

Report Number: PL10453-001A
Model: ZR14C-40L-30K-10V-FD
Date: 03/22/2017

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

Prepared For:
Jonathan Vollers
Cree, Inc
4600 Silicon Drive
Durham, NC 27703

Prepared By:

April Gressel, Photometric Technician

Approved By:

Becky Kuebler, Manager Test Engineering

Product Information	
Manufacturer	Cree, Inc.
Model Number (SKU)	ZR14C-40L-30K-10V-FD
Serial Number	WL061A04845
LED Type	PC56H19

Product Description
 1 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"	12"

Sample

The following sample was submitted for evaluation





NVLAP Lab Code 500077-0

Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	3850.0	3816.8	lm
Efficacy	124.88	123.60	lm/W
Correlated Color Temperature (CCT)	3061	K	
Color Rendering Index (CRI)	83		
R ₉	11		
Duv	0.000259		
S/P Ratio*	1.34		

Electrical Measurements	Sphere		Goniophotometer		
	120V	277V	120V	277V	
Input Wattage	30.83	30.58	30.84	30.64	W
Input Current	0.26	0.12	0.26	0.12	A
Input Voltage	120.04	277.06	120.07	277.08	V
Power Factor	0.994	0.955	0.992	0.951	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.05	0.05	0.07	0.07	%
Total Harmonic Distortion (Amperage)	6.35	11.52	5.86	12.52	%

Note: All photometric measurements taken at 120VAC.

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1382.9	Cd
Horizontal Angle of Max Candela	70	°
Vertical Angle of Max Candela	2.5	°
Zonal Lumens (0° – 30°)	1058.1 (27.7%)	lm (%)
Zonal Lumens (0° – 40°)	1724.7 (45.2%)	lm (%)
Zonal Lumens (0° – 60°)	3015.1 (79%)	lm (%)
Zonal Lumens (60° – 90°)	801.6 (21%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	40	31	min
Total Operating Time (Stabilization + Test)	40	51	min
Ambient Temperature	24.1	24.7	°C

