



## LM-79-08 Test Report

for

**Philips (China) Investment Co., Ltd.**

Building 9, Lane 888, Tianlin Road  
Shanghai, China

**InstantFit LEDtube**

**Model: 9290011814**

**(with the ballast ICF-2S26-H1-LD)**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ15070027i

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

Review by:

Engineer: April Zou  
Jul. 22, 2015

Approved by:



Manager: Jim Zhang  
Jul. 22, 2015

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: **9290011814 (with the ballast ICF-2S26-H1-LD)**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
96.7	1391.0	14.38	0.9932
CCT (K)	CRI	Stabilization Time (Light & Power)	
3949	82.5	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>	: Jul. 16, 2015
<b>Date of Test</b>	: Jul. 20, 2015 to Jul. 21, 2015
<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 Photos

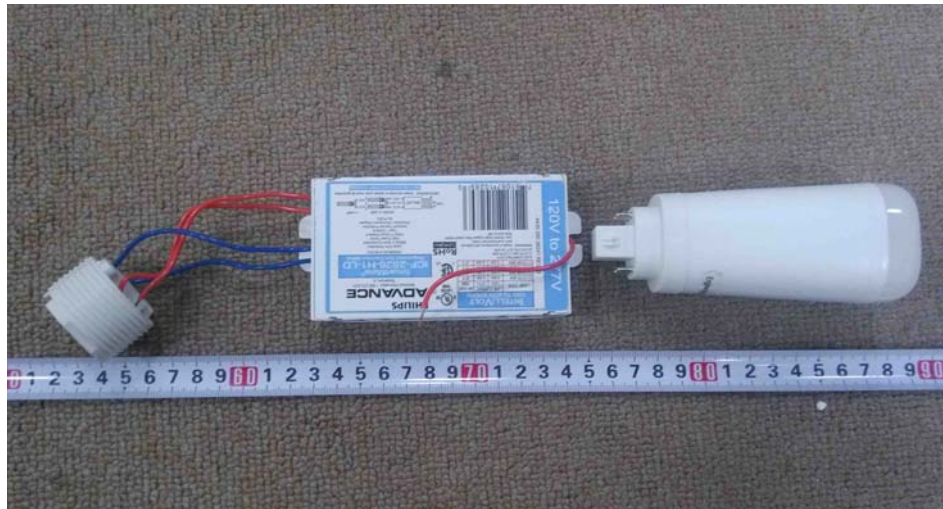


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: InstantFit LEDtube
<b>Model</b>	: 9290011814 (with the ballast ICF-2S26-H1-LD)
<b>Electrical Ratings</b>	: 120V, 60Hz, 10.5W
<b>Product Description</b>	: 4000K, Frosted plastic lens, 10.5PL-C/T LED/26V-4000 IF 4P 10/1 LED lamps supplied by a high frequency fluorescent lamp ballast: Philips ICF-2S26-H1-LD
<b>Manufacturer</b>	: Philips (China) Investment Co., Ltd.
<b>Address</b>	: Building 9, Lane 888, Tianlin Road Shanghai, China

## TEST RESULTS

Test ambient temperature was 24.8°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
Voltage frequency (Hz)	60
Test Current (A)	0.121
Power Factor	0.9932
Test Power (W)	14.38
Luminous Efficacy (lm/W)	96.7
THD A%	6.90
Total Luminous Flux (lm)	1391.0
Color Rendering Index (CRI)	82.5
R9	3.8
Correlated Color Temperature (CCT) (K)	3949
Chromaticity Chroma x	0.3835
Chromaticity Chroma y	0.3813
Chromaticity Chroma u	0.2253
Chromaticity Chroma v	0.3360
Duv	0.0012
Chromaticity Chroma u'	0.2253
Chromaticity Chroma v'	0.5040

Special Color Rendering Indices	
R1	80.4
R2	89.9
R3	95.9
R4	80.2
R5	80.6
R6	85.9
R7	85
R8	62.1
R9	3.8
R10	76
R11	78.7
R12	63.4
R13	82.8
R14	98.1

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 25.2°C.

The photometric distance is 2.475m.

