	49.1	62.0	68.6	71.9	75.2	77.6	78.3	78.1	76.5	68.2	65.5	61.5	50.3	39.3	51.0	53.8
155	54.7	52.4	42.6	36.5	47.9	64.6	68.7	70.0	72.8	73.3	73.2	60.4	56.5	53.7	51.6	37.4	42.8	53.8	55.8
160	57.2	56.9	51.0	37.1	35.7	39.7	50.7	62.3	65.4	69.3	47.5	49.4	48.1	43.0	36.5	36.2	44.6	53.4	56.7
165	59.1	58.8	57.1	53.2	41.8	38.1	45.3	49.3	52.3	33.8	52.0	47.2	41.4	36.6	34.7	38.4	45.4	50.7	55.3
170	60.6	60.2	58.7	57.0	56.0	52.8	49.5	48.0	45.8	27.3	43.8	42.9	40.6	39.0	42.1	43.8	45.7	50.0	53.9
175	61.7	61.4	61.3	61.2	60.8	60.6	60.3	60.7	59.2	52.0	47.0	46.5	46.5	46.7	49.3	52.9	56.2	58.8	
180	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1

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	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346		
5	345	346	346	346	346	346	346	346	346	346	346	345	345	345	345	345	345		
10	341	341	342	342	343	343	344	344	344	344	343	343	342	341	341	340	340		
15	335	335	336	337	339	339	340	341	341	341	340	338	337	335	334	333	332		
20	325	326	328	330	332	334	336	337	337	336	335	333	330	328	325	323	322		
25	312	314	317	321	324	327	330	331	331	331	328	325	322	318	314	310	308		
30	297	300	304	309	315	319	323	325	325	324	321	317	312	306	301	295	292		
35	279	283	290	297	304	310	314	317	317	316	312	307	300	293	285	279	274		
40	259	265	273	283	292	299	305	308	309	307	303	296	288	278	268	260	254		
45	237	245	255	268	278	288	295	298	299	297	292	284	274	262	250	239	231		
50	213	223	237	251	265	275	283	288	289	286	280	272	259	246	230	217	206		
55	188	200	217	235	250	262	271	276	277	275	268	258	245	228	211	194	180		
60	161	177	197	217	235	249	259	265	266	263	256	244	229	211	190	170	153		
65	134	153	177	201	220	235	246	252	254	251	243	231	215	194	170	146	125		
70	106	130	158	184	205	222	233	240	241	238	230	217	200	177	151	123	97.9		
75	78.5	108	141	168	191	208	221	227	228	225	217	204	185	162	134	101	71.6		
80	54.0	88.6	124	154	178	196	208	215	216	213	204	191	172	148	118	82.4	48.3		
85	34.8	72.8	110	141	165	183	195	202	204	200	192	178	159	135	104	67.4	30.5		
90	23.4	61.3	98.1	129	153	171	183	190	192	188	180	166	148	123	92.6	56.8	20.5		
95	19.0	53.6	88.3	118	142	159	171	178	180	176	168	155	137	113	83.5	49.9	17.1		
100	18.7	48.7	80.8	109	132	149	160	167	168	165	157	145	127	104	76.4	45.5	17.3		
105	21.1	45.7	74.5	101	122	139	150	156	157	155	147	135	118	96.4	70.6	43.1	20.2		
110	24.8	44.7	69.6	93.2	113	129	139	145	147	144	137	125	109	89.4	66.1	42.2	23.6		
115	29.2	45.3	65.7	86.7	105	119	129	135	136	134	127	116	102	83.3	62.7	42.8	27.8		
120	33.8	46.7	63.2	81.0	97.3	110	119	125	126	124	117	108	94.3	78.0	60.3	44.2	32.2		
125	37.7	48.7	62.0	76.5	90.3	102	110	115	116	114	109	99.6	87.7	73.7	59.1	46.4	36.1		
130	41.6	50.8	61.6	73.2	84.5	94.2	101	106	107	105	100.0	92.1	82.1	70.5	59.1	48.7	40.3		
135	45.9	52.8	61.6	70.8	79.8	87.8	93.6	97.0	98.1	96.5	92.3	85.8	77.5	68.6	59.5	50.9	44.0		
140	49.4	54.3	61.8	69.2	76.2	82.3	86.9	89.8	90.6	89.2	85.8	80.5	74.2	67.4	59.9	52.5	47.2		
145	52.5	56.5	62.0	67.8	73.3	78.0	81.5	83.5	84.0	83.1	80.6	76.7	71.8	66.3	60.3	54.7	50.6		
150	54.1	57.8	62.1	66.6	70.9	74.5	77.1	78.7	79.1	78.4	76.5	73.5	69.7	65.3	60.4	56.3	53.0		
155	56.5	59.6	62.4	65.5	68.6	71.3	73.3	74.5	74.8	74.3	72.8	70.5	67.6	64.1	60.6	57.9	55.5		
160	57.8	60.0	62.7	64.6	66.6	68.4	69.8	70.6	70.8	70.4	69.4	67.7	65.4	63.1	61.2	59.1	57.6		
165	58.4	60.7	62.8	64.0	65.1	66.0	66.7	67.1	67.1	66.8	66.1	65.1	63.9	62.7	61.4	60.2	59.5		
170	58.6	62.0	62.7	63.2	63.7	64.2	64.4	64.6	64.6	64.5	64.3	63.7	63.1	62.3	61.6	61.1	60.8		
175	61.9	62.7	62.6	62.6	62.7	62.7	62.8	62.9	62.9	62.8	62.6	62.5	62.3	62.1	62.0	61.9	61.8		
180	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1		

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.

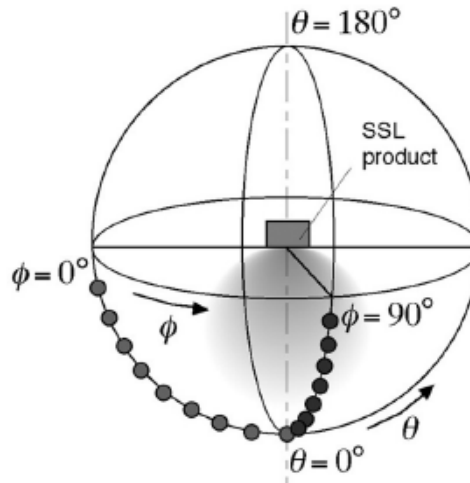
### **Color Spatial Uniformity**

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 \*\*\*

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.