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: 9290013631A

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18010014a

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

Review by: April Zou

Engineer: April Zou
Jan. 05, 2018

Approved by: Jim Zhang

Manager: Jim Zhang
Jan. 05, 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: **9290013631A**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
127.6	2085.0	16.34	0.9796

CCT (K)	CRI	Stabilization Time (Light & Power)
3153	81.3	60

Table 1: Executive Data Summary

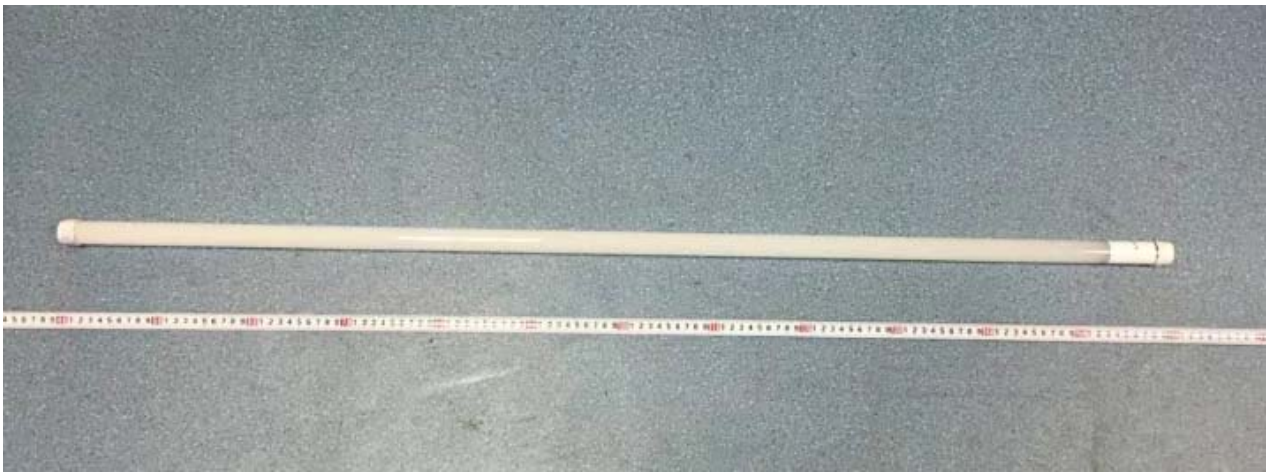
Note: The above results are recorded/ derived from measurements made using an Integrating Sphere.

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

TABLE OF CONTENT

Sample Photo



Sample view

Equipment Under Test (EUT)	
Name	: LED Tube
Model	: 9290013631A
Electrical Ratings	: 120-277V, 60HZ
Product Description	: 16.5T8PRO/48-830/BB20/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)	0.139	0.060
Power Factor	0.9796	0.9817
Test Power (W)	16.34	16.43
THD A%	19.39	12.57
Luminous Efficacy (lm/W)	127.6	126.7
Total Luminous Flux (lm)	2085.0	2082.0
Color Rendering Index (CRI)	81.3	
R9	2.2	
Correlated Color Temperature (CCT)(K)	3153	
Chromaticity Chroma x	0.4269	
Chromaticity Chroma y	0.4014	
Chromaticity Chroma u	0.2452	
Chromaticity Chroma v	0.3459	
Duv	0.0001	
Chromaticity Chroma u ’	0.2452	
Chromaticity Chroma v’	0.5188	

Special Color Rendering Indices	
R1	79.3
R2	88.8
R3	96.3
R4	79.7
R5	79.3
R6	85.7
R7	83.3
R8	58.4
R9	2.2
R10	74.2
R11	78.6
R12	66.2
R13	81.4
R14	98.1
Rf	82
Rg	97

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)	0.141
Power Factor	0.9753
Power (W)	16.45
Luminous Efficacy (lm/W)	127.5
Total Luminous Flux (lm)	2097.8
Beam Angle (°)	111.3（0^o-180^o）/ 182.7 (90^o-270^o)
Center Beam Candle Power (cd)	397
Maximum Beam Candle Power (cd)	397.7 (At: C=310.0, Gamma=4.5)
Spacing Criteria	1.24（0^o-180^o）/1.40 (90^o-270^o)
Zonal Lumens in the 0°-60°Zone	47.11%
Zonal Lumens in the 60°-90°Zone	26.47%
Zonal Lumens in the 90°-120°Zone	15.48%
Zonal Lumens in the 120°-180°Zone	10.94%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