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)	0.121
Power Factor	0.9928
Test Power (W)	14.38
Luminous Efficacy (lm/W)	95.8
Total Luminous Flux (lm)	1378.3
Beam Angle (°)	129.0 (0°-180°)/129.0 (90°-270°)
Center Beam Candle Power (cd)	322
Maximum Beam Candle Power (cd)	322.6 (At: C=10.0, Gamma=0.5)
Spacing Criteria	1.30 (0°-180°)/ 1.31 (90°-270°)
Zonal Lumens in the 0°-60°Zone	57.65%
Zonal Lumens in the 60°-90°Zone	26.50%
Zonal Lumens in the 90°-120°Zone	11.33%
Zonal Lumens in the 120°-180°Zone	4.52%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution - Sphere Spectroradiometer Method

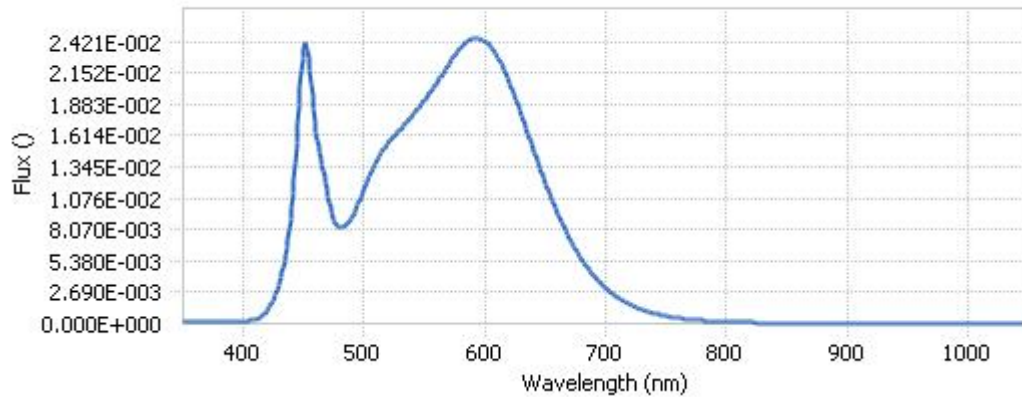


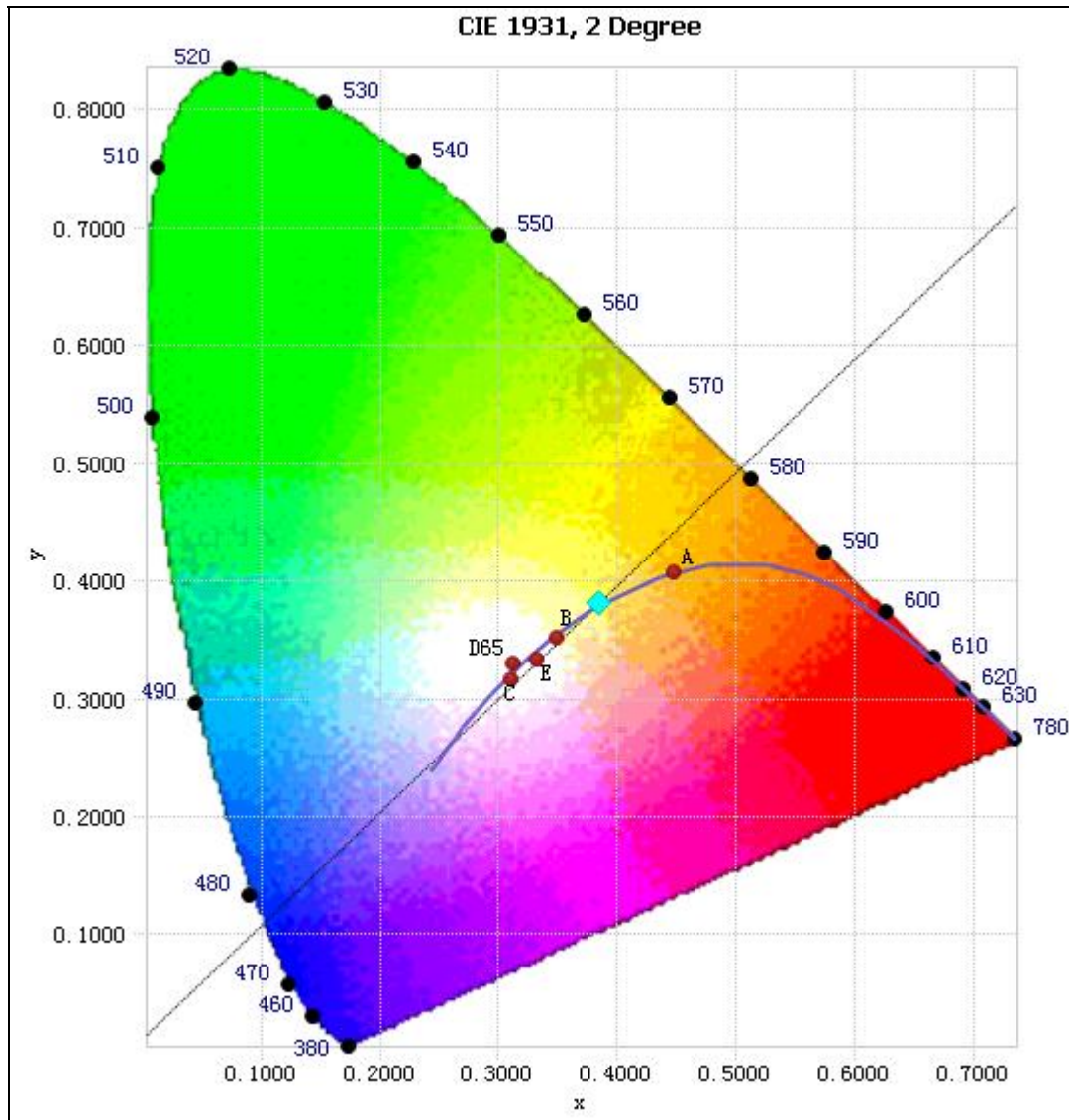
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.08E-04	485	8.49E-03	590	2.44E-02	695	3.55E-03
385	1.86E-04	490	9.18E-03	595	2.44E-02	700	3.03E-03
390	1.81E-04	495	1.04E-02	600	2.42E-02	705	2.61E-03
395	2.04E-04	500	1.16E-02	605	2.37E-02	710	2.23E-03
