Quality Assured

NVLAP LAB CODE 200960-0

LM-79-08 Test Report

for

IKIO LED LIGHTING

8470 Allison Pointe Blvd, Suite 128
Indianapolis, IN 46250

LED Corn Bulb Lamp Premium

Model: IK-CRA-L120-0120-50

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ15051112w

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

Review by: April Zou

Engineer: April Zou
Jun. 01, 2015

Approved by: Jim Zhang

LEADING TESTING LABORATORIES

Manager: Jim Zhang
Jun. 01, 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: **IK-CRA-L120-0120-50**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
132.2	15020.0	113.61	0.9941

CCT (K)	CRI	Stabilization Time (Light & Power)
5336	82.7	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 08, 2015
Date of Test	: May 14, 2015 to May 19, 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

TABLE OF CONTENT

Sample Photos

Figure 1- Overview of the sample

Equipment Under Test (EUT)	
Name	: LED Corn Bulb Lamp Premium
Model	: IK-CRA-L120-0120-50
Electrical Ratings	: 100-277Vac, 50-60Hz, 120W
Product Description	: E39 base, 5000K, Non-dimmable Model of the LED light source: 5630 2nd Generation Manufacturer of the LED light source: Samsung Quantity of LED light source: 336pcs
Manufacturer	: IKIO LED LIGHTING
Address	: 8470 Allison Pointe Blvd, Suite 128 Indianapolis, IN 46250

TEST RESULTS

Test ambient temperature was 24.8℃.

Base orientation was Base 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	100.0	277.0
Voltage frequency (Hz)	60	60	60
Test Current (A)	0.953	1.152	0.447
Power Factor	0.9941	0.9964	0.9038
Test Power (W)	113.61	114.72	111.81
THD A%	7.61	6.82	11.84
Luminous Efficacy (lm/W)	132.2		
Total Luminous Flux (lm)	15020.0		
Color Rendering Index (CRI)	82.7		
R9	5.8		
Correlated Color Temperature (CCT) (K)	5336		
Chromaticity Chroma x	0.3365		
Chromaticity Chroma y	0.3513		
Chromaticity Chroma u	0.2057		
Chromaticity Chroma v	0.3222		
Duv	0.0031		
Chromaticity Chroma u ’	0.2057		
Chromaticity Chroma v’	0.4833		

Special Color Rendering Indices	
R1	80.4
R2	86.7
R3	91.7
R4	83.3
R5	82
R6	82.4
R7	86.8
R8	67.9
R9	5.8
R10	69.1
R11	83
R12	67.2
R13	81.7
R14	95.6

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 25.1℃.

The photometric distance is 2.475m.

Luminous data was taken at 0.5°vertical intervals and 22.5°horizontal intervals.

Parameter	Result
Test Voltage (V)	120.0
Voltage frequency (Hz)	60
Test Current (A)	0.959
Power Factor	0.9943
Test Power (W)	114.42
Luminous Efficacy (lm/W)	129.7
Total Luminous Flux (lm)	14840.0
Beam Angle (°)	307.3
Center Beam Candle Power (cd)	765
Maximum Beam Candle Power (cd)	1566(At: C=292.5, Gamma=65.5)
Spacing Criteria	2.34 (0°-180°)/ 2.33(90°-270°)
Zonal Lumens in the 0°-60°Zone	26.43%
Zonal Lumens in the 60°-90°Zone	30.74%
Zonal Lumens in the 90°-120°Zone	28.00%
Zonal Lumens in the 120°-180°Zone	14.83%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

