

**Report Number:** PL10259-001A  
**Model:** ZR24RK-50L-35K-10V-FD  
**Date:** 03/02/2017

## Cree Engineering Services Testing Laboratory (CESTL) Photometric Testing and Evaluation Report

**Prepared For:**

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**Prepared By:**

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Product Information	
Manufacturer	Cree Inc
Model Number (SKU)	ZR24RK-50L-35K-10V-FD
Serial Number	1LL02Q90017
LED Type	Lextar PC56H19

**Product Description**  
 2 x 4 Retro-fit troffer with a white painted aluminum reflector, white plastic end caps, and curved diffuse lens, attached to a white painted metal pan.

**Driver Information (Where Applicable)**  
 Philips XI040C110V054BST1

Height	Length	Width
4"	48"	23.75"

**Sample**  
 The following sample was submitted for evaluation





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Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	5395.0	5333.1	lm
Efficacy	136.89	135.46	lm/W
Correlated Color Temperature (CCT)	3471	K	
Color Rendering Index (CRI)	83		
R <sub>9</sub>	15		
Duv	0.000283		
S/P Ratio*	1.49		

Electrical Measurements	Sphere		Goniophotometer		
	120V	277V	120V	277V	
Input Wattage	39.41	38.81	39.36	38.77	W
Input Current	0.33	0.14	0.33	0.14	A
Input Voltage	120.09	277.08	120.04	277.03	V
Power Factor	0.998	0.973	0.997	0.972	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.06	0.05	0.07	0.06	%
Total Harmonic Distortion (Amperage)	5.46	8.98	5.49	8.80	%

**Note:** All photometric measurements taken at 120VAC.

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1882.0	Cd
Horizontal Angle of Max Candela	70	°
Vertical Angle of Max Candela	2.5	°
Zonal Lumens (0° – 30°)	1433.9 (26.9%)	lm (%)
Zonal Lumens (0° – 40°)	2332.2 (43.7%)	lm (%)
Zonal Lumens (0° – 60°)	4076.0 (76.4%)	lm (%)
Zonal Lumens (60° – 90°)	1257.1 (23.6%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	50	46	min
Total Operating Time (Stabilization + Test)	50	66	min
Ambient Temperature	24.4	24.3	°C

