



## LM-79-19 TEST REPORT

for

**Industrial Lighting Products, LLC**

3224 McCraney Loop, Sanford, FL, 32771

**LED Retrofit-kits in Lithonia 2GT8 lensed 2x4**

**Model: ULB4-40L-U-50-L3**

**ULB4-40L-U-50-L3-MWS**

**40LB/4F/850/U/A3**

**40LB/4F/850/U/A3/MWS**

**Laboratory: Leading Testing Laboratories**

**NVLAP CODE: 200960-0**

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Report No.: HZ25030014z

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: **ULB4-40L-U-50-L3**

Luminous Efficacy (Lumens /Watt)	Total Luminous Flux (Lumens)	Power (Watts)	Power Factor
129.4	5050.2	39.02	0.9962
CCT (K)	CRI	Stabilization Time (Light & Power)	
5202	83.9	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. 27, 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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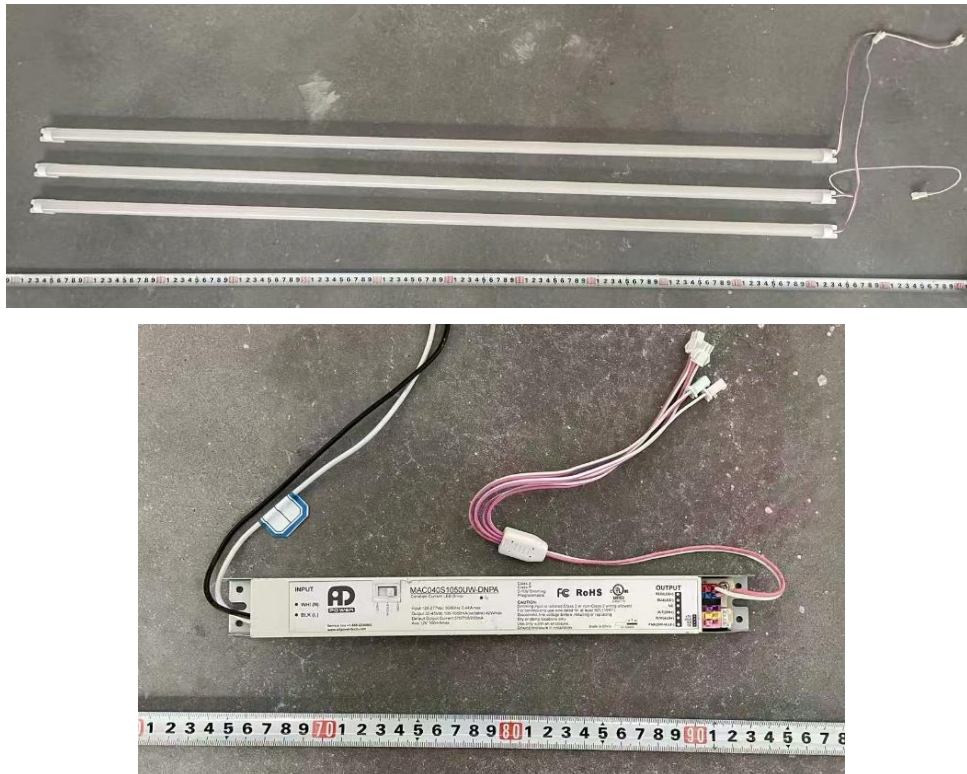


Figure 1- Overview of the sample



Sample in Lithonia 2GT8 lensed 2x4

#### Equipment Under Test(EUT)

<b>Name</b>	: LED Retrofit-kits	
<b>Model</b>	: ULB4-40L-U-50-L3	ULB4-40L-U-50-L3-MWS
	40LB/4F/850/U/A3	40LB/4F/850/U/A3/MWS
<b>Electrical Ratings</b>	: 120-277V, 50/60Hz	
<b>Product Description</b>	: Field-Adjustable 40W/36W/32W, 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)	0.327	0.146
Power Factor	0.9962	0.9610
Test Power (W)	39.02	38.77
THD A%	7.15	15.14
Luminous Efficacy (lm/W)	129.4	130.6
Total Luminous Flux (lm)	5050.2	5064.7
Color Rendering Index (CRI)	83.9	
R9	16.4	
Correlated Color Temperature (CCT)(K)	5202	
Chromaticity Chroma x	0.3395	
Chromaticity Chroma y	0.3451	
Chromaticity Chroma u	0.2101	
Chromaticity Chroma v	0.3204	
Duv	-0.0010	
Chromaticity Chroma u'	0.2101	
Chromaticity Chroma v'	0.4806	

Special Color Rendering Indices	
R1	83.4
R2	88.1
R3	90.4
R4	84.8
R5	84
R6	82.6
R7	87.1
R8	70.8
R9	16.4
R10	71.1
R11	84.7
R12	61.2
R13	84.6
R14	94.8

