NVLAP LAB CODE 200960-0

LM-79-08 Test Report

For

GREEN CREATIVE LTD

756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

LED commercial downlight

Model: 45CDLA9.5/840/277V

Laboratory: Leading Testing Laboratories

NVLAP CODE: 200960-0

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Report No.: HZ16020003h/R1

This report is replaced the old report No. HZ16020003h dated Mar. 25, 2016

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

Reviewed by: April Zou

Engineer: April Zou

Mar. 31, 2016

Approved by: Jim Zhang

Manager: Jim Zhang

Mar. 31, 2016

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: **45CDLA9.5/840/277V**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
89.9	4041.0	44.97	0.9934

CCT (K)	CRI	Stabilization Time (Light & Power)
4090	85.7	65

Table 1: Executive Data Summary

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

Test specifications:

Date of Receipt : Mar. 16, 2016

Date of Test : Mar. 23, 2016

Test item : Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters, Color Uniformity

Reference Standard : IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

TABLE OF CONTENT

Sample Photos

Sample view

Equipment Under Test (EUT)	
Name	: LED Downlight
Model	: 45CDLA9.5/840/277V
Electrical Ratings	: 120-277VAC, 60Hz, 45W
Product Description	: 4000K, Non-dimmable, CRI80 Manufacturer of LED light source: Lextar Electronics Corp Model of LED light source: PC35H11
Manufacturer	: GREEN CREATIVE LTD
Address	: 756 North Zhongshan Rd., Unit B301 Zhabei District, Shanghai

TEST RESULTS

Test ambient temperature was 25.2℃.

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

The stabilization time of the sample was 65 minutes, and the total operating time including stabilization was 70 minutes.

Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.377	0.174
Power Factor	0.9934	0.9273
Test Power (W)	44.97	44.76
THD A%	9.59	17.37
Luminous Efficacy (lm/W)	89.9	91.9
Total Luminous Flux (lm)	4041.0	4114.0
Color Rendering Index (CRI)	85.7	
R9	19.6	
Correlated Color Temperature (CCT)(K)	4090	
Chromaticity Chroma x	0.3752	
Chromaticity Chroma y	0.3693	
Chromaticity Chroma u	0.2246	
Chromaticity Chroma v	0.3316	
Duv	0.0025	
Chromaticity Chroma u ’	0.2246	
Chromaticity Chroma v’	0.4974	

Special Color Rendering Indices	
R1	84.8
R2	92.4
R3	96
R4	84
R5	84.9
R6	88.7
R7	86.4
R8	68
R9	19.6
R10	81.3
R11	83.4
R12	68.4
R13	87
R14	98.3

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 24.3℃.

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)	0.382
Power Factor	0.9931
Test Power (W)	45.55
Luminous Efficacy (lm/W)	91.4
Total Luminous Flux (lm)	4162.9
Beam Angle (°)	102.7
Center Beam Candle Power (cd)	1683
Spacing Criteria	1.18(0°-180°)/1.20(90°-270°)
Zonal Lumens in the 0°-60°Zone	83.49%
Zonal Lumens in the 60°-90°Zone	16.44%
Zonal Lumens in the 90°-120°Zone	0.02%
Zonal Lumens in the 120°-180°Zone	0.05%

