



## **LM-79-08 Test Report**

for

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

Building 9, Lane 888, Tianlin Road  
Shanghai, China

**InstantFit LEDtube**

**Model: 9290011198(2 lamps+ballast ICN-2P32-N)**

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Report No.: HZ14060013k

Review by:

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Jul. 01, 2014

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*Jim Zhang*

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Jul. 01, 2014

## Test Summary

Sample Tested: 9290011198(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	0.318	38.1	0.9976	4108.0	107.8	5.62

### Photometric and Colorimetric Measurements for each lamp

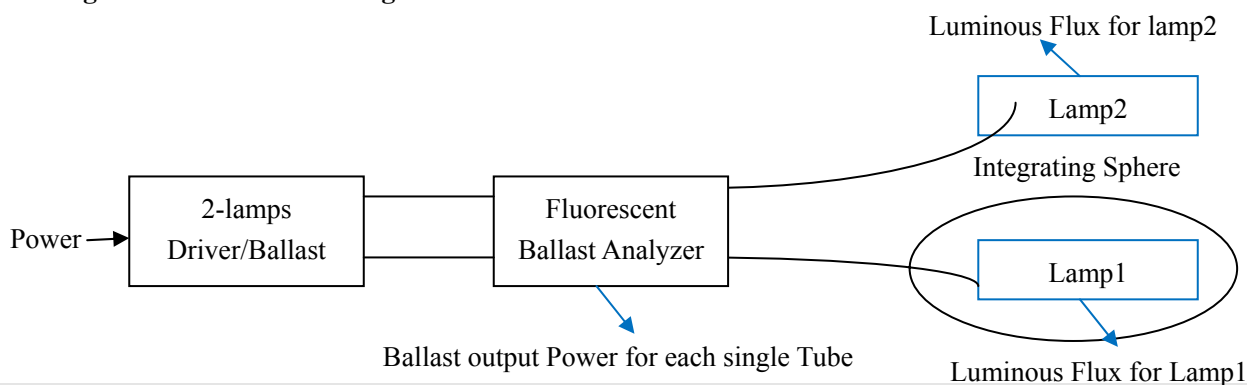
Sample Number	Luminous Flux(lm)	Test power (W)(bare tube)	Efficiency for single Tube (lm/W)	Correlated Color Temperature (K)
1#	2061.0	14.9	138.3	3884
2#	2047.0	15.1	135.6	3869
Sample Number	Color Rendering Index Ra	Color Rendering Index R9	Chromaticity Coordinate x	Chromaticity Coordinate y
1#	81.4	14.7	0.3863	0.3825
2#	82.7	19.2	0.3863	0.3804

