



## LM-79-08 Test Report

for

**ABB Lighting, Inc.**

1501 Industrial Way N. Toms River, NJ 08755

**Leopard series mini flood lights and wall packs**

**Model: MFW20501**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ16040046b

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

Reviewed by:

Engineer: April Zou  
May 10, 2016

Manager: Jim Zhang  
May 10, 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: **MFW20501**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
113.6	2274.8	20.03	0.9922
CCT (K)	CRI	Stabilization Time (Light & Power)	
5084	71.9	60	

Table 1: Executive Data Summary

### Test specifications:

<b>Date of Receipt</b>	: Apr. 21, 2016
<b>Date of Test</b>	: Apr. 28, 2016
<b>Test item</b>	: Total Luminous Flux, Luminous Distribution Intensity, Luminous Efficacy, Correlated Color Temperature, Color Rendering Index, Chromaticity Coordinate, Electrical parameters
<b>Reference Standard</b>	: IESNA LM-79-2008 Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

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## Sample Photo



Figure 1- Overview of the sample

### Equipment Under Test (EUT)

<b>Name</b>	: Leopard series mini flood lights and wall packs
<b>Model</b>	: MFW20501
<b>Electrical Ratings</b>	: 100~277Vac, 50/60Hz, 20W
<b>Product Description</b>	: 5000K, Aluminum Enclosure, Black Coating, Silver reflector Manufacturer of light source: Samsung Model of light source: 351B Quantity of LED light source: 10 (10SIP)
<b>Manufacturer</b>	: ABB Lighting (shanghai) Co., Ltd.
<b>Address</b>	: Room 1012, North Minch Fortune 108 Plaza,# 1839 Qixin road, Shanghai

## 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 60 minutes, and the total operating time including stabilization was 85 minutes.

The photometric distance of Goniophotometer is 2.47 m.

Luminous data was taken at 0.5° vertical intervals and 10.0° horizontal intervals.

Parameter	Result			Special Color Rendering Indices	
Test Voltage (V)	120.0	100.0	277.0	R1	68.5
Voltage frequency (Hz)	60	60	60	R2	77.7
Test Current (A)	0.168	0.206	0.076	R3	84.3
Power Factor	0.9922	0.9946	0.9241	R4	71.8
Test Power (W)	20.03	20.50	19.44	R5	69.9
THD A%	10.07	7.98	16.14	R6	68.8
Luminous Efficacy (lm/W)	113.6	111.9	114.4	R7	79.9
Total Luminous Flux (lm)	2274.8	2293.1	2224.6	R8	54.2
Color Rendering Index (CRI)	71.9			R9	-36.2
R9	-36.2			R10	47.1
Correlated Color Temperature (CCT) (K)	5084			R11	68.5
Chromaticity (Chroma x, Chroma y)	(0.3432, 0.3549)			R12	47.3
Chromaticity (Chroma u, Chroma v)	(0.2089, 0.3240)			R13	69.9
Chromaticity (Chroma u', Chroma v')	(0.2089, 0.4860)			R14	91.3
Duv	0.0024				
Average Beam Angle (°)	72.3				
Center Beam Candle Power (cd)	1016				
Spacing Criteria	0.92 (0°-180°)/ 1.37 (90°-270°)				
Zonal Lumens in the 0°-60°Zone	95.30%				
Zonal Lumens in the 60°-90°Zone	4.63%				
Zonal Lumens in the 90°-120°Zone	0.01%				
Zonal Lumens in the 120°-180°Zone	0.06%				

