

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: 9290019347

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ18050046b

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

Review by:



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Jun. 05, 2018

Approved by:



Manager: Jim Zhang

Jun. 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: **9290019347**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
139.3	2123.0	15.24	0.9852
CCT (K)	CRI	Stabilization Time (Light & Power)	
3467	82.8	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 : May 25, 2018

Date of Test : May 31, 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

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Sample Photo



Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: TYPEB LED TUBE
Model	: 9290019347
Electrical Ratings	: 120-277V, 50/60Hz, 15.5W
Product Description	: 15.5T8-6U PRO/24-835/BB20/G FB
Manufacturer	: Philips Lighting (China) Investment Co., Ltd
Address	: 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)	0.129	0.058
Power Factor	0.9852	0.9329
Test Power (W)	15.24	15.04
THD A%	16.59	19.84
Luminous Efficacy (lm/W)	139.3	139.0
Total Luminous Flux (lm)	2123.0	2090.0
Color Rendering Index (CRI)	82.8	
R9	6.3	
Correlated Color Temperature (CCT) (K)	3467	
Chromaticity Chroma x	0.4071	
Chromaticity Chroma y	0.3917	
Chromaticity Chroma u	0.2365	
Chromaticity Chroma v	0.3413	
Duv	0.0002	
Chromaticity Chroma u'	0.2365	
Chromaticity Chroma v'	0.5120	

Special Color Rendering Indices	
R1	81.4
R2	92.2
R3	95.1
R4	79.7
R5	81.8
R6	89.7
R7	82.8
R8	60
R9	6.3
R10	81.8
R11	78.6
R12	69.2
R13	84.3
R14	97.9
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 24.7°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)	0.130
Power Factor	0.9820
Test Power (W)	15.31
Luminous Efficacy (lm/W)	136.9
Total Luminous Flux (lm)	2095.7
Beam Angle (°)	108.0 (0°-180°)/ 193.4 (90°-270°)
Center Beam Candle Power (cd)	378
Maximum Beam Candle Power (cd)	378.8 (At: C=90.0, Gamma=5.5)
Spacing Criteria	1.25 (0°-180°)/ 1.38 (90°-270°)
Zonal Lumens in the 0°-60°Zone	45.07%
Zonal Lumens in the 60°-90°Zone	24.62%
Zonal Lumens in the 90°-120°Zone	15.79%
Zonal Lumens in the 120°-180°Zone	14.53%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