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)	0.327
Power Factor	0.9959
Power (W)	39.05
Luminous Efficacy (lm/W)	129.6
Total Luminous Flux (lm)	5059.9
Beam Angle ( ° )	93.8 (0°-180°) / 94.3 (90°-270°)
Center Beam Candle Power (cd)	2295
Maximum Beam Candle Power (cd)	2299 (At: C=320.0, Gamma=0.5)
Spacing Criteria	1.20 (0°-180°) / 1.26 (90°-270°)
Zonal Lumens in the 0 °-60 °Zone	88.44%
Zonal Lumens in the 60 °-90 °Zone	11.27%
Zonal Lumens in the 90 °-120 °Zone	0.10%
Zonal Lumens in the 120 °-180 °Zone	0.19%

Table 3: Test data per Goniophotometer Method

### Spectral Power Distribution - Sphere Spectroradiometer Method

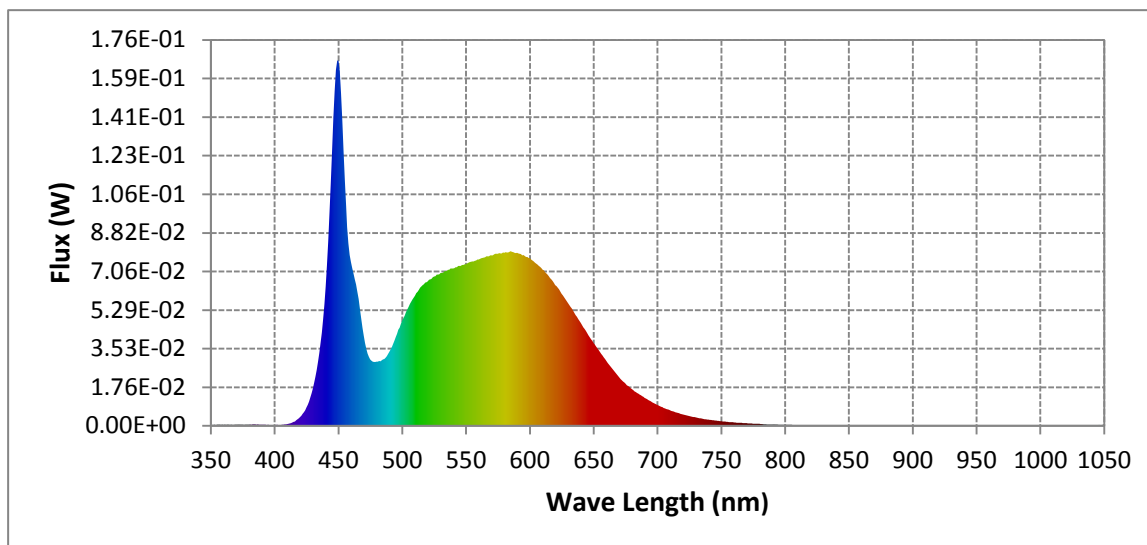


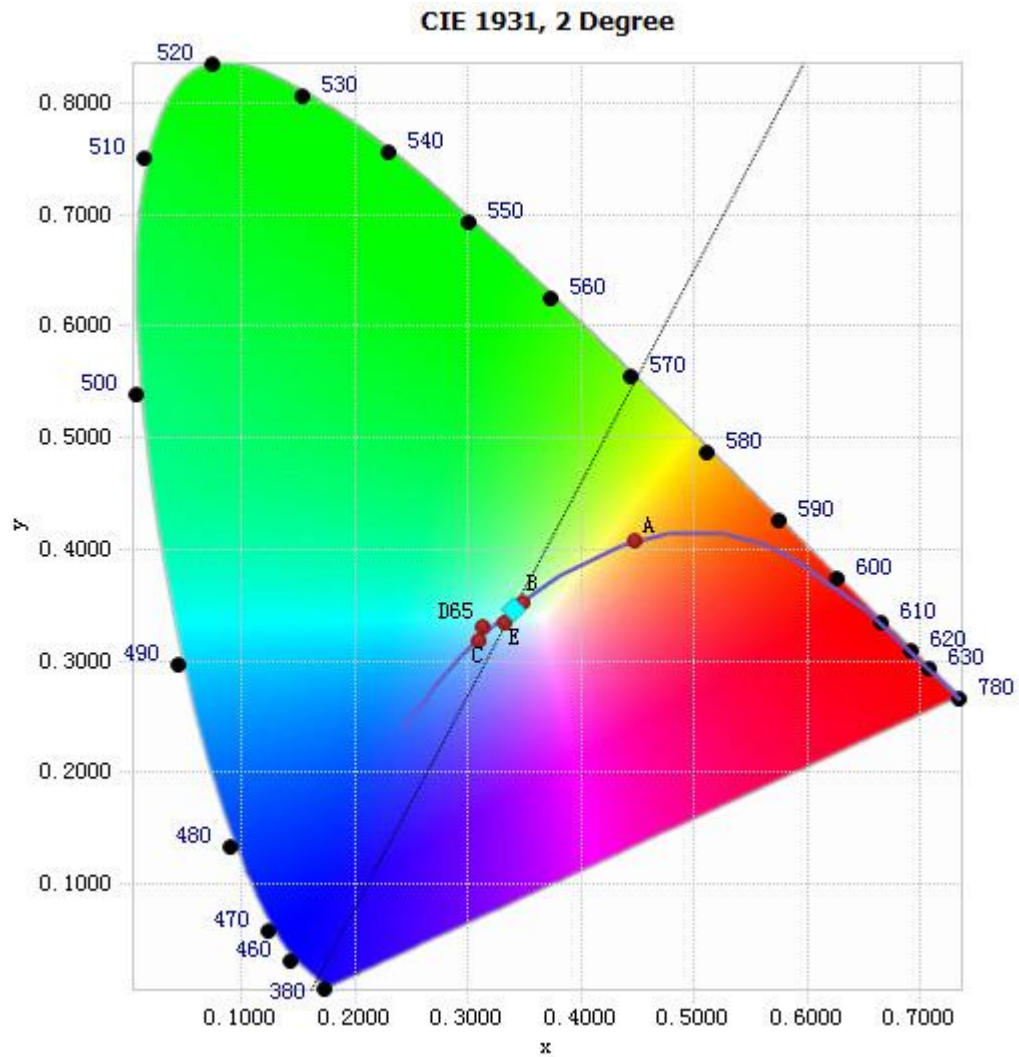
Chart 1: Spectral Power Distribution

Spectral Distribution over Visible Wavelength							
WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)	WL(nm)	Radiant(Watts)
380	6.95E-04	485	3.03E-02	590	7.91E-02	695	1.12E-02
385	6.07E-04	490	3.38E-02	595	7.80E-02	700	9.61E-03
390	5.59E-04	495	4.06E-02	600	7.65E-02	705	8.19E-03