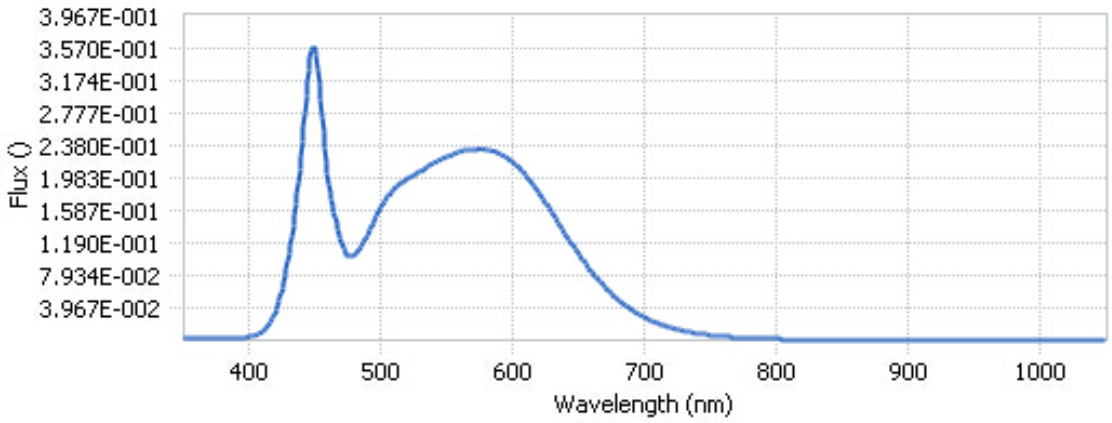
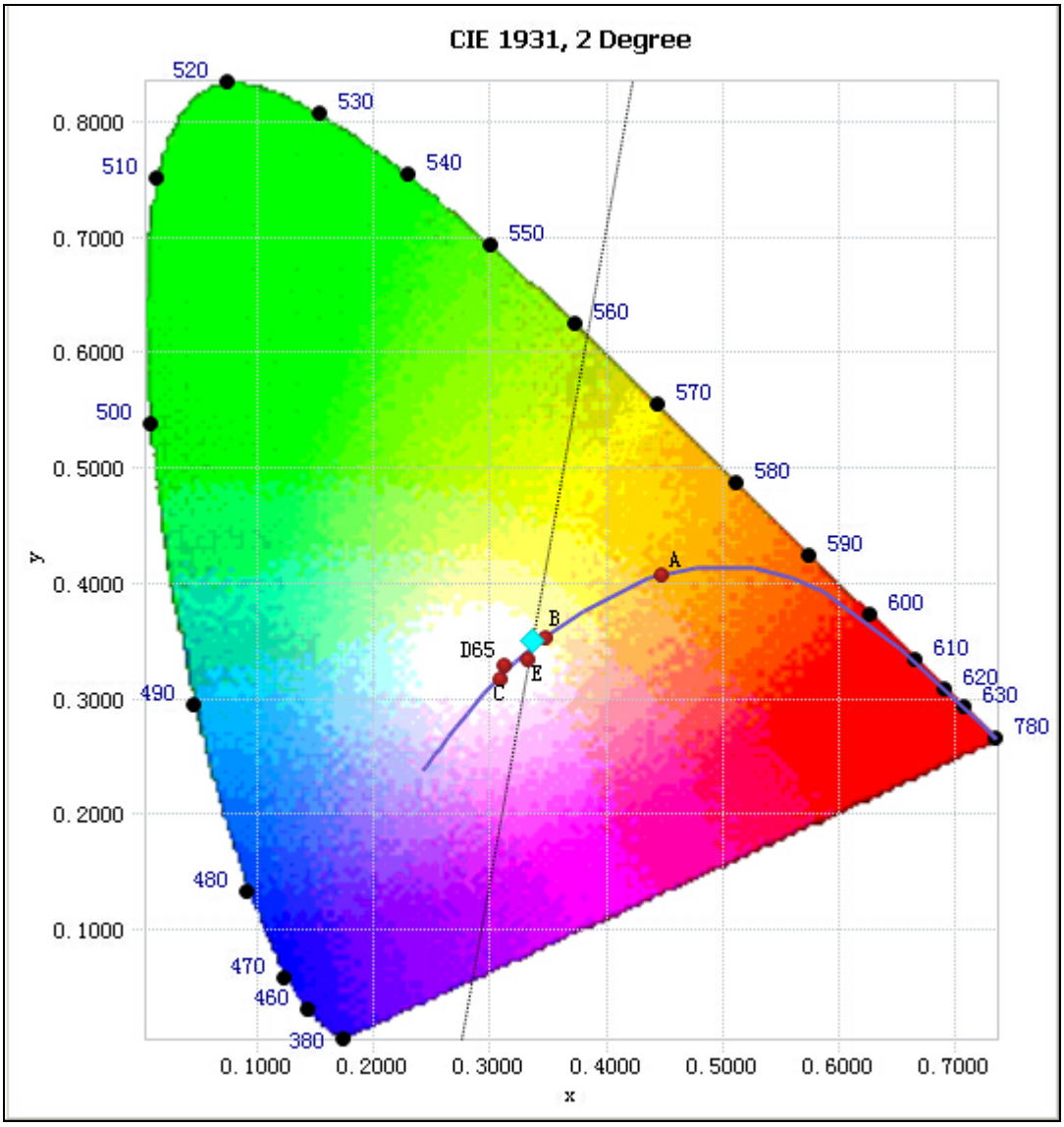