Table 3: Test data per Goniophotometer Method

Spectral Power Distribution - Sphere Spectroradiometer Method

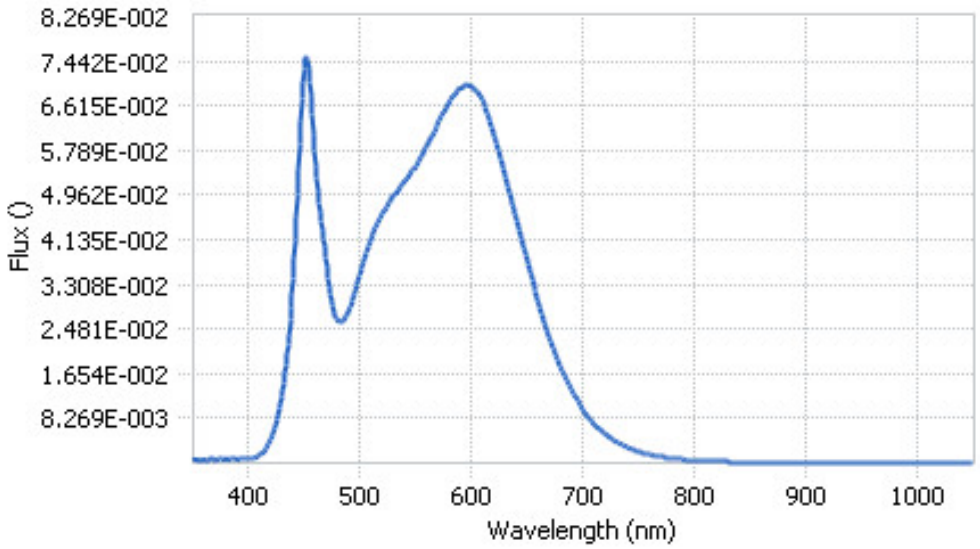
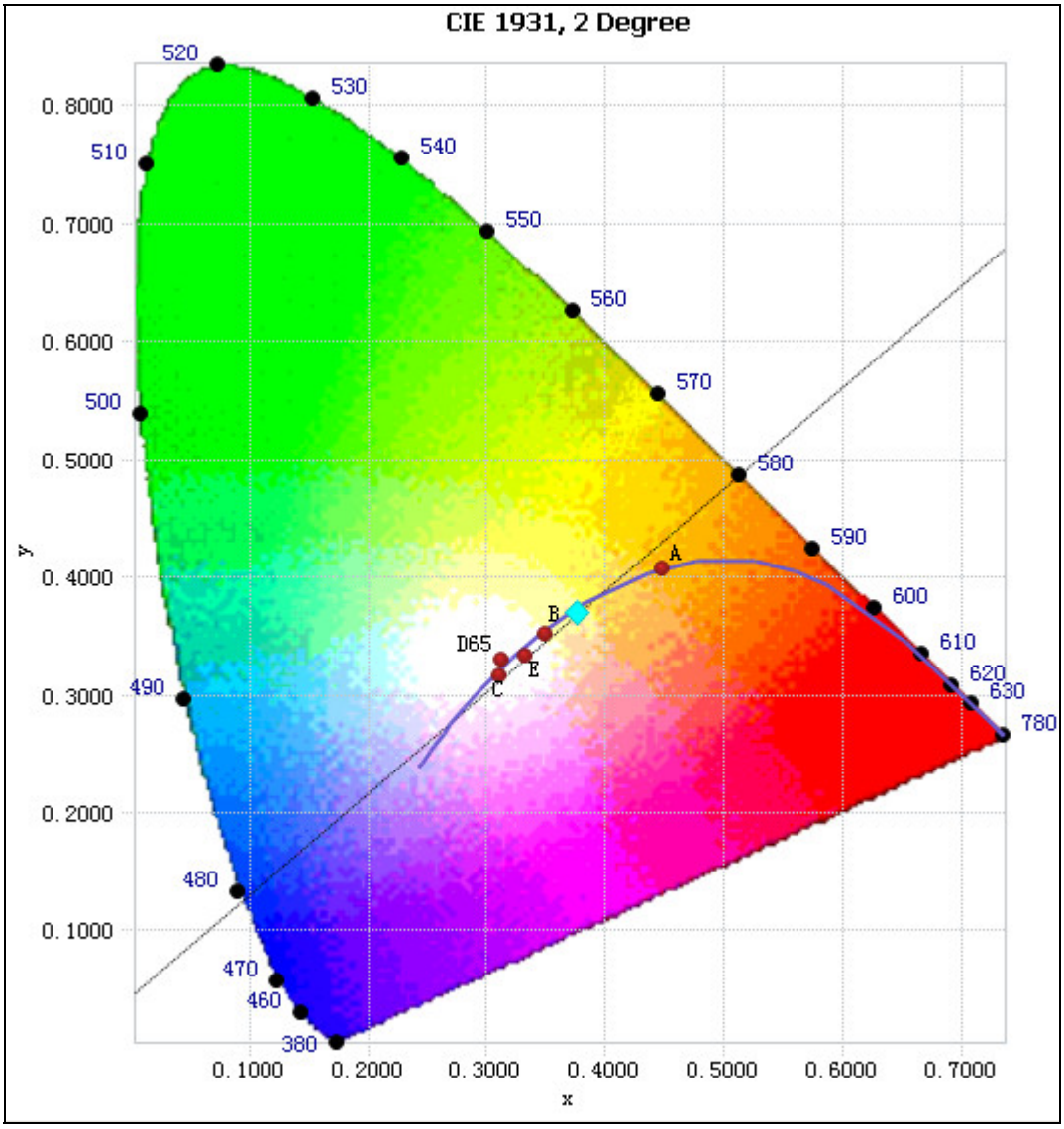


Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.66E-04	485	2.64E-02	590	6.94E-02	695	1.16E-02
385	6.95E-04	490	2.83E-02	595	6.99E-02	700	9.99E-03
390	6.67E-04	495	3.13E-02	600	6.96E-02	705	8.57E-03
395	7.11E-04	500	3.51E-02	605	6.86E-02	710	7.34E-03
400	8.15E-04	505	3.88E-02	610	6.71E-02	715	6.34E-03
405	1.02E-03	510	4.19E-02	615	6.46E-02	720	5.48E-03
410	1.50E-03	515	4.44E-02	620	6.12E-02	725	4.68E-03
415	2.52E-03	520	4.63E-02	625	5.76E-02	730	4.00E-03
420	4.54E-03	525	4.80E-02	630	5.36E-02	735	3.41E-03
425	8.08E-03	530	4.93E-02	635	4.96E-02	740	2.93E-03
430	1.36E-02	535	5.07E-02	640	4.55E-02	745	2.50E-03
435	2.22E-02	540	5.21E-02	645	4.16E-02	750	2.15E-03
440	3.44E-02	545	5.36E-02	650	3.76E-02	755	1.86E-03
445	5.43E-02	550	5.49E-02	655	3.37E-02	760	1.59E-03
450	7.29E-02	555	5.70E-02	660	3.01E-02	765	1.38E-03
455	7.05E-02	560	5.88E-02	665	2.66E-02	770	1.18E-03
460	5.49E-02	565	6.09E-02	670	2.34E-02	775	1.02E-03
465	4.47E-02	570	6.30E-02	675	2.05E-02	780	8.85E-04
470	3.61E-02	575	6.51E-02	680	1.78E-02		
475	2.89E-02	580	6.66E-02	685	1.55E-02		
480	2.62E-02	585	6.84E-02	690	1.35E-02		

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

Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y) : (0.3752, 0.3693)

