NVLAP Lab Code 500077-0

Report Number:	PL10257-001A
Model:	ZR22RK-32L-40K-10V-FD
Date:	03/02/2017

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:

Christopher McLaurin, Photometric Specialist

This report contains data that are not covered by the NVLAP accreditation. This report also contains goniometric data that was produced under subcontract by Cree Durham Technology Center, NVLAP Lab Code 500070-0.

NVLAP Lab Code 500077-0

Product Information	
Manufacturer	Cree Inc
Model Number (SKU)	ZR22RK-32L-40K-10V-FD
Serial Number	1LL02Q90027
LED Type	Lextar PC56H19

Product Description

2 x 2 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
3”	24”	24”

Sample

The following sample was submitted for evaluation

NVLAP Lab Code 500077-0

Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	3589.0	3575.6	lm
Efficacy	136.26	135.59	lm/W
Correlated Color Temperature (CCT)	4007		K
Color Rendering Index (CRI)	83		
R_9	8		
Duv	0.000259		
S/P Ratio*	1.69		

	Sphere		Goniophotometer		
Electrical Measurements	**120V**	**277V**	**120V**	**277V**	
Input Wattage	26.34	26.35	26.37	26.36	W
Input Current	0.22	0.10	0.22	0.10	A
Input Voltage	119.98	277.02	120.09	277.09	V
Power Factor	0.995	0.951	0.995	0.948	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.06	0.05	0.07	0.07	%
Total Harmonic Distortion (Amperage)	8.56	12.01	8.50	11.72	%

Note: All photometric measurements taken at 120VAC.

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1286.4	Cd
Horizontal Angle of Max Candela	0	˚
Vertical Angle of Max Candela	2.5	˚
Zonal Lumens (0˚ – 30˚)	974.3 (27.2%)	lm (%)
Zonal Lumens (0˚ – 40˚)	1581.0 (44.2%)	lm (%)
Zonal Lumens (0˚ – 60˚)	2751.1 (76.9%)	lm (%)
Zonal Lumens (60˚ – 90˚)	824.5 (23.1%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	120	43	min
Total Operating Time (Stabilization + Test)	120	63	min
Ambient Temperature	24.3	24.3	˚C

