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: 9290018456

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.: HZ17110001c

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

Review by: April Zou

Engineer: April Zou
Nov. 08, 2017

Approved by: Jim Zhang

Manager: Jim Zhang
Nov. 08, 2017

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: **9290018456**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
142.0	1898.0	13.37	0.9753

CCT (K)	CRI	Stabilization Time (Light & Power)
4104	83.1	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	: Nov. 01, 2017
Date of Test	: Nov. 01, 2017
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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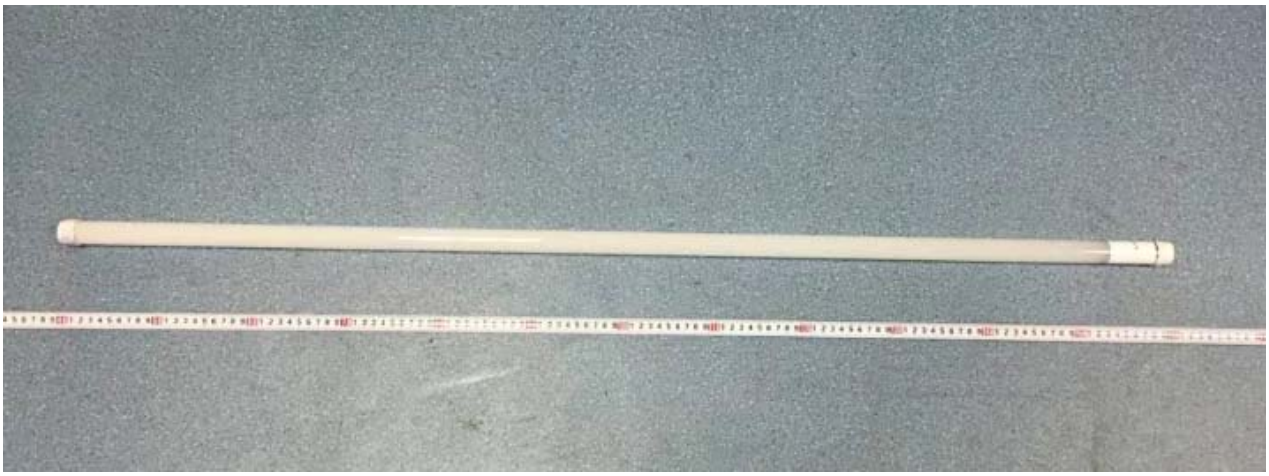
Sample Photo



Sample view

Equipment Under Test (EUT)	
Name	: LED Tube
Model	: 9290018456
Electrical Ratings	: 120-277V, 60HZ
Product Description	: 14T8PRO/48-840/BB18/G 10/1 FB
Manufacturer	: Philips Lighting (China) Investment Co., Ltd.
Address	: Building 9 #, Lane 888, Tianlin Road, Minhang District, Shanghai City

TEST RESULTS

Test ambient temperature was 24.9℃.

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)	0.114	0.051
Power Factor	0.9753	0.9720
Test Power (W)	13.37	13.69
THD A%	20.53	18.51
Luminous Efficacy (lm/W)	142.0	138.9
Total Luminous Flux (lm)	1898.0	1902.0
Color Rendering Index (CRI)	83.1	
R9	6.1	
Correlated Color Temperature (CCT)(K)	4104	
Chromaticity Chroma x	0.3764	
Chromaticity Chroma y	0.3761	
Chromaticity Chroma u	0.2227	
Chromaticity Chroma v	0.3338	
Duv	0.0004	
Chromaticity Chroma u ’	0.2227	
Chromaticity Chroma v’	0.5007	

Special Color Rendering Indices	
R1	81.4
R2	91.5
R3	95.7
R4	79.9
R5	81.5
R6	87.6
R7	84.6
R8	62.7
R9	6.1
R10	79.5
R11	78.6
R12	63.3
R13	84.3
R14	98.1
Rf	82
Rg	93

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 24.8℃.

