



## LM-79-19 TEST REPORT

for

**Industrial Lighting Products, LLC**

3224 McCraney Loop, Sanford, FL, 32771

**LED Retrofit-kits in Lithonia 2GT8 lensed 2x2**

**Model: ULB2-20L-U-50-L3**

**ULB2-20L-U-50-L3-MWS**

**20LB/2F/850/U/A3**

**20LB/2F/850/U/A3/MWS**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ25030014h

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

Review by:

*Wei Fei*

Approved by:



*April Zou*

Engineer: Wei Fei  
May 28, 2025

Manager: April Zou  
May 28, 2025

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: **ULB2-20L-U-50-L3**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
125.3	4034.8	32.20	0.9956
CCT (K)	CRI	Stabilization Time (Light & Power)	
5234	83.3	50	

Table 1: Executive Data Summary

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

### Test specifications:

<b>Date of Receipt</b>	: Mar. 18, 2025
<b>Date of Test</b>	: Mar. 19, 2025
<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-79-2019 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products ANSI/IES TM-30-18 IES Method for Evaluating Light Source Color Rendition

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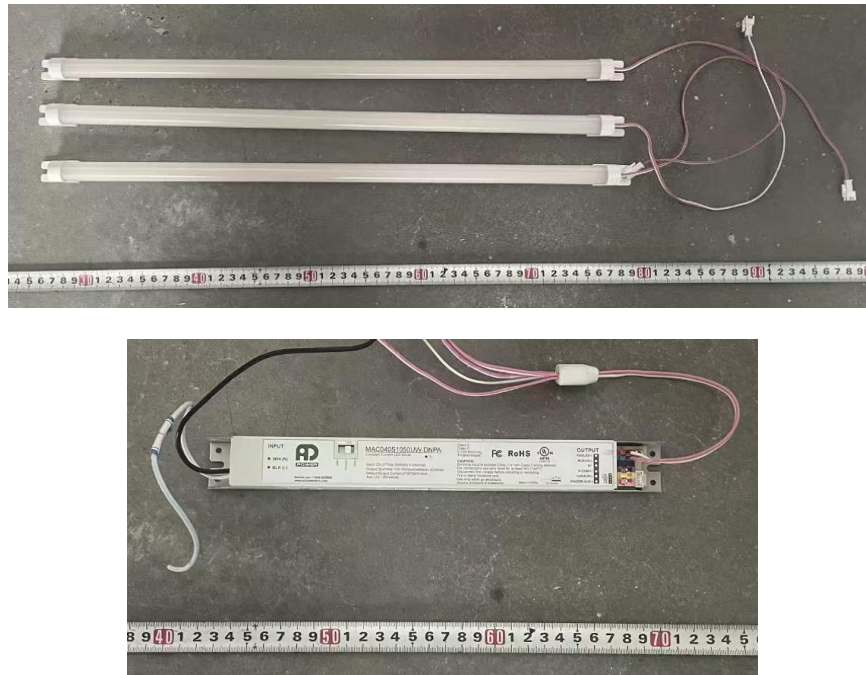
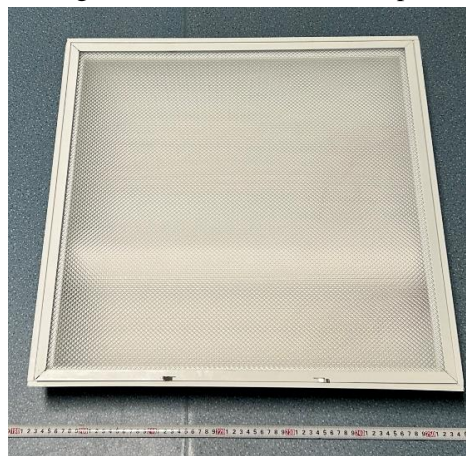


Figure 1- Overview of the sample



Sample in Lithonia 2GT8 lensed 2x2

#### Equipment Under Test(EUT)

<b>Name</b>	: LED Retrofit-kits	
<b>Model</b>	: ULB2-20L-U-50-L3	ULB2-20L-U-50-L3-MWS
	20LB/2F/850/U/A3	20LB/2F/850/U/A3/MWS
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz	
<b>Product Description</b>	: Field-Adjustable 33W/25W/18W, 5000K LED Tube supplied by a LED driver: MAC040S1050UW-DNPA	
<b>Manufacturer</b>	: Industrial Lighting Products, LLC	
<b>Address</b>	: 3224 McCraney Loop, Sanford, FL, 32771	

## TEST RESULTS

Test ambient temperature was 26.0 °C.

Base orientation was base up. Test was conducted without a dimmer in the circuit.

The stabilization time of the sample was 50 minutes, and the total operating time including stabilization was 55 minutes.

### Sphere-Spectroradiometer Method

Parameter	Result	
Test Voltage (V)	120.0	277.0
Voltage frequency (Hz)	60	60
Test Current (A)	0.270	0.122
Power Factor	0.9956	0.9540
Test Power (W)	32.20	32.25
THD A%	6.46	12.99
Luminous Efficacy (lm/W)	125.3	125.3
Total Luminous Flux (lm)	4034.8	4041.1
Color Rendering Index (CRI)	83.3	
R9	14.1	
Correlated Color Temperature (CCT)(K)	5234	
Chromaticity Chroma x	0.3388	
Chromaticity Chroma y	0.3468	
Chromaticity Chroma u	0.2090	
Chromaticity Chroma v	0.3209	
Duv	0.0002	
Chromaticity Chroma u'	0.2090	
Chromaticity Chroma v'	0.4814	

Special Color Rendering Indices	
R1	82.5
R2	87.3
R3	90
R4	84.3
R5	83.1
R6	81.8
R7	87
R8	70.3
R9	14.1
R10	69.3
R11	84.1
R12	60.5
R13	83.6
R14	94.5

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 24.8 °C.

