

**Report Number:** PL10456-001A  
**Model:** ZR24C-40L-30K-10V-FD  
**Date:** 03/20/2017

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

**Prepared For:**

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**Prepared By:**

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**Approved By:**

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**Product Information**

<b>Manufacturer</b>	Cree Inc
<b>Model Number (SKU)</b>	ZR24C-40L-30K-10V-FD
<b>Serial Number</b>	WL061A04828
<b>LED Type</b>	PC56H19

**Product Description**

2 x 4 Troffer with a white painted aluminum reflector, white painted aluminum end caps, and curved diffuse lens.

**Driver Information (Where Applicable)**

LEA02925X0042

Length	Width
48"	24"

**Sample**

The following sample was submitted for evaluation



Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	3922.0	3862.8	lm
Efficacy	125.75	123.81	lm/W
Correlated Color Temperature (CCT)	3071	K	
Color Rendering Index (CRI)	83		
R <sub>9</sub>	11		
Duv	0.000262		
S/P Ratio*	1.34		

Electrical Measurements	Sphere		Goniophotometer		
	120V	277V	120V	277V	
Input Wattage	31.19	30.97	31.20	30.95	W
Input Current	0.26	0.12	0.26	0.12	A
Input Voltage	120.03	277.06	120.08	277.09	V
Power Factor	0.994	0.953	0.992	0.951	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.05	0.05	0.06	0.06	%
Total Harmonic Distortion (Amperage)	6.31	12.65	5.98	12.47	%

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

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1345.6	Cd
Horizontal Angle of Max Candela	70	°
Vertical Angle of Max Candela	2.5	°
Zonal Lumens (0° – 30°)	1028.2 (26.6%)	lm (%)
Zonal Lumens (0° – 40°)	1675.2 (43.4%)	lm (%)
Zonal Lumens (0° – 60°)	2939.6 (76.1%)	lm (%)
Zonal Lumens (60° – 90°)	923.2 (23.9%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	40	32	min
Total Operating Time (Stabilization + Test)	40	52	min
Ambient Temperature	24.8	25.4	°C