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)	0.114
Power Factor	0.9748
Power (W)	13.39
Luminous Efficacy (lm/W)	142.6
Total Luminous Flux (lm)	1909.1
Beam Angle (°)	111.1（0^o-180^o）/ 185.9 (90^o-270^o)
Center Beam Candle Power (cd)	357
Maximum Beam Candle Power (cd)	357.1 (At: C=110.0, Gamma=0.5)
Spacing Criteria	1.25（0^o-180^o）/1.38 (90^o-270^o)
Zonal Lumens in the 0°-60°Zone	46.58%
Zonal Lumens in the 60°-90°Zone	26.39%
Zonal Lumens in the 90°-120°Zone	15.76%
Zonal Lumens in the 120°-180°Zone	11.27%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

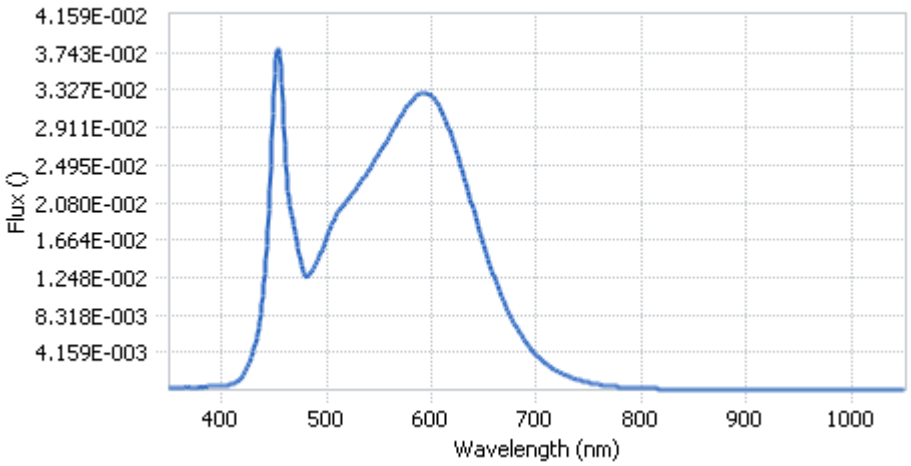
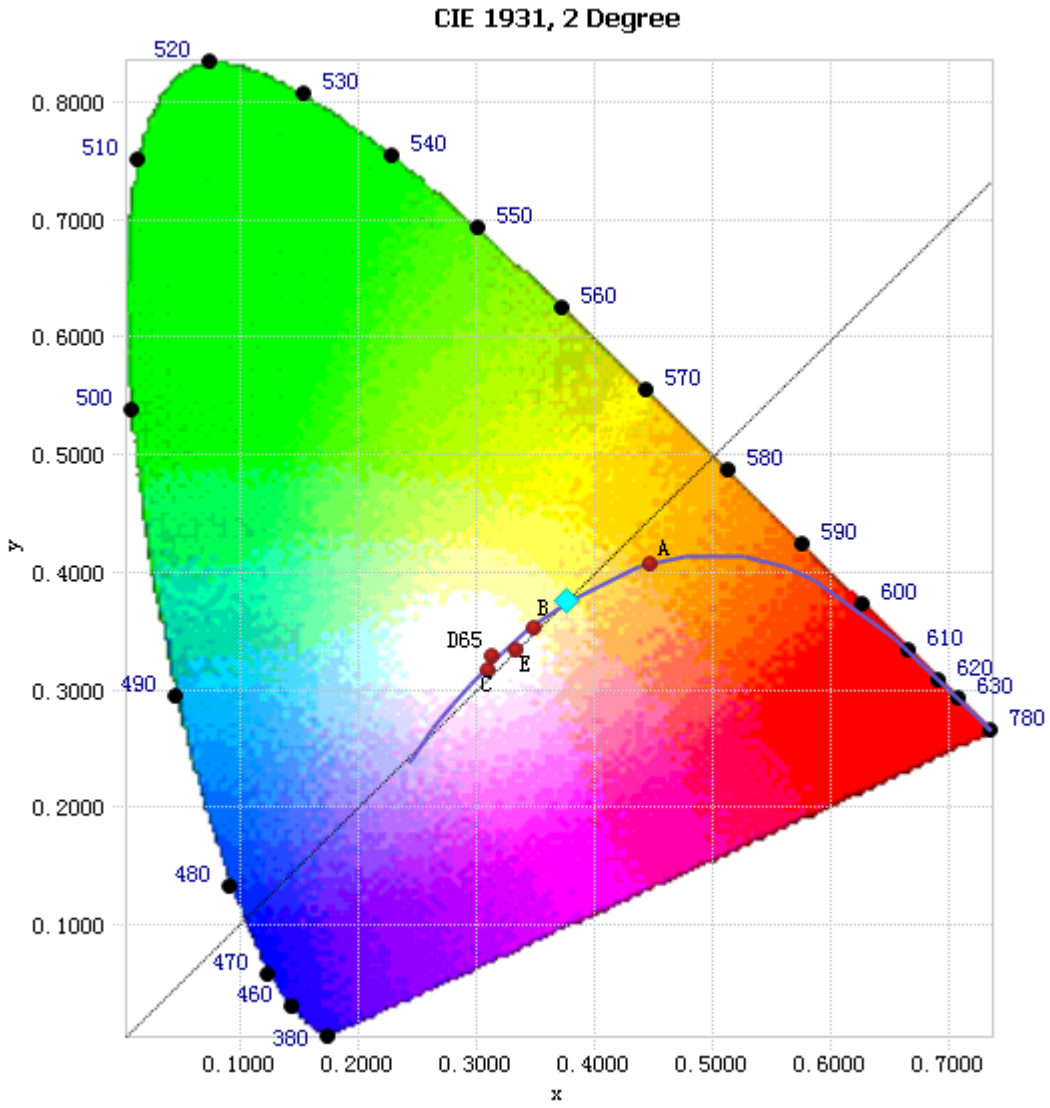