The photometric distance is 30 m.

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)	0.270
Power Factor	0.9955
Power (W)	32.20
Luminous Efficacy (lm/W)	125.6
Total Luminous Flux (lm)	4043.1
Beam Angle ( ° )	98.2 (0°-180°) / 87.8 (90°-270°)
Center Beam Candle Power (cd)	1783
Maximum Beam Candle Power (cd)	1787 (At: C=180.0, Gamma=2.5)
Spacing Criteria	1.27 (0°-180°) / 1.13 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	85.21%
Zonal Lumens in the 60 °-90 °Zone	14.31%
Zonal Lumens in the 90 °-120 °Zone	0.17%
Zonal Lumens in the 120 °-180 °Zone	0.31%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

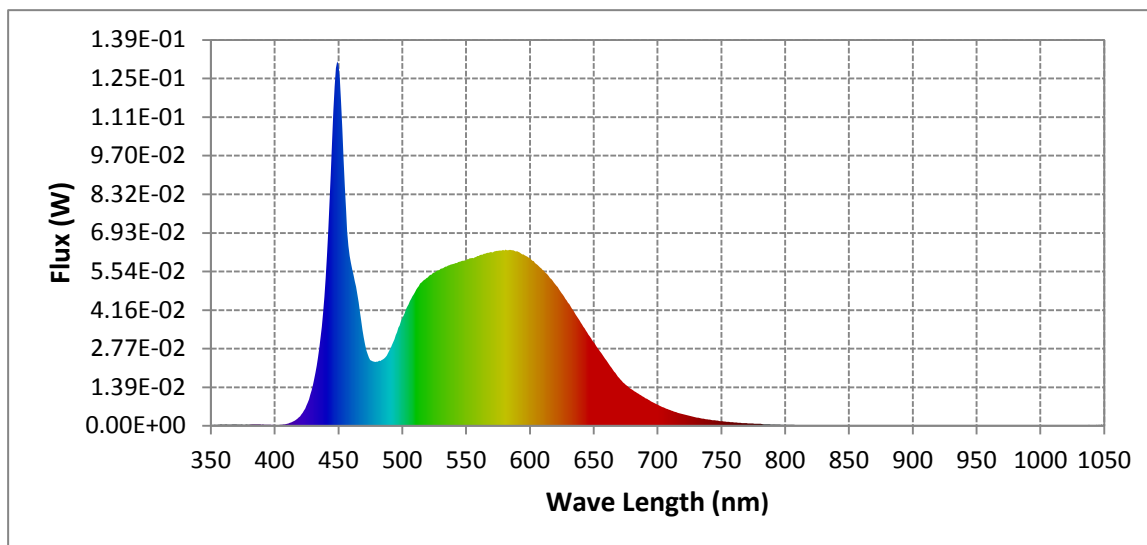


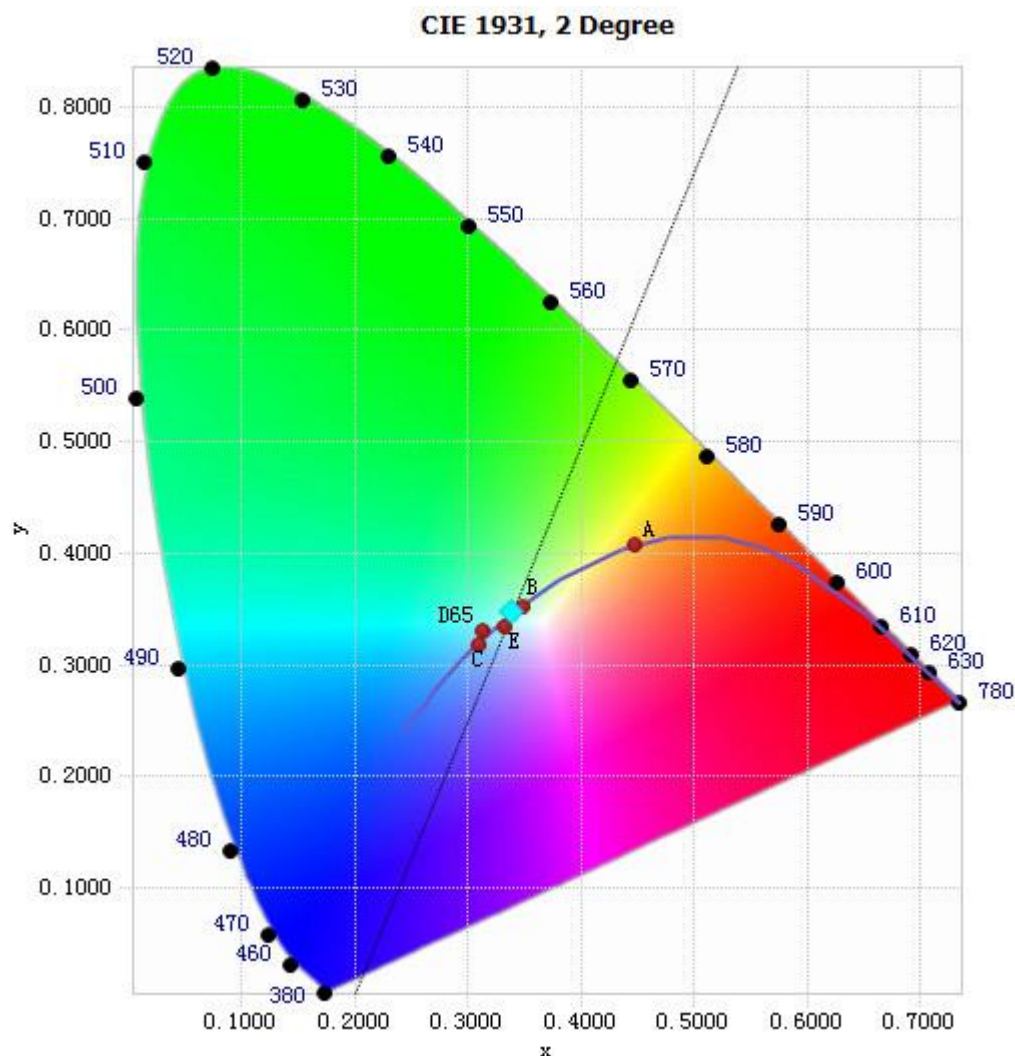
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	5.14E-04	485	2.39E-02	590	6.27E-02	695	8.85E-03
385	5.14E-04	490	2.70E-02	595	6.16E-02	700	7.64E-03
390	4.45E-04	495	3.25E-02	600	6.02E-02	705	6.57E-03
395	3.94E-04	500	3.85E-02	605	5.81E-02	710	5.64E-03