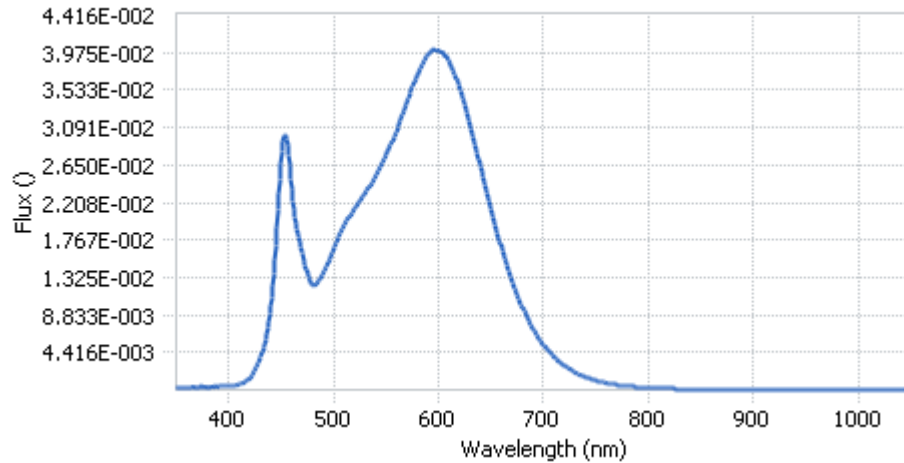
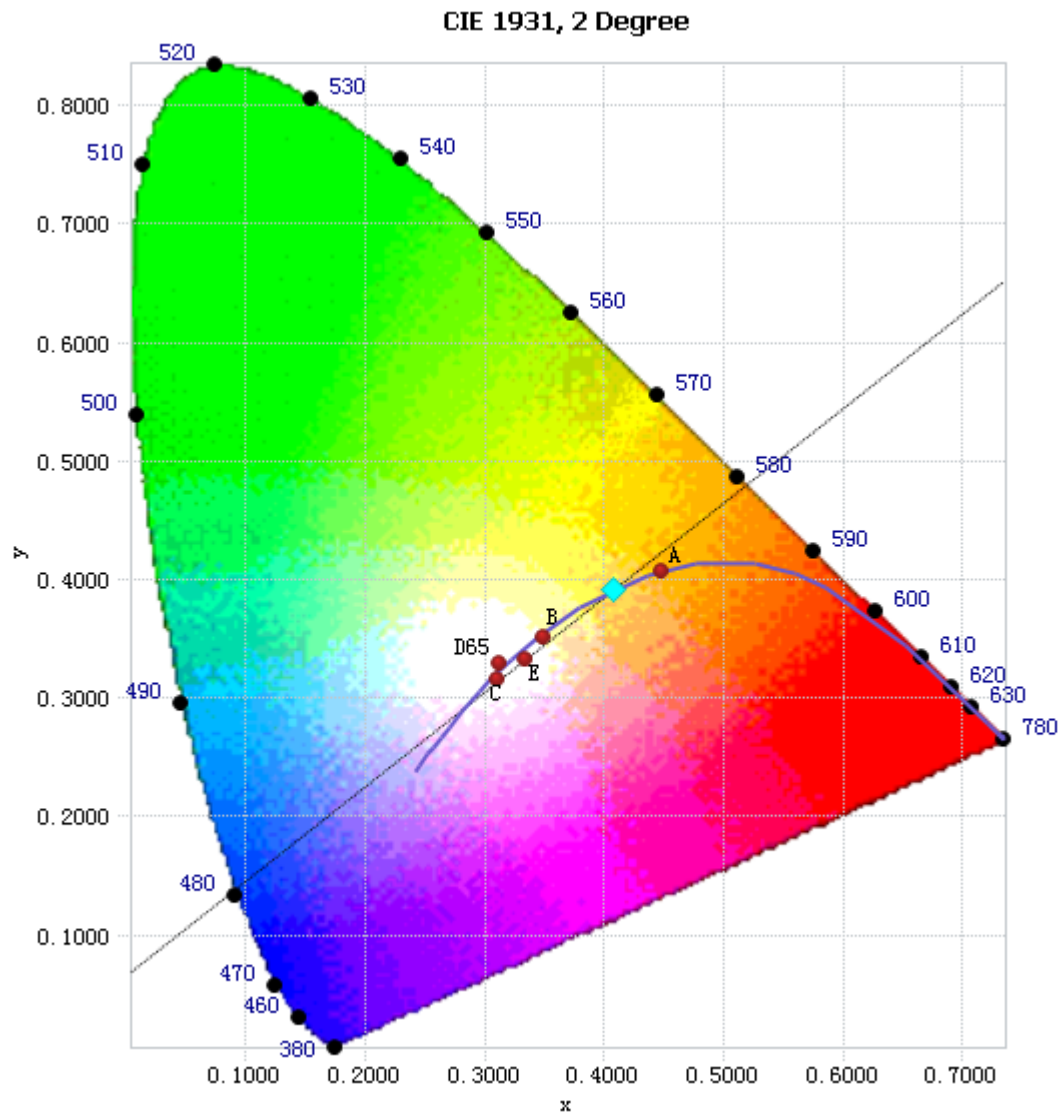


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.63E-04	485	1.27E-02	590	3.94E-02	695	6.21E-03
385	3.44E-04	490	1.37E-02	595	4.01E-02	700	5.32E-03
390	3.79E-04	495	1.51E-02	600	4.00E-02	705	4.56E-03
395	4.06E-04	500	1.67E-02	605	3.96E-02	710	3.88E-03
400	4.41E-04	505	1.82E-02	610	3.87E-02	715	3.33E-03
405	5.16E-04	510	1.93E-02	615	3.72E-02	720	2.86E-03
410	6.53E-04	515	2.06E-02	620	3.55E-02	725	2.44E-03
415	9.34E-04	520	2.15E-02	625	3.35E-02	730	2.08E-03
420	1.40E-03	525	2.23E-02	630	3.12E-02	735	1.78E-03
425	2.30E-03	530	2.32E-02	635	2.87E-02	740	1.52E-03
430	3.70E-03	535	2.41E-02	640	2.62E-02	745	1.30E-03
435	6.01E-03	540	2.53E-02	645	2.36E-02	750	1.11E-03
440	9.89E-03	545	2.65E-02	650	2.12E-02	755	9.56E-04
445	1.70E-02	550	2.76E-02	655	1.89E-02	760	8.20E-04
450	2.67E-02	555	2.91E-02	660	1.68E-02	765	7.03E-04
455	2.96E-02	560	3.06E-02	665	1.47E-02	770	6.05E-04
460	2.36E-02	565	3.23E-02	670	1.28E-02	775	5.18E-04
465	1.89E-02	570	3.40E-02	675	1.12E-02	780	4.52E-04
470	1.64E-02	575	3.57E-02	680	9.70E-03		
475	1.37E-02	580	3.71E-02	685	8.41E-03		
480	1.24E-02	585	3.86E-02	690	7.22E-03		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4071, 0.3917)