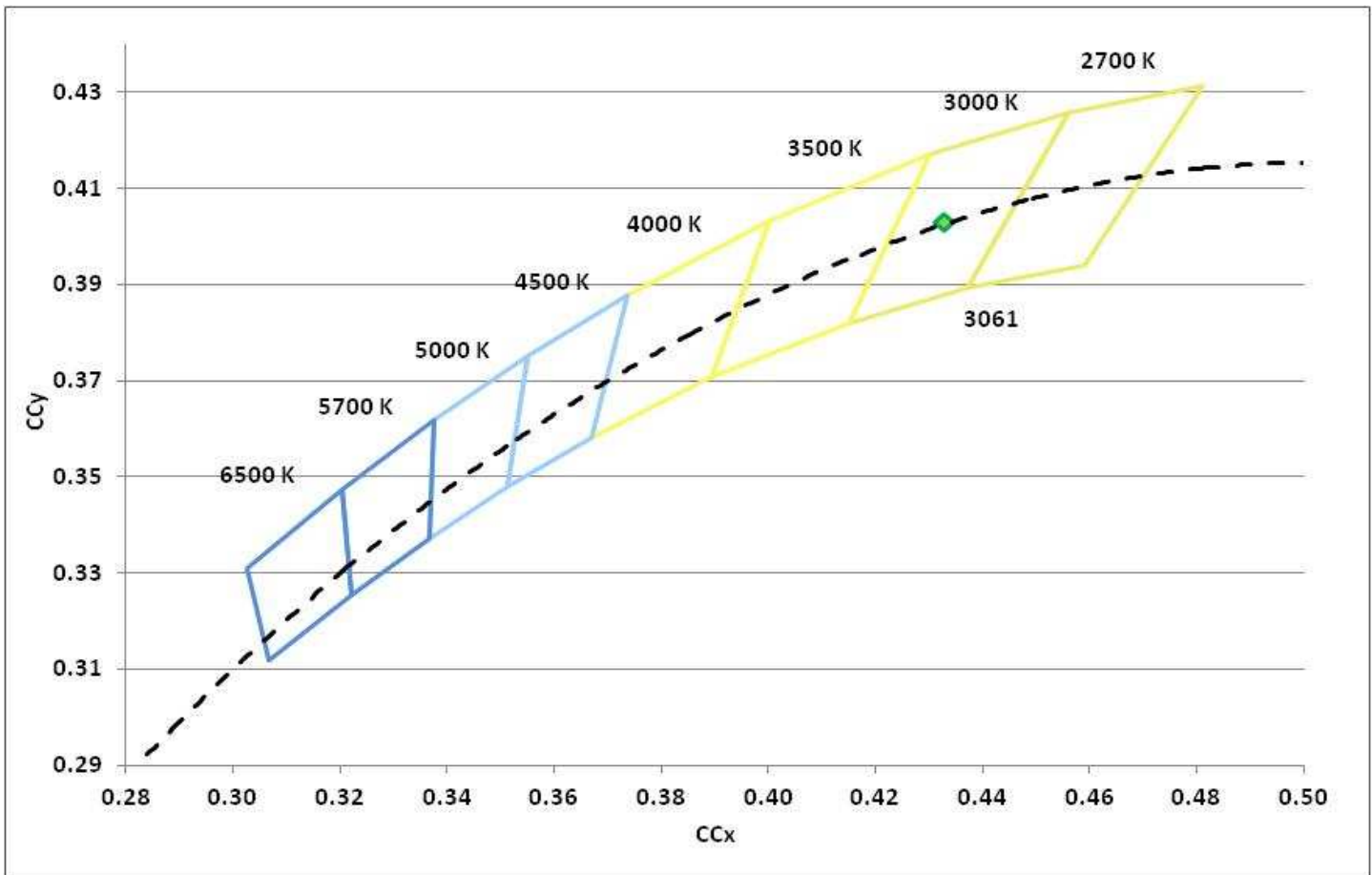
Chromaticity Coordinates

x	y	u	v	u'	v'	Duv
0.4329	0.4032	0.2483	0.3470	0.2483	0.5204	0.000259

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

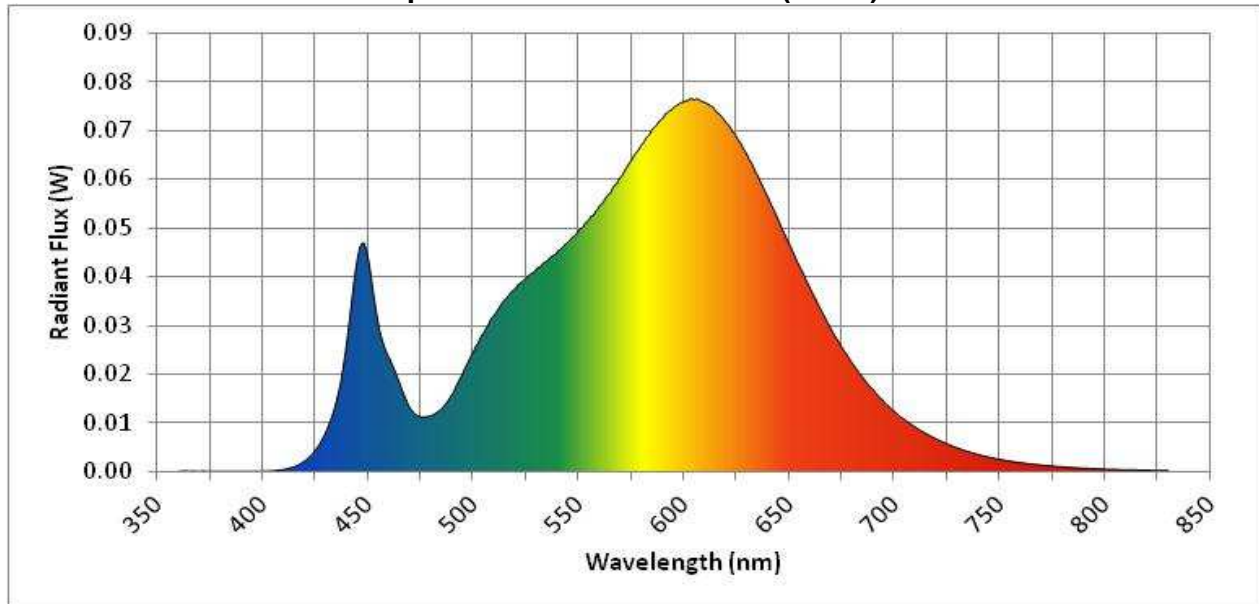
λ (nm)	W/nm
360	0.000198
370	0.000132
380	0.000147
390	0.000115
400	0.000180
410	0.000516
420	0.002351
430	0.008442
440	0.027558
450	0.043315
460	0.023255
470	0.012930
480	0.011611
490	0.016095
500	0.024760
510	0.032319
520	0.037665

