

**Report Number:** PL10455-001A  
**Model:** ZR22C-32L-50K-10V-FD  
**Date:** 03/20/2017

## 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)	ZR22C-32L-50K-10V-FD
Serial Number	WL041A14247
LED Type	PC56H19

Product Description
2 x 2 troffer with a white painted aluminum reflector, white painted aluminum end caps, and curved diffuse lens.

Driver Information (Where Applicable)
LEA02925X0032

Length	Width
24"	24"

Sample
<p>The following sample was submitted for evaluation</p> <div style="text-align: center;">  </div>



NVLAP Lab Code 500077-0

Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	3467.0	3450.5	lm
Efficacy	140.08	139.13	lm/W
Correlated Color Temperature (CCT)	5133	K	
Color Rendering Index (CRI)	84		
R <sub>9</sub>	9		
Duv	0.002069		
S/P Ratio*	2.01		

Electrical Measurements	Sphere		Goniophotometer		
	120V	277V	120V	277V	
Input Wattage	24.75	24.60	24.80	24.60	W
Input Current	0.21	0.10	0.21	0.10	A
Input Voltage	119.98	277.00	120.07	277.08	V
Power Factor	0.993	0.936	0.988	0.933	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.05	0.05	0.11	0.06	%
Total Harmonic Distortion (Amperage)	6.11	15.18	8.03	14.89	%

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

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1220.1	Cd
Horizontal Angle of Max Candela	175	°
Vertical Angle of Max Candela	2.5	°
Zonal Lumens (0° – 30°)	929.2 (26.9%)	lm (%)
Zonal Lumens (0° – 40°)	1510.7 (43.8%)	lm (%)
Zonal Lumens (0° – 60°)	2638.1 (76.5%)	lm (%)
Zonal Lumens (60° – 90°)	812.4 (23.5%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	35	33	min
Total Operating Time (Stabilization + Test)	35	53	min
Ambient Temperature	24.5	24.2	°C