395	5.01E-04	500	4.80E-02	605	7.40E-02	710	7.09E-03
400	4.16E-04	505	5.43E-02	610	7.14E-02	715	6.06E-03
405	3.94E-04	510	5.94E-02	615	6.83E-02	720	5.21E-03
410	8.19E-04	515	6.37E-02	620	6.43E-02	725	4.48E-03
415	1.78E-03	520	6.60E-02	625	6.04E-02	730	3.83E-03
420	4.02E-03	525	6.83E-02	630	5.61E-02	735	3.26E-03
425	8.43E-03	530	6.99E-02	635	5.15E-02	740	2.82E-03
430	1.71E-02	535	7.08E-02	640	4.70E-02	745	2.43E-03
435	3.31E-02	540	7.20E-02	645	4.24E-02	750	2.10E-03
440	6.36E-02	545	7.31E-02	650	3.79E-02	755	1.80E-03
445	1.26E-01	550	7.37E-02	655	3.37E-02	760	1.57E-03
450	1.67E-01	555	7.50E-02	660	2.96E-02	765	1.32E-03
455	1.12E-01	560	7.60E-02	665	2.58E-02	770	1.18E-03
460	7.49E-02	565	7.70E-02	670	2.21E-02	775	1.00E-03
465	6.12E-02	570	7.79E-02	675	1.92E-02	780	8.79E-04
470	4.12E-02	575	7.86E-02	680	1.67E-02		
475	3.03E-02	580	7.91E-02	685	1.47E-02		
480	2.93E-02	585	7.98E-02	690	1.28E-02		

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



## Chromaticity Diagram - Sphere Spectroradiometer Method



Tristimulus values(x, y): (0.3395, 0.3451)

