



LM-79-08 Test Report

for

Philips (China) Investment Co., Ltd.

Building 9, Lane 888, Tianlin Road
Shanghai, China

InstantFit LEDtube

Model: 9290011515(2 lamps+ballast ICN-2TTP40-SC)

Laboratory: Leading Testing Laboratories

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Report No.: HZ15040006c

Review by:

Handwritten signature of April Zou in blue ink.

Engineer: April Zou
Apr. 13, 2015

Approved by:



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Manager: Jim Zhang
Apr. 13, 2015

Test Summary

Sample Tested: 9290011515(2 lamps+ballast ICN-2TTP40-SC)

Photometric and Electrical Measurements for three 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	0.344	40.70	0.9868	4521.0	111.1	13.46

Photometric and Colorimetric Measurements for each lamp

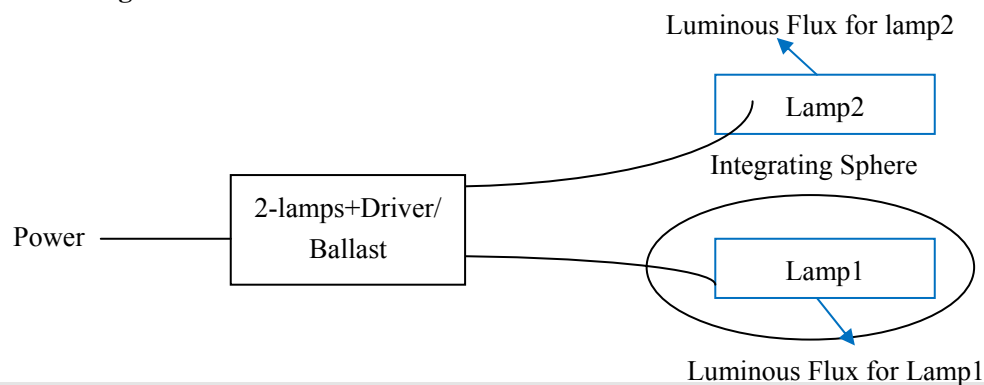
Sample Number	Luminous Flux(lm)	Correlated Color Temperature (K)	Color Rendering Index Ra
1#	2262.0	3853	83.1
2#	2259.0	3853	83.0
Sample Number	Color Rendering Index R9	Chromaticity Coordinate x	Chromaticity Coordinate y
1#	7.5	0.3878	0.3833
2#	7.4	0.3878	0.3834

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. 10, 2015

Date of Test : Apr. 10, 2015 to Apr. 13, 2015

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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Figure 1- Overview of the sample

Equipment Under Test (EUT)

Name	: InstantFit LEDtube
Model	: 9290011515(2 lamps+ballast ICN-2TTP40-SC)
Electrical Ratings	: 120Vac, 60Hz, 21W
Product Description	: 4 foot fixed ends tube, 4000K, Frosted Lens, 2G11 base LED tubes supplied by a high frequency fluorescent lamp ballast: Centium ICN-2TTP40-SC
Manufacturer	: Philips (China) Investment Co., Ltd.
Address	: 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	
	1#	2#
Test Voltage (V)	120.0	
Voltage frequency (Hz)	60	
Test Current (A)	0.344	
Power Factor	0.9868	
Test power (W) (ballast + 2 tubes)	40.70	
THD A%	13.46	
Luminous Efficacy (lm/W)	111.1	
Total Luminous Flux (lm)	2262.0	2259.0
Color Rendering Index (CRI)	83.1	83.0
R9	7.5	7.4
Correlated Color Temperature (CCT) (K)	3853	3853
Chromaticity Chroma x	0.3878	0.3878
Chromaticity Chroma y	0.3833	0.3834
Chromaticity Chroma u	0.2273	0.2273
Chromaticity Chroma v	0.3370	0.3370
Duv	0.0008	0.0008
Chromaticity Chroma u'	0.2273	0.2273
Chromaticity Chroma v'	0.5055	0.5056

Special Color Rendering Indices		
	1#	2#
R1	81.1	81
R2	89.5	89.4
R3	95.7	95.7
R4	81.8	81.8
R5	81.4	81.4
R6	85.8	85.7
R7	85.7	85.7
R8	63.6	63.6
R9	7.5	7.4
R10	75.3	75.2
R11	80.8	80.9
R12	65.1	65.1
R13	83.1	83.1
R14	97.8	97.8