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	2.81E-03	485	1.16E-01	590	2.29E-01	695	3.26E-02
385	2.81E-03	490	1.30E-01	595	2.24E-01	700	2.80E-02
390	2.99E-03	495	1.48E-01	600	2.18E-01	705	2.43E-02
395	3.39E-03	500	1.64E-01	605	2.10E-01	710	2.08E-02
400	4.58E-03	505	1.77E-01	610	2.01E-01	715	1.80E-02
405	6.42E-03	510	1.85E-01	615	1.91E-01	720	1.55E-02
410	1.08E-02	515	1.92E-01	620	1.80E-01	725	1.33E-02
415	2.00E-02	520	1.98E-01	625	1.68E-01	730	1.15E-02
420	3.67E-02	525	2.02E-01	630	1.56E-01	735	9.77E-03
425	6.47E-02	530	2.06E-01	635	1.43E-01	740	8.45E-03
430	1.06E-01	535	2.12E-01	640	1.30E-01	745	7.23E-03
435	1.67E-01	540	2.16E-01	645	1.17E-01	750	6.25E-03
440	2.45E-01	545	2.21E-01	650	1.06E-01	755	5.41E-03
445	3.32E-01	550	2.25E-01	655	9.42E-02	760	4.67E-03
450	3.55E-01	555	2.28E-01	660	8.36E-02	765	4.00E-03
455	2.71E-01	560	2.30E-01	665	7.41E-02	770	3.45E-03
460	1.90E-01	565	2.33E-01	670	6.49E-02	775	3.02E-03
465	1.50E-01	570	2.34E-01	675	5.70E-02	780	2.61E-03
470	1.19E-01	575	2.33E-01	680	4.98E-02		
475	1.04E-01	580	2.34E-01	685	4.34E-02		
480	1.05E-01	585	2.31E-01	690	3.75E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3365, 0.3513)