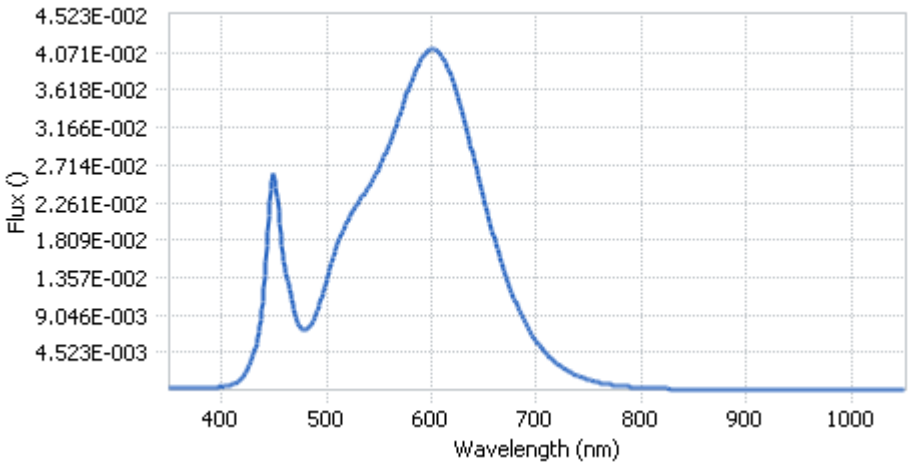
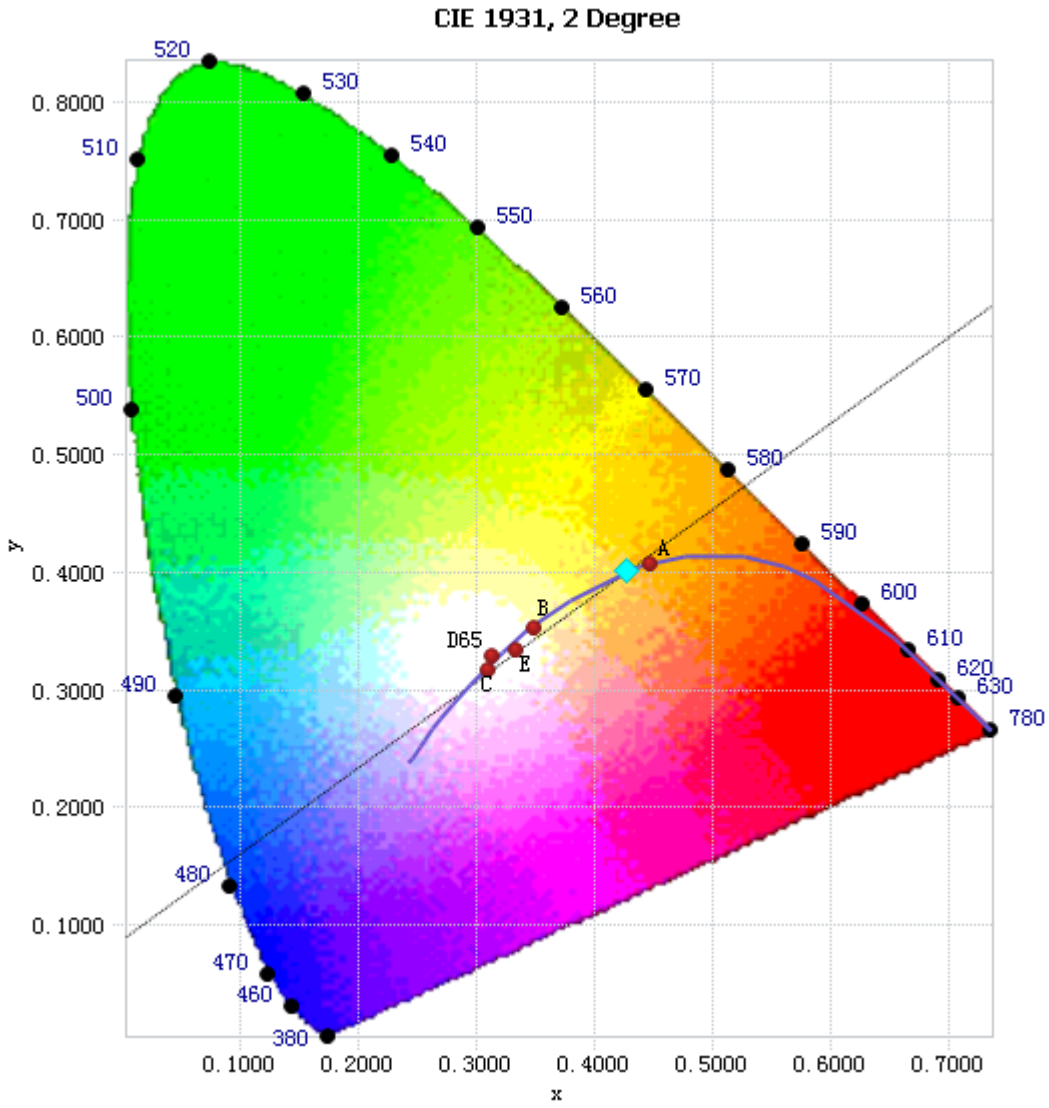