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

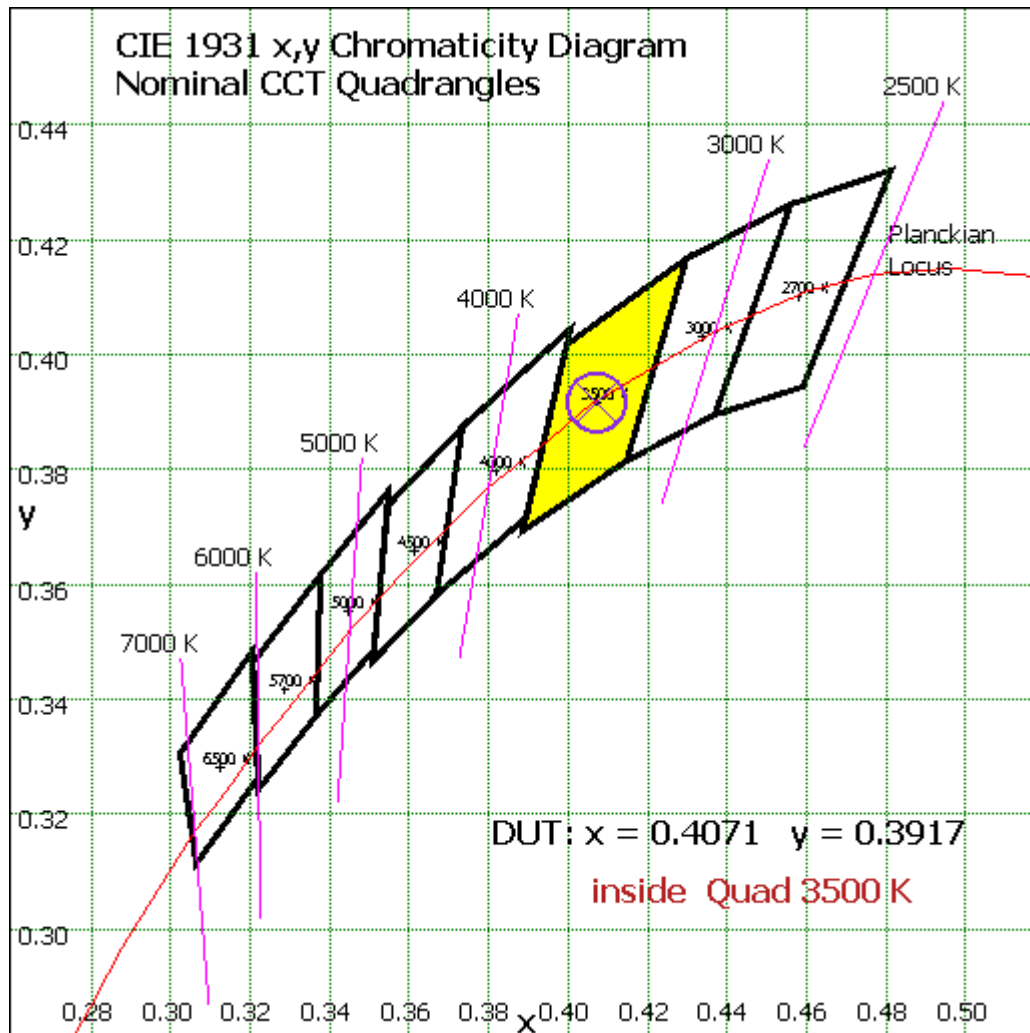


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	35.803	1.71%
10- 20	103.409	4.93%
20- 30	159.822	7.63%
30- 40	199.916	9.54%
40- 50	221.316	10.56%
50- 60	224.282	10.70%
60- 70	210.606	10.05%
70- 80	182.425	8.70%
80- 90	122.815	5.86%
90-100	100.201	4.78%
100-110	121.41	5.79%
110-120	109.196	5.21%
120-130	93.507	4.46%
130-140	77.444	3.70%
140-150	60.571	2.89%
150-160	42.747	2.04%
160-170	24.178	1.15%
170-180	6.002	0.29%
Total	2095.7	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	944.548	45.07%
60- 90	515.846	24.62%
0-90	1460.394	69.69%
90- 180	635.256	30.31%
0- 180	2095.7	100%