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** : Jun. 17, 2014

**Date of Test** : Jun. 27, 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

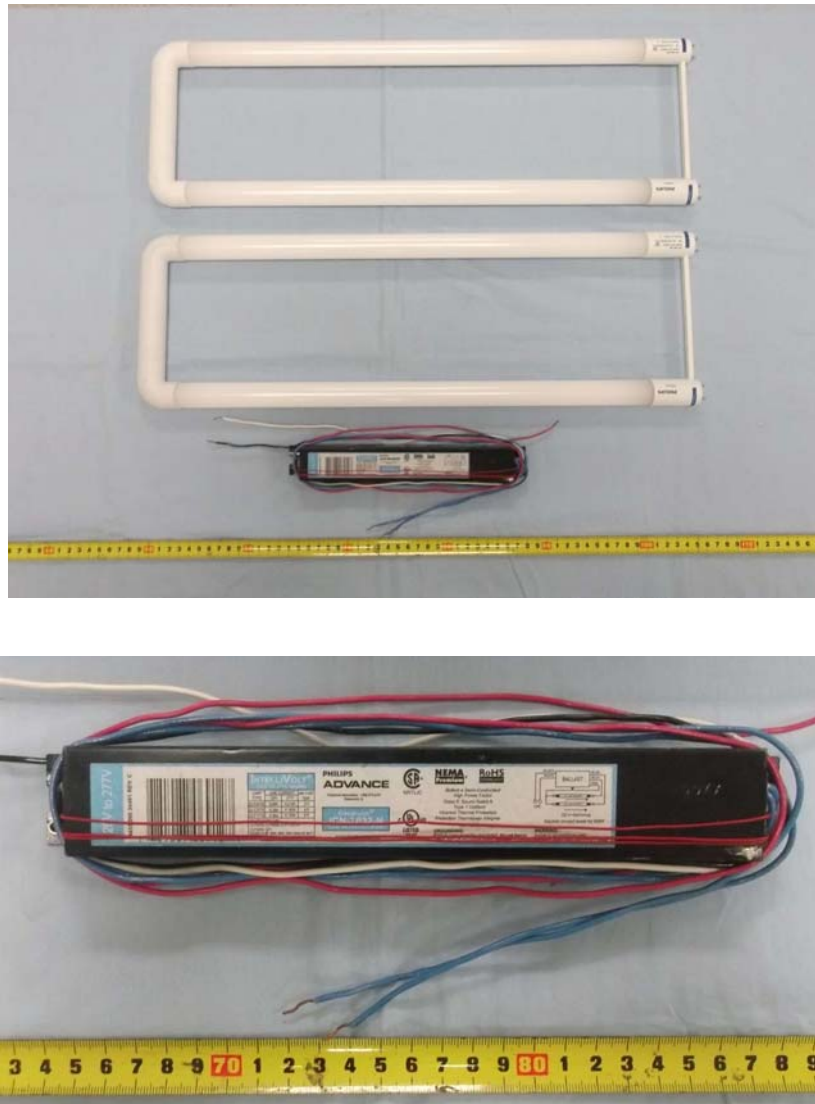


Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: InstantFit LEDtube
<b>Model</b>	: 9290011198(2 lamps+ballast ICN-2P32-N)
<b>Electrical Ratings</b>	: 120V AC, 60Hz, 16.5W
<b>Product Description</b>	: 16.5T8/24-4000 IF-6U 10/1, G13 base, 4000K, U bent tube 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 24.9°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 70 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result		Special Color Rendering Indices		
	1#	2#			
Test Voltage (V)	120.0			1#	2#
Voltage frequency (Hz)	60		R1	79.4	80.9
Test Current (A)	0.318		R2	86.5	88.5
Power Factor	0.9976		R3	91.5	93.1
Test power (W) (ballast + 2 tubes)	38.1		R4	80	80.4
Luminous Efficacy (lm/W)	107.8		R5	78.7	80.1
THD A%	5.62		R6	80.4	82.7
Total Luminous Flux (lm)	2061.0	2047.0	R7	87.4	87.6
Test power (W) (bare tube)	14.9	15.1	R8	67.3	68.3
Efficiency for single Tube (lm/W)	138.3	135.6	R9	14.7	19.2
Color Rendering Index (CRI)	81.4	82.7	R10	67.5	71.5
R9	14.7	19.2	R11	77	77.4
Correlated Color Temperature (CCT) (K)	3884	3869	R12	56.2	58
Chromaticity (Chroma x, Chroma y)	(0.3863, 0.3825)	(0.3863, 0.3804)	R13	80.7	82.6
Chromaticity (Chroma u, Chroma v)	(0.2267, 0.3366)	(0.2275, 0.3360)	R14	95.1	96.1
Chromaticity (Chroma u', Chroma v')	(0.2267, 0.5050)	(0.2275, 0.5040)			
Duv	0.0008	0.0001			

Table 2: Test data per Sphere-Spectroradiometer Method

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

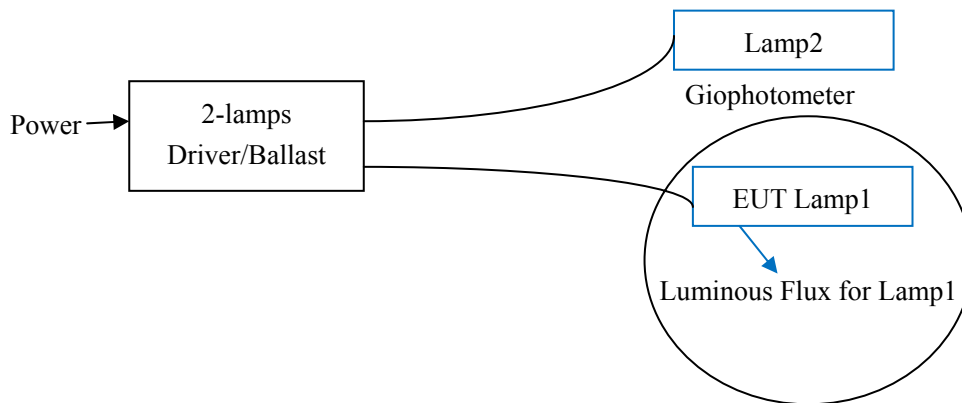
### Goniophotometer Method

Test ambient temperature was 25.5°C

The photometric distance is 2.475m.

Luminous data was taken at 0.5°vertical intervals and 5°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)	0.312
Power Factor	0.9973
Test power (W) (ballast + 2 tubes)/2	18.7
Luminous Efficacy (lm/W)	109.9
Total Luminous Flux (lm) (Single tube)	2054.2
Test power (W) (bare tube)	14.9
Luminous Efficacy (lm/W) (bare tube)	137.9
Beam Angle (°)	109.6 (0°-180°)/ 163.9 (90°-270°)
Center Beam Candle Power (cd)	494
Maximum Beam Candle Power (cd)	495.1 (At: C=300.0, Gamma=4.0)
Spacing Criteria	1.22 (0°-180°)/ 1.42(90°-270°)
Zonal Lumens in the 0°-60°Zone	59.17%
Zonal Lumens in the 60°-90°Zone	29.48%
Zonal Lumens in the 90°-120°Zone	9.20%
Zonal Lumens in the 120°-180°Zone	2.15%

