

Report Number: PL10454-001A
Model: ZR22C-32L-30K-10V-FD
Date: 03/20/2017

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

Prepared For:

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4600 Silicon Drive

Durham, NC 27703

Prepared By:

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Approved By:


Becky Kuebler, Manager Test Engineering

Product Information	
Manufacturer	Cree Inc
Model Number (SKU)	ZR22C-32L-30K-10V-FD
Serial Number	WL041A14271
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>



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Key Photometric Data	Sphere Output	Goniophotometer	
Luminous Flux	3138.0	3114.9	lm
Efficacy	126.38	125.05	lm/W
Correlated Color Temperature (CCT)	3066	K	
Color Rendering Index (CRI)	83		
R ₉	10		
Duv	0.000721		
S/P Ratio*	1.34		

Electrical Measurements	Sphere		Goniophotometer		
	120V	277V	120V	277V	
Input Wattage	24.83	24.70	24.91	24.71	W
Input Current	0.21	0.10	0.21	0.10	A
Input Voltage	120.05	276.99	120.10	277.01	V
Power Factor	0.991	0.938	0.988	0.935	
Off-State Power	0	0	0	0	W
Total Harmonic Distortion (Voltage)	0.05	0.06	0.11	0.06	%
Total Harmonic Distortion (Amperage)	7.47	14.63	8.09	14.36	%

Note: All photometric measurements taken at 120VAC.

Luminous Intensity Distribution	Goniophotometer	
Maximum Candela	1105.5	Cd
Horizontal Angle of Max Candela	180	°
Vertical Angle of Max Candela	2.5	°
Zonal Lumens (0° – 30°)	840.3 (27%)	lm (%)
Zonal Lumens (0° – 40°)	1365.1 (43.8%)	lm (%)
Zonal Lumens (0° – 60°)	2381.5 (76.5%)	lm (%)
Zonal Lumens (60° – 90°)	733.3 (23.5%)	lm (%)
Color Angular Uniformity	NA	

Key Test Parameters	Sphere Output	Goniophotometer	
Stabilization Time	40	38	min
Total Operating Time (Stabilization + Test)	40	58	min
Ambient Temperature	24.4	25.4	°C