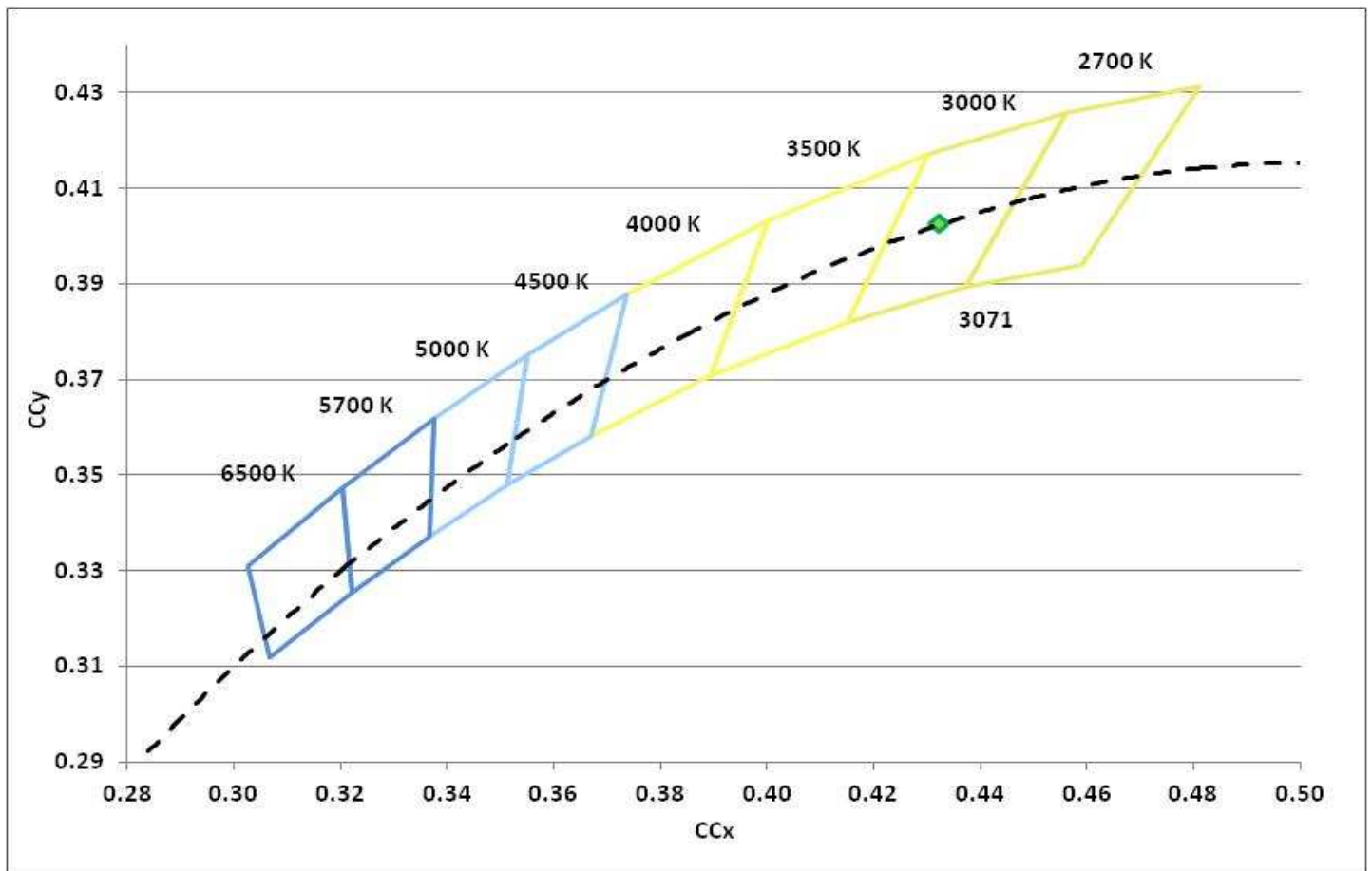
### Chromaticity Coordinates

x	y	u	v	u'	v'	Duv
0.4322	0.4029	0.2480	0.3468	0.2480	0.5202	0.000262

### Color Rendering Index Details

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
83	81	89	96	82	81	86	85	62	11	75	82	69	83	98