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

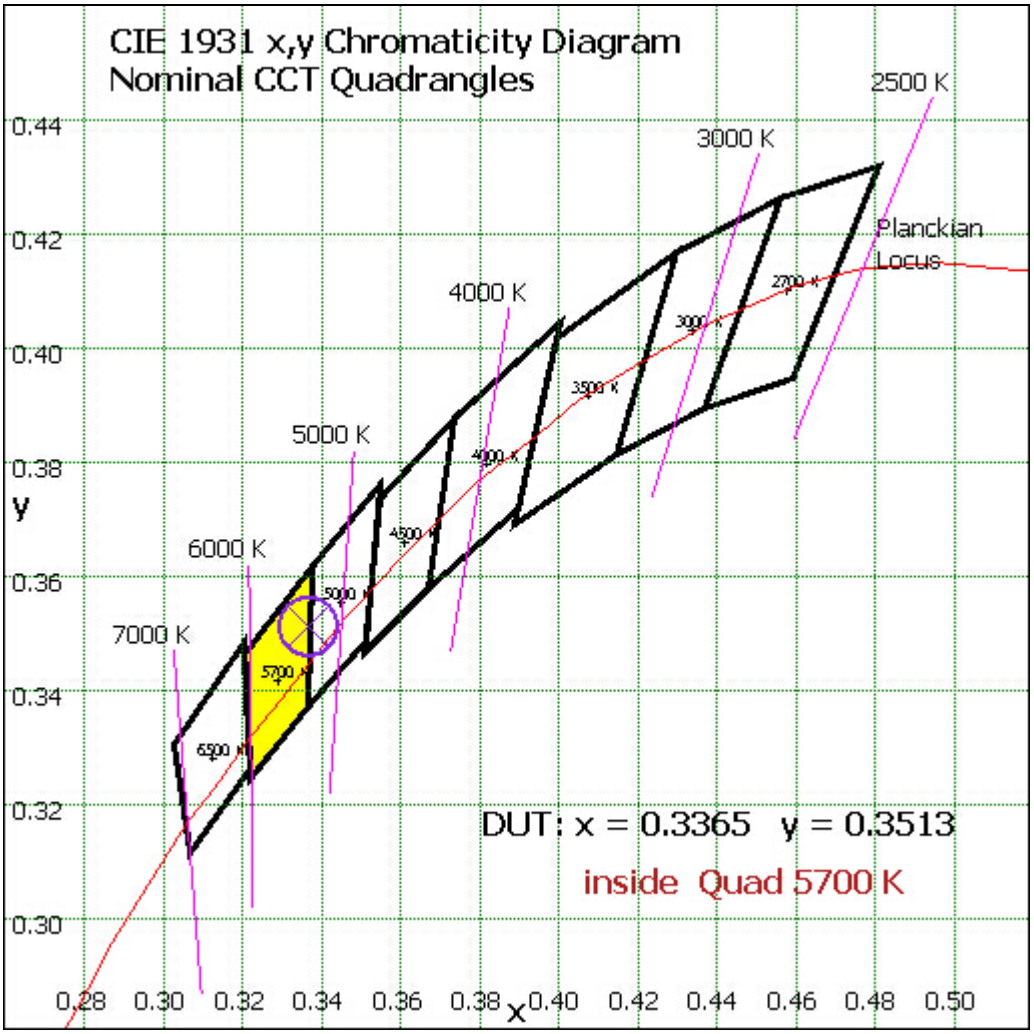


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total	γ(°)	Lumens	% Total
0~ 5	18.489	0.12%	90~95	770.537	5.19%
5~10	56.582	0.38%	95~100	757.647	5.11%
10~15	98.804	0.67%	100~105	731.497	4.93%
15~20	149.199	1.01%	105~110	689.529	4.65%
20~25	208.811	1.41%	110~115	634.217	4.27%
25~30	275.594	1.86%	115~120	572.158	3.86%
30~35	347.651	2.34%	120~125	507.049	3.42%
35~40	420.373	2.83%	125~130	438.935	2.96%
40~45	492.27	3.32%	130~135	367.389	2.48%
45~50	559.69	3.77%	135~140	294.066	1.98%
50~55	620.501	4.18%	140~145	223.837	1.51%
55~60	673.914	4.54%	145~150	161.237	1.09%
60~65	720.282	4.85%	150~155	105.845	0.71%
65~70	750.718	5.06%	155~160	61.474	0.41%
70~75	768.058	5.18%	160~165	29.32	0.20%
75~80	773.764	5.21%	165~170	10.05	0.07%
80~85	773.965	5.22%	170~175	1.906	0.01%
85~90	774.522	5.22%	175~180	0.105	0.00%

γ(°)	Lumens	% Total
0-135	13952.145	94.02%
135-180	887.84	5.98%
0-180	14840.0	100%