Table 2: Test data per Sphere-Spectroradiometer Method

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

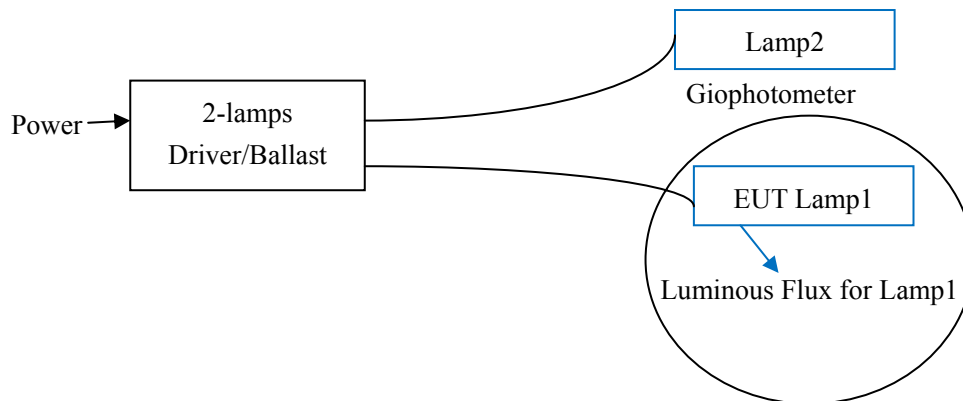
Goniophotometer Method

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.

Test figure is shown as following:



Note: One lamp was tested in Giophotometer 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)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.344
Power Factor	0.9870
Test Power (W) (ballast + 2 tubes)/2	20.35
Luminous Efficacy (lm/W)	110.9
Total Luminous Flux (lm) (Single tube)	2257.5
Beam Angle (°)	112.2 (0°-180°)/ 152.5 (90°-270°)
Center Beam Candle Power (cd)	508
Maximum Beam Candle Power (cd)	508.5 (At: C=30.0, Gamma=1.0)
Spacing Criteria	1.25 (0°-180°)/ 1.37 (90°-270°)
Zonal Lumens in the 0°-60°Zone	55.63%
Zonal Lumens in the 60°-90°Zone	26.81%
Zonal Lumens in the 90°-120°Zone	10.83%
Zonal Lumens in the 120°-180°Zone	6.73%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution of 1# tube - Sphere Spectroradiometer Method

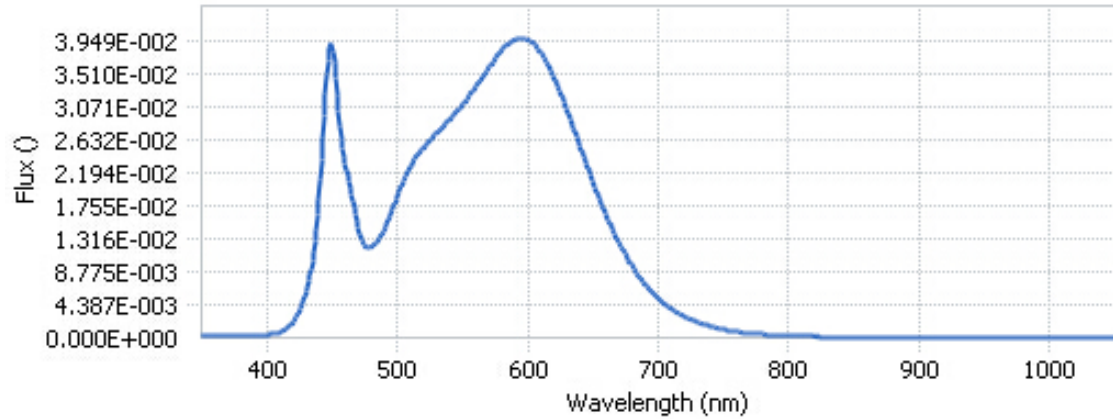


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	3.08E-04	485	1.28E-02	590	3.97E-02	695	6.15E-03
385	2.91E-04	490	1.44E-02	595	3.98E-02	700	5.27E-03
390	3.03E-04	495	1.66E-02	600	3.96E-02	705	4.51E-03
395	3.06E-04	500	1.89E-02	605	3.91E-02	710	3.87E-03
400	3.47E-04	505	2.09E-02	610	3.80E-02	715	3.33E-03
405	4.85E-04	510	2.27E-02	615	3.65E-02	720	2.86E-03
410	6.97E-04	515	2.42E-02	620	3.47E-02	725	2.42E-03
415	1.19E-03	520	2.53E-02	625	3.27E-02	730	2.07E-03
420	2.09E-03	525	2.63E-02	630	3.04E-02	735	1.76E-03
425	3.73E-03	530	2.72E-02	635	2.79E-02	740	1.50E-03
430	6.15E-03	535	2.80E-02	640	2.55E-02	745	1.27E-03
435	1.02E-02	540	2.90E-02	645	2.31E-02	750	1.10E-03
440	1.83E-02	545	3.00E-02	650	2.07E-02	755	9.48E-04
445	3.26E-02	550	3.10E-02	655	1.85E-02	760	8.15E-04
450	3.90E-02	555	3.21E-02	660	1.64E-02	765	6.93E-04
455	3.01E-02	560	3.33E-02	665	1.44E-02	770	5.99E-04
460	2.31E-02	565	3.47E-02	670	1.25E-02	775	5.15E-04
465	1.90E-02	570	3.59E-02	675	1.10E-02	780	4.38E-04
470	1.47E-02	575	3.71E-02	680	9.53E-03		
475	1.22E-02	580	3.82E-02	685	8.30E-03		
480	1.21E-02	585	3.91E-02	690	7.14E-03		