Table 3: Test data per Goniophotometer Method

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

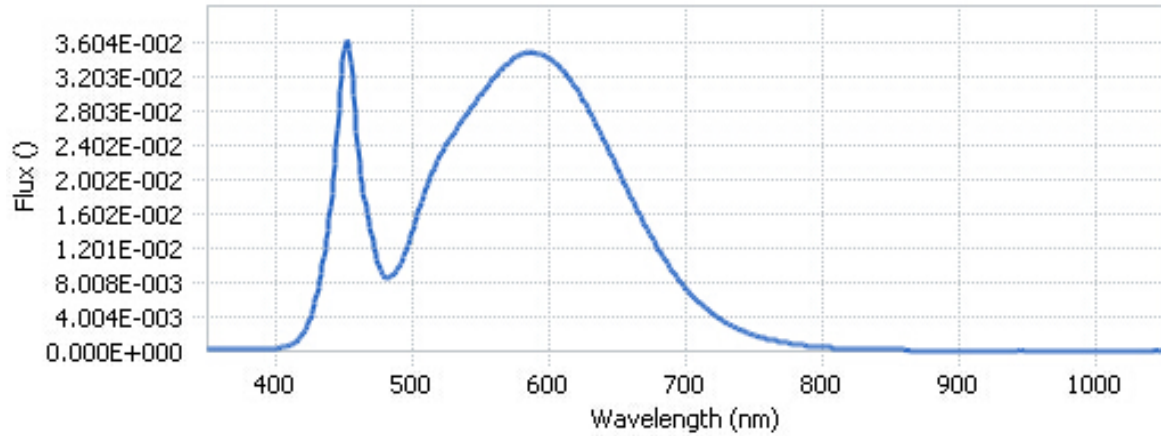
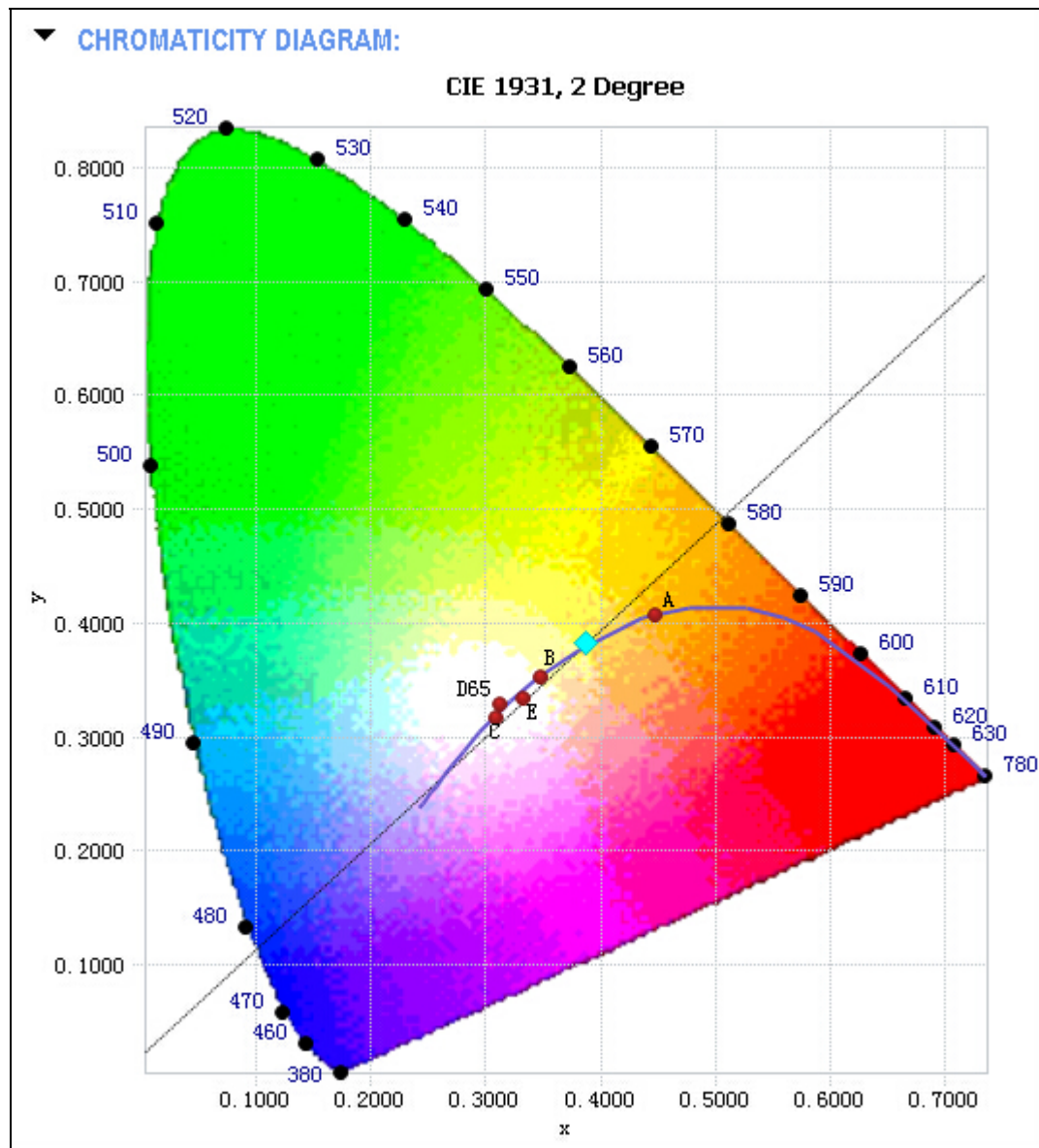