400	2.80E-04	505	4.36E-02	610	5.59E-02	715	4.85E-03
405	4.20E-04	510	4.80E-02	615	5.37E-02	720	4.17E-03
410	7.21E-04	515	5.14E-02	620	5.08E-02	725	3.60E-03
415	1.62E-03	520	5.32E-02	625	4.76E-02	730	3.09E-03
420	3.39E-03	525	5.50E-02	630	4.42E-02	735	2.63E-03
425	7.26E-03	530	5.63E-02	635	4.07E-02	740	2.26E-03
430	1.46E-02	535	5.71E-02	640	3.71E-02	745	1.96E-03
435	2.79E-02	540	5.81E-02	645	3.35E-02	750	1.67E-03
440	5.31E-02	545	5.89E-02	650	3.00E-02	755	1.45E-03
445	1.02E-01	550	5.94E-02	655	2.67E-02	760	1.26E-03
450	1.30E-01	555	6.03E-02	660	2.35E-02	765	1.08E-03
455	8.56E-02	560	6.09E-02	665	2.02E-02	770	9.45E-04
460	5.84E-02	565	6.18E-02	670	1.72E-02	775	8.08E-04
465	4.72E-02	570	6.24E-02	675	1.48E-02	780	6.99E-04
470	3.16E-02	575	6.28E-02	680	1.30E-02		
475	2.37E-02	580	6.29E-02	685	1.15E-02		
480	2.31E-02	585	6.32E-02	690	1.02E-02		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3388, 0.3468)

