

## LM-79-08 Test Report

for

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

Building 9, Lane 888, Tianlin Road, Minhang District, Shanghai China

### TYPEB LED TUBE

Model: 9290019341

### 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.: HZ18060001d

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

Review by:



Engineer: April Zou

Jun. 06, 2018

Approved by:



Manager: Jim Zhang

Jun. 06, 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: **9290019341**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
145.0	1206.0	8.32	0.9822
CCT (K)	CRI	Stabilization Time (Light & Power)	
5011	85.0	60	

Table 1: Executive Data Summary

Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

### Test specifications:

<b>Date of Receipt</b>	: Jun. 01, 2018
<b>Date of Test</b>	: Jun. 01, 2018
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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## Sample Photo



Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: TYPEB LED TUBE
<b>Model</b>	: 9290019341
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz, 8.5W
<b>Product Description</b>	: 8.5T8PRO/24-850/BB11/G FB
<b>Manufacturer</b>	: Philips Lighting (China) Investment Co., Ltd
<b>Address</b>	: Building 9, Lane 888, Tianlin Road, Minhang District, Shanghai China

## 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	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.071	0.034
Power Factor	0.9822	0.9236
Test Power (W)	8.32	8.61
THD A%	17.84	21.09
Luminous Efficacy (lm/W)	145.0	140.5
Total Luminous Flux (lm)	1206.0	1210.0
Color Rendering Index (CRI)	85.0	
R9	12.5	
Correlated Color Temperature (CCT) (K)	5011	
Chromaticity Chroma x	0.3451	
Chromaticity Chroma y	0.3555	
Chromaticity Chroma u	0.2099	
Chromaticity Chroma v	0.3244	
Duv	0.0011	
Chromaticity Chroma u'	0.2099	
Chromaticity Chroma v'	0.4865	

Special Color Rendering Indices	
R1	83.4
R2	91.4
R3	95.3
R4	83.8
R5	84.3
R6	87.4
R7	86.8
R8	67.8
R9	12.5
R10	79.3
R11	83.4
R12	68.2
R13	85.8
R14	97.9
Rf	84
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 24.6°C.

The photometric distance is 30m.

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)	0.071
Power Factor	0.9791
Test Power (W)	8.35
Luminous Efficacy (lm/W)	139.1
Total Luminous Flux (lm)	1161.8
Beam Angle (°)	107.9 (0°-180°)/ 211.6 (90°-270°)
Center Beam Candle Power (cd)	205
Maximum Beam Candle Power (cd)	205.2 (At: C=100.0, Gamma=0.5)
Spacing Criteria	1.24 (0°-180°)/ 1.41 (90°-270°)
Zonal Lumens in the 0°-60°Zone	44.43%
Zonal Lumens in the 60°-90°Zone	26.99%
Zonal Lumens in the 90°-120°Zone	16.87%
Zonal Lumens in the 120°-180°Zone	11.71%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