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.35E-04	485	8.78E-03	590	3.48E-02	695	8.27E-03
385	2.27E-04	490	9.76E-03	595	3.46E-02	700	7.26E-03
390	2.68E-04	495	1.16E-02	600	3.41E-02	705	6.39E-03
395	2.69E-04	500	1.42E-02	605	3.35E-02	710	5.61E-03
400	3.09E-04	505	1.67E-02	610	3.28E-02	715	4.89E-03
405	4.13E-04	510	1.90E-02	615	3.17E-02	720	4.31E-03
410	6.35E-04	515	2.10E-02	620	3.05E-02	725	3.75E-03
415	1.14E-03	520	2.28E-02	625	2.92E-02	730	3.25E-03
420	2.08E-03	525	2.42E-02	630	2.78E-02	735	2.82E-03
425	3.80E-03	530	2.54E-02	635	2.62E-02	740	2.44E-03
430	6.71E-03	535	2.66E-02	640	2.46E-02	745	2.12E-03
435	1.09E-02	540	2.76E-02	645	2.29E-02	750	1.83E-03
440	1.68E-02	545	2.88E-02	650	2.13E-02	755	1.59E-03
445	2.58E-02	550	2.99E-02	655	1.96E-02	760	1.39E-03
450	3.51E-02	555	3.09E-02	660	1.79E-02	765	1.19E-03
455	3.37E-02	560	3.20E-02	665	1.63E-02	770	1.03E-03
460	2.37E-02	565	3.29E-02	670	1.47E-02	775	8.92E-04
465	1.75E-02	570	3.36E-02	675	1.32E-02	780	7.67E-04
470	1.36E-02	575	3.43E-02	680	1.18E-02		
475	1.02E-02	580	3.46E-02	685	1.05E-02		
480	8.61E-03	585	3.48E-02	690	9.37E-03		

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

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



Tristimulus values(x, y): (0.3863, 0.3825)

