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: 9290013632A

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ17120040d/R1

This report is replaced the old report No. HZ17120040d dated Dec. 18, 2017

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. 07, 2018

Approved by: Jim Zhang

Manager: Jim Zhang

Mar. 07, 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: **9290013632A**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
139.1	2210.0	15.89	0.9818

CCT (K)	CRI	Stabilization Time (Light & Power)
3611	83.4	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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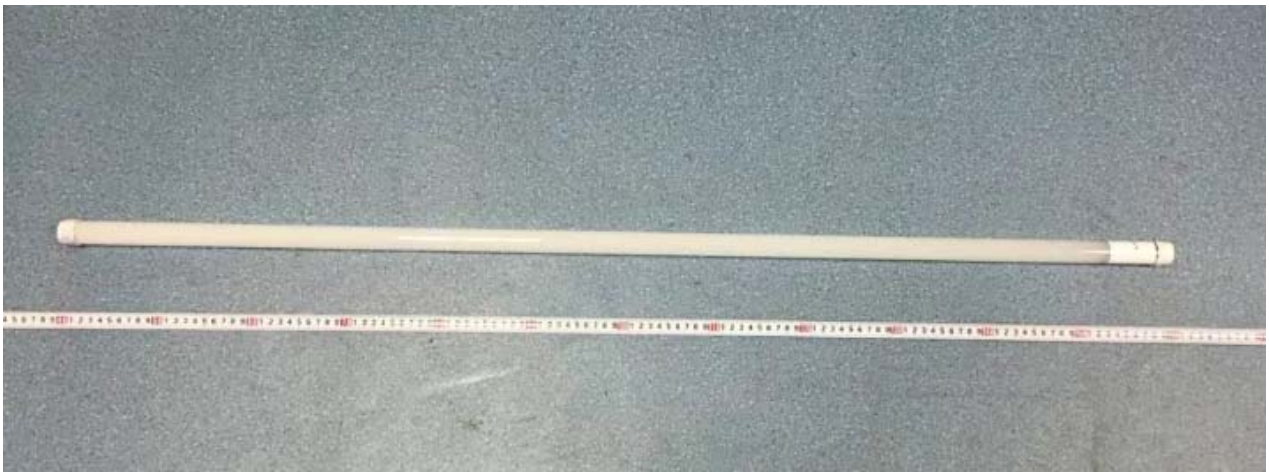
Sample Photo



Sample view

Equipment Under Test (EUT)	
Name	: LED Tube
Model	: 9290013632A
Electrical Ratings	: 120-277V, 60HZ
Product Description	: 16.5T8PRO/48-835/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)	0.135	0.059
Power Factor	0.9818	0.9798
Test Power (W)	15.89	15.96
THD A%	17.88	10.79
Luminous Efficacy (lm/W)	139.1	138.5
Total Luminous Flux (lm)	2210.0	2210.0
Color Rendering Index (CRI)	83.4	
R9	6.8	
Correlated Color Temperature (CCT)(K)	3611	
Chromaticity Chroma x	0.4001	
Chromaticity Chroma y	0.3902	
Chromaticity Chroma u	0.2325	
Chromaticity Chroma v	0.3402	
Duv	0.0009	
Chromaticity Chroma u ’	0.2325	
Chromaticity Chroma v’	0.5103	

Special Color Rendering Indices	
R1	82
R2	92.6
R3	95.1
R4	80.5
R5	82.5
R6	90.2
R7	83.3
R8	60.9
R9	6.8
R10	82.8
R11	80
R12	69.3
R13	84.9
R14	97.7
Rf	83
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 24.9℃.