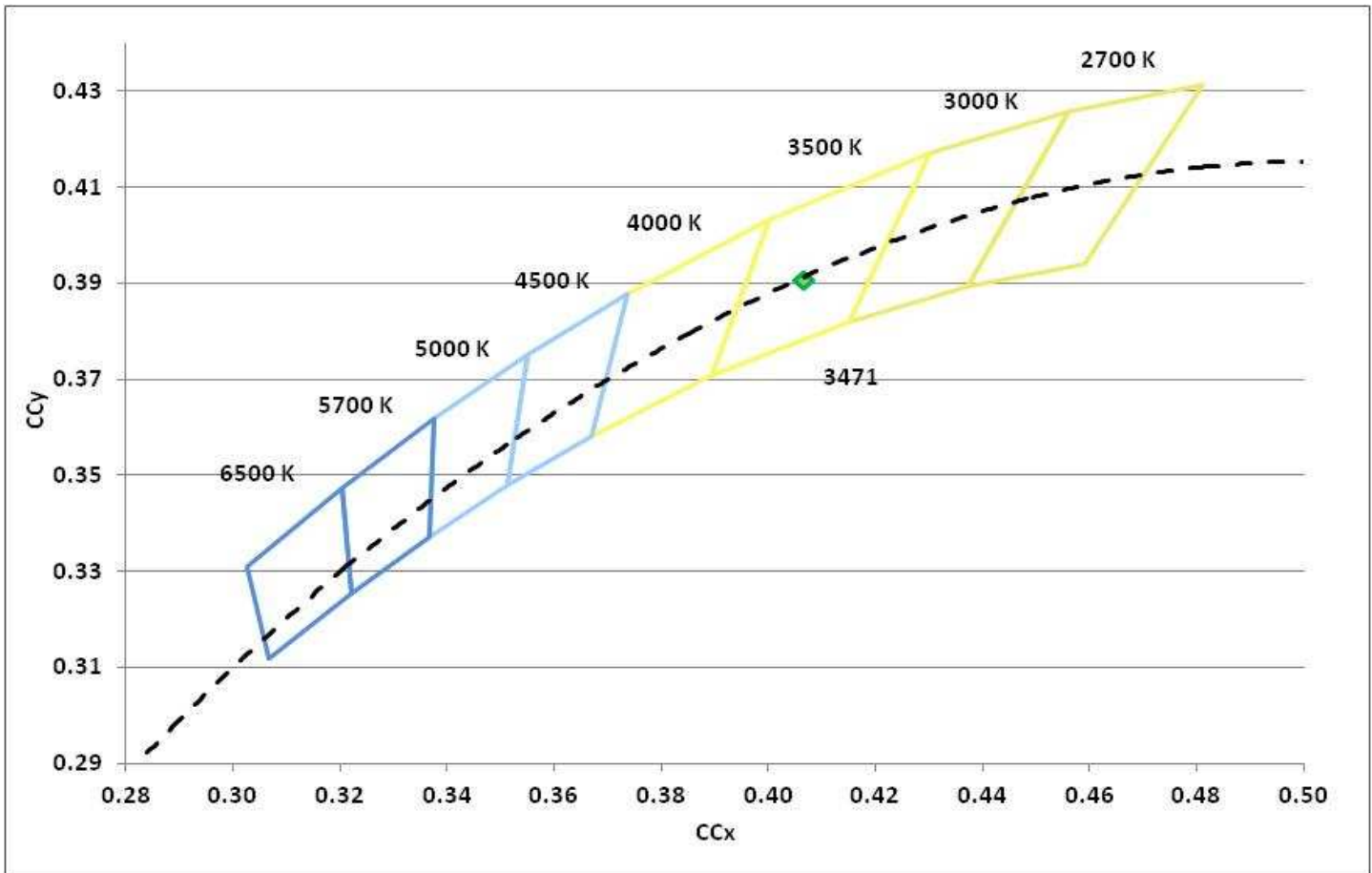
**Chromaticity Coordinates**

x	y	u	v	u'	v'	Duv
0.4066	0.3908	0.2365	0.3410	0.2365	0.5115	0.000283

**Color Rendering Index Details**

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
83	82	88	93	83	82	84	86	66	15	72	83	67	83	96

**Chromaticity Diagram**



**Spectral Distribution**

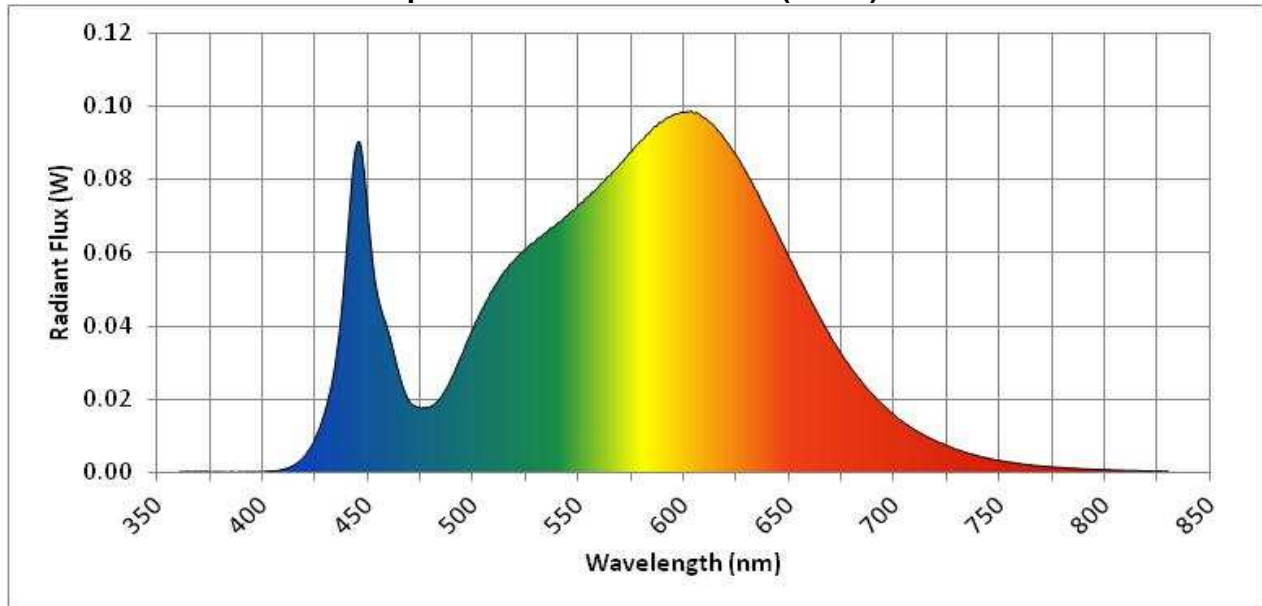
$\lambda$ (nm)	W/nm
360	0.000174
370	0.000386
380	0.000304
390	0.000196
400	0.000280
410	0.001058
420	0.004821
430	0.018078
440	0.063877
450	0.068800
460	0.037458
470	0.019102
480	0.018254
490	0.026335
500	0.039601
510	0.050963
520	0.058378