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

Chromaticity Diagram of 1# tube - Sphere Spectroradiometer Method

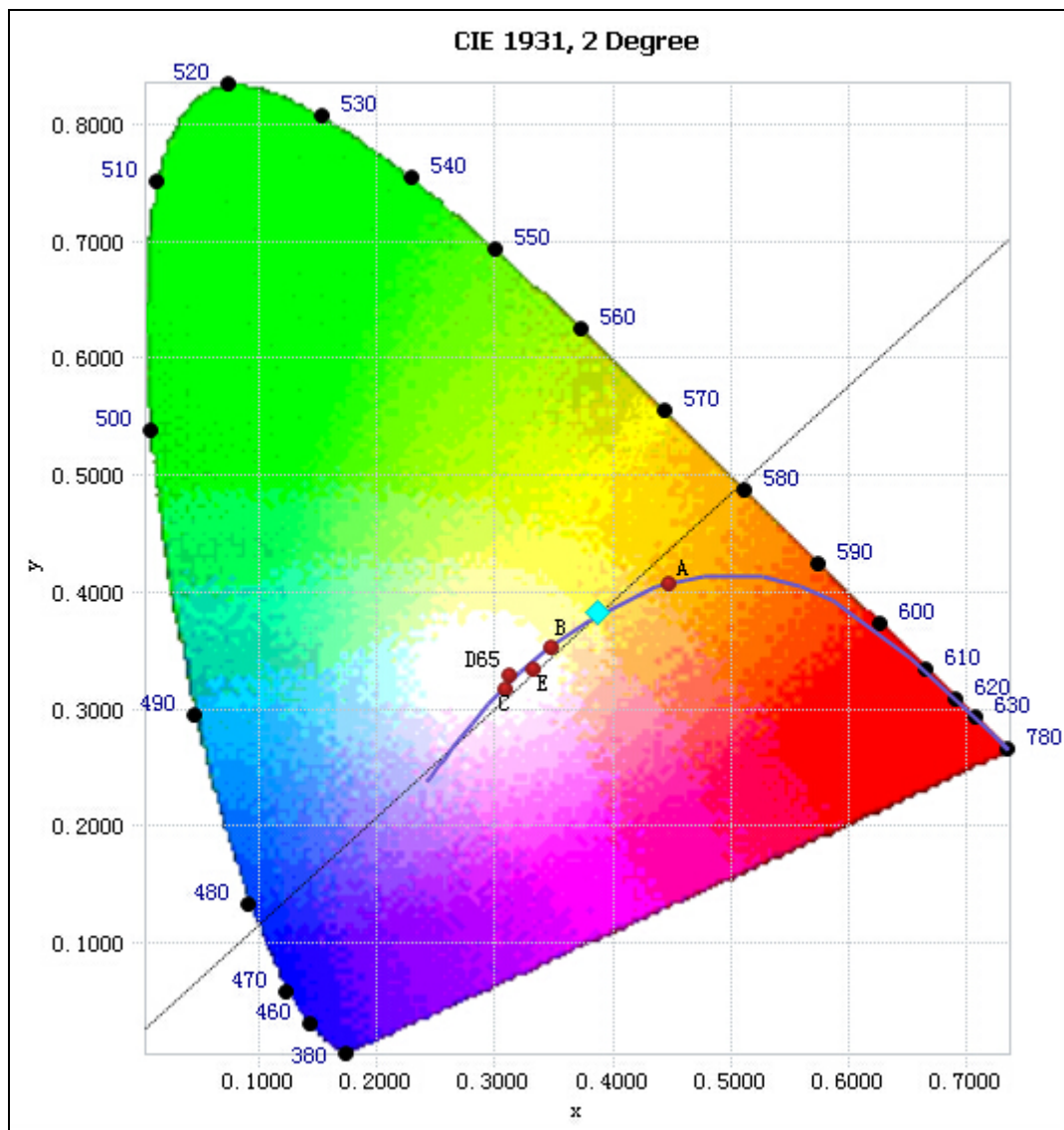


Chart 2: Chromaticity Diagram per Sphere - Spectroradiometer Method

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

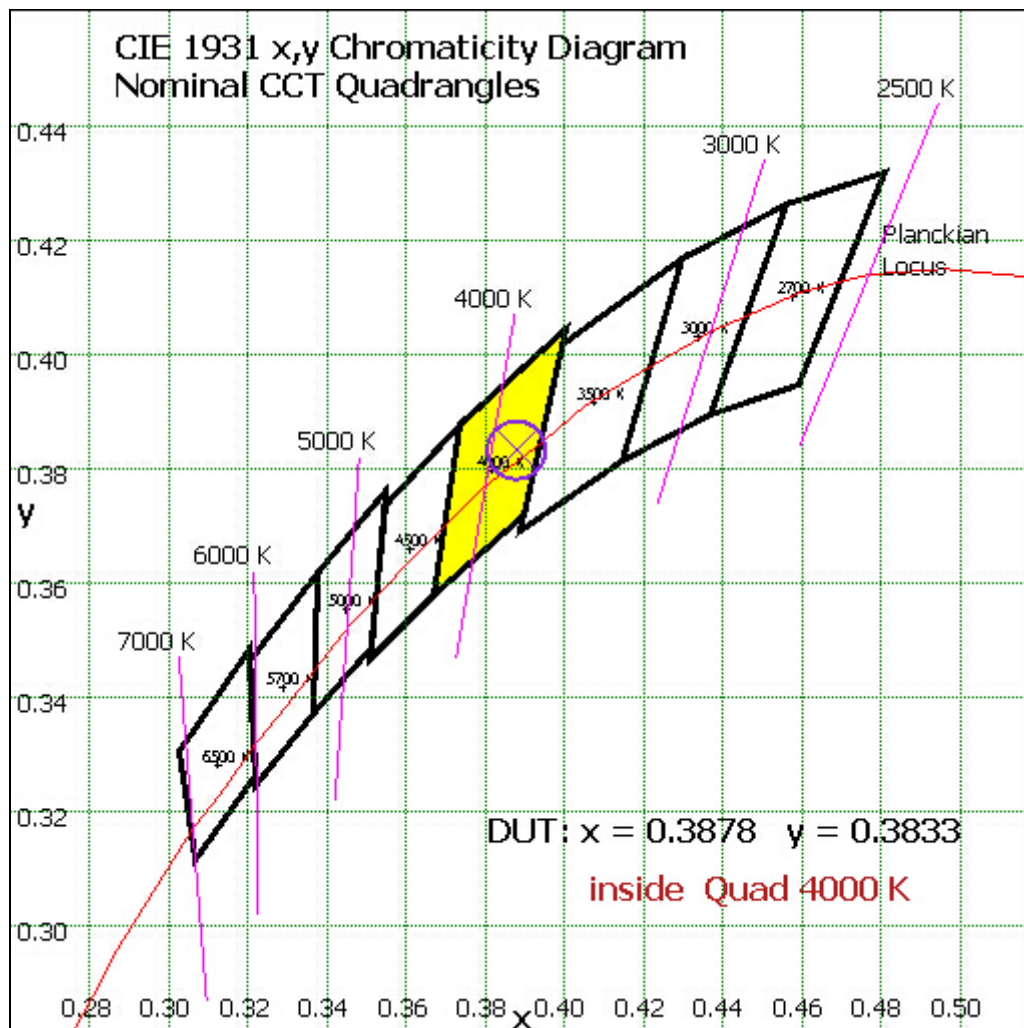


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	48.164	2.13%
10- 20	139.104	6.16%
20- 30	214.85	9.52%
30- 40	268.021	11.87%
40- 50	294.199	13.03%
50- 60	291.473	12.91%
60- 70	260.39	11.53%
70- 80	205.768	9.11%
80- 90	139.071	6.16%
90-100	99.259	4.40%
100-110	81.08	3.59%
110-120	64.117	2.84%
120-130	50.391	2.23%
130-140	39.481	1.75%
140-150	29.414	1.30%
150-160	19.815	0.88%
160-170	10.455	0.46%
170-180	2.479	0.11%
Total	2257.5	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1255.811	55.63%
60- 90	605.229	26.81%
0-90	1861.04	82.44%
90- 180	396.491	17.56%
0- 180	2257.5	100%