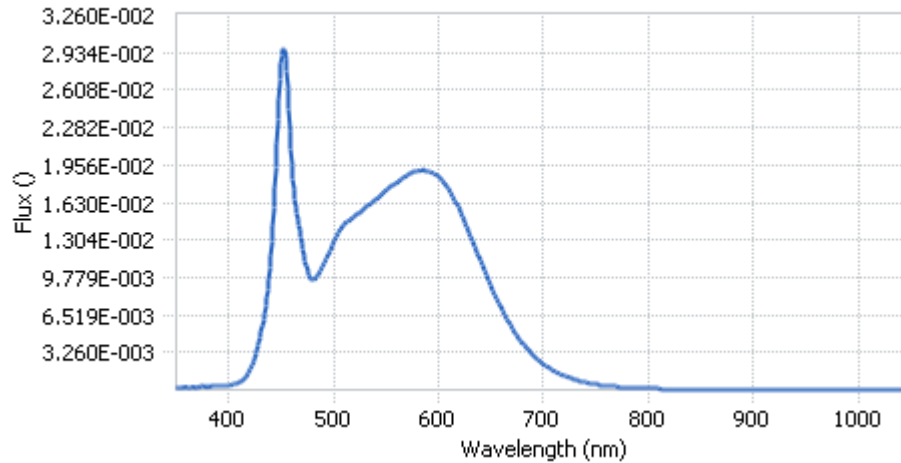
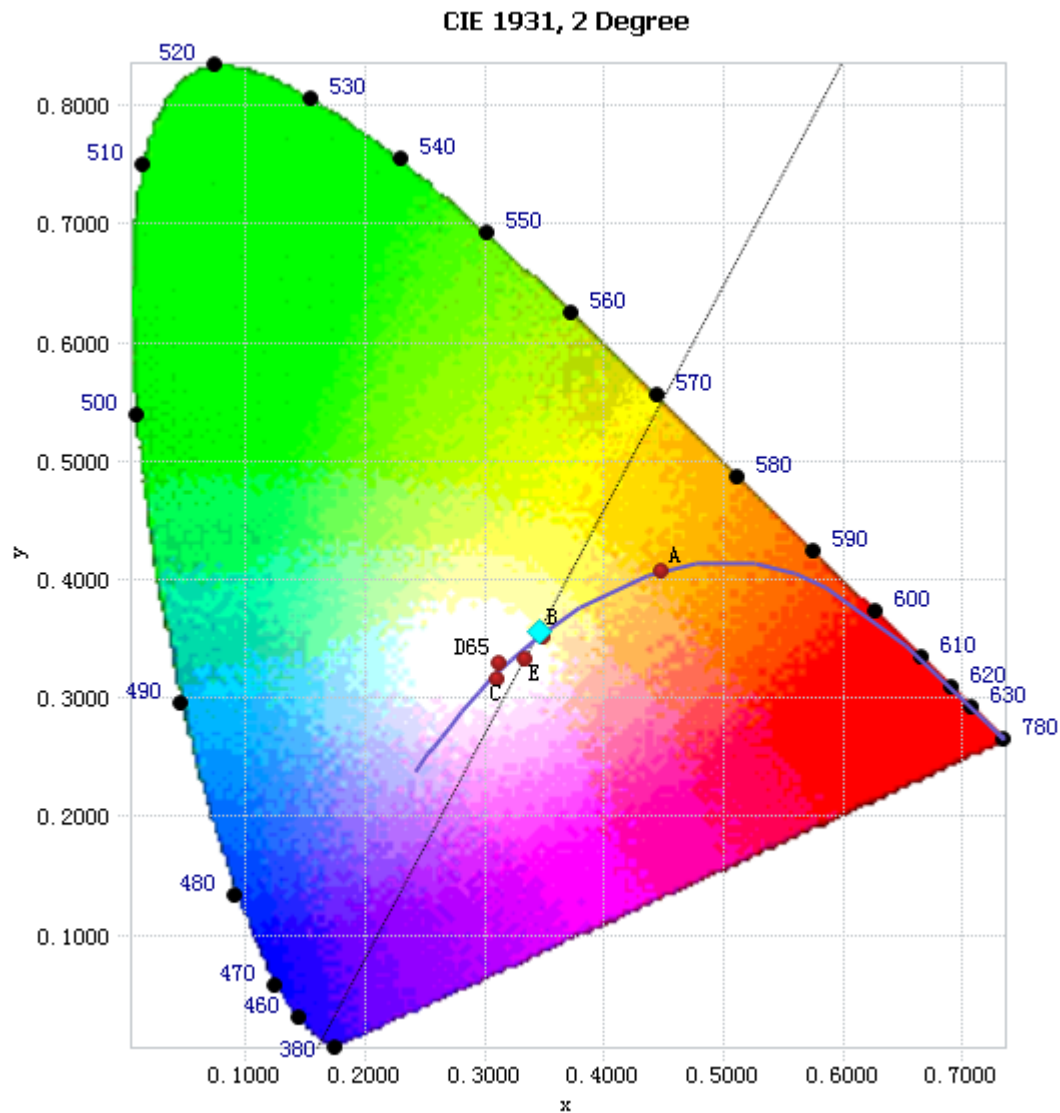