400	2.24E-04	505	1.28E-02	610	2.30E-02	715	1.93E-03
405	2.63E-04	510	1.38E-02	615	2.20E-02	720	1.64E-03
410	3.49E-04	515	1.48E-02	620	2.07E-02	725	1.41E-03
415	6.07E-04	520	1.55E-02	625	1.95E-02	730	1.21E-03
420	1.20E-03	525	1.61E-02	630	1.80E-02	735	1.03E-03
425	2.11E-03	530	1.67E-02	635	1.64E-02	740	8.80E-04
430	3.55E-03	535	1.72E-02	640	1.50E-02	745	7.51E-04
435	5.89E-03	540	1.79E-02	645	1.36E-02	750	6.50E-04
440	9.96E-03	545	1.85E-02	650	1.21E-02	755	5.65E-04
445	1.72E-02	550	1.92E-02	655	1.08E-02	760	4.83E-04
450	2.36E-02	555	1.99E-02	660	9.51E-03	765	4.13E-04
455	2.17E-02	560	2.06E-02	665	8.37E-03	770	3.56E-04
460	1.64E-02	565	2.14E-02	670	7.32E-03	775	3.09E-04
465	1.36E-02	570	2.23E-02	675	6.35E-03	780	2.67E-04
470	1.09E-02	575	2.30E-02	680	5.54E-03		
475	8.84E-03	580	2.37E-02	685	4.79E-03		
480	8.24E-03	585	2.41E-02	690	4.11E-03		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3835, 0.3813)