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)	0.136
Power Factor	0.9777
Power (W)	15.94
Luminous Efficacy (lm/W)	138.6
Total Luminous Flux (lm)	2208.8
Beam Angle (°)	111.9（0^o-180^o）/ 186.4 (90^o-270^o)
Center Beam Candle Power (cd)	410
Maximum Beam Candle Power (cd)	410.8 (At: C=190.0, Gamma=3.0)
Spacing Criteria	1.29（0^o-180^o）/1.40 (90^o-270^o)
Zonal Lumens in the 0°-60°Zone	46.57%
Zonal Lumens in the 60°-90°Zone	26.49%
Zonal Lumens in the 90°-120°Zone	15.65%
Zonal Lumens in the 120°-180°Zone	11.29%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

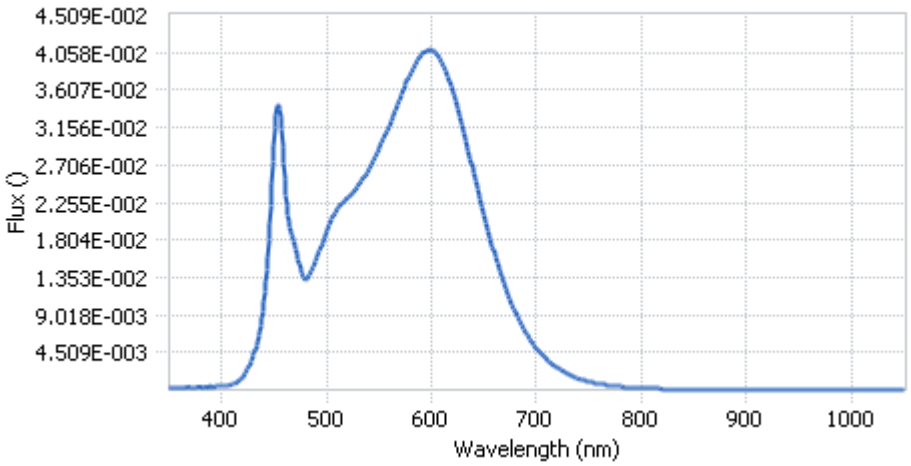
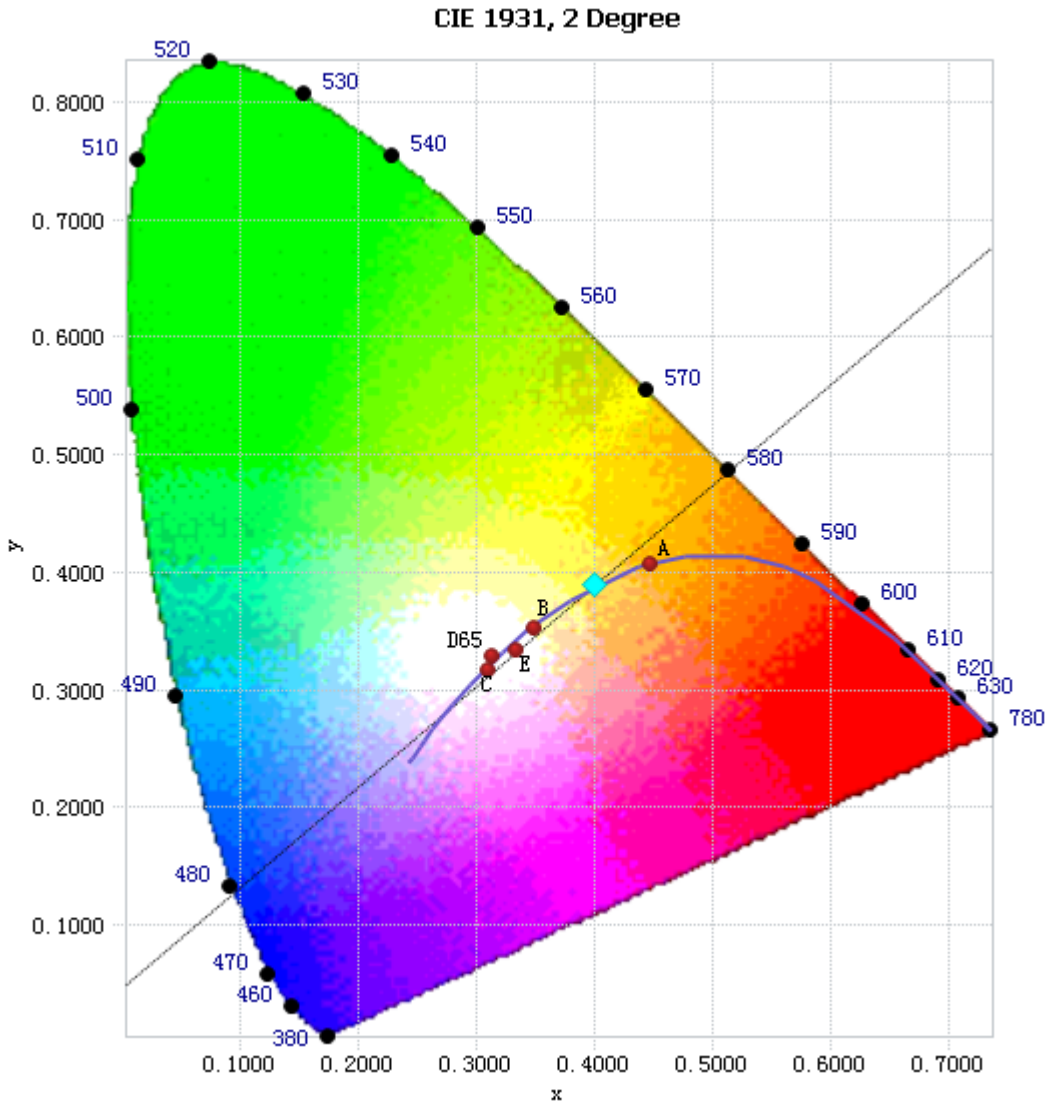