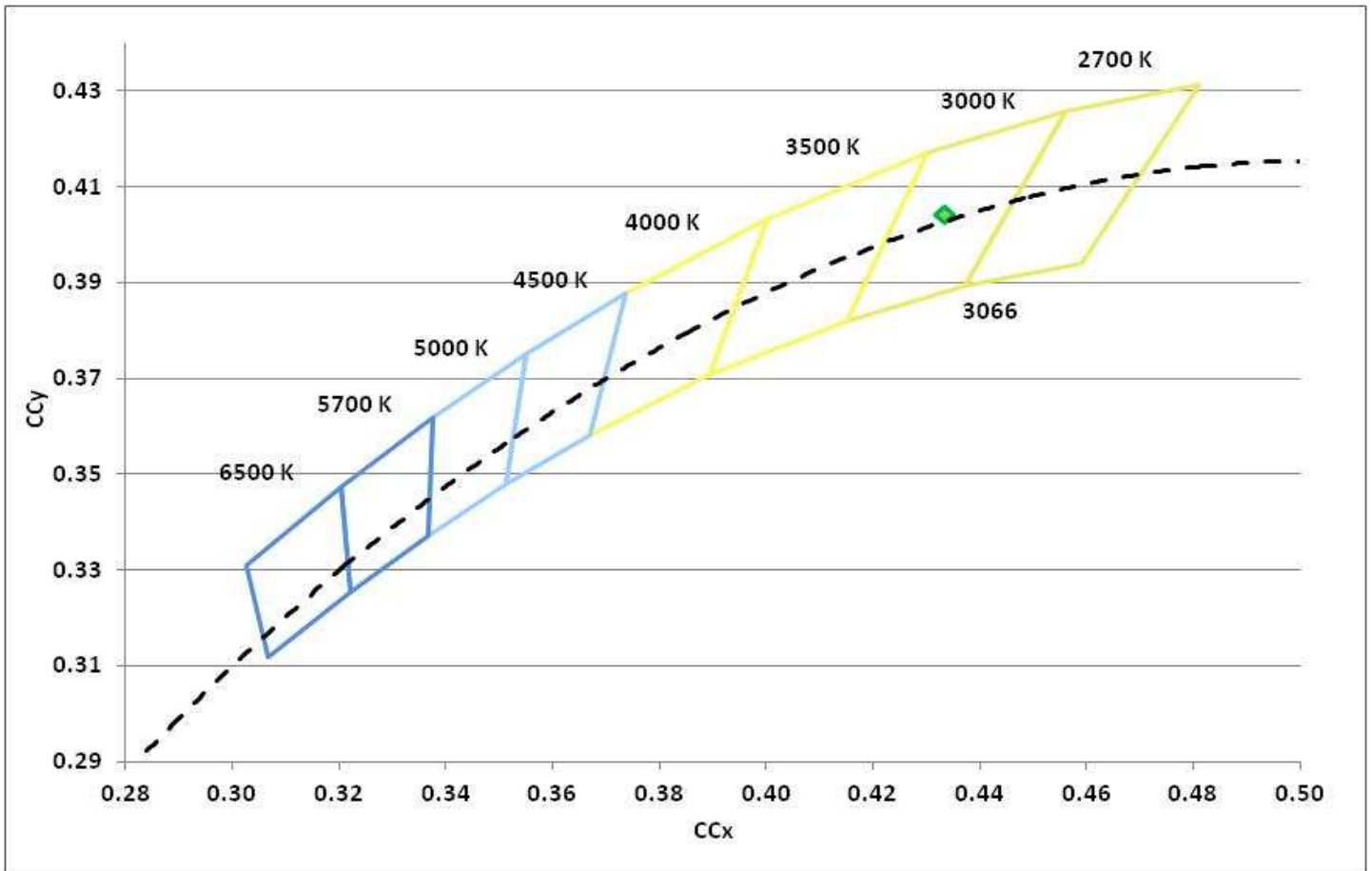
Chromaticity Coordinates

x	y	u	v	u'	v'	Duv
0.4332	0.4045	0.2480	0.3474	0.2480	0.5210	0.000721

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	10	75	81	68	83	98

Chromaticity Diagram



Spectral Distribution