Table 2: Test data per Goniophotometer Method

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

## Spectral Power Distribution

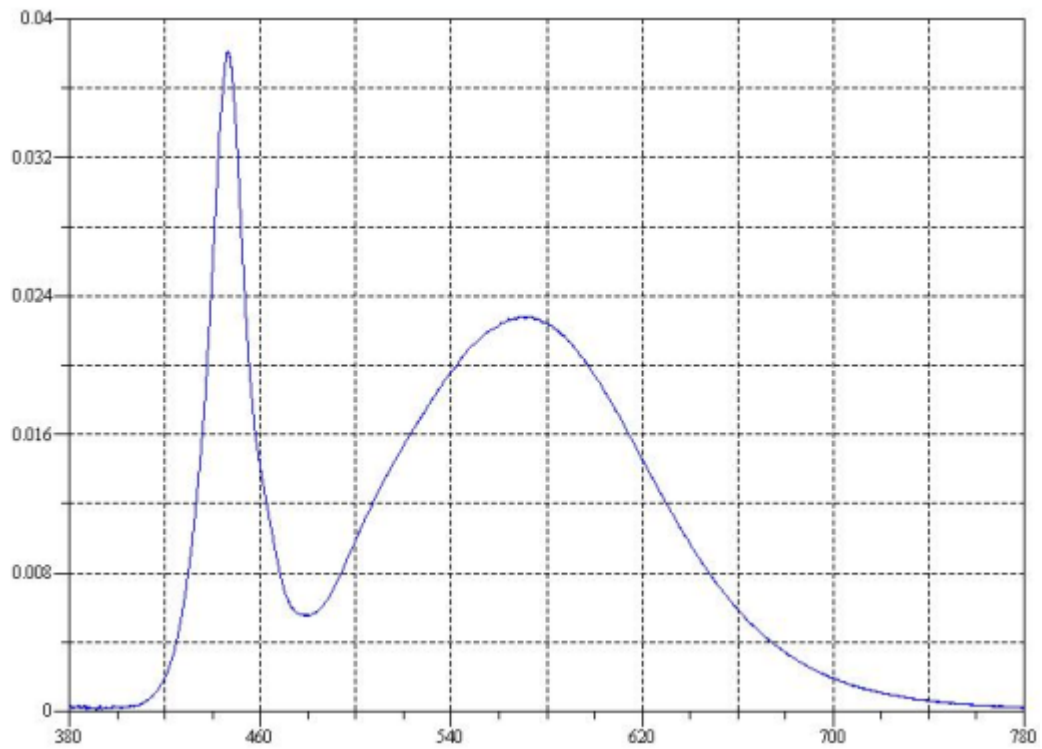


Chart 1: Spectral Power Distribution

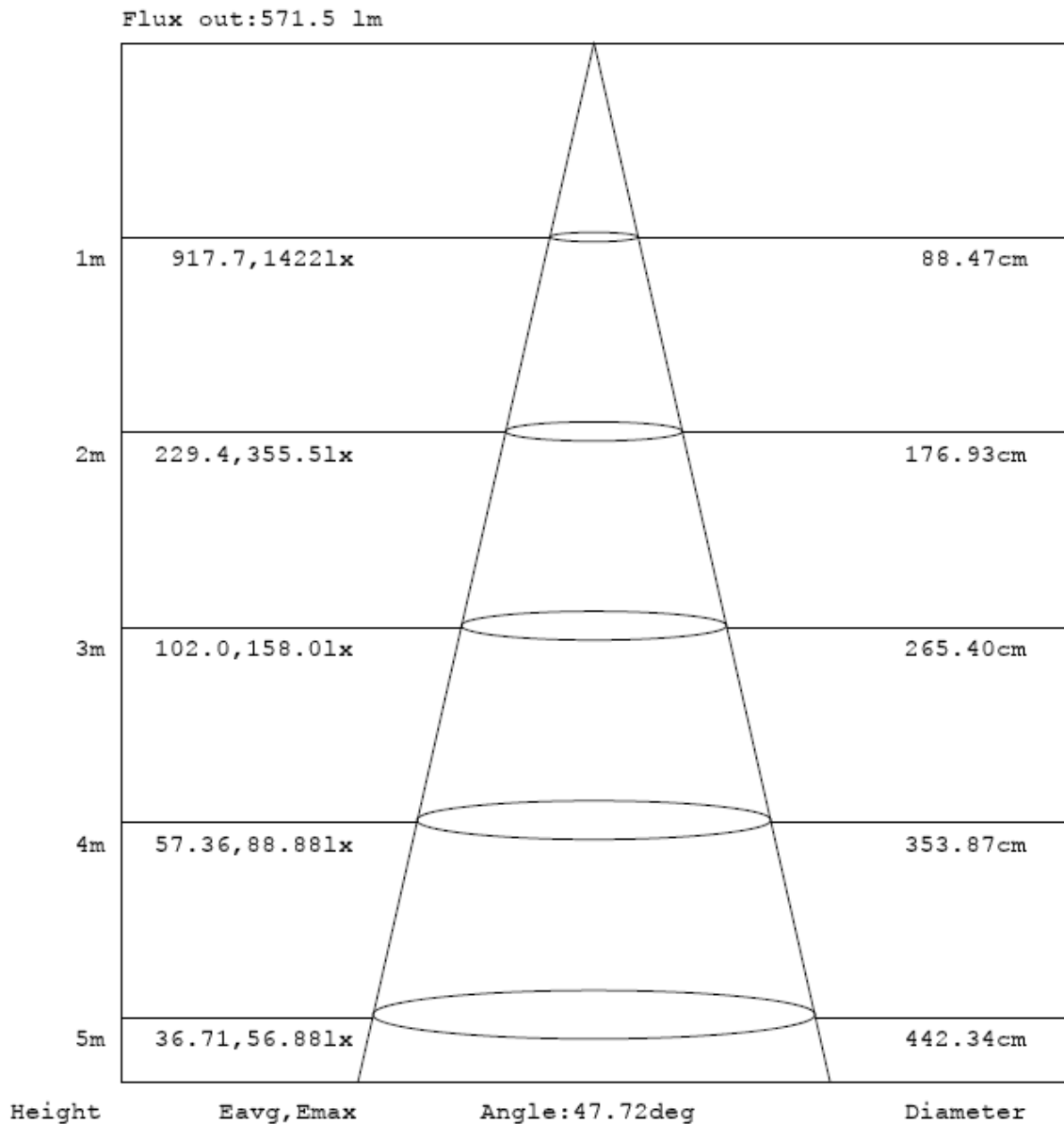
## Zonal Lumen Tabulation

$\gamma(^{\circ})$	Lumens	% Total
0- 10	95.062	4.18%
10- 20	297.151	13.06%
20- 30	500.356	22.00%
30- 40	569.101	25.02%
40- 50	450.862	19.82%
50- 60	255.394	11.23%
60- 70	92.935	4.09%
70- 80	11.535	0.51%
80- 90	0.868	0.04%
90-100	0.052	0.00%
100-110	0.066	0.00%
110-120	0.113	0.00%
120-130	0.187	0.01%
130-140	0.28	0.01%
140-150	0.312	0.01%
150-160	0.259	0.01%
160-170	0.176	0.01%
170-180	0.065	0.00%
Total	2274.8	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	2167.926	95.30%
60- 90	105.338	4.63%
0-90	2273.264	99.93%
90- 180	1.51	0.07%
0- 180	2274.8	100%

Table 3: Zonal Lumen Data

## Illuminance Plots



**Note:** The Curves indicate the illuminated area and the average illumination when the luminaire is at different distance.