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.17E-04	485	7.87E-03	590	3.98E-02	695	6.79E-03
385	2.87E-04	490	9.14E-03	595	4.07E-02	700	5.84E-03
390	3.21E-04	495	1.11E-02	600	4.10E-02	705	5.01E-03
395	3.53E-04	500	1.34E-02	605	4.09E-02	710	4.26E-03
400	3.73E-04	505	1.56E-02	610	4.02E-02	715	3.65E-03
405	4.77E-04	510	1.75E-02	615	3.91E-02	720	3.14E-03
410	6.56E-04	515	1.92E-02	620	3.73E-02	725	2.67E-03
415	9.48E-04	520	2.04E-02	625	3.54E-02	730	2.29E-03
420	1.55E-03	525	2.16E-02	630	3.32E-02	735	1.94E-03
425	2.58E-03	530	2.26E-02	635	3.07E-02	740	1.65E-03
430	4.20E-03	535	2.35E-02	640	2.81E-02	745	1.41E-03
435	6.94E-03	540	2.46E-02	645	2.55E-02	750	1.21E-03
440	1.23E-02	545	2.56E-02	650	2.29E-02	755	1.03E-03
445	2.10E-02	550	2.67E-02	655	2.04E-02	760	8.95E-04
450	2.58E-02	555	2.82E-02	660	1.81E-02	765	7.60E-04
455	2.02E-02	560	2.98E-02	665	1.60E-02	770	6.50E-04
460	1.48E-02	565	3.15E-02	670	1.40E-02	775	5.57E-04
465	1.21E-02	570	3.32E-02	675	1.22E-02	780	4.79E-04
470	9.22E-03	575	3.52E-02	680	1.06E-02		
475	7.45E-03	580	3.70E-02	685	9.18E-03		
480	7.31E-03	585	3.86E-02	690	7.91E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4269, 0.4014)