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

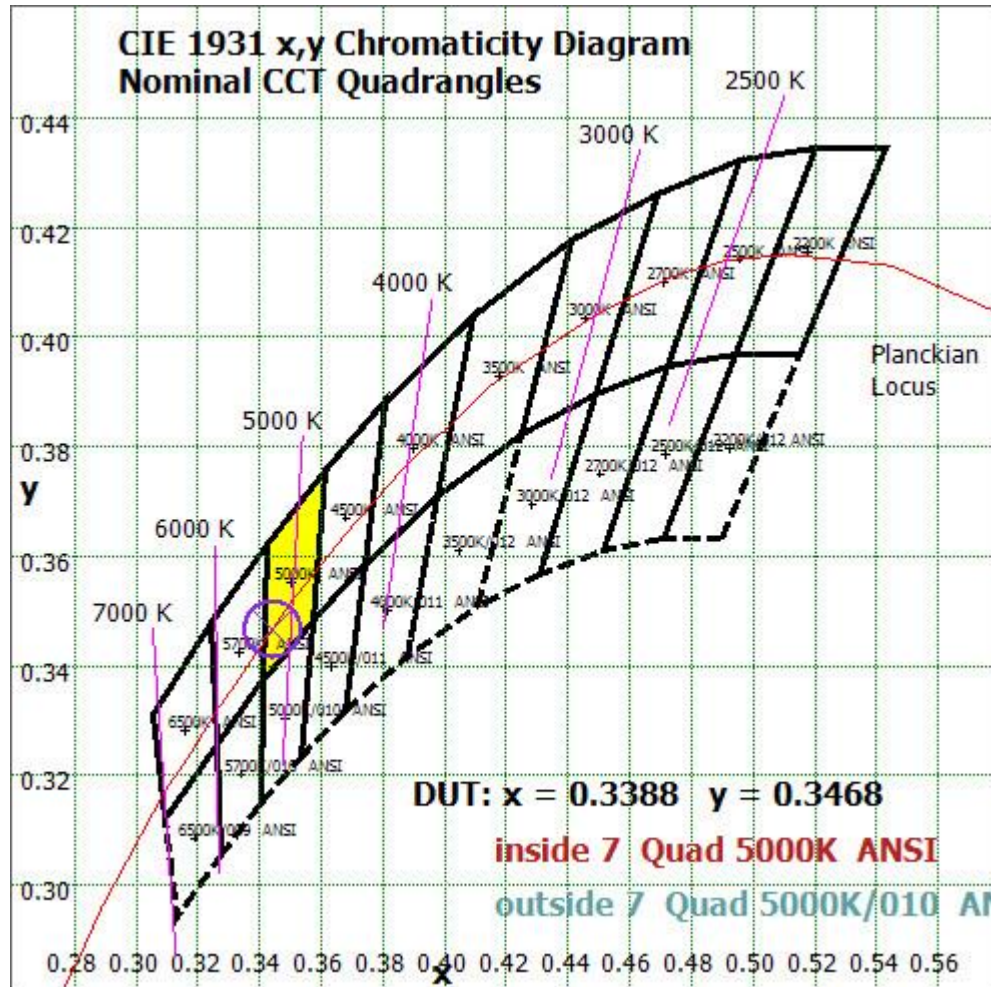


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram



Quality Assured  
Color Rendition Report – Sphere Spectroradiometer Method

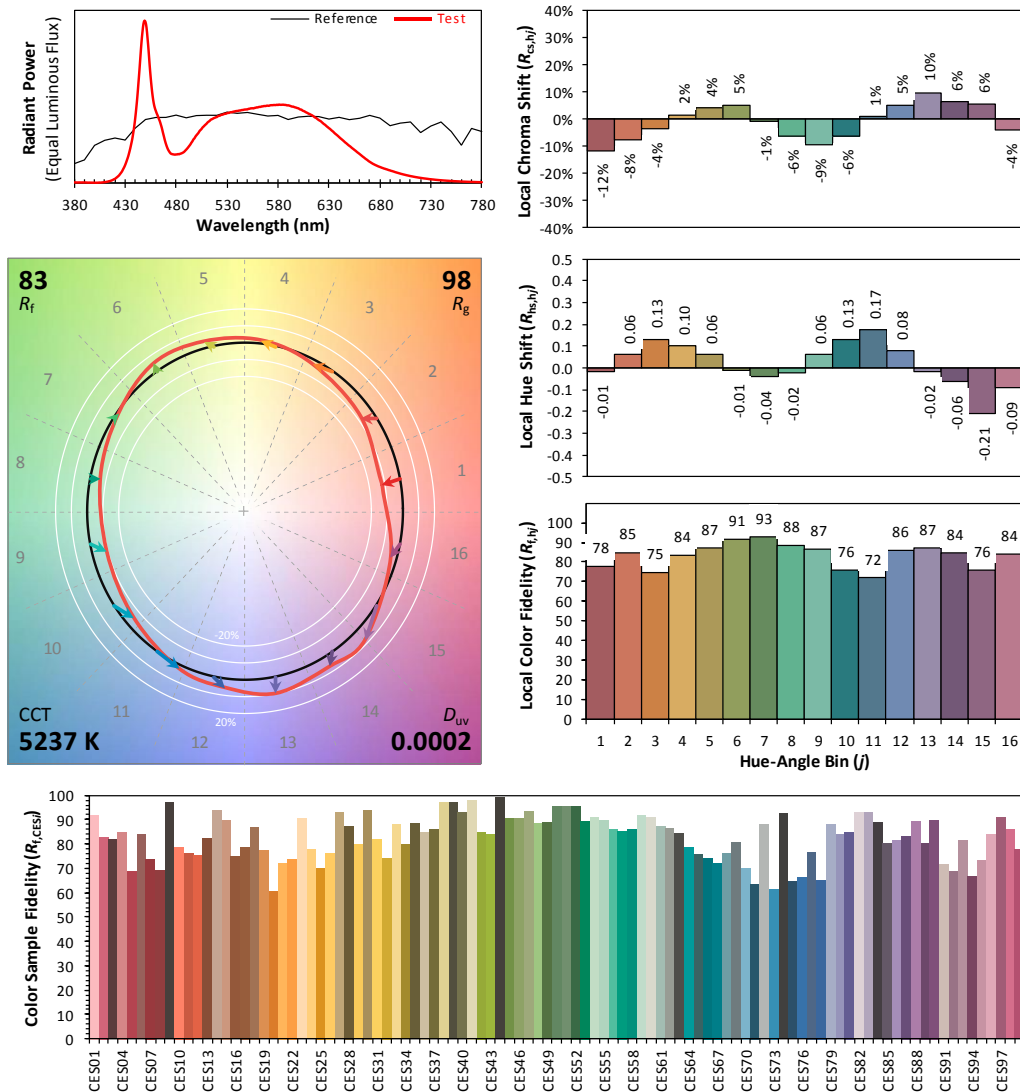
## ANSI/IES TM-30-18 Color Rendition Report

Source: LED

Manufacturer: Industrial Lighting Products, LLC

Date: 2025/03/19

Model: ULB2-20L-U-50-L3



Notes: This is a recommended method for displaying ANSI/IES TM-30-18 information.