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

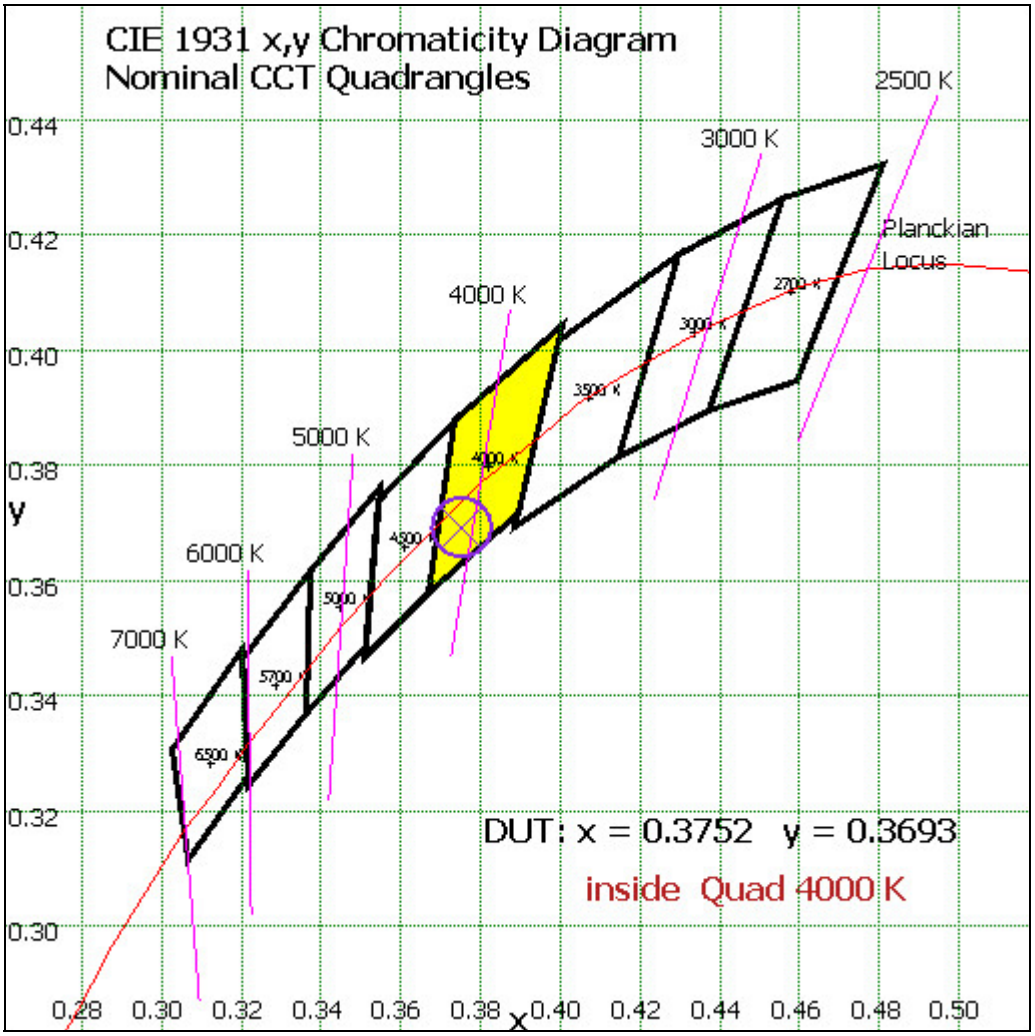


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

Zonal Lumen Tabulation- Goniophotometer Method

γ(°)	Lumens	% Total
0- 10	158.733	3.81%
10- 20	448.682	10.78%
20- 30	662.809	15.92%
30- 40	771.445	18.53%
40- 50	769.955	18.50%
50- 60	663.984	15.95%
60- 70	456.25	10.96%
70- 80	201.769	4.85%
80- 90	26.316	0.63%
90-100	0.168	0.00%
100-110	0.249	0.01%
110-120	0.34	0.01%
120-130	0.425	0.01%
130-140	0.517	0.01%
140-150	0.508	0.01%
150-160	0.387	0.01%
160-170	0.246	0.01%
170-180	0.088	0.00%
Total	4162.9	100%

γ(°)	Lumens	% Total
0- 60	3475.608	83.49%
60- 90	684.335	16.44%
0-90	4159.943	99.93%
90- 180	2.928	0.07%
0- 180	4162.9	100%