Table 5: Zonal Lumen Data

Illuminance Plots- Goniophotometer Method

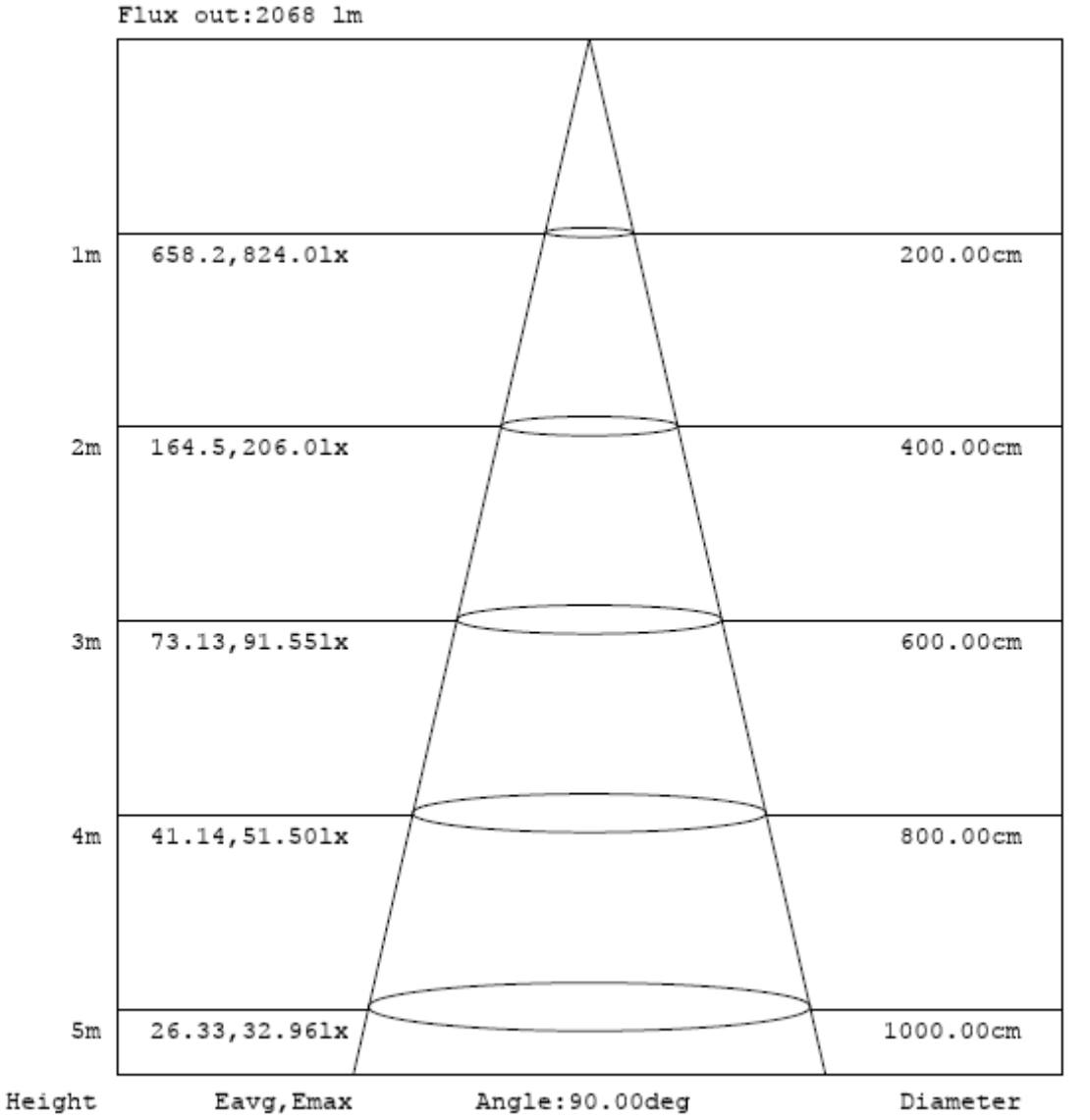


Chart 4: Beam Angle

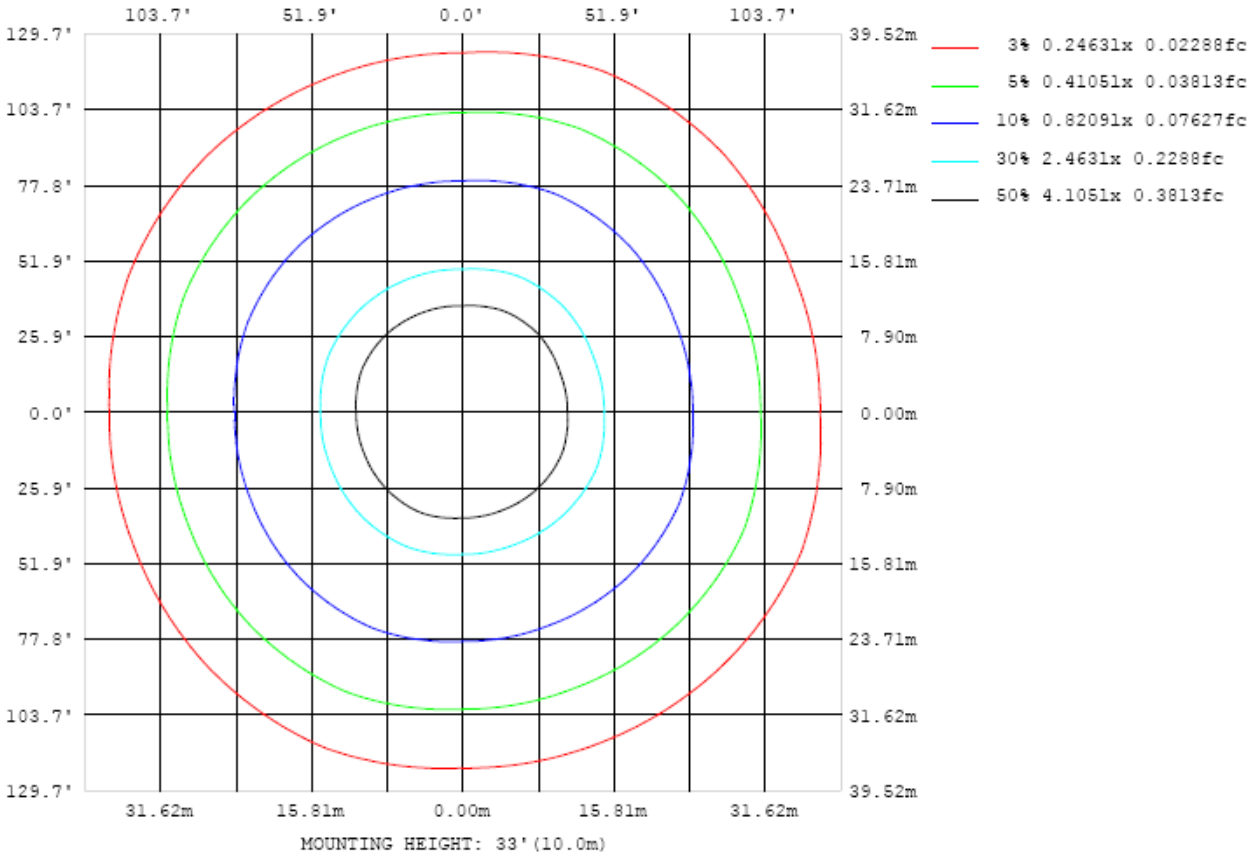


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

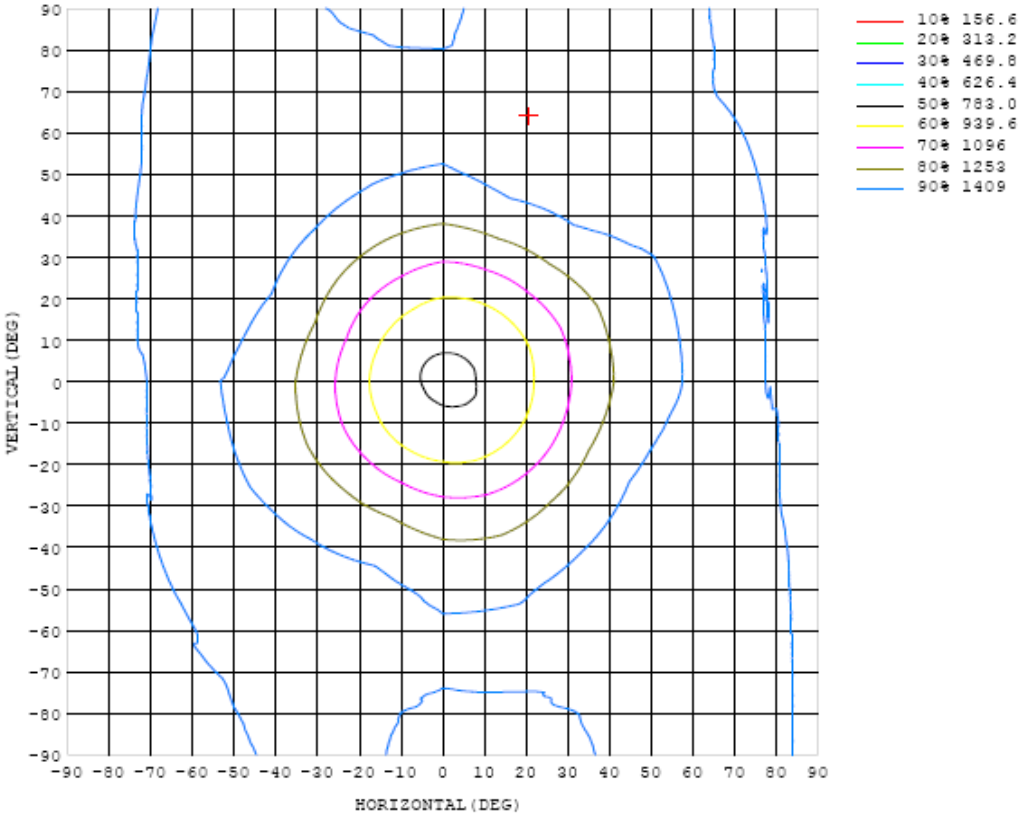


Chart 6: Isocandela Plot

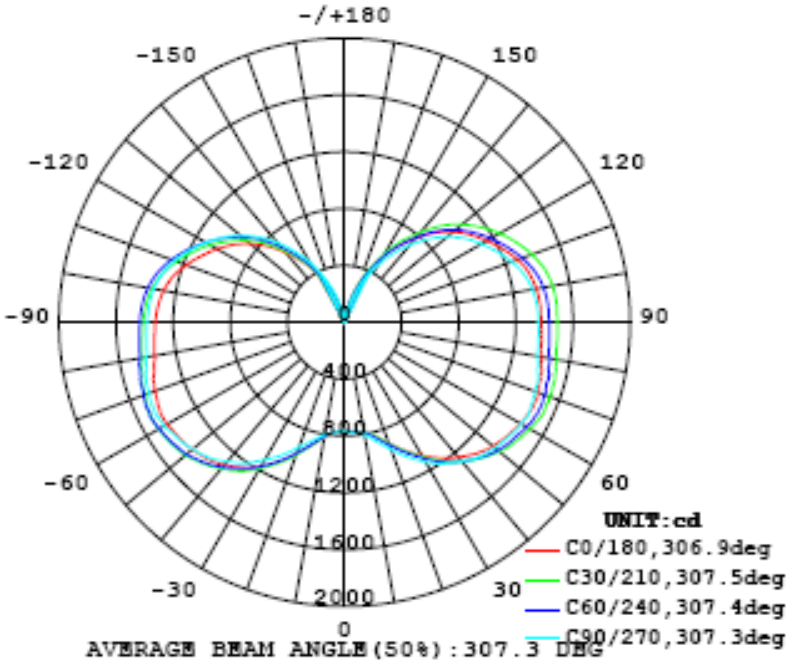


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C(DEG) / γ (DEG)	0	23	45	68	90	113	135	158	180	203	225	248	270	293	315	338			
0	765	765	765	765	765	765	765	765	765	765	765	765	765	765	765	765			
5	776	776	777	779	781	783	783	783	782	780	778	778	776	776	776	775			
10	790	787	792	799	805	812	818	823	820	817	815	811	803	797	792	790			
15	831	831	841	852	867	877	888	897	896	894	887	875	859	848	838	830			
20	907	910	920	931	951	968	978	985	985	992	977	960	935	925	913	903			
25	996	1001	1012	1023	1044	1073	1079	1075	1082	1092	1075	1059	1030	1022	1008	991			
30	1081	1093	1104	1112	1135	1166	1171	1170	1174	1189	1170	1149	1115	1122	1112	1081			
35	1168	1192	1201	1198	1214	1257	1257	1245	1249	1277	1254	1231	1208	1222	1210	1172			
40	1239	1280	1277	1262	1275	1330	1324	1308	1310	1342	1329	1303	1279	1311	1296	1243			