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

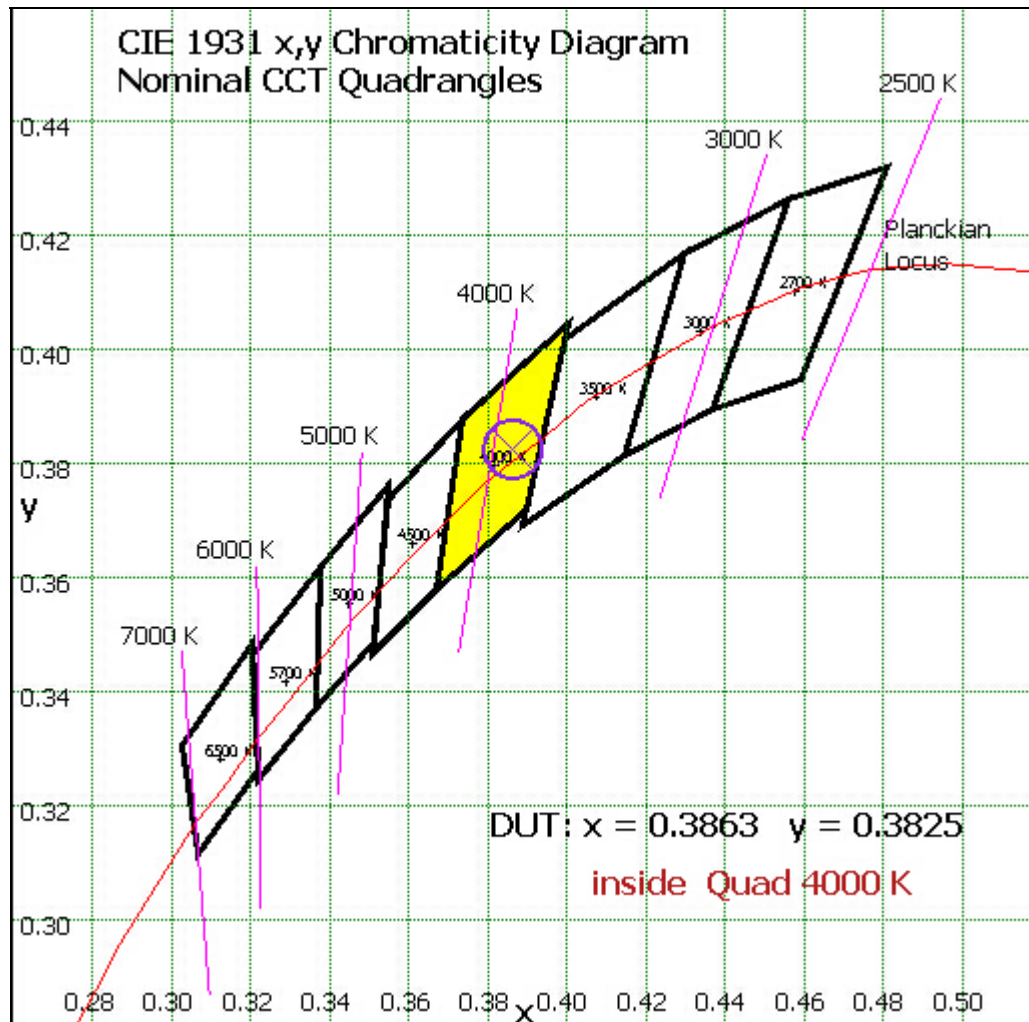


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	46.85	2.28%
10- 20	135.374	6.59%
20- 30	208.96	10.17%
30- 40	259.896	12.65%
40- 50	283.843	13.82%
50- 60	280.46	13.65%
60- 70	253.576	12.34%
70- 80	210.543	10.25%
80- 90	141.541	6.89%
90-100	79.649	3.88%
100-110	68.958	3.36%
110-120	40.349	1.96%
120-130	22.17	1.08%
130-140	11.383	0.55%
140-150	5.917	0.29%
150-160	2.94	0.14%
160-170	1.48	0.07%
170-180	0.333	0.02%
Total	2054.2	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	1215.383	59.17%
60- 90	605.66	29.48%
0-90	1821.043	88.65%
90- 180	233.179	11.35%
0- 180	2054.2	100%