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

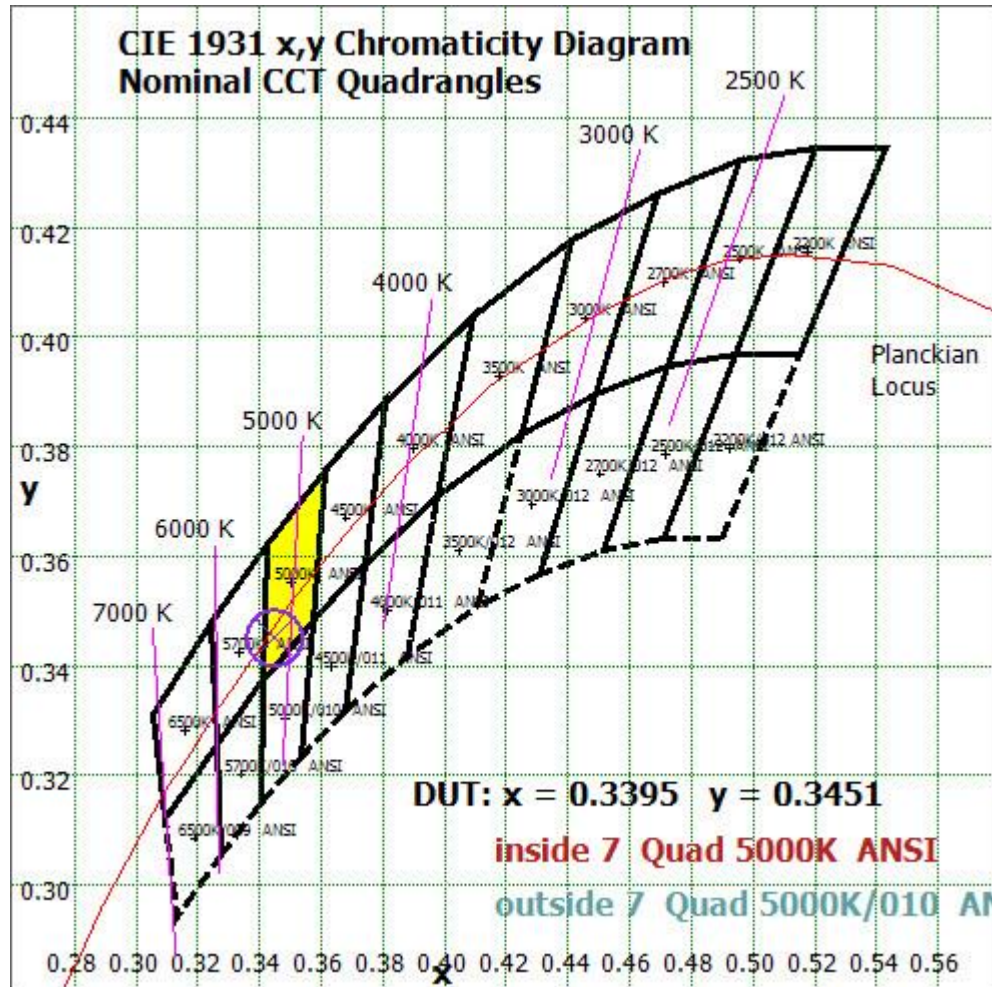
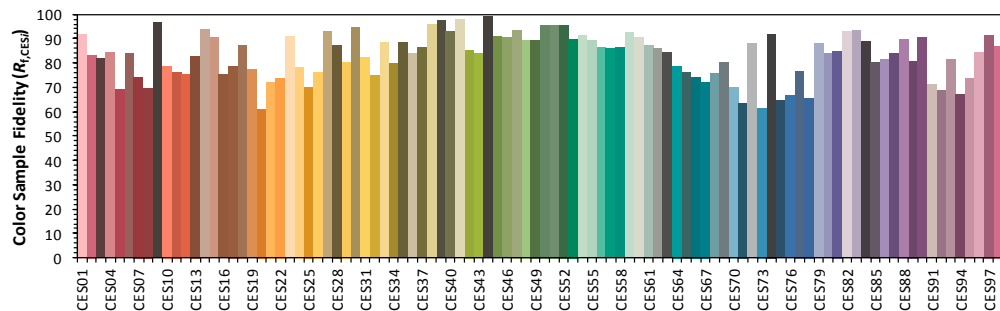
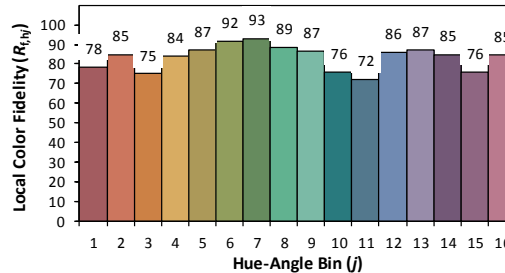
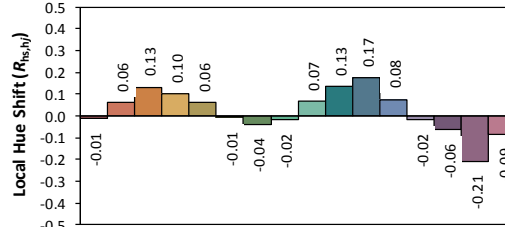
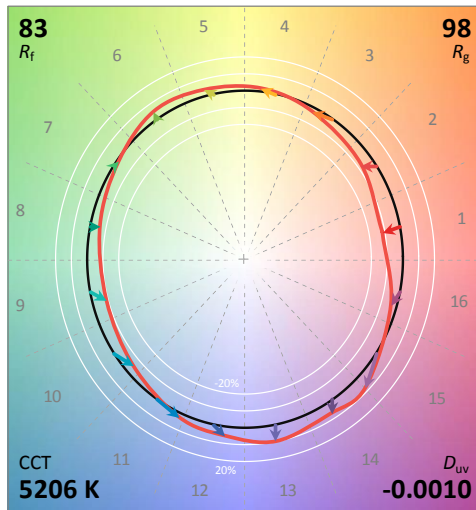
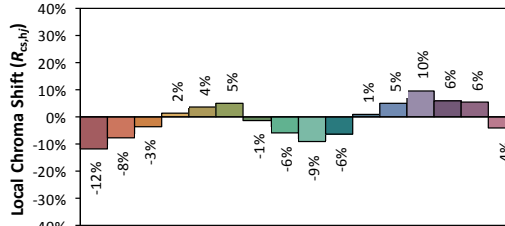
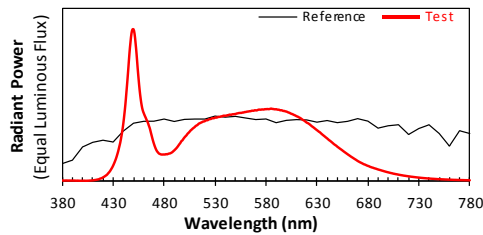