Table 5: Zonal Lumen Data

Illuminance Plots- Goniophotometer Method

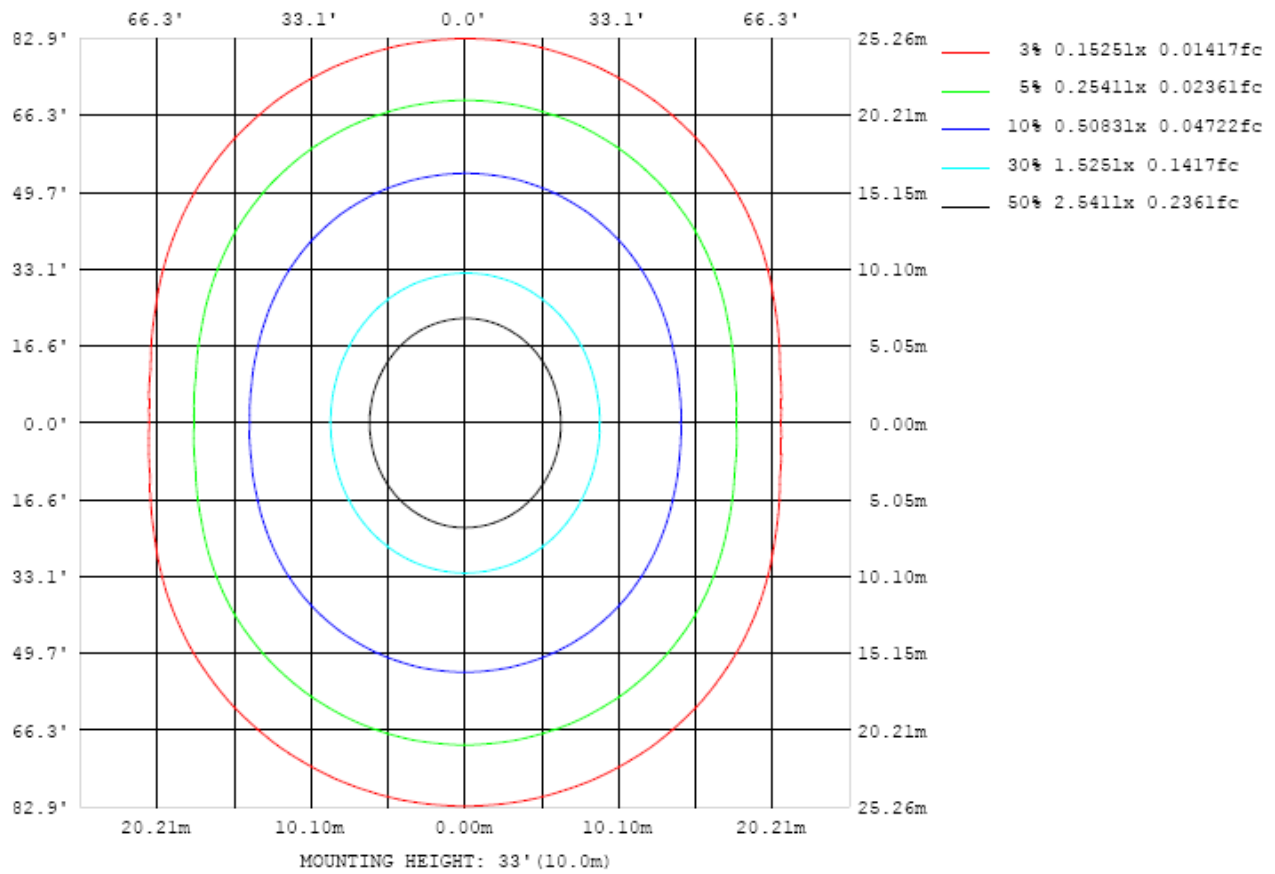


Chart 4: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

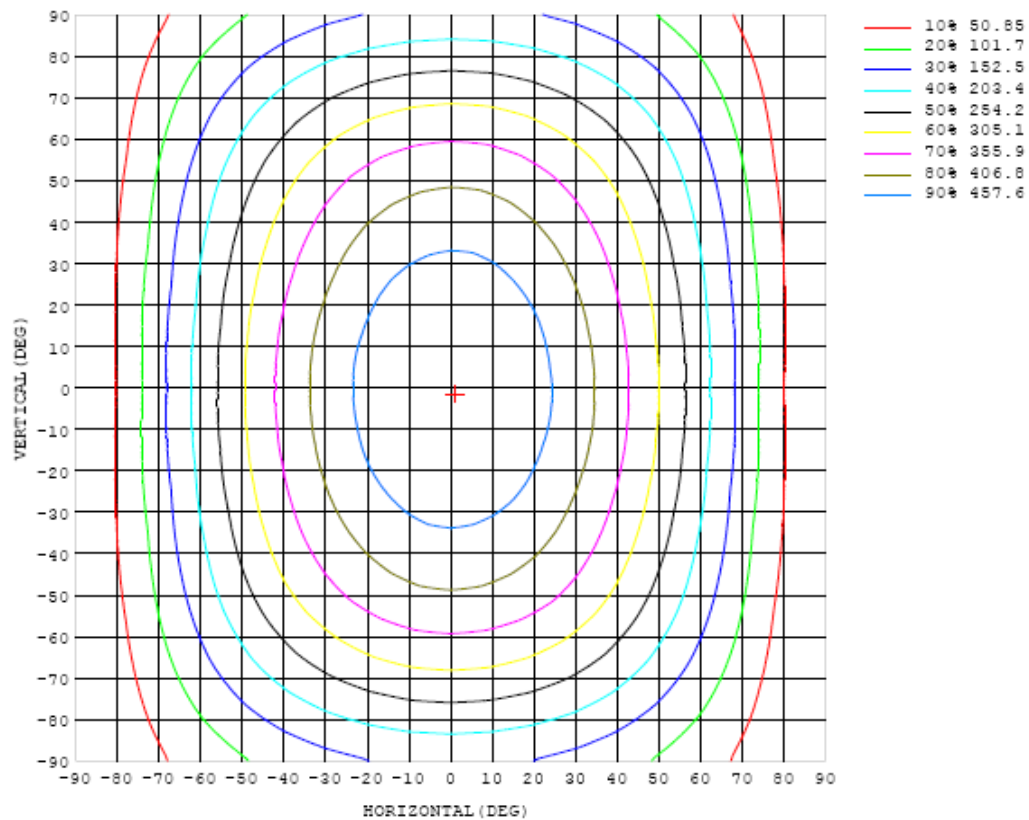


Chart 5: Isocandela Plot

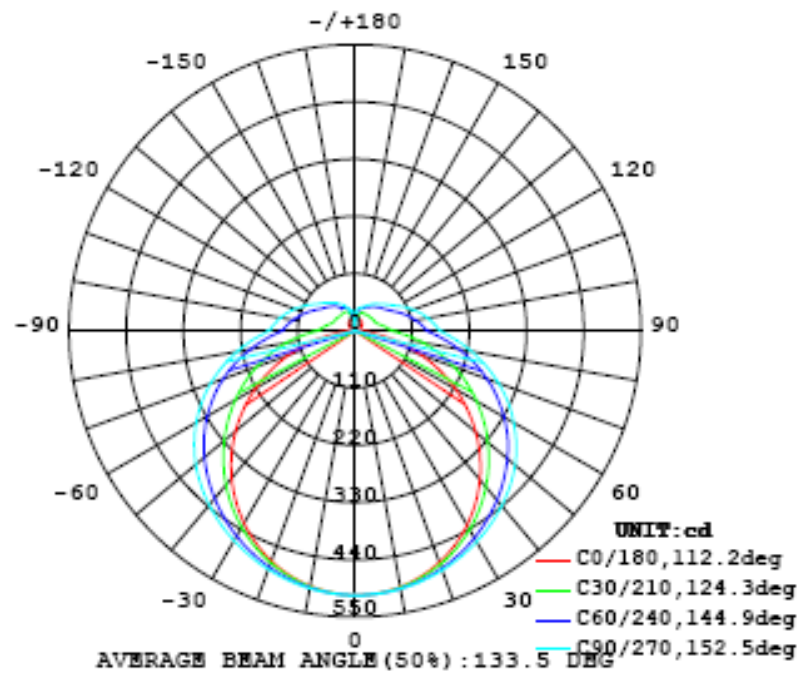


Chart 6: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1

UNIT: cd

C (DEG) y (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508
5	506	506	506	507	507	507	507	507	507	507	507	507	507	506	506	506	506	506	505
10	500	500	500	501	502	502	503	503	504	504	503	503	502	501	500	500	499	499	498
15	489	489	490	491	493	494	496	497	498	498	497	496	495	493	491	489	488	487	487
20	474	474	476	478	481	484	486	488	489	490	489	487	485	482	479	476	473	472	471
25	454	455	458	461	465	470	474	477	479	480	479	476	472	468	463	458	455	452	451
30	431	432	436	441	447	454	459	464	467	468	466	463	458	451	444	438	432	429	427
35	404	406	410	418	426	435	443	449	453	454	453	448	441	433	423	414	407	402	400
40	374	376	382	392	403	414	425	432	437	439	437	431	423	412	400	389	379	372	369
45	340	343	351	363	378	392	404	414	420	421	419	412	403	390	375	361	348	339	336
50	303	307	318	333	351	368	383	393	400	402	399	392	381	366	349	331	315	304	300