Table 5: Zonal Lumen Data

### Illuminance Plots- Goniophotometer Method

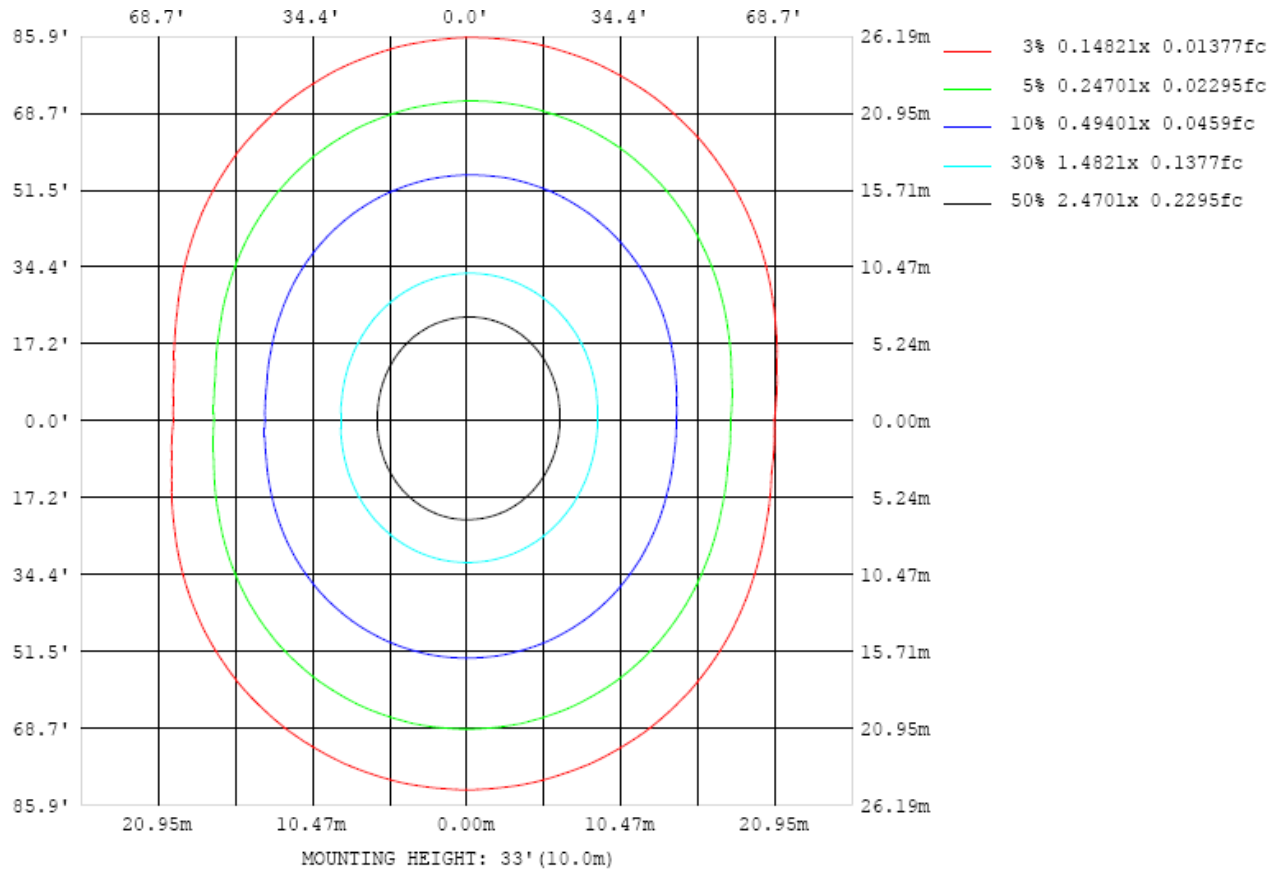


Chart 4: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

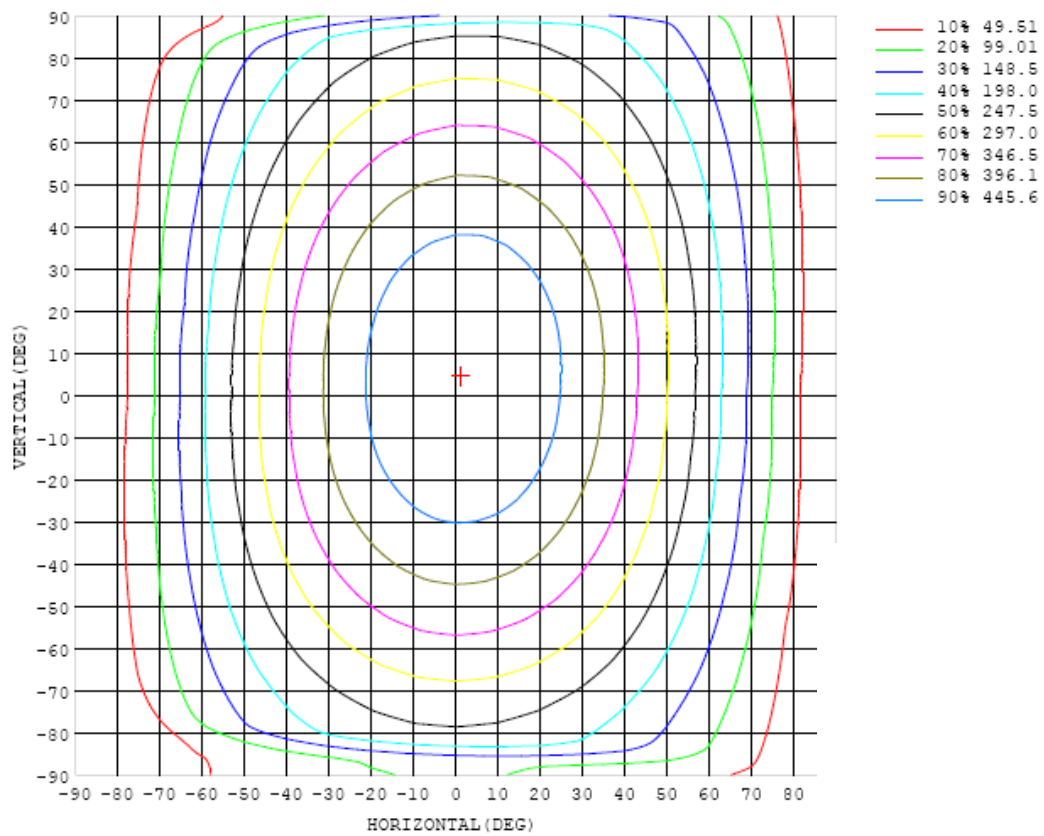


Chart 5: Isocandela Plot

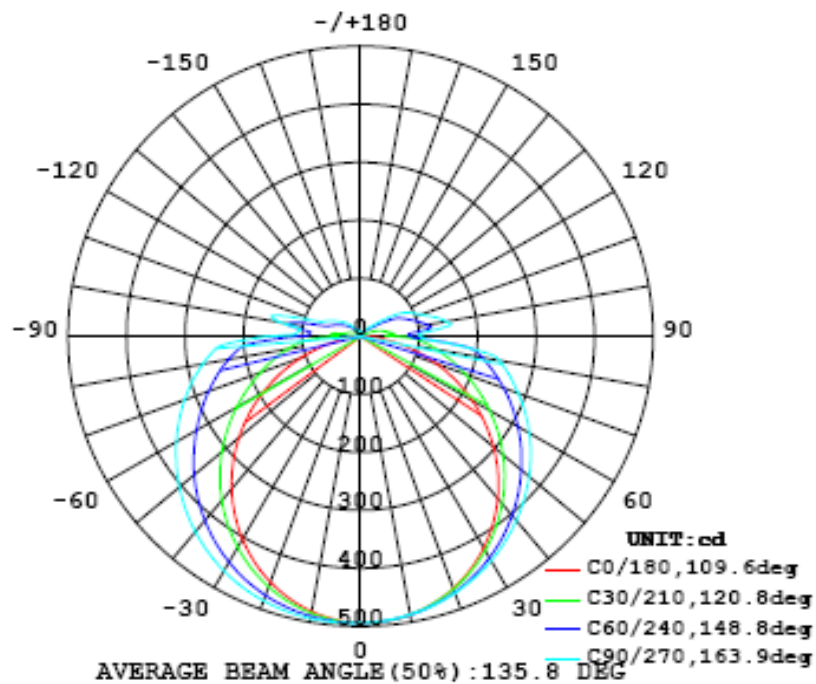


Chart 6: Polar Candela Distribution

## 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	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494
5	493	493	493	493	493	492	492	492	492	492	491	491	491	490	490	490	490	490	490
10	488	487	487	487	487	487	487	488	487	487	486	486	485	484	483	482	482	481	482
15	477	477	477	477	478	479	480	480	481	480	479	478	476	474	472	470	469	468	468
20	463	462	462	464	466	468	469	471	471	471	470	468	465	462	458	455	452	451	451
25	444	443	444	446	450	453	456	459	460	460	458	455	451	446	441	436	432	430	429
30	421	420	422	426	431	436	441	444	446	446	445	441	435	429	422	415	409	405	404
35	394	394	397	402	409	416	423	428	431	431	429	424	417	409	400	390	382	377	375
40	364	365	369	376	385	395	403	409	413	414	412	406	398	387	376	364	354	346	343
45	332	332	338	348	359	371	381	389	394	396	393	386	377	364	350	336	322	312	308
50	296	298	306	318	332	346	359	368	374	376	373	366	354	340	323	306	290	277	271
55	259	261	271	286	304	320	335	346	353	355	352	344	331	315	296	275	256	240	232
60	220	222	236	254	275	294	310	323	331	333	330	321	308	290	268	245	221	202	192
65	179	183	200	222	246	267	285	299	308	310	307	298	284	264	241	215	188	163	151
70	138	143	164	191	217	241	260	275	284	287	283	274	259	239	214	186	155	126	109
75	96.8	104	130	160	189	214	235	251	261	264	261	251	236	214	188	158	124	90.9	69.2
80	59.1	68.1	98.8	132	163	190	211	228	238	241	238	228	212	190	163	131	96.0	60.8	34.1
85	26.9	38.7	72.0	106	138	160	165	165	162	157	150	141	129	116	99.8	82.1	58.8	32.3	8.55