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.78E-04	485	1.42E-02	590	4.03E-02	695	5.85E-03
385	3.44E-04	490	1.58E-02	595	4.08E-02	700	5.03E-03
390	3.86E-04	495	1.74E-02	600	4.08E-02	705	4.26E-03
395	3.92E-04	500	1.91E-02	605	4.04E-02	710	3.62E-03
400	4.14E-04	505	2.07E-02	610	3.94E-02	715	3.09E-03
405	5.24E-04	510	2.17E-02	615	3.79E-02	720	2.64E-03
410	6.79E-04	515	2.25E-02	620	3.59E-02	725	2.24E-03
415	9.86E-04	520	2.31E-02	625	3.37E-02	730	1.91E-03
420	1.58E-03	525	2.38E-02	630	3.14E-02	735	1.62E-03
425	2.55E-03	530	2.46E-02	635	2.87E-02	740	1.38E-03
430	4.04E-03	535	2.56E-02	640	2.62E-02	745	1.18E-03
435	6.53E-03	540	2.66E-02	645	2.35E-02	750	1.00E-03
440	1.06E-02	545	2.78E-02	650	2.10E-02	755	8.52E-04
445	1.80E-02	550	2.90E-02	655	1.86E-02	760	7.34E-04
450	2.94E-02	555	3.05E-02	660	1.64E-02	765	6.27E-04
455	3.38E-02	560	3.19E-02	665	1.43E-02	770	5.40E-04
460	2.53E-02	565	3.35E-02	670	1.24E-02	775	4.59E-04
465	1.96E-02	570	3.50E-02	675	1.08E-02	780	3.96E-04
470	1.73E-02	575	3.67E-02	680	9.32E-03		
475	1.45E-02	580	3.81E-02	685	8.01E-03		
480	1.33E-02	585	3.94E-02	690	6.84E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4001, 0.3902)