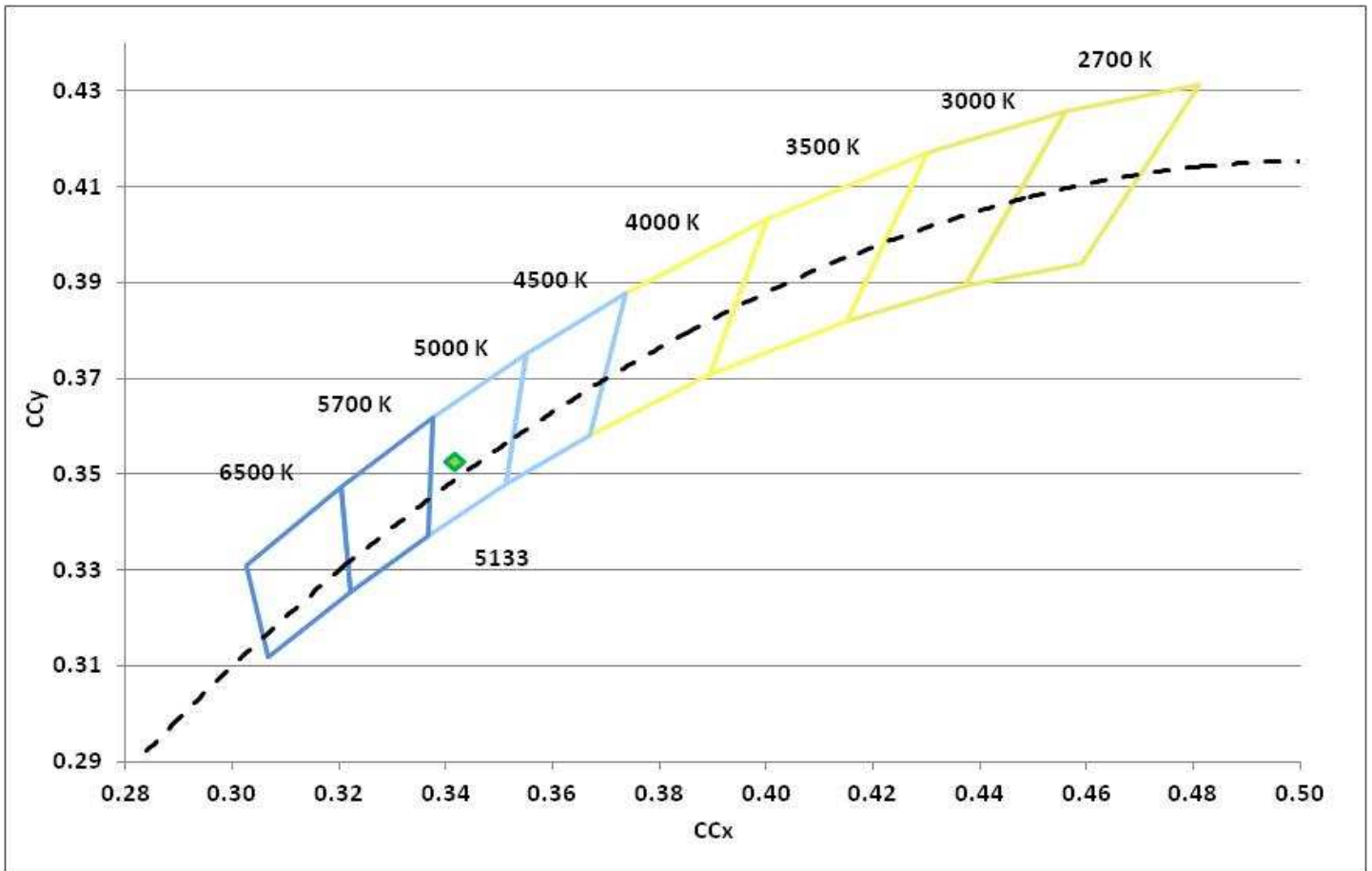
### Chromaticity Coordinates

x	y	u	v	u'	v'	Duv
0.3417	0.3529	0.2086	0.3232	0.2086	0.4848	0.002069

### Color Rendering Index Details

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
84	82	90	94	82	82	85	87	67	9	75	81	59	84	97

### Chromaticity Diagram



**Spectral Distribution**

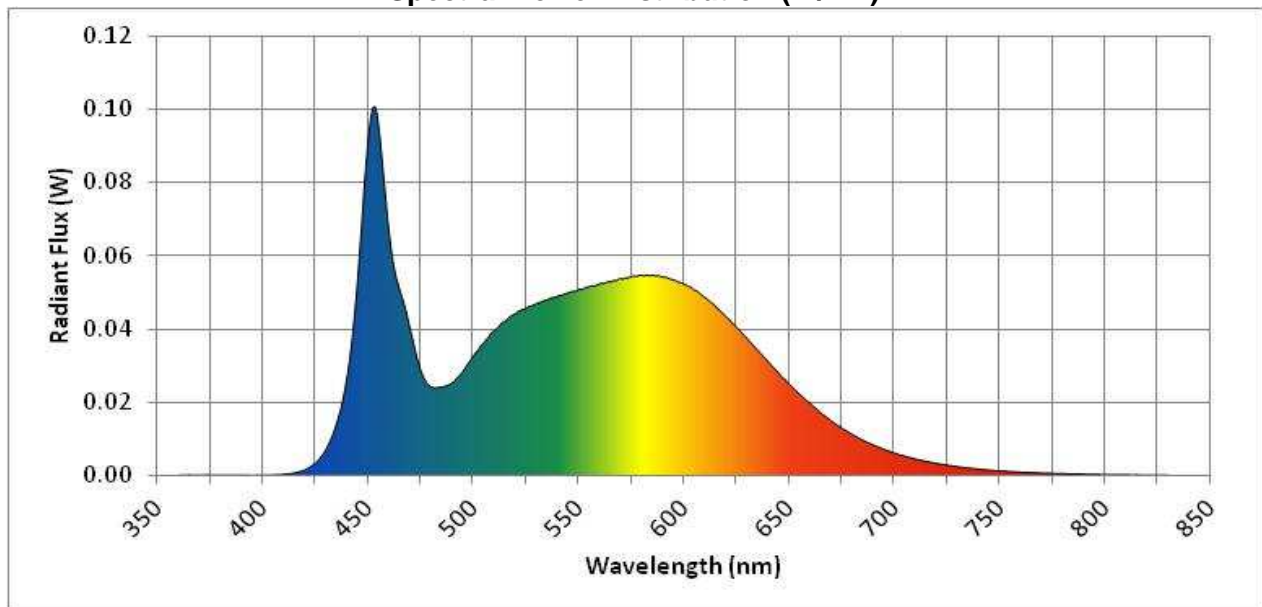
$\lambda$ (nm)	W/nm
360	0.000152
370	0.000191
380	0.000172
390	0.000152
400	0.000160
410	0.000346
420	0.001665
430	0.007419
440	0.027463
450	0.092916
460	0.065344
470	0.039621
480	0.024246
490	0.025467
500	0.032825
510	0.039845
520	0.044326