Table 5: Zonal Lumen Data

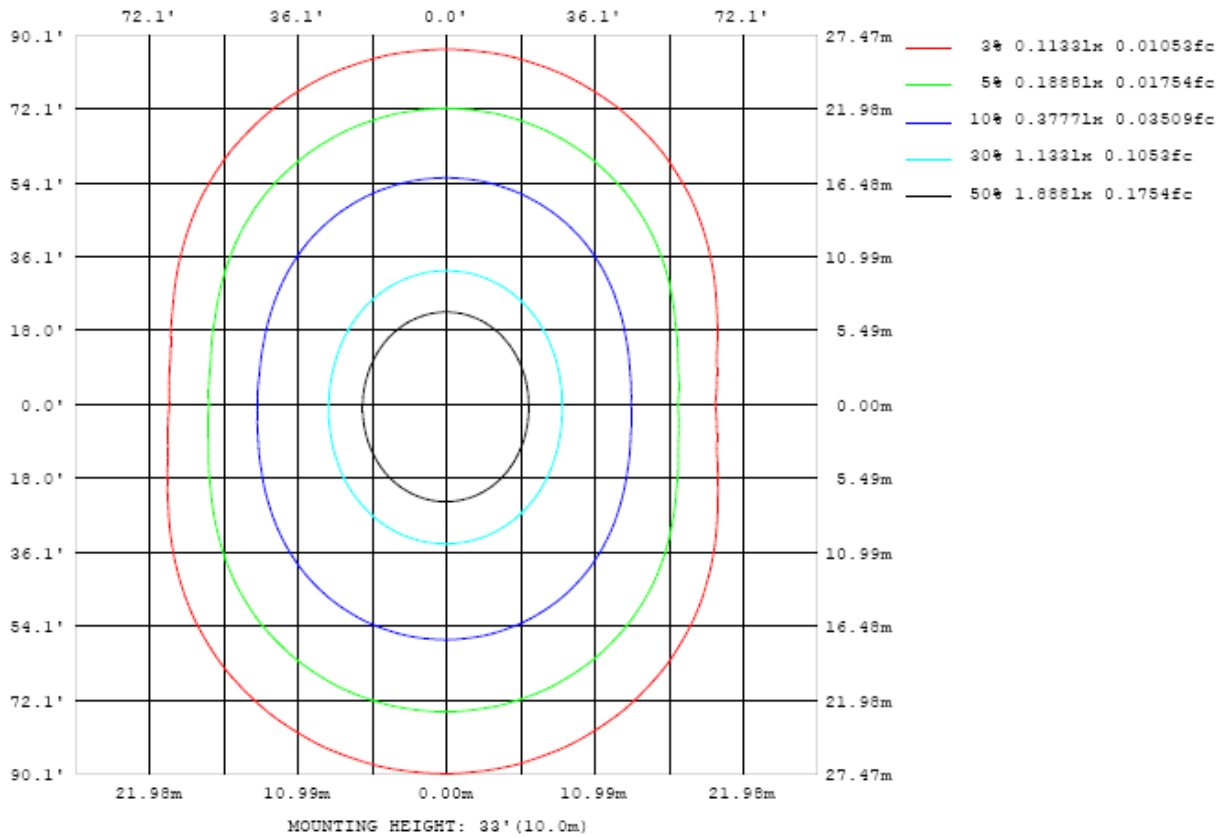


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

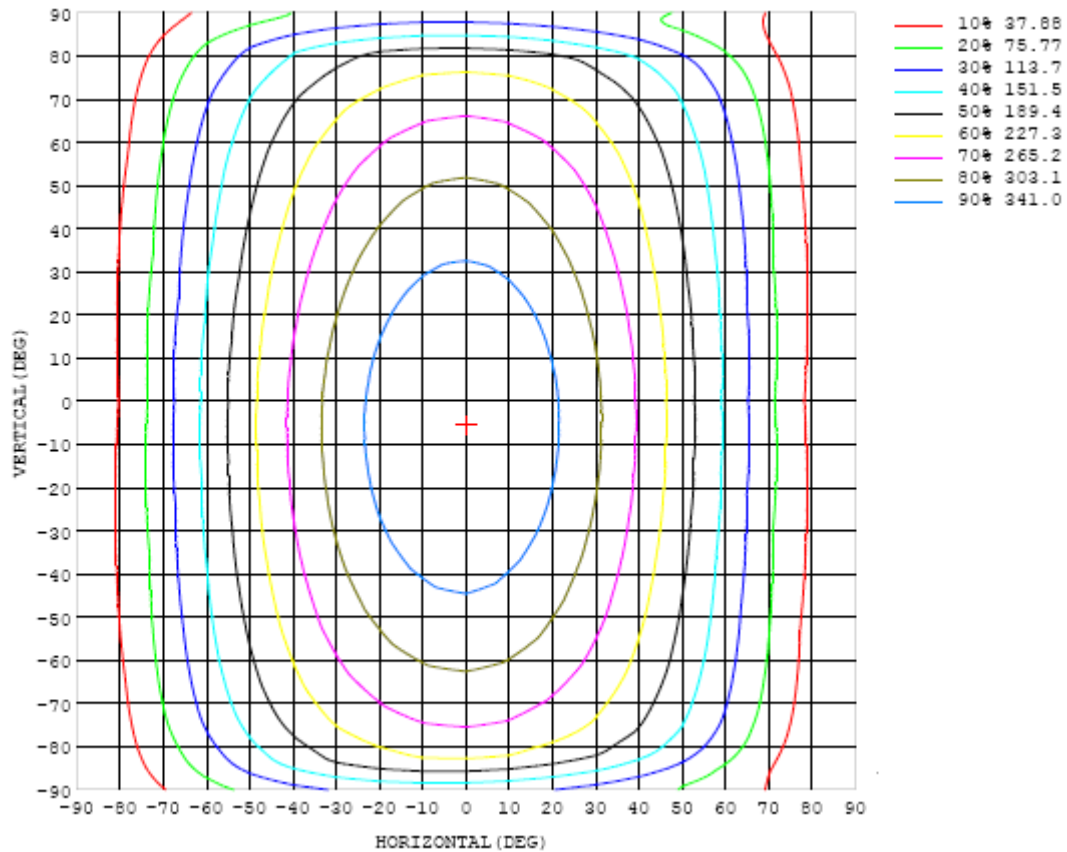


Chart 5: Isocandela Plot

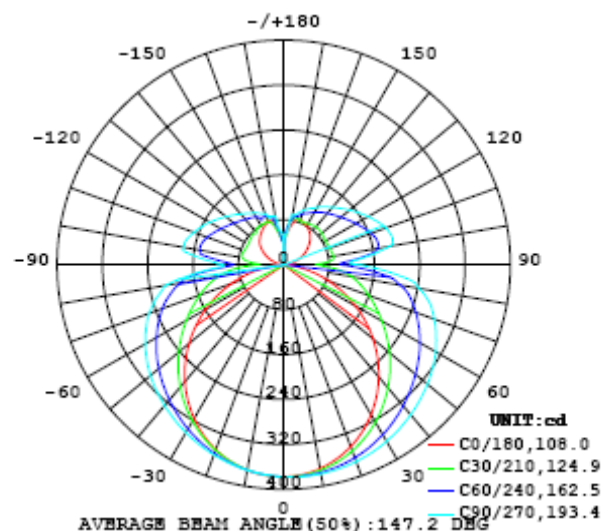


Chart 6: Polar Candela Distribution

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	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378
5	375	375	376	376	377	377	378	378	378	379	379	379	378	378	378	377	377	377	376
10	369	369	370	372	373	374	376	377	378	378	378	378	377	376	375	374	373	372	371
15	359	360	361	364	367	369	372	374	375	376	376	375	374	372	370	367	366	364	363
20	345	346	349	353	357	362	366	370	372	373	373	371	369	366	362	358	355	352	351
25	328	330	334	339	346	352	358	363	367	369	368	366	362	357	352	346	341	337	335
30	308	311	316	324	332	341	349	356	361	363	362	359	354	347	339	331	324	319	317
35	286	289	296	306	317	329	339	348	354	356	355	351	344	335	325	314	305	299	295
40	261	265	274	286	300	315	328	338	346	349	347	342	333	322	309	296	284	276	272
45	234	239	250	265	283	300	316	328	337	340	338	332	322	308	292	276	261	251	246
50	206	211	224	243	264	285	303	318	327	331	329	322	309	293	274	255	237	224	218