$x$  0.3388  
 $y$  0.3468  
 $u'$  0.2090  
 $v'$  0.4814

CIE 13.3-1995  
(CRI)

$R_a$  83  
 $R_g$  14

Colors are for visual orientation purposes only. Created with the ANSI/IES TM-30-18 Calculator Version 2.00.

Chart 4: Full Report Created with the IES TM-30 Calculator

Note: The values in this diagram might be a little different from the values in Table 2 due to rounding.

### Zonal Lumen Tabulation- Goniophotometer Method

$\gamma(^{\circ})$	Lumens	% Total
0- 10	168.422	4.17%
10- 20	479.113	11.85%
20- 30	710.282	17.57%
30- 40	808.18	19.99%
40- 50	739.393	18.29%
50- 60	539.604	13.35%
60- 70	324.569	8.03%
70- 80	191.44	4.73%
80- 90	62.686	1.55%
90-100	1.197	0.03%
100-110	2.441	0.06%
110-120	3.307	0.08%
120-130	3.181	0.08%
130-140	3.001	0.07%
140-150	2.705	0.07%
150-160	2.024	0.05%
160-170	1.193	0.03%
170-180	0.364	0.01%
Total	4043.1	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	3444.994	85.21%
60- 90	578.695	14.31%
0-90	4023.689	99.52%
90- 180	19.413	0.48%
0- 180	4043.1	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