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.45E-04	485	1.31E-02	590	3.29E-02	695	4.52E-03
385	3.25E-04	490	1.41E-02	595	3.29E-02	700	3.89E-03
390	3.74E-04	495	1.54E-02	600	3.26E-02	705	3.32E-03
395	4.07E-04	500	1.70E-02	605	3.19E-02	710	2.83E-03
400	4.26E-04	505	1.84E-02	610	3.08E-02	715	2.43E-03
405	5.21E-04	510	1.95E-02	615	2.95E-02	720	2.08E-03
410	6.75E-04	515	2.04E-02	620	2.78E-02	725	1.78E-03
415	9.81E-04	520	2.11E-02	625	2.59E-02	730	1.52E-03
420	1.62E-03	525	2.18E-02	630	2.40E-02	735	1.30E-03
425	2.65E-03	530	2.27E-02	635	2.20E-02	740	1.11E-03
430	4.23E-03	535	2.35E-02	640	1.99E-02	745	9.49E-04
435	6.99E-03	540	2.44E-02	645	1.79E-02	750	8.13E-04
440	1.17E-02	545	2.53E-02	650	1.60E-02	755	6.99E-04
445	2.00E-02	550	2.63E-02	655	1.41E-02	760	6.08E-04
450	3.27E-02	555	2.73E-02	660	1.24E-02	765	5.20E-04
455	3.71E-02	560	2.83E-02	665	1.09E-02	770	4.50E-04
460	2.72E-02	565	2.92E-02	670	9.47E-03	775	3.86E-04
465	2.05E-02	570	3.02E-02	675	8.24E-03	780	3.35E-04
470	1.77E-02	575	3.12E-02	680	7.11E-03		
475	1.43E-02	580	3.20E-02	685	6.14E-03		
480	1.26E-02	585	3.26E-02	690	5.27E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3764, 0.3761)