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

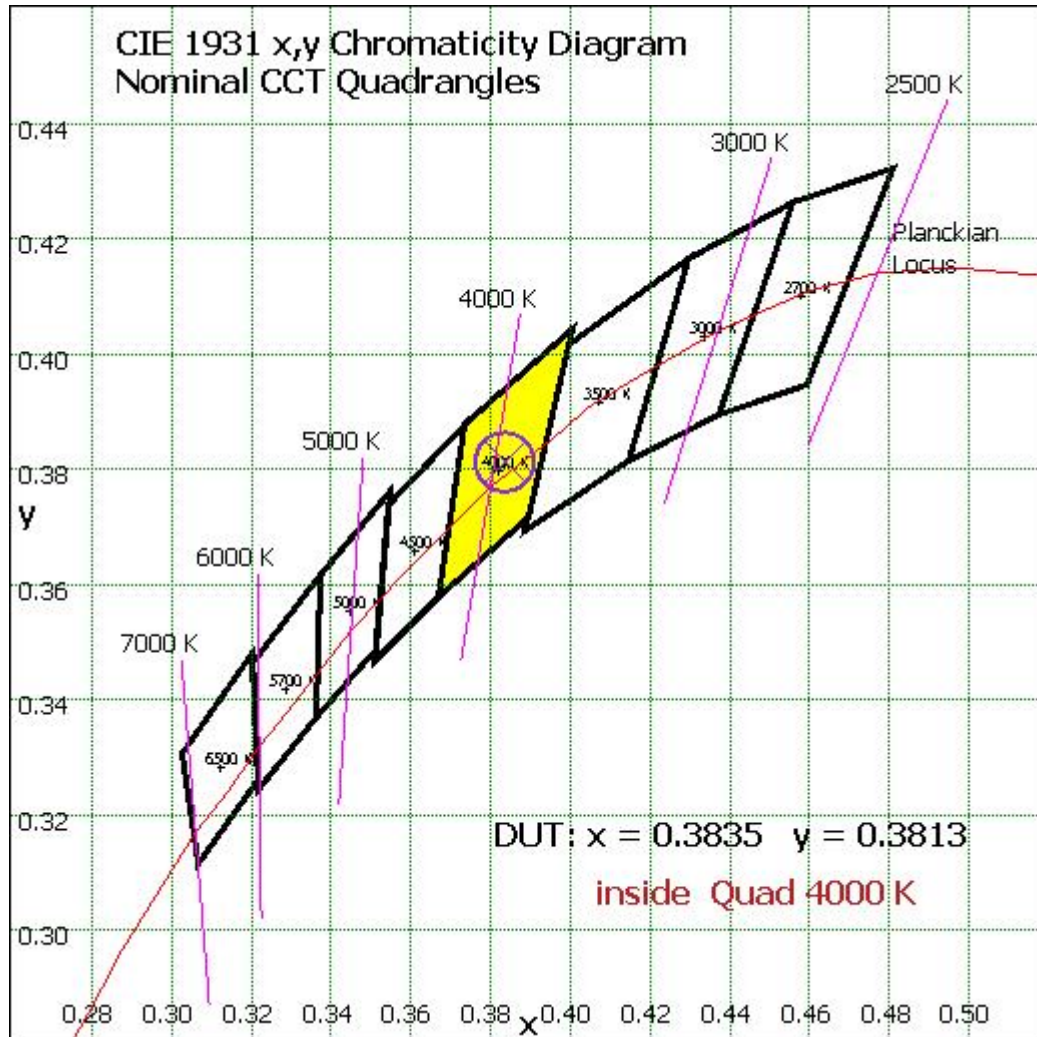


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	30.616	2.22%
10- 20	88.751	6.44%
20- 30	137.244	9.96%
30- 40	170.644	12.38%
40- 50	185.748	13.48%
50- 60	181.54	13.17%
60- 70	159.249	11.55%
70- 80	122.641	8.90%
80- 90	83.378	6.05%
90-100	63.884	4.63%
100-110	52.106	3.78%
110-120	40.211	2.92%
120-130	28.726	2.08%
130-140	18.432	1.34%
140-150	10.039	0.73%
150-160	4.107	0.30%
160-170	0.977	0.07%
170-180	0.049	0.00%
Total	1378.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	794.543	57.64%
60- 90	365.268	26.50%
0-90	1159.811	84.15%
90- 180	218.531	15.85%
0- 180	1378.3	100%