NVLAP Lab Code 500077-0

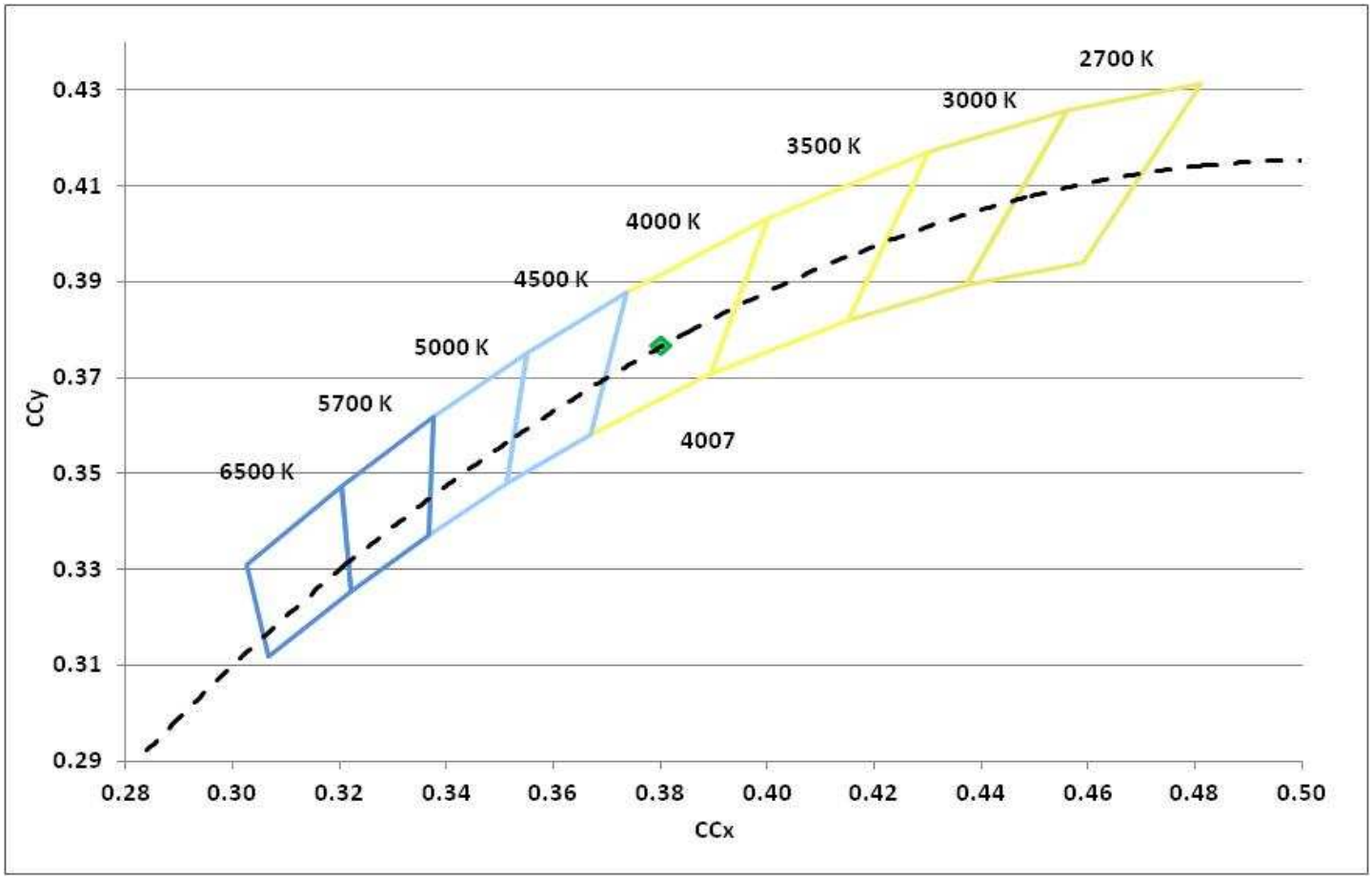
Chromaticity Coordinates

x	y	u	v	u'	v'	Duv
0.3802	0.3771	0.2248	0.3345	0.2248	0.5017	0.000259

Color Rendering Index Details

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
83	81	90	95	81	81	85	86	64	8	75	80	60	83	98