Chart 2: Beam Angle



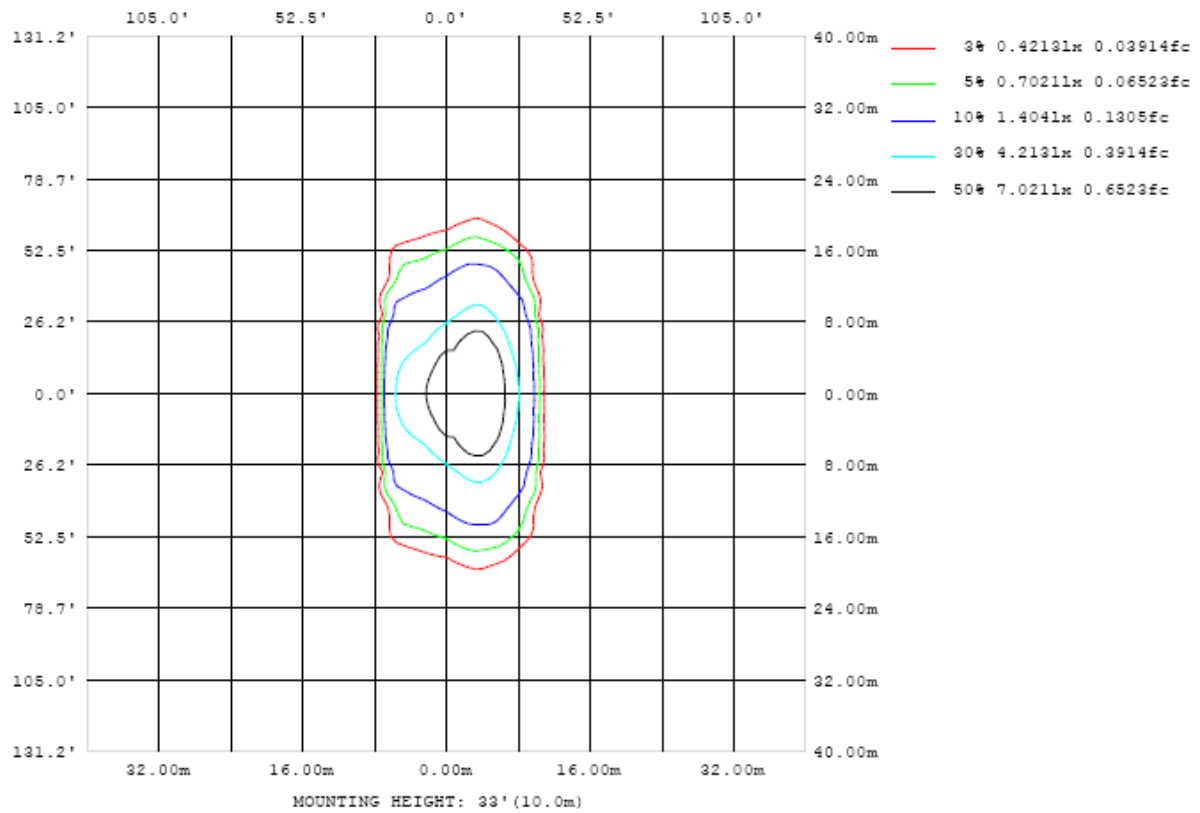


Chart 3: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots

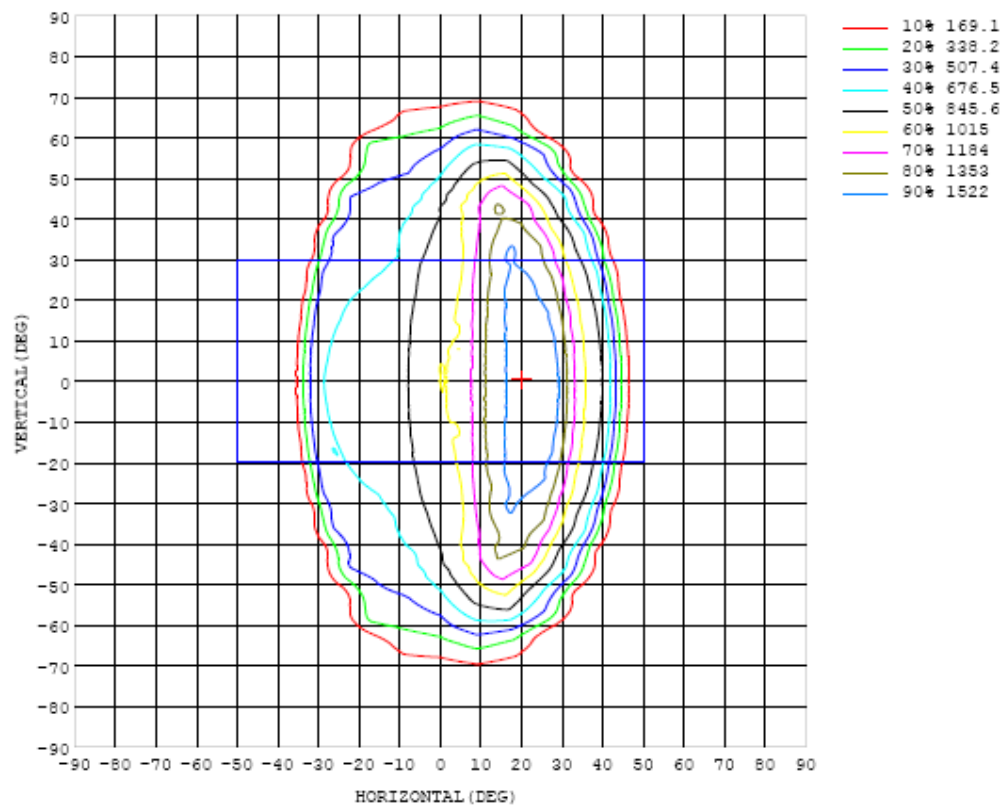


Chart 4: Isocandela Plot

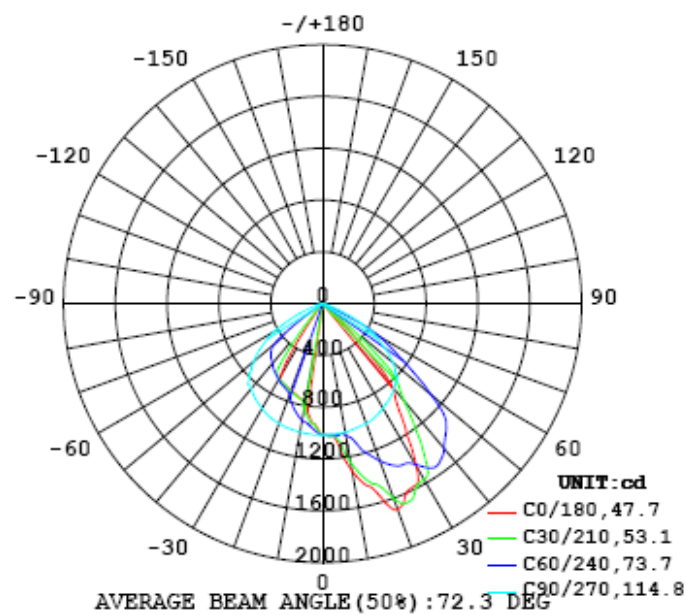


Chart 5: Polar Candela Distribution

## Luminous Intensity Data

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	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016
5	1030	1027	1021	1018	1022	1029	1025	1014	1014	1012	1000	979	958	940	931	929	926	923	923
10	1310	1302	1281	1245	1185	1088	1033	1021	1011	1008	973	930	914	881	849	819	793	779	776
15	1470	1464	1453	1431	1375	1286	1168	1027	1013	996	936	900	845	776	757	749	745	741	740
20	1691	1691	1669	1598	1481	1412	1291	1108	999	985	908	846	753	738	729	723	722	716	712
25	1585	1588	1608	1656	1653	1517	1383	1203	976	964	884	769	722	709	707	704	701	697	693
30	1447	1482	1547	1567	1571	1605	1434	1266	988	933	832	708	684	682	678	673	667	644	642
35	1064	1090	1176	1337	1510	1506	1533	1307	1014	900	775	676	654	650	647	566	379	246	204
40	831	854	896	978	1173	1428	1461	1312	1060	858	708	637	618	614	422	115	50.5	41.3	41.7
45	284	333	513	763	875	1111	1352	1359	1047	820	642	607	574	400	64.7	36.7	36.6	31.6	29.4
50	80.4	89.2	105	230	605	805	1090	1202	967	707	560	530	495	65.9	38.2	25.8	24.8	20.3	18.6