$\lambda$ (nm)	W/nm
530	0.063811
540	0.068318
550	0.073172
560	0.078638
570	0.084584
580	0.090801
590	0.095934
600	0.098357
610	0.096906
620	0.090548
630	0.081580
640	0.070614
650	0.058591
660	0.047302
670	0.036777
680	0.028081
690	0.021170

$\lambda$ (nm)	W/nm
700	0.015798
710	0.011611
720	0.008604
730	0.006234
740	0.004551
750	0.003329
760	0.002488
770	0.001808
780	0.001358
790	0.001050
800	0.000814
810	0.000628
820	0.000470
830	0.000415

<b>Dominant Wavelength</b>	581	nm
<b>Peak Wavelength:</b>	603	nm

**Spectral Power Distribution (W/nm)**





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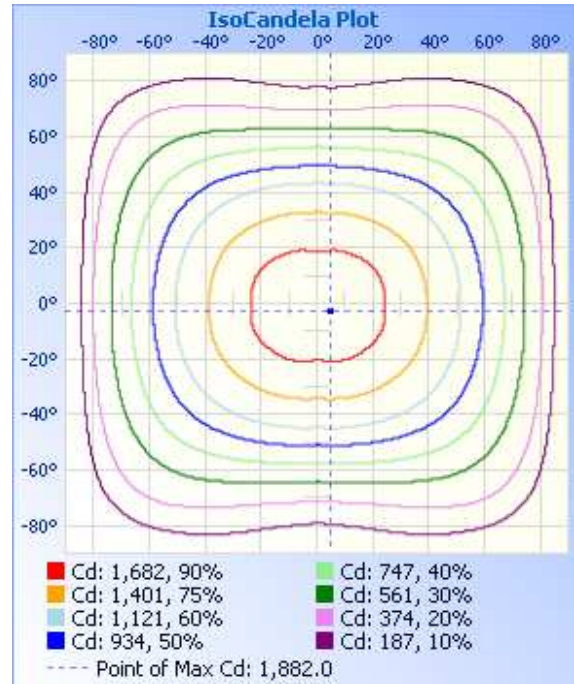
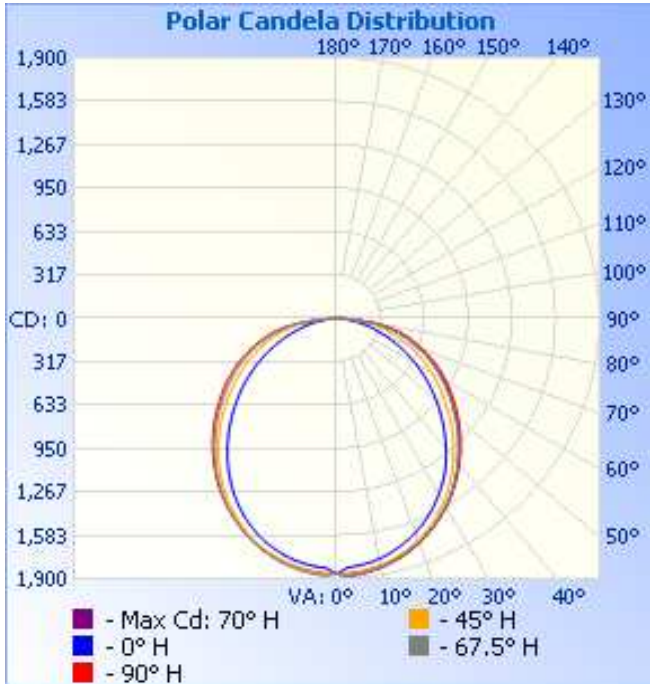
**Zonal Lumen Summary \*\***

Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	44.4	0.8%	90-95	0	0%
5-10	131.7	2.5%	95-100	0	0%
10-15	214.0	4.0%	100-105	0	0%
15-20	288.4	5.4%	105-110	0	0%
20-25	352.3	6.6%	110-115	0	0%
25-30	403.2	7.6%	115-120	0	0%
30-35	439.1	8.2%	120-125	0	0%
35-40	459.2	8.6%	125-130	0	0%
40-45	463.5	8.7%	130-135	0	0%
45-50	453.2	8.5%	135-140	0	0%
50-55	430.2	8.1%	140-145	0	0%
55-60	396.9	7.4%	145-150	0	0%
60-65	355.1	6.7%	150-155	0	0%
65-70	305.2	5.7%	155-160	0	0%
70-75	249.6	4.7%	160-165	0	0%
75-80	191.0	3.6%	165-170	0	0%
80-85	120.3	2.3%	170-175	0	0%
85-90	35.9	0.7%	175-180	0	0%
<b>Total</b>			<b>5333.1 lm</b>	<b>100%</b>	

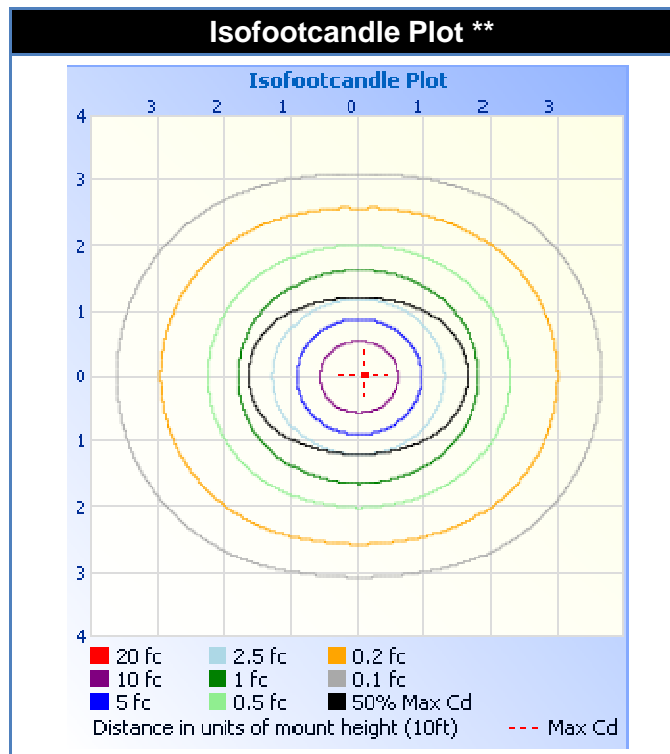
**Spacing Criteria \*\***

<b>Spacing Criterion (0 - 180)</b>	1.20
<b>Spacing Criterion (90 - 270)</b>	1.28
<b>Spacing Criterion (Diagonal)</b>	1.36

**Candela Plots \*\***



**Isofootcandle Plot \*\***





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**Candela Tabulations \*\***