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

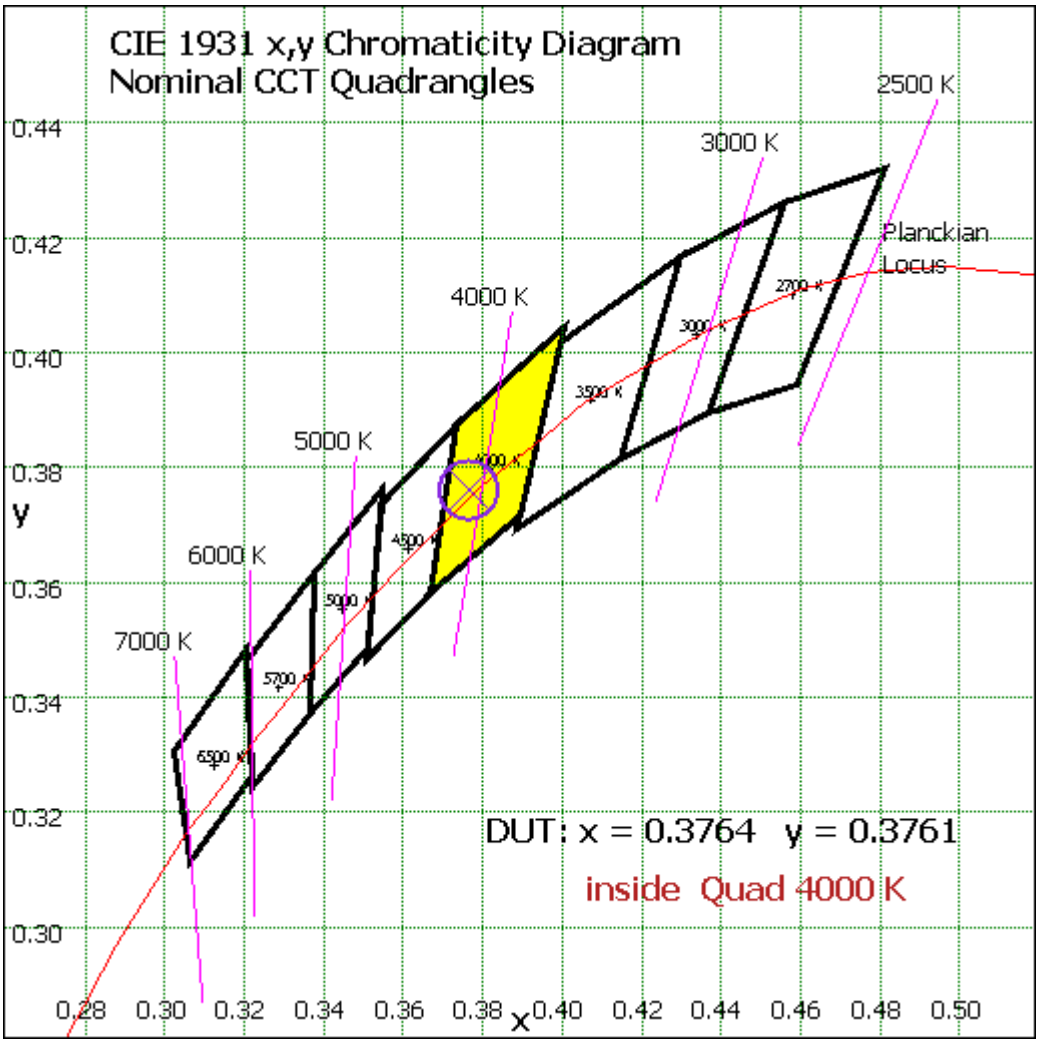


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	33.853	1.77%
10- 20	97.876	5.13%
20- 30	151.359	7.93%
30- 40	189.074	9.90%
40- 50	208.244	10.91%
50- 60	208.886	10.94%
60- 70	193.91	10.16%
70- 80	168.738	8.84%
80- 90	141.237	7.40%
90-100	118.558	6.21%
100-110	99.539	5.21%
110-120	82.735	4.33%
120-130	68.012	3.56%
130-140	54.872	2.87%
140-150	42.182	2.21%
150-160	29.402	1.54%
160-170	16.005	0.84%
170-180	4.637	0.24%
Total	1909.1	100%

γ(°)	Lumens	% Total
0- 60	889.292	46.58%
60- 90	503.885	26.39%
0-90	1393.177	72.97%
90- 180	515.942	27.03%
0- 180	1909.1	100%