55	40.0	41.4	51.0	75.1	116	542	741	985	840	578	477	459	139	38.4	25.6	18.2	18.8	14.0	12.6
60	26.5	28.3	35.8	40.1	59.2	93.6	508	689	640	443	375	368	32.6	23.0	19.8	16.4	14.2	11.7	11.1
65	9.68	10.8	14.1	22.0	30.4	32.0	84.0	334	388	257	232	68.9	15.3	15.6	14.1	9.28	10.5	8.47	8.28
70	0.29	0.43	1.22	4.23	10.6	12.5	21.8	125	162	106	105	16.2	14.5	11.2	7.87	7.39	7.68	6.13	5.84
75	0.04	0.04	0.07	0.13	0.60	3.52	6.48	16.9	27.3	24.4	21.0	9.59	11.2	5.86	4.54	3.68	3.49	3.05	2.97
80	0.02	0.02	0.02	0.03	0.05	0.37	1.44	5.27	10.4	10.5	8.70	4.16	2.64	2.39	1.98	1.51	0.42	0.29	0.27
85	0.02	0.02	0.02	0.02	0.02	0.03	0.09	0.44	2.15	2.10	1.33	0.71	0.24	0.16	0.15	0.14	0.14	0.14	0.14
90	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.06	0.07	0.09	0.09	0.10	0.10	0.11	0.11	0.11
95	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.06	0.04	0.05	0.06	0.07	0.06	0.05	0.06	0.06	0.06	0.06
100	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.08	0.10	0.06	0.06	0.06	0.07	0.06	0.04	0.03	0.02	0.02	0.02
105	0.02	0.02	0.02	0.02	0.02	0.05	0.08	0.11	0.15	0.08	0.08	0.08	0.09	0.08	0.06	0.03	0.02	0.02	0.02
110	0.02	0.02	0.02	0.02	0.04	0.07	0.11	0.15	0.20	0.11	0.11	0.11	0.11	0.10	0.08	0.05	0.03	0.03	0.03
115	0.02	0.02	0.03	0.04	0.07	0.10	0.14	0.19	0.24	0.15	0.15	0.14	0.14	0.14	0.11	0.08	0.06	0.05	0.05