### Chromaticity Diagram



**Spectral Distribution**

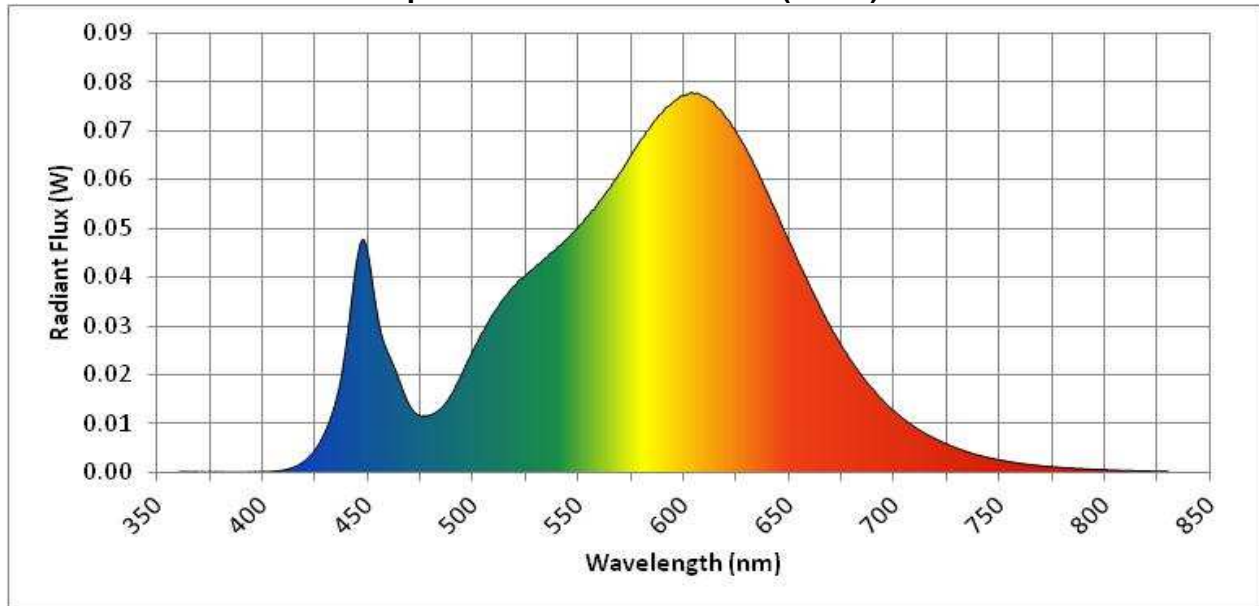
$\lambda$ (nm)	W/nm
360	0.000179
370	0.000116
380	0.000196
390	0.000113
400	0.000179
410	0.000532
420	0.002548
430	0.008958
440	0.028023
450	0.044209
460	0.023842
470	0.013368
480	0.011923
490	0.016413
500	0.025245
510	0.033002
520	0.038390