	0	5	15	25	35	45	55	60	62.5	65	67.5	70	72.5	75	77.5
0	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864
2.5	1819	1827	1844	1857	1862	1868	1871	1875	1877	1880	1881	1882	1882	1881	1878
5	1811	1820	1837	1849	1854	1861	1864	1868	1870	1872	1873	1875	1875	1875	1872
7.5	1798	1806	1823	1836	1841	1849	1851	1855	1857	1859	1860	1861	1861	1861	1858
10	1780	1787	1805	1817	1823	1832	1835	1839	1842	1844	1845	1845	1845	1845	1842
12.5	1758	1764	1781	1793	1800	1810	1815	1820	1823	1825	1826	1827	1827	1826	1824
15	1730	1736	1753	1766	1773	1785	1791	1796	1799	1801	1802	1803	1803	1803	1800
17.5	1699	1704	1721	1734	1742	1755	1762	1768	1771	1774	1775	1776	1775	1775	1773
20	1664	1667	1684	1698	1707	1721	1730	1737	1739	1742	1743	1745	1745	1745	1743
22.5	1624	1625	1643	1657	1668	1683	1694	1701	1704	1706	1708	1709	1709	1710	1708
25	1580	1578	1598	1612	1624	1642	1654	1661	1664	1667	1668	1670	1670	1671	1670
27.5	1531	1528	1548	1562	1577	1596	1610	1619	1622	1625	1627	1628	1629	1630	1629
30	1479	1473	1493	1509	1525	1547	1563	1572	1576	1579	1581	1583	1584	1586	1585
32.5	1424	1415	1434	1450	1470	1493	1512	1522	1526	1529	1531	1534	1535	1537	1537
35	1365	1352	1371	1388	1411	1436	1458	1469	1472	1476	1479	1481	1483	1485	1486
37.5	1300	1286	1306	1323	1349	1377	1401	1412	1417	1421	1423	1426	1428	1430	1432
40	1232	1219	1238	1257	1285	1315	1341	1354	1358	1363	1366	1369	1371	1374	1375
42.5	1160	1150	1168	1189	1220	1252	1280	1293	1298	1303	1306	1310	1313	1316	1318
45	1089	1079	1096	1119	1153	1186	1217	1232	1237	1242	1246	1250	1253	1256	1259
47.5	1017	1007	1023	1047	1084	1120	1153	1169	1175	1181	1185	1190	1193	1197	1200
50	945	933	950	975	1014	1053	1089	1105	1112	1118	1123	1128	1132	1136	1140
52.5	873	861	878	905	945	986	1024	1040	1048	1056	1061	1066	1070	1075	1079
55	803	790	807	836	878	922	960	978	986	994	1000	1005	1010	1014	1018
57.5	730	718	736	767	812	858	899	917	926	934	940	947	951	956	960
60	660	648	665	699	746	794	837	856	865	874	880	887	892	896	901
62.5	588	578	596	632	679	731	775	795	804	814	819	825	831	837	841
65	519	509	528	566	615	667	714	733	742	752	758	764	770	776	780
67.5	450	442	462	502	552	605	652	671	680	689	695	702	708	713	717
70	386	376	399	439	491	543	589	608	617	625	632	639	644	649	653
72.5	323	314	338	380	431	482	526	544	553	561	568	574	580	585	589
75	264	254	280	322	372	420	463	481	490	499	505	512	517	523	527
77.5	207	199	226	266	314	359	402	422	430	439	446	452	458	463	466
80	154	148	174	212	257	301	340	355	362	369	374	379	382	386	388
82.5	107	102	126	160	200	233	258	267	271	274	277	280	281	283	284
85	65	60	80	106	132	148	158	161	163	164	165	166	166	167	168
87.5	28	23	34	42	50	53	56	57	58	59	58	58	60	61	62
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0





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**Candela Tabulations (Continued) \*\***