Table 5: Zonal Lumen Data

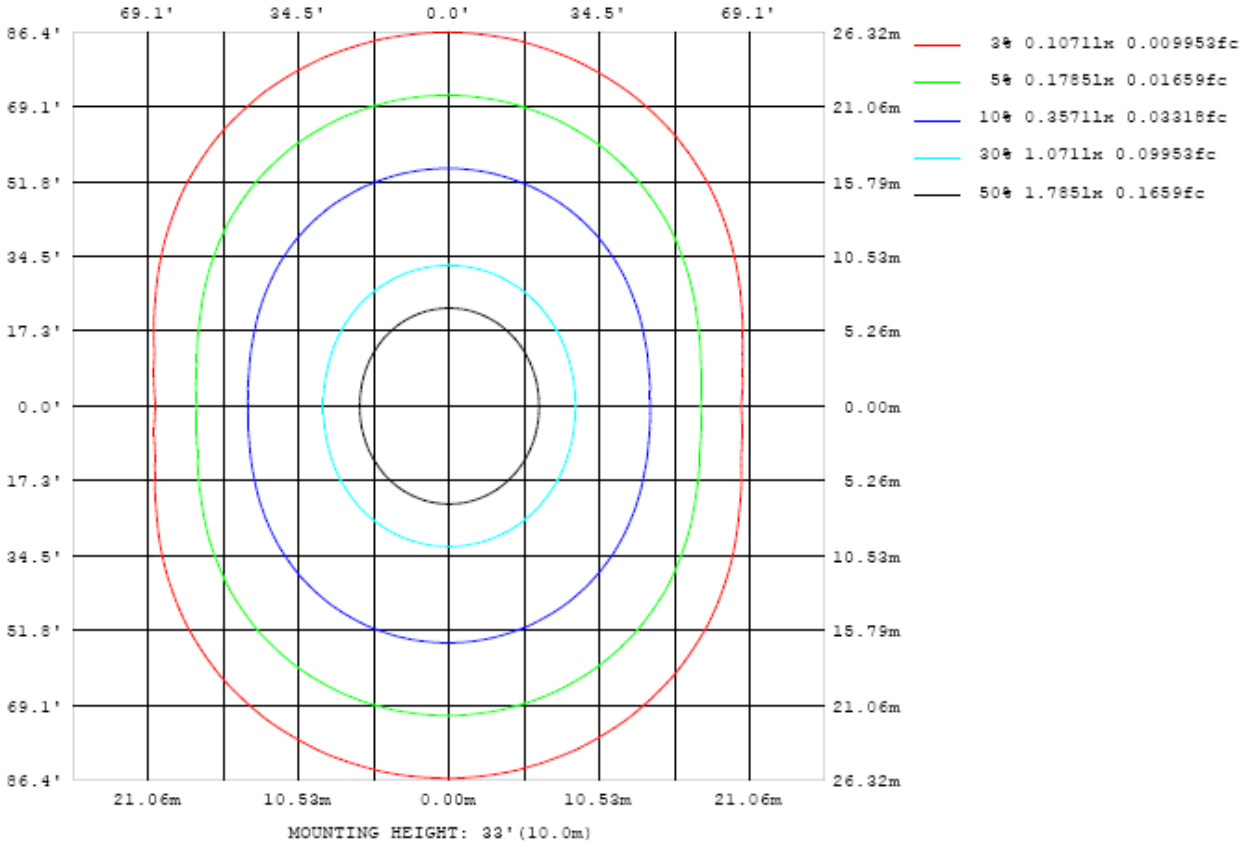


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

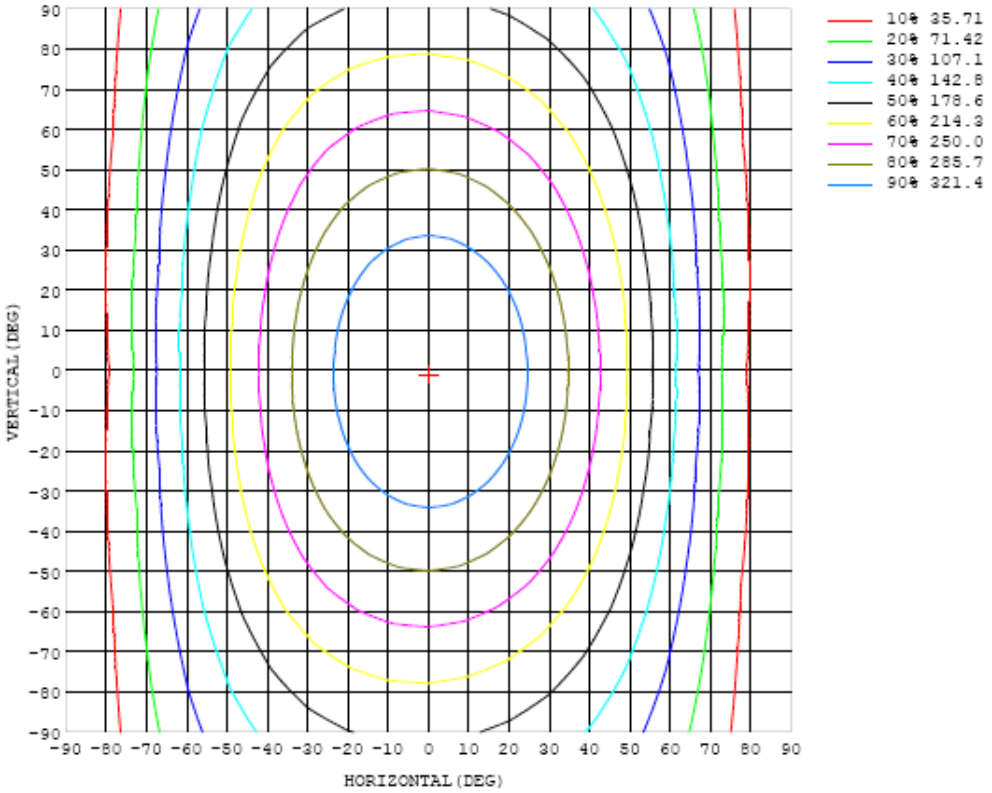


Chart 5: Isocandela Plot

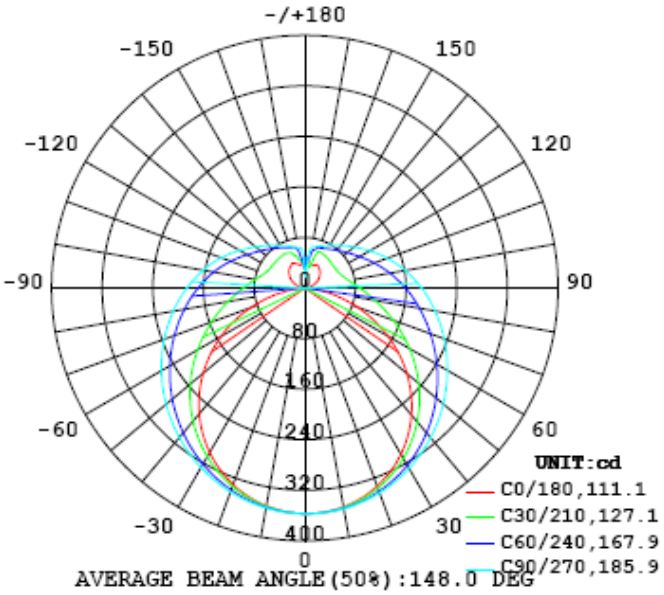


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C(DEG) / γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
5	356	356	356	356	356	356	356	357	357	357	357	356	356	356	356	355	355	355	355
10	352	352	352	352	353	353	354	354	354	355	354	354	353	352	352	351	351	350	350
15	344	344	345	346	347	348	349	350	350	350	350	349	348	347	346	344	343	342	342
20	334	334	335	337	339	341	342	344	345	345	344	343	341	339	337	335	333	332	331
25	320	321	323	325	328	331	334	336	337	338	337	335	333	330	326	323	320	318	317
30	304	305	307	311	315	320	324	327	329	329	329	326	323	319	314	309	305	302	301
35	284	286	289	295	301	307	312	316	319	320	319	316	311	306	299	293	287	283	281
40	262	264	269	276	284	292	299	304	308	309	308	305	299	292	284	275	267	262	260
45	237	240	247	256	267	277	285	292	296	298	296	292	286	277	267	256	246	238	236
50	210	214	223	235	248	260	271	278	283	285	284	280	272	262	249	236	223	213	210
55	182	186	198	213	229	244	256	265	270	273	272	267	258	247	232	215	199	187	182
60	151	157	172	191	210	227	241	251	257	260	259	253	244	231	214	194	174	159	153
65	120	127	146	169	191	210	226	237	244	247	246	240	230	216	197	174	150	130	123
70	88.4	97.8	121	149	174	195	211	223	231	234	233	227	217	201	180	154	126	101	91.4
75	58.2	70.2	98.7	130	157	180	197	210	218	221	220	214	203	187	164	136	105	74.3	60.8
80	30.2	46.0	79.1	113	142	166	184	197	205	209	208	202	191	173	150	120	85.7	51.0	32.5
85	8.94	28.0	64.2	98.8	129	153	171	185	193	197	196	190	178	161	137	107	70.7	32.8	10.1
90	0.41	18.4	53.3	87.4	117	141	159	172	181	185	184	178	167	149	126	95.6	60.1	22.7	0.20