λ (nm)	W/nm
530	0.041741
540	0.045314
550	0.049559
560	0.054677
570	0.060451
580	0.067147
590	0.072560
600	0.075857
610	0.075757
620	0.071532
630	0.064942
640	0.056130
650	0.046719
660	0.037573
670	0.029148
680	0.022252
690	0.016774

λ (nm)	W/nm
700	0.012373
710	0.009148
720	0.006756
730	0.004889
740	0.003533
750	0.002569
760	0.001872
770	0.001387
780	0.001026
790	0.000757
800	0.000542
810	0.000455
820	0.000340
830	0.000287

Dominant Wavelength	582	nm
Peak Wavelength:	603	nm

Spectral Power Distribution (W/nm)





NVLAP Lab Code 500077-0

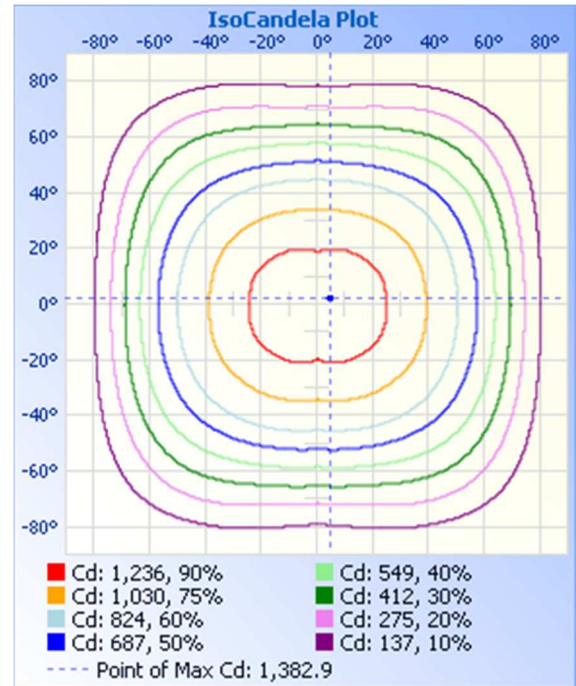
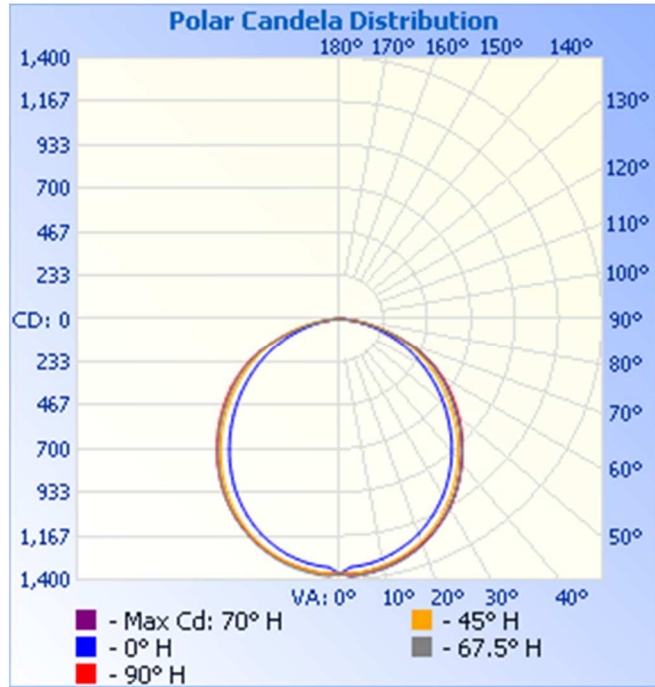
Zonal Lumen Summary **

Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	32.6	0.9%	90-95	0	0%
5-10	96.7	2.5%	95-100	0	0%
10-15	157.5	4.1%	100-105	0	0%
15-20	212.6	5.6%	105-110	0	0%
20-25	260.2	6.8%	110-115	0	0%
25-30	298.4	7.8%	115-120	0	0%
30-35	325.7	8.5%	120-125	0	0%
35-40	341.0	8.9%	125-130	0	0%
40-45	344.4	9.0%	130-135	0	0%
45-50	336.6	8.8%	135-140	0	0%
50-55	318.2	8.3%	140-145	0	0%
55-60	291.2	7.6%	145-150	0	0%
60-65	256.2	6.7%	150-155	0	0%
65-70	212.3	5.6%	155-160	0	0%
70-75	160.8	4.2%	160-165	0	0%
75-80	106.1	2.8%	165-170	0	0%
80-85	53.8	1.4%	170-175	0	0%
85-90	12.4	0.3%	175-180	0	0%
Total			3816.8 lm	100%	

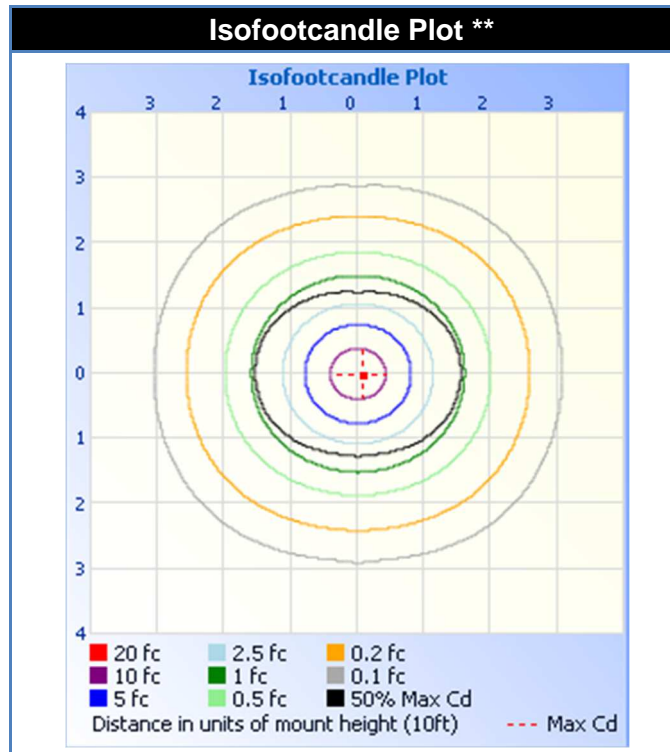
Spacing Criteria **

Spacing Criterion (0 - 180)	1.22
Spacing Criterion (90 - 270)	1.28
Spacing Criterion (Diagonal)	1.36

