



## LM-79-08 Test Report

for

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

Building 9, Lane 888, Tianlin Road  
Shanghai, China

**InstantFit LEDtube**

**Model: 9290002880 (2 lamps+ballast ICN-2P32-N)**

**Laboratory: Leading Testing Laboratories**

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Report No.: HZ14040022a

Review by:

*April Zou*

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Apr. 16, 2014

Approved by:



Manager: Jim Zhang  
Apr. 16, 2014

## Test Summary

Sample Tested: 9290002880 (2 lamps+ballast ICN-2P32-N)

### Photometric and Electrical Measurements for two lamps

Voltage (V AC)	Current (A)	Test power (W) (ballast + 2 tubes)	Power Factor	Total Luminous Flux (lm)	Luminous Efficacy (lm/W)	Total Harmonic Distortion
120.0	0.316	37.8	0.9974	3986.0	105.4	5.83

### Photometric and Colorimetric Measurements for each lamp

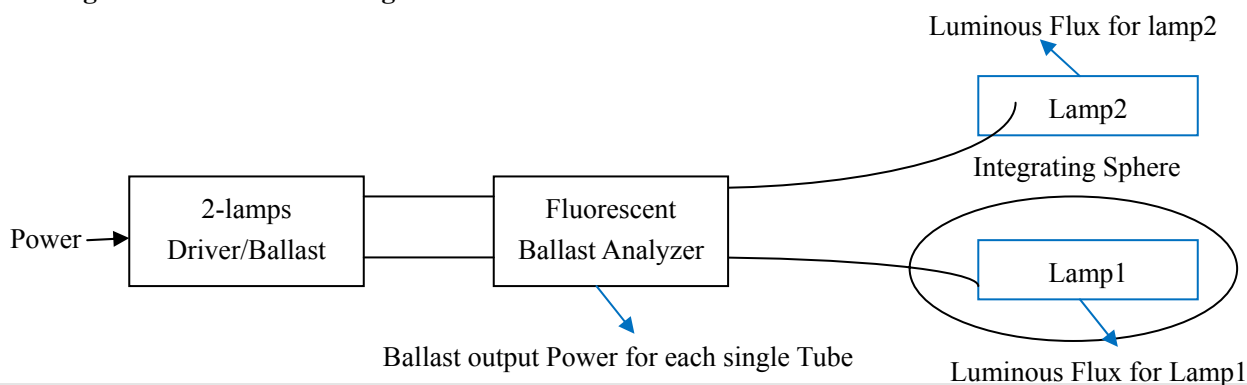
Sample Number	Luminous Flux(lm)	Test power (W)(bare tube)	Efficiency for single Tube (lm/W)	Correlated Color Temperature (K)
1#	1989.0	15.0	132.6	3046
2#	1997.0	15.1	132.3	3070
Sample Number	Color Rendering Index Ra	Color Rendering Index R9	Chromaticity Coordinate x	Chromaticity Coordinate y
1#	81.9	17.7	0.4315	0.3984
2#	81.9	17.6	0.4298	0.3979

Table 1: Executive Data Summary

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

Luminous Efficacy=(Luminous Flux for lamp1+ Luminous Flux for lamp2)/Power

Test figure is shown as following:



### Test specifications:

**Date of Receipt** : Apr. 15, 2014

**Date of Test** : Apr. 15, 2014

**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

The Ballast output Power for single Tube was tested using the Fluorescent Ballast Analyzer as per Client's requirement.