Table 4: Zonal Lumen Data

Illuminance Plots- Goniophotometer Method

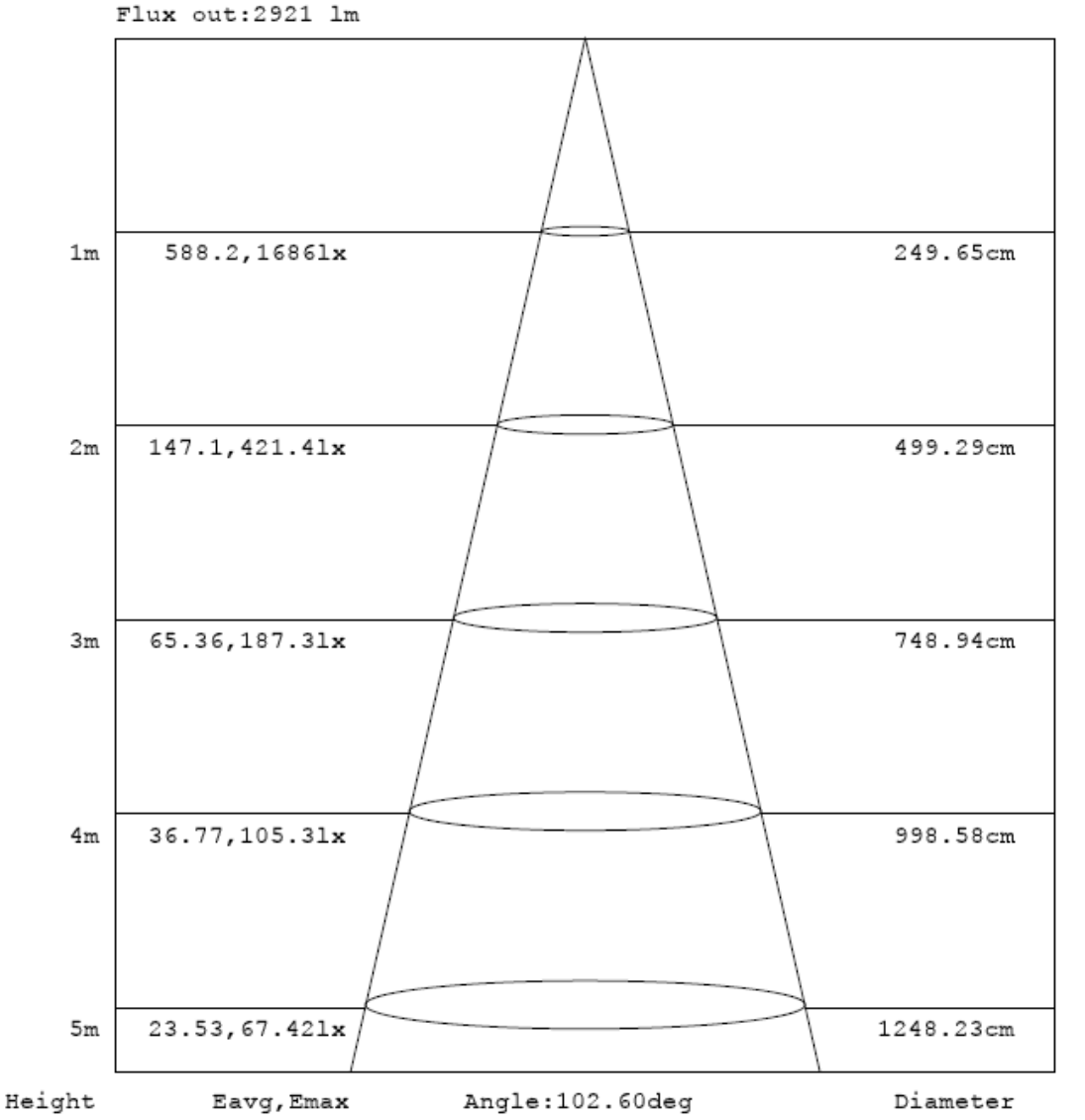


Chart 4: Beam Angle

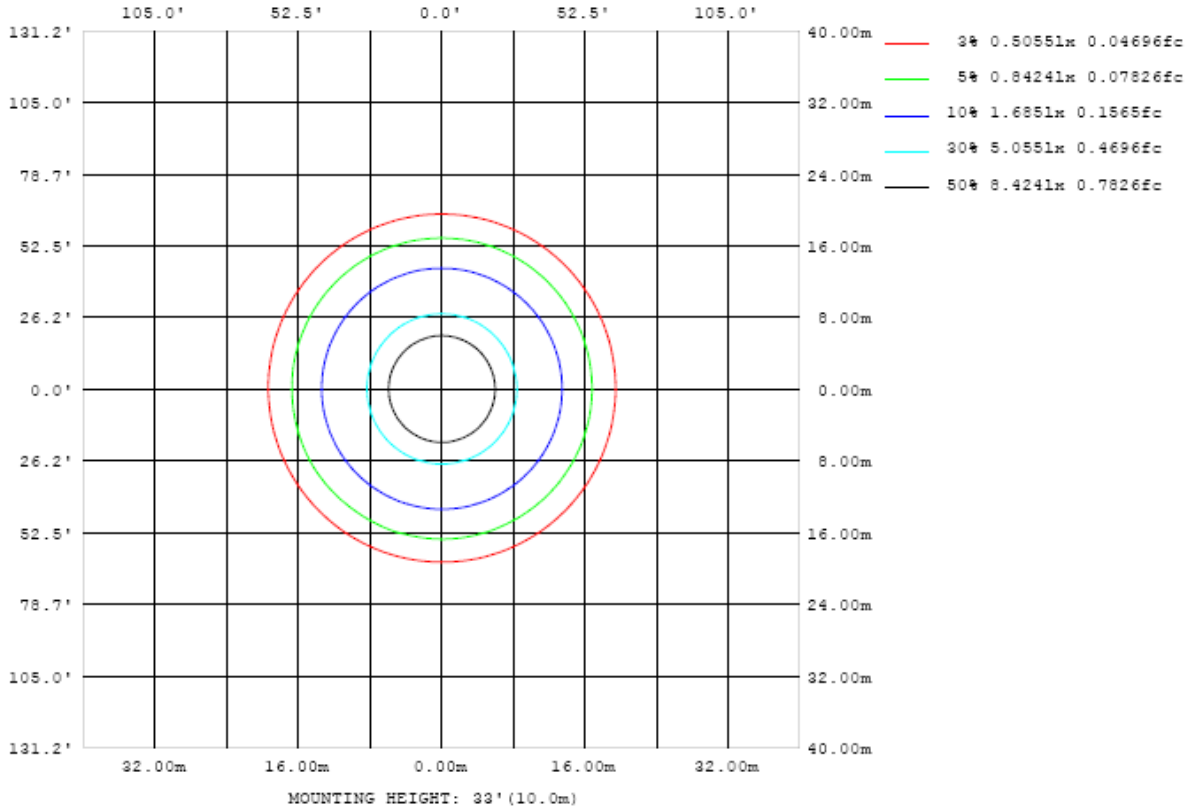


Chart 5: Illuminance Plot (Footcandles)