55	176	183	199	221	246	270	291	307	317	321	319	311	297	278	256	233	212	196	189
60	146	153	173	200	228	255	278	294	305	309	307	298	283	263	238	212	187	167	160
65	115	124	148	179	211	239	263	281	292	297	294	285	269	247	221	191	162	139	129
70	84.1	95.4	124	160	194	224	248	266	278	283	280	270	254	231	203	171	138	110	98.0
75	55.1	68.9	103	141	176	207	232	251	262	267	265	255	238	214	185	151	115	83.1	67.8
80	29.0	46.2	83.2	122	157	187	209	226	237	242	240	232	216	193	166	132	94.5	59.3	40.0
85	9.53	27.6	61.2	94.7	124	147	167	182	193	199	200	195	184	166	137	106	72.5	38.5	17.3
90	2.66	13.2	36.1	57.0	74.3	89.2	102	114	124	130	131	126	117	102	83.3	63.4	36.6	14.4	2.54
95	7.22	21.8	52.2	82.9	107	123	133	140	142	140	136	127	115	100	82.4	61.5	37.9	16.8	3.61
100	12.8	26.5	54.7	89.1	122	148	168	184	191	190	185	177	163	141	115	84.1	53.1	25.6	8.86
105	19.8	31.8	56.7	87.4	119	148	170	185	194	197	194	184	167	145	120	88.8	56.5	30.6	15.5
110	27.8	37.6	59.0	86.1	115	141	164	180	189	192	189	180	164	143	117	88.2	58.6	36.1	23.3
115	35.9	43.2	62.0	85.4	111	135	155	170	179	182	179	171	156	136	113	87.3	60.9	42.3	31.4
120	43.9	47.7	65.2	85.3	108	129	147	161	169	172	169	161	148	130	110	86.6	63.8	48.9	39.6