Chromaticity Diagram



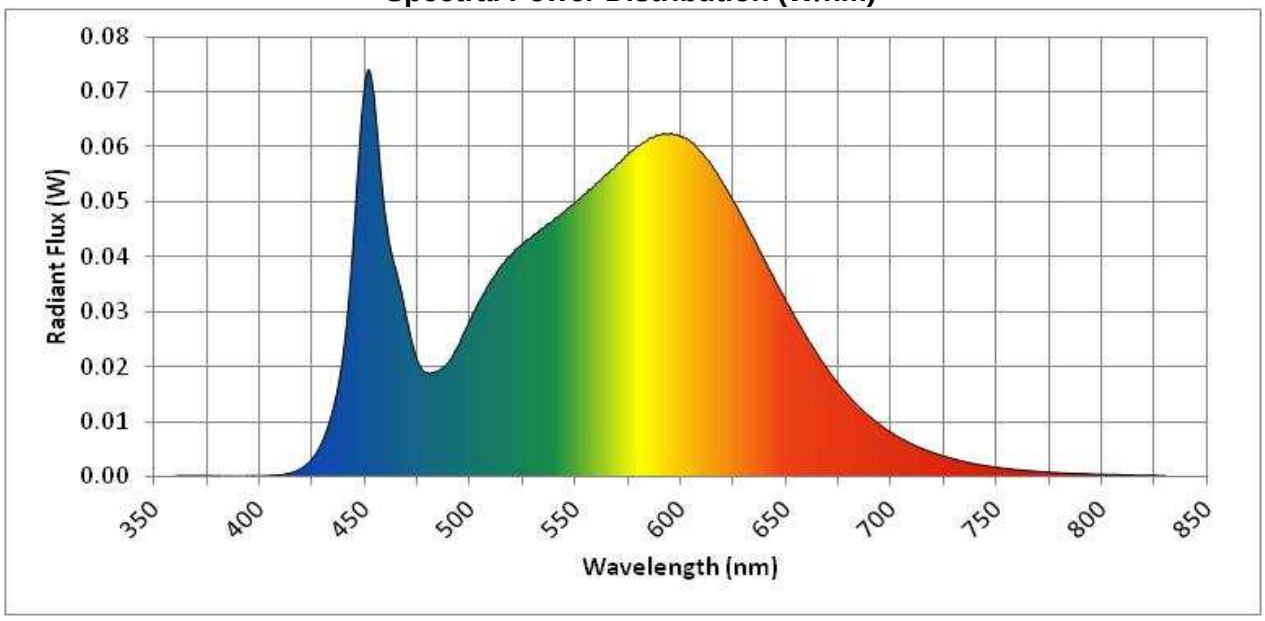
NVLAP Lab Code 500077-0

Spectral Distribution

λ(nm)	W/nm	λ(nm)	W/nm	λ(nm)	W/nm
360	0.000175	530	0.044138	700	0.008051
370	0.000167	540	0.047064	710	0.005911
380	0.000177	550	0.050057	720	0.004358
390	0.000141	560	0.053486	730	0.003164
400	0.000173	570	0.057003	740	0.002304
410	0.000365	580	0.060198	750	0.001695
420	0.001659	590	0.062140	760	0.001250
430	0.006863	600	0.061843	770	0.000958
440	0.024034	610	0.058920	780	0.000702
450	0.072139	620	0.053281	790	0.000551
460	0.045959	630	0.046554	800	0.000452
470	0.028024	640	0.039200	810	0.000317
480	0.018838	650	0.031834	820	0.000258
490	0.021116	660	0.025215	830	0.000216
500	0.028679	670	0.019306		
510	0.035866	680	0.014576		
520	0.040690	690	0.010888		

Dominant Wavelength	578	nm
Peak Wavelength:	451	nm

Spectral Power Distribution (W/nm)