Table 5: Zonal Lumen Data

## Illuminance Plots- Goniophotometer Method

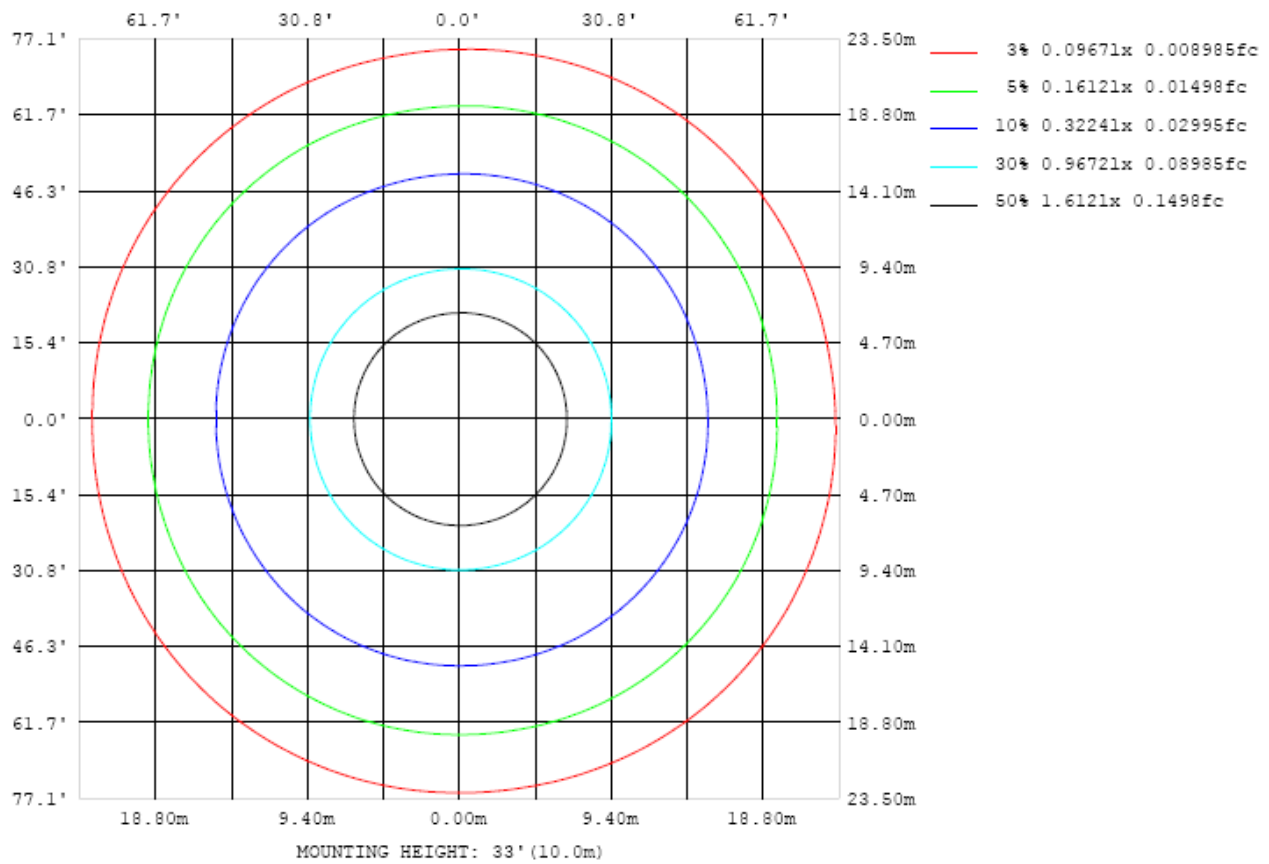


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

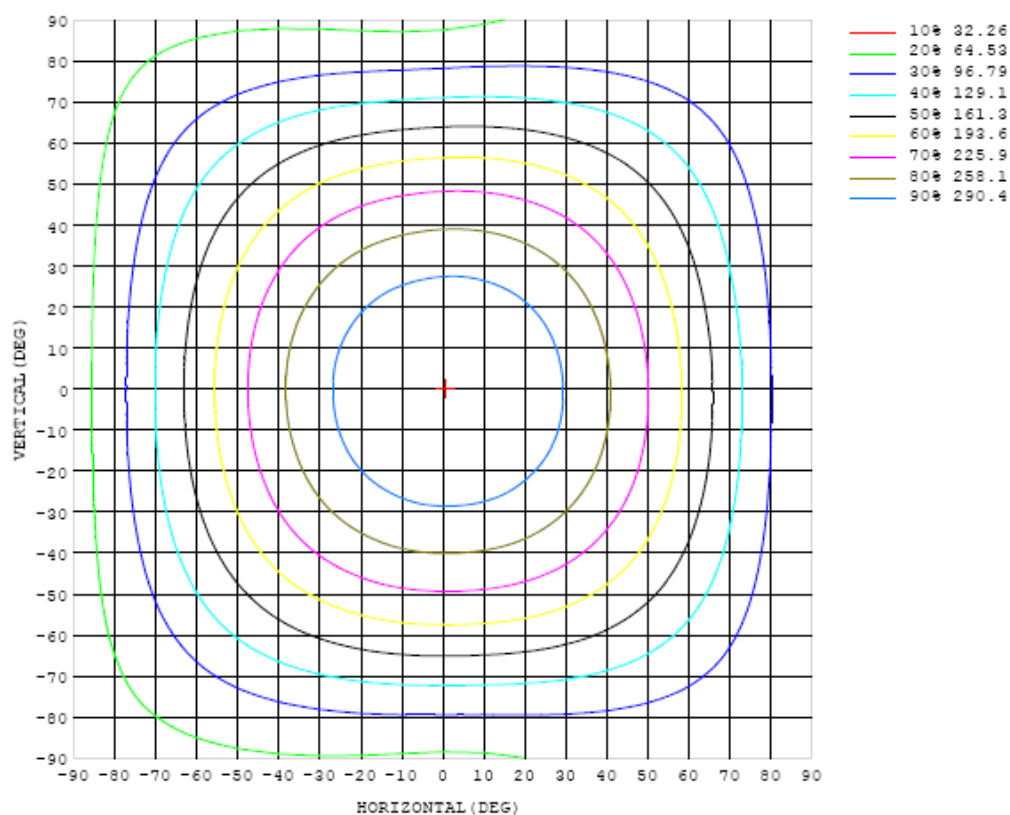


Chart 5: Isocandela Plot

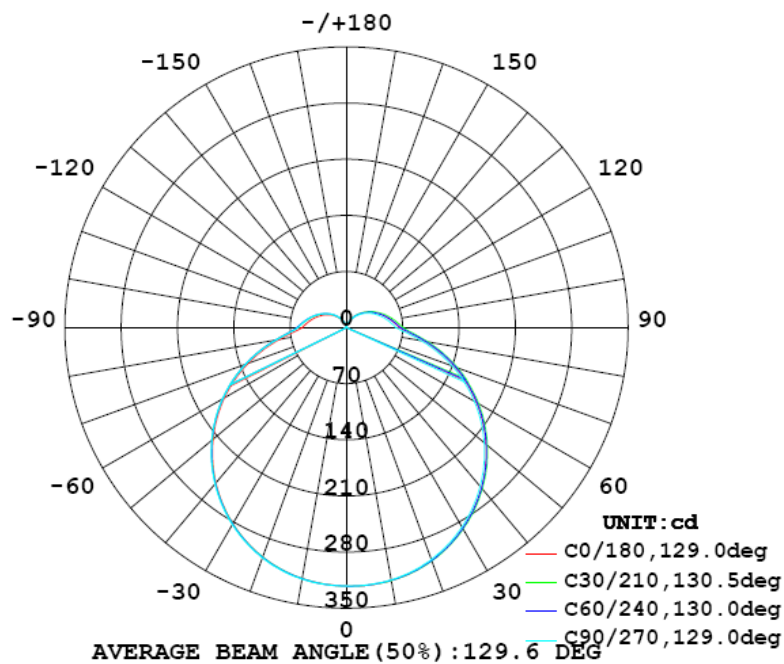


Chart 6: Polar Candela Distribution

## 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	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322
5	322	322	322	322	322	322	322	322	322	322	322	322	322	321	321	321	321	321	321
10	320	320	320	320	320	320	320	320	320	319	319	319	319	319	318	318	318	318	318
15	316	316	316	316	316	316	316	315	315	315	315	314	314	314	314	313	313	313	312
20	309	309	309	310	309	309	309	309	308	308	308	307	307	307	306	306	305	305	305
25	300	300	301	301	301	300	300	299	299	298	298	298	297	297	297	296	295	295	295
30	289	289	290	290	290	289	289	288	287	287	287	287	286	286	285	284	283	283	283
35	276	276	277	277	277	276	276	275	274	273	273	273	273	272	272	271	270	269	269
40	261	261	262	262	262	262	261	260	259	258	258	258	258	257	256	255	254	253	253
45	244	245	246	246	246	246	245	244	242	242	242	241	241	240	239	238	237	236	235
50	226	227	228	229	228	228	227	225	224	223	223	223	223	222	221	220	218	217	217