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.88E-04	485	1.00E-02	590	1.91E-02	695	2.61E-03
385	2.85E-04	490	1.08E-02	595	1.89E-02	700	2.24E-03
390	3.23E-04	495	1.18E-02	600	1.85E-02	705	1.92E-03
395	3.40E-04	500	1.29E-02	605	1.80E-02	710	1.64E-03
400	3.65E-04	505	1.38E-02	610	1.74E-02	715	1.41E-03
405	4.69E-04	510	1.44E-02	615	1.65E-02	720	1.21E-03
410	6.41E-04	515	1.48E-02	620	1.56E-02	725	1.03E-03
415	1.02E-03	520	1.52E-02	625	1.45E-02	730	8.87E-04
420	1.67E-03	525	1.54E-02	630	1.35E-02	735	7.56E-04
425	2.82E-03	530	1.58E-02	635	1.23E-02	740	6.50E-04
430	4.61E-03	535	1.61E-02	640	1.12E-02	745	5.56E-04
435	7.31E-03	540	1.66E-02	645	1.01E-02	750	4.78E-04
440	1.16E-02	545	1.70E-02	650	9.01E-03	755	4.10E-04
445	1.94E-02	550	1.74E-02	655	7.98E-03	760	3.57E-04
450	2.84E-02	555	1.77E-02	660	7.06E-03	765	3.06E-04
455	2.76E-02	560	1.80E-02	665	6.18E-03	770	2.64E-04
460	1.95E-02	565	1.84E-02	670	5.39E-03	775	2.30E-04
465	1.53E-02	570	1.87E-02	675	4.69E-03	780	1.97E-04
470	1.28E-02	575	1.89E-02	680	4.06E-03		
475	1.03E-02	580	1.91E-02	685	3.52E-03		
480	9.56E-03	585	1.92E-02	690	3.04E-03		

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

## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3451, 0.3555)