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## Sample Photos

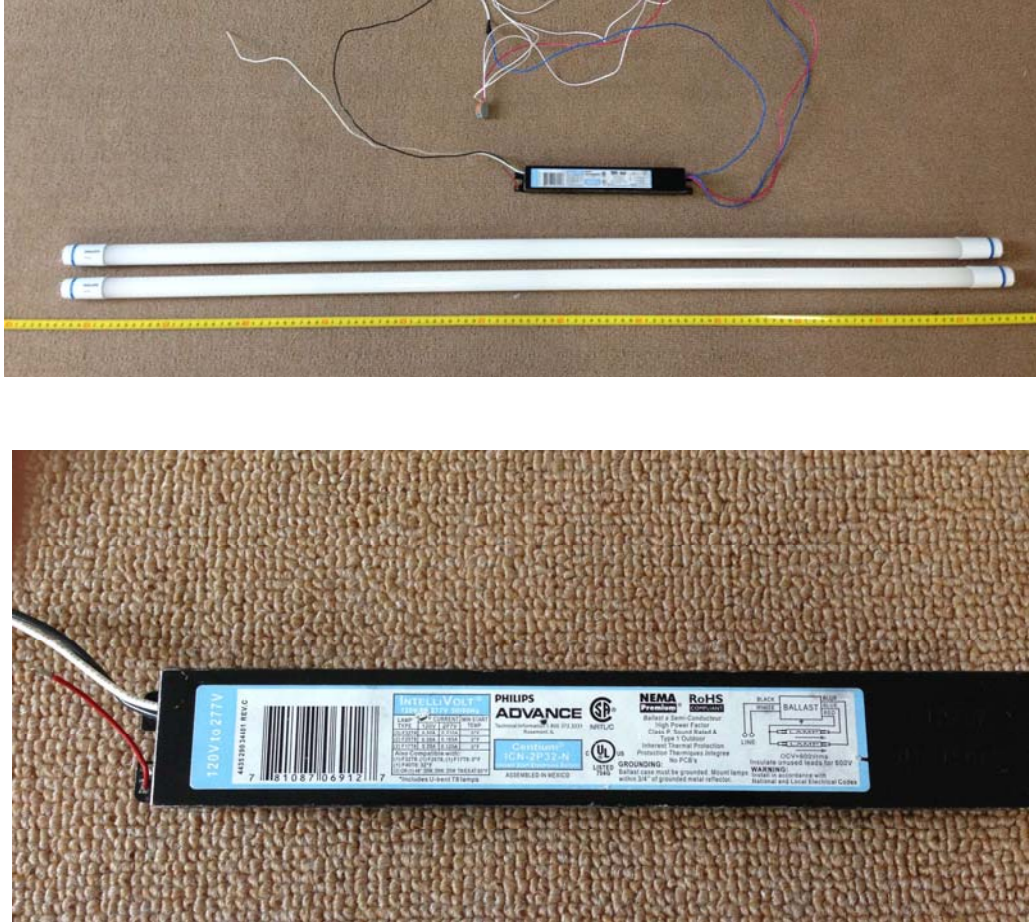


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: InstantFit LEDtube
<b>Model</b>	: 9290002880 (2 lamps+ballast ICN-2P32-N)
<b>Electrical Ratings</b>	: 12V AC, 50Hz, 16.5W
<b>Product Description</b>	: G13 base, 4 foot fixed ends tube, 3000K, 16.5T8/48-3000 IF 10/1 LED tubes supplied by a high frequency fluorescent lamp ballast: PHILIPS ICN-2P32-N
<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 24.3°C

Base orientation was light down. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 70 minutes, and the total operating time including stabilization was 105 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result			Special Color Rendering Indices		
	1#	2#	1#		1#	2#
Test Voltage (V)	120.0		277.0			
Voltage frequency (Hz)	60		60	R1	80.1	80.1
Test Current (A)	0.316		0.137	R2	88.4	88.3
Power Factor	0.9974		0.9817	R3	94.5	94.4
Test power (W) (ballast + 2 tubes)	37.8		37.1	R4	79.6	79.6
Luminous Efficacy (lm/W)	105.4		/	R5	79.4	79.3
THD A%	5.83		10.01	R6	83.7	83.6
Total Luminous Flux (lm)	1989.0	1989.0		R7	85.2	85.3
Test power (W) (bare tube)	15.0	15.0		R8	64.4	64.5
Efficiency for single Tube (lm/W)	132.6	132.6		R9	17.7	17.6
Color Rendering Index (CRI)	81.9	81.9		R10	72.5	72.3
R9	17.7	17.7		R11	76.9	76.9
Correlated Color Temperature (CCT) (K)	3046	3046		R12	64.7	64.4
Chromaticity (Chroma x, Chroma y)	(0.4315, 0.3984)	(0.4315, 0.3984)		R13	81.6	81.6
Chromaticity (Chroma u, Chroma v)	(0.2495, 0.3455)	(0.2495, 0.3455)		R14	96.7	96.6
Chromaticity (Chroma u', Chroma v')	(0.2495, 0.5183)	(0.2495, 0.5183)				
Duv	0.0016	0.0016				

Table 2: Test data per Sphere-Spectroradiometer Method

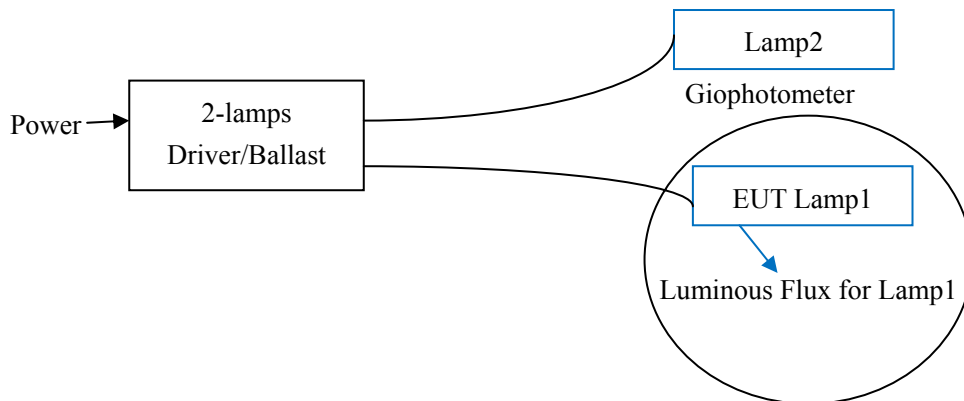
Note: According to CIE 1976 (u',v') diagram,  $u' = u = 4x/(-2x+12y+3)$ ,  $v' = 3v/2 = 9y/(-2x+12y+3)$ .

### Goniophotometer Method

The photometric distance is 2.475m.

Luminous data was taken at  $0.5^\circ$  vertical intervals and  $5^\circ$  horizontal intervals.

Test figure is shown as following:



Note: One lamp was tested in Goniophotometer system. The total electrical input data was recorded before the ballast and divided by 2 in table below to be used as the input data of the tested one lamp.