55	207	208	209	210	209	209	208	206	205	204	204	204	204	203	202	200	198	197	197
60	186	188	189	189	189	189	187	186	184	183	183	184	183	182	181	180	178	176	175
65	165	166	168	168	168	167	166	164	162	162	162	162	162	161	160	158	156	155	153
70	143	145	146	147	147	146	145	143	140	140	140	141	140	140	138	136	134	132	130
75	120	122	123	124	125	124	122	120	118	117	117	118	118	117	115	113	111	109	107
80	97.5	99.6	101	103	103	102	100.0	97.4	95.1	94.4	95.2	95.9	95.9	95.2	93.6	91.4	88.6	86.2	84.9
85	78.1	80.2	82.1	83.2	83.3	82.3	80.4	77.8	75.3	74.8	75.7	76.5	76.6	75.9	74.4	72.1	69.4	67.1	66.6
90	66.0	67.7	69.4	70.3	70.2	69.2	67.2	64.6	62.3	61.8	62.7	63.6	63.8	63.3	61.9	59.8	57.4	55.5	55.4
95	60.8	62.3	63.7	64.5	64.4	63.4	61.5	59.2	57.2	56.8	57.5	58.2	58.4	57.9	56.7	54.8	52.6	51.1	51.0
100	56.0	57.2	58.5	59.2	59.1	58.1	56.5	54.4	52.8	52.3	52.8	53.5	53.6	53.2	52.0	50.3	48.4	47.1	47.0
105	51.5	52.5	53.6	54.2	54.0	53.2	51.7	49.9	48.5	48.1	48.4	49.0	49.1	48.6	47.6	46.0	44.4	43.3	43.1
110	47.0	47.8	48.7	49.3	49.1	48.3	47.0	45.5	44.3	43.9	44.2	44.6	44.6	44.2	43.3	41.9	40.4	39.5	39.4
115	42.5	43.2	44.0	44.4	44.3	43.6	42.5	41.1	40.1	39.8	40.0	40.3	40.3	39.9	39.0	37.8	36.6	35.8	35.6