125	51.7	52.5	69.0	85.9	105	123	139	151	159	162	159	152	140	124	106	86.3	67.0	55.4	47.5
130	59.1	59.5	72.0	87.5	103	118	132	142	149	152	149	143	132	119	104	86.7	69.9	61.5	54.9
135	65.9	66.9	74.2	88.6	101	114	126	134	140	142	140	135	126	114	102	85.9	73.7	67.2	60.5
140	72.0	74.7	75.0	88.2	98.9	110	120	127	132	134	132	127	120	110	99.5	86.9	76.6	72.7	65.1
145	76.6	79.6	76.0	86.6	96.8	106	115	120	124	125	124	121	115	106	97.7	87.0	78.0	77.8	69.4
150	80.3	83.7	78.9	85.1	94.5	101	108	113	117	118	117	114	108	102	94.7	86.3	79.9	81.7	73.7
155	83.3	87.2	85.1	83.0	91.5	97.1	102	106	109	111	109	107	102	98.2	92.5	84.2	82.0	83.7	78.2
160	85.4	88.8	88.3	83.3	85.7	92.0	96.3	101	104	103	102	101	97.9	92.5	87.4	84.8	83.9	83.3	82.0
165	82.5	85.9	87.8	84.5	85.0	88.1	88.4	91.5	93.3	94.1	94.1	92.9	88.6	86.8	83.9	81.1	77.8	77.5	77.0
170	69.4	72.7	81.5	81.9	81.0	79.6	82.6	87.2	89.3	89.8	89.3	80.1	75.9	73.4	72.0	67.8	65.5	62.9	62.1
175	53.8	53.9	54.4	57.5	63.3	66.0	64.7	60.4	59.3	56.5	59.2	60.6	58.5	52.6	51.3	49.5	48.2	47.7	46.2
180	6.05	6.04	6.02	5.99	5.95	5.90	5.85	5.80	5.75	5.70	5.64	5.58	6.12	6.25	6.36	6.46	6.53	6.57	6.58