NVLAP Lab Code 500077-0

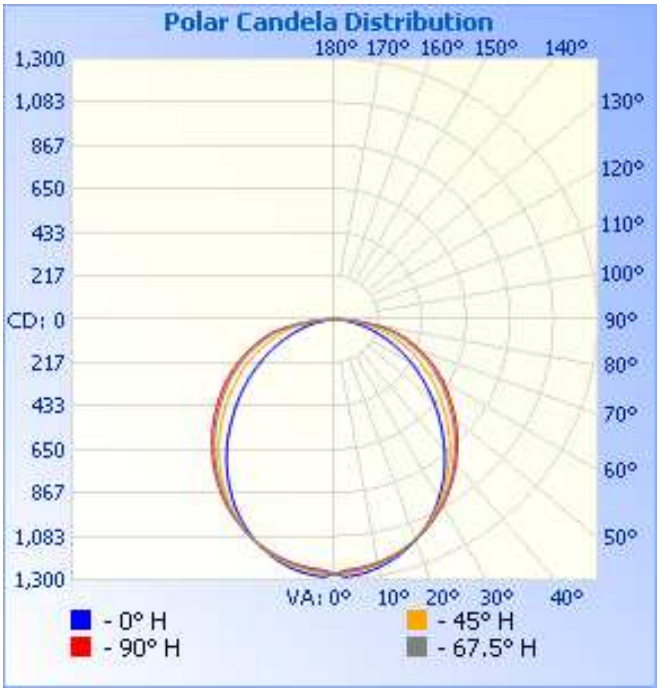
Zonal Lumen Summary **

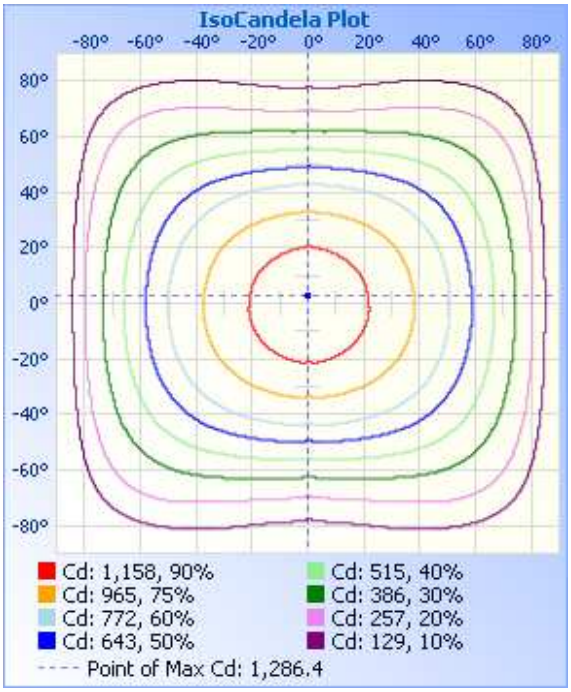
Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	30.3	0.8%	90-95	0	0%
5-10	89.7	2.5%	95-100	0	0%
10-15	145.7	4.1%	100-105	0	0%
15-20	196.1	5.5%	105-110	0	0%
20-25	239.2	6.7%	110-115	0	0%
25-30	273.3	7.6%	115-120	0	0%
30-35	297.0	8.3%	120-125	0	0%
35-40	309.8	8.7%	125-130	0	0%
40-45	312.0	8.7%	130-135	0	0%
45-50	304.5	8.5%	135-140	0	0%
50-55	288.3	8.1%	140-145	0	0%
55-60	265.2	7.4%	145-150	0	0%
60-65	236.6	6.6%	150-155	0	0%
65-70	202.5	5.7%	155-160	0	0%
70-75	164.9	4.6%	160-165	0	0%
75-80	124.8	3.5%	165-170	0	0%
80-85	75.3	2.1%	170-175	0	0%
85-90	20.4	0.6%	175-180	0	0%
			Total	**3575.6 lm**	**100%**

Spacing Criteria **

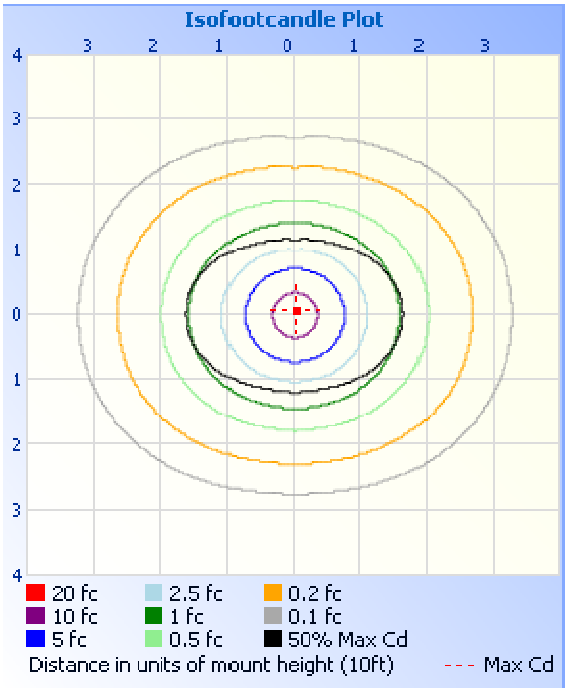
Spacing Criterion (0 - 180)	1.22
Spacing Criterion (90 - 270)	1.26
Spacing Criterion (Diagonal)	1.34