$\lambda$ (nm)	W/nm
530	0.047233
540	0.049258
550	0.051045
560	0.052619
570	0.053916
580	0.054885
590	0.054363
600	0.052358
610	0.048803
620	0.043463
630	0.037525
640	0.031172
650	0.025091
660	0.019684
670	0.014976
680	0.011288
690	0.008400

$\lambda$ (nm)	W/nm
700	0.006202
710	0.004545
720	0.003370
730	0.002451
740	0.001811
750	0.001308
760	0.000968
770	0.000737
780	0.000553
790	0.000426
800	0.000317
810	0.000251
820	0.000205
830	0.000167

<b>Dominant Wavelength</b>	568	nm
<b>Peak Wavelength:</b>	453	nm

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





NVLAP Lab Code 500077-0

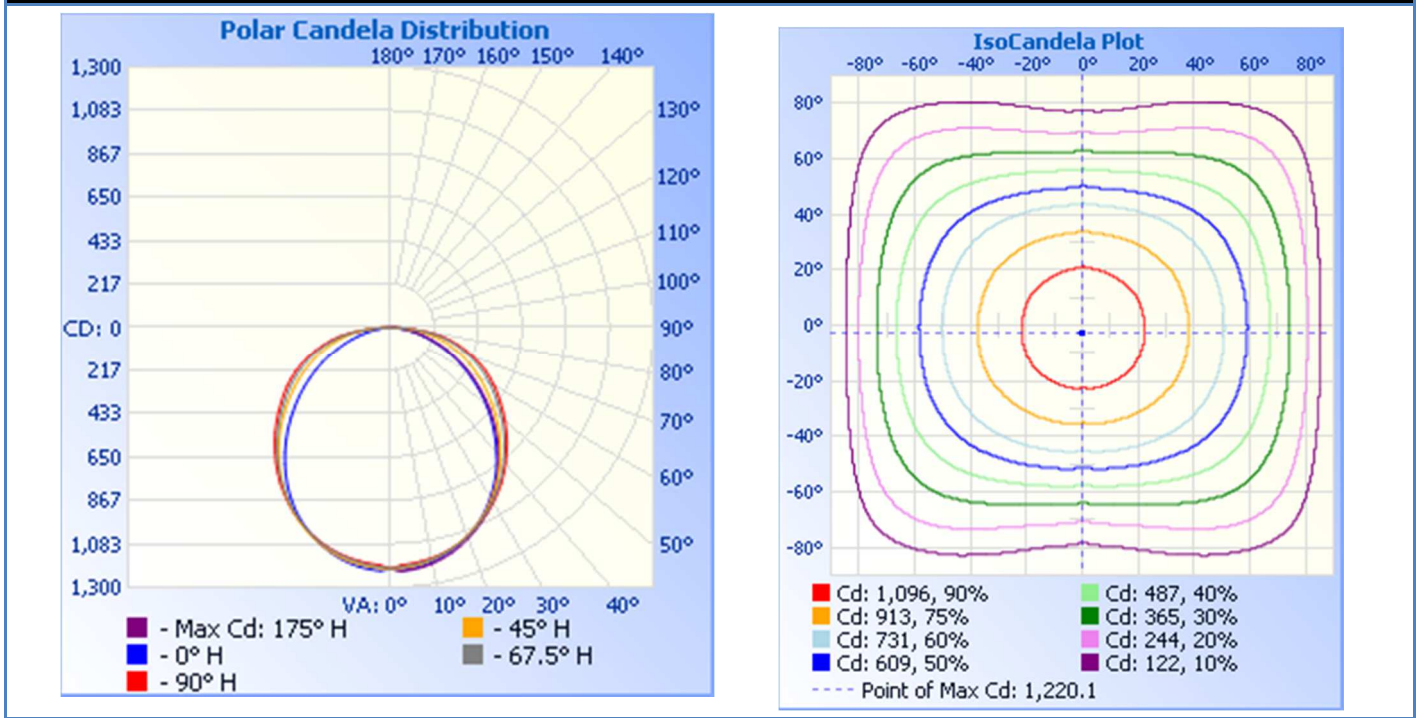
### Zonal Lumen Summary \*\*

Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	28.8	0.8%	90-95	0	0%
5-10	85.2	2.5%	95-100	0	0%
10-15	138.6	4.0%	100-105	0	0%
15-20	187.0	5.4%	105-110	0	0%
20-25	228.4	6.6%	110-115	0	0%
25-30	261.3	7.6%	115-120	0	0%
30-35	284.4	8.2%	120-125	0	0%
35-40	297.1	8.6%	125-130	0	0%
40-45	299.7	8.7%	130-135	0	0%
45-50	293.1	8.5%	135-140	0	0%
50-55	278.0	8.1%	140-145	0	0%
55-60	256.6	7.4%	145-150	0	0%
60-65	230.3	6.7%	150-155	0	0%
65-70	198.3	5.7%	155-160	0	0%
70-75	161.9	4.7%	160-165	0	0%
75-80	122.2	3.5%	165-170	0	0%
80-85	76.6	2.2%	170-175	0	0%
85-90	23.1	0.7%	175-180	0	0%
<b>Total</b>			<b>3450.5 lm</b>	<b>100%</b>	