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	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378	378		
5	376	376	376	376	376	376	375	375	375	375	375	375	375	375	375	375	375		
10	371	371	371	371	371	371	372	372	372	371	371	370	370	369	368	368	368		
15	362	362	363	364	364	365	366	366	366	366	365	363	362	361	359	358	358		
20	350	350	352	354	356	358	359	360	360	360	358	355	353	350	347	345	345		
25	335	336	338	341	345	348	351	353	353	352	350	346	342	337	333	330	328		
30	316	318	322	327	333	338	342	345	345	344	340	335	329	322	316	311	309		
35	295	298	304	311	319	326	332	336	337	335	330	324	316	306	298	291	287		
40	272	276	285	294	305	314	321	326	328	325	320	312	301	289	278	268	262		
45	247	253	264	276	290	301	310	316	318	315	309	299	286	272	257	245	236		
50	220	228	242	258	274	288	299	305	307	305	297	286	271	254	236	220	209		
55	192	203	220	240	259	274	286	293	295	293	285	273	256	236	214	195	181		
60	163	178	199	222	242	259	272	280	282	280	271	258	240	218	194	170	153		
65	135	153	178	203	226	244	258	266	269	265	257	243	224	200	173	146	124		
70	106	129	158	185	209	228	242	250	253	250	241	227	207	182	154	123	96.2		
75	78.3	106	138	166	190	208	222	231	234	231	222	208	188	164	135	102	70.2		
80	53.7	84.3	116	144	167	186	201	210	211	208	199	185	165	141	113	80.6	47.8		
85	32.5	60.0	87.8	112	128	139	146	149	149	145	139	129	117	101	80.8	55.8	27.9		
90	9.70	26.1	44.3	61.5	76.6	89.1	98.2	105	107	107	102	94.6	85.5	72.6	55.6	36.3	14.9		
95	14.0	34.5	62.4	86.8	108	126	138	147	151	151	147	140	129	109	82.0	50.7	22.5		
100	20.0	44.8	74.2	103	128	151	166	176	180	177	169	157	139	113	82.5	51.3	25.5		
105	24.2	46.3	75.5	104	129	149	164	174	177	174	166	153	134	109	80.4	52.0	30.1		
110	29.9	47.8	74.0	100	124	144	158	166	169	166	159	146	127	104	78.4	53.7	35.8		
115	36.3	50.5	73.0	96.4	118	136	149	157	160	158	151	138	121	100	77.2	56.3	41.6		
120	43.3	54.0	72.7	93.2	112	128	141	149	151	149	142	131	115	96.9	77.0	59.9	47.4		
125	50.2	58.0	73.7	90.8	107	121	132	139	142	140	134	124	111	94.5	77.7	63.9	52.9		
130	56.8	62.3	75.2	89.3	103	115	125	131	133	132	127	118	106	92.8	79.1	67.3	58.7		
135	62.9	66.8	76.6	88.5	100	110	118	123	125	124	120	113	103	91.9	81.0	70.4	66.0		
140	68.7	70.7	75.0	88.3	97.6	106	112	117	118	117	114	108	100	91.5	81.8	73.4	72.1		
145	73.9	74.1	80.1	85.0	95.5	102	107	111	112	111	108	104	98.1	89.6	82.4	75.1	76.6		
150	77.5	75.3	81.0	86.9	99.9	98.7	103	106	107	106	104	101	94.3	89.5	83.4	78.7	81.4		
155	76.7	77.6	81.0	86.5	90.4	91.8	96.5	99.9	101	101	99.2	96.2	93.3	89.3	81.9	81.2	83.2		
160	78.2	79.5	81.6	84.5	89.4	91.9	91.7	92.1	96.3	97.1	96.1	94.5	90.9	85.1	85.6	82.1	84.7		
165	75.8	73.4	76.7	78.8	82.3	88.5	89.5	90.2	89.2	87.5	85.7	84.7	84.9	85.7	82.6	80.2	83.7		
170	61.4	61.4	60.1	63.7	69.7	69.5	73.9	78.7	87.4	88.3	88.0	84.2	79.3	75.9	77.2	77.5	78.0		
175	46.2	45.2	45.0	44.6	45.3	47.6	51.6	60.4	59.5	57.2	59.0	59.4	62.4	64.9	66.1	56.4	53.3		
180	6.57	6.53	6.46	6.36	6.25	6.12	5.98	5.84	5.70	5.75	5.80	5.85	5.90	5.95	5.99	6.02	6.04		

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 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° 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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