$\lambda$ (nm)	W/nm
530	0.042498
540	0.046293
550	0.050527
560	0.055756
570	0.061697
580	0.068449
590	0.073858
600	0.077186
610	0.077003
620	0.072543
630	0.065794
640	0.056914
650	0.047300
660	0.038020
670	0.029565
680	0.022565
690	0.017003

$\lambda$ (nm)	W/nm
700	0.012630
710	0.009250
720	0.006861
730	0.004958
740	0.003578
750	0.002593
760	0.001925
770	0.001395
780	0.001036
790	0.000797
800	0.000569
810	0.000453
820	0.000345
830	0.000256

<b>Dominant Wavelength</b>	582	nm
<b>Peak Wavelength:</b>	603	nm

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





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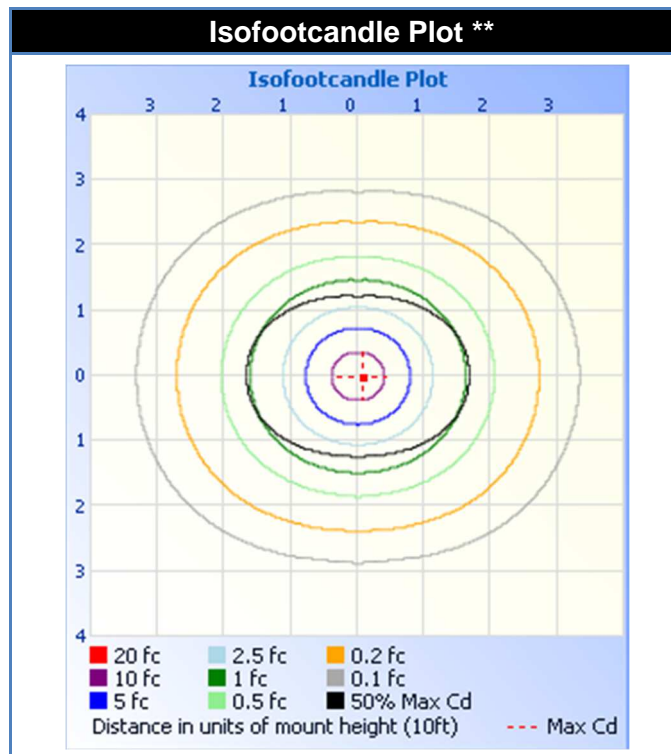
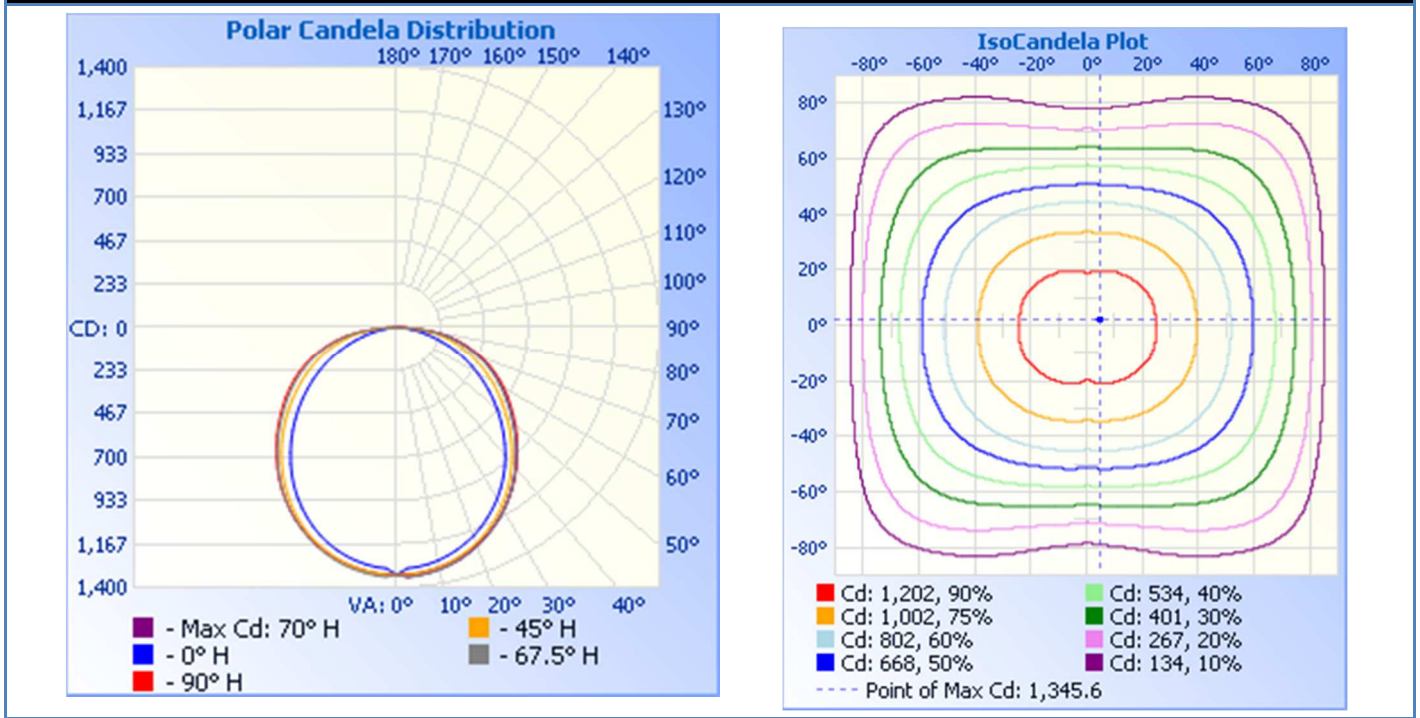
### Zonal Lumen Summary \*\*

Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	31.7	0.8%	90-95	0	0%
5-10	94.1	2.4%	95-100	0	0%
10-15	153.1	4.0%	100-105	0	0%
15-20	206.7	5.4%	105-110	0	0%
20-25	252.8	6.5%	110-115	0	0%
25-30	289.7	7.5%	115-120	0	0%
30-35	316.0	8.2%	120-125	0	0%
35-40	331.0	8.6%	125-130	0	0%
40-45	334.8	8.7%	130-135	0	0%
45-50	328.1	8.5%	135-140	0	0%
50-55	312.3	8.1%	140-145	0	0%
55-60	289.2	7.5%	145-150	0	0%
60-65	259.8	6.7%	150-155	0	0%
65-70	224.4	5.8%	155-160	0	0%
70-75	183.7	4.8%	160-165	0	0%
75-80	139.4	3.6%	165-170	0	0%
80-85	88.4	2.3%	170-175	0	0%
85-90	27.5	0.7%	175-180	0	0%
<b>Total</b>			<b>3862.8 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 \*\***