Parameter	Result
Test Voltage (V)	120.1
Voltage frequency (Hz)	60
Test Current (A)	0.323
Power Factor	0.9971
Test power (W) (ballast + 2 tubes)/2	19.3
Luminous Efficacy (lm/W)	98.5
Total Luminous Flux (lm) (Single tube)	1900.3
Test power (W) (bare tube)	15.0
Luminous Efficacy (lm/W) (bare tube)	126.7
Beam Angle ( $^\circ$ )	115.0 ( $0^\circ$ - $180^\circ$ )/ 162.1 ( $90^\circ$ - $270^\circ$ )
Center Beam Candle Power (cd)	424
Maximum Beam Candle Power (cd)	424.5 (At: C=0.0, Gamma=0.0)
Spacing Criteria	1.28 ( $0^\circ$ - $180^\circ$ )/ 1.38( $90^\circ$ - $270^\circ$ )
Zonal Lumens in the $0^\circ$ - $60^\circ$ Zone	55.77%
Zonal Lumens in the $60^\circ$ - $90^\circ$ Zone	29.08%
Zonal Lumens in the $90^\circ$ - $120^\circ$ Zone	12.13%
Zonal Lumens in the $120^\circ$ - $180^\circ$ Zone	3.02%

Table 3: Test data per Goniophotometer Method

## Spectral Power Distribution of 1# tube - Sphere Spectroradiometer Method

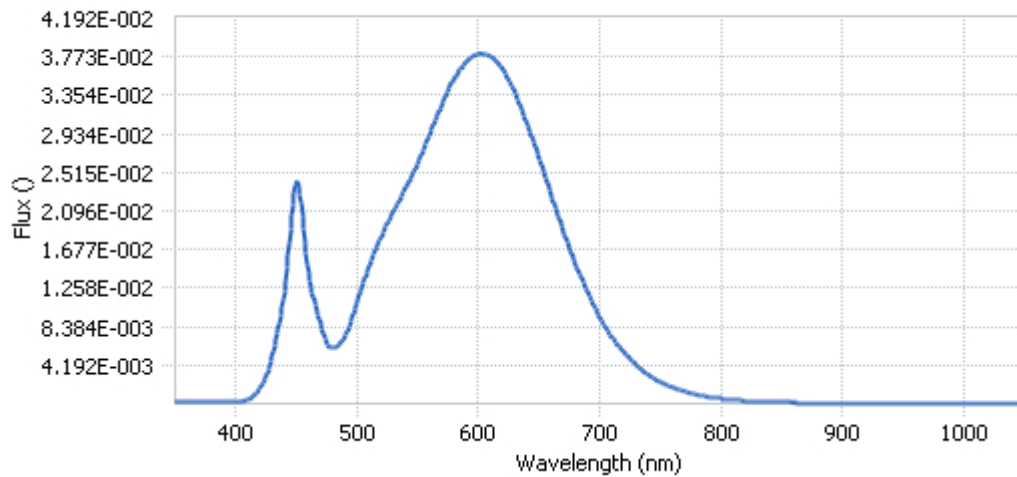


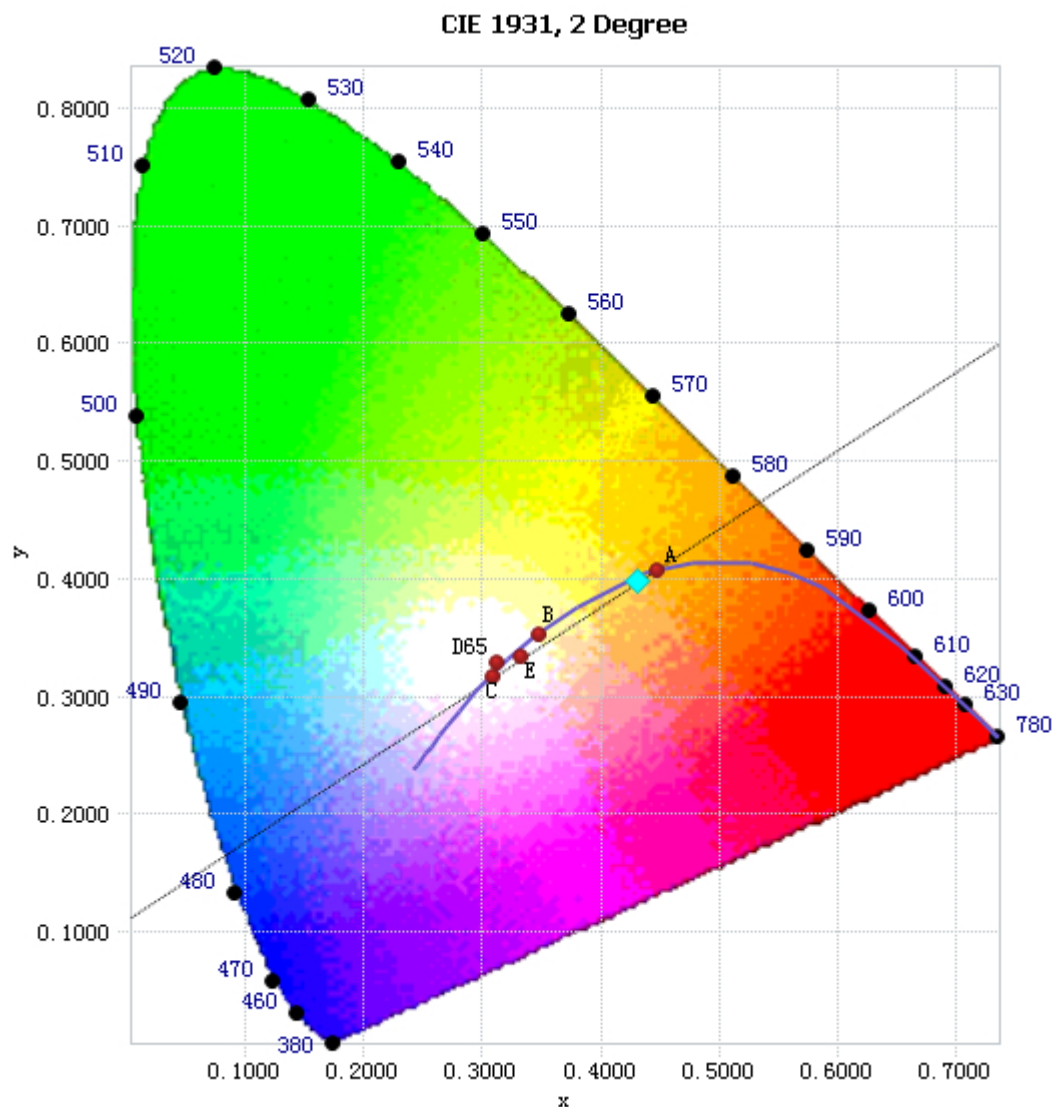