55	264	269	283	302	323	343	358	370	377	379	376	368	357	341	321	300	281	267	261
60	223	229	246	270	294	315	331	343	350	352	350	342	329	313	292	269	245	228	221
65	180	188	210	237	262	284	302	314	322	325	322	313	300	283	261	237	210	187	179
70	135	146	173	203	229	252	270	283	291	294	290	282	269	251	229	203	174	147	136
75	91.5	106	137	168	195	218	237	250	258	261	258	249	236	218	196	169	139	108	93.4
80	50.7	68.6	101	133	161	184	203	216	225	227	224	216	202	184	161	134	104	72.2	53.0
85	14.7	35.8	67.6	98.7	126	150	168	182	191	194	191	182	168	150	127	101	70.9	40.7	20.0
90	0.39	15.5	43.0	71.3	97.7	121	139	152	161	163	161	152	139	121	98.5	72.7	45.3	18.0	1.15
95	1.47	10.3	35.6	63.1	88.1	110	129	142	150	153	150	142	129	111	89.0	64.6	37.7	12.3	1.73
100	2.93	9.88	29.7	55.4	79.4	101	119	132	140	142	140	132	119	102	80.5	57.2	31.9	11.0	3.30
105	5.00	9.48	26.9	48.6	70.8	91.3	108	121	128	131	128	121	109	92.0	72.1	50.4	28.6	11.3	5.38
110	7.69	10.7	26.7	44.1	63.6	81.8	97.5	109	117	119	117	110	98.2	82.8	65.0	45.6	27.9	11.7	7.48
115	10.3	12.3	26.6	42.2	58.1	73.1	87.3	98.3	105	107	105	98.5	88.0	74.1	59.2	43.1	27.8	11.7	9.64
120	13.0	15.0	26.3	41.4	54.8	67.6	78.5	87.8	93.8	95.9	93.9	88.1	79.2	68.2	55.5	42.0	26.3	13.2	11.4