	80	82.5	85	87.5	90	95	105	112	125	135	145	155	165	175	180
0	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864	1864
2.5	1875	1871	1868	1865	1863	1868	1882	1879	1872	1868	1862	1857	1845	1829	1821
5	1868	1865	1861	1859	1857	1862	1875	1872	1864	1861	1855	1850	1838	1823	1815
7.5	1855	1852	1848	1847	1845	1851	1864	1861	1854	1850	1844	1840	1828	1812	1804
10	1839	1836	1833	1832	1830	1836	1850	1847	1840	1835	1829	1825	1812	1796	1788
12.5	1821	1818	1815	1813	1812	1817	1829	1827	1820	1816	1810	1804	1792	1775	1766
15	1798	1795	1793	1791	1790	1795	1806	1803	1795	1791	1786	1779	1766	1750	1740
17.5	1771	1769	1766	1766	1765	1769	1780	1777	1767	1762	1756	1748	1735	1720	1709
20	1741	1739	1736	1736	1736	1740	1749	1746	1736	1729	1723	1713	1700	1685	1673
22.5	1706	1705	1703	1702	1702	1706	1715	1711	1701	1692	1685	1674	1659	1644	1632
25	1669	1667	1666	1666	1666	1670	1678	1675	1662	1651	1642	1629	1614	1600	1587
27.5	1628	1628	1626	1627	1627	1630	1637	1633	1619	1606	1595	1580	1565	1552	1537
30	1585	1584	1584	1584	1584	1587	1592	1587	1572	1556	1544	1528	1510	1499	1483
32.5	1537	1537	1536	1537	1538	1540	1544	1538	1522	1504	1490	1471	1452	1441	1424
35	1486	1487	1487	1487	1488	1490	1494	1486	1468	1449	1432	1411	1391	1380	1362
37.5	1433	1434	1434	1435	1436	1437	1439	1432	1412	1390	1371	1348	1328	1316	1297
40	1377	1378	1379	1380	1381	1382	1383	1375	1353	1329	1308	1282	1261	1249	1231
42.5	1320	1321	1322	1323	1325	1325	1325	1316	1293	1267	1242	1215	1192	1181	1161
45	1261	1263	1265	1266	1268	1268	1266	1255	1231	1203	1174	1146	1121	1110	1091
47.5	1203	1205	1207	1208	1209	1209	1206	1195	1169	1138	1106	1076	1050	1037	1020
50	1143	1145	1147	1148	1150	1150	1147	1134	1106	1073	1038	1004	978	964	949
52.5	1082	1085	1087	1089	1090	1090	1086	1072	1043	1007	970	934	906	892	877
55	1022	1025	1027	1029	1031	1031	1024	1009	979	941	900	864	834	820	806
57.5	964	966	969	971	972	972	965	948	916	875	833	793	762	748	734
60	905	908	911	912	914	914	906	888	855	812	767	724	692	676	664
62.5	845	848	851	852	853	855	846	828	794	749	702	657	624	607	594
65	784	787	789	791	792	793	785	767	732	686	638	591	556	538	524
67.5	721	724	726	728	729	730	722	704	670	624	575	527	490	470	456
70	657	660	662	663	664	665	657	640	607	563	513	464	426	404	390
72.5	593	595	598	598	599	601	593	577	545	502	453	403	364	340	327
75	531	533	536	536	537	539	531	514	483	441	395	345	305	280	266
77.5	470	472	474	474	475	477	471	454	422	380	337	290	249	224	209
80	391	392	394	394	394	396	398	388	361	322	280	236	196	170	157
82.5	286	287	287	286	286	289	297	297	284	260	225	184	147	122	109
85	169	170	170	169	168	173	181	188	188	180	162	132	101	78	67
87.5	62	63	64	63	63	67	72	79	84	86	84	72	55	39	30
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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Candela Tabulations (Continued) \*\*

	0	5	15	25	35	45	55	60	62.5	65	67.5	70	72.5	75	77.5
92.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
157.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



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Candela Tabulations (Continued) \*\*

	80	82.5	85	87.5	90	95	105	112	125	135	145	155	165	175	180
92.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
97.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
102.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
122.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
127.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
132.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
137.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
142.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
147.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
152.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
157.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
162.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
167.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
172.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
177.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