45	1305	1351	1345	1329	1339	1392	1385	1362	1359	1406	1394	1372	1346	1391	1377	1313			
50	1356	1414	1400	1372	1374	1439	1427	1402	1392	1456	1445	1411	1389	1451	1434	1359			
55	1393	1460	1438	1406	1404	1475	1465	1425	1415	1486	1476	1445	1426	1503	1474	1397			
60	1425	1500	1471	1434	1427	1503	1486	1445	1437	1503	1499	1474	1458	1540	1509	1433			
65	1446	1530	1495	1448	1438	1512	1498	1451	1433	1511	1505	1487	1470	1564	1537	1456			
70	1435	1528	1493	1434	1417	1506	1480	1428	1410	1488	1499	1471	1459	1565	1543	1452			
75	1421	1525	1476	1430	1401	1487	1456	1399	1379	1468	1479	1459	1443	1555	1534	1436			
80	1404	1514	1460	1389	1369	1458	1429	1373	1351	1440	1456	1424	1412	1529	1517	1422			
85	1385	1494	1442	1375	1362	1449	1417	1359	1336	1425	1444	1411	1391	1508	1496	1401			
90	1379	1491	1435	1367	1357	1443	1409	1351	1326	1413	1435	1401	1383	1501	1488	1394			
95	1375	1490	1429	1361	1352	1434	1395	1336	1312	1398	1424	1392	1375	1494	1484	1390			
100	1363	1480	1414	1343	1336	1412	1368	1310	1287	1370	1400	1370	1357	1476	1470	1378			
105	1338	1451	1380	1310	1302	1369	1321	1265	1245	1322	1356	1332	1324	1440	1440	1352			