120	38.1	38.6	39.3	39.7	39.6	39.0	38.0	36.8	36.0	35.7	35.8	36.0	36.0	35.6	34.9	33.8	32.7	32.1	31.9
125	33.7	34.1	34.7	35.0	34.9	34.4	33.5	32.6	31.9	31.6	31.7	31.8	31.8	31.4	30.8	29.9	28.9	28.4	28.3
130	29.3	29.7	30.2	30.4	30.3	29.9	29.2	28.4	27.9	27.6	27.6	27.7	27.7	27.3	26.8	26.0	25.2	24.8	24.6
135	25.1	25.4	25.7	25.9	25.8	25.5	24.9	24.3	23.9	23.7	23.7	23.7	23.6	23.3	22.8	22.2	21.6	21.2	21.1
140	20.9	21.1	21.4	21.6	21.5	21.2	20.8	20.3	20.0	19.8	19.8	19.8	19.7	19.4	19.0	18.5	18.0	17.8	17.6
145	16.9	17.1	17.2	17.4	17.3	17.1	16.8	16.4	16.2	16.1	16.1	16.0	15.9	15.7	15.4	14.9	14.5	14.4	14.2
150	13.0	13.1	13.2	13.3	13.3	13.1	12.9	12.7	12.6	12.5	12.4	12.4	12.3	12.1	11.8	11.5	11.3	11.2	9.26
155	9.46	9.53	9.59	9.64	9.63	9.54	9.43	9.33	9.29	9.21	9.12	9.06	8.95	8.81	8.63	8.47	7.98	5.74	3.90
160	6.31	6.33	6.35	6.37	6.37	6.33	6.29	6.27	6.27	6.22	6.14	6.07	5.97	5.66	5.42	5.26	4.99	5.00	5.29
165	3.67	3.66	3.64	3.64	3.64	3.64	3.64	3.67	3.70	3.68	3.61	3.54	3.43	3.26	3.04	2.82	2.75	2.79	2.92
170	1.57	1.57	1.54	1.54	1.57	1.57	1.35	1.37	1.59	1.51	1.60	1.58	1.49	1.41	1.30	1.07	1.10	1.16	1.18
175	0.28	0.28	0.31	0.35	0.38	0.40	0.42	0.45	0.48	0.49	0.48	0.46	0.43	0.41	0.39	0.36	0.31	0.29	0.28
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