Chart 3: Plot of Lamp x/y coordinates on CIE 1931 Chromaticity Diagram

**Color Rendition Report – Sphere Spectroradiometer Method****ANSI/IES TM-30-18 Color Rendition Report****Source:** LED**Manufacturer:** Industrial Lighting Products, LLC**Date:** 2025/03/27**Model:** ULB4-40L-U-50-L3

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

$x$  0.3394  
 $y$  0.3451  
 $u'$  0.2101  
 $v'$  0.4806

CIE 13.3-1995  
(CRI)

$R_a$  84  
 $R_g$  16

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	217.113	4.29%
10- 20	621.625	12.29%
20- 30	938.526	18.55%
30- 40	1105.327	21.84%
40- 50	991.541	19.60%
50- 60	600.71	11.87%
60- 70	324.132	6.41%
70- 80	182.314	3.60%
80- 90	63.946	1.26%
90-100	1.138	0.02%
100-110	1.919	0.04%
110-120	2.114	0.04%
120-130	2.321	0.05%
130-140	2.433	0.05%
140-150	2.078	0.04%
150-160	1.445	0.03%
160-170	0.93	0.02%
170-180	0.282	0.01%
Total	5059.9	100%

$\gamma(^{\circ})$	Lumens	% Total
0- 60	4474.842	88.44%
60- 90	570.392	11.27%
0-90	5045.234	99.71%
90- 180	14.66	0.29%
0- 180	5059.9	100%

Table 5: Zonal Lumen

### Illuminance Plots- Goniophotometer Method

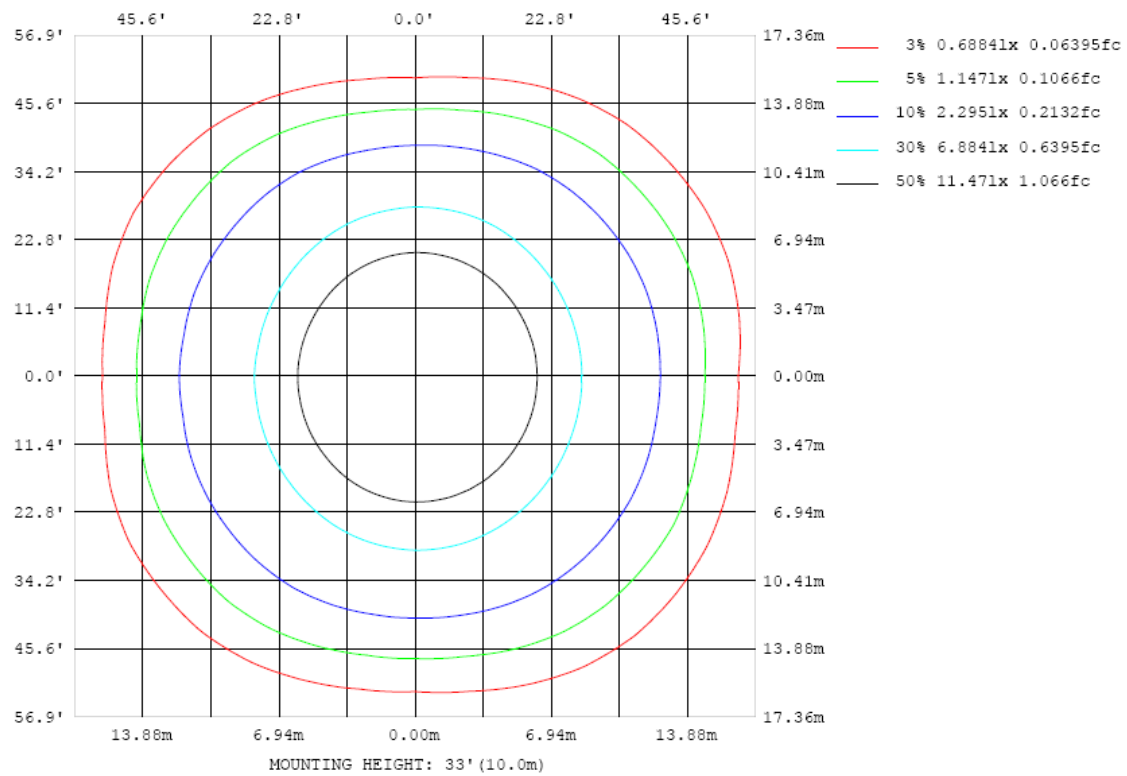


Chart 5: Illuminance Plot (Footcandles)