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

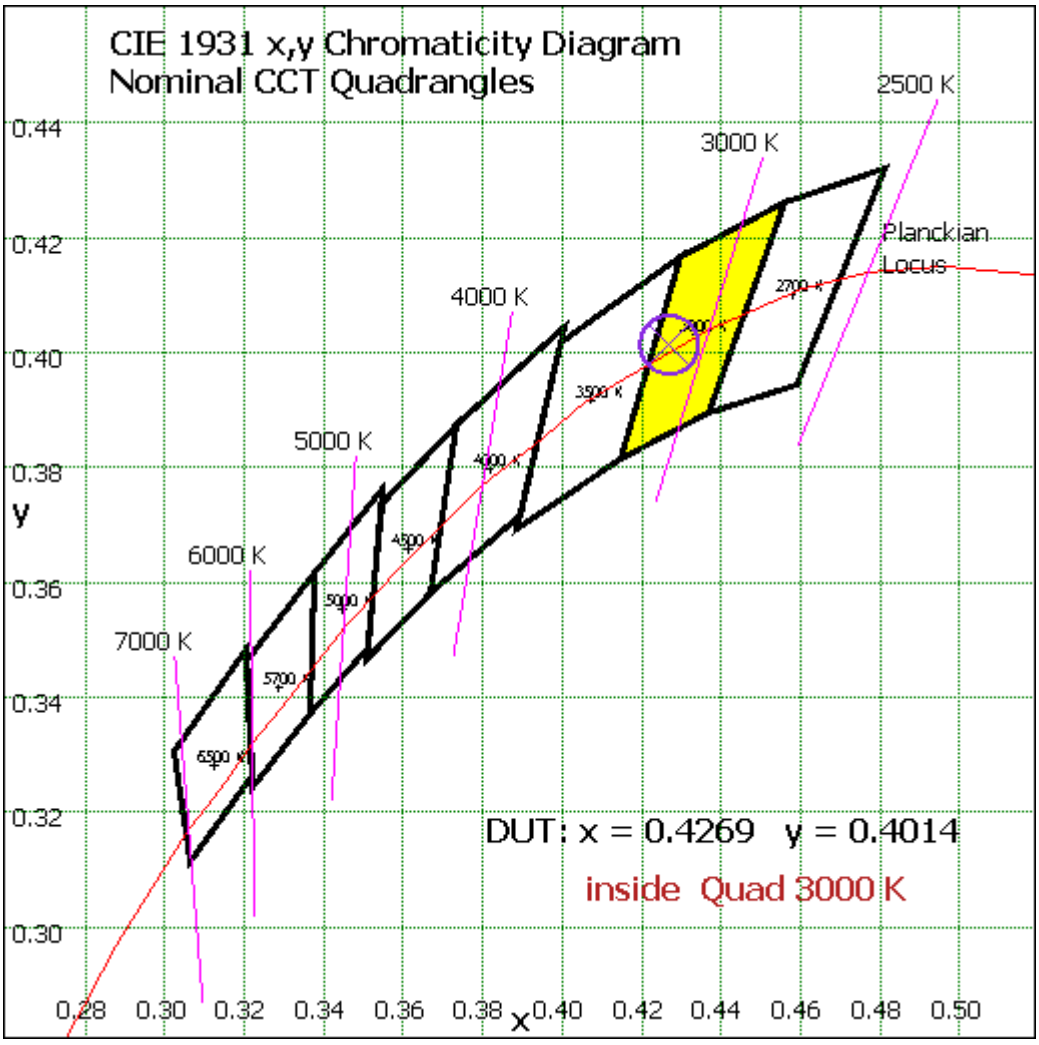


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	37.645	1.79%
10- 20	108.83	5.19%
20- 30	168.3	8.02%
30- 40	210.224	10.02%
40- 50	231.408	11.03%
50- 60	231.794	11.05%
60- 70	214.646	10.23%
70- 80	186.003	8.87%
80- 90	154.688	7.37%
90-100	128.755	6.14%
100-110	107.257	5.11%
110-120	88.826	4.23%
120-130	72.929	3.48%
130-140	58.582	2.79%
140-150	44.88	2.14%
150-160	31.034	1.48%
160-170	16.836	0.80%
170-180	5.13	0.24%
Total	2097.8	100%

γ(°)	Lumens	% Total
0- 60	988.201	47.11%
60- 90	555.337	26.47%
0-90	1543.538	73.58%
90- 180	554.229	26.42%
0- 180	2097.8	100%