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	1.81E-04	485	6.42E-03	590	3.72E-02	695	1.07E-02
385	1.97E-04	490	7.37E-03	595	3.77E-02	700	9.49E-03
390	2.05E-04	495	9.02E-03	600	3.80E-02	705	8.33E-03
395	1.98E-04	500	1.10E-02	605	3.80E-02	710	7.29E-03
400	2.26E-04	505	1.31E-02	610	3.77E-02	715	6.39E-03
405	3.08E-04	510	1.50E-02	615	3.71E-02	720	5.60E-03
410	5.05E-04	515	1.68E-02	620	3.63E-02	725	4.88E-03
415	9.03E-04	520	1.82E-02	625	3.52E-02	730	4.22E-03
420	1.68E-03	525	1.96E-02	630	3.38E-02	735	3.66E-03
425	3.05E-03	530	2.09E-02	635	3.22E-02	740	3.18E-03
430	5.18E-03	535	2.21E-02	640	3.06E-02	745	2.75E-03
435	8.17E-03	540	2.35E-02	645	2.87E-02	750	2.37E-03
440	1.23E-02	545	2.48E-02	650	2.67E-02	755	2.06E-03
445	1.90E-02	550	2.62E-02	655	2.48E-02	760	1.79E-03
450	2.42E-02	555	2.78E-02	660	2.27E-02	765	1.55E-03
455	2.03E-02	560	2.93E-02	665	2.07E-02	770	1.32E-03
460	1.42E-02	565	3.10E-02	670	1.89E-02	775	1.16E-03
465	1.11E-02	570	3.25E-02	675	1.70E-02	780	1.00E-03
470	8.63E-03	575	3.40E-02	680	1.53E-02		
475	6.58E-03	580	3.53E-02	685	1.37E-02		
480	6.08E-03	585	3.64E-02	690	1.21E-02		