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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	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331
2.5	1299	1306	1317	1327	1330	1334	1336	1339	1341	1343	1344	1346	1344	1343	1341
5	1294	1301	1312	1322	1326	1330	1332	1335	1337	1339	1340	1341	1340	1339	1337
7.5	1286	1292	1303	1313	1317	1322	1324	1327	1329	1331	1332	1333	1332	1331	1329
10	1274	1280	1291	1301	1305	1311	1314	1317	1319	1321	1322	1323	1322	1320	1319
12.5	1259	1264	1275	1285	1290	1296	1300	1305	1307	1309	1310	1311	1310	1309	1307
15	1241	1244	1256	1267	1272	1280	1284	1289	1291	1292	1294	1295	1294	1293	1291
17.5	1219	1223	1235	1245	1252	1260	1265	1270	1272	1274	1275	1276	1275	1274	1272
20	1195	1198	1211	1221	1228	1236	1243	1248	1250	1253	1253	1254	1253	1253	1251
22.5	1168	1170	1182	1193	1201	1210	1218	1223	1225	1227	1228	1229	1228	1228	1227
25	1137	1139	1152	1163	1171	1182	1190	1195	1197	1200	1201	1202	1201	1201	1200
27.5	1104	1104	1117	1129	1139	1150	1159	1166	1168	1170	1171	1172	1172	1172	1171
30	1070	1066	1080	1092	1103	1116	1126	1133	1135	1138	1139	1140	1140	1140	1139
32.5	1030	1025	1040	1052	1065	1078	1091	1098	1100	1102	1103	1104	1105	1105	1105
35	990	983	997	1009	1024	1039	1053	1060	1062	1064	1066	1067	1067	1068	1068
37.5	947	939	952	964	981	997	1012	1020	1022	1025	1026	1027	1028	1029	1029
40	901	892	905	918	936	954	970	978	981	984	985	987	988	988	989
42.5	853	844	856	870	890	909	927	935	938	941	942	944	945	947	947
45	803	794	806	821	842	863	882	891	894	898	899	901	903	905	905
47.5	753	743	755	771	794	817	838	846	850	853	855	857	860	862	863
50	702	692	703	720	745	769	792	801	805	809	812	814	816	818	820
52.5	652	641	652	670	696	722	745	756	760	764	767	770	772	775	777
55	600	590	601	621	648	676	700	712	716	721	724	728	730	733	735
57.5	548	539	550	572	600	631	657	668	674	678	682	686	689	692	694
60	496	488	500	524	553	586	614	625	631	636	640	645	648	650	653
62.5	446	437	450	475	506	541	570	582	588	593	598	602	606	609	611
65	396	387	400	428	460	496	526	539	545	550	555	560	563	566	568
67.5	347	337	352	380	415	452	482	495	501	507	511	516	519	522	525
70	296	288	304	334	371	408	438	451	456	462	466	470	473	476	479
72.5	247	240	258	290	327	364	394	406	410	415	419	422	426	429	431
75	200	194	214	246	285	320	347	358	363	367	370	373	376	379	381
77.5	157	150	172	205	242	275	300	311	315	320	323	326	329	331	333
80	115	110	132	166	200	229	254	264	268	272	274	276	278	280	281
82.5	78	74	96	127	157	182	200	207	208	210	210	211	211	212	212
85	46	44	64	88	111	125	133	134	134	134	133	132	131	131	131
87.5	22	19	32	43	52	55	55	55	55	54	53	52	52	51	51
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	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331	1331
2.5	1339	1338	1336	1334	1331	1336	1344	1343	1336	1332	1329	1325	1316	1306	1299
5	1335	1334	1333	1330	1327	1332	1340	1338	1331	1328	1324	1320	1311	1302	1295
7.5	1327	1326	1325	1322	1320	1325	1332	1331	1324	1320	1316	1312	1304	1293	1286
10	1317	1316	1314	1312	1310	1315	1323	1322	1315	1310	1306	1302	1293	1282	1274
12.5	1305	1303	1302	1300	1298	1302	1309	1308	1301	1297	1293	1288	1278	1267	1259
15	1290	1288	1287	1285	1283	1286	1293	1292	1285	1280	1276	1271	1260	1249	1240
17.5	1271	1270	1268	1267	1266	1269	1275	1274	1266	1260	1255	1249	1239	1227	1218
20	1250	1248	1247	1246	1246	1248	1253	1252	1243	1238	1232	1225	1214	1202	1192
22.5	1225	1224	1223	1222	1222	1224	1229	1227	1219	1211	1205	1197	1186	1174	1164
25	1199	1197	1196	1196	1196	1198	1203	1201	1192	1183	1176	1166	1155	1143	1131
27.5	1170	1169	1168	1168	1168	1169	1174	1171	1161	1151	1143	1132	1120	1108	1096
30	1139	1138	1137	1137	1137	1138	1141	1138	1127	1116	1107	1095	1082	1071	1059
32.5	1105	1104	1103	1103	1103	1104	1106	1103	1092	1079	1068	1055	1042	1031	1018
35	1068	1067	1067	1067	1067	1069	1070	1066	1054	1040	1027	1013	999	989	975
37.5	1030	1029	1029	1029	1030	1030	1031	1026	1013	998	985	969	954	944	929
40	989	989	989	989	990	990	991	985	971	955	940	923	908	898	882
42.5	948	948	948	949	949	949	949	943	928	911	894	875	859	850	834
45	906	907	908	908	908	908	907	900	884	866	847	827	809	800	784
47.5	864	865	865	866	866	867	865	857	840	820	798	777	759	749	734
50	821	822	823	824	825	824	822	814	796	773	750	727	708	697	684
52.5	779	780	782	782	783	782	779	770	750	726	701	677	657	646	633
55	737	738	740	740	741	740	736	726	705	679	653	627	605	594	582
57.5	696	697	699	700	701	700	694	683	660	632	604	576	554	543	531
60	655	656	658	659	660	659	653	640	617	587	557	527	503	492	480
62.5	614	615	617	617	618	618	611	598	574	543	510	479	454	441	430
65	571	573	574	575	575	575	568	555	531	498	465	431	404	390	379
67.5	527	528	530	530	531	531	524	511	487	454	419	383	356	340	328
70	481	482	483	484	484	484	478	465	442	410	374	337	308	291	278
72.5	433	434	434	435	435	435	430	419	398	367	331	293	262	243	230
75	383	384	385	385	385	386	381	371	352	322	288	249	218	197	184
77.5	335	336	337	337	337	338	333	324	305	278	246	208	175	153	141
80	283	283	283	283	282	284	281	275	258	233	203	169	135	112	100
82.5	212	212	211	211	210	211	212	212	204	186	161	130	99	76	65
85	130	130	129	128	128	128	133	137	135	128	114	91	65	45	35
87.5	51	51	51	50	50	50	53	57	58	58	55	46	32	19	13
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