## Luminous Intensity Distribution Plots- Goniophotometer Method

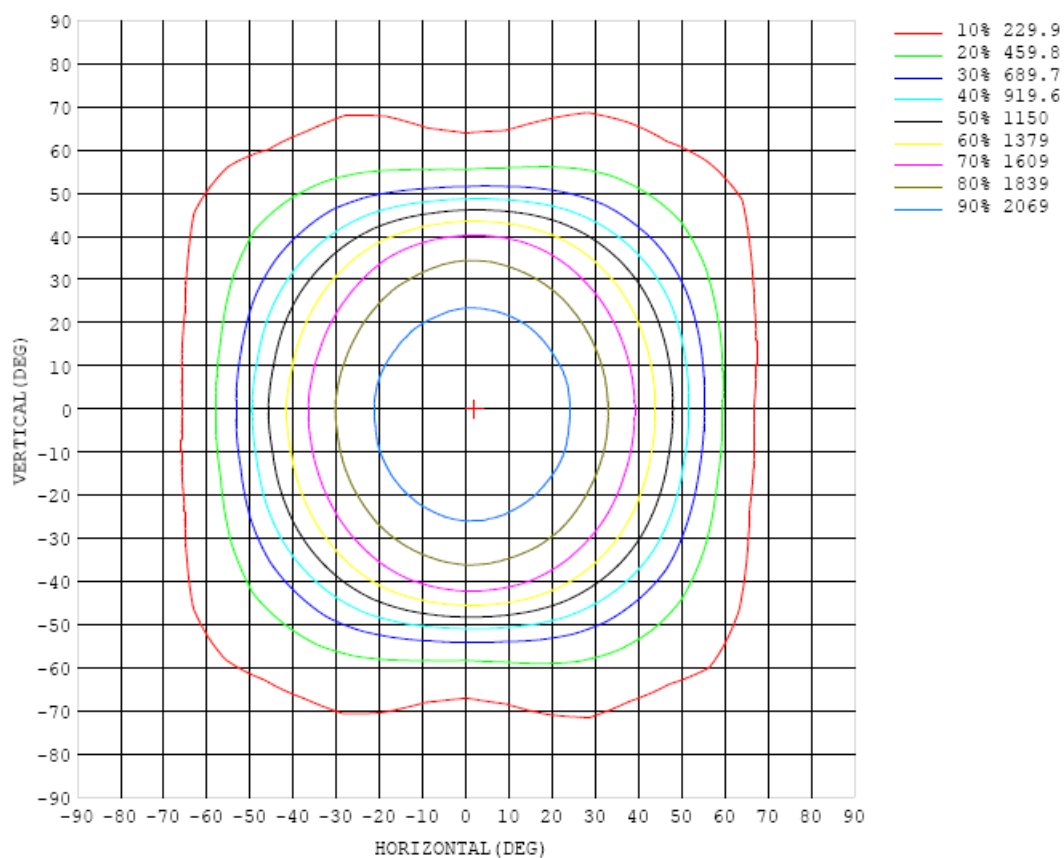


Chart 6: Isocandela Plot

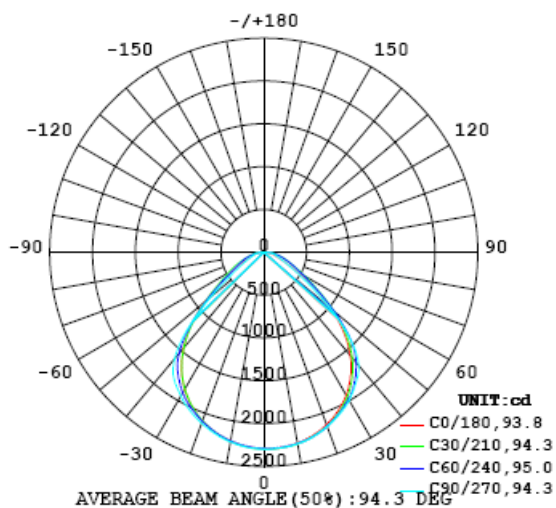


Chart 7: Polar Candela Distribution

## 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	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295
5	2284	2288	2294	2293	2285	2294	2287	2285	2291	2295	2287	2289	2285	2277	2289	2277	2278	2274	2280
10	2268	2270	2273	2270	2269	2270	2263	2267	2272	2268	2262	2263	2255	2249	2251	2256	2237	2235	2233
15	2215	2215	2223	2224	2223	2231	2233	2230	2230	2227	2221	2219	2213	2203	2204	2189	2181	2177	2182
20	2139	2150	2155	2160	2163	2169	2157	2161	2166	2169	2155	2153	2142	2129	2127	2114	2105	2094	2098
25	2052	2055	2067	2072	2069	2074	2080	2086	2087	2084	2076	2070	2052	2036	2028	2016	1994	1984	1980
30	1924	1925	1943	1948	1957	1976	1983	1990	2001	1997	1983	1970	1950	1923	1906	1877	1860	1847	1851
35	1766	1777	1786	1797	1815	1841	1846	1861	1870	1872	1856	1838	1806	1771	1740	1709	1687	1670	1675
40	1575	1577	1584	1607	1629	1653	1685	1711	1728	1723	1702	1671	1625	1572	1540	1501	1467	1451	1458
45	1323	1320	1338	1362	1383	1411	1429	1437	1431	1427	1407	1393	1364	1317	1279	1248	1217	1188	1199
50	1026	1024	1048	1068	1073	1076	1072	1054	1019	996	995	1013	1016	994	977	953	927	888	891
55	704	710	748	770	767	771	751	706	654	632	641	678	710	723	706	697	660	603	595
60	433	450	503	538	550	552	524	479	427	397	414	453	489	508	504	498	460	397	380
65	268	289	354	396	398	396	389	350	294	267	283	330	362	362	361	370	334	269	243
70	177	195	260	294	276	282	292	258	213	189	210	248	274	266	256	274	253	189	169
75	130	143	196	214	190	191	212	190	164	147	161	189	205	182	184	197	194	148	138
80	101	113	149	146	123	123	142	136	125	116	123	134	139	118	114	130	137	116	98.3
85	58.6	69.4	82.5	81.0	66.9	67.1	73.9	75.3	69.5	65.5	68.3	72.2	67.5	59.5	54.5	63.2	66.7	59.1	50.8