Table 3: Spectral Power Distribution Numerical Data per Sphere - Spectroradiometer Method



## Chromaticity Diagram of 1# tube - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.4315, 0.3984)

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 of 1# tube – Sphere Spectroradiometer Method

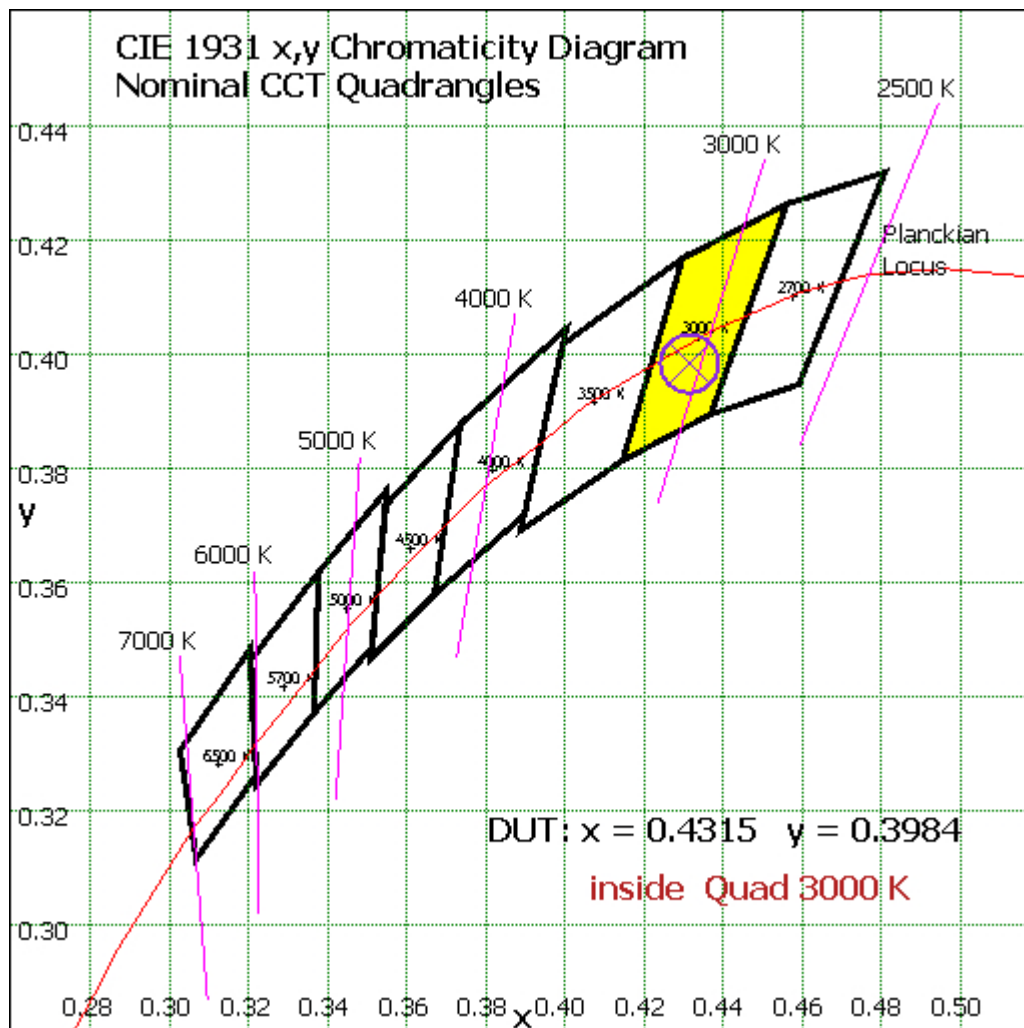


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	40.245	2.12%
10- 20	116.541	6.13%
20- 30	180.691	9.51%
30- 40	226.151	11.90%
40- 50	248.764	13.09%
50- 60	247.369	13.02%
60- 70	224.321	11.80%
70- 80	185.838	9.78%
80- 90	142.426	7.50%
90-100	105.363	5.54%
100-110	75.12	3.95%
110-120	49.971	2.63%
120-130	30.452	1.60%
130-140	16.408	0.86%
140-150	7.205	0.38%
150-160	2.563	0.13%
160-170	0.704	0.04%
170-180	0.119	0.01%
Total	1900.3	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1059.761	55.77%
60- 90	552.585	29.08%
0-90	1612.346	84.85%
90- 180	287.905	15.15%
0- 180	1900.3	100%