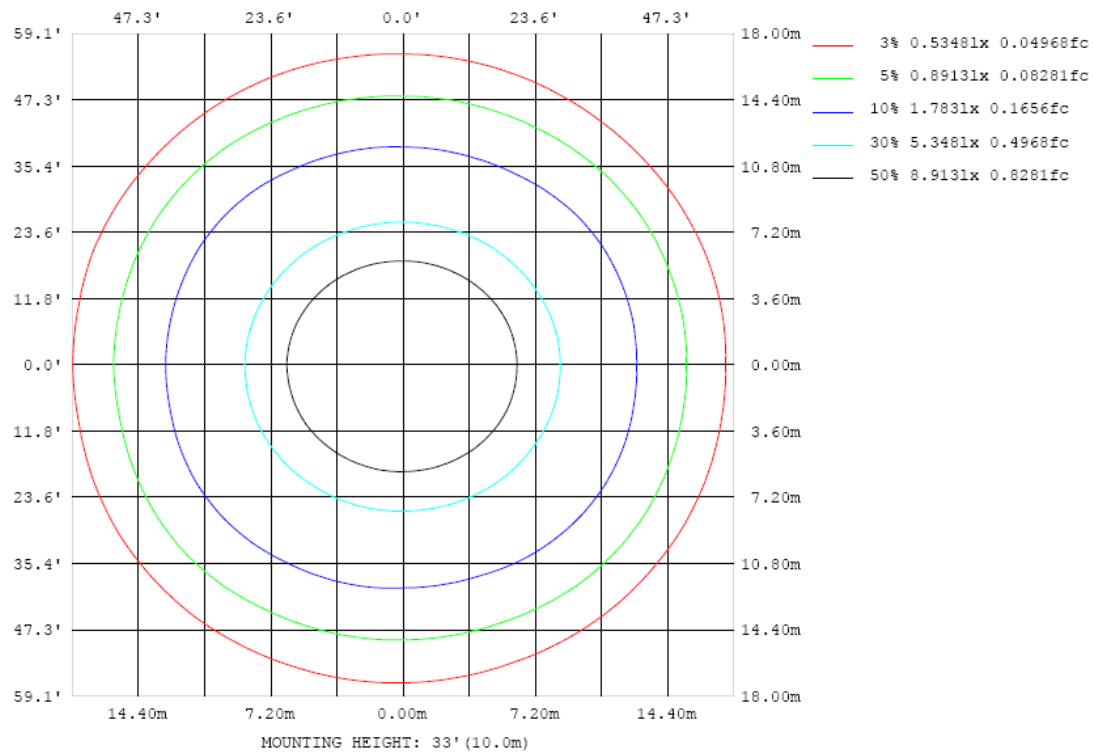


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

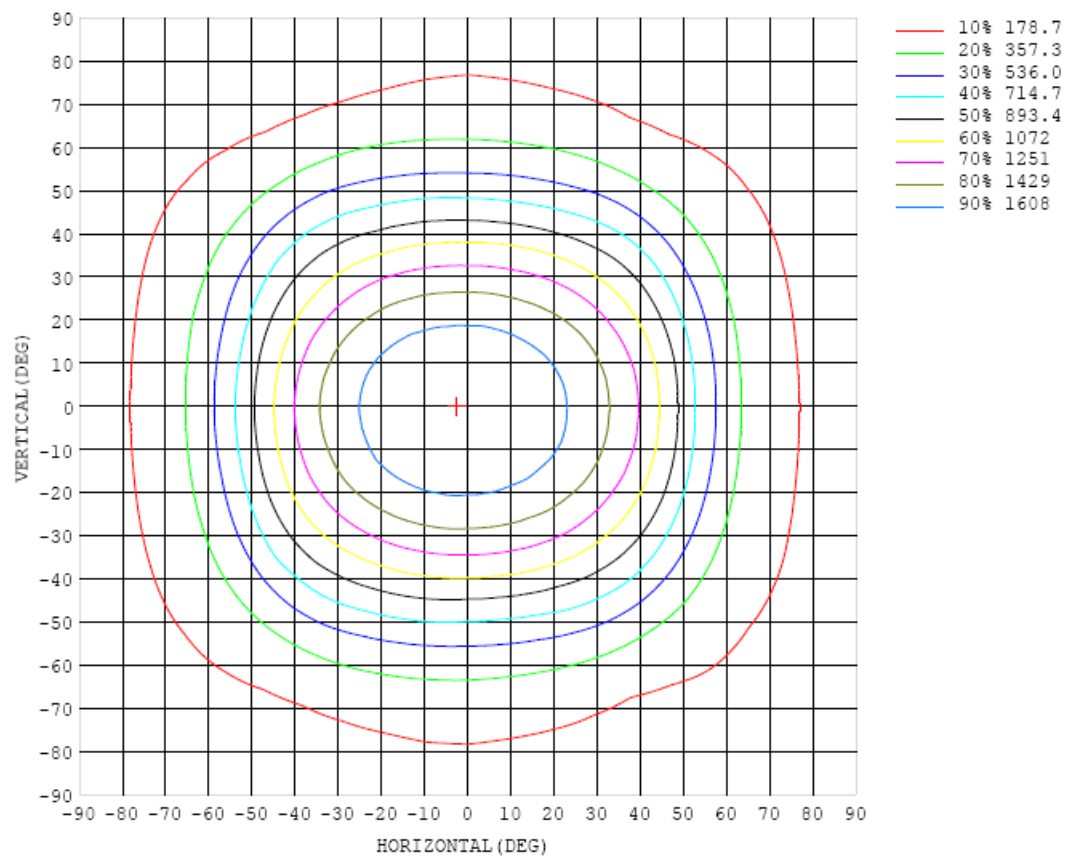


Chart 6: Isocandela Plot

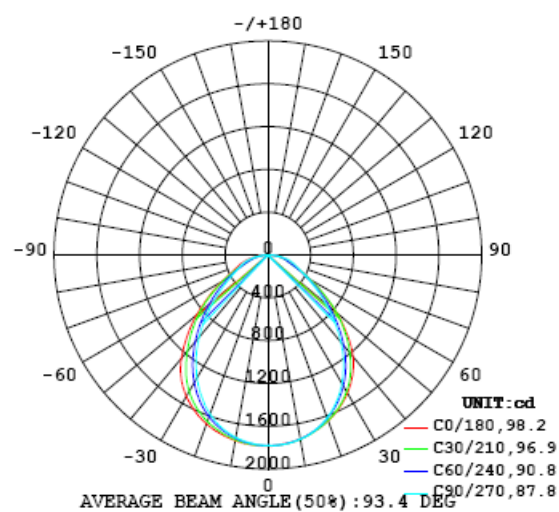


Chart 7: Polar Candela Distribution

## 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	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783
5	1772	1772	1774	1775	1772	1777	1772	1773	1774	1772	1778	1778	1779	1778	1776	1783	1779	1778	1779
10	1745	1745	1751	1745	1745	1747	1746	1747	1748	1749	1753	1751	1754	1756	1759	1759	1763	1757	1763
15	1701	1702	1705	1704	1699	1702	1697	1697	1696	1697	1700	1705	1710	1715	1718	1721	1722	1725	1724
20	1649	1651	1652	1645	1637	1634	1625	1619	1618	1620	1628	1631	1638	1650	1658	1672	1677	1674	1682
25	1579	1578	1579	1571	1557	1546	1529	1521	1516	1513	1523	1532	1548	1562	1582	1594	1603	1609	1610
30	1488	1490	1485	1472	1452	1435	1413	1396	1384	1385	1393	1406	1425	1449	1472	1498	1512	1517	1527
35	1380	1379	1369	1348	1321	1298	1271	1249	1238	1233	1243	1257	1280	1306	1337	1369	1390	1404	1417
40	1237	1236	1221	1193	1162	1135	1106	1083	1066	1064	1075	1092	1117	1145	1181	1211	1235	1250	1258
45	1048	1052	1042	1020	993	962	928	901	885	883	901	923	948	981	1017	1046	1064	1066	1068
50	839	845	850	838	817	790	749	724	711	709	729	748	775	812	849	869	874	870	872
55	624	628	635	637	628	609	581	560	552	553	564	578	600	635	660	682	675	667	674
60	453	455	457	457	449	441	430	421	422	425	431	440	455	473	488	496	495	488	494
65	326	325	322	317	306	303	310	320	327	334	337	337	337	336	338	347	355	361	365
70	258	252	236	223	209	205	221	245	263	273	273	266	246	227	224	235	255	279	290
75	202	195	176	172	166	161	172	189	208	220	218	201	181	169	168	176	185	205	229
80	136	136	123	121	126	121	126	132	142	154	151	130	122	117	114	123	124	139	148
85	61.5	68.3	66.3	59.9	61.6	58.0	65.9	68.6	75.1	70.3	73.9	65.9	60.8	55.3	53.0	55.6	56.1	61.0	59.5