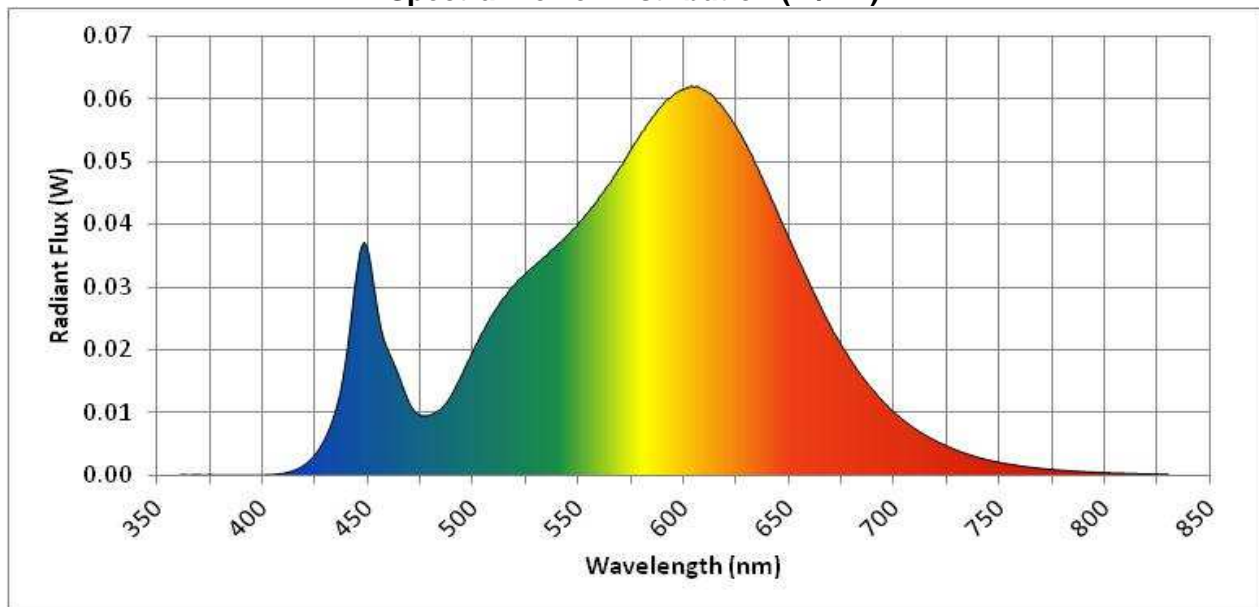
λ (nm)	W/nm
360	0.000070
370	0.000187
380	0.000131
390	0.000128
400	0.000109
410	0.000413
420	0.001847
430	0.006410
440	0.020167
450	0.035587
460	0.019455
470	0.011202
480	0.009776
490	0.013179
500	0.020090
510	0.026342
520	0.030669