Table 4: Zonal Lumen Data

## Illuminance Plots- Goniophotometer Method

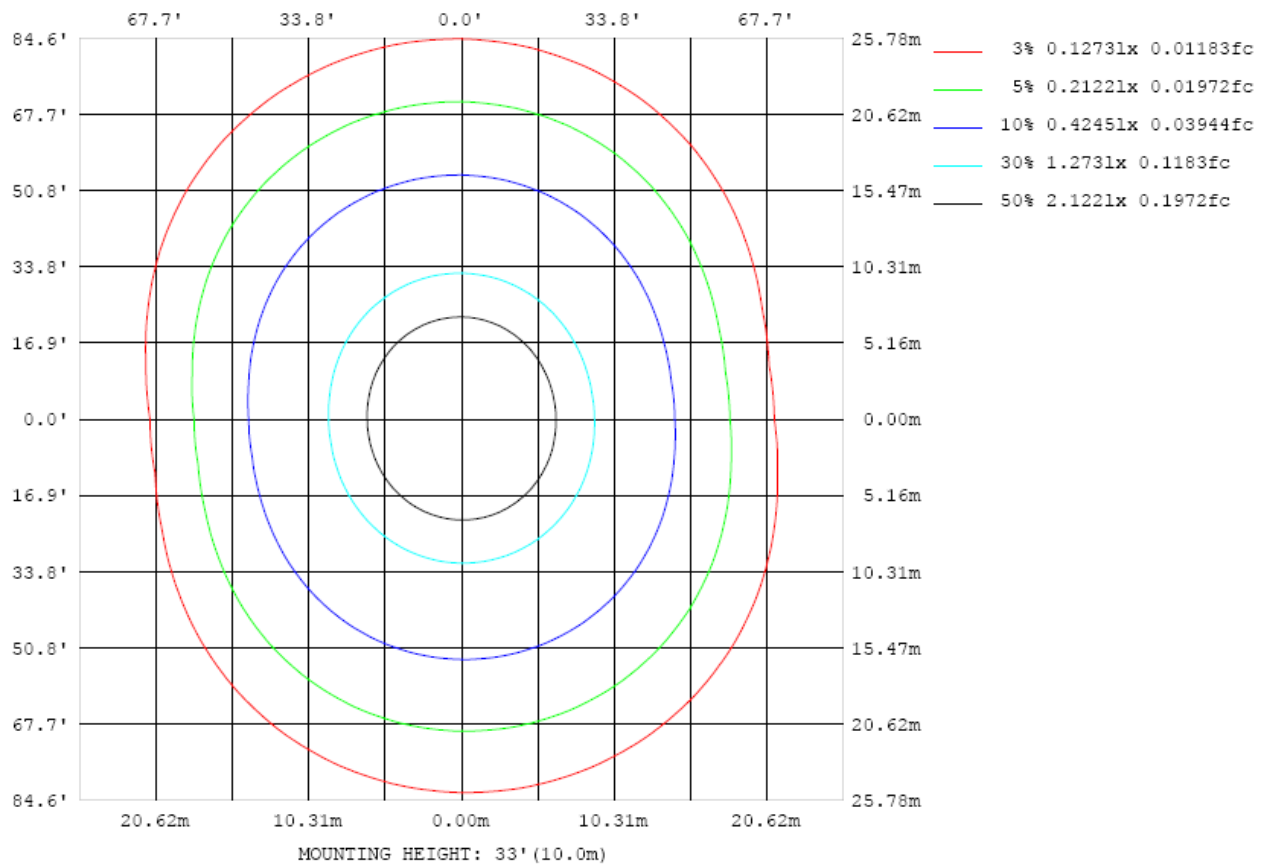


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

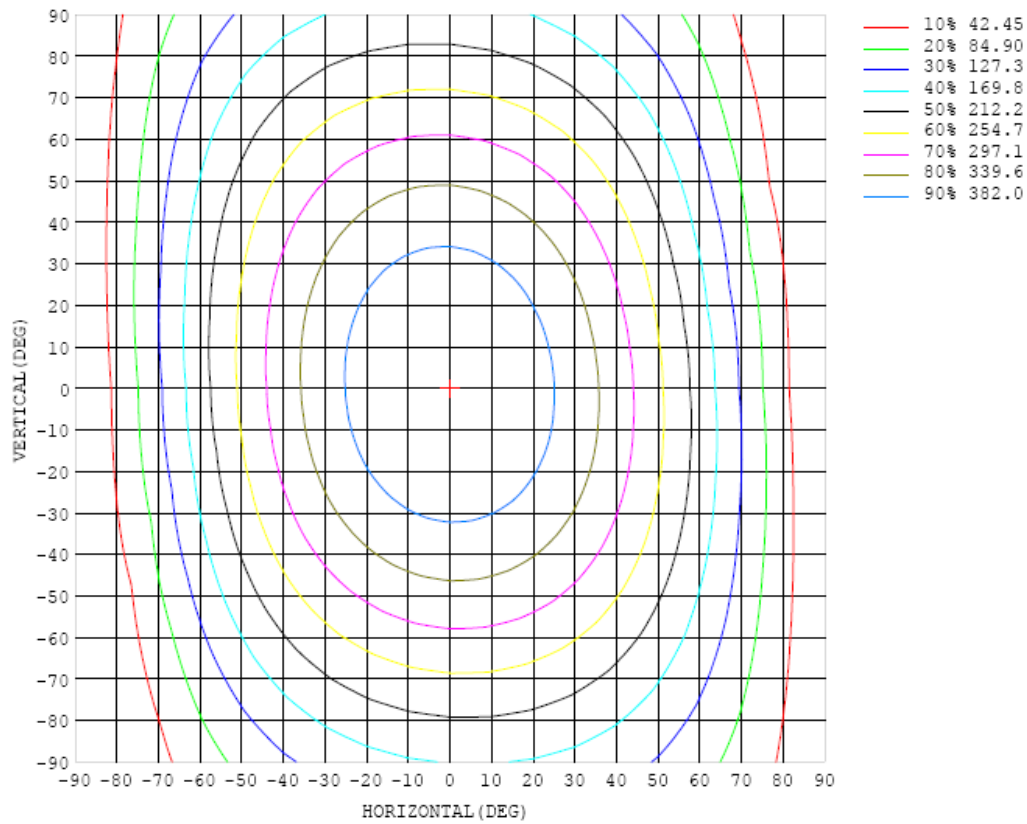


Chart 5: Isocandela Plot

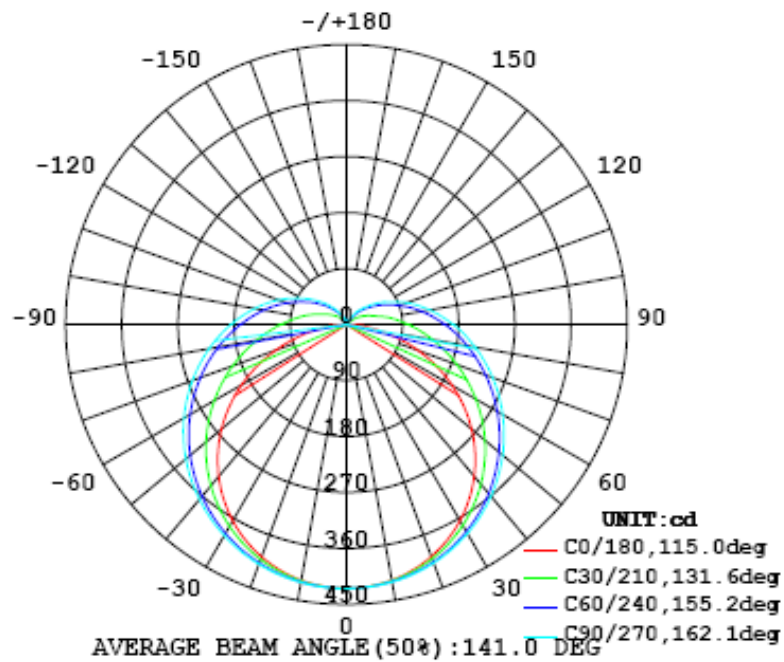


Chart 6: Polar Candela Distribution

## Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424
5	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423
10	417	418	418	418	419	419	420	420	420	420	420	420	419	419	418	418	417	417	418
15	409	409	410	411	412	413	414	415	415	415	415	414	413	412	411	410	409	409	409
20	397	398	399	401	403	405	406	407	408	408	408	406	405	403	401	399	398	397	397
25	382	383	385	388	391	394	396	398	399	399	398	396	394	391	388	386	384	382	383
30	364	366	369	373	377	381	384	386	388	388	386	384	381	377	373	369	366	364	364
35	343	345	350	355	361	366	370	373	375	375	373	370	366	360	355	350	345	343	343
40	318	322	328	335	342	349	354	358	360	360	358	354	349	342	335	328	322	319	319
45	291	296	304	313	322	331	337	342	344	344	342	337	330	322	313	304	296	291	292
50	262	268	278	290	301	311	319	324	327	327	324	318	310	300	289	277	267	261	261
55	230	238	251	265	278	290	299	305	308	308	305	298	289	277	264	249	237	229	229
60	196	207	223	239	255	269	279	286	289	289	285	278	267	254	238	220	204	194	194
65	160	174	194	213	232	247	258	266	269	269	265	257	245	230	211	191	171	157	158
70	123	141	165	188	208	225	237	245	249	249	245	236	223	206	186	162	137	120	120
75	85.7	109	137	164	186	203	217	225	229	229	225	215	202	183	160	133	104	82.2	83.8
80	51.2	79.5	112	140	164	183	196	205	209	209	205	195	181	161	137	107	74.0	48.1	50.5
85	23.7	55.0	88.8	119	143	163	177	186	190	190	185	176	161	141	115	83.9	49.2	20.9	23.6