NVLAP Lab Code 500077-0

### Integrating Sphere Equipment List

Description	Manufacturer	Model	Serial Number
3M Sphere	Labsphere	CSTM-CSLMS-3M98-HDS	82456
CCD Array Spectrometer	Otsuka	MC-9801	98010165
Programmable AC Source	Chroma	61603	616030000761
Single Channel Power Analyzer	Xitron	2801	28011110008
Aux Lamp Power Supply	Labsphere	LPS-100-0833	1002104538

### Goniophotometer Equipment List

Description	Manufacturer	Model	Serial Number
AC Power Source	Adaptive	FC210	2300229
AC Power Source	Elgar	CW1251	1126A06399
Type C Goniophotometer	LSI / UL	6440T	6440TE0192T
Spectroradiometer	Gooch & Housego	770VIS/NIR	11414155
Power Meter	Yokogawa	WT210	91L220953

### Test Methods Used:

Title	Description
ANSI C82.77:2002	Harmonic Emission Limits- Related Power Quality Req't's for Lighting Equipment
CIE Pub. 13.3:1995	Method of Measuring and Specifying Color Rendering of Light Sources
CIE Pub. 15:2004	Colorimetry
IES LM-58:1994	Spectroradiometric Measurements
IES LM-79:2008	Electrical and Photometric Measurements of Solid-State Lighting Products

### Reference Standard Used:

Equipment	Description
3m Sphere	Tungsten Halogen Omni-Directional 75W Calibration Lamp, Serial Number G141
Type C Goniophotometer	Tungsten Halogen Omni-Directional 500W Calibration Lamp, Serial Number 97A

**Disclaimers:**

This report must not be used by the customer to claim product certification, approval or endorsement by NVLAP, NIST or any agency of the federal government.

The results contained in this report pertain only to the tested sample.

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\* Items marked with a single asterisk are not covered by the NVLAP accreditation.

In the event that the recorded temperature is outside of  $25 \pm 1^\circ\text{C}$ , this is considered a non-standard condition.

\*\* In the event that testing is subcontracted, test results in this report marked with the symbol \*\*, or noted as “Goniophotometer”, were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All other tests are performed using an integrating sphere.

The goniophotometer information in the equipment list, report items marked with \*\*, or results specifically identified as “Goniophotometer”, are the actual equipment used, and test results produced, by the subcontracted laboratory.

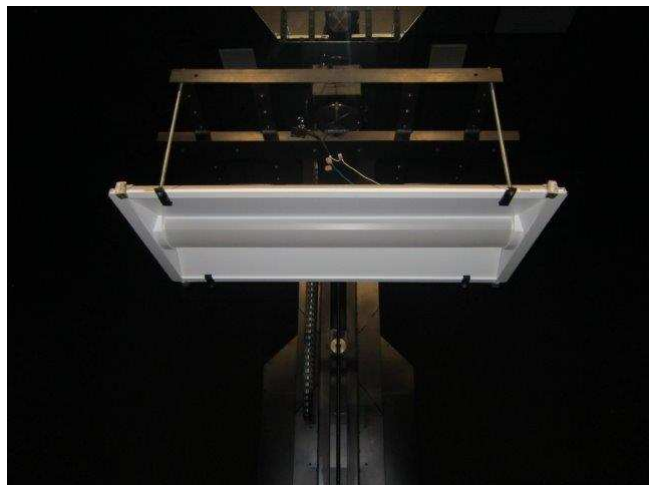
**Additional Comments:**

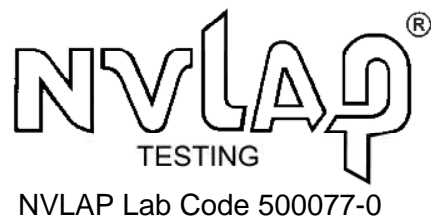
The photos below are intended to show the orientation and fixturing/set-up of the units under test. These are critical to understanding the results of the test given the sensitivity of many products and measurement systems to orientation and set-up considerations, and also for reproducing the conditions of the test.

**Sphere Picture**



**Goniophotometer Picture**





**Document Revision History:**

Each subsequent revision of this report replaces the preceding report.

Date	Rev	DCN #	Change Details	By	Approval
03/02/17	A	DMS	Origination	A. Gressel	C. McLaurin