Luminous Intensity Distribution Plots- Goniophotometer Method

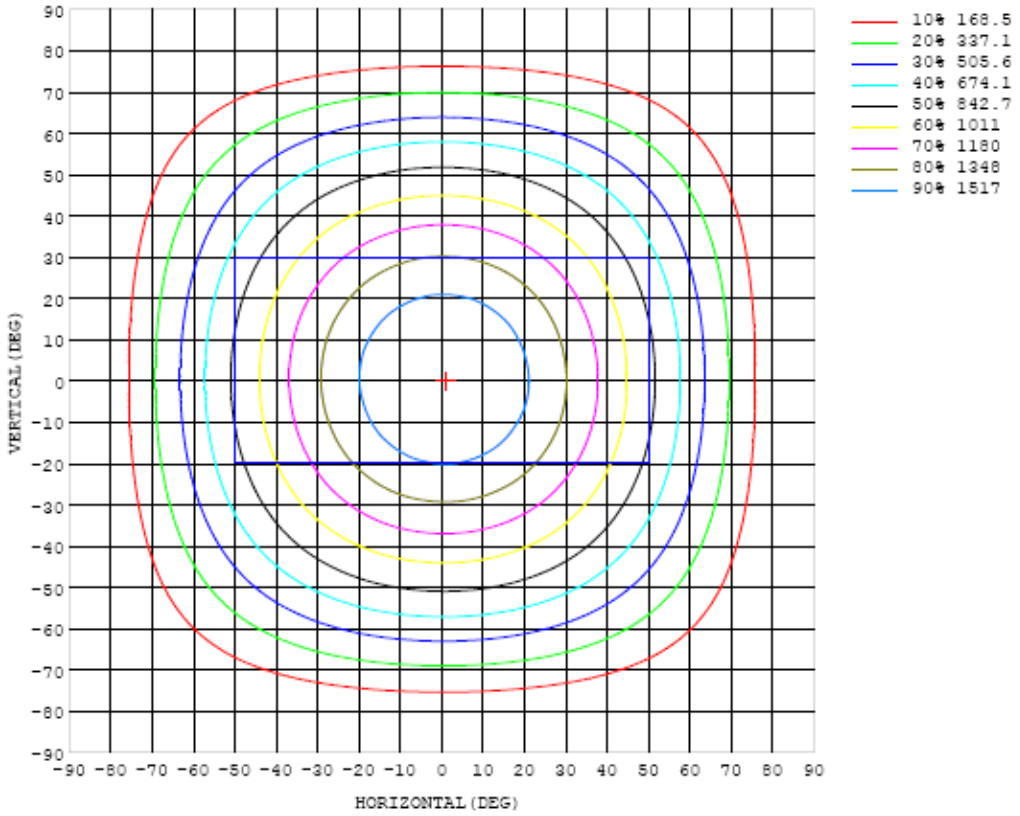


Chart 6: Isocandela Plot

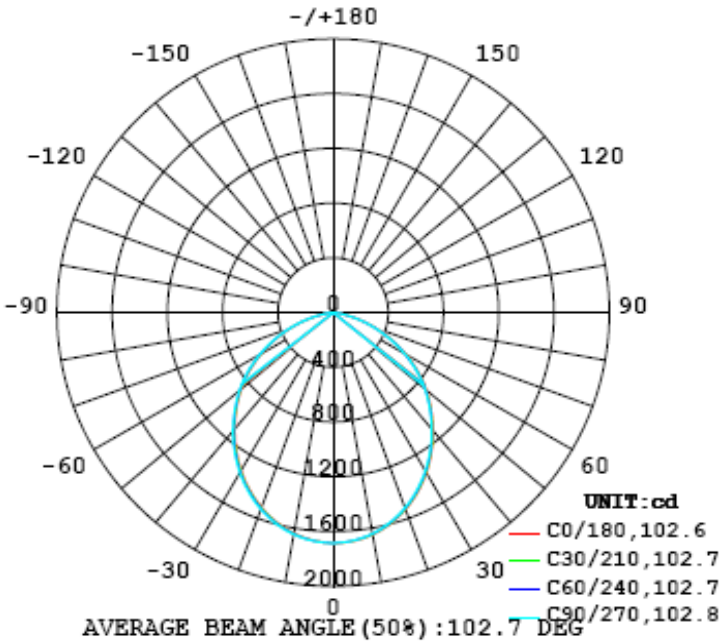


Chart 7: Polar Candela Distribution

Luminous Intensity Data- Goniophotometer Method

Table--1 UNIT: cd

C(DEG) / γ (DEG)	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683
5	1676	1675	1675	1674	1673	1673	1671	1672	1672	1671	1670	1670	1671	1670	1669	1670	1670	1670	1671
10	1648	1647	1646	1645	1643	1643	1641	1641	1641	1639	1638	1637	1637	1636	1636	1636	1637	1637	1637
15	1599	1597	1597	1595	1594	1593	1590	1590	1588	1587	1586	1584	1584	1583	1583	1583	1584	1584	1585
20	1532	1531	1529	1527	1526	1524	1521	1520	1519	1517	1516	1515	1514	1513	1513	1513	1514	1514	1515
25	1448	1447	1445	1443	1441	1439	1437	1435	1434	1432	1430	1429	1428	1427	1427	1427	1428	1428	1430
30	1351	1349	1347	1345	1343	1341	1338	1337	1335	1333	1331	1331	1329	1329	1328	1328	1329	1330	1332
35	1243	1241	1239	1236	1234	1232	1229	1228	1226	1224	1222	1221	1220	1220	1219	1219	1220	1222	1223
40	1126	1124	1122	1120	1118	1116	1113	1111	1109	1108	1106	1106	1105	1104	1104	1104	1105	1106	1108
45	1005	1003	1001	999	997	995	992	991	989	988	986	985	985	984	984	984	986	987	989
50	882	880	878	876	874	872	870	868	867	865	864	864	863	863	863	863	865	866	868
55	749	747	745	743	741	739	737	735	734	733	731	731	730	731	731	732	733	735	737
60	608	604	602	600	597	596	594	592	592	591	590	590	589	589	590	597	593	594	598
65	464	462	460	457	455	454	452	451	450	449	448	449	448	449	449	450	452	454	458
70	323	320	319	316	314	313	311	310	309	309	308	308	308	309	310	311	313	315	319