Table 5: Zonal Lumen Data

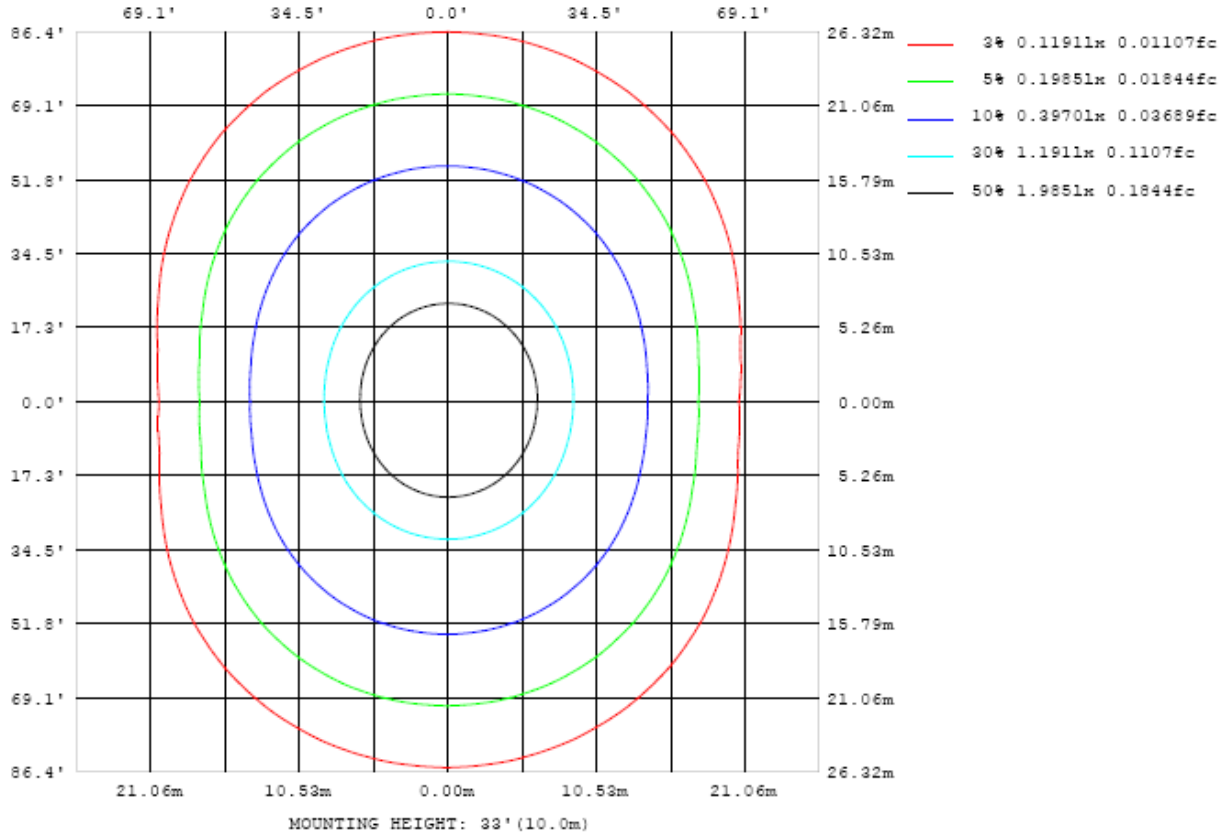


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

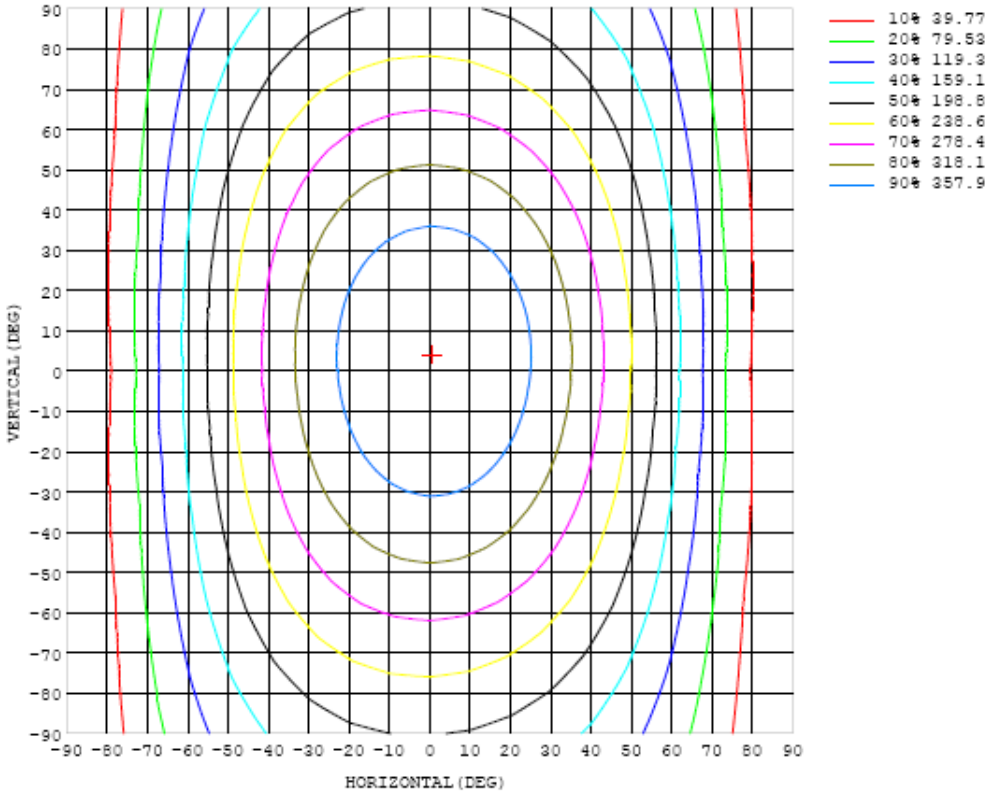


Chart 5: Isocandela Plot

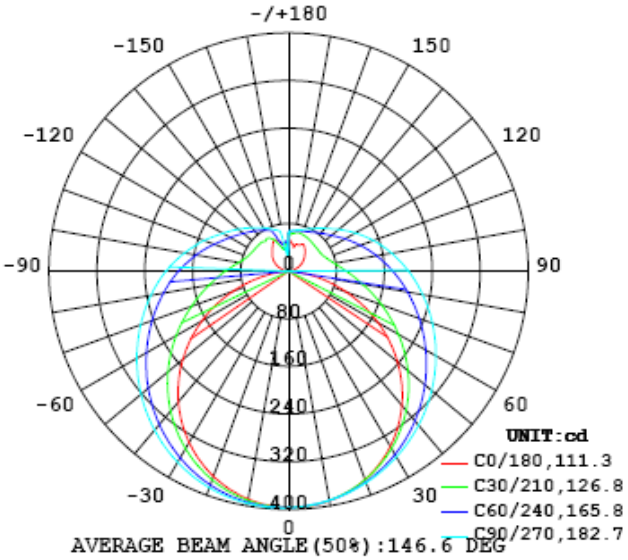


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

γ (DEG) \ C (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397
5	396	396	396	395	395	395	395	395	395	395	394	394	394	394	394	394	394	394	394
10	392	391	391	391	391	391	391	391	391	391	390	390	390	389	388	388	388	388	388
15	384	383	383	383	384	384	385	385	385	385	385	384	383	382	380	380	379	379	379
20	372	372	372	373	374	375	377	378	378	378	377	376	374	372	370	368	367	366	367
25	358	357	358	360	362	364	367	369	369	370	369	367	364	361	357	354	352	350	351
30	340	339	341	344	347	352	355	358	360	360	359	356	353	348	343	338	334	332	332
35	318	318	321	326	331	337	342	346	349	349	348	345	340	334	327	320	314	311	311
40	294	294	298	305	313	321	328	333	337	338	336	332	326	319	309	300	292	287	286
45	267	268	274	283	294	304	313	320	324	325	323	319	312	302	291	279	268	261	260
50	237	239	248	260	273	286	297	305	310	312	310	305	297	286	272	257	243	233	231