λ (nm)	W/nm
530	0.033940
540	0.037016
550	0.040437
560	0.044695
570	0.049462
580	0.054907
590	0.059308
600	0.061688
610	0.061558
620	0.058033
630	0.052566
640	0.045474
650	0.037811
660	0.030414
670	0.023655
680	0.018091
690	0.013665

λ (nm)	W/nm
700	0.010094
710	0.007468
720	0.005527
730	0.003999
740	0.002885
750	0.002112
760	0.001538
770	0.001141
780	0.000861
790	0.000649
800	0.000475
810	0.000359
820	0.000282
830	0.000228

Dominant Wavelength	582	nm
Peak Wavelength:	606	nm

Spectral Power Distribution (W/nm)





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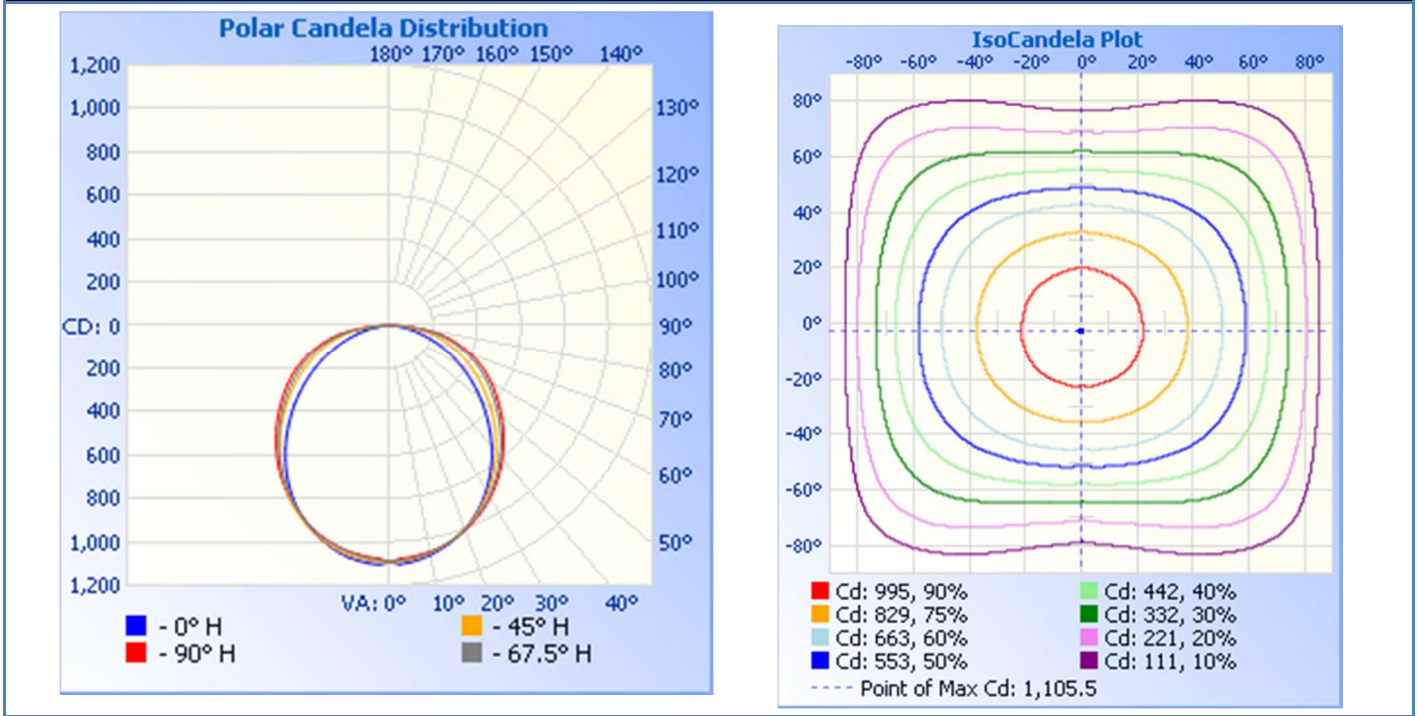
Zonal Lumen Summary **