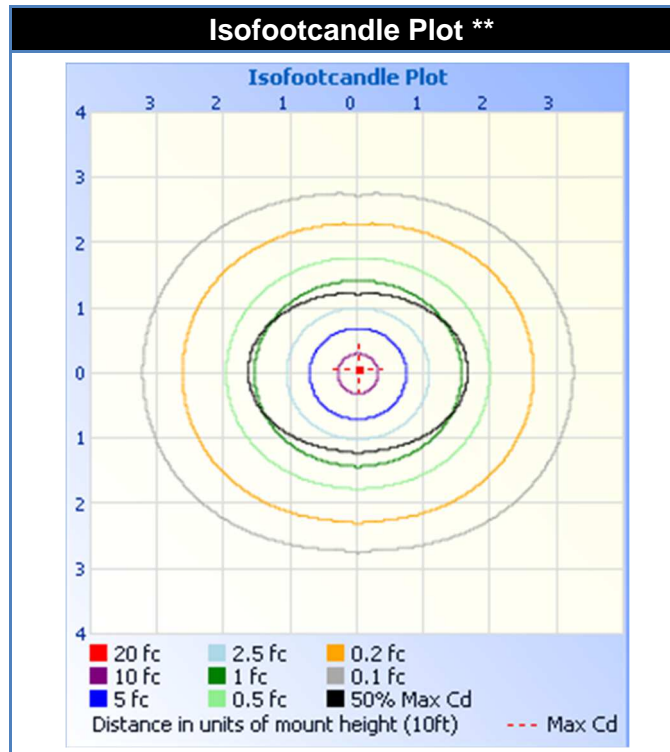
### Spacing Criteria \*\*

<b>Spacing Criterion (0 - 180)</b>	1.22
<b>Spacing Criterion (90 - 270)</b>	1.26
<b>Spacing Criterion (Diagonal)</b>	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	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207
2.5	1217	1218	1214	1210	1207	1205	1201	1200	1199	1198	1198	1197	1196	1195	1194
5	1211	1212	1208	1205	1202	1200	1197	1196	1195	1195	1194	1193	1192	1191	1190
7.5	1202	1202	1199	1196	1193	1191	1189	1188	1187	1187	1186	1185	1184	1183	1183
10	1190	1190	1187	1183	1181	1180	1178	1177	1177	1177	1176	1176	1175	1174	1174
12.5	1175	1174	1171	1168	1166	1166	1166	1166	1165	1165	1164	1164	1163	1162	1162
15	1157	1155	1152	1150	1150	1150	1150	1150	1150	1150	1149	1149	1148	1147	1148
17.5	1136	1133	1130	1129	1130	1130	1132	1132	1132	1132	1132	1132	1132	1131	1131
20	1113	1108	1106	1105	1106	1109	1112	1112	1112	1113	1113	1113	1113	1112	1112
22.5	1086	1080	1078	1079	1080	1084	1088	1089	1089	1090	1090	1090	1090	1090	1090
25	1056	1049	1048	1049	1051	1057	1061	1063	1064	1064	1065	1066	1066	1066	1066
27.5	1022	1013	1014	1016	1021	1027	1033	1036	1037	1038	1038	1039	1039	1039	1040
30	986	976	977	981	987	994	1002	1005	1006	1008	1009	1010	1010	1011	1011
32.5	947	936	937	943	950	959	969	972	974	975	977	978	978	979	980
35	907	894	896	902	911	922	933	937	939	941	943	944	946	947	947
37.5	862	849	852	860	870	882	896	902	903	906	908	909	911	912	913
40	815	802	807	816	828	842	857	863	866	868	871	873	875	876	878
42.5	767	755	760	771	785	801	818	825	828	831	833	836	838	840	841
45	720	707	713	725	741	760	778	786	790	793	796	799	801	803	805
47.5	672	658	665	679	697	718	738	746	750	754	758	761	763	766	768
50	624	609	617	632	652	675	697	707	711	715	718	722	725	728	730
52.5	574	560	568	586	607	632	655	666	670	675	679	683	686	689	692
55	523	510	521	539	563	589	615	626	631	636	640	644	648	651	654
57.5	474	463	474	494	520	549	576	588	594	599	603	608	612	615	618
60	427	417	428	450	478	508	538	550	556	562	567	572	576	580	583
62.5	382	371	383	407	436	468	499	512	518	524	530	534	539	543	546
65	337	325	338	364	395	428	460	474	480	486	491	497	501	505	508
67.5	292	281	295	322	354	388	421	435	441	447	452	458	462	466	468
70	247	238	253	281	314	349	381	395	401	407	412	417	421	425	428
72.5	205	197	213	241	275	309	341	355	360	366	371	375	379	383	385
75	166	158	174	203	236	270	300	313	318	324	328	332	336	339	341
77.5	129	121	138	166	199	230	258	271	276	280	285	289	292	296	298
80	94	87	103	130	160	189	214	226	231	235	239	243	246	250	251
82.5	63	57	71	95	120	144	165	173	176	179	182	185	187	190	190
85	36	31	41	60	76	92	104	109	110	112	114	115	117	118	118