55	206	209	220	236	253	268	281	290	296	298	296	291	281	268	252	234	216	204	200
60	172	177	192	212	232	250	264	275	282	284	282	276	266	251	233	211	189	173	167
65	138	144	163	188	212	232	248	260	267	270	268	262	251	234	213	188	162	141	134
70	102	111	136	165	192	214	232	245	252	255	254	247	235	218	195	167	136	109	99.1
75	68.0	80.7	111	144	174	198	216	230	238	241	240	233	221	202	178	147	112	79.5	65.1
80	36.9	53.8	89.1	126	157	182	202	215	224	227	226	219	206	188	162	129	91.4	53.8	33.9
85	11.9	32.8	71.5	110	142	168	187	201	210	214	212	205	193	174	148	114	74.9	34.1	9.65
90	0.43	20.9	59.3	96.5	129	154	174	188	197	200	199	192	180	161	135	102	63.6	23.5	0.25
95	2.06	16.7	50.9	86.0	117	142	161	175	184	187	186	179	167	149	124	92.1	56.0	20.0	2.13
100	5.33	17.0	45.6	77.5	107	131	149	163	171	175	173	167	155	137	114	84.1	51.1	20.6	5.85
105	9.48	19.8	42.8	71.3	97.7	120	138	151	159	163	161	155	144	127	105	77.6	48.4	23.8	10.6
110	14.1	23.8	42.5	66.4	90.0	111	127	140	147	151	149	144	133	117	96.9	72.9	48.1	28.3	15.4
115	19.4	28.7	43.5	63.1	83.6	102	118	129	136	139	138	133	123	109	90.2	69.5	49.2	33.4	20.6
120	24.7	33.7	45.2	61.5	78.4	95.0	109	119	126	129	127	123	114	101	84.7	67.7	51.1	38.5	25.7