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	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271
2.5	1286	1285	1280	1276	1272	1268	1265	1263	1262	1261	1260	1259	1258	1257	1256
5	1280	1279	1274	1270	1266	1263	1260	1258	1258	1257	1256	1255	1254	1253	1252
7.5	1270	1269	1265	1260	1257	1254	1252	1250	1249	1248	1247	1246	1246	1245	1244
10	1257	1255	1251	1247	1244	1242	1240	1239	1238	1238	1237	1236	1235	1235	1234
12.5	1241	1238	1234	1231	1228	1227	1227	1226	1225	1225	1224	1224	1223	1222	1222
15	1221	1217	1214	1211	1210	1210	1210	1209	1209	1209	1208	1208	1207	1207	1206
17.5	1197	1193	1190	1188	1188	1189	1190	1191	1191	1191	1190	1190	1190	1189	1189
20	1171	1166	1163	1162	1163	1166	1169	1170	1170	1170	1170	1170	1170	1170	1170
22.5	1142	1135	1133	1133	1135	1140	1144	1145	1146	1146	1146	1147	1147	1147	1147
25	1109	1101	1100	1101	1105	1111	1117	1119	1120	1121	1121	1121	1122	1122	1122
27.5	1072	1063	1063	1066	1072	1080	1087	1090	1091	1092	1093	1094	1094	1095	1095
30	1032	1022	1023	1028	1035	1045	1055	1058	1060	1061	1062	1063	1064	1065	1066
32.5	990	978	980	987	996	1008	1020	1024	1026	1027	1029	1030	1032	1033	1034
35	946	933	936	943	955	969	983	989	990	992	994	996	997	999	1000
37.5	897	884	889	898	912	928	944	951	953	956	958	960	961	963	964
40	847	835	841	852	868	886	903	911	914	917	919	922	924	926	927
42.5	794	784	791	804	822	843	862	871	874	877	880	883	885	888	889
45	744	733	741	756	777	799	821	830	834	837	841	844	846	849	851
47.5	693	682	691	707	730	755	778	788	793	797	800	804	807	809	812
50	642	630	640	658	682	710	735	746	751	756	760	763	766	769	772
52.5	590	579	589	609	635	664	691	703	708	714	718	722	725	728	731
55	539	528	539	561	588	619	648	661	666	672	676	680	684	688	690
57.5	491	479	491	514	544	576	606	619	625	631	636	641	644	648	650
60	443	430	444	467	499	533	564	578	584	591	596	600	604	608	611
62.5	395	383	397	422	454	489	522	536	543	549	554	559	563	567	570
65	346	337	351	377	410	446	480	494	501	508	512	517	522	526	529
67.5	302	292	306	334	367	403	438	452	458	465	470	475	480	484	486
70	257	249	264	291	325	360	395	409	416	422	428	433	437	440	443
72.5	217	208	223	250	284	319	352	367	373	380	385	390	394	398	400
75	177	169	184	210	243	277	310	325	331	338	343	349	353	357	360
77.5	140	133	147	172	204	236	268	283	289	295	300	306	310	314	316
80	105	99	112	136	164	195	223	235	239	244	248	252	255	258	260
82.5	73	68	79	99	124	147	166	174	176	179	182	185	186	188	189
85	44	39	47	62	77	90	101	104	105	106	107	108	109	110	110
87.5	19	14	18	24	28	33	38	39	39	39	40	40	40	41	41
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	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271	1271
2.5	1256	1255	1254	1253	1253	1254	1257	1261	1265	1268	1272	1276	1281	1286	1286
5	1252	1251	1250	1249	1249	1250	1253	1256	1259	1263	1266	1270	1275	1280	1281
7.5	1243	1242	1241	1241	1241	1243	1246	1248	1252	1255	1258	1262	1266	1272	1272
10	1233	1233	1232	1232	1232	1234	1237	1239	1242	1245	1248	1250	1254	1259	1259
12.5	1222	1221	1220	1220	1221	1223	1225	1226	1229	1231	1233	1235	1239	1242	1241
15	1206	1206	1205	1206	1206	1208	1210	1211	1212	1214	1214	1216	1219	1222	1220
17.5	1189	1188	1188	1189	1189	1191	1193	1193	1193	1194	1193	1193	1195	1199	1195
20	1170	1169	1169	1170	1170	1172	1173	1172	1171	1170	1169	1167	1169	1172	1167
22.5	1147	1147	1147	1147	1148	1150	1151	1149	1147	1144	1142	1138	1139	1141	1135
25	1122	1122	1123	1123	1124	1126	1126	1123	1120	1116	1112	1107	1106	1108	1100
27.5	1096	1096	1096	1097	1098	1099	1098	1095	1090	1084	1078	1071	1069	1070	1061
30	1066	1067	1067	1068	1069	1071	1069	1064	1058	1049	1042	1033	1029	1030	1019
32.5	1034	1035	1036	1037	1038	1039	1037	1031	1023	1013	1003	993	987	986	974
35	1001	1002	1003	1004	1004	1006	1003	996	986	974	962	950	942	941	928
37.5	966	967	968	969	970	971	968	959	947	933	919	904	896	892	879
40	929	930	931	932	933	934	930	921	907	891	874	858	847	843	829
42.5	891	893	894	895	896	896	892	881	866	848	829	810	797	793	777
45	853	854	856	857	858	858	853	841	825	804	782	762	747	741	725
47.5	814	816	818	819	819	820	814	801	782	760	735	713	697	689	672
50	775	777	778	779	780	780	774	760	739	715	688	664	646	637	621
52.5	734	736	738	738	739	740	733	718	696	670	642	615	596	586	571
55	693	695	697	698	699	699	692	676	653	624	594	566	546	535	521
57.5	653	655	658	658	659	660	651	635	610	580	548	519	497	485	471
60	614	616	618	619	620	620	612	595	569	537	503	472	450	437	422
62.5	573	575	577	578	579	579	571	554	527	494	459	426	403	390	375
65	531	533	535	536	537	538	529	512	484	450	415	382	357	343	328
67.5	488	490	492	493	494	494	486	469	442	408	372	338	313	298	284
70	446	447	449	450	450	451	443	426	399	366	330	296	270	255	241
72.5	403	404	406	407	407	408	400	384	356	323	288	255	229	214	200
75	362	363	365	366	367	367	360	342	314	282	248	215	190	175	162
77.5	318	319	320	322	322	322	316	298	272	240	208	177	153	138	126
80	261	262	264	265	266	265	260	247	227	199	170	140	118	104	93
82.5	190	191	192	192	193	192	189	182	170	152	129	105	84	72	63
85	111	112	113	114	114	114	111	108	104	95	82	67	52	43	35
87.5	41	42	43	43	43	43	42	41	40	37	32	29	22	18	12
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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