125	15.2	16.9	27.1	40.8	52.7	63.5	72.3	80.0	84.8	86.5	84.9	80.1	72.8	63.9	53.0	40.9	26.9	15.3	13.3
130	17.4	18.8	27.8	39.6	50.8	60.3	68.0	73.9	77.9	79.2	77.8	73.9	68.7	60.4	50.7	38.6	27.3	16.9	15.6
135	19.5	20.7	28.2	38.9	48.9	57.3	64.1	69.0	72.3	73.4	72.2	68.8	64.2	57.1	48.2	37.8	27.4	18.5	17.5
140	21.0	22.1	30.0	38.9	47.1	54.2	60.3	64.9	67.9	67.9	67.7	64.6	60.2	53.8	45.3	37.8	28.7	19.7	19.6
145	21.9	25.0	31.9	37.7	46.0	51.5	56.4	60.5	63.0	63.6	62.6	60.2	55.8	50.1	44.3	37.2	28.4	21.2	21.1
150	23.2	27.1	33.3	37.8	44.3	49.2	52.9	56.0	57.9	58.0	57.0	55.1	52.2	48.0	43.0	36.3	29.1	23.0	22.2
155	23.8	28.2	33.8	37.8	42.3	46.8	50.0	52.3	53.8	53.8	53.0	51.4	49.0	45.7	41.1	34.7	29.7	24.3	22.3
160	23.6	26.6	34.0	38.7	41.0	43.6	46.5	48.9	50.0	50.0	49.3	48.0	46.2	43.6	38.6	35.2	28.6	23.4	21.5
165	23.6	25.2	27.7	34.3	40.5	42.7	44.0	45.7	46.5	46.8	46.4	45.5	44.0	40.9	33.7	28.4	24.5	21.8	20.7
170	23.0	24.0	23.9	24.8	31.1	38.5	42.2	43.5	44.4	44.7	44.4	42.2	33.2	26.5	23.5	22.1	21.4	21.2	19.5
175	22.2	22.3	22.7	23.1	23.6	23.2	26.0	31.5	34.0	30.4	21.9	19.7	20.5	20.7	20.9	22.2	20.0	19.4	19.4
180	28.6	28.1	27.5	26.4	23.9	21.5	16.9	12.5	8.31	1.22	9.54	12.4	15.3	19.3	24.3	25.7	26.8	28.2	28.8