125	29.6	38.7	47.3	60.9	74.9	88.6	101	110	116	119	118	113	105	94.0	80.7	66.7	53.3	43.4	30.6
130	34.2	43.6	50.0	60.9	72.8	83.7	93.6	102	107	109	108	105	97.8	88.7	77.7	66.4	55.7	48.0	35.0
135	38.4	47.9	52.7	61.1	70.9	79.9	88.1	94.6	98.9	101	100	97.2	91.8	84.4	75.4	66.4	58.0	52.1	39.2
140	42.7	51.8	55.6	61.8	69.4	76.8	83.5	88.8	92.4	94.0	93.5	91.1	86.7	80.7	73.8	66.8	60.3	55.4	43.0
145	47.2	55.5	58.3	62.8	68.4	74.1	79.5	83.8	86.7	88.0	87.6	85.7	82.3	77.6	72.4	67.2	61.9	57.8	47.5
150	50.9	58.4	60.8	63.9	68.1	72.2	76.0	79.4	81.6	82.7	82.4	81.0	78.4	74.9	71.2	67.6	63.6	60.7	53.0
155	49.7	60.0	62.9	65.1	67.9	70.7	73.3	75.7	77.3	78.1	78.0	77.0	75.3	72.9	70.3	67.8	64.0	62.4	57.3
160	47.3	63.1	64.6	66.1	67.9	69.9	71.5	72.8	73.9	74.4	74.3	73.8	72.7	71.4	70.1	67.6	62.4	58.7	54.7
165	46.4	61.5	65.9	67.0	68.0	69.0	70.2	70.8	71.0	71.6	71.6	71.5	71.6	70.5	69.5	62.9	56.7	53.3	49.9
170	45.3	59.7	63.8	65.5	67.3	68.6	69.1	69.6	69.8	70.0	70.0	69.9	69.7	68.3	62.0	54.9	49.8	49.7	48.6
175	49.1	56.3	61.6	63.2	64.4	66.5	67.9	68.2	68.3	68.4	68.6	68.2	66.0	61.1	53.8	47.8	46.5	48.0	48.6
180	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0