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

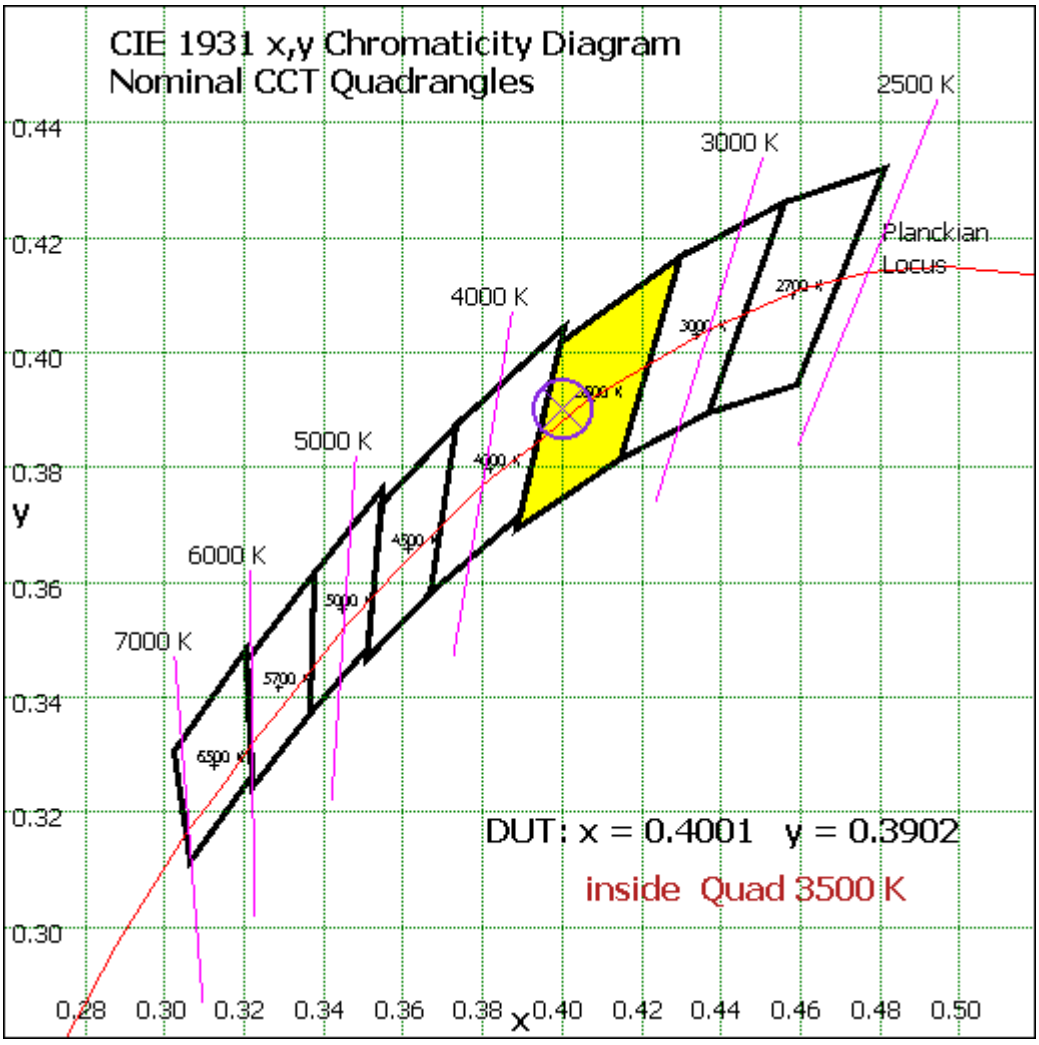


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	38.907	1.76%
10- 20	112.611	5.10%
20- 30	174.517	7.90%
30- 40	218.587	9.90%
40- 50	241.376	10.93%
50- 60	242.61	10.98%
60- 70	225.43	10.21%
70- 80	196.035	8.88%
80- 90	163.55	7.40%
90-100	136.307	6.17%
100-110	114.093	5.17%
110-120	95.384	4.32%
120-130	79.003	3.58%
130-140	63.672	2.88%
140-150	48.886	2.21%
150-160	33.689	1.53%
160-170	18.173	0.82%
170-180	5.989	0.27%
Total	2208.8	100%

γ(°)	Lumens	% Total
0- 60	1028.608	46.57%
60- 90	585.015	26.49%
0-90	1613.623	73.05%
90- 180	595.196	26.95%
0- 180	2208.8	100%