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

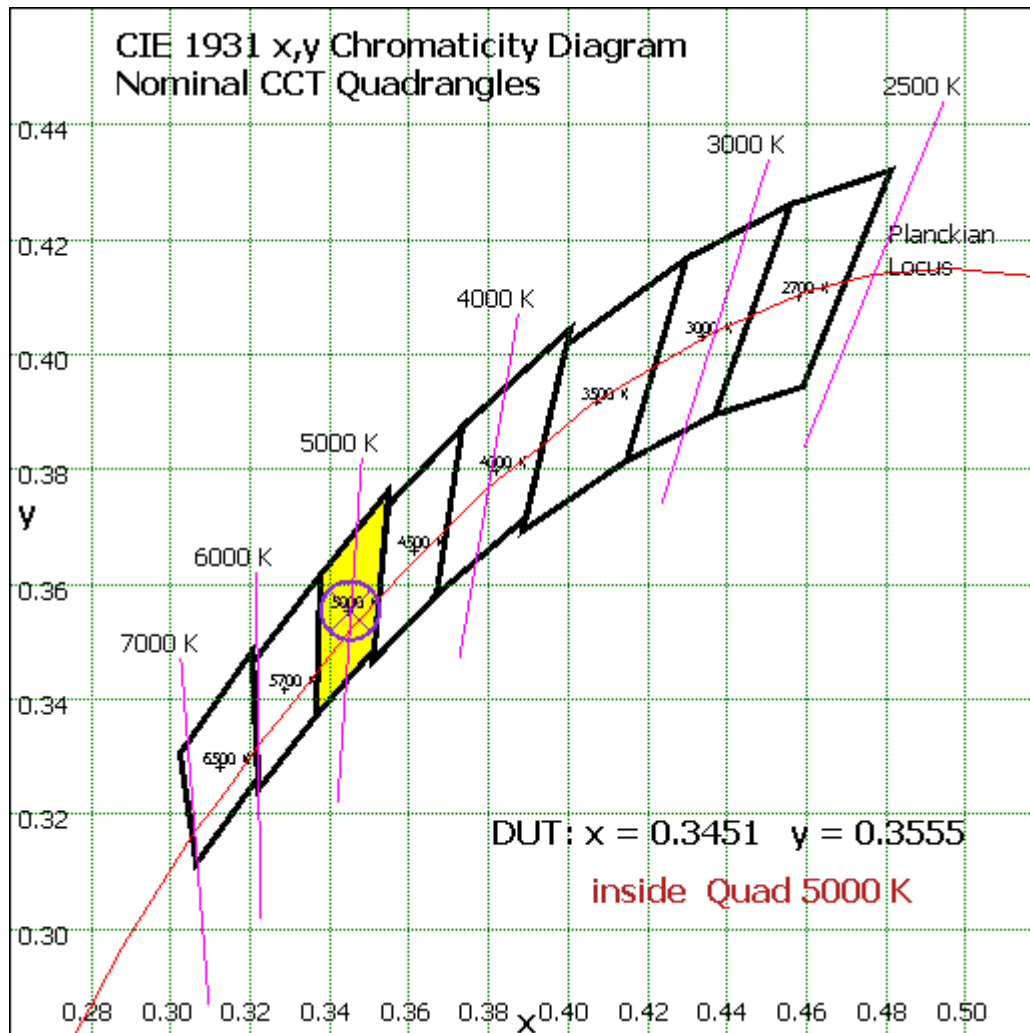


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	19.454	1.67%
10- 20	56.241	4.84%
20- 30	87.036	7.49%
30- 40	109.074	9.39%
40- 50	121.114	10.42%
50- 60	123.267	10.61%
60- 70	117.13	10.08%
70- 80	105.23	9.06%
80- 90	91.204	7.85%
90-100	77.754	6.69%
100-110	64.955	5.59%
110-120	53.258	4.58%
120-130	43.35	3.73%
130-140	34.629	2.98%
140-150	26.435	2.28%
150-160	18.459	1.59%
160-170	10.337	0.89%
170-180	2.853	0.25%
Total	1161.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	516.186	44.43%
60- 90	313.564	26.99%
0-90	829.75	71.42%
90- 180	332.03	28.58%
0- 180	1161.8	100%