Zone	Lumens	% of Total	Zone	Lumens	% of Total
0-5	26.1	0.8%	90-95	0	0%
5-10	77.2	2.5%	95-100	0	0%
10-15	125.5	4.0%	100-105	0	0%
15-20	169.1	5.4%	105-110	0	0%
20-25	206.4	6.6%	110-115	0	0%
25-30	236.0	7.6%	115-120	0	0%
30-35	256.7	8.2%	120-125	0	0%
35-40	268.1	8.6%	125-130	0	0%
40-45	270.3	8.7%	130-135	0	0%
45-50	264.2	8.5%	135-140	0	0%
50-55	250.6	8.0%	140-145	0	0%
55-60	231.4	7.4%	145-150	0	0%
60-65	207.7	6.7%	150-155	0	0%
65-70	178.9	5.7%	155-160	0	0%
70-75	146.2	4.7%	160-165	0	0%
75-80	110.4	3.5%	165-170	0	0%
80-85	69.2	2.2%	170-175	0	0%
85-90	20.9	0.7%	175-180	0	0%
Total			3114.9 lm	100%	

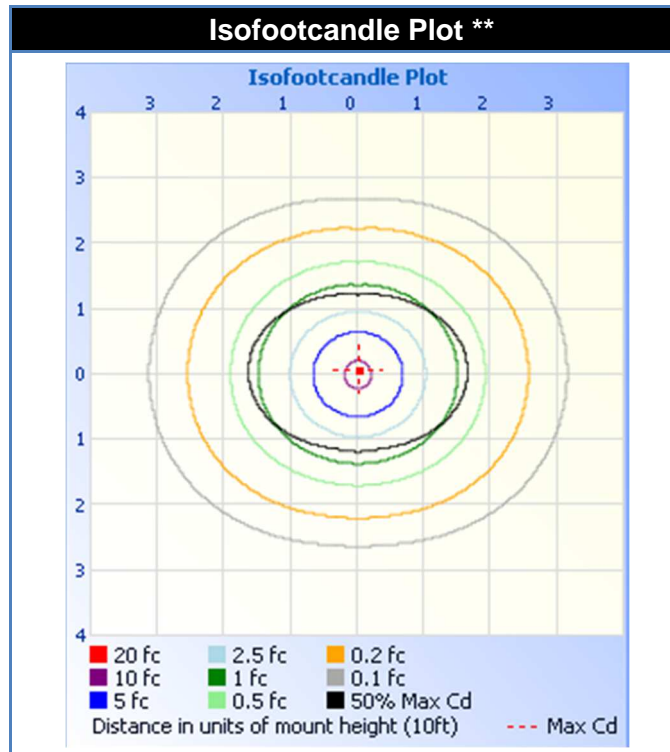
Spacing Criteria **

Spacing Criterion (0 - 180)	1.22
Spacing Criterion (90 - 270)	1.26
Spacing Criterion (Diagonal)	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	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093
2.5	1103	1103	1100	1096	1094	1091	1088	1087	1086	1085	1084	1084	1083	1082	1081
5	1097	1097	1094	1090	1088	1086	1083	1083	1082	1081	1081	1080	1079	1078	1078
7.5	1088	1087	1085	1081	1079	1078	1076	1075	1074	1074	1073	1072	1072	1071	1070
10	1076	1075	1072	1069	1067	1067	1066	1065	1065	1065	1064	1063	1063	1062	1062
12.5	1061	1060	1057	1055	1054	1054	1054	1054	1054	1054	1053	1053	1052	1052	1052
15	1044	1042	1039	1038	1037	1039	1039	1039	1039	1039	1039	1039	1039	1038	1038
17.5	1024	1021	1018	1018	1018	1020	1023	1023	1023	1023	1023	1024	1023	1023	1023
20	1001	997	995	995	997	1000	1004	1004	1004	1005	1005	1006	1005	1005	1005
22.5	976	971	969	970	973	977	981	982	983	984	984	985	985	985	985
25	947	941	940	942	946	952	957	959	960	960	961	962	963	963	963
27.5	916	909	909	912	917	924	932	934	935	936	937	938	939	939	940
30	882	874	875	879	886	894	903	906	907	908	910	912	912	913	914
32.5	845	838	839	844	852	862	872	876	877	879	881	882	884	885	885
35	807	798	801	807	817	828	840	845	846	848	850	852	854	855	856
37.5	768	758	760	768	780	792	806	811	814	816	818	821	822	824	825
40	725	716	718	728	741	756	771	777	780	783	785	788	789	791	792
42.5	681	672	677	687	702	718	735	742	745	748	751	754	756	758	760
45	637	628	634	646	662	681	700	707	710	714	717	720	722	725	726
47.5	593	583	590	604	622	643	663	671	675	679	682	686	688	691	693
50	549	540	547	562	582	604	626	635	639	643	647	651	654	656	659
52.5	505	495	503	520	541	565	588	598	603	608	612	616	619	622	624
55	461	452	460	479	502	527	552	563	568	572	577	581	584	588	590
57.5	418	409	419	439	463	491	517	529	534	539	544	548	552	556	558
60	375	367	378	400	426	455	483	495	500	505	510	515	519	523	526
62.5	334	326	338	361	388	419	448	460	466	472	477	482	486	490	493
65	294	286	298	322	351	383	413	426	432	438	443	448	452	456	459
67.5	255	246	259	285	314	347	378	390	396	402	407	412	416	421	423
70	215	208	222	248	278	311	342	355	360	366	371	376	380	384	386
72.5	178	172	186	212	244	276	306	318	323	328	333	338	342	346	348
75	142	137	152	178	210	240	269	280	285	290	294	299	302	306	308
77.5	109	104	120	146	175	204	230	242	246	251	255	259	262	266	268