Table 5: Zonal Lumen Data

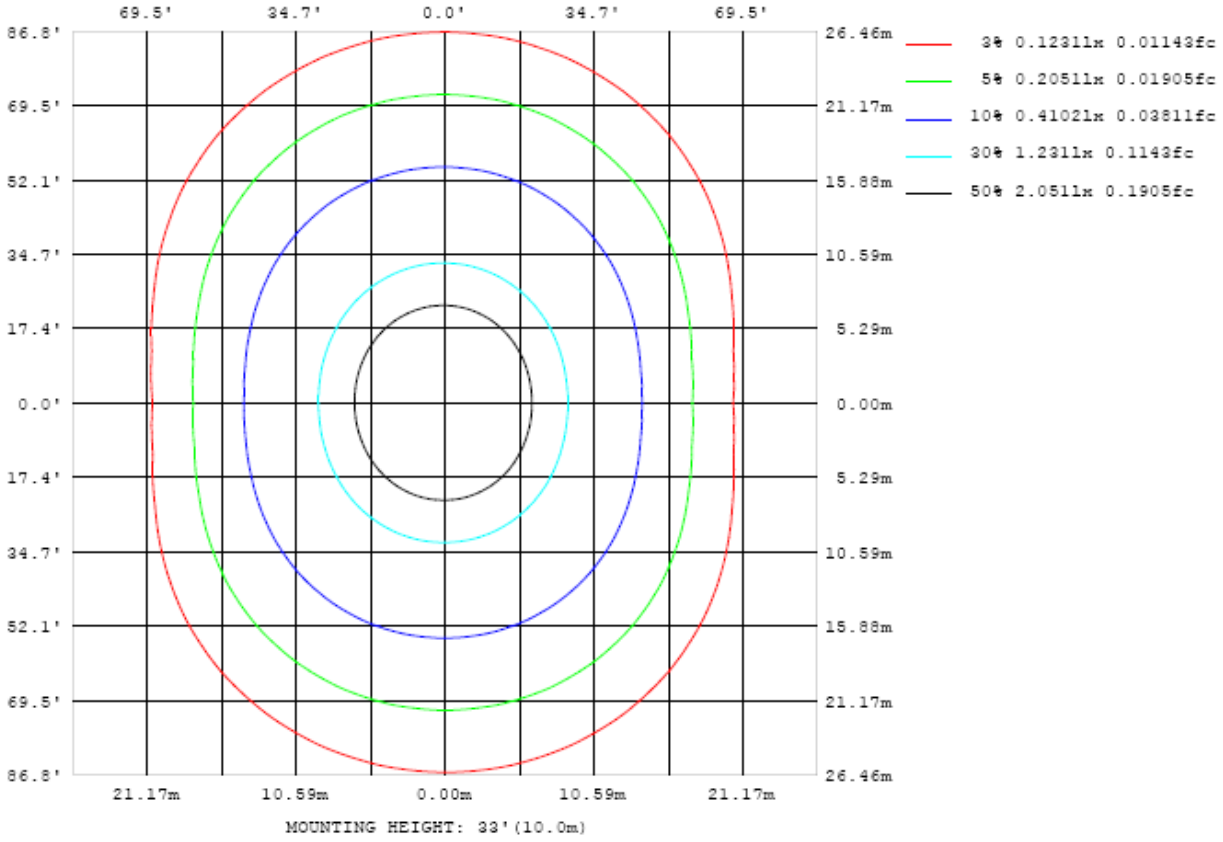


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

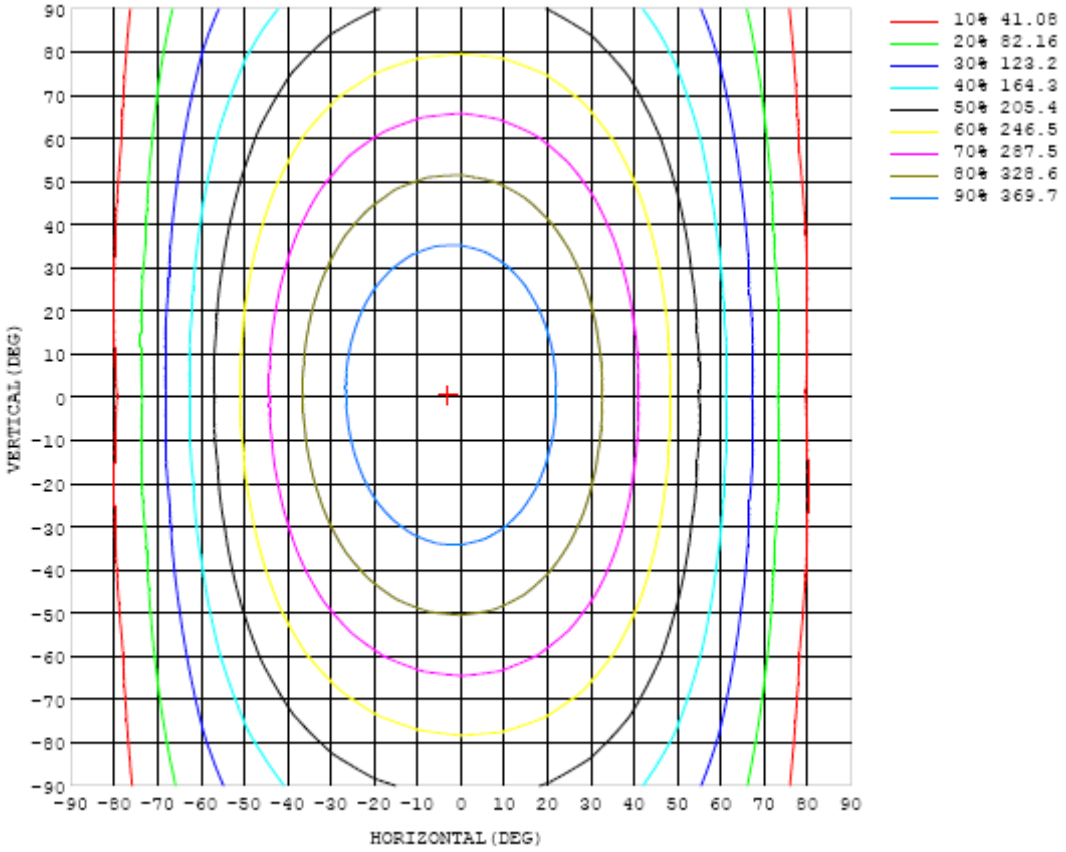


Chart 5: Isocandela Plot

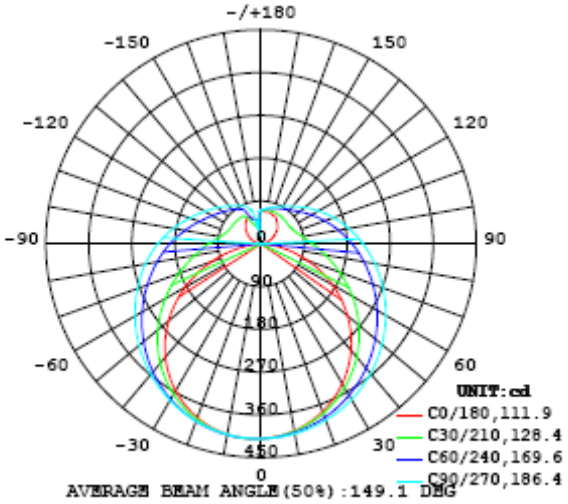


Chart 6: Polar Candela Distribution

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	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410
5	406	407	407	407	407	407	408	408	409	409	409	409	410	410	410	410	410	410	410
10	400	400	400	401	401	402	403	404	405	406	407	407	407	407	407	407	407	407	407
15	389	389	390	392	393	395	397	399	400	401	402	402	402	402	401	400	400	400	400
20	376	376	378	380	383	386	389	392	394	395	396	396	395	394	393	391	390	389	389
25	359	360	362	366	370	375	379	383	386	388	388	387	386	384	381	379	376	375	375
30	340	341	344	349	356	362	368	373	376	378	379	378	375	372	367	363	360	357	357
35	318	319	324	331	340	348	355	362	366	368	368	366	362	357	351	345	340	336	336
40	293	295	301	311	322	332	342	349	354	356	356	353	348	341	333	325	317	312	311
45	266	269	277	290	303	316	327	336	341	343	343	339	333	324	313	302	292	285	283
50	236	240	251	267	284	299	312	321	328	330	329	324	316	306	292	278	264	255	252