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	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322		
5	321	321	321	321	321	321	321	321	321	322	322	322	322	322	322	322	322		
10	318	318	318	318	318	318	318	318	318	319	319	319	319	319	320	320	320		
15	312	312	312	312	313	313	313	313	313	314	314	314	315	315	315	316	315		
20	305	305	305	305	305	305	305	305	306	306	307	307	308	308	309	309	309		
25	295	295	295	295	295	295	295	295	296	296	297	298	299	299	300	300	300		
30	283	283	283	283	283	283	283	283	284	285	285	286	287	288	288	288	288		
35	269	269	269	269	269	269	269	269	270	271	272	273	274	275	275	275	275		
40	253	253	253	254	254	254	253	253	254	256	257	258	259	260	260	260	260		
45	236	236	236	237	237	237	236	236	237	239	240	241	243	244	244	244	244		
50	217	218	218	218	218	218	218	218	219	220	222	223	225	226	226	226	226		
55	197	198	198	199	199	199	198	198	199	201	203	204	206	206	207	206	206		
60	176	177	178	178	178	178	177	177	178	180	182	184	185	186	186	186	186		
65	154	155	156	156	156	156	155	155	156	158	160	162	164	165	165	164	164		
70	131	133	134	134	134	134	133	132	133	136	138	140	142	142	142	142	141		
75	108	110	111	112	112	111	110	109	111	113	116	118	119	120	120	119	118		
80	86.4	88.2	89.5	90.2	90.3	89.5	88.5	87.7	88.6	91.4	94.2	96.4	97.9	98.4	98.1	96.9	95.8		
85	68.2	70.1	71.4	72.2	72.3	71.8	70.8	69.8	70.8	73.1	75.8	78.0	79.4	79.8	79.1	77.8	76.5		
90	57.2	59.3	60.9	62.0	62.2	61.7	60.7	60.0	60.8	63.2	65.8	67.8	69.0	69.2	68.4	66.9	65.6		
95	52.4	54.4	55.9	56.9	57.1	56.7	55.8	55.3	56.0	58.1	60.4	62.3	63.4	63.5	62.8	61.5	60.5		
100	48.2	49.8	51.3	52.1	52.4	52.0	51.3	51.0	51.6	53.4	55.4	57.1	58.1	58.3	57.7	56.6	55.8		
105	44.1	45.5	46.8	47.6	47.9	47.6	47.0	46.8	47.4	48.9	50.7	52.2	53.1	53.3	52.7	51.8	51.2		
110	40.1	41.4	42.5	43.3	43.5	43.3	42.9	42.7	43.2	44.5	46.1	47.4	48.2	48.4	47.9	47.2	46.7		
115	36.3	37.3	38.3	39.0	39.2	39.0	38.7	38.6	39.1	40.2	41.5	42.7	43.5	43.6	43.3	42.6	42.2		
120	32.4	33.3	34.2	34.8	35.0	34.9	34.6	34.6	35.0	35.9	37.1	38.1	38.8	38.9	38.6	38.1	37.8		
125	28.6	29.4	30.1	30.6	30.8	30.7	30.5	30.5	30.9	31.7	32.6	33.6	34.1	34.3	34.1	33.7	33.5		
130	24.9	25.5	26.1	26.5	26.7	26.7	26.5	26.6	26.9	27.5	28.3	29.1	29.6	29.7	29.6	29.3	29.2		
135	21.2	21.7	22.1	22.5	22.7	22.7	22.6	22.7	22.9	23.4	24.0	24.7	25.1	25.3	25.2	25.0	24.9		
140	17.6	18.0	18.3	18.6	18.8	18.8	18.8	18.8	19.0	19.4	19.9	20.4	20.8	20.9	20.9	20.8	20.7		
145	14.2	14.4	14.7	14.9	15.0	15.1	15.1	15.2	15.3	15.6	15.9	16.3	16.6	16.7	16.7	16.7	16.7		
150	6.63	9.08	10.3	11.3	11.5	11.5	11.6	11.7	11.8	11.9	12.2	12.4	12.7	12.8	12.8	12.8	12.9		
155	6.97	8.06	7.75	7.63	8.13	8.27	8.30	8.40	8.49	8.54	8.70	8.87	9.03	9.14	9.21	9.27	9.37		
160	5.14	5.15	4.98	4.80	5.12	5.34	5.33	5.45	5.53	5.46	5.52	5.64	5.76	5.88	5.97	6.06	6.18		
165	2.82	2.64	2.11	1.77	2.00	2.26	2.59	2.93	3.05	3.02	2.93	2.99	3.06	3.14	3.26	3.38	3.51		
170	1.13	0.92	0.62	0.34	0.28	0.28	0.29	0.27	0.27	0.28	0.31	0.46	0.66	0.86	1.20	1.32	1.48		
175	0.28	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.28	0.28		
180	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	PF2010A	HZTE028-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-08	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	WY12010	HZTE004-03	Sep. 18, 2014	Sep. 17, 2015
Temperature Meter	TES1310	HZTE017-01	Sep. 18, 2014	Sep. 17, 2015
Standard source	D908	HZTE012-01	Sep. 18, 2014	Sep. 17, 2015
Integrate Sphere system	2M	HZTE015-01	Sep. 18, 2014	Sep. 17, 2015
Digital Power Meter	WT210	HZTE008-01	Sep. 18, 2014	Sep. 17, 2015
AC Power Supply	PCR 500L	HZTE001-07	Sep. 18, 2014	Sep. 17, 2015
DC Power Supply	6154	HZTE004-04	Sep. 18, 2014	Sep. 17, 2015
Temperature and humidity recorder	JR900	HZTE018-01	Sep. 18, 2014	Sep. 17, 2015
Standard source	SCL-1400	HZTE012-02	Sep. 18, 2014	Sep. 17, 2015

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 expended uncertainty is 1.06% 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 1.94% with a coverage factor  $k=2$ .

### **Color Characteristics Measurements**

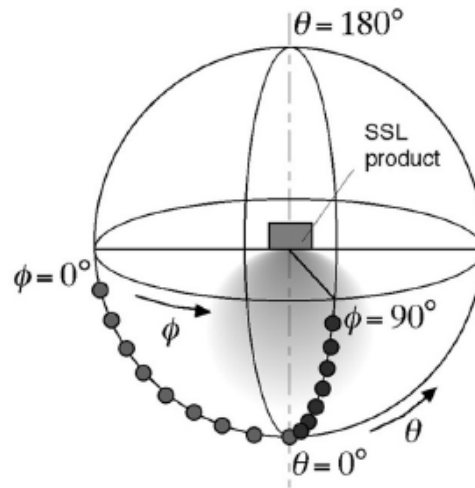
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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