Table 5: Zonal Lumen Data

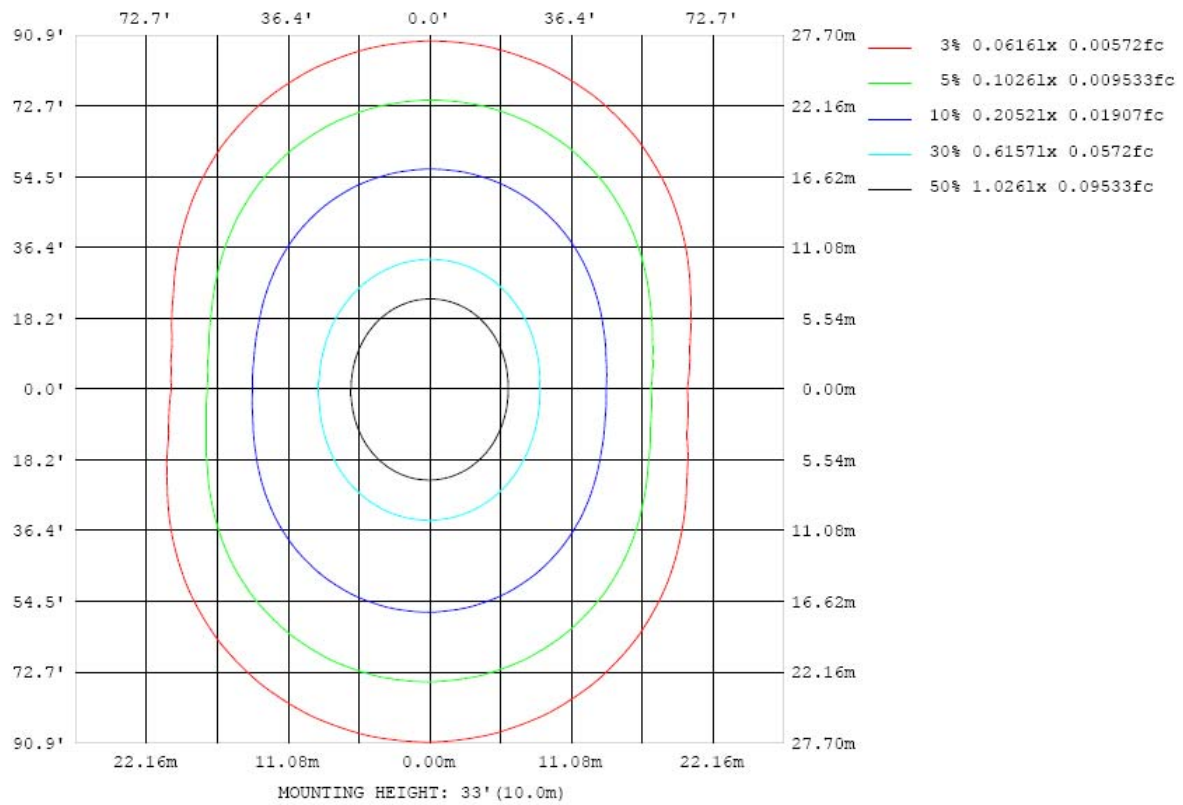


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

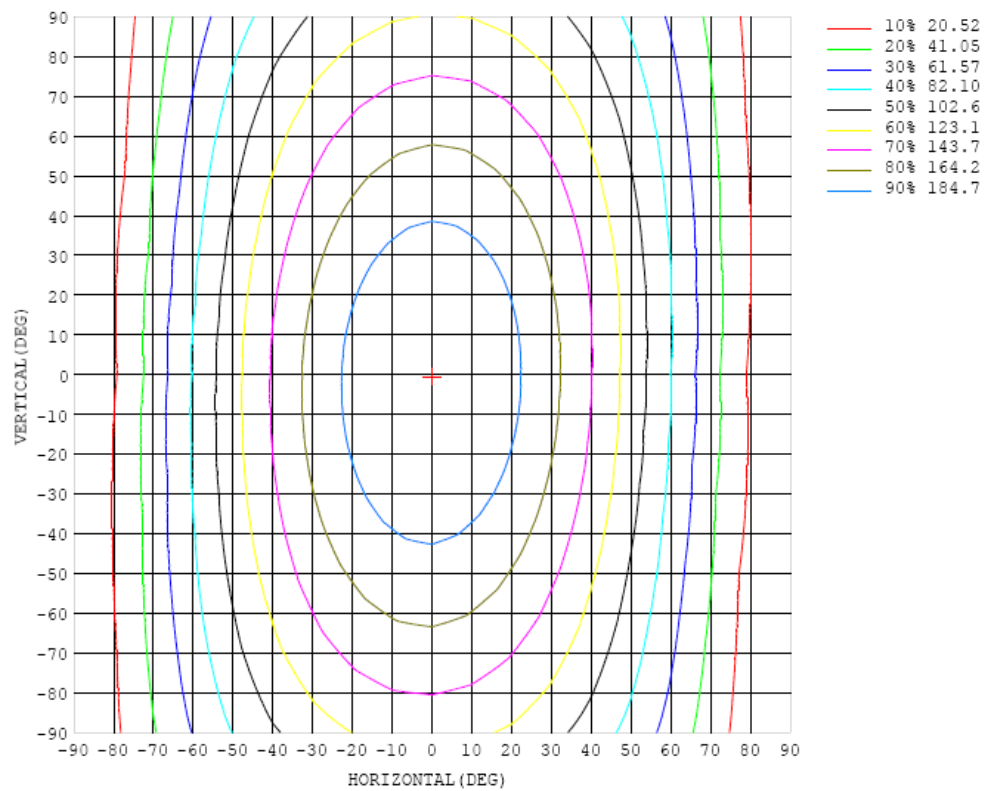


Chart 5: Isocandela Plot

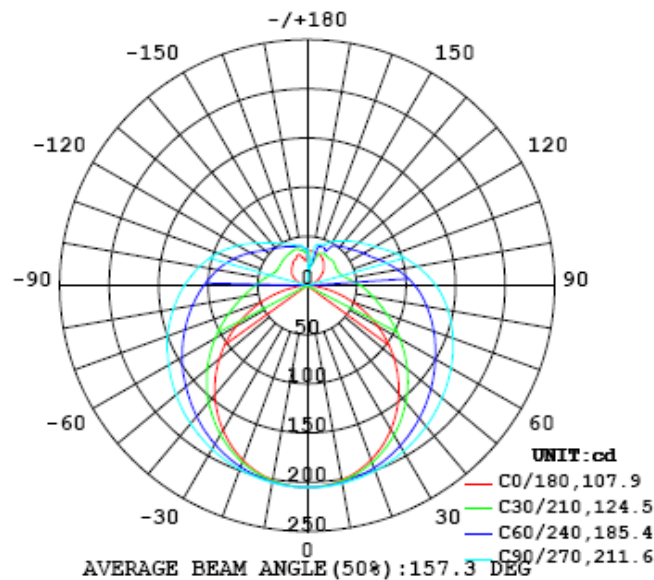


Chart 6: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C (DEG) γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205
5	204	204	204	204	205	205	205	205	205	205	205	205	205	205	205	204	204	204	204
10	201	201	202	202	202	203	203	204	204	204	204	204	204	203	203	202	202	201	201
15	196	196	197	198	199	200	201	202	202	203	202	202	201	200	199	198	197	196	196
20	189	189	190	192	193	195	197	199	200	200	200	200	198	196	194	193	191	190	189
25	180	180	182	184	187	190	193	195	197	198	198	196	194	191	189	186	183	181	180
30	169	170	172	176	180	184	188	191	194	195	194	192	189	186	182	177	174	171	170
35	157	158	161	166	171	177	182	187	190	191	190	188	184	179	174	168	163	160	158
40	144	145	149	155	162	170	176	182	185	187	186	183	179	172	165	158	152	147	145
45	130	131	136	144	153	162	170	176	181	183	182	178	173	165	156	148	140	134	131
50	114	116	123	132	143	154	163	171	176	178	177	173	166	158	147	136	127	119	116
55	98.5	101	109	120	133	145	156	165	171	173	172	168	160	150	138	125	113	104	99.9
60	82.0	84.9	94.6	108	123	137	150	159	165	168	167	162	154	142	129	114	99.8	88.3	83.1
65	65.4	68.9	80.7	96.9	114	129	143	153	160	162	161	156	147	135	120	103	86.6	72.8	66.2
70	48.7	53.2	67.7	86.0	105	122	136	147	154	157	156	150	141	128	112	93.2	74.0	57.8	49.2
75	32.5	38.0	55.5	76.2	96.5	115	129	141	148	151	149	144	134	121	104	84.0	63.2	43.6	32.8
80	17.8	24.6	45.0	68.0	88.9	108	123	134	141	144	143	137	128	114	96.3	75.8	53.4	31.3	18.4