90	6.90	17.5	41.6	57.6	68.2	75.7	85.6	94.4	100	102	101	96.3	87.8	76.2	62.2	46.4	30.2	11.5	1.40
95	2.31	8.26	31.2	58.2	75.6	88.9	101	111	120	126	129	128	123	111	85.8	59.2	33.8	11.5	1.71
100	1.89	4.09	22.8	46.4	71.2	95.2	115	132	144	149	147	137	122	102	77.9	52.5	27.4	5.20	1.94
105	2.26	2.75	15.9	37.3	60.9	81.7	99.9	115	125	130	128	119	106	88.5	67.9	43.1	13.3	4.25	2.25
110	2.57	2.85	7.66	27.9	50.6	70.7	86.4	99.0	107	111	109	103	91.7	76.2	55.1	23.9	9.84	3.99	2.58
115	2.69	2.79	6.00	14.6	36.3	58.5	74.2	85.3	92.7	95.7	94.2	88.4	77.8	59.1	32.1	16.5	8.14	3.66	2.86
120	2.96	2.62	5.22	10.4	20.5	38.7	56.5	69.0	77.2	80.1	77.5	68.9	53.5	35.6	21.8	13.1	6.75	3.33	3.08
125	3.08	2.42	4.52	8.58	14.2	22.7	35.4	45.8	52.5	54.7	51.5	43.9	34.3	24.3	16.8	10.7	5.71	3.18	3.29
130	3.32	2.44	3.95	7.41	11.5	16.5	22.2	28.2	32.9	34.6	33.0	28.8	23.9	18.7	13.6	8.76	4.97	3.05	3.55
135	3.51	2.42	3.59	5.85	9.60	13.2	17.0	20.3	22.8	23.9	23.4	21.4	18.5	14.9	10.9	7.15	4.41	2.94	3.80
140	3.83	2.44	3.25	4.93	7.59	10.7	13.4	15.8	17.5	18.3	18.0	16.7	14.6	11.8	8.78	5.98	3.94	2.83	4.02
145	4.02	2.50	2.99	4.30	5.99	8.36	10.6	12.4	13.6	14.2	14.0	13.0	11.4	9.31	6.91	5.07	3.53	2.76	4.22
150	4.18	2.89	2.82	3.76	4.98	6.37	7.86	9.44	10.4	10.8	10.6	9.91	8.72	7.12	5.69	4.30	3.15	2.87	4.43
155	4.38	3.30	2.72	3.34	4.19	5.11	6.03	6.88	7.46	7.76	7.62	7.23	6.52	5.64	4.64	3.65	2.92	3.47	4.58
160	4.07	3.22	2.59	2.94	3.55	4.17	4.71	5.22	5.63	5.80	5.71	5.40	4.97	4.44	3.73	3.07	2.71	3.91	4.54
165	3.63	3.28	2.78	2.71	3.01	3.40	3.80	4.10	4.33	4.39	4.32	4.14	3.78	3.34	2.95	2.69	3.09	3.89	4.12
170	3.06	2.98	2.52	2.69	2.79	2.89	3.06	3.20	3.24	3.26	3.11	2.86	2.78	2.73	2.62	3.03	3.48	3.36	3.48
175	3.04	2.97	2.82	2.74	2.58	2.55	2.75	2.83	2.74	3.12	3.22	3.30	3.06	3.00	2.99	2.97	3.05	3.10	3.25
180	3.56	3.45	3.36	3.24	2.99	2.98	3.12	2.34	2.11	1.12	1.61	1.67	2.79	3.09	3.21	3.25	3.17	3.34	3.55