95	2.07	15.2	46.0	77.9	106	130	148	161	169	173	172	166	155	138	115	86.1	52.5	18.8	1.84
100	5.34	16.2	41.6	70.5	97.1	119	137	149	157	161	160	155	144	128	106	78.5	47.9	19.4	5.34
105	9.54	18.9	39.9	65.3	89.2	110	126	138	146	150	149	143	133	118	97.3	72.4	45.6	22.2	9.82
110	14.1	22.8	40.0	61.4	82.5	101	117	128	135	139	138	133	123	109	90.0	68.0	45.7	26.0	14.4
115	18.8	27.3	41.2	59.1	77.1	93.9	108	118	125	128	128	123	114	101	84.1	65.8	46.8	30.2	19.2
120	23.3	31.8	43.0	57.9	73.3	87.6	99.9	109	116	118	118	113	105	93.8	79.7	64.2	48.6	34.2	24.0
125	27.2	35.8	45.5	57.4	70.3	82.6	93.2	101	107	109	109	105	98.0	88.3	76.2	63.3	50.7	37.9	28.4
130	30.8	39.0	48.3	57.4	68.1	78.6	87.6	94.6	99.3	101	101	97.7	91.9	83.6	73.5	63.0	52.9	40.8	32.0
135	34.3	41.7	51.1	58.0	66.8	75.2	82.8	88.7	92.7	94.6	94.1	91.4	86.5	79.6	71.4	63.0	54.9	42.6	35.4
140	37.2	43.4	53.6	59.0	65.7	72.3	78.5	83.5	86.9	88.4	88.0	85.7	81.8	76.1	69.7	63.1	57.0	43.8	38.7
145	39.1	44.1	55.7	60.0	65.1	70.0	74.8	78.8	81.6	82.8	82.5	80.8	77.6	73.2	68.4	62.8	58.1	44.1	40.7
150	41.6	42.1	56.6	60.9	64.8	68.6	72.0	74.8	77.0	77.9	77.7	76.4	74.1	71.0	67.5	63.2	60.1	43.3	42.7
155	40.4	35.9	51.0	62.1	64.4	67.4	69.6	71.6	73.1	73.8	73.7	72.8	71.3	69.3	64.2	60.1	58.2	40.6	43.8
160	38.1	32.4	40.6	60.7	64.0	65.9	68.0	69.4	70.2	70.6	70.5	70.1	69.3	62.0	57.3	54.1	50.6	36.6	41.1
165	38.8	30.4	31.9	38.6	57.0	62.2	63.5	66.3	67.9	68.2	68.4	64.8	55.1	49.3	48.3	46.0	41.2	35.3	38.5
170	42.4	33.5	36.0	35.1	36.9	46.1	54.0	59.8	63.0	65.6	56.0	42.5	46.8	46.3	45.5	39.8	36.6	35.9	36.3
175	45.4	44.2	43.1	44.8	47.2	47.7	46.9	45.3	45.6	24.0	43.7	47.3	46.9	46.8	46.5	45.4	44.5	42.5	43.1
180	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357		
5	355	355	355	355	355	356	356	356	356	356	356	356	356	356	356	356	356		