110	1290	1398	1325	1253	1246	1305	1254	1199	1181	1254	1291	1272	1269	1382	1385	1302			
115	1223	1330	1256	1183	1179	1232	1177	1123	1108	1175	1212	1197	1198	1305	1312	1234			
120	1150	1255	1182	1111	1107	1151	1096	1045	1033	1090	1126	1117	1122	1223	1232	1161			
125	1076	1168	1103	1036	1031	1060	1007	965	954	997	1034	1034	1043	1131	1146	1087			
130	992	1072	1014	946	938	959	910	867	860	900	934	940	952	1033	1052	1004			
135	892	962	907	844	832	841	797	760	757	788	824	835	848	924	945	903			
140	778	827	781	730	710	708	675	642	643	663	695	718	732	790	817	791			
145	659	701	654	612	591	583	554	524	526	545	570	594	610	660	688	670			
150	538	555	523	493	466	445	426	402	410	419	443	470	488	529	556	550			
155	408	412	385	363	341	318	302	284	292	298	317	339	356	392	416	418			
160	281	278	259	240	219	200	186	174	181	185	201	219	236	258	280	290			
165	161	156	147	130	114	99.5	90.3	83.9	89.3	91.4	102	116	129	142	159	171			
170	67.2	64.6	58.7	48.9	39.3	32.6	28.0	26.7	29.4	30.6	35.1	42.5	50.6	57.3	65.3	71.4			
175	13.0	11.7	10.0	8.05	6.94	5.59	4.54	4.13	4.81	5.48	6.95	8.60	10.8	12.8	14.2	14.8			
180	1.25	0.73	0.11	0.00	0.00	1.19	1.25	1.24	1.26	1.26	1.26	1.26	1.26	1.27	1.27	1.28			