55	205	210	225	244	264	282	296	307	313	316	314	309	300	287	271	253	236	223	219
60	172	179	197	220	244	264	280	292	299	301	299	293	282	268	249	227	206	189	183
65	139	147	170	197	224	247	264	277	284	286	284	277	265	249	227	202	176	154	147
70	104	115	143	175	205	230	249	262	269	271	269	261	248	230	207	178	147	119	109
75	69.7	84.7	118	155	187	214	233	247	254	256	253	245	232	213	187	156	120	86.4	71.7
80	38.3	57.8	96.3	136	171	198	218	232	240	242	239	230	216	196	170	136	96.9	57.9	37.7
85	12.8	36.5	78.7	121	156	184	204	218	225	227	224	215	201	181	154	120	78.7	36.2	11.4
90	0.32	23.9	66.2	107	142	170	190	204	211	213	210	201	187	167	140	106	65.9	24.3	0.42
95	2.36	19.4	57.7	96.4	130	157	177	191	198	200	196	188	174	154	127	94.8	57.4	20.1	2.41
100	6.44	19.8	52.2	87.7	120	145	165	178	185	186	183	175	161	142	117	86.0	52.0	20.7	6.38
105	11.9	23.2	49.4	80.8	110	134	153	165	172	174	170	162	149	131	107	79.4	49.4	24.2	11.7
110	17.8	27.8	49.1	75.7	102	124	141	153	160	161	158	151	138	121	99.5	74.8	49.2	29.0	17.3
115	23.8	32.8	50.3	72.6	95.2	115	131	142	148	150	147	140	128	113	93.1	71.6	50.5	34.6	23.4
120	30.1	38.3	52.5	70.6	89.7	107	122	132	137	139	136	130	119	105	88.0	69.8	52.7	40.3	29.5