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 Reqt'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

NVLAP Lab Code 500077-0

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 ± 1˚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.

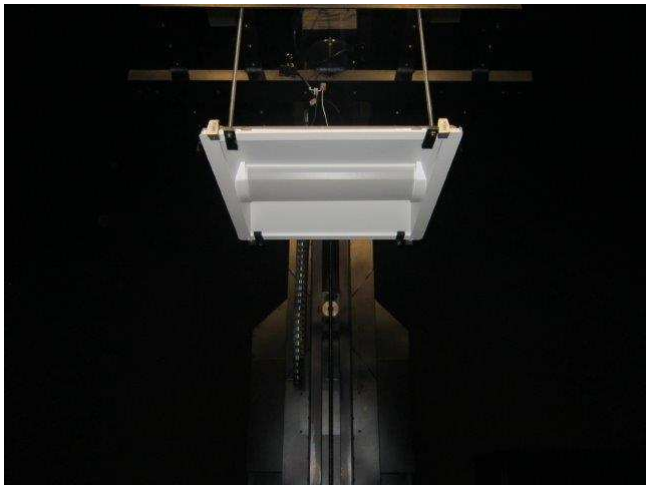
The goniophotometer information in the equipment list, report items marked with **, or results specifically identified as "Goniophotometer", are the actual equipment used, and test results produced, by the subcontracted laboratory.

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



NVLAP Lab Code 500077-0

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