90	3.78	2.67	3.44	4.05	4.97	4.49	4.63	4.67	2.32	5.02	4.90	4.80	6.17	4.75	4.74	1.90	2.28	0.18	0.15
95	0.22	0.24	0.35	0.53	0.76	0.86	1.00	1.21	1.41	1.14	1.51	1.48	1.44	1.19	1.13	0.83	0.56	0.31	0.33
100	0.63	0.69	0.81	1.07	1.35	1.62	1.98	2.22	2.03	1.39	1.65	2.10	2.06	2.05	1.94	1.74	1.40	1.21	1.11
105	1.59	1.76	1.63	1.56	2.35	2.43	3.49	2.95	2.42	1.98	2.22	2.88	3.16	3.19	2.72	2.21	1.73	1.56	1.43
110	2.55	2.95	3.02	3.10	3.21	3.94	3.60	3.10	2.87	2.66	2.79	3.57	3.70	3.73	3.06	2.94	2.36	2.30	2.07
115	1.69	3.89	4.21	4.35	4.28	3.71	3.45	3.44	3.18	3.39	3.34	4.01	4.09	4.15	3.98	3.22	2.86	2.57	2.20
120	3.67	3.51	3.87	3.84	3.27	3.55	3.67	3.67	3.58	3.97	3.74	4.24	4.33	4.34	4.04	3.94	3.40	3.14	2.26
125	2.87	2.62	3.32	3.06	3.43	3.47	3.93	3.94	4.06	4.43	4.19	4.39	4.62	4.20	4.19	3.77	4.12	3.70	3.67
130	3.41	2.40	3.47	3.27	3.81	3.80	3.97	3.79	4.24	4.54	4.21	4.10	4.56	4.55	4.09	3.76	4.11	3.37	3.48
135	3.29	2.63	3.98	3.83	3.47	4.23	4.20	4.23	4.81	4.86	4.65	4.46	4.61	4.67	4.08	4.41	4.42	3.50	4.12
140	3.64	3.31	4.02	4.06	4.01	3.72	4.22	4.74	4.81	4.79	4.66	4.38	4.26	4.67	4.88	4.82	4.60	2.63	4.32
145	3.99	3.91	3.37	4.10	4.05	4.36	4.31	4.58	4.49	4.78	4.65	4.39	4.50	4.57	5.17	5.05	4.86	3.09	5.03
150	3.58	3.53	2.46	4.37	4.57	4.60	4.72	4.82	4.62	4.75	4.92	4.72	4.59	4.75	4.47	5.03	4.71	3.64	5.29
155	4.45	4.74	3.34	3.69	4.74	4.94	4.94	4.94	4.86	4.75	4.61	4.70	4.44	4.29	4.47	4.84	3.27	4.24	5.18
160	4.78	5.02	3.86	3.10	4.25	5.12	5.22	4.90	4.72	4.50	4.21	4.42	4.50	4.60	4.83	4.00	3.69	4.48	4.44
165	4.73	4.91	4.66	3.46	3.01	3.77	4.09	4.45	4.55	4.55	4.39	4.53	4.47	4.20	3.73	3.73	3.97	4.69	4.54
170	4.54	4.70	4.71	4.40	3.67	3.30	2.96	3.00	3.35	3.20	3.29	3.34	3.38	3.68	3.81	4.13	4.52	4.61	4.54
175	3.45	3.64	3.78	3.62	3.48	3.47	3.53	3.51	3.24	3.25	3.57	3.75	3.87	4.09	4.35	4.36	4.38	4.35	4.21
180	3.98	4.01	3.96	3.99	4.14	4.17	4.01	4.03	4.38	4.92	4.51	4.45	3.85	3.85	4.05	4.07	3.89	3.64	3.88