125	36.4	43.7	55.1	69.7	85.3	100	113	122	127	128	126	120	111	98.6	83.9	69.1	55.5	45.0	34.2
130	43.2	48.7	57.8	69.6	82.2	94.5	105	113	118	119	117	112	104	93.1	81.2	69.1	58.5	49.7	39.9
135	49.0	53.0	60.6	70.0	80.0	90.0	98.6	105	109	110	108	104	97.3	88.8	79.2	69.6	61.3	54.5	45.8
140	52.9	56.1	63.1	70.5	78.5	86.4	93.2	98.4	102	102	101	97.7	92.3	85.5	77.9	70.3	64.0	57.9	50.7
145	57.4	59.7	65.3	71.3	77.4	83.5	88.8	92.9	95.3	96.0	95.0	92.3	88.1	82.8	77.0	71.2	66.3	59.9	55.4
150	62.7	63.8	67.3	71.7	76.7	81.2	85.1	88.2	90.0	90.5	89.7	87.7	84.5	80.7	76.3	71.9	68.5	62.9	59.9
155	64.7	66.1	68.7	72.1	75.8	79.3	82.1	84.3	85.5	85.9	85.4	84.0	81.8	78.9	75.8	72.6	69.6	65.2	62.0
160	66.6	69.0	70.0	72.2	74.9	77.4	79.4	81.0	81.9	82.2	81.8	80.8	79.3	77.4	75.1	73.1	70.2	63.1	56.5
165	67.9	70.5	71.2	72.3	74.2	75.7	77.0	78.0	78.5	78.7	78.5	78.0	77.0	75.8	74.6	73.3	68.7	60.7	54.1
170	68.1	70.5	71.7	72.0	73.0	73.9	74.6	75.3	75.7	75.8	75.7	75.4	74.9	74.4	73.8	71.1	64.2	57.1	50.5
175	68.1	69.6	71.2	72.2	72.6	72.6	72.6	72.7	72.7	72.8	72.8	72.8	72.9	73.1	72.6	70.0	64.6	58.2	53.1
180	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4