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, 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 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 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 BR30s) 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 1.39% with a coverage factor k=2.

Goniophotometer Method

Photometric and Electrical Measurements

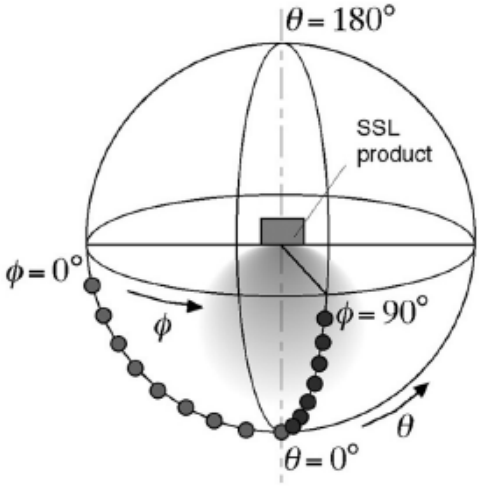
An EVERFINE Type C Model GO-R5000 Goniophotometer was used to measure the intensity at each angle of distribution for each sample. The photometric distance is 2.475m for near-field measurement or 30m for far-field measurement. Bandwidth of spectroradiometer is 380nm-780nm.
Ambient temperature was measured 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 BR30s) 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 expended uncertainty is 1.8% 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°/180° and C=90°/270°) 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, Δu'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.



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