80	79	74	89	114	141	167	192	202	206	210	214	218	221	224	226
82.5	51	47	60	82	105	126	146	153	156	159	161	164	167	170	171
85	28	25	34	50	64	77	89	94	95	96	98	100	102	103	104
87.5	10	7	10	16	20	26	31	34	34	35	36	36	38	39	40
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	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093	1093
2.5	1081	1080	1079	1078	1077	1080	1083	1086	1089	1093	1095	1098	1102	1105	1106
5	1077	1076	1075	1075	1074	1076	1079	1082	1085	1089	1092	1094	1099	1102	1102
7.5	1070	1069	1069	1068	1068	1070	1073	1077	1080	1084	1086	1089	1093	1096	1096
10	1062	1061	1061	1061	1061	1063	1067	1070	1073	1077	1079	1080	1084	1087	1087
12.5	1052	1051	1051	1051	1051	1054	1057	1060	1062	1066	1067	1069	1072	1075	1074
15	1038	1038	1037	1038	1038	1041	1044	1046	1049	1053	1053	1054	1057	1059	1058
17.5	1023	1023	1022	1023	1024	1027	1030	1032	1034	1037	1036	1036	1038	1041	1038
20	1006	1006	1006	1007	1008	1010	1013	1014	1016	1017	1016	1016	1017	1019	1016
22.5	985	986	986	987	988	990	993	994	995	996	994	993	994	995	990
25	963	964	964	966	967	969	972	972	972	972	970	968	968	968	963
27.5	940	940	941	943	944	946	948	947	947	946	942	940	938	939	932
30	914	915	916	917	918	920	922	921	919	917	913	908	906	906	899
32.5	886	887	888	890	891	892	894	893	890	886	880	875	871	871	863
35	857	858	860	861	863	864	866	863	859	853	846	839	835	834	825
37.5	826	828	830	831	832	834	835	831	826	818	810	802	796	795	784
40	794	796	798	800	801	802	803	798	791	782	772	763	756	754	742
42.5	761	763	766	767	768	769	770	764	756	746	733	724	714	711	698
45	728	731	733	734	736	736	736	730	720	708	694	683	672	668	655
47.5	695	697	700	701	702	703	703	695	684	670	654	641	629	624	611
50	661	664	666	668	669	669	669	660	648	632	613	599	586	580	567
52.5	627	630	632	634	635	635	634	624	610	593	573	556	542	535	522
55	593	596	598	600	601	601	599	589	573	554	532	514	498	491	478
57.5	561	564	566	568	569	569	566	555	537	517	493	473	456	447	435
60	529	531	534	535	537	537	534	522	503	480	455	433	414	405	392
62.5	496	498	501	502	504	504	501	488	468	444	417	393	374	362	350
65	462	464	466	468	470	470	467	453	433	408	380	353	333	321	308
67.5	426	428	430	432	434	434	431	418	398	372	342	315	293	280	267
70	389	391	392	394	396	396	394	382	362	336	306	277	254	240	228
72.5	350	352	354	355	357	357	356	345	326	300	270	241	217	202	190
75	310	312	313	314	316	317	316	306	290	264	235	206	181	166	154
77.5	270	272	273	274	275	276	276	267	252	228	200	172	146	131	120
80	228	229	230	231	232	234	235	226	212	191	165	138	114	99	88
82.5	172	173	173	175	176	178	183	178	170	153	130	107	83	69	60
85	105	106	107	108	109	112	119	119	118	109	93	75	55	43	35
87.5	40	41	42	43	43	45	52	54	57	55	48	41	29	22	16
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.

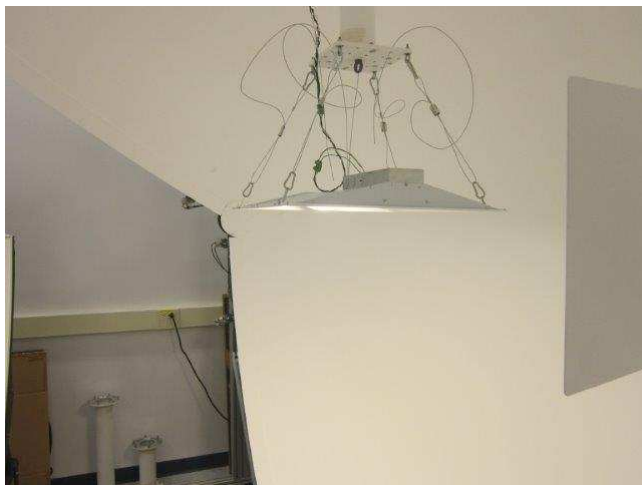
** In the event that testing is subcontracted, test results in this report marked with the symbol **, or noted as "Goniophotometer", were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All other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