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	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783	1783		
5	1780	1781	1777	1771	1774	1768	1767	1765	1763	1770	1766	1768	1767	1769	1773	1770	1768		
10	1758	1754	1753	1746	1746	1738	1738	1733	1731	1731	1732	1734	1734	1736	1739	1741	1746		
15	1722	1718	1709	1701	1695	1685	1678	1676	1669	1675	1674	1677	1683	1686	1692	1698	1698		
20	1674	1670	1657	1641	1628	1610	1595	1585	1581	1585	1588	1595	1604	1617	1632	1636	1646		
25	1603	1592	1574	1555	1534	1507	1483	1476	1466	1468	1478	1489	1507	1530	1548	1567	1572		
30	1517	1499	1473	1440	1410	1377	1353	1336	1326	1333	1342	1363	1390	1420	1448	1469	1485		
35	1400	1373	1337	1298	1264	1229	1201	1180	1175	1178	1191	1217	1247	1282	1318	1348	1372		
40	1240	1213	1175	1136	1100	1060	1032	1013	999	1004	1021	1050	1085	1122	1161	1200	1229		
45	1052	1034	1007	974	934	886	858	837	824	825	838	866	905	952	989	1019	1048		
50	864	850	832	806	766	720	690	671	655	655	666	689	729	773	806	825	839		
55	664	657	651	627	599	561	536	519	508	510	517	532	560	588	610	620	628		
60	490	491	478	459	439	423	408	396	391	390	391	395	402	416	435	447	455		
65	367	353	329	310	303	305	311	312	311	305	297	288	279	281	297	314	327		
70	284	251	222	204	204	219	240	254	257	248	232	215	197	196	208	227	251		
75	209	180	163	156	156	157	170	191	202	190	174	164	157	159	164	171	188		
80	139	120	111	98.9	96.6	102	104	125	128	125	115	115	110	115	117	118	133		
85	60.3	51.3	44.0	40.5	37.7	40.3	42.1	48.0	45.3	50.9	50.7	51.3	47.4	51.2	53.5	60.9	69.8		
90	0.14	0.32	0.50	0.74	1.06	1.11	1.00	1.49	0.90	1.44	1.19	3.02	2.95	2.25	1.47	0.66	0.67		
95	0.35	0.55	0.72	0.94	1.07	1.15	1.15	1.25	0.90	1.29	1.18	1.00	0.84	0.82	0.65	0.46	0.30		
100	1.00	1.31	1.51	1.65	2.09	2.19	2.05	1.84	1.45	1.74	2.09	2.04	1.87	1.55	1.29	0.94	0.77		
105	1.53	1.86	2.22	2.51	2.88	2.96	2.76	2.32	1.95	2.20	2.61	3.29	3.00	2.62	2.20	1.52	1.82		
110	2.39	2.67	2.71	2.77	3.31	3.26	3.17	2.74	2.52	2.56	2.95	3.28	3.80	3.74	3.23	2.50	2.94		
115	2.49	2.69	2.68	3.25	3.57	3.49	3.41	3.01	3.00	2.88	3.24	3.27	3.48	3.85	3.95	2.01	2.18		
120	2.32	3.29	2.84	3.17	3.50	3.65	3.54	3.31	3.46	3.20	3.46	3.58	3.37	3.16	3.24	3.77	3.09		
125	3.36	3.84	3.35	3.01	3.40	3.49	3.53	3.45	3.63	3.34	3.40	3.57	3.27	3.26	3.14	3.04	2.67		
130	2.65	3.89	3.87	3.59	3.41	3.73	3.48	3.42	3.57	3.28	3.29	3.63	3.42	3.08	3.01	3.51	2.96		
135	3.70	3.77	4.22	3.82	4.29	3.49	3.44	4.01	3.96	3.85	3.52	3.33	3.54	3.41	3.60	3.49	2.81		
140	3.83	4.63	4.59	4.69	4.15	4.01	4.20	3.94	3.85	3.64	3.83	4.21	3.73	3.94	4.16	3.67	3.36		
145	4.75	4.46	3.98	4.87	4.58	4.42	4.13	4.46	3.81	4.21	4.17	3.91	4.28	4.14	3.69	4.14	4.17		
150	5.31	4.37	5.27	3.83	4.47	4.76	4.62	4.78	3.86	3.92	4.28	4.43	4.59	4.12	3.79	3.63	3.59		
155	5.36	4.57	3.86	4.46	3.89	4.13	4.77	4.86	4.06	4.62	4.05	3.84	3.66	3.83	4.41	4.19	4.75		
160	4.64	4.65	3.92	3.99	4.76	4.71	4.36	4.07	3.93	4.08	3.93	4.01	3.88	3.50	3.58	4.62	5.17		
165	4.56	4.74	4.59	4.24	3.88	4.01	4.17	4.45	4.27	4.02	4.20	3.61	3.38	3.37	4.21	4.70	4.35		
170	4.52	4.53	4.64	4.57	4.41	4.23	3.84	3.61	3.29	3.11	3.22	3.23	3.23	3.30	3.35	3.56	3.74		
175	4.22	4.25	4.28	4.26	4.23	4.12	3.90	3.73	3.46	3.36	3.31	3.48	3.44	3.39	3.52	3.60	3.82		
180	3.88	4.01	4.00	4.05	4.13	4.02	4.09	3.95	4.18	4.30	4.25	3.95	4.03	3.89	4.02	4.01	3.96		

Table 7: Luminous Intensity Data



## EQUIPMENT LIST

Test Equipment	Model	Equipment No.	Calibration Date	Calibration Due date
Goniophotometer system	GO-R5000	HZTE011-01	Feb. 05, 2025	-
Digital Power Meter	PF2010A	HZTE028-01	Aug. 08, 2024	Aug. 07, 2025
AC Power Supply	DPS1060	HZTE001-06	Aug. 08, 2024	Aug. 07, 2025
DC Power Supply	WY12010	HZTE004-03	Aug. 08, 2024	Aug. 07, 2025
Temperature recorder	JM624U	HZTE018-08	Aug. 08, 2024	Aug. 07, 2025
Temperature and humidity recorder	JR900	HZTE018-01	Aug. 08, 2024	Aug. 07, 2025
Standard source	D908	HZTE012-01	Aug. 14, 2018	-
Integrate Sphere system	3M	HZTE015-04	Dec. 10, 2024	-
Digital Power Meter	WT210	HZTE008-01	Aug. 08, 2024	Aug. 07, 2025
AC Power Supply	PCR 500L	HZTE001-07	Aug. 08, 2024	Aug. 07, 2025
DC Power Supply	IT6154	HZTE004-04	Aug. 08, 2024	Aug. 07, 2025
Standard source	SCL-1400	HZTE012-06	Nov. 04, 2021	-
Temperature and humidity recorder	JR900	HZTE018-02	Aug. 08, 2024	Aug. 07, 2025
Temperature Meter	TES1310	HZTE017-01	Aug. 08, 2024	Aug. 07, 2025

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 3 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 Tubes) 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 20 min, taken 10 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 expanded uncertainty is 2.1% 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 Tubes) 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 20 min, taken 10 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 2.3% 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.

\*\*\* End of Report \*\*\*

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