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	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508	508		
5	505	506	506	506	506	506	506	507	507	506	507	507	506	506	506	506	506		
10	498	499	499	500	500	501	502	502	503	503	502	502	502	501	501	500	500		
15	487	488	489	490	492	493	495	496	496	496	496	495	493	492	491	490	489		
20	471	472	475	477	480	483	486	487	488	488	487	485	482	480	477	475	474		
25	451	454	457	461	466	470	474	477	478	477	475	472	468	464	460	457	455		
30	428	431	436	442	449	455	461	464	466	465	462	458	452	446	440	435	432		
35	401	406	413	421	430	439	446	450	452	451	447	441	433	425	416	409	405		
40	371	377	386	398	409	420	429	435	437	435	431	423	413	401	390	381	375		
45	338	346	358	373	387	400	410	417	419	418	412	403	390	376	362	350	342		
50	303	313	329	346	363	378	390	397	400	398	392	381	366	350	332	317	307		
55	266	279	298	318	338	355	367	375	378	376	369	357	341	322	302	282	269		
60	227	243	266	290	311	328	341	350	353	351	343	331	314	293	269	246	229		
65	186	208	234	259	282	300	314	322	326	323	316	302	284	262	237	210	188		
70	146	172	201	228	251	270	284	292	296	293	285	272	253	230	203	173	147		
75	107	138	168	195	218	237	252	261	264	261	253	239	220	197	169	139	107		
80	71.1	103	134	161	185	204	218	227	230	228	220	206	186	163	135	103	70.4		
85	39.5	70.7	101	129	152	171	185	194	197	194	186	172	153	129	102	70.4	37.2		
90	17.0	44.2	72.7	99.0	122	141	154	163	166	163	155	142	123	100	73.7	44.6	16.7		
95	11.9	36.9	64.3	89.9	112	131	145	153	156	153	146	132	114	90.9	65.0	37.2	11.8		
100	11.5	31.7	57.1	81.6	103	121	135	143	146	143	135	122	104	82.3	57.6	31.8	11.7		
105	13.3	28.9	50.9	73.6	94.2	111	124	132	135	133	125	112	94.8	74.1	51.2	29.2	13.3		
110	15.4	28.8	46.3	66.3	85.3	101	113	121	124	121	114	102	85.7	66.6	46.6	29.4	15.5		
115	17.6	29.6	44.3	60.4	76.9	91.5	103	110	112	110	103	91.8	77.1	60.7	45.1	30.2	17.4		
120	19.6	30.6	43.5	57.1	70.4	82.4	92.3	98.5	101	98.6	92.4	82.6	70.6	57.7	44.1	31.1	19.5		
125	21.8	31.4	43.1	55.0	66.1	75.9	83.7	88.7	90.4	88.7	83.8	76.1	66.4	55.3	43.6	32.3	21.9		
130	23.4	32.1	41.2	52.8	62.7	71.0	77.4	81.4	82.9	81.5	77.6	71.2	62.9	53.2	43.0	33.5	23.7		
135	25.7	33.3	41.0	49.1	59.3	66.6	72.1	75.5	76.7	75.6	72.2	66.7	59.6	51.4	42.7	34.4	25.0		
140	27.9	34.7	41.1	47.5	52.9	62.4	67.1	69.9	70.8	69.9	67.1	62.6	56.5	49.4	42.6	35.4	26.6		
145	29.4	36.0	41.0	46.2	51.0	57.1	62.5	64.8	65.5	64.7	62.4	58.5	53.4	47.9	42.2	35.7	27.6		
150	30.1	37.1	41.0	45.0	48.8	51.1	55.5	59.4	60.1	59.4	57.5	54.5	50.8	46.6	42.0	35.6	26.7		
155	30.5	37.5	40.9	43.8	46.6	48.7	45.6	53.7	55.0	54.6	53.4	51.4	48.8	45.6	41.0	36.3	29.0		
160	25.6	34.6	39.7	42.3	44.3	46.0	46.1	43.8	49.4	50.3	49.5	48.3	46.3	43.3	40.1	36.3	29.5		
165	21.2	24.9	29.3	33.7	38.9	43.2	43.8	43.1	41.5	45.7	45.6	45.1	43.8	42.5	39.3	30.7	26.8		
170	19.5	20.6	21.7	22.5	24.1	27.1	35.3	40.9	40.1	39.8	39.8	40.0	38.0	37.2	30.7	24.0	22.3		
175	19.3	19.1	19.2	21.2	20.0	19.6	19.4	18.9	21.7	29.4	33.4	30.0	24.5	21.0	19.9	19.8	21.0		
180	28.8	28.5	27.6	26.1	23.9	21.3	17.4	13.3	9.91	3.47	9.09	12.7	15.8	19.5	23.4	25.7	27.0		

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
Fluorescent Ballast Analyzer	HB-6B	HZTE002-01	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 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 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

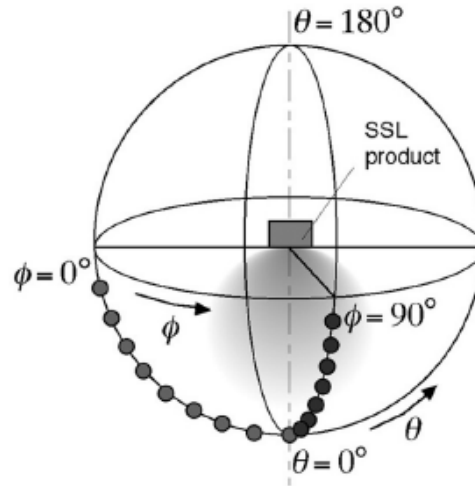
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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