10	350	350	351	351	352	352	353	353	353	353	353	353	353	352	352	352	352		
15	342	343	344	345	346	347	348	349	349	349	349	348	347	346	345	344	344		
20	331	332	334	336	338	340	342	343	343	343	342	341	339	338	336	335	334		
25	318	320	322	325	329	332	334	335	336	336	334	332	330	327	324	322	320		
30	301	304	308	313	317	322	325	327	328	327	325	322	318	314	310	307	304		
35	283	287	292	299	305	311	315	318	319	318	315	311	306	300	294	289	285		
40	262	267	275	283	292	299	304	307	308	307	304	298	291	283	276	269	264		
45	239	246	256	267	278	286	293	296	298	296	292	285	276	266	256	247	240		
50	213	223	236	250	263	273	281	285	286	284	279	271	261	248	235	223	214		
55	187	199	216	233	248	260	268	273	274	272	266	257	245	230	214	198	187		
60	159	175	196	216	233	246	255	260	262	259	253	242	229	212	193	173	158		
65	131	152	176	198	218	233	242	248	249	246	239	228	213	194	172	149	129		
70	103	128	157	182	203	219	229	235	236	233	226	214	197	177	152	125	100		
75	75.3	106	139	167	190	206	217	223	224	221	213	200	183	161	134	102	72.9		
80	51.2	87.2	123	154	176	193	204	210	211	208	200	187	169	147	117	83.3	49.0		
85	32.7	71.9	109	140	164	181	192	198	199	195	187	174	157	133	104	68.1	31.2		
90	22.2	60.6	97.4	128	152	169	180	186	187	183	175	162	145	121	91.8	57.0	21.1		
95	18.1	53.0	87.8	118	141	157	168	174	175	171	163	151	134	111	82.3	49.5	17.1		
100	18.6	47.6	79.6	108	130	146	157	162	163	160	152	140	123	101	74.3	44.2	17.1		
105	21.5	45.1	72.9	98.6	120	135	146	151	152	149	141	129	113	92.5	67.7	41.5	19.7		
110	25.8	44.9	68.0	90.8	110	125	134	140	141	138	130	119	104	84.9	63.0	40.9	23.9		
115	30.6	46.0	65.1	84.3	101	115	124	129	130	127	120	110	95.8	78.8	60.1	41.3	28.4		
120	35.2	47.8	63.5	79.6	94.1	106	114	118	119	117	111	101	88.9	74.3	58.4	43.2	33.0		