87.5	16	11	14	22	28	34	39	42	43	44	44	45	46	47	47
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	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207	1207
2.5	1194	1193	1191	1190	1190	1192	1196	1199	1202	1206	1209	1211	1216	1220	1218
5	1190	1189	1187	1187	1186	1189	1192	1195	1198	1202	1205	1207	1211	1216	1214
7.5	1183	1181	1180	1180	1179	1182	1185	1188	1191	1195	1198	1201	1205	1209	1207
10	1174	1173	1172	1171	1171	1174	1178	1181	1183	1187	1189	1191	1195	1199	1196
12.5	1162	1162	1161	1161	1160	1164	1167	1169	1172	1176	1177	1178	1182	1184	1181
15	1148	1147	1147	1147	1147	1149	1153	1155	1157	1161	1162	1162	1164	1167	1164
17.5	1131	1131	1130	1131	1131	1134	1137	1139	1140	1142	1143	1143	1145	1147	1142
20	1112	1112	1112	1113	1113	1116	1118	1119	1120	1121	1121	1120	1121	1124	1118
22.5	1090	1090	1090	1091	1092	1094	1097	1097	1097	1098	1096	1095	1096	1098	1090
25	1066	1066	1067	1068	1068	1071	1073	1073	1073	1072	1069	1067	1066	1068	1059
27.5	1040	1041	1041	1042	1043	1045	1047	1046	1045	1042	1039	1036	1034	1036	1026
30	1012	1012	1013	1014	1015	1017	1018	1016	1014	1011	1006	1001	999	1000	989
32.5	980	981	982	984	985	986	988	985	981	977	970	964	961	961	949
35	948	950	951	952	954	954	955	952	946	941	933	925	921	920	906
37.5	914	916	917	918	920	921	921	916	910	902	893	884	878	876	861
40	879	880	882	883	884	885	885	879	872	862	851	842	834	832	815
42.5	843	844	846	848	848	850	849	842	833	821	808	797	789	786	768
45	806	808	810	812	813	813	813	804	794	780	765	752	742	738	720
47.5	770	772	774	775	776	777	775	766	753	738	721	706	694	689	670
50	732	734	737	738	739	740	737	728	712	696	676	660	646	639	621
52.5	694	696	699	700	701	702	699	688	671	653	631	612	597	590	573
55	656	659	661	662	664	664	661	648	631	609	586	566	549	541	524
57.5	621	623	626	627	628	628	624	611	591	568	542	520	502	492	476
60	585	588	590	592	593	593	588	574	553	528	500	476	456	445	428
62.5	549	551	553	555	556	557	552	537	515	488	458	432	410	398	381
65	511	513	516	517	518	519	514	499	476	448	416	388	365	352	335
67.5	471	474	476	477	478	479	475	460	437	408	375	345	320	307	289
70	430	432	434	435	436	437	434	420	397	368	334	303	277	262	244
72.5	388	390	392	392	393	394	391	378	357	329	295	263	236	220	203
75	344	345	347	348	349	350	347	336	316	289	256	224	196	179	163
77.5	299	301	302	303	304	305	304	293	274	248	218	186	158	141	126
80	252	253	255	255	256	258	258	248	231	208	179	149	122	105	91
82.5	191	192	193	193	194	195	200	194	183	164	140	114	88	73	60
85	119	120	120	120	120	122	128	128	124	114	97	78	58	44	34
87.5	47	48	48	49	49	50	55	56	57	54	48	40	28	22	14
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