85	6.56	14.5	36.8	60.6	82.0	101	116	128	135	138	136	131	121	107	89.4	69.0	45.6	22.0	6.35
90	1.23	9.23	30.7	54.1	75.3	93.9	109	120	127	130	129	123	114	100	82.7	62.5	39.5	16.4	1.02
95	1.59	6.53	25.0	47.3	67.9	86.2	101	112	119	122	120	115	106	92.3	75.5	55.9	33.7	12.6	1.46
100	2.98	7.05	21.7	41.5	61.3	78.6	92.9	103	110	113	112	107	97.5	84.8	69.5	49.9	29.6	12.2	3.13
105	4.90	9.50	21.2	37.4	55.2	71.3	84.9	95.1	101	104	103	98.1	89.5	77.4	62.5	45.1	28.1	13.2	5.60
110	7.22	12.1	21.5	35.3	50.4	65.0	77.2	86.7	92.8	95.5	94.4	89.7	81.6	70.4	57.1	42.5	27.9	15.4	8.62
115	10.2	14.5	22.9	34.2	47.5	60.0	70.4	78.7	84.4	86.8	85.9	81.5	74.4	65.3	53.5	40.8	28.5	17.8	12.0
120	13.6	16.4	24.8	34.1	45.2	56.4	65.9	72.6	77.3	79.3	78.6	75.1	69.1	61.0	50.8	39.8	29.4	20.1	15.3
125	17.1	18.7	27.0	34.7	43.7	53.3	61.6	67.9	71.6	73.3	72.7	69.7	64.7	57.4	48.6	39.3	30.7	22.5	18.5
130	20.6	20.8	29.1	35.6	43.0	50.8	57.9	63.3	66.8	68.4	67.8	65.1	60.6	54.4	47.0	39.1	31.7	24.6	20.4
135	23.6	21.8	30.6	36.2	42.6	48.9	54.7	59.2	62.3	63.6	63.1	60.8	56.9	51.7	45.8	37.3	32.2	26.2	22.3
140	26.4	22.1	31.4	35.6	41.1	47.4	51.9	55.6	58.1	59.3	58.8	56.9	53.7	49.5	43.8	37.3	33.0	27.7	24.0
145	29.0	22.0	32.3	35.6	39.5	43.9	49.7	52.4	54.4	55.3	55.0	53.5	51.0	47.4	41.3	37.8	34.8	27.9	25.7
150	31.4	22.9	31.9	36.5	38.9	39.3	43.0	49.2	51.1	51.9	51.7	50.4	47.8	40.4	39.5	38.5	34.6	27.0	28.1
155	33.1	26.5	30.2	36.5	39.2	40.7	41.8	41.9	44.1	46.6	48.5	45.5	43.1	42.6	41.3	38.8	32.1	26.5	29.1
160	34.1	31.0	25.6	34.4	39.0	40.6	41.8	43.0	43.8	44.7	45.2	44.5	43.3	41.2	40.0	37.4	27.7	27.0	31.3
165	34.6	33.1	26.0	25.2	28.9	31.2	37.3	42.2	42.4	43.1	43.3	39.1	34.8	32.8	31.6	27.5	24.4	27.0	32.6