125	39.9	49.7	62.7	76.1	88.3	98.2	105	109	110	107	102	94.0	83.5	71.0	57.4	45.8	37.4		
130	43.9	51.8	62.4	73.3	83.5	91.9	97.6	101	102	99.6	94.9	88.0	79.1	68.4	57.5	48.5	41.4		
135	47.4	54.0	62.3	71.2	79.4	86.4	91.2	94.0	94.5	92.8	88.8	82.9	75.4	66.7	58.3	51.2	45.4		
140	50.7	55.9	62.5	69.5	76.0	81.6	85.5	87.8	88.3	86.8	83.4	78.5	72.4	65.7	59.3	53.7	47.9		
145	51.2	56.1	62.8	68.1	73.2	77.5	80.5	82.3	82.7	81.5	78.7	74.9	70.2	65.2	60.2	56.1	49.6		
150	54.1	59.1	62.9	66.9	70.8	74.1	76.3	77.7	77.9	77.0	74.9	72.1	68.7	64.9	61.1	57.9	52.1		
155	54.6	57.3	61.9	66.0	68.7	71.1	72.8	73.9	74.0	73.4	71.9	69.9	67.4	64.5	61.9	59.3	53.0		
160	49.2	55.8	58.4	63.9	66.9	68.4	69.6	70.4	70.6	70.3	69.2	67.8	66.2	64.3	62.6	60.7	56.0		
165	43.1	47.9	52.5	56.5	64.0	66.5	66.9	67.4	67.7	67.5	66.9	66.2	65.3	64.3	63.1	59.8	56.6		
170	38.6	42.3	44.7	46.5	51.2	60.5	64.9	65.1	65.3	65.2	65.0	64.6	64.1	62.1	59.5	58.1	54.0		
175	43.3	42.5	41.4	40.1	39.1	41.7	48.6	56.7	63.1	63.8	63.0	63.0	61.3	58.5	56.9	54.3	49.7		
180	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3		

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 4π. 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 Tubes) 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 expended 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 Tubes) 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 expended uncertainty is 2.3% with a coverage factor k=2.

Color Characteristics Measurements

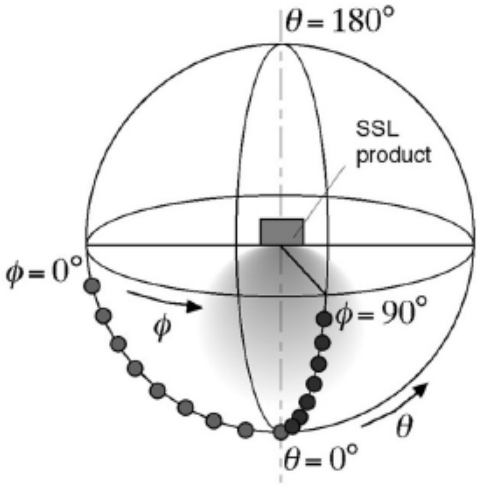
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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°/180° and C=90°/270°) and at 10° 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, Δu'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 ***