90	4.55	4.37	5.71	5.05	4.38	3.86	6.36	4.59	3.80	3.04	2.81	2.76	2.45	2.21	3.99	4.03	2.82	2.32	1.19
95	0.70	0.90	1.06	0.97	0.72	0.70	0.58	0.47	0.43	0.40	0.41	0.46	0.55	0.61	0.71	0.81	1.02	1.02	0.73
100	0.82	0.69	0.82	1.35	1.35	1.83	1.73	1.46	1.55	1.57	1.64	1.75	1.85	1.77	1.46	1.49	1.47	1.11	1.34
105	1.40	1.27	1.03	1.78	2.00	2.12	1.96	1.77	1.67	1.63	1.67	1.77	1.90	1.99	2.11	1.88	1.51	1.44	2.03
110	1.69	1.37	1.34	1.89	2.18	2.43	2.47	2.43	2.39	2.41	2.37	2.31	2.30	2.32	2.41	1.52	1.68	1.90	2.05
115	2.04	1.61	1.76	1.73	2.32	2.35	2.62	2.66	2.65	2.56	2.54	2.48	2.51	2.04	2.02	1.53	2.06	1.82	2.32
120	2.42	2.10	1.87	2.12	2.01	2.56	2.42	2.34	2.38	2.43	2.35	2.11	2.18	2.15	2.01	1.74	2.47	2.29	2.42
125	2.44	2.50	1.76	2.72	2.39	2.49	2.39	2.50	2.46	2.44	2.41	2.41	2.37	2.31	2.40	2.13	2.12	2.57	2.48
130	1.47	1.94	2.56	2.65	2.84	2.65	2.96	2.31	2.20	2.41	2.33	2.45	2.54	2.77	2.88	2.66	1.99	2.54	2.33
135	1.73	3.10	3.41	1.59	3.45	3.13	3.21	3.17	2.79	2.82	2.94	3.00	3.16	3.15	3.11	1.65	2.39	2.56	2.39
140	1.81	3.14	3.26	2.98	1.72	3.72	3.55	3.63	3.55	3.56	3.43	3.55	3.55	3.44	1.80	2.23	3.23	2.85	1.72
145	1.65	3.28	3.30	3.22	2.53	1.78	3.44	3.85	3.78	3.79	3.71	3.87	3.81	1.79	1.94	3.22	3.39	3.26	1.77
150	1.83	3.02	3.32	3.31	3.31	2.67	1.73	1.83	2.18	2.50	2.28	1.78	1.66	1.92	2.92	3.44	3.53	3.23	1.91
155	1.95	3.05	3.60	3.72	3.46	2.86	3.27	2.83	2.31	2.13	1.95	2.55	3.02	3.05	2.85	2.71	3.04	3.28	1.99
160	1.76	2.55	3.08	2.96	3.02	3.42	3.66	3.43	3.42	3.02	2.96	3.21	3.29	3.29	3.54	3.03	2.58	2.52	1.84
165	1.77	2.15	2.57	3.35	3.72	3.79	3.66	3.74	3.64	3.22	3.06	3.42	3.40	3.34	2.91	2.72	2.73	2.65	1.90
170	2.00	2.27	2.79	3.47	3.55	3.51	3.55	3.69	3.46	3.18	3.18	3.31	2.88	2.77	2.77	2.88	2.95	2.73	2.09
175	2.29	2.38	2.58	2.98	3.45	3.45	3.26	3.24	3.19	3.17	2.92	2.38	2.43	3.20	3.40	3.48	3.01	2.62	2.24
180	2.28	2.32	2.34	2.36	2.37	2.38	2.29	2.31	1.50	1.68	1.56	3.11	2.07	2.48	2.15	2.31	1.91	2.27	2.27