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	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397	397		
5	395	395	396	396	396	397	397	397	398	398	398	398	397	397	397	397	396		
10	389	390	391	392	393	394	395	396	396	396	396	396	395	394	394	393	392		
15	380	382	383	385	387	389	391	392	392	392	392	392	390	389	388	386	385		
20	368	370	373	376	379	382	384	386	387	387	386	385	383	380	378	376	374		
25	353	356	360	364	369	373	376	378	380	380	378	376	373	369	366	362	360		
30	335	339	344	350	356	362	366	369	371	370	369	365	361	356	351	346	342		
35	314	319	326	334	343	350	355	358	360	359	357	353	347	340	333	326	321		
40	290	297	307	317	327	336	342	346	348	347	344	339	331	322	313	304	298		
45	264	273	285	298	311	321	329	334	335	334	330	323	314	303	291	280	271		
50	236	248	263	279	294	306	314	320	321	320	315	307	296	282	268	253	243		
55	206	221	240	259	276	290	300	306	307	305	300	290	277	261	243	226	212		
60	175	194	217	239	259	274	284	291	293	290	284	273	258	240	219	197	180		
65	144	167	194	220	242	258	269	276	278	275	268	256	240	219	195	169	148		
70	112	141	172	201	225	243	254	261	263	260	252	240	222	199	172	142	115		
75	81.9	117	153	184	209	227	239	246	248	245	237	223	205	180	151	117	84.0		
80	55.3	95.5	135	167	193	212	225	232	233	230	222	208	189	163	132	94.4	56.5		
85	35.3	78.4	119	153	179	198	210	217	219	216	207	193	173	148	115	76.3	35.7		
90	24.1	65.8	106	139	165	184	196	203	205	201	193	179	160	134	102	63.2	23.6		
95	19.7	56.5	94.1	126	152	170	182	189	191	187	179	165	147	121	89.7	53.4	18.3		
100	20.2	50.7	84.6	115	139	157	168	175	177	173	165	152	134	109	79.8	47.1	18.3		
105	23.3	48.5	77.4	105	127	144	156	162	163	160	152	140	122	99.1	72.3	44.4	21.2		
110	27.2	48.6	73.0	96.5	117	132	143	149	151	147	140	128	111	90.9	67.4	43.7	25.2		
115	31.0	49.8	70.2	90.4	108	122	131	137	138	135	128	117	103	84.7	64.3	44.7	29.2		
120	34.4	51.4	68.5	85.6	101	113	122	126	127	125	119	109	95.8	80.0	62.7	46.9	32.7		
125	37.5	53.4	67.5	81.9	95.0	106	113	117	118	116	110	102	90.1	76.5	62.3	49.4	35.9		
130	40.5	55.4	67.0	79.0	89.9	98.9	105	109	110	108	103	95.2	85.4	74.1	62.6	51.6	38.7		
135	41.7	57.0	66.6	76.6	85.6	93.1	98.5	102	102	100	96.1	89.7	81.6	72.5	63.0	53.8	40.7		
140	42.2	57.4	65.5	74.6	81.9	88.0	92.4	94.9	95.4	93.9	90.5	85.2	78.7	71.3	63.5	54.3	40.8		
145	41.0	57.4	65.7	72.5	78.5	83.6	87.2	89.2	89.6	88.3	85.6	81.4	76.1	70.3	63.9	54.6	39.8		
150	39.3	57.1	64.2	68.6	75.5	79.4	82.3	84.0	84.4	83.4	81.4	78.1	74.0	69.5	63.5	53.7	38.1		
155	37.8	51.8	58.5	63.9	68.7	75.5	77.6	79.0	79.4	78.8	77.4	75.1	72.2	68.7	63.0	45.9	34.0		
160	40.6	42.7	48.3	53.1	58.0	63.6	72.9	74.2	74.7	74.5	73.6	72.4	70.5	66.5	58.5	37.4	34.3		
165	43.0	37.1	40.1	42.6	46.3	48.0	49.9	63.9	70.8	70.8	70.3	66.0	64.1	58.8	41.3	31.5	33.1		
170	44.2	40.0	40.0	42.0	45.5	47.5	47.3	40.3	50.1	64.1	57.9	53.8	47.5	41.8	38.2	35.3	35.4		
175	47.2	47.4	47.4	47.1	48.4	51.0	53.1	54.0	33.1	49.3	51.8	51.2	47.8	44.3	42.6	43.4	45.2		
180	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0		

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

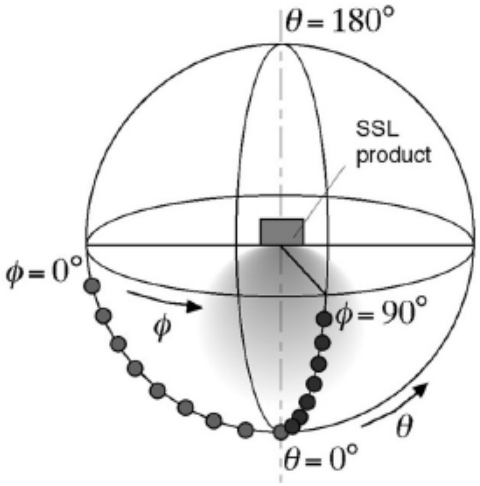
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as 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 ***