Candela Plots **



Isofootcandle Plot **





NVLAP Lab Code 500077-0

Candela Tabulations **

	0	5	15	25	35	45	55	60	62.5	65	67.5	70	72.5	75	77.5
0	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368
2.5	1334	1341	1352	1363	1367	1370	1373	1376	1379	1381	1382	1383	1382	1382	1379
5	1329	1336	1347	1358	1362	1366	1368	1372	1374	1376	1378	1379	1378	1377	1375
7.5	1321	1327	1338	1349	1353	1358	1360	1364	1366	1369	1369	1370	1369	1369	1367
10	1308	1314	1325	1336	1341	1346	1350	1354	1356	1358	1359	1360	1359	1358	1356
12.5	1292	1298	1309	1320	1325	1332	1337	1341	1343	1346	1347	1347	1347	1346	1344
15	1274	1279	1290	1301	1307	1315	1320	1325	1327	1330	1330	1331	1331	1330	1328
17.5	1252	1257	1268	1280	1286	1295	1301	1306	1308	1311	1311	1312	1311	1311	1309
20	1228	1231	1244	1255	1262	1272	1278	1284	1286	1288	1289	1290	1290	1289	1288
22.5	1200	1202	1215	1227	1235	1245	1253	1258	1260	1263	1263	1264	1264	1264	1262
25	1169	1170	1184	1196	1205	1216	1225	1230	1232	1234	1235	1236	1236	1235	1234
27.5	1135	1135	1149	1162	1172	1184	1193	1199	1201	1203	1204	1205	1205	1205	1204
30	1100	1097	1112	1125	1136	1148	1159	1166	1168	1170	1171	1172	1172	1172	1172
32.5	1061	1056	1071	1083	1096	1110	1122	1129	1131	1133	1134	1135	1136	1136	1136
35	1019	1012	1027	1040	1054	1069	1083	1089	1091	1094	1095	1096	1096	1097	1097
37.5	976	967	981	994	1010	1026	1040	1047	1049	1052	1053	1054	1055	1055	1056
40	930	920	934	946	964	980	996	1002	1005	1008	1008	1010	1011	1012	1012
42.5	882	871	884	897	916	934	949	956	959	962	963	964	965	966	967
45	831	820	834	847	867	886	902	910	912	915	916	918	919	920	921
47.5	780	769	781	796	816	836	853	861	864	867	868	870	871	873	874
50	729	718	728	743	764	784	803	810	814	817	819	821	822	824	825
52.5	677	665	675	690	712	733	751	759	763	767	768	770	772	775	776
55	624	612	622	638	660	682	700	709	713	717	720	722	724	726	727
57.5	571	560	570	587	608	632	651	660	664	668	670	673	675	676	678
60	518	508	518	535	557	581	601	610	614	617	620	622	624	626	628
62.5	466	456	465	483	506	531	550	558	562	565	568	570	572	573	575
65	415	404	413	432	454	480	498	505	508	511	513	515	516	517	519
67.5	363	351	361	380	405	429	444	449	452	454	455	456	456	457	458
70	310	300	310	330	356	377	388	391	392	393	393	392	392	392	392
72.5	259	250	261	283	307	324	330	330	329	328	327	326	325	324	324
75	210	201	215	236	258	270	270	267	265	264	262	260	259	258	258
77.5	164	155	170	191	208	214	210	206	204	203	201	199	198	198	197
80	119	112	128	146	157	159	153	150	148	146	144	143	142	141	140
82.5	80	73	88	101	108	107	100	97	96	94	92	90	90	89	89
85	46	41	52	58	61	57	52	50	48	47	46	45	44	44	44
87.5	20	16	20	20	20	16	14	13	13	13	12	12	12	12	12
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



NVLAP Lab Code 500077-0

Candela Tabulations (Continued) **

	80	82.5	85	87.5	90	95	105	112	125	135	145	155	165	175	180
0	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368	1368
2.5	1377	1375	1374	1371	1369	1373	1382	1380	1373	1370	1366	1362	1352	1342	1335
5	1373	1371	1369	1368	1366	1369	1377	1376	1368	1365	1361	1357	1348	1338	1330
7.5	1365	1363	1361	1359	1358	1362	1370	1369	1361	1357	1353	1349	1339	1329	1322
10	1354	1353	1351	1349	1348	1353	1361	1360	1352	1347	1342	1339	1329	1318	1310
12.5	1342	1341	1339	1337	1336	1340	1347	1346	1339	1334	1330	1325	1314	1303	1295
15	1327	1325	1323	1322	1321	1324	1332	1330	1322	1318	1313	1308	1296	1285	1276
17.5	1307	1306	1305	1304	1303	1306	1313	1311	1302	1297	1292	1287	1275	1263	1253
20	1286	1285	1283	1283	1282	1285	1291	1289	1280	1274	1269	1262	1250	1239	1228
22.5	1261	1260	1258	1258	1257	1260	1265	1264	1256	1249	1242	1234	1222	1210	1199
25	1233	1232	1230	1231	1231	1234	1239	1237	1228	1219	1213	1203	1191	1179	1167
27.5	1203	1202	1202	1202	1202	1204	1208	1206	1196	1187	1179	1169	1156	1144	1131
30	1171	1170	1170	1170	1170	1171	1175	1173	1162	1152	1144	1132	1119	1108	1094
32.5	1135	1134	1134	1134	1134	1136	1139	1137	1126	1114	1104	1092	1078	1067	1053
35	1097	1096	1096	1096	1097	1099	1101	1098	1086	1073	1063	1049	1035	1024	1009
37.5	1056	1056	1055	1056	1056	1057	1060	1056	1044	1030	1019	1004	989	979	964
40	1012	1012	1012	1013	1013	1014	1016	1012	1000	986	974	958	942	933	916
42.5	968	968	969	969	969	969	971	967	955	940	926	909	893	884	868
45	922	922	923	923	924	924	925	921	908	892	876	859	843	834	818
47.5	875	876	876	877	878	878	878	873	860	843	826	808	792	782	768
50	827	828	828	829	830	830	830	824	811	794	775	757	740	731	717
52.5	778	779	780	781	782	782	781	774	760	743	724	705	688	678	665
55	729	730	732	732	733	733	731	725	709	691	672	652	635	626	613
57.5	680	681	682	683	684	684	681	676	659	640	620	599	582	573	561
60	630	631	632	632	633	634	631	625	610	588	568	546	529	521	509
62.5	576	577	578	579	579	580	578	574	560	539	517	495	478	469	457
65	520	520	521	522	522	523	522	519	508	488	466	443	426	416	405
67.5	458	458	458	459	459	461	461	462	454	437	416	392	374	364	352
70	392	392	391	391	391	393	396	401	398	386	367	341	323	312	301
72.5	324	323	322	322	321	324	329	337	340	334	318	294	274	262	250
75	257	256	255	255	254	256	262	272	281	279	268	247	226	214	201
77.5	197	196	195	194	194	196	201	210	220	223	219	201	181	167	155
80	140	139	138	138	137	140	144	153	163	168	169	156	138	123	111
82.5	89	88	88	87	87	89	92	100	109	116	119	112	98	83	72
85	44	44	44	44	44	44	47	52	60	67	72	69	61	49	39
87.5	12	12	12	12	12	12	14	16	19	23	28	29	27	22	15
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