120	0.04	0.04	0.05	0.07	0.10	0.15	0.18	0.23	0.28	0.19	0.19	0.18	0.18	0.18	0.15	0.12	0.09	0.08	0.09
125	0.09	0.09	0.10	0.12	0.16	0.20	0.23	0.28	0.34	0.25	0.25	0.24	0.24	0.23	0.21	0.18	0.15	0.14	0.15
130	0.15	0.15	0.17	0.19	0.22	0.26	0.29	0.34	0.41	0.34	0.33	0.31	0.31	0.30	0.28	0.25	0.22	0.22	0.23
135	0.23	0.24	0.25	0.27	0.30	0.33	0.37	0.42	0.50	0.44	0.43	0.41	0.40	0.38	0.36	0.33	0.32	0.32	0.34
140	0.31	0.31	0.32	0.33	0.36	0.39	0.43	0.49	0.56	0.51	0.50	0.48	0.47	0.45	0.43	0.40	0.40	0.41	0.42
145	0.38	0.37	0.38	0.39	0.41	0.44	0.49	0.54	0.61	0.54	0.54	0.53	0.52	0.51	0.48	0.47	0.47	0.48	0.49
150	0.45	0.43	0.43	0.44	0.45	0.48	0.52	0.57	0.63	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.55	0.55
155	0.51	0.49	0.48	0.48	0.49	0.51	0.54	0.58	0.63	0.50	0.51	0.51	0.54	0.56	0.58	0.59	0.60	0.60	0.58
160	0.58	0.56	0.55	0.54	0.54	0.54	0.56	0.59	0.62	0.51	0.51	0.52	0.54	0.57	0.59	0.62	0.64	0.62	0.60
165	0.66	0.64	0.63	0.62	0.61	0.60	0.60	0.61	0.63	0.56	0.56	0.57	0.59	0.62	0.65	0.67	0.66	0.64	0.61
170	0.75	0.72	0.70	0.69	0.68	0.66	0.64	0.64	0.64	0.59	0.60	0.61	0.63	0.66	0.68	0.69	0.67	0.64	0.61
175	0.81	0.78	0.75	0.73	0.70	0.68	0.66	0.65	0.64	0.67	0.69	0.71	0.74	0.76	0.77	0.77	0.75	0.72	0.69
180	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	0.68	0.68	0.68