170	35.3	31.2	24.5	20.3	19.7	20.5	21.2	21.2	24.9	25.6	21.0	21.5	22.2	22.5	23.1	23.5	23.8	25.8	28.8
175	35.4	34.4	28.9	22.3	18.8	17.6	18.7	18.7	13.8	6.87	19.8	22.2	21.7	21.7	21.3	20.2	20.3	22.6	25.7
180	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205		
5	204	204	204	204	204	205	205	205	205	205	205	205	204	204	204	204	204		
10	201	201	202	202	202	203	203	203	203	203	203	203	202	202	202	201	201		
15	196	197	197	198	199	200	201	201	202	201	201	200	199	198	197	197	196		
20	189	190	191	193	195	196	198	199	199	199	198	197	195	193	192	190	189		
25	181	182	184	186	189	192	194	195	196	196	194	192	190	187	184	182	180		
30	170	172	175	179	183	186	189	191	192	192	190	187	184	180	176	173	170		
35	159	161	165	170	175	180	184	187	188	187	185	182	177	172	166	162	159		
40	147	150	155	161	168	174	179	182	183	183	180	175	169	163	156	151	146		
45	133	137	144	152	160	167	173	177	178	177	174	169	162	154	146	138	132		
50	118	123	132	142	152	160	167	171	173	172	168	162	154	145	134	125	118		
55	102	109	120	131	143	153	160	165	167	166	162	156	146	135	123	111	103		
60	85.6	94.5	107	121	135	146	155	159	162	160	156	149	138	125	111	98.0	87.3		
65	69.2	80.4	95.7	112	126	139	148	154	156	155	150	142	130	116	100	84.7	71.8		
70	53.2	66.9	84.7	102	118	132	141	148	150	149	144	135	123	107	90.1	72.1	56.7		
75	38.0	54.6	74.6	93.9	111	125	135	141	144	142	137	128	115	99.2	80.6	60.6	42.5		
80	24.7	44.0	65.9	86.1	104	118	128	135	137	136	131	121	108	91.6	72.2	50.7	30.1		
85	14.8	35.8	58.5	79.1	96.8	111	121	128	131	129	124	115	101	84.7	64.9	42.7	20.7		
90	9.23	30.1	52.4	72.9	90.4	104	115	121	124	123	117	108	95.0	78.4	58.8	36.9	15.1		
95	7.22	26.5	47.7	67.4	84.4	98.2	108	115	117	116	111	102	88.8	72.7	53.7	32.8	12.4		