Table 6: Luminous Intensity Data

Table--2

UNIT: cd

C (DEG) γ (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494	494		
5	491	491	492	492	493	493	494	495	495	495	495	495	495	495	495	494	494		
10	482	483	485	486	488	490	492	493	494	494	494	494	493	492	491	489	488		
15	469	471	474	477	481	484	487	489	490	491	491	489	488	485	483	481	479		
20	452	455	460	465	470	475	480	483	485	486	485	483	479	476	472	468	465		
25	431	435	441	449	456	464	470	475	477	478	476	473	468	463	457	451	446		
30	406	412	420	430	440	450	458	464	467	468	466	461	454	447	439	431	424		
35	378	385	396	408	421	433	443	450	454	455	452	446	438	428	417	407	399		
40	346	356	369	384	400	414	426	435	440	440	436	429	419	406	393	380	370		
45	312	324	340	358	377	394	407	418	423	423	419	410	397	383	367	351	339		
50	276	290	309	331	352	371	387	398	404	404	399	389	374	357	338	320	305		
55	237	254	277	302	326	348	366	378	384	384	378	367	350	330	309	287	269		
60	198	218	245	273	300	324	343	357	364	364	357	343	325	303	278	253	232		
65	158	182	213	245	274	300	321	335	342	342	334	320	300	275	247	219	194		
70	118	147	182	217	249	276	298	313	320	320	312	296	274	247	217	185	156		
75	79.9	114	154	191	224	253	275	290	298	297	289	273	250	221	188	153	119		
80	46.8	84.8	127	166	200	229	251	266	274	273	265	248	225	195	161	123	85.0		
85	20.7	57.1	98.2	138	170	203	226	241	249	248	240	224	200	171	136	96.8	56.3		
90	4.30	19.9	40.0	60.1	79.1	102	124	141	153	160	160	155	145	129	106	72.6	34.0		
95	5.35	19.0	51.0	70.2	77.9	86.1	96.0	103	106	106	101	92.1	80.5	66.2	49.7	36.2	17.8		
100	4.61	14.0	28.7	58.5	97.4	126	142	141	137	132	125	117	108	87.5	47.7	25.7	12.8		
105	4.49	12.2	23.3	37.0	51.1	77.3	106	127	136	135	122	96.7	65.8	45.7	31.8	20.8	9.72		
110	4.44	10.2	19.9	30.9	43.4	54.8	64.0	70.4	74.1	73.2	68.3	60.9	50.6	38.3	26.1	16.7	7.83		
115	4.43	8.47	16.7	26.1	36.9	46.9	55.0	60.5	63.0	62.4	58.7	52.0	42.8	32.0	21.4	13.5	6.84		
120	5.22	7.42	13.6	21.9	31.1	39.7	46.8	51.6	53.8	53.2	49.8	43.9	35.9	26.6	17.6	10.6	6.14		
125	5.42	6.55	10.6	18.0	25.9	33.3	39.3	43.5	45.3	44.7	41.8	36.7	29.8	21.9	14.1	8.60	6.53		
130	5.33	5.89	8.80	14.0	21.3	27.5	32.6	36.1	37.6	37.1	34.5	30.2	24.4	17.8	10.8	7.30	6.04		
135	5.26	5.49	7.55	10.9	16.2	22.3	26.5	29.4	30.6	30.2	28.1	24.4	19.5	13.7	8.66	6.32	5.64		
140	5.15	6.46	6.46	8.94	12.2	15.9	20.8	23.3	24.3	23.9	22.1	18.9	14.7	10.4	7.20	7.95	5.04		
145	5.05	7.31	5.66	7.41	9.69	12.1	14.8	17.3	18.1	17.8	16.3	13.8	11.0	8.41	6.09	7.25	4.93		
150	4.96	6.58	6.58	6.16	7.71	9.40	10.7	12.4	12.9	12.7	11.8	10.4	8.66	6.80	8.92	6.60	4.62		
155	4.85	5.89	7.85	6.86	6.28	7.22	8.18	8.49	9.55	9.47	8.90	7.97	6.87	8.88	8.24	5.74	4.46		
160	4.63	5.22	6.33	8.08	8.69	7.64	6.46	6.59	7.01	7.03	6.87	7.22	9.70	9.57	7.07	5.29	4.23		
165	4.03	4.41	5.07	5.91	6.71	8.21	9.82	10.4	10.3	10.7	10.9	10.2	9.14	7.39	5.75	4.78	3.97		
170	3.48	3.72	4.08	4.46	5.08	5.64	5.97	6.13	6.79	7.84	7.69	6.74	5.74	4.88	4.40	4.00	3.51		
175	3.25	3.31	3.38	3.45	3.57	3.70	3.87	4.08	3.93	3.66	3.67	3.34	3.56	3.67	3.46	3.04	2.95		
180	3.54	3.52	3.46	3.31	3.09	3.03	2.95	2.68	2.26	2.02	2.08	2.17	2.56	2.91	3.14	3.24	3.25		

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, 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 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.

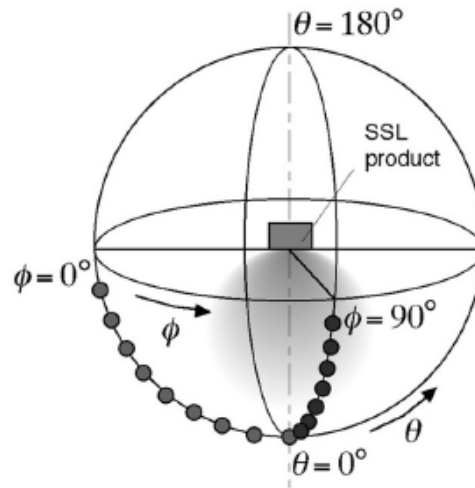
### **Color Spatial Uniformity**

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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