Table 4: 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	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016		
5	924	927	929	933	944	962	981	1004	1013	1013	1013	1023	1029	1023	1016	1020	1029		
10	779	794	819	850	881	916	935	978	1007	1007	1018	1021	1089	1183	1244	1279	1303		
15	742	744	747	749	777	845	909	948	998	1008	1022	1163	1283	1367	1424	1454	1466		
20	714	717	718	724	732	747	845	915	987	992	1102	1292	1403	1475	1596	1670	1692		
25	695	694	692	696	698	708	768	891	966	971	1205	1371	1508	1662	1645	1595	1581		
30	640	665	672	674	674	679	695	840	935	986	1268	1432	1624	1548	1536	1524	1458		
35	246	375	567	643	641	645	655	779	901	1022	1299	1542	1479	1464	1302	1146	1082		
40	41.6	48.2	114	422	601	601	623	711	855	1046	1321	1447	1372	1122	961	888	851		
45	31.2	37.9	39.8	57.7	399	567	599	621	796	1037	1372	1276	1038	861	753	490	318		
50	20.0	24.3	26.1	39.6	53.8	491	516	534	691	945	1190	1000	776	579	204	99.7	88.3		
55	13.7	17.7	18.6	24.6	36.4	136	447	455	568	820	906	692	506	92.4	69.7	50.0	40.1		
60	11.5	13.8	14.7	17.6	23.0	25.8	360	359	431	630	608	485	75.7	52.8	38.7	33.2	28.1		
65	8.43	10.7	9.32	15.2	15.6	15.6	56.8	212	252	380	301	50.0	27.2	28.8	20.0	14.0	11.0		
70	6.20	7.71	7.12	7.85	11.0	12.5	15.2	99.2	104	137	100	17.1	12.5	11.1	3.98	1.18	0.42		
75	3.05	3.47	3.73	4.45	6.15	9.62	9.34	20.7	23.6	23.0	13.3	5.69	3.58	0.62	0.12	0.06	0.04		
80	0.28	0.44	1.47	1.89	2.07	2.75	5.04	9.33	9.83	9.05	4.36	1.47	0.33	0.05	0.03	0.02	0.02		
85	0.14	0.14	0.14	0.14	0.16	0.22	0.63	1.06	2.32	1.74	0.32	0.06	0.03	0.03	0.02	0.02	0.02		
90	0.11	0.11	0.10	0.10	0.09	0.08	0.07	0.05	0.05	0.04	0.04	0.03	0.02	0.03	0.02	0.02	0.02		
95	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.05	0.08	0.07	0.05	0.04	0.02	0.02	0.02	0.02	0.02		
100	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.13	0.10	0.08	0.06	0.03	0.02	0.02	0.02	0.02		
105	0.02	0.03	0.05	0.06	0.08	0.08	0.09	0.09	0.19	0.15	0.11	0.08	0.05	0.03	0.02	0.02	0.02		
110	0.03	0.05	0.07	0.09	0.11	0.12	0.12	0.12	0.25	0.20	0.16	0.12	0.08	0.04	0.03	0.02	0.02		
115	0.06	0.09	0.12	0.14	0.15	0.15	0.15	0.16	0.28	0.24	0.19	0.15	0.11	0.07	0.04	0.03	0.02		
120	0.11	0.14	0.18	0.19	0.20	0.20	0.20	0.20	0.32	0.28	0.23	0.19	0.15	0.11	0.07	0.05	0.05		
125	0.17	0.22	0.25	0.26	0.25	0.25	0.25	0.26	0.36	0.32	0.28	0.24	0.20	0.18	0.13	0.10	0.09		
130	0.27	0.30	0.32	0.32	0.32	0.32	0.33	0.33	0.44	0.40	0.36	0.31	0.27	0.23	0.20	0.17	0.15		
135	0.37	0.39	0.40	0.40	0.41	0.42	0.42	0.43	0.55	0.51	0.46	0.41	0.36	0.32	0.29	0.26	0.24		
140	0.44	0.45	0.45	0.47	0.48	0.49	0.49	0.49	0.64	0.61	0.56	0.50	0.44	0.40	0.37	0.34	0.32		
145	0.50	0.50	0.50	0.51	0.53	0.54	0.54	0.53	0.72	0.69	0.64	0.58	0.52	0.48	0.44	0.42	0.40		
150	0.54	0.52	0.52	0.51	0.52	0.52	0.52	0.51	0.75	0.74	0.70	0.65	0.59	0.54	0.51	0.48	0.46		
155	0.56	0.53	0.51	0.50	0.49	0.48	0.48	0.48	0.76	0.76	0.73	0.70	0.65	0.61	0.58	0.56	0.53		
160	0.57	0.54	0.52	0.50	0.48	0.47	0.46	0.46	0.74	0.75	0.75	0.74	0.71	0.68	0.66	0.64	0.61		
165	0.57	0.55	0.53	0.51	0.49	0.48	0.48	0.48	0.72	0.73	0.73	0.74	0.74	0.73	0.72	0.71	0.69		
170	0.60	0.58	0.57	0.56	0.54	0.53	0.52	0.52	0.73	0.73	0.74	0.76	0.78	0.79	0.79	0.79	0.78		
175	0.67	0.65	0.63	0.61	0.58	0.57	0.56	0.57	0.73	0.73	0.74	0.76	0.78	0.80	0.81	0.82	0.82		
180	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	0.68		

Table 5: 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
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.

### 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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