90	8.05	36.8	69.7	99.4	124	144	158	167	172	171	166	156	141	121	95.4	64.7	31.5	6.25	8.89
95	2.70	24.2	54.2	82.5	107	126	140	149	153	153	148	138	123	103	78.5	49.6	20.3	2.28	4.07
100	1.71	13.8	39.3	67.6	90.7	109	123	132	136	135	131	121	107	87.6	64.2	38.1	13.9	0.73	2.11
105	0.00	10.1	28.5	52.1	74.8	92.6	106	115	119	119	114	105	91.4	73.5	52.2	29.3	9.42	0.16	1.11
110	0.00	6.70	23.2	41.3	60.6	77.9	89.5	97.2	102	103	98.8	90.1	77.5	61.2	42.0	22.1	6.46	0.12	1.52
115	0.13	2.45	16.5	34.0	50.0	64.1	75.8	83.5	85.7	85.9	84.0	76.6	64.9	50.1	33.2	16.5	4.00	0.21	1.62
120	0.32	0.86	11.1	26.3	40.3	52.8	63.0	70.0	73.6	71.8	68.7	63.9	53.3	40.0	25.7	11.7	2.45	0.35	1.60
125	0.41	0.75	5.01	18.4	31.7	42.2	50.9	57.0	60.2	60.2	55.9	49.7	42.6	31.6	19.0	7.10	1.57	0.42	1.57
130	0.44	0.75	2.45	10.4	23.0	33.3	40.5	45.3	47.9	47.8	44.4	38.6	31.9	23.3	12.6	4.41	1.33	0.47	1.46
135	0.53	0.61	1.70	5.37	14.0	24.6	31.2	35.5	37.6	37.5	35.1	30.2	23.4	15.1	6.82	2.98	1.01	0.58	1.31
140	0.61	0.54	1.22	3.32	7.31	14.2	21.3	26.5	28.7	28.6	26.5	21.9	15.1	8.49	4.95	2.07	0.74	0.63	1.23
145	0.66	0.52	0.87	1.99	4.25	6.89	11.2	15.0	17.2	17.5	15.7	12.1	8.01	5.39	2.70	1.47	0.59	0.68	1.18
150	0.74	0.53	0.66	1.37	2.34	4.11	5.64	6.86	7.89	8.05	7.41	6.50	5.04	2.94	1.98	0.95	0.60	0.68	1.09
155	0.80	0.56	0.58	0.88	1.56	2.13	2.96	3.98	4.60	4.72	4.24	3.34	2.68	1.99	1.22	0.70	0.63	0.72	1.07
160	0.84	0.64	0.58	0.59	0.85	1.29	1.69	2.03	2.24	2.31	2.21	1.94	1.57	1.13	0.79	0.62	0.62	0.73	1.03
165	0.88	0.72	0.63	0.59	0.57	0.61	0.85	0.99	1.08	1.10	1.06	0.97	0.84	0.68	0.62	0.65	0.71	0.77	0.87
170	0.89	0.77	0.69	0.63	0.60	0.60	0.60	0.59	0.60	0.61	0.62	0.64	0.65	0.65	0.67	0.73	0.79	0.85	0.90
175	0.95	0.84	0.75	0.69	0.66	0.63	0.63	0.63	0.64	0.66	0.67	0.69	0.71	0.71	0.76	0.83	0.89	0.95	1.03
180	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79