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	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410
5	410	411	410	411	410	410	410	410	410	409	409	408	408	408	407	407	407
10	407	407	408	408	408	408	408	408	407	407	406	405	403	402	401	400	400
15	400	401	402	403	403	404	404	404	403	402	400	399	396	394	392	391	390
20	390	391	393	395	396	397	398	398	397	396	393	390	387	384	381	378	377
25	376	378	381	384	386	389	390	390	390	388	385	381	376	371	367	363	360
30	359	362	366	370	374	378	380	381	381	378	374	369	363	357	350	345	341
35	338	342	348	355	361	366	369	371	370	368	363	356	349	340	332	324	319
40	314	320	328	337	345	352	357	359	359	356	351	342	333	322	311	302	295
45	287	295	306	317	328	336	343	346	346	343	337	328	316	303	290	277	269
50	257	267	282	296	310	321	328	333	333	330	323	312	299	283	267	251	240
55	225	239	257	275	291	304	313	318	319	316	308	297	281	263	243	224	210
60	191	209	231	253	272	287	297	303	304	301	294	281	264	243	220	197	179
65	156	179	206	232	253	270	281	288	290	287	278	265	247	224	197	169	147
70	122	151	182	211	235	253	266	273	275	272	263	249	230	205	175	143	115
75	88.7	124	160	192	217	237	250	258	260	257	249	234	214	187	155	118	84.1
80	59.5	101	141	174	201	221	234	243	245	243	234	219	198	170	136	96.2	56.6
85	38.0	82.2	124	158	185	205	220	228	231	228	220	205	184	156	120	78.4	35.5
90	25.8	68.2	109	144	170	190	204	213	216	213	205	190	170	142	107	65.4	23.5
95	20.9	58.2	96.6	130	156	175	189	198	201	198	190	176	156	129	94.8	55.6	18.8
100	21.2	52.4	86.7	118	143	162	175	183	186	184	176	162	143	117	85.1	50.1	19.5
105	24.2	50.5	79.9	107	131	149	161	169	172	170	163	150	131	107	78.1	48.1	23.2
110	28.0	50.8	75.6	99.7	121	137	149	156	159	157	150	138	121	99.0	73.6	48.4	27.9
115	31.6	52.3	73.0	93.8	112	127	138	144	147	145	139	128	113	93.0	71.1	50.3	32.4
120	34.7	54.4	71.5	89.3	105	118	128	134	136	135	129	119	106	88.4	70.1	53.0	36.4
125	36.8	56.7	71.0	85.9	99.7	111	119	125	127	125	120	112	99.7	85.2	70.0	55.8	39.7
130	37.8	58.4	70.3	83.1	94.9	105	112	117	118	117	113	105	95.0	82.9	70.4	58.1	41.5
135	37.9	59.2	69.9	79.6	90.9	99.0	105	109	111	109	106	99.4	91.0	81.2	70.9	59.7	41.8
140	38.1	58.9	70.2	77.8	85.3	94.3	99.2	103	104	103	99.7	94.5	87.8	79.9	71.3	59.3	41.4
145	41.5	55.0	69.6	76.1	82.5	89.0	94.0	96.5	97.7	97.0	94.5	90.5	85.2	78.8	70.6	56.1	46.6
150	47.6	49.2	66.6	72.1	78.8	83.7	87.9	91.4	92.2	91.9	90.1	87.1	82.9	77.8	69.3	54.2	54.6
155	53.6	41.4	54.0	61.1	65.3	72.0	82.0	84.2	87.4	87.3	86.2	83.9	80.6	75.8	61.5	46.1	59.1
160	50.4	40.8	42.6	47.8	51.9	55.2	58.8	71.8	80.1	82.6	81.5	79.3	76.1	65.9	48.8	46.0	58.2
165	48.6	40.4	37.8	38.6	43.2	52.1	54.4	45.9	69.2	75.6	72.3	65.6	52.2	44.1	41.8	47.5	63.5
170	51.5	50.0	45.3	44.1	47.7	53.1	57.3	60.3	28.1	59.3	58.0	55.7	51.4	46.1	46.5	58.1	66.1
175	49.1	46.6	45.8	46.4	45.9	43.5	37.8	29.3	55.5	55.5	55.1	56.6	59.3	62.8	64.8	65.8	66.8
180	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4	69.4

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

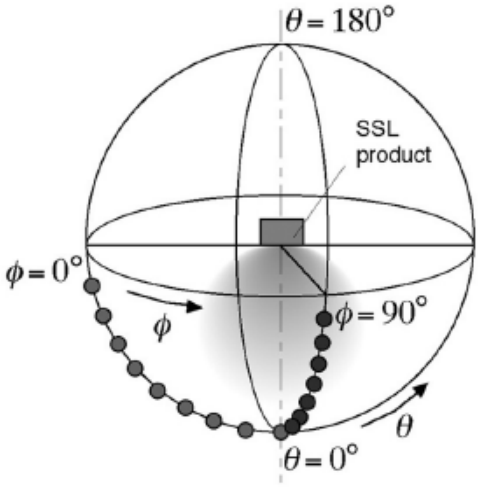
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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