NVLAP Lab Code 500077-0

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



NVLAP Lab Code 500077-0

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.

This report shall not be reproduced, except in full, without written approval of the CESTL.

* 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.

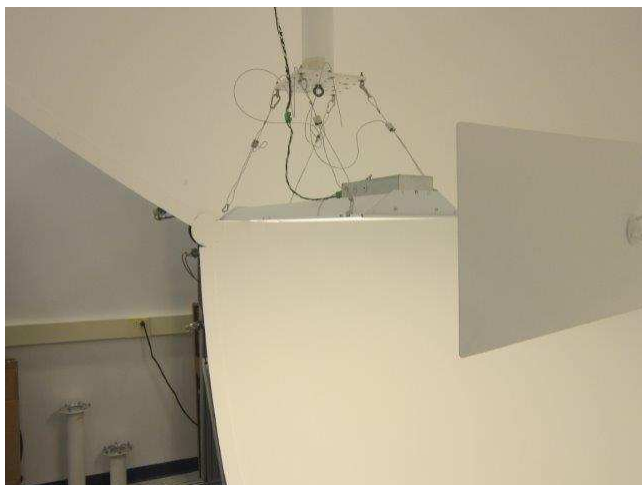
** In the event that testing is subcontracted, test results in this report marked with the symbol **, or noted as "Goniophotometer", were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All other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

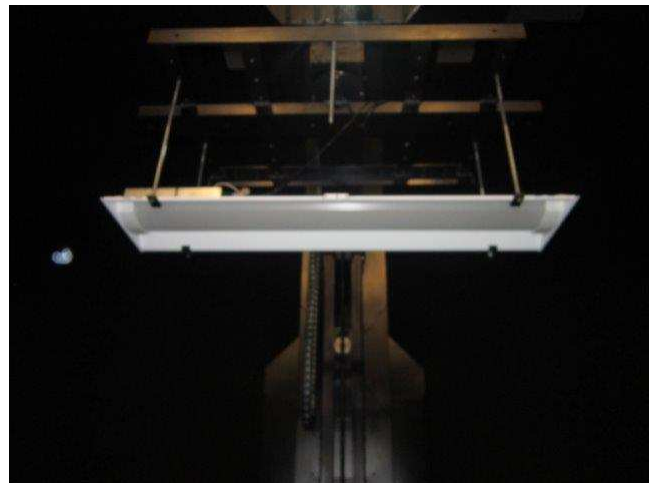
Additional Comments:

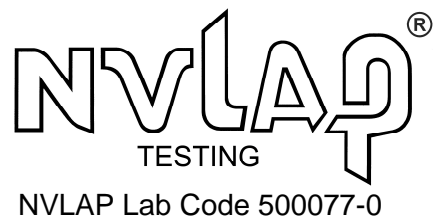
The photos below are intended to show the orientation and fixturing/set-up of the units under test. These are critical to understanding the results of the test given the sensitivity of many products and measurement systems to orientation and set-up considerations, and also for reproducing the conditions 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
03/22/17	A	DMS	Origination	A. Gressel	B. Kuebler