100	7.58	23.6	43.5	62.4	78.8	92.1	102	108	111	109	104	95.4	83.0	67.5	49.2	29.4	11.1		
105	9.03	21.9	39.7	57.4	73.0	85.8	95.3	101	104	102	97.4	88.9	77.0	62.1	44.9	26.7	11.9		
110	11.4	22.1	36.6	52.7	67.2	79.3	88.3	94.0	96.3	95.0	90.3	82.2	71.0	57.0	41.2	25.5	13.6		
115	15.1	23.2	34.8	48.6	61.8	72.9	81.3	86.6	88.7	87.5	83.1	75.6	65.1	52.3	38.2	25.4	16.4		
120	18.3	24.8	34.2	45.2	56.7	66.8	74.4	79.4	81.3	80.2	76.1	69.1	59.6	48.2	36.5	26.0	19.3		
125	20.8	26.1	34.3	43.2	52.3	61.0	67.8	72.3	74.0	73.0	69.3	63.1	54.6	45.3	35.9	27.2	22.2		
130	22.8	28.1	34.8	42.0	49.4	56.0	61.6	65.5	67.1	66.1	62.8	57.6	51.0	43.5	35.8	29.0	25.1		
135	25.2	30.1	35.4	41.2	47.1	52.6	56.9	59.8	61.0	60.3	57.7	53.7	48.4	42.3	36.1	30.9	27.9		
140	27.9	31.7	36.0	40.8	45.4	49.7	53.2	55.5	56.4	55.8	53.8	50.5	46.4	41.6	36.7	32.9	30.4		
145	30.3	33.4	36.6	40.5	44.1	47.4	50.1	51.8	52.6	52.1	50.5	48.0	44.8	41.1	37.6	34.8	32.8		
150	30.0	34.9	37.1	40.0	43.0	45.5	47.5	48.8	49.4	49.1	47.9	46.0	43.6	41.0	38.4	36.3	34.8		
155	31.1	36.4	37.9	39.6	41.9	43.9	45.4	46.4	46.8	46.5	45.7	44.4	42.8	40.9	39.1	37.7	35.7		
160	32.2	35.2	38.8	39.7	41.0	42.3	43.4	44.2	44.6	44.5	44.0	43.1	42.0	40.8	39.7	38.7	36.6		
165	32.8	34.8	38.2	39.8	40.6	41.3	41.9	42.3	42.5	42.5	42.3	42.0	41.4	40.9	40.3	39.2	36.5		
170	32.8	35.4	36.6	39.0	40.2	40.5	41.0	41.3	41.5	41.5	41.5	41.3	41.0	40.6	39.4	38.1	36.7		
175	28.9	31.5	34.3	36.2	37.0	37.8	38.2	38.2	38.2	38.1	37.8	37.6	37.2	36.8	36.6	36.6	35.9		
180	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7	36.7		

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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