### 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.

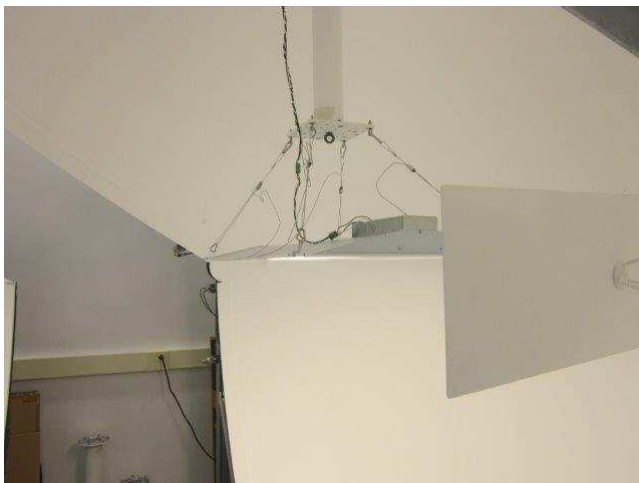
\*\* In the event that testing is subcontracted, test results in this report marked with the symbol \*\*, or noted as “Goniophotometer”, were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All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

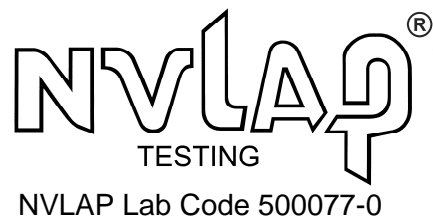
The photos below are intended to show the orientation and fixturing/set-up of the units under test. These are critical to understanding the results of the test given the sensitivity of many products and measurement systems to orientation and set-up considerations, and also for reproducing the conditions 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
03/20/17	A	DMS	Origination	A. Gressel	B. Kuebler