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		2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295	2295		
5		2280	2284	2279	2272	2278	2268	2276	2283	2283	2280	2287	2282	2278	2294	2294	2287	2285		
10		2236	2241	2240	2238	2242	2240	2236	2243	2251	2250	2250	2255	2252	2263	2255	2264	2263		
15		2179	2177	2178	2175	2180	2179	2186	2193	2192	2195	2201	2201	2202	2211	2216	2212	2214		
20		2096	2096	2094	2089	2098	2098	2105	2114	2124	2122	2131	2129	2127	2144	2143	2139	2141		
25		1979	1984	1984	1989	2001	2012	2018	2037	2040	2043	2043	2046	2043	2043	2040	2049	2052		
30		1841	1838	1845	1853	1877	1891	1915	1922	1936	1941	1946	1936	1931	1934	1928	1920	1924		
35		1661	1661	1671	1692	1720	1747	1778	1811	1825	1820	1818	1805	1785	1780	1772	1761	1766		
40		1437	1442	1452	1472	1504	1538	1575	1597	1618	1632	1635	1618	1599	1588	1574	1566	1569		
45		1174	1182	1188	1191	1203	1217	1225	1227	1245	1269	1300	1324	1322	1327	1325	1315	1317		
50		877	891	884	873	877	868	831	800	804	834	886	949	980	1005	1028	1037	1031		
55		600	630	634	627	622	586	537	493	477	508	567	632	681	703	729	742	730		
60		399	446	472	459	440	409	372	330	310	332	392	444	482	505	517	509	478		
65		268	331	355	317	310	311	280	235	211	226	281	334	350	360	383	369	318		
70		187	249	253	225	224	238	218	180	154	166	207	248	257	250	272	277	212		
75		146	190	179	158	149	172	163	141	125	131	155	182	173	170	190	206	154		
80		111	129	117	93.7	91.0	107	108	102	93.1	98.2	109	122	109	103	130	148	120		
85		55.4	60.6	51.5	42.1	39.0	42.2	46.3	44.6	42.8	45.5	54.3	57.8	57.1	57.2	72.6	75.5	72.5		
90		2.25	2.66	0.70	1.90	0.81	0.49	0.34	0.27	0.27	0.28	0.30	0.36	0.53	0.81	0.86	1.31	1.66		
95		1.20	1.71	1.46	1.46	0.89	0.64	0.55	0.53	0.49	0.48	0.46	0.51	0.57	0.70	0.82	1.00	1.29		
100		1.86	1.65	1.44	2.09	2.09	2.22	2.21	2.08	1.89	2.02	2.06	2.26	2.23	1.65	1.45	0.83	0.79		
105		2.12	2.12	1.14	1.60	2.00	2.51	2.55	2.55	2.43	2.31	2.18	2.05	1.77	1.29	1.28	1.14	1.40		
110		2.13	2.62	1.49	1.92	1.66	1.67	1.90	1.89	1.77	1.67	1.52	1.52	1.52	1.66	1.68	1.47	1.72		
115		2.51	3.20	1.86	2.35	2.05	2.05	1.84	1.83	1.82	1.80	1.79	1.89	2.02	2.07	2.29	1.79	1.97		
120		3.04	2.60	2.16	2.98	2.52	2.35	2.23	2.25	2.23	2.26	2.28	2.38	2.42	2.69	2.93	1.96	2.56		
125		3.29	2.68	2.46	3.57	3.26	2.98	2.76	2.70	2.73	2.70	2.75	2.89	3.05	3.39	3.54	1.58	2.80		
130		2.87	2.98	1.69	4.17	3.76	3.72	3.40	3.33	3.33	3.33	3.39	3.59	3.71	4.05	3.56	3.06	2.00		
135		3.32	2.39	1.69	4.09	4.39	4.30	4.10	4.02	3.98	4.00	4.06	4.21	4.37	4.24	1.51	3.79	3.56		
140		2.94	3.74	3.62	1.81	4.37	4.50	4.63	4.63	4.59	4.60	4.76	4.66	4.59	1.80	3.17	3.45	3.41		
145		3.33	3.88	4.11	3.78	1.93	3.65	4.87	4.96	5.06	4.97	4.82	3.92	1.88	3.42	3.76	3.65	3.62		
150		3.60	3.89	4.24	3.93	3.20	2.30	2.15	2.13	2.34	2.05	1.98	1.99	3.27	3.96	3.90	3.76	3.78		
155		3.29	3.55	3.23	3.37	4.16	4.08	4.27	3.57	2.97	3.43	4.23	4.20	3.07	3.63	4.22	4.10	3.71		
160		2.31	2.88	3.22	3.85	4.39	4.27	4.28	4.08	3.47	4.10	4.41	4.66	4.40	3.57	3.44	3.28	2.88		
165		1.89	2.70	2.87	2.91	3.18	4.07	4.07	4.00	3.77	3.94	4.44	4.36	4.47	4.32	4.12	3.68	2.31		
170		2.09	2.32	3.04	3.12	3.04	2.90	3.08	3.69	3.53	3.54	3.89	4.16	3.89	4.09	3.74	3.72	2.18		
175		2.25	2.27	2.43	3.11	3.40	3.60	2.75	2.31	2.39	3.42	3.34	3.32	3.40	3.20	3.00	2.34	2.17		
180		2.27	2.31	2.32	2.32	2.33	2.34	2.29	2.32	2.18	2.12	2.10	2.26	2.27	2.33	2.30	2.29	2.30		

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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