75	189	187	185	184	182	181	179	178	177	177	176	177	177	178	179	180	182	183	187
80	76.9	75.4	73.8	72.4	70.9	69.8	68.7	67.9	67.4	66.8	66.7	66.9	67.2	67.7	68.6	69.5	70.7	72.0	74.9
85	17.0	16.7	16.5	16.3	16.0	15.8	15.7	15.6	15.6	15.6	15.6	15.8	15.9	16.0	16.2	16.4	16.6	16.9	17.2
90	0.15	0.13	0.12	0.11	0.11	0.11	0.11	0.11	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.21
95	0.11	0.11	0.11	0.11	0.12	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.19
100	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.23
105	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.29
110	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.36
115	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.41
120	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.47
125	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.40	0.54
130	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.64
135	0.58	0.58	0.58	0.58	0.58	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.77
140	0.64	0.64	0.64	0.64	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.88
145	0.67	0.67	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.96
150	0.66	0.66	0.66	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	1.00
155	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.66	0.9998
160	0.69	0.69	0.69	0.69	0.69	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.70	0.70	0.69	0.69	0.69	0.69	0.98
165	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.98
170	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.99
175	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.99
180	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.91	0.92	0.91	0.91	0.91	0.91	0.91	0.93	0.95	0.96	0.93