Table 5: 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	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424	424		
5	423	423	423	423	423	423	423	423	423	423	423	423	423	423	423	422	423		
10	418	418	419	419	420	420	421	421	421	421	420	420	419	418	418	418	417		
15	410	411	412	413	414	415	416	416	416	416	415	414	413	411	410	409	409		
20	398	400	402	404	406	408	409	410	410	409	408	406	404	401	400	398	397		
25	384	387	390	393	396	399	401	402	402	401	399	396	393	389	386	384	382		
30	367	370	375	380	384	388	390	392	392	390	387	384	379	374	370	366	364		
35	346	351	358	364	370	375	378	380	380	378	374	369	363	357	351	346	343		
40	323	330	338	346	354	360	364	367	367	364	360	353	346	337	329	322	319		
45	297	306	317	327	337	344	349	352	352	349	344	336	326	316	305	297	291		
50	269	281	294	307	318	327	333	336	336	333	326	317	306	293	280	268	262		
55	239	253	270	285	298	309	316	319	319	315	308	297	284	268	252	238	229		
60	207	225	245	263	278	290	297	301	301	297	289	277	261	243	224	206	195		
65	174	196	219	240	257	270	278	282	282	277	269	256	239	218	195	173	159		
70	140	168	194	217	235	249	258	263	263	258	248	234	215	192	166	140	121		
75	108	140	169	194	214	229	239	243	243	238	228	213	193	168	139	107	84.4		
80	79.2	114	146	173	194	209	219	224	224	218	208	192	171	144	113	78.2	50.4		
85	55.3	92.0	125	152	173	189	199	204	204	199	188	172	150	123	90.2	53.8	22.5		
90	37.2	72.9	105	133	154	170	180	185	185	180	169	153	131	103	71.1	35.6	7.12		
95	25.6	58.0	88.6	115	136	152	162	167	167	162	151	135	114	87.2	56.5	24.4	3.60		
100	17.9	45.4	74.2	99.0	119	135	145	150	149	144	134	119	97.9	73.1	44.5	17.1	2.07		
105	12.8	35.5	60.9	84.5	104	118	128	133	133	128	118	103	84.0	60.5	34.7	12.4	1.63		
110	10.4	27.9	49.6	70.5	88.6	102	112	116	116	111	102	88.6	70.4	49.0	27.5	10.0	1.57		
115	8.75	22.1	40.2	58.5	74.3	86.8	95.2	99.7	99.8	95.4	87.0	74.2	58.0	39.9	22.1	8.22	1.44		
120	7.27	18.0	32.4	48.2	62.2	73.1	80.6	84.2	84.3	80.8	72.9	61.8	47.9	32.9	18.0	6.91	1.47		
125	6.25	14.6	26.2	39.3	50.9	60.7	67.6	71.1	71.2	67.7	60.9	51.1	39.6	26.2	14.5	6.00	1.42		
130	5.39	12.2	21.3	31.6	41.5	49.4	55.3	58.5	58.5	55.6	50.0	42.1	32.1	21.5	12.1	5.27	1.35		
135	4.59	10.1	17.0	25.2	32.7	38.8	45.1	47.6	47.6	45.3	40.4	33.8	25.5	17.1	10.0	4.56	1.27		
140	3.87	8.40	13.7	19.7	26.2	31.3	35.4	37.5	37.6	35.9	32.1	26.6	20.1	13.9	7.97	3.93	1.21		
145	3.36	6.78	11.1	15.6	20.0	24.0	27.1	28.6	28.8	27.5	24.4	20.4	15.7	11.0	6.68	3.33	1.12		
150	2.63	5.21	8.74	12.1	15.2	18.2	20.3	21.5	21.4	20.3	18.3	15.4	11.9	8.16	5.03	2.65	1.06		
155	2.01	4.11	6.42	9.04	11.4	13.3	14.7	15.5	15.6	14.8	13.6	11.4	8.21	5.80	3.53	2.11	1.03		
160	1.53	2.84	4.55	6.19	7.85	9.55	10.6	11.1	11.0	10.6	8.76	6.81	5.17	3.72	2.59	1.64	1.04		
165	1.32	1.85	2.65	4.07	5.05	5.88	6.72	7.05	7.09	5.87	4.57	4.01	3.50	2.74	1.95	1.28	1.09		
170	1.13	1.56	1.89	2.32	2.86	3.34	3.63	4.14	3.76	2.46	2.80	2.73	2.38	2.00	1.51	1.28	1.11		
175	1.09	1.23	1.42	1.60	1.78	1.91	1.94	2.00	1.23	1.90	1.90	1.85	1.55	1.51	1.36	1.18	1.05		
180	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79		

Table 6: Luminous Intensity Data

## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Sep. 18, 2013	Sep. 17, 2014
Digital Power Meter	PF2010A	HZTE028-01	Sep. 18, 2013	Sep. 17, 2014
AC Power Supply	PCR 500L	HZTE001-08	Sep. 18, 2013	Sep. 17, 2014
DC Power Supply	WY12010	HZTE004-03	Sep. 18, 2013	Sep. 17, 2014
Temperature Meter	TES1310	HZTE017-01	Sep. 18, 2013	Sep. 17, 2014
Standard source	D908	HZTE012-01	Sep. 18, 2013	Sep. 17, 2014
Integrate Sphere system	2M	HZTE015-01	Sep. 18, 2013	Sep. 17, 2014
Digital Power Meter	WT210	HZTE008-01	Sep. 18, 2013	Sep. 17, 2014
AC Power Supply	PCR 500L	HZTE001-07	Sep. 18, 2013	Sep. 17, 2014
DC Power Supply	6154	HZTE004-04	Sep. 18, 2013	Sep. 17, 2014
Temperature and humidity recorder	JR900	HZTE018-01	Sep. 18, 2013	Sep. 17, 2014
Standard source	SCL-1400	HZTE012-02	Sep. 18, 2013	Sep. 17, 2014
Fluorescent Ballast Analyzer	HB-6B	HZTE002-01	Sep. 18, 2013	Sep. 17, 2014

Table 7: 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**

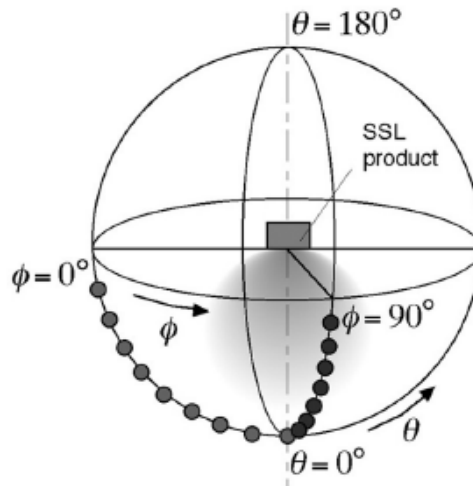
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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