### 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.

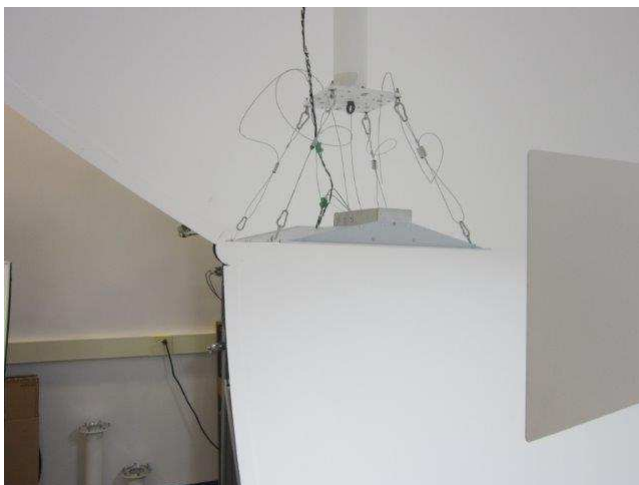
\*\* In the event that testing is subcontracted, test results in this report marked with the symbol \*\*, or noted as "Goniophotometer", were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All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

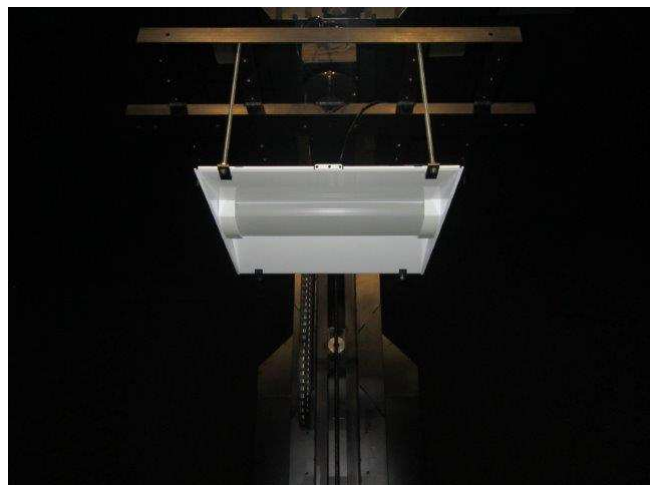
**Additional Comments:**

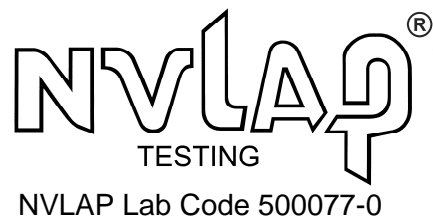
The photos below are intended to show the orientation and fixturing/set-up of the units under test. These are critical to understanding the results of the test given the sensitivity of many products and measurement systems to orientation and set-up considerations, and also for reproducing the conditions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