Table 6: Luminous Intensity Data

Table--2 UNIT: cd

γ (DEG) \ C (DEG)	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350		
0	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683	1683		
5	1671	1672	1672	1672	1673	1673	1674	1675	1675	1675	1676	1676	1676	1676	1676	1676	1676		
10	1638	1640	1640	1641	1642	1643	1645	1646	1647	1647	1648	1649	1649	1649	1648	1648	1648		
15	1586	1588	1589	1591	1593	1594	1596	1598	1598	1599	1600	1601	1601	1601	1601	1601	1600		
20	1516	1519	1520	1522	1524	1526	1528	1530	1533	1533	1534	1535	1535	1535	1534	1534	1533		
25	1431	1434	1436	1438	1441	1443	1445	1448	1450	1451	1452	1452	1452	1452	1451	1451	1449		
30	1333	1336	1338	1341	1344	1346	1349	1351	1353	1354	1355	1356	1356	1355	1355	1354	1352		
35	1225	1228	1231	1233	1237	1239	1242	1244	1246	1247	1248	1249	1248	1248	1247	1246	1244		
40	1110	1113	1116	1119	1122	1124	1126	1129	1131	1132	1133	1133	1133	1132	1131	1130	1128		
45	991	994	996	999	1002	1005	1007	1009	1011	1011	1012	1012	1012	1011	1010	1009	1007		
50	870	873	875	878	880	883	885	887	888	889	890	890	889	888	887	886	884		
55	740	743	745	748	750	753	755	757	758	758	758	758	758	756	755	754	752		
60	601	603	606	608	611	613	615	616	617	618	618	617	616	615	614	612	610		
65	460	463	465	468	470	471	473	474	475	475	475	475	474	473	471	470	468		
70	321	324	326	328	330	331	333	334	334	334	334	334	333	331	330	328	326		
75	189	191	193	195	197	198	199	200	200	200	200	200	199	198	197	195	193		
80	76.3	77.7	79.1	80.5	81.5	82.6	83.6	84.3	84.5	84.5	84.8	84.4	83.8	83.0	82.2	81.0	79.9		
85	17.5	17.9	18.1	18.5	18.7	19.0	18.6	18.7	18.8	19.7	18.8	19.7	19.6	19.3	19.0	18.6	18.2		
90	0.24	0.31	0.35	0.40	0.44	0.48	0.50	0.52	0.51	0.49	0.47	0.45	0.42	0.36	0.32	0.26	0.21		
95	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18		
100	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23		
105	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29		
110	0.36	0.36	0.36	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35		
115	0.41	0.41	0.41	0.41	0.41	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40		
120	0.47	0.47	0.47	0.47	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46		
125	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.53		
130	0.65	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.63	0.64	0.64	0.64	0.64		
135	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76		
140	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87		
145	0.96	0.96	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95		
150	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		
155	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
160	0.99	1.00	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99		
165	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98		
170	1.00	1.00	0.999	0.999	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
175	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
180	0.93	0.93	0.93	0.93	0.93	0.93	0.94	0.94	0.94	0.94	0.93	0.94	0.94	0.94	0.94	0.94	0.93		

Table 7: Luminous Intensity Data

EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Jul. 17, 2015	Jul. 16, 2016
Digital Power Meter	PF2010A	HZTE028-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-08	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	WY12010	HZTE004-03	Jul. 17, 2015	Jul. 16, 2016
Temperature Meter	TES1310	HZTE017-01	Jul. 17, 2015	Jul. 16, 2016
Standard source	D908	HZTE012-01	Jul. 23, 2015	Jul. 22, 2016
Integrate Sphere system	2M	HZTE015-01	Jul. 16, 2015	Jul. 15, 2016
Digital Power Meter	WT210	HZTE008-01	Jul. 17, 2015	Jul. 16, 2016
AC Power Supply	PCR 500L	HZTE001-07	Jul. 17, 2015	Jul. 16, 2016
DC Power Supply	6154	HZTE004-04	Jul. 17, 2015	Jul. 16, 2016
Temperature and humidity recorder	JR900	HZTE018-01	Jul. 21, 2015	Jul. 20, 2016
Standard source	SCL-1400	HZTE012-02	Oct. 21, 2015	Oct. 20, 2016

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 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

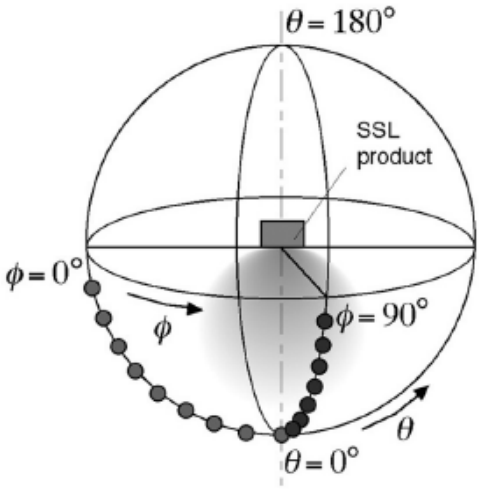
The color characteristics of SSL products include chromaticity coordinates, correlated color temperature, and color rendering index. These characteristics of SSL products may be spatially non-uniform, and thus, in order that they can be specified accurately, the color quantities shall be measured as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



*** End of Report ***